

Implementing Green Pattern in the International Egyptian Airports

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Abstract: Airports play a vital role in the development of aviation infrastructure and have significant implications on global needs. A notable gap exists in the availability of dedicated green practices designed to develop airports into green patterns. Consequently, there is a legitimate and urgent call to formulate a green rating system tailored to airports, considering aspects like carbon footprint, technological integration, and infrastructure expansion. The objective of this research is to establish a proposed green pattern for airports, intended to gauge the greenness of airport activities based on environmental factors and technological progress. This study seeks to showcase the beneficial outcomes of integrating eco-friendly practices in various international Egyptian Airports, with a focus on curtailing carbon emissions, easing congestion, and enhancing airport capacity utilization. The primary approach for data acquisition entailed conducting structured in-person and telephone interviews with 50 managers and supervisors affiliated with the Cairo Airport Company and the Egyptian Airports Company in Cairo.

Keywords: Green Airports, Environment, Digitalization, Congestion, Capacity.

1. INTRODUCTION

Numerous airport operators are currently in pursuit of a reliable and independent energy source powered by renewable sources. Presently, various airport operators are engaging in competition by publicizing their adherence to CO2 mapping standards and the attainment of certifications like ISO 14001 and Airport Carbon Accreditation. Meanwhile, other airport operators are striving to outdo their competitors by touting their utilization of environmentally friendly energy solutions such as hydrogen, on-site production of Sustainable Aviation Fuel (SAF), and the adoption of eVTOL (electric Vertical Take-Off and Landing) technology [1]. ICAO (International Civil Aviation Organization) is currently advocating for the utilization of hybrid electric and fully electric architectures, as well as disruptive technologies that facilitate the development of hydrogen-powered aircraft through the "Clean Sky 2" project in an effort to minimize carbon emissions [2].

Responding to global requirements, airport operators are taking steps towards creating green airports that focus not only on environmental concerns and achieving zero emissions, but also on optimizing airport capacity, reducing congestion, and enhancing traveler accessibility. Many operators are transforming their airports into green patterns through digitalization and automation, using these technologies as tools to improve efficiency and capacity utilization. Digitalization enables airports to create seamless connections among stakeholders, systems, and travelers, thus enhancing services [3],[4]. Those techniques are designed to enhance productivity by decreasing the duration of each transaction, minimizing the time between landing and take-off, and increasing the number of aircraft movements [5],[6].

Furthermore, airport operators promote the integration of airside and landside areas to enhance accessibility, a key component of sustainable practices. Multimodal transport, such as bus shuttles, subways, ferries, and train stations connected through the airport, plays a vital role in linking the airport with the city center [7].

In light of the growing pressure on the aviation sector to address its impact on climate change, this study seeks to explore and propose solutions for the challenges faced by airports. Beyond the issue of gas-guzzling airplanes, airports themselves contribute to carbon emissions through their expansions, necessitating more energy for new terminals, ground vehicles, and

infrastructure. Moreover, the expansion of airport capacity can increase carbon emissions. Consequently, this study intends to investigate how airport operators can incorporate green airport patterns to enhance ground operations, optimize fuel emissions, and find the best solution to use the capacity in the best way possible instead of expanding buildings [2].

2. LITERATURE REVIEW

According to ICAO (2021), the International Civil Aviation Organization is actively working towards reducing emissions through the implementation of policies and the continuous update of standards related to aircraft emissions. The organization has set a goal of achieving a 2% annual reduction in emissions leading up to 2050. To achieve this target, ICAO is implementing various measures including advancements in aircraft technology, operational improvements, the use of sustainable aviation fuels, and the adoption of market-based mechanisms such as CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation) [2]. The International Air Transport Association (IATA, 2022) has outlined the steps that operators must adhere to in order to transition to a more environmentally sustainable approach. These steps include reducing emissions by providing zero-emission transportation options, improving the integration of public transport with high-speed, regional, and local rail services to airports, designing terminal forecourts that facilitate a smooth flow of traffic, and consolidating off-airport car rental facilities and hotel shuttle services. [8].

Moreover, FAA (2021) and ICAO (2022) have delineated that ACI, ICAO, and FAA (Federal Aviation Administration) are responsible for establishing the construction design of airport infrastructure and safety standards pertaining to various elements such as the runway, taxiway, apron, and ground area. The regional offices of IATA, FAA, and ICAO conduct assessments regarding the environmental quality of the designated airport vicinity, encompassing factors like air, water, and land quality. Additionally, they oversee aspects such as wind patterns and climate variations, ensuring the absence of wildlife in close proximity to the airport [09],[10].

