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Passengers satisfaction with the technologies used in smart airports: An empirical study from a gender perspective

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1. Introduction

Airports are a fundamental piece in the air transport value chain. They need to continuously adapt to the technology demands from the different interfacing stakeholders participating in the sector. It is therefore fundamental to modernize airports to enhance passenger transit (Bao et al., 2016) while providing higher quality experiences and increased satisfaction. Airports are therefore evolving towards the concepts of Smart Airport or Airport 3.0 (Fattah et al., 2009). Smart Airports aim at providing safe and fast travel experiences, requirements that become even more relevant in the times of COVID-19, by making use of advanced technologies by all the integrated airport services. Airports can enhance the passenger experience by avoiding delays and cancellations, overbooking, and baggage losses; all of them being events that have a negative impact on travellers' perception of service quality (Greghi et al., 2013).

Technology increases passenger experience, improving its perception of the service. Passengers do not clearly comprehend the meaning of smart airport. This study seeks to give a more precise vision of what the so-called "Smart Airport" could be, considering passenger's perception of technology - a key component in its conceptualization and a crucial differentiating element of a tourist destination competitiveness. This paper aims at analysing the differences in the passenger perception of competitiveness of Smart Airports compared to airports managed under traditional schemes, with a deeper look into the gender perspective, which is a remarkable novelty with respect to the existing literature. This matter is particularly relevant since, according to the World Economic Forum, air transport infrastructures will be a pillar of the competitiveness of the destinations that they support. High competitivity in the tourism sector increases the pressure on airports to differentiate, to identify, and accommodate rapidly to passenger needs (Fodness and Murray, 2007).

Several discussions about the impact of airport technology improvements in the traveller experience can be found in the literature. Abdelaziz et al. (2010) assess the benefits of Common User Self Service technologies in airports by comparison to traditional operation and equipment.

Yang et al. (2015) analysed airport customer expectations reaching the conclusion that they are generally not met. Bogicevic et al. (2017) developed a tool to capture passenger perceptions about airport technologies and tested a theoretical model that examines the relationships between airport technologies and traveller confidence, satisfaction, and enjoyment. All findings indicate a positive correlation between the use of self-service technology in airports and the degree of traveller confidence and pleasure, increasing its satisfaction levels. Other investigations identified that passenger satisfaction is also related to airport services quality, such as flight punctuality, adequate and timely availability of information, effective security procedures, adequate and clear signalling, and marking, as well as the quality of the services available at the terminal (Chen y Chang, 2015; De Barros et al., 2007; Fodness and Murray, 2007).

New technologies, when integrated into adequate platforms, provide a unique opportunity to develop the concept of a future smart airport (Rostworowski, 2012). Therefore, this paper focuses on airports that are actively acting on improving passenger experience, viewing airports as experience providers, and using the experience of all airport users as a key factor for the aviation business (Tuchen et al., 2020). It develops the above-mentioned concept according to traveller expectations and satisfaction criteria, while considering gender perspectives as a fundamental dimension. The objectives of this investigation are (i) to analyse the degree of satisfaction derived from Information and Communication Technology (ICT) use in airports, (ii) to extend such analysis to the

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complete End-to-End travel experience – a term that refers to the comprehensive travel process, starting from the ticket search and reservation, and ending with the arrival at the destination; In this sense, Alansari et al. (2019) remark that airports and airlines have a tremendous opportunity to create a decisive and coordinated understanding for travellers from the moment of booking to movement through airports to the end of their journey in the End-to End framework for the experience of travellers. –, and (iii) to assess the positive effects of technologies in travel time reduction and overall passenger experience. Additionally, socio-demographic characteristics of female travellers are assessed in order to value their influence in the generation of opinions and perceptions about airport technologies.

First, the Smart Airport concept is analysed in detail, reviewing the technologies involved in the concept with an End-to-End scope. Then, a traveller satisfaction analysis regarding those technologies is performed to assess the consistency of expectations and perceptions. Finally, gender dimensions are reviewed, and specific research questions are raised to be addressed by means of the empirical study.

2. Smart airport concept

The Smart Airport concept (from now on SA) is born as a result of the concurrence of the Internet of Things -IoT (technologies that interconnect objects of daily use to the Internet and support emergent business models resulting from their digital transformation) and Industry 4.0 (which is the merge of physical and cybernetic worlds, allowing for remote control of devices), aligned with the global commercial air traffic growth (Koroniotis et al., 2020). Otherwise, it should be also noted that, during the last years, the SA concept has progressively incorporated the sustainability dimension. Simultaneously, Sustainable or Green Airports (GA from now on) development is leaning on advanced IT's that concur with the SA concept to achieve sustainability goals (Boca et al., 2020); reaching a point where both concepts are developed symbiotically. The most visible and direct link between technology and sustainability in airports is that of energy production, management, and consumption in efficient ways through the use of technology.

SA is being discussed in the literature under different viewpoints: from a passenger perspective, from the airline standpoint, management wise, or in connection with the smart city concept. Focusing on the passenger – the main focus of this study –, airports shall provide the best, nicest, fastest experience, relying on superior services (Barkham et al., 2018), and all that can be achieved through the use of advanced technologies (SITA, 2019). Understanding of passenger needs and experiences can better equip airport management to utilise smart technology (Buhalis, D., & Amaranggana, A., 2015). Airports now view passengers as their primary customers and are becoming more aware of passenger needs throughout the travel experience. Airports need to invest in technology that addresses health and safety concerns, elevates the passenger experience, and provides a substantial return on investment in the long run (Macnaughton, 2022). According to Alabsi and Gill (2021), digital technology enabled cooperation between airports' facilities, data, and applications, helping to personalize customer experiences. This leads to the emergence of the smart airport concept. Contemporary smart airports use a range of digital technologies such as self-service, flight information systems, baggage tracking, and smart parking, but it is necessary to know what the passengers' perceptions about this concept are.

