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Does Technology Acceptance of Airport Self-service engender Passenger Satisfaction with Airport Self-Service? Mediation effect

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Abstract

Purpose: *Based on the Theory of Acceptance and Use of Technology (UTAUT), this Research aims to investigate which Performance Expectancy (PE) and Effort Expectancy (EE) affect Passenger Satisfaction indirectly through the mediating role of Propensity to Cross-Cultural Adaptation (PCCA).*

Design/ methodology/ approach: *The current study empirically examines this model using questionnaires administered to international passengers at Borg El Arab International Airport, as a strategic aviation hub in the Middle East and North Africa (MENA) region, known for its culturally diverse passenger base, by using covariance-based structural equation modeling (CB-SEM). Technologies are easy to understand and operate when these systems are. However, expecting technology to improve performance alone does not seem to affect satisfaction directly. The analysis also shows that the capacity to adapt to different cultural settings (PCCA) plays a key mediating role between both expectations and satisfaction. This means that cultural flexibility helps passengers turn their perceptions of usefulness and ease of use into actual satisfaction.*

Research implications/limitations: *This Research extends the Unified UTAUT by introducing a structural framework for travel environments that brings together people from diverse cultural backgrounds. The degree to which passengers accept and are satisfied with these technologies may depend on their personal views of the technology itself, as well as their ability to adapt across cultures.*

Practical implications/ limitations: *In practice, managers and system developers should not only focus on how effective or easy a system is but also consider cultural inclusiveness to raise satisfaction and promote more sustainable behavior among travelers.*

Originality: *By introducing this psychological model, the study expands the application of technology acceptance theory within aviation. It provides new insight from airports in emerging economies that could support Airport managers and technology designers to drive satisfaction.*

Keywords: *Smart airports; performance expectancy; effort expectancy; cross-cultural adaptation; passenger satisfaction; Alexandria Airport; Technology acceptance.*

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1. Introduction

Smart technology has become a global trend across the industry sectors, and airports are integrating digital technologies to improve the efficiency of their operational services, transforming the airport into a smart hub (Choi *et al.*, 2024). In recent years, the digital transformation has quickened, especially with global crises and sustainability pressures that prioritise contactless services and resource efficiency (Controls, 2019). For example, during the COVID-19 pandemic, airports had to adopt touchless self-service technologies (such as biometric check-in kiosks and e-gates) to minimise physical contact for the passengers to enhance their safety (Berti, 2020). That impact on the percentage of adopting smart technology in the airport, therefore, industry surveys report that, as of 2023, over 82% of airports have increased IT investments to deliver more seamless, personalised services, aligning with travellers' heightened expectations for convenient, sustainable journeys (Choi *et al.*, 2024). There is a growing concern about the role of smart airport technologies for improving passenger satisfaction and supporting sustainable aviation practices (Choi *et al.*, 2024).

The recognition of these benefits and how readily passengers accept and utilize the innovations introduced is raised. Notably, Many travelers, on one hand, appreciate self-service options that simplify procedures and reduce waiting time. On the other hand, some may experience travelers' hesitation or discomfort—particularly in airports with high cultural and linguistic diversity and constant passenger turnover (Yafi, Tehseen, and Haider, 2021). In this context, Alexandria International Airport in Alexandria, Egypt, provides a telling context in this matter. This airport serves as a significant link point among Africa, the Middle East, Asia, and Europe; therefore, travelers from diverse cultural and linguistic origins cross through there (Helmy, 2018). This cultural diversity often shapes visitors' interactions with smart technology, affecting their comfort and confidence in using it. With that in mind, these cultural norms are not taken into account. In that case, they may be reflected in differences in satisfaction levels across traveler groups.

The current study examines the impact of performance expectancy (PE), effort expectancy (EE), and cross-cultural adaptability (PCCA) on passenger satisfaction. PE, analogous to perceived usefulness in the Technology Acceptance (Robbins, 1964), reflects the degree to which a passenger believes that utilizing technology will enhance travel efficiency, such as by conserving time or improving the airport experience. Effort expectancy refers to the perceived ease of learning and use of self-service applications at airports (Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, 2003). Furthermore, both performance expectancy (PE) and effort expectancy (EE) are important indicators of user acceptance within the unified theory of technology acceptance (UTAUT) (Venkatesh *et al.*, 2003), which have been empirically used in many travel technology applications, including airline e-ticketing (Escobar-Rodríguez and Carvajal-Trujillo, 2023), biometric applications (Kim, Sung, and Lee, 2023), and airport self-check-in kiosks (Wongyai *et al.*, 2024). Therefore, The current study suppose that When travelers realize that a system saves them time and is easy to use, they are generally more likely to use it and feel more satisfied afterward, as a High PE (e.g., believing a self-check-in kiosk makes one's journey more efficient) and high effort expectancy (e.g., finding the kiosk easy to use) are generally associated with stronger intention to use and greater user satisfaction with the technology. Nevertheless, in an international airport setting, an intermediate variable may condition these relationships: PCCA is defined as a traveller's personal tendency or openness to adjust to different cultural environments and practices – in this case, adapting to unfamiliar technologies, languages, or customs encountered during travel (Wong, Sia and Ling, 2020).

