

Evaluation of the Effectiveness of Mobile Boarding Passes Implementation in Egyptian Airlines: A Case Study Based on the Opinions of Traffic officers

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Abstract

The adoption of Mobile Boarding Passes in the aviation industry has gained significant momentum as an effective strategy to improve operational efficiency, reduce passenger wait times, and enhance the overall travel experience. However, within the context of Egyptian airlines, the implementation of Mobile Boarding Pass systems has faced several operational challenges. This study examines the case of Mobile Boarding Pass implementation in Egyptian airlines. The main aims are discovering of opportunities, challenges, benefits of the application process for passengers and Egyptian Airlines. A field study was conducted using a questionnaire as a data collection tool. The questionnaire was designed based on the Kirkpatrick Model of Evaluation, which includes four Dimensions: Reaction of Traffic officers, Knowledge and Skills Acquired, Changes in Work Practices, and Operational Effectiveness of Mobile Boarding Passes Implementation in Egyptian Airlines. A total of 408 questionnaires were distributed to traffic officers, seniors, supervisors, and station managers in Egyptian airlines to identify practical barriers and limitations related to the system's implementation. The results indicate that Mobile Boarding Pass systems have been partially implemented; however, passengers continue to face challenges, including the need for reliable connectivity in airports, robust cybersecurity measures, and the need to visit check-in desks for checking in luggage and printing boarding passes, although they have them on their mobile devices. The study ultimately recommends that airlines implement specific improvements to the system, such as establishing centralized baggage drop-off locations in city centers to facilitate early check-in ahead of the travel date and enhancing airport infrastructure to prevent delays, both of which would enhance the implementation process of Mobile Boarding Pass.

Keywords: Mobile Boarding Pass, Aviation, Airlines, Egyptian Airlines.

Introduction

The aviation industry has increasingly relied on digital technology to enhance operations and improve the passenger experience, with the mobile boarding pass being one of the most prominent innovations in this field. Mobile Boarding Passes allow passengers to bypass traditional check-in counters by using mobile devices to obtain digital boarding passes, reducing the need for paper tickets. This technological innovation not only improves customer convenience but also provides airlines with an opportunity to reduce costs, minimize operational delays, and enhance overall efficiency (Taneja, 2017). With

advanced technology, the mobile boarding pass can include secure biometric identity procedures, improving security and accelerating the boarding process (Humza & Hacıoglu, 2023).

In many global airports, Mobile Boarding Passes have become the norm, as several airlines and airports have implemented systems that allow passengers to check in online, access digital boarding passes, and even handle baggage via self-service kiosks (Taneja, 2016). However, the adoption of mobile boarding pass systems in Egypt has been slow and still faces many structural and operational limitations such as the fingerprint technology that was supposed to replace boarding passes, however it hasn't been implemented yet because of a shortage of funding since 2017. As the aviation sector in Egypt grows, especially with the increase in both international and domestic flights, the need to digitize the boarding process becomes more pressing (Mohamed, Gomaa, & El-Sherif, 2018). The study aims to explore the status of the implementation of mobile boarding in Egyptian airlines. The research was conducted on traffic officers in various types of Egyptian airlines, including low-cost airlines, charter airlines, scheduled airlines, and ground handling service companies. To achieve this primary objective, the study targets several sub-objectives as follows:

1. To evaluate the impact of mobile boarding pass implementation on speeding up and improving the boarding process in Egyptian airlines.
2. To know the time and effort savings in airport operations through the use of Mobile Boarding Passes.
3. To explore the impact of Mobile Boarding Passes on customer satisfaction in Egyptian airlines.
4. To identify the obstacles hindering the implementation of Mobile Boarding Passes in Egyptian airlines and how to address them.
5. To study the financial impact of mobile boarding pass implementation on operational costs in airlines.
6. To analyze the role of Mobile Boarding Passes in improving operational efficiency in Egyptian airlines.

Research contributes significantly to ongoing discussions on connecting technology to the aerospace industry by significantly increasing the efficiency of the application and implementation of Mobile Boarding Pass in Egyptian Airlines. Furthermore, it examines Employee Perception, Knowledge and Skills, Changes in Work Practices, Operational Efficiency and its impact, and Challenges facing Mobile Boarding Pass application through both the theoretical framework of the study and the field study.

Literature review

Airlines and airports can improve customer service, safety, and operational efficiency while cutting costs and fostering sustainability by moving away from legacy systems and toward digital solutions. Digital ticketing, predictive maintenance, and personalized services as examples of digital transformation in the aviation industry that help airlines streamline operations and address issues like security, environmental impact, and

operational efficiency (Nabila, 2023; Newbold, 2020). Currently, airlines allow passengers to use their mobile phones at security checkpoints and when boarding the plane. Passengers can display their boarding passes on their mobile devices in QR code format through the airline's app, mobile browser, or via an email link (Patel, 2018).

The Importance of Mobile Boarding Passes as Digital Transformation in the Aviation Industry:

Passengers with Mobile Boarding Passes can quickly complete their transactions by scanning the barcode on their mobile boarding pass. For airports that accept Mobile Boarding Passes, it has become common at many international and domestic destinations, making travel easier. Environmental protection and recycling are priorities for airlines, which is why they encourage the use of Mobile Boarding Passes instead of printed ones. Additionally, the design of electronic boarding passes has been updated to provide passengers with a smoother and more sustainable travel experience (Turkish Airlines, n.d.).