In the literature, the integration of services has also been of interest in other studies. Alansari et al. (2019), Koroniotis et al. (2020), and Raj and Raman (2017) establish a link between the SA and Airport 3.0 concepts, being airport 3.0 the platform to implement IoT concepts and services. A horizontal transversal-to-all-services technology platform is required to guarantee an efficient and safe information management coming from all parties and applications involved. In a technical report from 2009 (Fattah et al., 2009), CISCO remarked that SA or Airport 3.0 requires a real-time interconnection of all elements in the ecosystem, concerning not only the airport but also the logistic services, the cities, the institutions, etc. According to these authors, process integration is a must to improve operating efficiency, service quality, and safety. Sohn et al. (2012) refer to the concept of intelligent service as that where information is proactively provided essentially in two categories: orientation in the airport space and support to mobility, all integrated into an automatic information system. Sohn et al. (2013) frame the SA concept in the development of an integrated plan supported by advanced technology aiming at improving customer satisfaction and system efficiency. More recently, in 2020, Koronitis et al. provided the following SA definition: "a smart airport is an airport, which has been augmented by the incorporation of cyber security-aware IoT devices, with an aim to improve efficiency, productivity, security, and service."

All SA definitions consider IT as a fundamental element, which is consistent with the revolutionary evolution of IT in the last decade: wireless technologies (RFID, Wi-Fi, Bluetooth), positioning satellite systems (GPS, GLONASS), global spread of portable systems (smart telephones, tablets), wearable technology (smartwatch, fit-band, etc.) and user-oriented technology, particularly customization of products and services (by means of recommender systems) based on Artificial Intelligence (AI). In this line, this study focuses in analysing which technologies could define the concept of smart airport from the potential airport user's perceptions. In the literature the SA is studied when dealing with the result of the customer expectation and airport effectiveness (Sohn et al., 2013) or when analysing the relationship among different types of airport technologies and travellers' confidence, enjoyment, and satisfaction (Bogicevic et al., 2017). But there is a lack of literature identifying which technologies form part of the Smart Airport concept.

In the aeronautical sector, different institutions have recommended the use of technologies (OACI, 2015) and members of the Airport Council International (ACI) recognize the benefits of using biometrics, simplifying, streamlining, and improving the passenger travel process (ACI, 2009, Monge et al., 2000). According to ACI (2021) new technologies and digitalization can lead to new ways of addressing airport capacity challenges to recover pre-pandemic levels of air traffic. From the tourism sector, experts highlight smart travel facilitation, showing that passengers can book their flights and check in online, have their boarding passes on their smartphones, go through automated clearance gates and validate their boarding passes electronically. These measures are related with improving both travel facilitation and security. (UNWTO, 2021). Experts from other sectors indicate that Airports that are becoming intelligent will use multiple digital and automation technologies that will have to act in an integrated manner. They also indicate that these technologies help airport operators improve the passenger experience, operational efficiency, and compliance, setting the basis for future growth.

High levels of maturity in airports globally are possible thanks to years of research and development. In this sense, IoT-based systems and services allow airports for enhanced robustness and increased efficiency while enabling real-time control. Airport development plans in 2019 accounted for investment in self-service processes, cybersecurity, biometric ID, cloud services, and business intelligence (BI). Eighty percent of the airports are either using these technologies or planning to use them. As a reference, airports invested US$ 8600 million in technology in 2017 (SITA 2018, 2019). Embracing technology will be fundamental for airports to be able to adapt to rapid changes such as the COVID-19 crisis (Al-;Humairi et al., 2021; Khan et al., 2021). Higher degrees of automation and enhancement in airport processes fluidity are aligned with an appropriate response to evolving COVID-19 requirements and constraints. ICT mainly by using personal devices, will help in alleviating congestion and minimizing the number of interactions among service personnel and passengers (SITA, 2020). This study also analyses which technologies are most valued by passengers according to their potential for the near future. Security control by digital identity is the most valued (34%), followed by AI (17%) and wireless 5G (13%). The study also refers to an increase in the use of mobile applications for reservations (16%) and check-in (13%). Passengers also expressed their preference to use their smartphones while in the airport (security check and boarding) (57%) as well as while on-board (62%). Passengers are also keen on using technologies for enhancing sustainability. 45% support the use of mobile data to reduce fuel consumption, carbon emissions, and acoustic contamination (SITA, 2020).

Finally, according to the SITA (2017) report, a travel End-to-End experience includes all aspects and phases from ticket reservation to arrival at destination. Traveller expectation is that the whole process is safe, fluid, and seamless, with quick transitions through check-in, security checks, immigration controls, while supported by quality information about nearby services, including commercial offers from restaurants, bars, and hotels (Amadeus, 2012). Provision of a satisfactory End-to-End travel experience at the airport requires an End-to-End SA architecture.

After having analysed the concept of smart airport according to travellers' perception, the next epigraph aims to study what kind of satisfaction these technologies produce and in which specific services.

3. Passenger satisfaction resulting from the use of new technologies

The concept of satisfaction has been subject to extensive research in social sciences (See for example Anderson and Narus (1990), Mohr and Spekman (1994)). In this study, we used satisfaction based on customer perceptions of products and services meeting their needs and expectations, thus following definitions as Westbrook (1987) "global evaluative judgment about product usage/consumption", or Bradley (2007) who points out satisfaction is dependent on prior expectations and their accomplishment (Bradley, 2007). So, the main elements of satisfaction are expectations and perceptions (see Grönroos, 1982; Parasuraman et al., 1985; Grönroos and Gummenson, 1987).

Satisfaction in the airport sector is the result of a traveller's cognitive process. Traveller perception depends on their behaviour and expectations with regards to their airport experience (Fodness and Murray, 2007; Tuchen et al., 2020). Bogicevic et al. (2013) find that travellers appreciate cleanliness, shopping options, Wi-fi availability, and comfortable seating. The main sources of dissatisfaction are security control, deficient signalling, and long queues. Once in the airport terminal, a significant part of traveller satisfaction derives from process and discretionary activities (Popovic et al., 2009). Process activities are those strictly needed to board/unboard aircrafts (baggage check-in, security control, displacement to boarding gates). Discretionary activities are those that the passenger can perform during the waiting times between process activities (shopping, resting, currency exchange, eating and drinking, cash withdrawing, etc.). Process activities are valued in terms of efficiency parameters (time consumption, frequency, congestion levels, personnel attitude, cleanliness, screen indications), while discretionary activities are valued according to a customer's perception of their convenience (originality, luxury feeling, entertaining capability, comfort, etc.). Discretionary activities are gaining importance as they are perceived as a tool for differentiation and attraction of both passengers and airlines.