Of note, recent academic discussions (Alexandra and Dias, 2024) have emphasized the need for models that better reflect the cultural diversity of modern mobility contexts. They argue that the PCCA model may serve as a crucial link between how travelers perceive technology and its outcomes. In response to these calls, this study presents an integrated model that links PE, EE, PCCA, and traveler satisfaction. Moreover, Florido-Benítez (2024 indicates that international travel environments require a combination of technological readiness and cultural flexibility (Florido-Benítez, 2024). They suggest that PCCA may be an important factor in shaping how people evaluate smart airport technologies. However, despite its importance, the PCCA model has received little attention in aviation-related technology acceptance research (Won, Chiu, and Byun, 2023). Recent academic discussions (Alexandra and Dias, 2024) have emphasized the need for models that better reflect the cultural diversity of modern mobility contexts. They argue that the PCCA model may serve as a crucial link between how travelers perceive technology and its outcomes. In response to these calls, this study presents an integrated model that links PE, EE, PCCA, and traveler satisfaction. This model extends the UTAUT framework by positioning the PCCA as a mediator that directs the impact of utility and usability expectations toward satisfaction. In a multicultural smart airport environment, simply perceiving a system as useful or simple (PE/EE) may not be sufficient to guarantee a positive experience; travelers must also be able to adapt to the cultural cues embedded in the technology itself. To test this hypothesis, the study draws on evidence from Alexandria Airport in Egypt. As smart airport initiatives are still in initial phases, they are gaining increasing momentum (Celemín-Pedroche, Ostomo, and Escat-Cort, 2023). Thus, the study contributes to existing literature in several areas of digitalization research. It adds a case study from Alexandria Airport—an environment combining newly introduced smart systems with a diverse passenger base (Khalaf, ASHOUR and Abdel Rady, 2023)—and moves beyond the traditional focus on large hub airports in West or East Asia (Sreenath, Sudhakar and Yusop, 2021; Eid *et al.*, 2022; Genina, Sakty and Ali, 2023). This answers calls for more scholarly attention to smart mobility in emerging markets and provides data on technology adoption in the Middle East/North Africa aviation context (Mohamed, Gomaa, and El-Sherif, 2018), which remains under-represented in academic Research (Mohamed, Gomaa, and El-Sherif, 2018; Bieliatynskyi *et al.*, 2022; Choi *et al.*, 2024). Moreover, by merging technological and human cultural factors, this study advances theoretical knowledge. It offers actionable insights for developing smarter, more inclusive, and sustainable airport systems (Choi *et al.*, 2024).

The remainder of the study is structured as follows. The next section presents literature reviews on smart airports. Then, the methodology section analysis results, including CB-SEM tables, are presented. Then discuss the implications of the findings, limitations, and future research directions before concluding.

2. Literature Review

2.1 Smart Airports and Sustainable Passenger Experience

The concept of “smart airports” applies to leveraging digital applications to deliver seamless travel (Rubio-Andrada *et al.*, 2023), depending on much information and communication technologies (ICT) and automation to make their operations more efficient, their services better, and their environmental impact smaller. Hence, technology is the enabler, but a technological individual’s culture is what transforms automated facilities into performance. (Sugandha, Freestone, and Favaro, 2025). Unlike traditional airports, smart airports integrate systems such as self-service check-ins, biometric identity verification, real-time information delivery, and IoT-based asset management to create a seamless passenger journey(Mäkelä, 2024). Of note, the smart airport framework eliminates the need for physical check-in counters by using automated kiosks and e-gates, reducing paper waste and advancing environmental sustainability goals (Rupcic *et al.*, 2023). Williady, Handani & Kim (2024) have shown that airport service quality significantly shapes passengers’ overall satisfaction and loyalty (Williady, Handani and Kim, 2024), by Avoiding delays, queues, and lost baggage through smart solutions can improve travellers’ comfort and confidence. For instance, self-service baggage and check-in kiosks have been linked to higher traveler satisfaction, as these systems enable travelers to complete travel procedures at their own pace (Williady, Handani, and Kim, 2024). Notably, some research indicates that automation can have mixed effects: while efficiency and novelty can delight many passengers, the lack of human interaction may dissatisfy others who value personalized service (Al Sarrah, Ajmal, and Mertzanis, 2020; Eid *et al.*, 2024). In particular, cultural background can affect whether passengers prefer self-service or staff assistance (Simarmata *et al.*, 2025). The next subsections delve into these factors—PE and EE—and investigate the PCCA as a mediator of technology-driven satisfaction.

2.2 Performance Expectancy and Effort Expectancy in Technology Adoption

PE is defined as the extent to which travelers realize that using technology helps achieve gains in job or task performance (Simarmata *et al.*, 2025). In travel-related consumer settings, PE simply reflects how much people believe a service will actually improve their trip—whether by helping them save time, move more easily, or enjoy greater comfort. EE, on the other hand, is about how easy and straightforward the technology feels to use (Venkatesh *et al.*, 2003). These two ideas grew out of earlier concepts in the Technology Acceptance Model, which focused on perceived usefulness and ease of use (Davis, 1989). Despite the evolution of digital services, PE and EE remain among the strongest predictors of users’ acceptance of a new system (Ursava, 2022). Of note, Research in tourism and transportation consistently highlights their importance. For instance, Escobar Rodríguez and Carvajal Trujillo (2014) used the UTAUT model to investigate the passengers’ purchase intention of online airline tickets; they found that PE influenced purchase intention. When passengers felt the booking online platform offered better prices, faster booking, or simpler processes, they were more willing to purchase tickets from an airline’s website (Escobar-Rodríguez and Carvajal-Trujillo, 2014). Likewise, EE (as ease of navigating the website) emerged as a significant predictor of intention. In airport settings, PE and EE have been shown to influence passengers’ adoption of self-service technologies. A study (Lu *et al.*, 2024) on self-check-in kiosks found that perceived usefulness (PE) positively affected both usage intention and satisfaction, as passengers valued the efficiency gains (shorter check-in times, bypassing queues) (Choi *et al.*, 2024). EE, often operationalised as kiosk user-friendliness, also positively affected intention. If the check-in machines were easy to understand and use, passengers would be more inclined to use them. They felt more satisfied with the process (Lu *et al.*, 2024). Similarly, Kim et al. (2023) observed that, in a sample of Korean airport users, both the performance benefits and the ease of use of self-service systems enhanced travellers' technology acceptance and their perceived value of the service. In the context of biometric e-gates for border control, studies in the U.S. and Korea have reported that PE and EE are salient drivers of willingness to use these systems. Travellers tend to show stronger intentions to use biometric gates when they believe these systems will speed up border processing (high PE) and when they find them simple to operate (high EE(Kim, Costello and Lee, 2019).