Battal and Bakir (2017) along with ICAO (2022) have deliberated on the efforts made by ICAO to mitigate the emissions and noise pollution generated by aircraft, by mandating airline carriers to settle emissions fees. In certain nations, these emission charges are integrated into the landing fees with the objective of minimizing noise pollution and enhancing environmental conditions [11],[10].

Additionally, as reported by IATA (2022), a new platform has been established to monitor jet fuel costs at more than 400 airports. This platform provides daily updates and issues notifications for any alterations [12]. Additionally, according to the Aviation Report (2021), a new platform named Aircraft Performance Monitoring (APM) has been introduced to oversee carbon emissions. This solution can be seamlessly integrated with SkyBreathe® 360° eco-flying platform, the prominent solution in the market that encompasses all optimal fuel practices across all airline operations to enhance fuel efficiency and reduce CO₂ emissions [13].

According to El-Hinnawi (2022) and Subramanain (2021), the importance of using digitalization and automation in solving the problem of congestion and utilizing the airport's capacity in the best way possible was discussed. Digitalization is the system that enables operators to enhance performance in all sectors of the airport. It provides airports with hyper-connectivity of all employees across all sectors. The digitalized system allows for automated feed processes with the required information and provides accurate data in real-time. It contributes to facilitating the systems/applications of automated machines. In addition, digitalization enables the automation process to monitor transactions, track operational flights, and improve operating systems. Travelers can complete all transactions in seconds by using a digital system in an automated process [3],[4]. Automation solves the congestion of many airports around the world. It is the way to improve the performance of airports and enables operators to use the capacity of an airport in the best way without needing to increase the number of runways or expand the capacity of airports. Automation is the process that simplifies the transfer of passengers within the airport using the following methods: Self Check-in Device (Kiosk, Self-Drop Bag, Biometric Machine, Smart Path, Biometric Boarding Gate) [14],[6].

Liebert & Niemeier (2012) discussed that airport operators can increase revenues and have constant costs in a range that serves from 3.5 to 12.5 million travelers. If operators serve over 12.5 million travelers, their costs will increase due to the need to expand the airport's capacity. When airport operators serve less than 3 million travelers, they do not accomplish their target. This means that operators need to serve over 3.5 million travelers to accomplish their target and have constant costs [15]. To achieve this, it is important to use strategies that aim to reduce congestion and increase productivity.

Many operators have established applications which provide travelers with health and travel information. These applications permit travelers to know the restricted destinations. Besides, they enable travelers to know all the details about tests,

vaccinations, and travel services. Several airport operators use robots for cleaning or for information services. They also use touchless self-services that enable travelers to finish all travel processes with less contact with employees. In addition, they also offer touchless ordering services in the airport [16]. It was concluded that airport operators transform into a green pattern by adopting new innovations, by improving airport services, and by providing the safest environment.

Additionally, governments contribute to transforming airports into green patterns by reinforcing airports through investing in projects that aim to provide accessibility. This is achieved by presenting an intermodal system or multimodal system at the airport, offering bus shuttles, a rail station, or a ferry hub that connects with it. This type of project intends to facilitate the transfer of travelers to and from the city. Governments empower airports by establishing a road or railway that connects the airport with a marine hub [17].

According to the International Air Transport Association (IATA, 2022), it is crucial to optimize the utilization of current assets in order to prevent unnecessary expenditure costs. This can be achieved through developing a concept of operations that enhances efficiency and utilization of facilities, integrating technology to streamline airport processes and lessen environmental impact, adhering to sustainable building practices to maximize energy efficiency and minimize CO₂ emissions, and designing buildings with energy-efficient envelopes to reduce unnecessary carbon emissions and energy consumption. [8].

3. METHODOLOGY:

In the study, a qualitative approach was employed to gather secondary data through face-to-face and telephone interviews with top-level and sectional administrative employees at airports throughout Egypt conducted between April 2024 and June 2024. A proposed pattern was developed based on the findings, aimed at aiding international Egyptian airports in transform into green practices. The interviews involved 50 managers from two major operator companies overseeing 11 international airports in Egypt, namely Cairo Airport Company managing Cairo Airport exclusively, and Egyptian Airports Company overseeing the remaining 10 airports in the country to assess the implementation of green practices. Notably, interviews with Egyptian Airports Company included the deputy manager along with managers and supervisors from various subsidiaries such as Borg al-Arab Airport, Sharm El-Sheikh Airport, Hurghada Airport, and Aswan Airport.