The benefit of completing travel procedures and issuing boarding passes online includes several advantages for passengers. It saves time at the airport by allowing seat selection in advance through the website or mobile app. Passengers can also purchase additional services, such as extra baggage, during check-in. They can also choose the counter to drop off their luggage, which reduces waiting times. Furthermore, some airlines offer loyalty points for online check-in, adding extra benefits (Wingie, n.d.). Otherwise, Zissis and Lekkas (2012) noted that Mobile Boarding Passes could be susceptible to data breaches or theft of personal information if not properly secured, along with issues faced by older passengers or those with lower technical skills, such as difficulty in downloading, storing, leading to errors or delays, app crashes, or scanner problems, and forge or clone Mobile Boarding Passes (Saha, Khan, Lalitha, & Prasad, 2024; El Samra, 2017; Taneja, 2016).

Level 1: Employee Perception of Mobile Boarding Pass Implementation:

Mobile Boarding Passes enhance passenger comfort during check-in and boarding, ensuring a smoother travel experience. Moreover, reducing stress and waiting times can significantly improve customer satisfaction (Kuchta, Sergei, and Ökal Sarı, 2022). Mohamed and Al-Azab (2021) explained that collecting passenger data via Mobile Boarding Passes helps improve operational plans and service offerings. Furthermore, implementing mobile boarding pass systems can reduce expenses related to staffing check-in counters and supervising boarding procedures (Abdelaziz, Hegazy, & Elabbassy, 2010). Samy (2012) noted that the more convenient and user-friendly mobile boarding pass experience can increase passenger satisfaction and loyalty to airports and airlines.

Level 2: Learning – Knowledge and Skills Acquired Regarding Mobile Boarding

Both Magano and Cunha (2019) and Egger (2013) mentioned that significant investment in advanced technologies would be necessary to integrate mobile boarding pass solutions with existing check-in and boarding systems. Additionally, the costs associated with mobile boarding pass technology, staff training, resistance to change, lack of technical

skills, and infrastructure upgrades can present significant challenges for some airlines (Oktadiana and Pearce, 2020; Hirsh, 2016). Both Sigala (2016) and Venkatesh, Thong, and Xu (2012) noted that device limitations, software incompatibility, and advanced technological infrastructure could be obstacles to airlines implementing Mobile Boarding Passes. Furthermore, some travelers may be resistant to using Mobile Boarding Passes due to lack of familiarity with technology or concerns about data protection and reliability (Suwannakul, 2021). Wattanacharoensil, Schokert, and Graham (2016) pointed out that the difference in regulations concerning passenger data and security across international borders is one of the barriers facing implantation process.

Level 3: Behavior – Changes in Work Practices Due to Mobile Boarding

Airlines can better allocate resources and enhance services by collecting real-time data on passengers' movements and preferences through the use of Mobile Boarding Passes (Jiang, Tran, & Williams, 2023). It helps enhance security at airports while maintaining efficiency through advanced security features like biometric recognition (Bogicevic, Bujisic, Bilgihan, Yang, & Cobanoglu, 2017). Sigala (2016) noted that passenger flow and waiting times can be reduced by streamlining the process at security and boarding points using Mobile Boarding Passes. Strong cyber security measures are also crucial in preventing fraud and data breaches, which can be difficult and costly (Khan and Efthimiou, 202). Finally, it meets the changing needs of airports, regulations, and technological advancements (Ahmed, 2018).

Level 4: Operational Effectiveness of Mobile Boarding Passes Implementation in Airlines

This system helps reduce the number of staff at boarding gates and check-in counters, allowing airlines to save on operational costs (Bruno, Deglio, Genovese, and Piccolo, 2019). Additionally, it plays a key role in reducing operations at airports and accelerating flight turnaround times (Schultz, 2018). Florido-Benitez (2016) and Egger (2013) clarified that they can be made more environmentally friendly by reducing paper usage and speeding up boarding procedures in the aviation industry. Morosan (2014) stated the Mobile Boarding Passes system can be integrated well with other systems (e.g., flight information, security checks) at airports

. By updating and adapting to new regulations or technological advances, one of the main functions of Mobile Boarding Passes is to assist airlines in meeting changing market needs (Zaharia and Petreanu, 2018).

Mobile Boarding Passes Implementation in Egyptian Airlines

The passenger experience is often inconsistent and confusing, especially in developing countries, due to a lack of support from all airports (Rubio-Andrada, Celemín-Pedroche, Escat-Cortés, & Jiménez-Crisóstomo, 2023). In recent years, Egyptian airlines have taken concrete steps toward adopting Mobile Boarding Pass technology to enhance the passenger experience and streamline travel procedures. There are some of these steps as follows:

- EgyptAir has launched its official mobile application, which allows passengers to book flights, complete check-in procedures, select seats, and receive electronic

boarding passes up to 48 hours before departure. The app is available on both Google Play and Apple App Store (EgyptAir, 2023).

- Nile Air provides an online check-in service, enabling passengers to choose their seats and print their boarding passes before arriving at the airport, saving time and effort (Nile Air, 2023).
- Air Cairo has introduced its own mobile application, allowing passengers to search for flights, view flight details, select seats, and share their itinerary with family and friends. The app also enables check-in and receipt of electronic boarding passes (Air Cairo, 2023).

These initiatives reflect Egyptian airlines' commitment to adopting modern technology to enhance their services and provide a smoother, more convenient travel experience for passengers.