Beyond intention, earlier studies show that these perceptions also shape users' satisfaction after using a technology. In airport settings, passengers generally report greater satisfaction when a self-service system genuinely reduces waiting time or when the interface feels uncomplicated (Wongyai *et al.*, 2024). Similar patterns have been observed in digital travel services. Yuan, Tseng, and Ho (2019) found that perceived usefulness had a direct and positive influence on passenger satisfaction with airline mobile apps(Yuan, Tseng, and Ho, 2019). Of note, a recent study from Europe supports this point, demonstrating that the usefulness and ease of use of automated services, such as passport control and self-check-in, were reliable predictors of overall satisfaction scores (Simarmata *et al.*, 2025). These results align with much Research in information systems, which identifies perceived system quality (ease of use) and usefulness as key factors in passenger satisfaction. (Ursava, 2022). It is also important to note that the strength of these relationships could differ from passenger to passenger. For example, passengers with limited prior experience are often more sensitive to the effort required to use a system. In contrast, experienced users tend to view ease of use as less critical (Ursava, 2022). In summary, PE and EE are fundamental to understanding technology uptake and satisfaction in airports. High perceived usefulness (e.g., "using this self-service kiosk will make my trip more efficient") and high perceived ease (e.g., "it is easy to operate this kiosk") generally foster positive attitudes, usage intentions, and satisfaction. Nevertheless, these perceptions do not exist in a vacuum – they are experienced by individuals who bring their own cultural backgrounds and adaptive capabilities to the situation. A passenger who finds a helpful kiosk and, in theory, easy to use might still not be satisfied or fully utilise it if, for example, they could struggle with language differences or unfamiliar procedures. This points to the importance of PCCA, which we explore next.

2.3 Cross-Cultural Adaptation and Technology Use in Travel

Cross-cultural adaptation is defined as the procedures by which individuals adjust to an unfamiliar cultural environment, acquiring the skills and comfort necessary to function effectively (Ahmed *et al.*, 2022). Key aspects of adaptation involve learning local norms/language, coping with "culture shock," and modifying behavior as a result (Leal *et al.*, 2017). In the context of tourism and travel, visitors, even for short stays, often have to deal with these challenges in simple ways—such as understanding signs written in a foreign language or using technologies designed for a local user base (Dube and Humbani, 2024).

Travelers differ in their propensity to adapt to new cultural environments: some possess high cultural intelligence and readily accept new cultures (Ang et al., 2007), while others experience difficulties and stress when confronted with new cultures (Wardle, 2003). This variability can significantly impact travel experiences. For instance, Cultural Intelligence (CQ) – a related construct defined as the ability to function effectively in culturally diverse situations – has been linked to better satisfaction with travel services. (Coves-Martínez, Sabiote-Ortiz and Frías-Jamilena, 2022) Demonstrated that tourists with higher CQ reported greater satisfaction with a mobile travel app and with their overall trip, presumably because they could overcome language or format barriers in the app and derive more value from it. This refers to individuals who are adept at cultural adaptation, being able to more fully utilise and appreciate technological services encountered abroad, leading to higher satisfaction. In an airport setting, PCCA might manifest as passengers struggling with technology interfaces that are not tailored to their home culture. Airports strive to be international, yet the implementation of technology inevitably carries local specificities (e.g., a kiosk might default to the local language or assume knowledge of specific airport processes) (Lim, Innes, and Meitner, 2015). A traveller's PCCA can determine whether these differences are experienced as minor inconveniences or major hurdles.

A traveller with a high level of PCCA is generally more comfortable navigating unfamiliar elements in the airport environment. They can adjust language settings on a kiosk, interpret symbols that differ from those at home, and confidently seek assistance when needed. These behaviours reduce stress and make it easier for them to use self-service technologies effectively.

In contrast, a traveller with low PCCA may find that even small differences—such as an unfamiliar credit card swipe direction or slightly different identification procedures—can create confusion and slow them down. These minor mismatches can quickly accumulate into frustration, limiting both their use of the technology and their overall satisfaction. Notably, ACI's global survey reported that certain cultural groups rate courtesy and human warmth highly in their satisfaction evaluations; these passengers might be less satisfied in a heavily automated airport if their expectations for human help or social interaction are unmet. Thus, airports face the challenge of finding the optimal balance between technological efficiency and human touch (Lee, 2024), especially given the cultural diversity of international travellers. Cultural differences in service expectations are well documented. For example, Eastern cultures may place more emphasis on hospitality and human support. In contrast, Western cultures might prioritise speed and autonomy (Wattanacharoensil, 2019).

Accordingly, smart airport initiatives must consider cross-cultural user needs to ensure that improvements in one dimension (such as efficiency) do not inadvertently erode satisfaction for some groups (ACI, 2024). In conclusion, smart airports seem to be a meeting point for technological innovation with sustainability goals. These airports could seek to enhance passenger satisfaction by providing faster, more reliable, and environmentally friendly services (Eshtaiwi *et al.*, 2018). The success of these technologies in airports depends on passenger acceptance, which is influenced by factors such as perceived performance benefits, the effort required, and cross-cultural adoption. In summary, the authors propose that PCCA acts as a crucial link between travellers' perceptions of smart airport technology and their eventual satisfaction. If a passenger has high performance and EE regarding a new self-service system, a high PCCA will enable them to capitalise on those positive perceptions by overcoming any cultural or contextual hurdles during use, resulting in a satisfying experience. On the other hand, if PCCA is low, even strong initial PE/EE may falter in practice; the traveller might not fully utilise the technology or use it under stress, dampening satisfaction. This mediating role of PCCA in technology acceptance and satisfaction has not been extensively studied, making it a focal point of our Research.

