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Passengers' Perceptions and Satisfaction with Digital Technology Adopted by Airlines during COVID-19 Pandemic

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Abstract: Airlines' major adoption of digital technology during the COVID-19 crisis may have changed how customers experience the services and may affect passengers' perceptions compared to the past. However, there is a lack of studies systematically examining the adoption of new technology in the airline industry from a passenger satisfaction-centric perspective. This study investigates passengers' perceptions and satisfaction with digital technology adoption by airlines during the COVID-19 pandemic. An online questionnaire survey was conducted to examine Chinese passengers' perceptions and satisfaction with 11 digital technology-based services offered by airlines. A total of 365 valid responses were analyzed using ANOVA tests and stepwise multiple linear regression analysis. The analysis indicates that most passengers have a positive attitude towards airlines' new technology adoption. In the final selected regression model, six technologies offered by the airlines are statistically significant and have impacted passenger satisfaction. They are artificial intelligence (AI) customer service, e-luggage tag, cleaning robot, ultraviolet light and antimicrobial cabin cleaning, an app-controlled in-flight entertainment system, and e-library. The facial recognition service, digital documentation and AI Customer service are the least favorable among the 11 technologies offered by the airlines. There is an opportunity for airlines to improve these services further to gain the trust of the passengers.

Keywords: digital transformation; passengers' satisfaction; emerging technology; SAR-CoV-2; survey; aviation; future technology

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1. Introduction

The airline industry is vulnerable to external disruptions [1]. Since the 21st century, crises such as the 9/11 terrorist attack in 2001, the SARS outbreak in 2003, the global financial crisis in 2008, the natural disasters like volcanic ash clouds in Eyjafjallajökull, etc., had a significant impact on aviation activities [1]. While unplanned disruptions in public transport have been handled in the past [2], the outbreak of COVID-19 has the most intense and long-lasting crisis in various industries, including aviation sector [3]. The nature of human-to-human transmission of COVID-19 has created public concern about being infected. To prevent COVID-19 transmission, numerous restrictions were enforced by countries, authorities, and airlines. These restrictions have dramatically decreased travel demand, resulting in the airline industry suffering a 60% reduction in passenger numbers, hundreds of billions of dollars lost in commercial revenue, and triggering a wave of bankruptcies [1,4,5].

The pandemic has forced the airline industry to change and adopt new business strategies [6]. Apart from ensuring business continuity, passengers also have higher expectations. Maintaining the same level of service standards as in the pre-pandemic era may be insufficient to retain passengers' satisfaction with the airlines [4]. Passengers are now more stringent with health and hygiene [4]. New digital technology can assist the airline industry in overcoming the challenges posed by the crisis [6]. During the pandemic

period, many airlines have strengthened their digital technology capability, significantly accelerating transformation and innovation to digitalization.

Airlines worldwide have been working on digitalization for decades to enhance efficiency and customer experience. By implementing digital technology, airlines could increase passenger satisfaction and enhance their competitiveness [7]. However, during the COVID-19 era, the study of new digital or technology-based services and passenger satisfaction has become an emergent field [3]. Several researchers have briefly summarized some airlines' new business strategies [4,8,9] with cases of digital technologies that airlines have implemented. Utilization of Artificial Intelligence and the Internet of Things can enhance passengers' confidence and service quality while travelling during the pandemic [10]. However, these studies are theoretical-based and lack data support from passenger surveys.

Although several studies have surveyed changes in factors regarding passenger satisfaction for full-service airlines and low-cost airlines during the pandemic, the types of services contained in the questionnaires are limited to traditional services and airlines' preventive measures. Studies have discovered that passengers showed greater interest in digital technology-related services during the COVID-19 pandemic [11,12]. Positive views have been received towards several specific non-contact digital services such as biometrics [13], self-check-in kiosks [14], service robots [15], and inflight entertainment and connectivity services [16]. However, there is a lack of systematic analysis of passengers' perceptions of different digital technologies together. Major digital technology adoption by airlines during the crises may have changed how customers experience the services and may affect passengers' perceptions compared to the past [14]. Data analyzed by [5] indicates that the airline industry is gradually recovering. Passenger satisfaction is critical in the incoming competitive market. However, the uptake of new technology in the airline industry has yet to be researched from a passenger satisfaction-centric perspective.