As already discussed, satisfaction within airports is related to service quality and the resulting traveller perceived quality. Satisfaction surveys have been carried out by international institutions such as the Airport Council International (ACI) or the International Air Transport Association (IATA). But there are also studies from researchers (ex. Bezerra and Gomes 2015; Brida et al., 2016; Fernandes and Pacheco 2010) focusing on quality parameters such as process times, congestion, efficiency or in the impact on satisfaction of specific services such as check-in, security, mobility, environment, boarding or the information system (ex. de Barros, Somasundaraswaran, et al., 2007; Chang and Chen 2011). In most cases, the focus is on efficiency measurements, such as those of ACI, or in survey analysis by means of statistical methods (factorial analysis or probabilistic models). Most used items are related to: (i) Airport accessibility; (ii) Security; (iii) Installations, terminal facilities; and (iv) Flight interface (including services from airlines).

Technology can therefore impact airport efficiency and convenience perception. Currently, technology contributes to timesaving, security enhancements, and service improvements for passengers (Brida et al., 2016). Notwithstanding the benefits of technology, it can also cause disaffection in some cases. For example, auto check-in posts do not please all passengers. Nevertheless, information and communication technologies such as mobile apps with flight and boarding information are widely welcomed by both passengers and airlines.

Hereafter, the satisfaction that technologies may produce is analysed from a gender perspective.

4. Conceptualization of a smart airport from a gender perspective

This study focuses on understanding passenger satisfaction in relation to the application of IT in every end-to-end process from a gender perspective since this issue has not been sufficiently addressed in the existing literature. Available studies covering the issue of traveller satisfaction related to the use of IT in airports, normally present aggregated results lacking discrimination by gender (Brida et al., 2016; Chen et al., 2015; Cheng-Hua and Hsin-Li, 2012; Huang et al., 2018; Ku and Chen, 2013; Venkatesh et al., 2003).

Few studies introduce the gender perspective. Jiang and Zhang (2016) studied passenger satisfaction with services at Melbourne airport by means of a survey run through a similar number of men and women to conclude that female passengers are more concerned about comfort, convenience, and pleasure dimensions in airport services, scoring higher on services improvements on those areas. There is therefore a gender factor on passenger satisfaction. When studying the use of biometric analysis during check-in, Negri et al. (2019), in their analysis of Brazilian airports, showed that there were very subtle differences between men and women propensity to make use of them, with 83.70% of men and 82% of women supporting their use.

Furthermore, Technology Anxiety (TA) was investigated to determine whether it influenced usage of various Self-Service Technologies (SST) options by Meuter et al. (2003). They found the demographic variables do seem to have some influence on usage of SST options. However, their impact is less definitive (negative relationships for gender indicate males use SSTs more frequently). There are also some studies dealing with Technology Acceptance Model Age and gender differences in online travel reviews and user-generated-content (UGC) adoption. Assaker (2020) studies extending the technology acceptance model (TAM) with credibility theory. The results provide additional contributions on the effects of gender and age in online travel reviews to help advance both theory and practice.

After this literature review, this study addresses the following exploratory research questions.

RQ1 Are there significant gender differences in travellers' appreciation of the different technologies that could be part of the smart airport concept?

RQ2 Are there significant gender differences in the satisfaction levels produced or potentially produced by the use of those technologies in all the processes conforming traveller experience throughout their travel?

Simultaneously, this study addresses the effects that IT's could have on quality, competitiveness, and sustainability, recognizing that information and communication technologies have a significant role in airport functionality with an impact on its quality. This is proven by Brida et al. (2016), who identify a clear opportunity for improvement by using information technology to provide travellers with flight information as well as with the localization of the different airport services. This study aimed at identifying airport functional services susceptible of being improved by means of information and communication technologies use and so increasing traveller perception of their quality. The study was based on a survey equally responded by men and women, but no gender considerations are made in its results.

According to the World Economic Forum, air transport infrastructure is a fundamental pillar for measuring tourism competitiveness. Hitt et al. (2001) identified the accelerated technology development, and the rapid increment of consumer demands as two of the main characteristics of the XXI Century economy. Both are aspects on which SA competitiveness relies. In this research line, Johannessen and Olsen (2010) state that companies must acquire competencies in knowledge-intensive activities with the goal of stimulating their capabilities for innovation and boosting the development of a customer-focused vision since innovation success will depend on its ability to meet customer needs.

Regarding sustainability, women are more sensitive and supportive to problems and initiatives related to sustainability, as discussed by Brough et al. (2016). Rice et al. (2020) surveyed passengers about their predisposition to pay for higher ticket prices in order to reduce greenhouse gas emissions. Female travellers showed higher willingness than men to assume such higher cost as they acknowledged sustainability improvement as an added value to their ticket. Female passengers are also more aware of the economic benefits of sustainability improvements in airports, as discussed by Caballero and García (2020). This study also concludes that women are in general more concerned about environmental issues than men.

After this literature review, it can be concluded that gender is a relevant variable that determines passenger perception of sustainability initiatives and intensive use of information and communication technologies in SA. Consequently, an additional research question is proposed:

> RQ3 Are there significant gender differences in the perception of SA regarding competitiveness, efficiency, and sustainability?

An additional question analysed in this research is the existence of sociodemographic differences, by age, occupation, nationality, travel motivations, and involvement in the aeronautic sector, in the female passenger perceptions with regards to SA. In academic literature, Potgieter (2020) found that there are some gender differences in the business travel decision process. Chiappa et al. (2020) conclude that there are also gender differences in travel expenditure decision-making processes and shopping behaviour. By means of a survey run on passengers in Athen's airport, Kavoura and Stavrianeas (2013) studied traveller perception of social networks as relevant to their choice of the Mediterranean Sea as their destination, finding significant differences among different age groups.

Other studies focus on the relationship between age and technology, but not so much on gender. Venkatesh et al. (2003) concluded that age diminishes expectations of: efficiency and intention of use of technology; expected effort and intention of use; social influence and intention of use; and existence of access conditions to technology. On the other hand, Monge et al. (2000) state that age is related to technology use in three phases of the end-to-end travel process: boarding, labelling, and baggage check-in. Moreover, Zamorano et al. (2020) show that the use new technologies and the use of video games and biometric passports is related to the age of the passengers.