2.4 Passenger Satisfaction in Multicultural Service Environments

Passenger Satisfaction in the airport context refers to travellers' contentment with their airport experience and services. High satisfaction is associated with positive word of mouth, loyalty, and a greater likelihood of choosing the same airport or airline again (Han *et al.*, 2020). Satisfaction is typically conceptualised as resulting from the disconfirmation of expectations (Ali *et al.*, 2021) – passengers compare their pre-travel expectations of airport service quality with the actual performance they perceive. Smart technologies have introduced new dimensions to this evaluation. Modern passengers might expect quick, convenient, and digitally enabled services; meeting these expectations through technology can drive satisfaction, while any gap (e.g., technology breakdowns, confusing interfaces) can lead to dissatisfaction (Sharma, 2024). Prior Research has identified various determinants of airport passenger satisfaction, such as service efficiency, staff courtesy, facility cleanliness, security processing, and amenities (Halpern and Mwesiumo, 2021). With the proliferation of SSTs, "technology service quality" has become a pertinent factor. (Khan *et al.*, 2024) Note that reliability, responsiveness, and usability of self-service technologies contribute to perceptions of e-service quality. At airports, if kiosks or e-gates function reliably and swiftly, passengers view the service as high quality, boosting their overall satisfaction (Kim, Stepchenkova, and Babalou, 2018).

In contrast, satisfaction is likely to decrease if a machine malfunctions or if it is difficult to operate, even if other factors, such as staff courtesy, are exceptional. Therefore, it is now essential to manage airport satisfaction by guaranteeing a seamless digital service experience (Greer, Rakas, and Horvath, 2020). In multicultural passenger bases, perceptions of satisfaction can vary by cultural background. As discussed, ACI (2018) found that cultural differences influence what passengers value; for example, passengers from collectivist cultures might place greater weight on how family-friendly and accommodating the airport is. In contrast, those from individualist cultures focus on personal convenience and efficiency. The disparities indicate that a uniform strategy for enhancing satisfaction may be inadequate in an international airport; the design and execution of services, including technology, must be attuned to varied requirements. These measures can improve comfort and satisfaction for diverse groups (Wang *et al.*, 2024). Nonetheless, personal adaptability (PCCA) is expected to affect satisfaction in an environment where complete customization to each culture is unattainable. Satisfaction arises from a complex interaction between service performance and user variables. Our Research focuses on how user perceptions of technology (PE, EE) and their PCCA collectively influence satisfaction outcomes. Hypothesis Development (next section) will formally articulate the expected relationships between these constructions based on the above literature synthesis.

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3. Hypothesis Development

Drawing on the literature, the researcher develops five hypotheses linking PE, EE, PCCA, and passenger satisfaction (Figure 1 conceptually summarises these relationships).

H1. Performance expectancy positively affects passenger satisfaction.

This hypothesis asserts that when passengers recognize that smart airport technology offers significant advantages (high PE), they are more inclined to experience greater satisfaction with their travel experience (Rashid and Pandit, 2018). Satisfaction occurs when passengers perceive that their expectations for efficiency and convenience have been met (Venkatesh *et al.*, 2003). Suppose a traveler perceives that utilizing a biometric boarding gate will markedly decrease boarding time and alleviate stress. In that case, this perceived performance enhancement directly correlates with satisfaction with the service (Mazloum, 2025). According to (Eccles and Wigfield, 2002), individuals generally assess experiences more favorably when they attain desired outcomes (Eccles and Wigfield, 2002).

Recent studies substantiate this rationale. (Simarmata *et al.*, 2025) discovered that the perceived utility of self-service technologies in airports directly augmented passenger satisfaction by enhancing service efficiency and dependability. Likewise, (Harding, 2019) found that passengers anticipating robust performance from digital wayfinding systems demonstrated heightened satisfaction with their navigation and overall airport experience. Recently, Moon *et al.* (2025) revealed that international tourists who regarded mobile travel applications as highly beneficial exhibited greater engagement and satisfaction with their journeys (Moon *et al.*, 2025). These studies indicate that perceptions of technological efficacy considerably influence satisfaction. In the realm of smart airports, passengers with elevated perceived ease (PE) are inclined to associate technology adoption with streamlined processes, reduced waiting times, and enhanced service quality—factors that are crucial to satisfaction (Williady, Handani, and Kim, 2024). Consequently, when passengers recognize significant performance advantages, they are more inclined to assess the overall service experience favorably. Suppose passengers anticipate that smart airport technologies will provide significant efficiency and convenience. In that case, their satisfaction with the travel experience will rise.

H2: Effort Expectancy (EE) has a positive influence on Passenger Satisfaction (PS).

When passengers perceive airport technologies as simple, intuitive, and easy to operate, their overall satisfaction with the travel experience increases. A user-friendly interface—such as a clear, responsive self-check-in kiosk—reduces frustration and the cognitive effort required to complete tasks (Lu *et al.*, 2024). Passengers who can navigate these systems smoothly are more likely to feel confident and in control, which contributes to a sense of comfort and enjoyment (Hasanain, 2024). Conversely, when systems are complex or confusing, travellers often experience stress or delays before even beginning their journey, which negatively affects satisfaction (Gómez-Llanos, Durán-Barroso, and Robina-Ramírez, 2020). The “confidence factor” in service adaptation (Dash and Paul, 2021) supports this idea: people who feel capable of using a system tend to evaluate the service more positively. High EE fosters this confidence by assuring users that the technology will not be demanding or intimidating (Otieno, 2010).

Empirical studies in information systems have also shown that low perceived effort encourages users to engage more fully with a technology and to resolve issues on their own (Jan, Alshare, and Lane, 2024). In an airport context, this translates into smoother check-in experiences, shorter waiting times, and greater trust in the overall service process—all of which enhance Passenger Satisfaction. Thus, when travellers find airport technologies easy to use, their satisfaction with the journey is likely to rise.

H3: Propensity to Cross-Cultural Adaptation positively affects Passenger Satisfaction.