Objective and Scope of the Study

This study investigates passengers' perceptions and satisfaction with digital technology adopted by airlines during the COVID-19 pandemic. Existing studies regarding airlines' uptake of new technology have primarily focused on the theoretical discussion of the airline industry's innovations and examining the passengers' satisfaction with traditional services and preventive measures. The lack of scholarly attention on the passengers' satisfaction with airlines' digital technological uptake, especially during the COVID-19 pandemic, is the inspiration for this research study.

With the relaxation of various COVID-19 restrictions, passenger flow is on the course to recover to pre-pandemic levels. Passengers' perceptions of the new technology are critical to the recovery and future growth of the airline business. This research provides insight into the effect of new technology that airlines adopt on passengers' experience; hence, airlines will benefit by identifying passengers' needs and better understanding the pandemic's changes. Since passenger satisfaction is crucial to airlines and changes in passengers' air travel experience might influence their satisfaction, a deeper insight into the changes in passenger satisfaction towards airlines' new technology adoption is needed. Customer satisfaction surveys are frequently used to collect users' opinions on the quality of services. It is one of the most popular methods for data collection in qualitative and quantitative studies [17]. Major survey questionnaires provide a 5-point evaluation scale that allows respondents to express their feeling [17]. Hence, a questionnaire survey has been conducted in this study to collect passengers' satisfaction with airlines' adoption of new technology during the COVID-19 pandemic from various aspects, with an evaluation scale from 1 (completely disagree) to 5 (completely agree). The scope of the survey is limited to the online survey conducted in Australia, targeting specifically the Chinese market, with the respondents being a mix of Australian Chinese, Hong Kong and Mainland China.

2. Literature Review

2.1. Technology Adoption before COVID-19

The COVID-19 pandemic has accelerated global digital transformation trends, indicated by the greater utilization of digital (new) technology in multiple industries and the creation and growth of digital infrastructures. Nonetheless, several digital transformation trends were evident before the emergence of the COVID-19 pandemic. The Internet of Things (IoT) trends were on the rise. Businesses have already started embracing IoT analytics to turn big data collected into revenue. For example, mining companies were using IoT analytics to monitor the efficiency of their production processes, while company fleets were fitted with IoT devices to track efficiency [18]. Edge computing technology was also widespread before the pandemic. By processing data close to the source rather than in the cloud, edge computing enhances how organizations acquire and analyze data. The technology delivers real-time data that enables businesses to make data-driven choices and more informed decisions.

5G deployment was successful, although mainstream adoption was still low before COVID-19. With many implementations across various sectors, Intel and Nokia had demonstrated significant promise. All these installations demonstrated that 5G technology was on the verge of becoming ubiquitous, with significant benefits for enterprises [19]. Major cloud companies were providing blockchain as a service for greater security. From finance to human resources, blockchain was set to disrupt sectors and departments. While blockchain technology has received much attention, many smaller businesses were yet to adopt it. Furthermore, Artificial Intelligence (AI) technology was mainstream. Companies started looking for methods to incorporate AI into their systems to simplify operations and procedures for their staff and customers. Most businesses, for example, had AI assistants built into their computer systems, platforms, and software [20]. Chatbots were already implemented by businesses to facilitate customer support. While Augmented Reality (AR) was fast-rising, Virtual Reality (VR) was stagnating. Firms have already discovered that AR could improve their relationship with technology in various important ways [21]. The attention on VR was gradually decaying as businesses discovered that AR was less expensive and easier to utilize than VR, as they could better train, pitch, and envisage new ideas with 3-D virtualization at a lower cost than VR.