Focusing on other sociodemographic variables, Lee et al. (2018) and Jung and Yoo (2014) identified travel motivation (business or pleasure) as a key element of the travel decision. Schmalz et al. (2021) indicate that age and gender influence the experience of business air travel; and Namukasa (2013) analyses airline service quality impact in passenger satisfaction considering demographic factors such as age, gender, occupation, and education.

Finally, regarding nationality and gender variables, Pantouvakis and Renzi (2016) provide evidence that satisfaction or dissatisfaction perceptions of passengers in airports vary according to their nationalities, but there are not many studies relating both Latin-American and Spanish nationalities with gender in this subject. For instance, Zamorano et al. (2020) concluded that the satisfaction of Spanish passengers who used technology in the boarding processes - issuing baggage tags and checking-in – is greater than that of passengers who did not use it – this ratio being higher in baggage check-in. But in this study the gender variable is not studied. Besides, studying Latin American passengers, Brida et al. (2016) empirically analyse users at Santiago de Chile's Arturo Merino Benítez International Airport (AMB) – with a sample of 64.05% Chilean passengers and almost no gender differences (male 52.28% and female 47.72%)- to show that investment in new ways of communication based on ICTs would improve passenger's perception of airport service quality. Following with Latin American passengers, a global survey of 23,000 people from 20 countries conducted by Travelport revealed that travellers demand a further digitalization of the tourism experience, while Latin American passengers feel "frustrated" by not being able to talk to a human during the process (Hosteltur, 2019).

Having identified room for further research after the literature review, a new research question is formulated:

> RQ4 Are there sociodemographic and cultural characteristics of female passengers that support differences in their answers?

5. Material and methods

5.1. Measurement instruments

A structured survey (see Tables 1 and 2.) of 29 closed questions using a Likert scale 0–10 has been run through a 6400 people target sample survey. The time for completion is estimated at 10 min.

First of all, the objective of the survey was explained, pointing out that it would assess the technologies used in the most modern airports in those processes that most directly affect the passenger. Through this, it will be possible to elucidate what the future trends will be, providing a more precise vision of the so-called "Smart Airport" as a key differentiating element in a tourist destination competitiveness, considering the level of satisfaction that each of these technologies produce or would produce in passengers and, finally, measuring the impact on the quality of airports due to the use of new technologies.

Questions are grouped in three blocks devoted to:

- Appraisal of satisfaction with the use of technologies in SA: Rate from 0 to 10 the level of satisfaction that each of the following technologies produces or will produce used in airport services, with 0 being the minimum satisfaction and 10 being the maximum satisfaction.
- Appraisal of satisfaction with the use of technologies in the end-to-end travel process: Evaluate from 0 to 10 the level of satisfaction that the use of technologies produces or would produce, some of them already mentioned, in each of the processes that make up the experience of passenger experience during their trip, with 0 being the minimum satisfaction and 10 being the maximum satisfaction.
- Appraisal of perception of impacts of SA: Rate from 0 to 10 or level of agreement with the following statements, all of them referring to the so-called smart airports -which employ the aforementioned technologies in each process indicated- and how these affect the quality and competitiveness of tourism, being 0 or minimum agreement and 10 or maximum agreement.

An additional identification block of 9 questions is used to collect sociodemographic characteristics.

The questionnaire was distributed in Spanish and Portuguese languages throughout October and November 2018 using Survey Monkey. The link to the questionnaire was sent mostly via email and WhatsApp. Five nationalities were included: Brazil, Chile, Spain, Mexico, and Peru.

Table 1
Sociodemographic characteristics of the interviewees.

Characteristic	% Total	%Women
Gender		
Male	46.0	–
Female	41.9	–
Prefer not to answer	12.0	–
Age		
Under 26	38.5	45.7
26 to 35	14.0	13.9
36 to 45	16.9	17.5
46 to 55	17.5	15.3
Over 55	13.1	7.7
Education		
Basic-compulsory	9.3	11.6
High School	14.3	15.1
University Degree	39.8	42.3
Master – PhD	36.6	31.0
Nationality		
Brazilian	6.9	5.7
Chilean	12.5	7.2
Spanish	23.3	22.7
Mexican	47.1	53.0
Peruvian	4.5	4.3
Other	5.7	7.1
Occupation (multiple choices are possible)		
Student	32.4	43.1
Private sector employee	29.7	29.0
Public sector employee	11.1	13.2
Entrepreneur	9.1	5.9
Self-employed	7.0	8.1
Other	4.7	8.8
Computing knowledge		
None/Basic	9.3	12.6
Intermediate	37.4	42.2
Advanced	42.3	40.3
Professional	10.9	4.9
Flights during the last year		
0	10.4	11.5
1 to 5	47.9	53.4
6 to 10	21.7	19.5
11 to 15	8.7	8.0
15 or more	11.3	7.7
Travel motivation		
Leisure	50.6	60.5
Work or business	25.3	14.8
Leisure and work or business	13.5	10.5
Other	8.3	11.5
Involvement in sectors		
Aeronautic	12.2	7.6
Tourism	13.7	16.8
Tourism and Aeronautic	1.5	1.1
Other	72.6	74.5

Source: own process from survey data analysis.

The questionnaire was distributed among the contacts of the project team members, who were mainly professionals -some of them in the field of aeronautics and tourism-, university professors and students. Therefore, the sample features are obviously derived from the project researchers' own contexts, being this a joint project devoted to training, research and cultural activities in Latin America. Consequently, the resulting sample is a convenience sample and cannot be considered as random.

1703 valid answers were collected (response rate of 27%). Therefore, considering that the target sample population is representative of the total population, then, the sampling error for a significance level of 5% can be estimated at 0.01%.

Collected data were used to perform descriptive analysis, several contrasts of hypothesis (parametric and non-parametric), and exploratory factorial analysis. Software package SPSS was used for this purpose.

Table 2
Mean differences according to gender.