We expect that travellers who are more adept at PCCA (higher PCCA) will experience greater satisfaction with their airport journey (Coves-Martínez, Sabiote-Ortiz, and Frías-Jamilena, 2022). As discussed, individuals with high PCCA can navigate culturally novel situations more effectively, resulting in more successful and pleasant service encounters (Lu *et al.*, 2024). In the context of smart airport services, a high PCCA could make a passenger less likely to be deterred by, for example, language barriers or differing social norms for queuing at a kiosk (Simarmata *et al.*, 2025). Instead, they adjust and complete the process, leading to the intended outcome (e.g., a smooth check-in) and, in turn, satisfaction (Wongyai *et al.*, 2024). Meanwhile, a low-PCCA passenger might become frustrated or fail to fully utilise available services, resulting in delays or reliance on traditional counters – outcomes likely to diminish satisfaction. Findings in tourism behavior research support this hypothesis: for example, Coves-Martínez, Sabiote-Ortiz, and Frías-Jamilena (2022) found that tourists with higher cultural intelligence (which overlaps with adaptive propensity) experienced greater satisfaction with travel apps and their overall trip (Won, Chiu, and Byun, 2023). Those authors argue that culturally competent tourists can better handle foreign technology and content, thereby enabling the service to meet their needs better, driving higher satisfaction. Similarly, in expatriate consumer studies, individuals who adapt to the host culture tend to report higher satisfaction with local services and life in general (Lo and Nguyen, 2023). Applying this pattern to short-term airport users, we predict that PCCA will enhance satisfaction by enabling passengers to reap the benefits of smart services without being hindered by cultural frictions. Thus, a one-unit increase in a traveller's adaptation propensity should result in a significant increase in their satisfaction with airport services (Wang *et al.*, 2024).

H4: PCCA mediates the positive relationship between Performance Expectancy and Passenger Satisfaction.

This hypothesis suggests that PE influences satisfaction primarily by affecting PCCA. In other words, we expect the indirect path from PE to PCCA to Satisfaction to be significant. While PE may also have a direct effect on satisfaction (a valuable service tends to satisfy customers), we posit that in a multicultural environment, the satisfaction arising from perceived usefulness is channeled through the traveller's adaptive response. High PE motivates adaptation (as per H1), and then through adaptation, the passenger effectively uses the service and becomes satisfied (H3). Without adaptation, the benefits of high PE might not fully materialize in experience, thereby tempering satisfaction (Simarmata *et al.*, 2025). We anticipate that after accounting for PCCA, the direct effect of PE on satisfaction will diminish or become non-significant, indicating that PCCA carries the influence of PE. Empirically, Lu *et al.* (2024) observed a similar phenomenon, finding that cultural adjustment mediated the relationship between satisfaction. Here, even if passengers believe the tech is useful, it is their cross-cultural adaptability in using it that ultimately determines how satisfied they are. Thus, we hypothesize a mediated relationship: PE leads to higher PCCA, which in turn leads to higher satisfaction (PCCA mediates PE's effect).

H5: PCCA mediates the positive relationship between Effort Expectancy and Passenger Satisfaction.

Analogous to H4, we propose that EE impacts satisfaction primarily via PCCA. A high perceived ease of use will increase one's adaptation propensity (H2); with greater adaptation, the passenger uses the technology successfully and is satisfied (H3).

If adaptation is not present, even an easy-to-use system might not yield satisfaction for culturally unadaptable individuals (Lu *et al.*, 2024)—they might technically find it easy, but still avoid it or feel uneasy due to cultural disconnects, thereby not significantly improving their satisfaction. As an example, consider a passenger who finds the idea of a biometric gate straightforward (high EE) but has low adaptation propensity (Lo and Nguyen, 2023) – they may still avoid the gate due to discomfort with the concept in a foreign setting, choosing manual processing and thus not benefiting (and not particularly satisfied). Only when that passenger decides to adapt (perhaps because the ease encourages them enough to try) do they use the gate and appreciate its speed, resulting in satisfaction. In line with this reasoning, we expect an indirect effect such that EE → PCCA → Satisfaction is significant, potentially rendering any direct EE → Satisfaction effect weaker. Prior Research on IS user satisfaction often finds that perceived ease of use influences satisfaction through actual use or reduced stress (Amin, Rezaei, and Abolghasemi, 2014). In our model, PCCA can be viewed as an enabler of usage under cultural variance, fulfilling a similar role. Therefore, the current study hypothesizes that PCCA mediates the relationship between EE and passenger satisfaction.

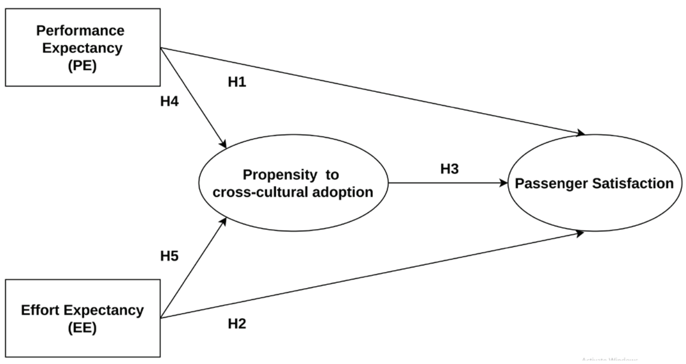

Figure 1: about here – conceptual model of hypothesised relationships

4. Methodology

4.1 Research Design and Context

This Research employs a quantitative research design using a single cross-sectional questionnaire to collect data from air travellers. The research setting is Alexandria International Airport, which is the second-

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busiest airport in Egypt and a regional hub for several airlines. The study selects this airport because it serves a highly diverse mix of passengers—North African, Gulf, European, and Asian—and because it has been actively rolling out smart technologies, including newly installed self-check-in kiosks and pilot-phase biometric immigration gates (ElMassah, 2018; Helmy, 2018). Moreover, focusing on a single airport may minimize variations in service quality across different locations while still capturing a wide range of cultural reactions to the same technological setting. The study was conducted over six months, from November to April 2025, during the return of high travel volumes following the pandemic. Throughout this time, health-related restrictions were minimal, and the airport operated close to full capacity. This created a realistic and dynamic environment in which to observe how travellers interacted with smart technologies and how these interactions shaped their satisfaction.