Methodology:

To explore the implementation of Mobile Boarding Passes in Egyptian airlines, a structured questionnaire was distributed to airline employees at several major airports (Cairo, Alexandria, Sharm Elsheikh, Hurghada, Marsa Alam, Luxor, and Aswan) in Egypt. A total of 408 employees participated in the study, including ground officers, responsible officers, supervisors, and station managers from various airport locations. The sample was carefully selected to reflect a diverse range of job roles and work environments within the aviation sector.

The field study conducted through an online questionnaire directed at traffic officers in Egyptian airlines between 5 September 2024 and 15 October 2024 to provide valuable insights into the reality of mobile boarding pass implementation. The questionnaire was based on the Kirkpatrick Model of Evaluation, a globally recognized evaluation method that classifies the data according to four levels of criteria: reaction, learning, behavior, and results (Azmy & Setiarini, 2023).

The questionnaire was developed based on a thorough review of relevant literature that applied the Kirkpatrick Model, which consists of four levels. Al-Maleh (2019), Abdelhakim, Jones, Redmond, Griffith, and Hewedi, (2018), Fithry, and Anwar, (2018), and Udeshika, (2024) as references were consulted to ensure the questionnaire's validity and alignment with established evaluation frameworks. This approach ensures varied data and detailed content reviews for each source, supporting the credibility of the research. Accordingly, the questionnaire was structured to collect comprehensive data and was organized into the following sections:

- **Demographic Information:** This section captured relevant details about the participants, such as job roles, years of experience, and educational background.
- **Level 1: Reaction** – This assessed employee perceptions of mobile boarding, focusing on their attitudes toward its effectiveness and impact on passenger experience.
- **Level 2: Learning** – This section examined the knowledge and skills employees had acquired regarding the mobile boarding system.

- **Level 3: Behavior** – This focused on how employees' work practices had changed due to the adoption of mobile boarding technology.
- **Level 4: Results** – This section explored the operational efficiency and overall impact of mobile boarding on airline operations.

Participants' responses were measured using a 5-point Likert scale, where "5" represented "Strongly Agree" and "1" represented "Strongly Disagree." This scale allowed for a nuanced analysis of the participants' views and experiences. Data analysis was carried out using SPSS version 26. Various statistical methods were employed, including frequency distributions, mean and standard deviation calculations, and correlation analyses by using Kruskal-Wallis Test, to examine relationships between demographic data and four dimensions. These methods provided insights into the implementation and effectiveness of Mobile Boarding Passes in the context of Egyptian airlines.

To ensure the validity and reliability of the questionnaire, it was reviewed by three experts in the field: a Director of Ground Services at a charter company based in Hurgada with 20 years of experience in the field; a Station Manager at Cairo International Airport with 16 years of experience; and a Ground Services Supervisor at Borg El Arab International Airport with 15 years of experience. Their feedback helped refine the instrument, ensuring that the items were clear, relevant, and aligned with the study's objectives. A reliability test was conducted to ensure the consistency of measurements across the different items in the questionnaire. Reliability reflects the stability and consistency of the tool, which can be assessed by examining the internal consistency of the study instrument. In this study, the items of the questionnaire were organized in a structured format. According to Liu, Wu, and Zombo (2010), accepted Cronbach's alpha values typically range between 0.70 and 0.95, indicating the acceptable range for internal consistency in reliability testing.

As shown in Table (1), the reliability of the scales was calculated, with Cronbach's Alpha values for all scales ranging from 0.72 to 0.85. Furthermore, the overall Cronbach's Alpha for the questionnaire items was 0.89, demonstrating an acceptable level of reliability, as values exceeding 0.7 are typically regarded as acceptable.

Table (1) Cronbach's Alpha Value for Application of Mobile Boarding Card

Variables	No. of items	Cronbach's Alpha Value
Reaction of Traffic officers for Mobile Boarding Passes Implementation	8	0.74
Knowledge and Skills Acquired Regarding Mobile Boarding Passes Implementation	7	0.72
Changes in Work Practices Due to Mobile Boarding Passes Implementation	8	0.85
Operational Effectiveness of Mobile Boarding Passes Implementation in Egyptian Airlines	9	0.76
Total	32	0.89

Results and Discussion

Table (2) shows the demographic data of the participants in the study, providing a comprehensive overview of their job roles, work locations, years of experience, educational levels, and the type of airline they work for. This table aims to illustrate the diversity of the participants and their representation of the target environment in the study.

Table (2) Demographic Data

No	Items		Frequency	Percent
1	Profession of Respondents	Traffic Officer	245	60 .0
		Senior Traffic Officer	70	17.0
		Supervisor	53	13 .0
		Station Manager	40	10 .0
Total			408	100%
2	Location of Airport	Cairo	143	35.1
		Alexandria	85	20.8
		Sharm Elsheikh	44	10.8
		Hurghada	36	8.8
		Marsa Alam	9	2.2
		Luxor	59	14.5
		Aswan	32	7.8
Total			408	100%
3	Years of Experience	Below 3 years	80	19.6
		From 3 to 5 years	112	27.5
		From 6 to 10 years	72	17.6
		Above 10 years	144	35.3
Total			408	100%
4	Education of Respondents	Bachelor	324	79.4
		Master	72	17.7
		PhD	12	2.9
Total			408	100%
5	Type of Airline	Low-Cost Airline	36	8.8
		Charter Airline	49	12.0
		Scheduled Airline	247	60.6
		Ground Handling Service Company	76	18.6
Total			408	100%

The results clarified that the majority of participants (60%) work as ground handling officers, while the smallest percentage are station managers (10%). The largest proportion of participants are located at Cairo Airport (35.1%), which is expected as it is the main airport in Egypt. Furthermore, the data indicates that participants with long experience (more than 10 years) make up 35.3%, reflecting the significance of their perspectives in

evaluating the system. In terms of academic qualifications, the majority hold a bachelor's degree (79.4%), suggesting that the sample consists of qualified individuals in their field of work.