QUESTION	*Male mean*	*Female mean*	*Significance*
Q1. SMARTPHONES.	8.80	8.93	0.128
Q2. QR CODES	8.05	8.42	**0.002**
Q3. WIFI.	9.49	9.55	0.365
Q4. Near Field Communication (NFC).	7.98	8.09	0.298
Q5. Radio Frequency Identification (RFID).	8.05	8.44	**0.000**
Q6. Biometric Passports	8.71	8.75	0.709
Q7. Beacons	7.43	7.54	0.364
Q8. Mobile applications (Apps)	8.72	8.91	**0.030**
Q9. Internet of Things (IoT).	8.04	8.31	**0.014**
Q10. Self-service kiosk	8.32	8.53	**0.039**
Q11. Recommendation systems	6.66	6.69	0.835
Q12. Ticket reservation or booking (PC, smartphone, self-service kiosk)	8.92	9.02	0.140
Q13. Luggage check-in, boarding pass obtention (PC, smartphone, self-service kiosk, biometric service)	8.87	8.97	0.235
Q14. Security control (x-ray scanner, metal detector, body scanner, biometric system)	8.27	8.53	**0.017**
Q15. In customs (electronic ID, electronic passport, or biometric systems)	8.58	8.75	0.072
Q16. Dwell time (beacons, GPS, RFID, recommendation systems)	8.01	8.16	0.161
Q17. During the boarding process (bar codes, QR, digital documents or biometric systems)	8.64	8.83	**0.028**
Q18. During baggage collection and transit (messaging to Passenger mobile devices about luggage location and transit status)	8.77	8.89	0.163
Q19. Transportation to and from city/town (GPS info about transport services, app-based transports such as Cabify)	8.61	8.77	0.065
Q20. Passengers using SA will perceive a higher service quality	8.65	8.74	0.328
Q21. Passengers using SA will enjoy a substantial reduction of time spent through all processes (booking, check-in, security, boarding),	8.73	9.01	**0.001**
Q22. Passengers using SA will reduce their stress when going through the different processes conforming air transit	8.23	8.61	**0.000**
Q23. Passengers using SA will take better advantage of dwell time.	8.50	8.87	**0.000**
Q24. Passengers using SA will enjoy the opportunity of doing new activities enhancing their experience at the airport.	8.14	8.36	**0.030**
Q25. Passengers using SA will benefit of services lower prices compared to traditional airports.	7.27	7.74	**0.000**
Q26. A traveller having to choose between a SA and a traditional airport competing in the same tourist destination will choose the SA (under similar conditions of price and transit time).	8.17	8.45	**0.013**
Q27. SA's will enhance destination competitiveness as SA will be preferred choices.	7.67	8.05	**0.003**
Q28. SA will enable that the other air transport stake holders (airlines, handling suppliers, air traffic control) work more efficiently.	8.42	8.67	**0.008**
Q29. Extensive use of emerging technologies in SA will positively impact economic development of regions served by said SA.	7.90	8.33	**0.000**

Source: own process from survey data analysis.

6. Results

6.1. Analysis of survey profiles

Results from survey identification section are summarised in Table 1.

The results of the fourth part of the questionnaire are shown in Table 1, indicating the percentage of the different responses for each question, as well as the percentages of those that indicated female gender.

Population responding to the survey were nearly equally distributed between male and female; were either younger than 26 or between 36 and 55; with a significantly higher percentage of women in the younger segments; predominantly with university studies (degree, master or Ph. D.); predominantly Mexican (more than 50% of females were Mexican) and Spanish; predominantly students (significantly bigger occupation among females) or private-sector employees; with good competencies in computer use (intermediate or advanced); had used air transport between 1 and 5 times in the last year, travelling for leisure (even more relevantly in the case of women) with no involvement in tourism or air transport sector. However, it should be noted that 17% of women expressed to be involved in the tourism sector, a much higher percentage than that of men, while in the aeronautic sector the percentage of men involved was significantly higher than that of women.

6.2. Gender differences in questions related to information and communication technologies, SA and their effects

A test of equality of means for independent samples, based on the student's t-test, was performed for the 29 questions of the first block mentioned previously, with gender as a segmentation (independent) variable. The main results of this analysis are shown in Table 2., where means corresponding to men and women are captured as well as the bilateral significance, with 55% of the contrasts being lower or equal to 0.05 (marked in bold), leading to rejection of the null hypothesis of equal means for male and female. Substantial differences were therefore observed depending on gender.

A detail analysis of Table 2 leads to the following results:

- Regarding part 1 (questions 1 to 11), appraisal of satisfaction with the use of technologies in SA
    i. Both men and women highly valued 10 of the 11 questions, with only "Recommendation Systems" receiving a low score.
    ii. Most valued questions are for both men and women Q3 – WIFI (9,5) and Q1- Smartphones (9)
    iii. In 5 out of the 11 questions there are significant gender differences: Q2-QR codes, Q5 – RFID, Q8 – Apps, Q9 -IoT, and Q10 – Self-service kiosks
    iv. In every single question, women scored higher than men, reflecting their higher appreciation of the use of technologies in airports.
- Regarding part 2 (questions 12 to 19), appraisal of satisfaction with the use of technologies in the end-to-end travel process:
    i. Both women and men provide high scores (higher than 8) in all 8 questions.
    ii. Highest scores correspond to Q12 – Ticket reservation or booking and Q13 – Check-in or boarding pass obtention.
    iii. Lowest score (even though it exceeds 8) correspond to dwell time.
    iv. Only 2 of the 8 questions yield significant differences between women and men, namely Q14 – During security control and Q17 – During boarding process.
    v. Again, women scored higher than men in every single question, reflecting their higher expectations on airport processes improvements through the use of technologies.
- Regarding part 3 (questions 20 to 29), appraisal of perception of effects of SA:
    i. Scores are high and similar to the ones obtained in previous sections.
    ii. Highest score is attained in Q21 - Passengers using SA will enjoy a substantial reduction of time spent through all processes.
    iii. Lowest score corresponds to Q25 - Passengers using SA will benefit from services lower prices compared to traditional airports.
    iv. And again, women score higher than men in all questions, confirming women's higher expectations on overall SA impacts.