2.2. Technology Adoption in the Airline Industry Due to COVID-19

Under the global phenomenon of digitalization, the airline industry is inevitably trending towards increased digitalization. Digital technologies have been widely adopted in different areas within the airline industry over the past decades, for instance, air traffic management, airlines and airports, aircraft maintenance, and more [22]. Airline executives have also acknowledged and agreed on digital technology in the passenger service sector [23]. A better passenger experience may be achieved if airlines can conduct their business more mechanistically. Therefore, the airline industry was already undergoing digital or new technology evolution before the pandemic. Some studies have discussed the benefit and importance of digitalization for passengers in the airline industry. Digitalization can enhance aviation safety, efficiency, accessibility, collaboration, and cost reduction [22]. A study [22] has highlighted that the airline industry has benefited from numerous technologies to achieve these objectives, specifically the use of seven digital technologies in the airline industry: blockchain technology, artificial intelligence (AI), augmented reality and virtual reality, beacons technology, big data and analytics and biometrics. A framework for understanding the relationship between the use of artificial intelligence and the internet of things (IoT) with passenger satisfaction has been proposed in [10]. According to this framework, AI and IoT enabled sustainable practices enhance passenger confidence positively, which then further enhances positive word of mouth and passenger satisfaction. Likewise, it has been stated that the digital transformation process in airlines is not an easy task, and several interconnected organizationl factors and passengers' perspectives need to be considered [24]. As such, a Digital Transformation Maturity (DTM) self-assessment frame-

work for the airline industry has been proposed in the literature that takes into account nine dimensions to measure digital transformation maturity along with feedback from experts on the relative importance of the selected dimensions, resulting in a self-assessment tool that can be used by practitioners [24].

Internet of Things (IoT) is integrated into E-luggage tags, E-menu, and Self-check-in kiosks, enabling airline passengers' data to be collected and connected seamlessly with stakeholders in real-time. This can lead to better customer understanding to enhance customer experience [10]. Artificial Intelligence (AI) played an important role during the pandemic. Airlines have adopted AI for customer service through numerous channels, including the official airline website and social media platforms. Combined with IoT, AI can quickly respond to passengers' queries with airline information in a timely manner [10].

A survey found that personal entertainment systems and online ticket booking are essential for Indian passengers [25]. Similarly, an online survey found that focusing on online services and inflight services, including the in-flight entertainment system and in-flight Wi-Fi, can improve the overall satisfaction level and passenger loyalty toward the airline [26].

In addition, blockchain technology has been utilised in the airline industry to transform passenger processing from physical ID checks to digital ID checks, through a decentralised database that can be accessed by relevant personnel. Thus, it helps build a robust security system to manage customer data and allows for the achievement of biometrics recognition [27]. Spirit Airlines, JetBlue and Delta Airways have utilised this technology to allow passengers to perform facial recognition for baggage drop, security, boarding and more [28]. Such transformation helps minimize the time for identifying passengers [22]. Apart from that, AirAsia also integrates AI into the mobile application–Scan2Fly, where AI is used instead of staff for the verification of the Polymerase Chain Reaction (PCR) test certificate, as well as other COVID-19 related documents [29]. Similarly, Singapore Airlines begun the trial of the International Air Transport Association's Travel Pass Framework based digital health verification process, which allows passengers to digitally store and present their COVID-19 tests and vaccine status [30]. The services utilised big data analysis, allowing stakeholders, including other airlines, ground services, airports, etc., to share the information. This not only improves passengers' experience but also strengthens the collaboration of the airline industry [30].

The pandemic has also raised attention to the need for the adoption of improved hygiene procedures due to travellers' health and safety concerns. In 2020, Honeywell introduced Ultraviolet Cabin, which has been applied by multiple airlines as the technology to reduce certain viruses and bacteria on targeted surfaces, including SAR-CoV-2 (COVID) [31]. Nevertheless, airlines have also developed similar products to sanitise the airport and cabin, such as automatic cleaning robots introduced by United Airlines. These cleaning robots spray antimicrobial agents on the cabin surface and form a durable protective barrier to provide hygiene for both travellers and crew members [32].

2.3. Passengers' Perceptions

In the highly competitive market, airlines' advantage lies in the quality of service perceived by passengers, as only passengers can define the quality of services [11]. Therefore, the digital technology uptake in the airline industry needs to be accomplished with quality to influence passengers' satisfaction positively. During the COVID-19 era, studying airlines' digital transformations, passenger satisfaction, or the relationship between the two is becoming an emergent field [3].