4.2 Sample and Data Collection

The target population was international departing passengers who had the opportunity to use the airport's self-service technologies, particularly the touchless biometric self-service check-in kiosks (referred to as TBSS in the survey). The study used a random sampling method in the airport's departure hall. The questionnaire was offered in English and Arabic, covering the dominant languages of the airport's users. To encourage honest feedback, respondents were assured of anonymity and that the survey was for academic purposes, with no influence on their travel or airline. The survey took approximately 7–10 minutes to complete, which was feasible during waiting times. A total of 1,200 passengers were approached. Of these, 1,050 agreed to participate (response rate: 87.5%). After discarding incomplete questionnaires (e.g., those missing entire sections) and those with apparent straight-line answering, we retained 1,025 valid responses for analysis. This sample size exceeds the minimum requirements for SEM given our model complexity (Hair et al., 2010) and allows robust hypothesis testing, including mediation, via bootstrapping. The sample encompassed a broad demographic range.

Approximately 56% of respondents were male and 44% female. Ages ranged from 18 to 72, with a median age in the early 30s. The largest age group was the 20s (roughly 34% of the sample), followed by the 30s (27%), the 40s (18%), and the 50s (13%), with smaller proportions in the teens and 60+ categories (as shown in Table 1). Education levels were relatively high: about 60% held a bachelor's degree or higher, 25% had some college or technical diploma, and 15% had secondary or lower education. The participants in this study were almost equally divided between men (498; 48.6%) and women (527; 51.4%), showing a balanced gender distribution. In terms of age, most respondents were in their forties (26.1%) and twenties (24.8%), followed by those in their fifties (17.7%) and thirties (16.3%). The youngest group (10–19 years) represented about 15% of the sample, while older adults were less frequently represented. Educational levels varied considerably. A quarter of participants reported having a graduate degree (25.5%). In comparison, others held a university degree (19.5%), a college diploma (21.5%), or a high school qualification (19.1%). Interestingly, 23.8% reported "other" educational backgrounds, suggesting diverse academic and training pathways. Overall, the demographic profile reflects a diverse group, with balanced gender representation, broad age coverage, and relatively high educational attainment. This variety provides a strong basis for interpreting the study results across different subgroups. Importantly, all respondents had used the TBSS kiosk for check-in or boarding pass printing for their current flight, as intended; their prior exposure to such technology ranged from first-time users (about 20% indicated it was their first experience with airport self-check-in) to regular users (around 30% had used such kiosks more than 7 times in the past). This variation helps capture differences in PE, EE, and adaptation.

Table 1: illustrates the demographic variables

Demographic variables	Criteria	Frequency	Percentages
gender	Male	498	49.8%
	Female	527	50.2%
age	10s (10–19)	153	%14
	20s (20–29)	255	%25
	30s (30–39)	267	%26
	40s (40–49)	268	%26
	50s (50–59)	42	%4
	60s and above	40	%4
level of education	High school	196	%19
	College (2–3 years)	241	%23.5
	University (bachelor's degree)	280	%27
	Graduate school (master's or higher)	262	%25.5
	Other	46	%4

4.3 Measures and Instrument Development

The Research evaluated four latent constructions using 5-point Likert-type items (1 = Strongly Disagree, 5 = Strongly Agree), each modified from recognized models specifically relevant to airport self-service. We used four UTAUT items (Venkatesh *et al.*, 2003) to measure PE. These items ask how much the kiosk

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improves travel efficiency, productivity, and the overall experience (for example, "Using the self-check-in technology improves my travel efficiency"). Four UTAUT items were used to assess EE. These items focused on how easy it was to learn how to use the system, how well it worked, and how much mental effort it took (e.g., "It was easy for me to learn how to operate the self-check-in kiosk"). The PCCA consists of four items, derived from the literature on cultural intelligence and adaptation (Ang *et al.*, 2007), to evaluate openness and ease of adjustment to unfamiliar technologies and cultural environments during travel (e.g., "I can adapt easily to technologies used in other cultures"). In the end, Passenger Satisfaction (PS) was measured using four items from service satisfaction studies (Brady and Robertson, 2001) that assessed both cognitive and emotional evaluations of the self-service experience (e.g., "Overall, I am satisfied with the self-check-in service"). These measures, together, assess how passengers feel about airport technology in terms of its usefulness, ease of use, cultural adaptability, and overall satisfaction.

All scale items were arranged by construct in the questionnaire, with clear section headings (e.g., "Please indicate your agreement with the following statements about the self-check-in technology…"). The use of a 5-point Likert scale throughout made it easy for respondents and is a common choice in travel surveys, where extreme granular scales may not yield proportionally more information. The survey instrument was developed in English and then translated into Arabic using a back-translation method to maintain semantic equivalence (Barakat *et al.*, 2023).

5. Data Analysis Approach

Pre-Testing: Before field deployment, the survey was pilot tested with 156 individuals (including graduate students and airport passengers) to assess clarity, translation accuracy, and relevance. Feedback led to minor wording adjustments, especially on the PCCA items to ensure they were interpreted as intended (for example, clarifying "technologies used in other cultures" by giving a concrete hint like "(e.g., different countries' airport systems)" in the pilot, which was later streamlined). The pilot also checked the flow and approximate completion time. Based on pilot data, the scales demonstrated promising internal consistency, and respondents found the questions comprehensible (as shown in Table 2). The results indicated that all factor loadings met the 0.50 threshold (Simarmata *et al.*, 2025), ranging from 0.701 to 0.962, confirming acceptable indicator reliability. In addition, the composite reliability (CR) values reached the optimal level of 0.70 (Elshaer *et al.*, 2021), with scores ranging from 0.807 to 0.855 across the four constructs. The average variance extracted (AVE) values also exceeded the required 0.50 threshold (Wongyai *et al.*, 2024), ranging from 0.512 to 0.596, thereby supporting convergent validity. Model-fit indices indicated that the measurement model's overall structure was appropriate: Chi-square = 384.972, degrees of freedom (df) = 192, GFI = 0.904, AGFI = 0.861, IFI = 0.963, TLI = 0.951, and CFI = 0.962 (Mueller and Hancock, 2018). Although some researchers argue that model-fit indices alone do not fully determine model adequacy, additional indices, such as χ^2/df = 2.01 and RMSEA = 0.047, further confirm that the model achieved an acceptable and reliable fit to the data.