4. DISCUSSION OF RESULTS

1. Relevant Practices Concerning the Environment need to be Considered:

During the interviews, all respondents emphasized the importance of operators taking measures to reduce emissions and noise pollution caused by aircraft by implementing charges for airline carriers. Their goal is to mitigate the negative impact on the environment and shift towards more green practices. Moreover, the respondents collectively highlighted the initiative to encourage airlines to minimize pollution and environmental harm by substituting 27 single-use plastic products on flights with eco-friendly alternatives. Cairo Airport Company is actively promoting eco-friendly flights through partnerships with EgyptAir, offering a 40% discount on the inaugural eco-friendly flight from Cairo to Paris. This flight showcases a unique 'Green Service Flight' logo to symbolize the airline's commitment to a green future, which is in line with the strategy of ICAO (2021;2022), IATA (2022), & Battal and Bakir (2017). Additionally, the respondents unanimously agreed on the significance of prioritizing quality and health certifications over Skytrax ratings. It was also mentioned that Cairo Airport was honored with the ACI Africa Environment and Sustainable Development award in 2023 (Fig.1).

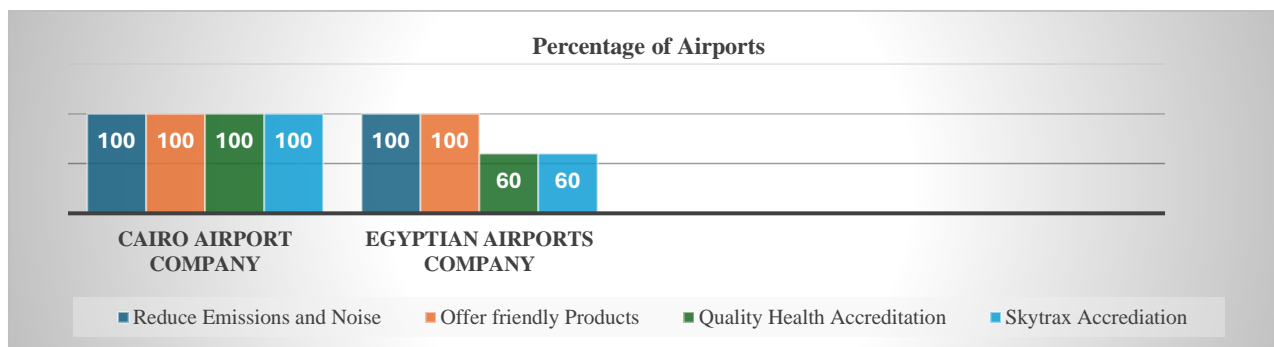


Fig.1 The Environmental Practices

Furthermore, all respondents at Cairo Airport have indicated that the facility has been awarded a 3-star rating for both terminal 1 and terminal 2 amenities, as well as overall airport performance. Additionally, respondents from the Egyptian

Airports Company have highlighted that Sharm El Sheikh and Hurghada Airports have elevated their ratings from 2-star to 3-star following the acquisition of health, hygiene, and safety certifications. This lower rating is attributed to the high congestion and the absence of intermodal or multimodal transportation systems linking the airports to other city destinations. Skytrax has also noted that these airports lack innovation and entertainment facilities (Fig.1).

2. Relevant Practices Concerning Technology and Accessibility need to be Considered:

Informed by feedback from respondents of the Cairo Airport Company, it has been emphasized that Egypt Air is the sole provider of a limited number of check-in kiosks at Cairo International Airport. Additionally, the airport offers travelers the opportunity to complete immigration procedures using both traditional counters and biometric systems. Unlike other airports, Cairo International Airport exclusively utilizes biometric machines capable of scanning both eyes and fingerprints. This contrasts with other airports where biometric technology is primarily employed for security purposes. The technological strategies implemented by Cairo International Airport align with the assertions of Kovynyova&Mikut (2018) regarding the imperative need to transition airports toward a digitalized and automated framework in order to use the capacity with the best way possible. Respondents from the Egyptian Airports Company also noted specific technologies in use at various airports within Egypt. Luxor Airport employs a passport and visa scanning system through an application named OCR 48 (Optical Character Recognition Reader), while Sharm el-Sheikh Airport uses OCR 20 for this purpose. Furthermore, Sharm el-Sheikh Airport is equipped with an advanced luggage detection system and an integrated network linking the information systems of terminals 1 and 2. Borg Al Arab Airport has implemented a robotic landing system known as ILS/DME (Instrument Landing System/Distance Measuring Instrument) to streamline the landing process. Notably, all international airports in Egypt have deployed thermal cameras to oversee and manage the transmission of Covid-19. However, it was determined from the conducted interviews that the current technological solutions in Egyptian airports represent only isolated efforts geared towards enhancing operational efficiency through automation. To achieve full digitalization and automation, substantial technological advancements will be indispensable (Fig. N).