Passengers are now demanding higher levels of hygiene and require airlines to provide adequate preventive measures [3]. Digital technology is one of the most effective methods to provide contactless services and is a part of an airlines' business strategy in response to the pandemic, which has been discussed in several studies. A study [9] has summarised touchless technology used by airlines, including electronic bag tags (EBTs), high-efficiency particulate air (HEPA) filters, etc. Additionally, another study [4] created a concept called 'CoviNovation', which illustrated COVID-19-induced innovation activ-

ities such as ultraviolet light (UV) to disinfect the cabin, touchless processes at airports, and biometric check-in and boarding. However, these studies are theoretically based on research papers and organization reports. The lack of data support, especially passengers' perceptions of those technologies, hindered the study of deeper insights. Additionally, existing studies on digital technology adoption in the airline industry often focus on the airlines' business perspective. For example, [10] discussed the utilization of AI and the IoT to enhance service quality and rebuild passengers' confidence and satisfaction while travelling during the pandemic. Passengers who have a positive experience with airlines will spread positive word of mouth to their friends, relatives, etc., which will also benefit the airlines [10]. The study uses conceptual analytics to analyze and present how technological advancements would benefit the industry and customer satisfaction. However, the study lacked verification from the empirical data.

In terms of passenger satisfaction, some researchers have studied the changes in the drivers of passenger satisfaction during the pandemic based on the analysis of passengers' comments on airline websites, social media platforms and questionnaires [3,33,34]. Machine learning approach was applied to data collected from local surveys to evaluate service attributes [11]. The study determined that online boarding, inflight Wi-Fi, and inflight entertainment systems are crucial services to increase passenger satisfaction and emphasized that airlines should prioritize services that are digitally relevant. The result is supported by [12], which also adopted a survey and discovered that digital services positively affect passenger satisfaction throughout the journey with airlines, especially during the pre-arrival, pre-boarding, and arrival stages.

3. Methodology

3.1. Data Collection

A questionnaire was developed to examine passengers' satisfaction with digital technology adopted by airlines during the COVID-19 pandemic. The questionnaire consists of 62 questions (including an open-ended question that sought recommendations for airlines regarding digital technology by passengers), divided into 13 sections based on identified digital technology adopted by airlines and administrative questions. Section 1 had 11 sub-questions on demographics and travel frequency information before and after the COVID-19 pandemic. It was followed by 11 sections that measured passengers' perceptions of digital services, as shown below.

- AI Customer Service
- Digital Documentation (Advice, verify, store and present travel-required documents during COVID-19)
- Self-Check in Kiosk
- Facial Recognition (Use facial information as a boarding pass to access the lounge and boarding)
- E-Menu (Lounge & Cabin) to order food and beverages
- E-Library (Lounge & Cabin) to replace physical catalogues
- Contactless Boarding (Self-scan boarding pass at the boarding gate)
- E-Luggage Tag
- Automatic Cleaning Robot (Airport & Lounge)
- Ultraviolet Light & Antimicrobial Cleaning (Aircraft cabin)
- Digital Application Controlled In-flight Entertainment System

The meaning of the questionnaires was briefly explained to the respondents when the survey was conducted. For example, E-Menu (Lounge & Cabin) to order food and beverages means passengers can order food and beverages by using electric devices such as mobile phones or iPad to access the manual online rather than a paper-based menu. Each digital service section mentioned above contained four sub-questions to assess the passenger satisfaction level. Additionally, a dedicated section measured the passengers' overall satisfaction with the digital technologies adopted by the airlines. It had 6 sub-questions. An open-ended question was asked at the end (Do you have any comments or

suggestions on the airline's current and future digital transformations?) to have insights into participants' general views on digital transformation adopted by the airline industry.