Table 2: Scale Items and Confirmatory Factor Loadings (pilot study)

Construct	Items	Factor Loadings	Composite Reliability (CR)	AVE (%)
Performance Expectancy (PE)				
(Venkatesh *et al.*, 2003)	PE1	0.802	0.841	57.3
	PE2	0.818		
	PE3	0.794		
	PE4	0.831		
Effort Expectancy (EE)				
(Venkatesh *et al.*, 2003)	EE1	0.765	0.855	59.6
	EE2	0.786		
	EE3	0.781		
	EE4	0.770		
Propensity to Cross-Cultural Adaptation (PCCA)				
(Li, 2024)	PCCA1	0.701	0.807	51.2
	PCCA2	0.744		
	PCCA3	0.962		
	PCCA4	0.715		
Passenger Satisfaction (PS)				
(Fodness & Murray, 2007)	PS1	0.734	0.843	57.3
	PS2	0.788		
	PS3	0.761		
	PS4	0.757		

5.1 Measurement Model Assessment

The confirmatory factor analysis on the four latent constructs (PE, EE, PCCA, Satisfaction) demonstrated a good fit to the data. Reliability and validity checks confirmed the adequacy of the measurement model before hypothesis testing. Following Hair, Howard, and Nitzl (2020), all items met the accepted cut-off values for factor loading (≥ 0.50), composite reliability (≥ 0.70), and AVE (≥ 0.50) (Hair, Howard, and Nitzl, 2020). Discriminant validity was also established, as the square root of each construct's AVE exceeded its inter-construct correlations (Fornell and Larcker, 1981; Alarcón et al., 2015). The CFA results supported the model's overall fitness (χ^2/df = 1.998; CFI = 0.986; NFI = 0.973; IFI = 0.986; TLI = 0.983; RMSEA = 0.032). These indices, together with high reliability coefficients and satisfactory AVE values, indicate that the measurement model is both reliable and valid. Consequently, it provides a strong empirical basis for proceeding with hypothesis testing (Ali *et al.*, 2019).

5.2 Non-response bias and common method bias

Non-response bias is a type of bias that researchers test for; it is not a technique that guarantees the absence of disparity between initial and subsequent replies (Ali *et al.*, 2019). Levene's test showed a non-significant p-value, suggesting no difference between early and late replies. Standard method bias will be assessed to confirm that no single item accounts for 50% or more of the overall variation (K and Ranjit, 2020). The results of the bias (Zhang and Merchant, 2020).

Table 3: Scale Items and Confirmatory Factor Loadings (main study)

Construct	Items	Factor Loadings (λ)	Composite Reliability (CR)	AVE
Performance Expectancy (PE)	PE1	0.764	**0.862**	**0.611**
	PE2	0.755		
	PE3	0.78		
	PE4	0.826		
Effort Expectancy (EE)	EE1	0.805	**0.871**	**0.628**
	EE2	0.785		
	EE3	0.793		
	EE4	0.787		
Propensity to Cross-Cultural Adaptation (PCCA)	PCCA1	0.696	**0.808**	**0.513**
	PCCA2	0.69		
	PCCA3	0.729		
	PCCA4	0.749		
Passenger Satisfaction (PS)	PS1	0.767	**0.858**	**0.603**
	PS2	0.775		
	PS3	0.766		
	PS4	0.799		

Note: *For PCCA3, λ = 0.962 implies $R^2 \approx 0.925$; the original AMOS output showed 0.479, which appears to be a typographical error.

5.3 Discriminant validity

Discriminant validity was confirmed by comparing the square root of the AVE for each construct with its correlations (Eid, Ali, and Barakat, 2024). As shown in Table 3, all √AVE values (PE = 0.782, EE = 0.793, PCCA = 0.716, PS = 0.777) exceeded the inter-construct correlations, indicating satisfactory discriminant validity. Composite Reliability (CR) values were also above the 0.70 threshold, confirming internal consistency: CR = 0.841 (PE), 0.855 (EE), 0.807 (PCCA), and 0.843 (PS). These results collectively demonstrate that the measurement model possesses strong reliability and both convergent and discriminant validity.

Table 4: Convergent Validity (AVE and √AVE)

	PE	EE	PCCA	PS	SQR AVE
PE	1.000	0.132	0.293	0.084	0.781728374
EE	0.132	1.000	0.002	0.211	0.792538327
PCCA	0.293	0.002	1.000	0.079	0.716407356
PS	0.084	0.211	0.079	1.000	0.776864049

5.4 Structural Model Results

The hypotheses were examined using covariance-based structural equation modeling (CB-SEM). The results refer to the fact that PE had no significant direct effect on Passenger Satisfaction (PS) (β = 0.065, p = 0.292); therefore, H1 was not supported. In contrast, EE positively influenced Passenger Satisfaction (β = 0.203, p = 0.000), supporting H2. The third hypothesis (H3) was validated, as PCCA demonstrated a significant direct effect on Passenger Satisfaction (β = 0.164, p = 0.009). In addition, PCCA represents a mediating role in two relationships: it mediated the relationship between PE and PS (β = 0.082, p = 0.008), supporting H4, and also mediated the link between EE and PS (β = 0.015, p = 0.006), confirming H5. These findings collectively highlight the essential influence of passengers' cross-cultural adaptability on their satisfaction with airport self-service technologies. Figure 2 presents the structural model with standardized path coefficients and significance levels for clarity.