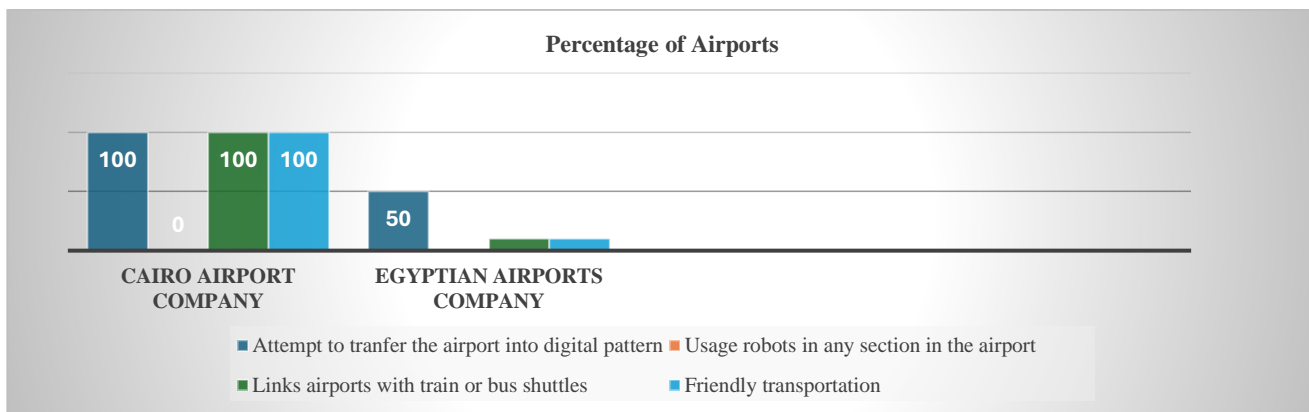


Fig.N The Technological and Accessibility Practices

It is noteworthy that certain Egyptian airports provide applications aimed at enhancing convenience for travelers. For instance, the 'Cairo Airport Guide Application' allows passengers to monitor their flights, while the Cairo Airport Company Application permits booking of flights, hotel accommodations, and car rentals . The utilization of apps to streamline procedures for travelers aligns with the approach adopted by various global airports studied, such as Beijing, Haneda, Atlanta Hartsfield-Jackson, and King Khalid Airports. Survey respondents confirmed that Egyptian airports do not utilize robots in any operational area, a deviation from the strategies proposed by Subramanain (2021), El-Hinnawi (2022), and Shallow (2021) in their discussions on transitioning airport operations to a more advanced automated and digital framework (Fig.N.).

Furthermore, Cairo International Airport has made efforts to enhance its accessibility through the provision of small metro and bus shuttle services to assist travelers in navigating the airport premises. In comparison, Sharm el-Sheikh Airport is the sole airport offering bus shuttle connections for travelers to commute to the city center which is in line with the strategy of Feron (2013) . Additionally, Cairo International Airport stands out as the exclusive airport connecting to a newly constructed 5-star hotel comprising 360 rooms (Fig. N).

In all responses, it was noted that the responsibility for establishing development strategies for all Egyptian airports lies solely with the Civil Aviation Authority, in collaboration with the Ministry of Tourism and Antiquities. The primary goal of

these strategies is to transition towards environmentally friendly operations by prompting airlines to adopt green aircraft and minimize plastic usage to a single-time. The Ministry of Civil Aviation has formulated an all-encompassing strategy in response to environmental concerns and climate change. As part of this initiative, electric bus shuttles have been introduced at Sharm El-Sheikh Airport, with plans to extend this environmentally-friendly project to all international airports in Egypt. This strategy is in line with the strategy of ICAO (2021) (Fig.1).

5. CONCLUSIONS

According to the results, Cairo International Airport is equipped with a limited number of check-in kiosks and one biometric machine for immigration procedures. In contrast, the Egyptian Airports Company does not provide any kiosk machines, relying instead on a few machines for scanning passports and visas, along with biometric machines for staff security purposes. Borg El Arab Airport stands out for its robotic landing system. This underscores the observation that none of the international airports in Egypt have embraced advanced technological solutions such as artificial intelligence tools, despite the current wave of high-tech advancements.