The university's research ethics committee approved the survey (approval number: SEHAPP 31-17). The questionnaire was conducted online in Australia. As the focus of this study was to explore customer satisfaction, specifically in the Chinese market, the survey was distributed via various Chinese social media platforms in late April 2022. The Chinese market was targeted because China had one of the strict COVID-19 lockdown measures, and quickly adopted digital technologies for contact tracing, medical diagnosis, and other COVID-19 operations [35]. As such, respondents are a mix of Australian Chinese, Hong kong and Mainland China. Friends, family, and team members' relatives also aided in the distribution of the questionnaire to ensure the questions reached the targeted participants and had a good representation of participants among all age groups. Over the active questionnaire distribution period of 24 April 2022 to 9 May 2022, a total of 407 responses were recorded; however, only 365 responses were complete, and therefore, 365 responses were used (response rate of 89.7%) for this study. Literature suggests 384 is a good sample for a population of more than 1 million (95% confidence) [36]. Although 384 was not achieved, a sample size near 384 is also acceptable [37].

3.2. Data Analysis

Both descriptive and explanatory analyses were adopted for data analysis. First, a reliability test was applied to examine internal consistency in variables based on Cronbach's alpha. Second, a One-way Analysis of Variance (ANOVA) was applied to examine whether there were significant differences in the means between demographic results such as gender, age, frequency of travel, and level of awareness of digital technology adoption by airlines. Finally, when a large number of variables are involved in a study, stepwise regression is a suitable procedure for selecting variables for a model [38]. Given the considerable number of digital technologies and the demographic information considered in this study, a stepwise multiple linear regression analysis was therefore conducted to examine whether the digital technology adoption initiatives by airlines and demographics information in combination impacted overall passenger satisfaction.

4. Results

4.1. Demographic

Table 1 illustrates the demographic result of the questionnaire. Of the total of 365 valid responses, 67.4% of respondents were female, and the remainder, 32.6%, were male, with the majority being between the ages of 41–50 (46.8%) and 21–30 (15.9%). In addition, Chinese citizens were the primary respondents to the questionnaire sample, accounting for 88.2%.

Among all respondent's levels of education, 56.2% completed a bachelor's degree, followed by 23.3% who had a high school degree or below. Employees are the dominant group at 44.9% of the total respondents with annual incomes of $\leq$30,000 AUD (22.7%) and 30,001–40,000 AUD (23.6%). When travelling by air, 76.4% of respondents prefer economy class, and business class at 11.0%.

A comparison of the travel frequency before and during COVID-19 demonstrates that most of the respondents reduced their travel frequency due to the pandemic. Prior to the COVID-19 pandemic, 35.6% of respondents travelled 2–4 times per year, followed by 1 time per year at 29.7%, then 5–7 times per year at 10.1%, and 19.7% of respondents had no air travel experience. However, during the COVID-19 pandemic, only 24.1% of respondents had air travel experience, with a peak of 2–4 times at 11.5%.

In addition, regarding the awareness of digital technology adoption in the airline industry, a total of 61.7% of the respondents were slightly unaware and completely unaware (37% and 24.7%, respectively), and only 18.4% of respondents had slight awareness, and 2.7% of respondents had complete awareness.

In terms of the open ended-question, only 66 valid responses were obtained. The key observations from these responses are discussed later in the discussion section.

Table 1. Demographic information (N = 365).

Measures	Options	Frequency	Percentage (%)
Gender	Male	119	32.6
	Female	246	67.4
Age	≤20	22	6.0
	21–30	58	15.9
	31–40	55	15.1
	41–50	171	46.8
	51–60	49	13.4
	>60	10	2.7
Nationality	Chinese	322	88.2
	Non-Chinese	43	11.8
Education	High School or lower	85	23.3
	Certificate/Diploma	34	9.3
	Bachelor	205	56.2
	Master or higher	41	11.2
Occupation	Student	48	13.2
	Business Owner	39	10.7
	Employee	164	44.9
	Self-employee	28	7.7
	Retired	28	7.7
	Others	58	15.9
Yearly Income (AUD)	≤30,000	83	22.7
	30,001–50,000	86	23.6
	50,001–70,000	69	18.9
	70,001–90,000	35	9.6
	90,001–120,000	35	9.6
	>120,000	57	15.6
Travel Frequency Before COVID-19	0	72	19.7
	1	102	27.9
	2–4	130	35.6
	5–7	37	10.1
	8–10	9	2.5
	>10	15	4.1
Have you travelled during COVID-19	Yes	89	24.4
	No	276	75.6
Travel Frequency During COVID-19	0	271	74.2
	1	23	6.3
	2–4	42	11.5
	5–7	14	3.8
	8–10	5	1.4
	>10	10	2.7
Class	Economy	279	76.4
	Premium Economy	37	10.1
	Business	40	11.0
	First	9	2.5
Awareness of Digital Technology Adoption	Completely Unaware	90	24.7
	Slightly Unaware	135	37.0
	Neutral	63	17.3
	Slightly Aware	67	18.4
	Complete Aware	10	2.7