6.3. Differences among women

In order to simplify the analysis, one indicator or factor from each group of variables was extracted by performing an exploratory factor analysis on each of these groups, considering only the 714 answers from women. The maximum likelihood extraction method was used, leading to the following results:

i. For the EFA related to part 1 about appreciation of technologies used in SA, the KMO measuring of sample adequacy was 0.87, with a Bartlett test of sphericity significance of 0.00; two eigenvalues statistically significant accounted for 45.86% of the total variance, with the first one being accountable for 35.19%
ii. For the EFA on part 2 about appreciation of satisfaction with the use of technologies in the end-to-end travel process, the KMO was 0.88; with a Bartlett test of sphericity significance of 0.00; a single eigenvalue accounted for 54.06% of the total variance.
iii. For the EFA related to part 3 about the overall impact of SA, the KMO was 0.93, with a Bartlett test of sphericity significance of 0.00, and an eigenvalue statistically significant accounting for 58.37% of the total variance.

After checking that all EFA's were correct, the decision was made to keep the first factor from each analysis – like a new variable for the regression method – with the goal of using it in later contrast as a representative of its questions group, in order to check the behaviour of the 8 population characteristics other than gender.

Those contrasts were performed by means of non-parametric tests, making use of Kruskal-Wallis[1] for independent samples, each of them corresponding to the response level of the 8 questions. That test was chosen because of the differences in the sample sizes in the different answers (refer to Table 1) and the risk of violating the initial assumptions required in variance analysis with such big differences. In any case, this test allows to check whether the answers of the factors retained from the three parts have been different among the identification questions.

The asymptotic significance of the Kruskal-Wallis test is shown in Table 3. In those cases where they are equal or lower than 0.05, the null hypothesis of all independent samples being part of the same population (or identical populations with the same median) is rejected. In those cases where the null hypothesis is rejected there are significant differ-

Table 3
Kruskal-Wallis test results.

Characteristics	Primer Factor/First factor		
	Information and communication technologies	Airport Processes	SA impacts
Age	0.157	**0.001**	0.471
Education	0.066	0.464	0.045
Nationality	**0.000**	**0.000**	**0.000**
Occupation	0.839	**0.007**	0.066
Computer competence	0.145	0.051	0.459
Flights during the last year	0.453	0.489	0.263
Travel motivation	**0.003**	0.402	0.153
Involvement in tourism and air transport	0.079	0.530	**0.008**

Source: own process from survey data analysis.

[1] Recall that the Kruskal-Wallis test allows testing whether several independent samples come from the same continuous population, for which the values are ordered from smallest to largest giving a rank -starting with 1 for the smallest, 2 for the second smallest and so on. A mean rank is also assigned with the mean ranks of the values involved at each level.

ences in the answers from the levels of a characteristic.

There are significant differences in the answers given by the population from different segments in the blocks of questions.

1. Nationality is the most relevant, as for the three factors, relevance is 0.0, showing that there are significant differences in the answers:
   i. Regarding part 1 of technologies in SA, there are substantial differences in the answers from Brazilian women, with a mean range of 477.03 (implying a high appraisal of technologies in SA) and those answers from Mexican and Peruvian women, scoring 393.35 and 368.15 respectively. Even lower scores are attained for Chilean (269.41) and Spaniards (291.75).
   ii. Regarding part 2 of processes within SA, again Brazilians attain the highest score with an average of 408.94, while Mexicans attain 379, Chileans 368.75, and Peruvians 355.13. At the lower end, Spaniards score 300.78.
   iii. Regarding part 3 about SA overall impact, Brazilians scored highest, at 434.21; followed closely by Peruvians (413.95) and Mexicans (407.09). Chileans scored 336.61 and Spaniards get again at the lower end at 230.92.
2. Regarding age, there are significant differences in block two, airport processes appraisal. Low scores are attained for ages below 26 years (average of 339.41) while ages above 56 score significantly higher (451.35).
3. Occupation is also relevant in airport processes appraisal, with high scores attained by employees in both private (402.16) and public (392.44) corporations, while students scored significantly lower (324.63).
4. Travel motivation is also significant in the appreciation of technologies in airports, with low values attained for leisure travellers (334.26) and high scores for business/work travellers (397.66).
5. In the appreciation of the impacts of SA, it is remarkable that women involved in the aeronautic sector scored lower (273.90) than those involved in the tourism sector (351) and those independent from both sectors (365.39).

There were no significant differences in the three blocks of variables associated with education, computer competence, and flights during the last year since their asymptotic significance was above 0.05.

In summary, nationality is a key characteristic in women's perception of technologies in SA, in their satisfaction with process improvements derived from the use of technologies, and in the impact of SA, with Brazilians scoring higher in all three blocks and Spaniards at the lower end. Focusing on appreciation of process improvements, age becomes a relevant factor (with the over-56 segment scoring higher) as well as occupation (with students scoring lower). Travel motivation becomes relevant to the appreciation of technology use in airports, with business/work travellers scoring significantly higher than leisure ones.

A similar analysis was carried out among men, detecting many similarities and some differences with the results obtained for women. Thus, for the same characteristics shown in Table 3, it was observed that: (i) there were no differences in terms of age, computer competence, flights during the last year (similar to the case of women); (ii) significant differences in terms of information and communication technologies were found in nationality, travel motivation, education, and involvement in tourism and air transport (with some small differences with women); (iii) significant differences in terms of SA impacts were also found in nationality and involvement in tourism and air transport (the same as women); and (iv) the major difference with women is that occupation shows significant differences in all three dimensions noted for men, playing a similar role to that of nationality for women.

The study of meaning and the verification of test scores is one of the elements of validity. A central aspect of any measurement is that it must measure constructs identically, especially when the aim is to compare groups, to compare the meaning of the construct on different measurement occasions in the same group and even in different cultural groups (Putnick and Bornstein, 2016). When the outcome of a measurement has this characteristic, scores can be said to be invariant. If we can demonstrate measurement invariance, participants, be they from different groups (cultural, gender, among others), interpret items under the same latent factor in the same way (Byrne, 2008).