Table No. (3): Implementation of Mobile Boarding Card within Companies

No	Items	Frequency	Percent
1	Yes	266	65.2
2	No	142	34.8
Total		408	100 %

The data in Table 4 shows that 65.2% of the responding ground operations officers work for airlines that have adopted the mobile boarding pass system, while 34.8% work for airlines that have not yet implemented it. According to the respondents, the airlines that apply mobile boarding in Egypt are EgyptAir, Nile Air, and Air Cairo, which aligns with the theoretical study. These figures indicate that the system has started to spread but has not yet reached full adoption.

Level 1: Reaction – Employee Perception of Mobile Boarding

Table 4 clarified employee Perception regarding the implementation of mobile boarding cards. It reflects their opinions on how this system impacts the passenger experience, improvements, and environmental sustainability. The objective of the table is to assess employee perceptions and analyze their responses to identify the strengths and weaknesses in the system's implementation.

Table No. (4): Reaction of Traffic officers for Mobile Boarding Passes Implementation

Items			Frequencies *					Mean	SD
			Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree		
1	Mobile boarding Passes allow passengers to check in and board more conveniently.	Freq.	5	5	22	155	221	4.43	0.7579
		%	1.2	1.2	5.4	38	54.2		
2	Passengers who use mobile boarding enjoy a smoother travel experience.	Freq.	2	4	9	61	332	4.76	0.5885
		%	0.5	1.0	2.2	15.0	81.3		
3	Mobile boarding leads to reduce stress and waiting times.	Freq.	3	7	41	171	186	4.30	0.7767
		%	0.7	1.7	10	41.9	45.7		
4	It leads to an increase in customer	Freq.	4	3	18	198	185	4.37	0.6950
		%	1.0	0.7	4.4	48.6	45.3		

Items			Frequencies *					Mean	SD
			Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree		
	satisfaction.								
5	It helps to reduce the need for staff at check-in counters and boarding gates.	Freq.	6	4	21	202	175	4.31	0.7449
		%	1.5	1.0	5.1	49.5	42.9		
6	Mobile Boarding allows to improve service offerings and operational strategies as a result of collection of passenger data.	Freq.	3	13	36	216	140	4.17	0.7732
		%	0.7	3.2	8.8	53.0	34.3		
7	Mobile Boarding enhances aviation security.	Freq.	6	53	84	121	144	3.84	1.0905
		%	1.5	13	20.5	29.7	35.3		
8	It enhances expediting boarding.	Freq.	5	4	33	156	210	4.38	0.7772
		%	1.2	1.0	8.1	38.2	51.5		
Total mean								4.32	0.4168

The table clearly indicated a general acceptance of the "Reaction of Traffic Officers to Mobile Boarding Passes Implementation" dimension ($X=4.32$, $SD= 0.4168$), suggesting a stable consensus among respondents regarding this aspect. The highest level of acceptance within their Reaction was for "Passengers who use mobile boarding enjoy a smoother travel experience." which recorded a Mean of 4.76. This reflects the respondents' strong acceptance that implementing mobile boarding has a positive impact on making travel more seamless and efficient. On the other hand, respondents showed a neutral stance toward the statement "Mobile Boarding enhances aviation security" ($X=3.84$, $SD= 1.0905$). This neutrality may be attributed to the fact that passengers using mobile boarding do not pass through the check-in desk at the airport, meaning they do not receive the usual security questions asked by ground officers. These questions are essential to ensuring that no unauthorized individuals have tampered with the passenger's luggage, which is a crucial step in maintaining flight safety.

Level 2: Learning – Knowledge and Skills Acquired Regarding Mobile Boarding

Table 5 presented an evaluation of the knowledge and skills acquired by employees regarding the mobile boarding card system. The focus is on their confidence in the system, the training they received, their ability to resolve issues related to it, and their understanding of the security aspects and regulations associated with the system. The aim of the table is to measure the technical and operational readiness of employees.

Table No. (5): Learning: Knowledge and Skills Acquired Regarding Mobile Boarding Passes Implementation

Items			Frequencies *					Mean	SD
			Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree		
1	Some issues like software compatibility, hardware limitations, Advanced technology infrastructure face passengers during using Mobile Boarding Cards	Freq.	2	10	25	122	249	4.49	0.7613
		%	0.5	2.5	6.1	29.9	61.0		
2	High costly due to the robust cyber security measures related to data breaches and fraud one of challenges that face employees and passengers	Freq.	0	11	108	31	258	4.31	0.9533
		%	0.0	2.7	26.5	7.6	63.2		
3	A lack of familiarity with technology for passengers is one of resistance factors faced with the implementation process	Freq.	3	5	50	103	247	4.44	0.8090
		%	0.7	1.2	12.3	25.2	60.6		
4	Staff knowledge of regulations regarding passenger data and security in different countries across international borders is critical factor for implementation	Freq.	1	14	86	37	270	4.38	0.9452
		%	0.2	3.4	21.1	9.1	66.2		
5	Mobile boarding application requires substantial investment to integrate mobile boarding solutions with current check-in and boarding systems.	Freq.	1	10	95	150	152	4.08	0.8487
		%	0.2	2.5	23.2	36.8	37.3		
6	Airlines need more cost for mobile boarding technology, staff training, and infrastructure	Freq.	4	11	44	244	105	4.07	0.7472
		%	1.0	2.7	10.8	59.8	25.7		