Several Egyptian airports are experiencing congestion and failing to meet their capacity targets. Consequently, they are addressing the congestion issue by expanding their infrastructure rather than utilizing digitalized or automated systems to enhance efficiency.

Furthermore, the findings indicate that Egyptian operators prioritize quality certificates and health accreditations over the Skytrax Rating Accreditation when competing. Additionally, the research highlights that all international Egyptian airports are making efforts to minimize emissions and noise pollution by implementing emissions charges for airline carriers.

The results indicate that numerous international airports have implemented initiatives to develop their facilities into environmentally friendly spaces, particularly through incorporating green public transportation options like electric train services, electric bus shuttles, and bike parking. Notably, the majority of airports in Egypt do not have intermodal or multimodal systems in place to streamline traveler transfers to and from urban areas. Cairo International Airport currently offers limited metro and bus shuttle services for traveler convenience within the airport premises. On the other hand, Sharm El-Sheikh Airport stands out as the sole airport providing bus shuttles to facilitate traveler transportation to the city center.

Furthermore, the Ministry of Civil Aviation, the Cairo Airport Company, and the Egyptian Airports Company employ a strict approach in formulating their strategies. This encompasses determining pricing policies, airport investments, performance evaluations, and service quality without granting individual airports the autonomy to establish their own regulations.

6. RECOMMENDATIONS

To achieve this, the following steps are recommended:

It is recommended that the Civil Aviation Authority, along with the Egyptian Holding Company for Airports and Navigation, collaborates with the Ministry of Transportation to implement the electric bus shuttle project, connecting all Egyptian airports to city centers in a manner similar to Sharm El-Sheikh Airport.

Maximize the utilization of current assets to prevent unnecessary capital expenses, develop an operations concept that improves efficiency and utilization, utilize technology to streamline airport operations and minimize environmental impact, comply with sustainable building standards and design principles to boost energy efficiency and reduce CO₂ emissions related to materials and construction processes throughout the infrastructure's lifespan, and create building envelopes that enhance energy efficiency by avoiding excessive spaces and unnecessary architectural elements that could result in increased embodied or operational carbon emissions.

The study presents a proposed practice for minimizing congestion and meeting the desired capacity at each airport. This includes implementing kiosk machines for expedited check-in procedures, self-drop baggage machines for quicker baggage handling, and biometric machines for speedier immigration processes. By streamlining these operations, operators can significantly reduce boarding times for travelers. Furthermore, operators are advised to collaborate with airlines to introduce kiosk machines at airports to streamline check-in processes (TABLE I.). Additionally, it is recommended that all international airport companies offer applications for travelers to track flights, request services, make duty-free purchases, and retrieve items from specified locations. Moreover, activating services like WhatsApp airport service and chatbots on websites can enhance customer experience. Lastly, Egyptian operators can enhance competitiveness by utilizing robots in

information centers to assist travelers with inquiries, guide them to gates, and provide information on various airport services and amenities.

TABLE I: The Number of the Proposed Kiosk , Self-Drop baggage and Biometric Machines in the Egyptian Airports

Name of airport	Duration of each Kiosk machine	Number of required machines	Duration of each self bag machine	Number of Required machines	Duration of Biometric machines (1 minute)	Number of required machines	The target number of travelers	The implemented capacity based on the highest year in the last 8 years
Cairo	12 second	13	30 seconds	34	20 pax	4	33,989,760	Less than 20,000,000
Sharm El-Sheikh	12 second	15	30 seconds	37	20 pax	4	37,152,000	Less than 6,500,000
Hurghada	12 second	10	30 seconds	25	20 pax	3	25,920,000	Less than 7,500,000
Borg al Arab	12 second	2	30 seconds	4	20 pax	1	4,320,000	Less than 2,800,000
Luxor	12 second	14	30 seconds	34	20 pax	4	34,560,000	Less than 1,200,000
Aswan	12 second	11	30 seconds	27	20 pax	3	27,648,000	Less than 800,000
Marsa Matrouh	12 second	1	30 seconds	3	20 pax	1	2,592,000	Less than 57,000
Taba	12 second	2	30 seconds	5	20 pax	1	5,184,000	Less than 70,000
Assuit	12 second	3	30 seconds	7	20 pax	1	6,912,000	Less than 400,000
Sohag	12 second	2	30 seconds	4	20 pax	1	3,456,000	Less than 800,000
Port Said	12 second	2	30 seconds	5	20 pax	1	4,320,000	Less than 55,000

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