To try to verify that the study does not present this problem in the EFA used and that the first factor was saved as a new variable - and there were only one or two statistically significant ones -, the Kruskal Wallis test was replicated on the 29 variables of the questionnaire. Its asymptotic significances are provided in the appendix. As it can be seen, the overall results support the conclusions achieved in the former analysis. Thus:

i) Of the 29 variables in the questionnaire, 27 show statistically significant differences regarding the Nationality question (asymptotic significances less than or equal to zero), as shown in the previous analysis.
ii) Of the 8 Airport Processes variables, 3 showed statistically significant differences in the Age question (Q12, Q15 and Q18) and two were statistically significant at 10%, which is at least partially consistent with what we have seen.
iii) Of the 8 Airport Processes variables, 4 yielded statistically significant differences (Q12, Q13, Q15 and Q18) against the Occupation question, and others would be significant at 10%, which is at least partially consistent with what we have seen.
iv) Of the 10 SA Impacts variables, 5 showed statistically significant differences (Q22, Q24, Q25, Q27 and Q29) against the Education question, and two others would be statistically significant at 10%, which is consistent with what we have seen.
v) Of the 11 Information and communication technologies variables, only 3 showed statistically significant differences (Q5, Q7 and Q11) for the Travel Motivation question, and one was statistically significant at 10%, which is not consistent with what we have seen.
vi) Of the 10 SA Impacts variables, 4 showed statistically significant differences (Q20, Q26, Q27 and Q29) against the Involvement in tourism and air transport question, and one would be significant at 10%, which is partially consistent with what we have seen.

7. Conclusions

Airports are the first and last place visited by tourists when getting to and leaving their destination. Those first and last impacts are fundamental for encouraging future visits and to conform to the overall country's international image. It is therefore essential to develop modern-intelligent airports able to provide the passengers-tourists with pleasant new experiences relying on new technologies and facilitating their transit.

After the empirical analysis carried out, we are now in a position to answer, at least partially, the objective set at the beginning of this study: The general objective of this research is to determine which technologies are the most valued by passengers' perceptions at an airport with a view to call it smart. That is to establish a scenario with the technologies that an airport must have in order to be called smart according to the vision of passengers. Also, the technologies conforming to the concept and with an End-to-End have been reviewed. According to Brida et al. (2016) passenger satisfaction is a key performance indicator for the operation of an airport. This study reflects this need, but according to technologies that produce satisfaction.

This study shows that Wi-Fi and Smartphones are the most valued technologies. The combination of both enables airport congestion alleviation by reducing interaction points. These improvements are aligned with the reduced interaction requirements emerging from COVID-19 measures. The use of technology during dwell time is poorly valued as passengers intend to minimize their stay and interactions at the airport in order to avoid infections. Consequently, time reduction in airport processes is highly valued by passengers. Certainly, the waiting time has an impact on customer satisfaction (Otieno and Govender, 2016).

This study, therefore, proves that IT investment in airports will pay by improving passenger experience, being this even more relevant in the current pandemic situation. Rohit Talwar, CEO of Fast and Future Research stated on his article (Talwar, 2020) that in response to the COVID-19 crisis, in the next one to three years the use of technology effects will have a more dramatic impact on the company/business markets and on the economy in general (Serrano and Kazda, 2020).

Passengers are satisfied using technology in the ticket reservation and booking processes as well as in the check-in or issuing the boarding pass. These results are well aligned with Carmona's (2004) study about the digitalization of boarding, luggage labelling, luggage check-in, customs checks, and leisure during dwell times. Digitalization has been progressively applied in all those processes through boarding kiosks, access turnstiles, passport biometric control, baggage label printing kiosks, baggage delivery kiosks, augmented reality guides in the airport, and video games, among others.

The most innovative research aim of this study is to analyse the technology satisfaction gender perspective in the concept of smart airport. This research proves that women give higher value to the use of technology, their benefits in end-to-end airport processes, and their impact on the overall airport functionality. This is consistent with Jiang and Zhang's (2016) studies pointing out that female passengers are more conscious of services related to comfort, convenience, and pleasure, scoring consistently higher on airport service improvements, susceptible of being enhanced by means of technology application.

Kurtulmuşoğlu et al. (2018) indicate the need to enhance gender-focused strategies in airlines. Their study points out that female passengers value seat comfort, legroom, and flexibility in changing reservations in a higher degree than male passengers. Bahar et al. (2018) reached similar conclusions. Since the present study also found significant gender differences in passenger preferences regarding technology use or technology-based services at the airport, it seems important that gender focused strategies should be devised in airports as well. When applicable, airlines' gender strategies should be implemented in airports.

Moreover, technology use allows for a better achievement of sustainability goals. Women are also more concerned about this subject than men and are more aware of the positive economic impact of sustainability (Caballero and García, 2020).

The more developed female sensitivity to technology use and application, and the development of SA, are concurrent with initiatives and resolutions from public and private air transport stakeholders aiming at succeeding in Sustainable Development Goal number 5, Achieve gender equality and empower all women and girls. The International Civil Aviation Organisation, ICAO, in their resolution A39-30 (ICAO-OACI, 2016 - Resolutions Adopted at the 39th Session of the Assembly) sets an aspirational goal to achieve gender parity in aviation employment by 2030. More recently, during the 2020 Airport Experience conference, the Airports Council International (ACI) general director stated the importance of gender diversity in aviation and the need to attract competitive workforce to the sector, including technical and professional profiles supporting the airports of the future (https://aci.aero/news/2020/03/04/gender-diversity-vital-for-the-sustainability-of-the-airport-industry/). Airport managers should take advantage of the existing synergy between these initiatives and women higher sensitivity to technology use in airports.

An additional contribution of this research is the identification of sociodemographic differences in women's appreciation of technology use in airports, being nationality the most relevant factor. This proves that the cultural background of women influences their preferences for technology use when travelling. Age and occupation are also relevant factors in the appreciation of some key elements of SA. However, no significant differences were found regarding education level, computer competence, or frequency of air travel.

SA are key for tourism competitiveness. It is the solution to problems such as waiting times, stress, uncertainty about baggage collection, etc. The best airport innovations are not necessarily those of a higher degree of complexity, but those that provide higher benefits to passengers and airlines.

Moreover, traveller satisfaction measurement provides valuable information to airport managers. This information shall be used to improve service quality, by differentiation attending to gender, social and cultural characteristics. Some deficiencies in airport services can be corrected by taking advantage of passenger willingness to manage some travel processes using technology. This implies an enhancement of passenger perception of airports services quality linked to the use of technology. As proven by Brida et al. (2016), investments in improvements of flight information and other services increase passenger perception of the quality of such services.