Items			Frequencies *					Mean	SD
			Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree		
	upgrading application. for								
7	Staff needs for technological skills are essential during implementing Mobile Boarding Passes	Freq.	1	10	207	29	161	3.81	0.9977
		%	0.2	2.5	50.7	7.1	39.5		
Total mean								4.30	0.4216

The table indicated a moderate acceptance for dimension of the Knowledge and Skills of employees acquired regarding Mobile Boarding Passes Implementation ($X=4.30$, $SD=0.4216$) that reflects a stable consensus among respondents with a low level of acceptance. While the highest level of acceptance within this dimension was for the statement "Some issues like software compatibility, hardware limitations, and advanced technology infrastructure face passengers during the use of Mobile Boarding Cards," which recorded a Mean of 4.49. This highlights the importance of having knowledge about software and the necessity of a supportive technological infrastructure from the respondents' perspective, as it is directly linked to the system's implementation. The results clarified that passengers' limited technological knowledge acts as a barrier to mobile boarding implementation as a result of a lack of familiarity with technology for passengers ($X=4.44$, $SD=0.8090$). Finally, participations perceived that ground officers as already possessing sufficient technological knowledge required for the implementation of mobile boarding.

Level 3: Behavior – Changes in Work Practices Due to Mobile Boarding

Table 6 reviewed the impact of implementing mobile boarding cards on employees' work practices. It focuses on their involvement in assisting passengers, and the challenges they face, including technical issues and the need for manual intervention. The aim of this dimension is to measure the practical impact of the system on daily workflow.

Table No. (6): Changes in Work Practices Due to Mobile Boarding Passes Implementation

Items			Frequencies *					Mean	SD
			Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree		
1	Mobile boarding can simplify the flow of passengers through security	Freq.	2	5	15	188	198	4.41	0.6699
		%	0.5	1.2	3.7	46.1	48.5		

Items			Frequencies *					Mean	SD
			Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree		
	and boarding processes.								
2	Mobile boarding decreases congestion and waiting times of passengers.	Freq.	2	6	25	111	264	4.54	0.7205
		%	0.5	1.5	6.1	27.2	64.7		
3	Mobile boarding minimizes the cost of staffing check-in counters and managing boarding processes.	Freq.	1	8	62	206	131	4.12	0.7483
		%	0.2	2	15.2	50.5	32.1		
4	Mobile Boarding increases passengers' satisfaction and loyalty to airlines due to a more convenient and user-friendly boarding experience.	Freq.	1	5	56	179	167	4.24	0.7492
		%	0.2	1.2	13.7	43.9	41.0		
5	Mobile Boarding helps airline to collect real-time data on passenger movements and preferences that leads to optimize resource allocation and improve services.	Freq.	1	6	66	192	143	4.15	0.7559
		%	0.2	1.5	16.2	47.1	35		
6	Mobile boarding service enhances efficiency and staff performance	Freq.	2	4	21	196	185	4.37	0.6739
		%	0.5	1	5.1	48	45.4		
7	Mobile Boarding contributes to a more environmentally friendly operation by reducing the need for paper boarding passes.	Freq.	0	10	25	209	164	4.29	0.6909
		%	0	2.5	6.1	51.2	40.2		
8	Mobile Boarding solutions can be easily adapted and scaled to meet areas of changing airport requirements, regulations, and advancements in technology.	Freq.	2	8	78	208	112	4.03	0.7673
		%	0.4	2.0	19.1	51.0	27.5		
Total mean								4.27	0.5059

The results reflected that one of the benefits of application is decreasing congestion and waiting times of passengers ($X=4.54$, $SD=0.7205$). This reflects that mobile boarding indeed helps reduce waiting times and congestion for travelers. With a mobile boarding pass, passengers are not required to stand in long check-in queues. With a mean score of 4.03, the statement that was least accepted was "Mobile Boarding solutions can be easily adapted and scaled to meet areas of changing airport requirements, regulations, and advancements in technology". This result indicates that while respondents acknowledge the flexibility of mobile boarding to adapt to different airport changes, regulations, and technological advancements, they accept this idea to a lesser extent compared to other statements.

Level 4: Results – Operational Effectiveness of Mobile Boarding Passes Implementation in Egyptian Airlines

Table 8 evaluates the operational efficiency and impact of the Mobile Boarding Card System on the airlines' operational performance. It includes measuring the system's effect on boarding times, reducing congestion at airports, decreasing the need for staff, and achieving customer satisfaction. The aim is to understand the actual impact of the system on operational processes and economic efficiency.

Table No. (7): Operational Effectiveness of Mobile Boarding Passes Implementation in Egyptian Airlines

Items			Frequencies *					Mean	SD
			Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree		
1	The mobile boarding pass reduces the overall boarding time in airport.	Freq.	102	198	42	33	33	2.26	1.1582
		%	25	48.5	10.3	8.1	8.1		
2	Passengers experience fewer issues when using the mobile boarding pass compared to traditional boarding passes	Freq.	41	76	230	37	24	2.82	0.9404
		%	10	18.6	56.4	9.1	5.9		
3	The mobile boarding pass application is easy to use for both passengers and ground staff	Freq.	61	82	93	100	72	3.09	1.3191
		%	15	20.1	22.8	24.5	17.6		
4	Mobile boarding passes can decrease airport operations and faster flight turnaround times	Freq.	5	11	44	181	167	4.21	0.8322
		%	1.2	2.7	10.8	44.4	40.9		
5	The mobile boarding pass helps improve overall passenger satisfaction	Freq.	72	94	0	242	0	3.01	1.2382
		%	17.6	23	0	59.3	0		