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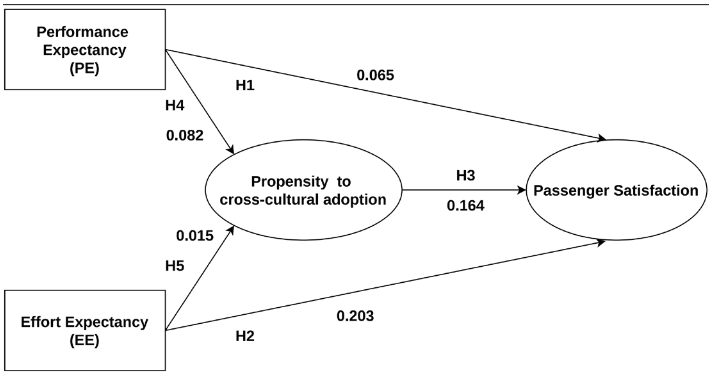

Figure 2: main study results

6. Discussion

The integration of smart applications has significantly transformed airport operations, making it essential to identify strategies that support their smooth adoption. This Research examines the impact of specific elements of the UTAUT framework on the use and passenger experience with smart airport technologies. Specifically, the study focuses on how performance expectations, perceived effort expected, and cross-cultural adaptability impact passenger satisfaction with smart airport services. The study employed CB-SEM for our data analysis. The results provided strong support for the model by illustrating how travelers use self-service technologies at Alexandria Airport. The initial hypothesis (H1) examined whether expecting optimal system performance would lead to increased satisfaction. Although previous research (Davis, 1989; Venkatesh *et al.*, 2003) suggested that perceived utility often plays a significant role, our results did not show a conclusive relationship (β = 0.065, p = 0.292). This indicates that a system seen as efficient by passengers does not inherently lead to heightened pleasure. Recent studies have elucidated this transition.

Passengers confirmed that the comfort of the experience, the system's ease of use, and the process's transparency, rather than focusing only on the expected performance (Celemín-Pedroche, Ostomo, and Escat-Cort, 2023; Sharma, 2024). As self-service options become widespread, their practical benefits are often taken for granted (Choi *et al.*, 2024), and cultural differences may further shape how useful these technologies are deemed (Jan, Alshare, and Lane, 2024). As a result, airport administrators should balance technical innovation with user-centric design and culturally aware communication to convert perceived efficiency into genuine satisfaction (Harding, 2019). The second hypothesis (H2) evaluated the impact of EE. Our analysis demonstrated a clear positive relationship between the perceived simplicity of a system and passenger satisfaction (β = 0.203, p = 0.000). This aligns with findings indicating that intuitive and user-friendly interfaces reduce cognitive burden and bolster user experience (Venkatesh *et al.*, 2003; Amin, Rezaei, and Abolghasemi, 2014). When travellers use airport technologies without feeling weighed down, they usually end up more relaxed and more in control of what is happening around them.

That calmer state tends to make the whole airport experience feel more comfortable (Dube and Humbani, 2024). These findings support theories of cross-cultural usability, which contend that straightforward systems help people from diverse backgrounds adjust more readily (Ang *et al.*, 2007). Enhancing instructions, providing clear signage, and ensuring quick support can all contribute to higher satisfaction. For the third hypothesis (H3), the study result showed that individuals with higher levels of cultural adaptability reported greater satisfaction with self-service options (β = 0.164, p = 0.009). This adaptability seems to ease uncertainty and build confidence when travellers face unfamiliar procedures (Ang *et al.*, 2007; Lu *et al.*, 2024). Our findings further support the idea that cultural intelligence plays a central role in shaping how services are evaluated in multicultural settings. In practical terms, airports can respond to this by introducing clearer multilingual signage, using universally recognisable symbols, and training frontline staff in cultural awareness and communication. We also examined whether intercultural adaptability mediates the relationship between expectations and satisfaction.

Hypothesis four (H4) proposed that adaptability acts as the mechanism linking performance expectations to eventual satisfaction (β = 0.082, p = 0.008). Although high performance expectations did not directly predict satisfaction, they did influence it indirectly by encouraging adaptive responses. This suggests that when airports clearly communicate the benefits and advantages of smart systems, they prompt passengers to adjust their behaviour—ultimately leading to a more positive experience (Eccles and Wigfield, 2002; Ang *et al.*, 2007). Hypothesis five (H5) confirmed that adaptability also mediates the relationship between ease of use and satisfaction (β = 0.015, p = 0.006). Thus, when passengers find self-service solutions user-friendly, they feel better equipped to navigate unfamiliar cultural or procedural scenarios (Lu *et al.*, 2024). Improve satisfaction not only directly but also by supporting adaptive actions, leading to a smoother and less stressful airport journey (Davis, 1989; Venkatesh *et al.*, 2003). To conclude, our Research highlights that while high performance expectations alone are insufficient for increasing satisfaction, ease of use, and adaptability across cultures are vital. Passenger perceptions of self-service technologies are primarily influenced by their accessibility, reliability, and inclusiveness. For airport authorities, this underscores the importance of not only technical quality but also of fostering an environment that encourages trust, comprehension, and cultural inclusivity for all passengers.

7. Conclusion

Airports are becoming more automated each year, but technology alone does not shape the passenger experience. The people who use these systems—coming from different cultures, languages, and levels of familiarity with digital tools—remain central to how well airport services work. Insights from Alexandria Airport illustrate this clearly. Even when modern self-service options are available, satisfaction does not automatically improve. What truly matters is whether travellers can adapt to technology and feel comfortable using it in an environment that may differ from what they are used to at home. In other words, smart airports succeed only when passengers can adapt, not when new machines are installed. PE and EE both play a central role in encouraging passengers to adapt to new smart services, and this adaptive behaviour ultimately feeds into their overall satisfaction. Importantly, the findings show that PCCA acts as a bridge, mediating the effects of perceived usefulness and ease of use on satisfaction. In other words, the advantages of smart technologies are only fully realised when travellers are willing—and able—to adapt to them.

Theoretical contribution: These findings integrate perspectives from technology acceptance and cross-cultural consumer research, suggesting that models of technology use in travel contexts should incorporate concepts of cultural adaptation to better explain the results. The study's findings indicate that PCCA represents a turning point in how travelers understand smart airport services. It also helps explain why two people might interact with the same system but leave with vastly different impressions, one satisfied and the other frustrated. Moreover, the study strengthens existing knowledge on smart tourism and helps clarify why user experiences diverge so sharply.

Practical contribution: The effects are clear and profound; investing in the human element is as much about investing in technology itself. By creating systems that focus on users and adapt to different cultures, helping passengers adjust to changes, and providing other choices for those who need them, airports can ensure that new technology leads to happier customers. By doing so, smart airports can become not just technologically advanced but also truly inclusive and sustainable, delivering superior experiences to travelers from all walks of life.

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