This study raises the issues of the need to (1) analyse and comprehend the passenger journey to understand the technological preferences, specifically by demographic variables, most importantly by gender; (2) academically identify the technologies that can form the concept of smart airport from a traveller's perspective and (3) implement managerial strategies to solve problems through the use of technologies, with special focus on the after-Covid crisis.

Finally, it should be stated that this study has a series of limitations derived from the characteristics of the project itself and the sample. Such sample features the 5 countries taking part in the project -Brazil, Chile, Spain, Mexico and Peru-with respondents being mainly teachers and researchers in the tourism and aeronautical sector – thus with high educational level. In addition, 46% of the women are under 26 years old. But in the case of men, according to the data provided, only 32% are under 26 years old. We were aware of the biases in the selected group: greater computer literacy and greater use of air transport than the average population. Nevertheless, these were intended biases, given our goal of collecting the thoughts that people with sufficient knowledge of the most relevant aspects of this study had about the aforementioned sub-objective.

Autor contribution

Rubio-Andrada, L.: Conceptualization, Methodology, Validation, Formal Analysis, Investigation, Resources, Data Curation, Writing –Original Draft **Celemín-Pedroche, M.S:** Conceptualization, Investigation, Writing –Review & Editing, Supervision, Project administration, Funding acquisition **Jiménez-Crisóstomo, A.:** Writing –Original Draft **Escat-Cortés, M.:** Writing –Original Draft, Writing –Review & Editing.

Declaration of competing interest

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jairtraman.2022.102347.

Appendix

Asymptotic significances of the Kruskal Wallis Test.

QUESTION	Age	Education	Nationality	Occupation	Computer competence	Flights during the last year	Travel motivation	Involvement in tourism and air transport
Q1. SMARTPHONES.	0.332	0.215	0.000	0.602	0.448	0.938	0.734	0.101
Q2. QR CODES	0.050	0.397	0.022	0.102	0.528	0.705	0.196	0.235
Q3. WIFI.	0.125	0.916	0.040	0.046	0.522	0.282	0.766	0.124
Q4. Near Field Communication (NFC).	0.055	0.568	0.000	0.603	0.496	0.486	0.078	0.172
Q5. Radio Frequency Identification (RFID).	0.443	0.023	0.001	0.858	0.860	0.437	0.035	0.082
Q6. Biometric Passports	0.146	0.867	0.003	0.014	0.137	0.028	0.200	0.180
Q7. Beacons	0.082	0.183	0.000	0.630	0.836	0.571	0.008	0.339
Q8. Mobile applications (Apps)	0.034	0.548	0.000	0.247	0.411	0.901	0.565	0.264
Q9. Internet of Things (IoT).	0.347	0.652	0.000	0.914	0.261	0.638	0.227	0.610
Q10. Self-service kiosk	0.062	0.006	0.000	0.212	0.434	0.165	0.297	0.187
Q11. Recommendation systems	0.006	0.001	0.000	0.012	0.895	0.035	0.020	0.089
Q12. Ticket reservation or booking (PC, smartphone, self-service kiosk)	0.022	0.645	0.058	0.017	0.085	0.541	0.735	0.274
Q13. Luggage check-in, boarding pass obtention (PC, smartphone, self-service kiosk, biometric service)	0.097	0.182	0.004	0.009	0.208	0.048	0.891	0.184
Q14. Security control (x-ray scanner, metal detector, body scanner, biometric system)	0.280	0.212	0.017	0.214	0.697	0.525	0.019	0.991
Q15. In customs (electronic ID, electronic passport, or biometric systems)	0.014	0.352	0.004	0.040	0.776	0.294	0.271	0.733
Q16. Dwell time (beacons, GPS, RFID, recommendation systems)	0.534	0.873	0.000	0.232	0.540	0.669	0.305	0.799
Q17. During the boarding process (bar codes, QR, digital documents or biometric systems)	0.202	0.521	0.001	0.062	0.125	0.240	0.390	0.006
Q18. During baggage collection and transit (messaging to Passenger mobile devices about luggage location and transit status)	0.003	0.908	0.290	0.005	0.114	0.646	0.345	0.320
Q19. Transportation to and from city/town (GPS info about transport services, app-based transports such as Cabify)	0.066	0.630	0.027	0.256	0.394	0.706	0.847	0.868
Q20. Passengers using SA Will perceive a higher service quality	0.127	0.061	0.000	0.725	0.638	0.257	0.093	0.035
Q21. Passengers using SA will enjoy a substantial reduction of time spent through all processes (booking, check-in, security, boarding),	0.705	0.207	0.000	0.158	0.294	0.943	0.277	0.305
Q22. Passengers using SA will reduce their stress when going through the different processes conforming air transit	0.574	0.002	0.000	0.151	0.479	0.423	0.474	0.536
Q23. Passengers using SA Will take better advantage of dwell time.	0.224	0.242	0.000	0.117	0.945	0.386	0.270	0.601
Q24. Passengers using SA Will enjoy the opportunity of doing new activities enhancing their experience at the airport.	0.367	0.001	0.000	0.173	0.994	0.130	0.010	0.302
Q25. Passengers using SA will Benefit of services lower prices compared to traditional airports.	0.017	0.000	0.000	0.002	0.088	0.173	0.288	0.065
Q26. A traveller having to choose between a SA and a traditional airport competing in the same tourist destination will choose the SA (under similar conditions of price and transit time).	0.118	0.439	0.000	0.052	0.148	0.889	0.726	0.012
Q27. SA's will enhance destination competitiveness as SA will be preferred choices.	0.266	0.022	0.000	0.063	0.211	0.101	0.016	0.049
Q28. SA will enable that the other air transport stake holders (airlines, handling suppliers, air traffic control) to work more efficiently.	0.528	0.052	0.000	0.611	0.928	0.598	0.048	0.107
Q29. Extensive use of emerging technologies in SA will positively impact economic development of regions served by said SA.	0.026	0.001	0.000	0.193	0.159	0.217	0.280	0.035

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