Items			Frequencies*					Mean	SD
			Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree		
	during the boarding process								
6	Mobile Boarding reduces airlines’ operational costs as a result of reducing check-in counters and boarding gates	Freq.	6	4	21	202	175	4.31	0.7449
		%	1.5	1.0	5.1	49.5	42.9		
7	The Mobile Boarding Passes has reduced the need for paper boarding passes, leading to environmental benefits	Freq.	82	106	111	79	30	2.68	1.2050
		%	20.1	26	27.2	19.4	7.4		
8	The Mobile Boarding Passes system is integrated well with other systems (e.g., flight information, security checks) at airports	Freq.	61	102	62	183	61	2.90	1.1356
		%	15	25	15.2	44.9	15		
9	It allows Airlines to adapt to evolving market demands by updating and adapting to changing regulations or technologies	Freq.	5	35	89	132	147	3.93	1.0149
		%	1.2	8.6	21.8	32.4	36		
Total mean								3.25	0.3598

Operational Effectiveness dimension aims to understand the actual impact of the system on operational processes and economic efficiency. Participations assured that Mobile Boarding Cards help Egyptian airlines to reduce operational costs as a result of reducing check-in counters and boarding gates ($X=4.31$, $SD=0.7449$) as well as faster flight turnaround times ($X=4.21$, $SD=0.8322$). This reflects that mobile boarding is closely linked to cost reduction, as it minimizes the need for check-in counters and boarding gates, in addition to reducing paper usage compared to the traditional system. According to participation opinions, the results reflected that Mobile Boarding is still in its early stages in Egypt and faces several challenges. some statements such as the effects of Mobile Boarding Pass on reducing the overall boarding time in the airport have a less mean (2.26) as a result of the need to queue at the check-in counter to drop off their baggage except passengers who travel without checked luggage.

Participants showed a neutral attitude towards paper boarding passes that leads to environmental benefits ($X= 2.68$, $SD=1.2050$). Respondents from EgyptAir indicated that

this is due to the fact that baggage handling is managed by a separate cargo company under the EgyptAir Holding Group, requiring coordination between different subsidiaries to fully implement a paperless boarding system. Finally, results clarified that passengers face fewer problems when using a mobile boarding pass instead of a standard one. This indicates that the current implementation of mobile boarding in Egyptian airlines has yet to deliver its full potential, as it remains in its early stages and still faces operational challenges.

Table No.8. Overall means and standard deviation for all Dimensions of Application of Mobile Boarding Card

Tour Type	No.	Mean	Std. Deviation
Reaction of Traffic officers for Mobile Boarding Passes Implementation	408	4.32	0.4168
Knowledge and Skills Acquired Regarding Mobile Boarding Passes Implementation	408	4.30	0.4216
Changes in Work Practices Due to Mobile Boarding Passes Implementation	408	4.27	0.5059
Operational Effectiveness of Mobile Boarding Passes Implementation in Egyptian Airlines	408	3.25	0.3598

Table (8) showed the various facts and opinions about Mobile Boarding Passes Implementation in Egyptian Airlines. Reaction of Traffic officers yielded the highest mean ($X=4.32$, $SD= 0.4168$) that having successfully explained and covered their reaction toward Mobile Boarding Passes. importance of Knowledge and Skills acquired regarding the implementation process was ranked second in the ranking with the mean= 4.30. The table indicates a moderate acceptance of the "Changes in Work Practices Due to Mobile Boarding" dimension, with an average mean value of 4.27 and an average Standard Deviation of 0.5059, suggesting a stable consensus among respondents and acknowledging some changes in work practices alongside the implementation of mobile boarding.

The table indicates a neutral tendency of acceptance regarding the "Operational Effectiveness of Mobile Boarding Passes Implementation in Egyptian Airlines" dimension, with an average Mean value of 3.25 and an average Standard Deviation of 0.3598. This suggests a variation in ground officers' opinions, ranging between acceptance, rejection, and neutrality. It is worth noting that the responses of traffic officers in this dimension reflect the actual implementation of the mobile boarding system in Egyptian airlines, providing insights into what is truly happening on the ground at Egyptian airports. In contrast, their responses to the previous dimensions were more focused on their general perception of the system and their views on mobile boarding as a concept, without specifically addressing the extent to which each statement applies to Egyptian airlines. This dimension, however, successfully captures that aspect.

Kruskal-Wallis Test according to Profession of Participations, Location of airport, Years of Experience, Their Education,

Table No. (9) Kruskal-Wallis Test according to Profession of Participations

	Profession	N	Mean Rank	Sig.
Reaction of Traffic officers	Traffic Officer	166	259.31	.000
	Senior Traffic Officer	77	105.52	
	Supervisor	61	253.01	
	Station Manager	104	161.85	
	Total	408	-----	
Knowledge and Skills Acquired	Traffic Officer	166	262.08	.002
	Senior Traffic Officer	77	60.60	
	Supervisor	61	226.49	
	Station Manager	104	206.24	
	Total	408	-----	
Changes in Work Practices	Traffic Officer	166	267.86	.008
	Senior Traffic Officer	77	202.10	
	Supervisor	61	141.24	
	Station Manager	104	142.25	
	Total	408	-----	
Operational Effectiveness of Mobile Boarding Passes Implementation	Traffic Officer	166	245.45	.000
	Senior Traffic Officer	77	216.54	
	Supervisor	61	135.60	
	Station Manager	104	170.63	
	Total	408	-----	

The table (9) tested an effect of profession of participations on main four dimensions of the study. There were statistically significant differences between the Profession of Participations with regard to Reaction of Traffic officers, Knowledge and Skills Acquired, Changes in Work Practices, and Operational Effectiveness of Mobile Boarding Passes Implementation in Egyptian airlines where the value of “Sig. (2-tailed)” = .000, .002, .008, .000.

Table No. (10) Kruskal-Wallis Test according to Location of airport

	Location of Airport	N	Mean Rank	Sig.
Reaction of Traffic officers	Cairo	143	261.09	.002
	Alexandria	85	106.98	
	Sharm Elsheikh	44	261.61	
	Hurghada	36	198.17	

	Location of Airport	N	Mean Rank	Sig.
	Marsa Alam	9	57.00	
	Luxor	59	215.14	
	Aswan	32	161.11	
	Total	408	-----	
Knowledge and Skills Acquired	Cairo	143	289.74	.003
	Alexandria	85	83.06	
	Sharm Elsheikh	44	223.64	
	Hurghada	36	206.42	
	Marsa Alam	9	276.39	
	Luxor	59	171.37	
	Aswan	32	158.53	
	Total	408	-----	
Changes in Work Practices	Cairo	143	287.16	.000
	Alexandria	85	206.99	
	Sharm Elsheikh	44	162.74	
	Hurghada	36	107.28	
	Marsa Alam	9	124.94	
	Luxor	59	127.53	
	Aswan	32	159.58	
	Total	408	-----	
Operational Effectiveness of Mobile Boarding Passes Implementation	Cairo	143	275.41	.009
	Alexandria	85	217.62	
	Sharm Elsheikh	44	153.17	
	Hurghada	36	112.26	
	Marsa Alam	9	41.61	
	Luxor	59	194.50	
	Aswan	32	91.34	
	Total	408	-----	

The table (10) showed the results of the “Kruskal-Wallis Test” to study the differences between the Location of Airport related to all dimensions of the Mobile Boarding Passes Implementation. the results suggests that the responses of traffic officers vary statistically significantly based on the airport's location with the p-value is 0.002, which is less than the standard significance level of 0.05. Finally, the location of the airport seems to influence the officers' reactions.

Based on the statistical values in the next table 11, the results clarified that there are significant statistical differences years of experience in perception and its effects of four dimensions, with values “Sig.” Less than 0.05. This indicates that experience levels could

affect how traffic cops react, perhaps because more seasoned officers are better used to their jobs or don't encounter as much stress right away, compare to those with more experience.

Table No. (11) Kruskal-Wallis Test according to Years of Experience

	Years of Experience	N	Mean Rank	Sig.
Reaction of Traffic officers	Below 3 years	80	171.61	.007
	From 3 to 5 years	112	319.53	
	From 6 to 10 years	72	182.92	
	Above 10 years	144	144.09	
	Total	408	-----	
Knowledge and Skills Acquired	Below 3 years	80	199.27	.010
	From 3 to 5 years	112	298.22	
	From 6 to 10 years	72	162.51	
	Above 10 years	144	155.50	
	Total	408	-----	
Changes in Work Practices	Below 3 years	80	152.28	.005
	From 3 to 5 years	112	329.06	
	From 6 to 10 years	72	167.28	
	Above 10 years	144	155.24	
	Total	408	-----	
Operational Effectiveness of Mobile Boarding Passes Implementation	Below 3 years	80	168.43	.020
	From 3 to 5 years	112	311.74	
	From 6 to 10 years	72	154.57	
	Above 10 years	144	166.10	
	Total	408	-----	

Previous table 12 indicated that education level has a statistically significant effect (the p-value of 0.000) for four variables dependent that includes their reaction, knowledge and skills acquired, changes in work environment, and operational effectiveness. The results indicated that the level of education plays a main role in how officers respond to these aspects of their work and make changes in their work practices.

Table No. (12) Kruskal-Wallis Test according to Education of Participations

	Education	N	Mean Rank	Sig.
Reaction of Traffic officers	Bachelor	324	216.96	.000
	Master	72	159.77	
	PhD	12	136.46	
	Total	408	-----	

	Education	N	Mean Rank	Sig.
Knowledge and Skills Acquired	Bachelor	324	202.32	.002
	Master	72	220.92	
	PhD	12	164.79	
	Total	408	-----	
Changes in Work Practices	Bachelor	324	225.15	.006
	Master	72	126.35	
	PhD	12	115.83	
	Total	408	-----	
Operational Effectiveness of Mobile Boarding Passes Implementation	Bachelor	324	216.36	.000
	Master	72	159.63	
	PhD	12	153.58	
	Total	408	-----	

Table 12 clarified the Kruskal-Wallis test that was conducted to determine whether there is a statistically significant difference in the Reaction of traffic officers, their Knowledge, Skills, changes in Work Practices, and Operational Effectiveness of Mobile Boarding Passes based on the type of airline (Low-Cost Airline, Charter Airline, Scheduled Airline, and Ground Handling Service Company). The test reflected that there is a statistically significant difference in the four dimensions across different airline types with the significant p-value (0.000).

Table No. (13) Kruskal-Wallis Test according to Type of Airline

	Type of Airline	N	Mean Rank	Sig.
Reaction of Traffic officers	Low-Cost Airline	36	116.50	.000
	Charter Airline	49	165.30	
	Scheduled Airline	247	237.05	
	Ground Handling Service Company	76	165.68	
	Total	408	-----	
Knowledge and Skills Acquired	Low-Cost Airline	36	107.38	.000
	Charter Airline	49	121.50	
	Scheduled Airline	247	245.51	
	Ground Handling Service Company	76	170.74	
	Total	408	-----	
Changes in Work Practices	Low-Cost Airline	36	154.93	.000
	Charter Airline	49	174.52	
	Scheduled Airline	247	228.41	

	Type of Airline	N	Mean Rank	Sig.
	Ground Handling Service Company	76	169.60	
	Total	408	-----	
Operational Effectiveness of Mobile Boarding Passes Implementation	Low-Cost Airline	36	201.17	.000
	Charter Airline	49	166.41	
	Scheduled Airline	247	232.22	
	Ground Handling Service Company	76	140.55	
	Total	408	-----	

Conclusion and Recommendations

Egyptian Airlines' adoption of mobile boarding cards is essential to improving sustainability, operational effectiveness, and passenger convenience. Its efficacy affects airline performance and customer pleasure, and it influences the success of digital transformation in the aviation industry. A structured questionnaire was distributed to airline employees across major Egyptian airports, including Cairo, Alexandria, Sharm El-Sheikh, Hurghada, Marsa Alam, Luxor, and Aswan. A total of 408 employees participated, comprising ground officers, responsible officers, supervisors, and station managers. The results confirmed that mobile boarding cards contribute to speeding up and improving the boarding process, but they face significant challenges in Egypt, such as technology incompatibility and limited infrastructure. Ground officers mentioned that mobile boarding cards help speed up some processes. However, challenges remain related to reducing queues and minimizing manual intervention in case of technical issues.

Results showed a moderate improvement in customer satisfaction through the use of mobile boarding cards, despite challenges related to some passengers' unfamiliarity with the technology, software compatibility issues, device limitations, lack of technological infrastructure, and cyber security concerns. 65.2% of airlines have implemented the system, reflecting the beginning of adoption but not full implementation. The results showed that mobile boarding cards could improve operational efficiency, but obstacles remain, such as the need for staff intervention in case of system failures.

Key recommendations include improving the implementation process, such as establishing centralized baggage collection points in city centers, to streamline the mobile boarding experience. Enhancing cyber security and data protection through increasing training on security and technical aspects, increasing technology awareness, and convincing employees are critical factors during the implementation process. Working on reducing resistance from some employees and passengers to adopt the new system through ongoing training and technical support. Finally, these improvements are essential not only to meet international standards but also to enhance operational efficiency and improve the overall passenger experience.

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تقييم فعالية تطبيق بطاقات الصعود للطائرة عبر الهواتف المحمولة في شركات الطيران المصرية: دراسة حالة مبنية على آراء ضباط الحركة

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الملخص:

حقق اعتماد بطاقة الصعود عبر الهاتف المحمول في صناعة الطيران دورا كبيرا كاستراتيجية فعالة لتحسين الكفاءة التشغيلية، وتقليل أوقات الانتظار للمسافرين، وتحسين تجربة السفر بشكل عام. وبالرغم من ذلك، واجهت عملية تطبيق أنظمة بطاقة الصعود عبر الهاتف المحمول بشركات الطيران المصرية عدة تحديات تشغيلية. يتناول البحث تقييم مدى فاعلية تطبيق بطاقة الصعود عبر الهاتف المحمول في شركات الطيران المصرية. ويهدف لاكتشاف الفرص والتحديات وفوائد عملية التطبيق للمسافرين وخطوط الطيران المصرية. أجريت دراسة ميدانية باستخدام الاستبيان كأداة لجمع البيانات. صُممت استمارة الاستبيان بناءً على نموذج Kirkpatrick للتقييم، والذي يتضمن أربعة أبعاد: رد فعل ضباط الحركة، والمعرفة والمهارات المكتسبة، والتغييرات في ممارسات العمل، والفعالية التشغيلية لتطبيق بطاقات الصعود عبر الهاتف المحمول في شركات الطيران المصرية. تم توزيع 408 استمارة على ضباط الحركة والمشرفين ومديري المحطات بشركات الطيران المصرية وذلك لتحديد الحواجز والقيود العملية المتعلقة بتنفيذ النظام. تُظهر النتائج أن أنظمة بطاقات الصعود عبر الهواتف المحمولة قد طُبقت جزئياً، إلا أن المسافرين لا يزالون يواجهون عدة تحديات، مثل الحاجة إلى وجود اتصال فعال في المطارات، والحاجة لوجود إجراءات محكمة تعزز الأمن السيبراني، فضلاً عن الحاجة إلى زيارة مكاتب الفحص بالمطار لتسليم الأمتعة وطباعة بطاقات الصعود، على الرغم من توافرها على أجهزتهم المحمولة. توصي الدراسة بأن تقوم شركات الطيران بتنفيذ عدة تحسينات على النظام، من أهمها إنشاء مواقع مركزية لتسليم الأمتعة في مراكز المدن لتسهيل تسجيل الوصول المبكر قبل موعد السفر، وتعزيز البنية التحتية للمطارات لتفادي التأخيرات، الأمر الذي من شأنه أن يساعد في تسهيل عملية استخدام بطاقات الصعود عبر الهاتف المحمول بشكل أكثر فاعلية.

الكلمات المفتاحية: بطاقات الصعود عبر الهواتف المحمولة، الطيران، شركات الطيران، الخطوط الجوية المصرية.