4.2. Reliability Analysis and Ranking of Variable Means

Table 2 shows the reliability analysis for digital services using Cronbach's Alpha. The lowest value is 0.876. Since the acceptable reliability value starts from 0.70 [39], all digital

services alpha values are reliable. Table 2 also reveals the mean scores of all variables contained in the survey. Ultraviolet light cleaning & antimicrobial cleaning achieved the highest overall mean value of 4.39. To be specific, "Ultraviolet light cleaning & antimicrobial cleaning to clean aircraft cabin should be utilised by more airlines" achieved the highest mean score of 4.46, followed by "Ultraviolet light cleaning & antimicrobial cleaning to clean the lounge and airport improved my health and hygiene safety during COVID-19" achieved mean score of 4.41.

Table 2. Reliability analysis and mean.

Variables	Cronbach's Alpha	Mean
AI Customer Service	0.876	3.53
Airline providing AI customer service is well known		3.47
I am satisfied with airlines providing AI customer service		3.44
I am willing to experience AI customer service		3.69
AI customer service enhanced my air travel experience during COVID-19		3.51
Digital Documentations	0.936	3.82
Airline providing digital documentation is well known		3.51
I am satisfied with airlines providing digital documentation		3.78
I am willing to experience digital documentation		3.78
Digital documentation enhanced my air travel experience during COVID-19		3.89
Self-Check-in Kiosk	0.934	4.01
Airline providing self-check-in kiosk is well known		4.06
I am satisfied with airlines providing self-check-in kiosks		3.95
I am willing to experience a self-check-in kiosk		4.04
Self-check-in kiosk enhanced my air travel experience during COVID-19		3.94
Facial Recognition	0.951	3.97
Airline providing face recognition is well known		3.93
I am satisfied with airlines providing face recognition		3.94
I am willing to experience face recognition		4.02
Face recognition enhanced my air travel experience during COVID-19		3.91
E-Menu	0.948	4.13
Airline providing e-menu is well known		4.09
I am satisfied with airlines providing e-menu		4.08
I am willing to experience e-menu		4.23
E-menu enhanced my air travel experience during COVID-19		4.09
E-Library	0.950	4.06
Airline providing e-library is well known		4.00
I am satisfied with airlines providing e-library		4.02
I am willing to experience e-library		4.15
E-library enhanced my air travel experience during COVID-19		4.04
Contactless Boarding	0.952	4.32
Airline providing contactless boarding is well known		4.30
I am satisfied with airlines providing contactless boarding		4.31
I am willing to experience contactless boarding		4.36
Contactless boarding enhanced my air travel experience during COVID-19		4.28
E-Luggage Tag	0.961	4.23
Airline providing e-luggage tag is well known		4.21
I am satisfied with airlines providing e-luggage tag		4.21
I am willing to experience an e-luggage tag		4.28
E-luggage tag enhanced my air travel experience during COVID-19		4.19

Table 2. *Cont.*

Variables	Cronbach's Alpha	Mean
Automatic Cleaning Robot	0.952	4.26
Airline providing Automatic cleaning robot tags is well known		4.17
I am satisfied with airlines providing Automatic cleaning robot		4.25
Automatic cleaning robots to clean airline lounges and airports should be utilized by more airlines		4.33
Automatic cleaning robot to clean the lounge and airport improved my health and hygiene safety during COVID-19		4.28
Ultraviolet Light Cleaning & Antimicrobial Cleaning	0.955	4.39
Airline providing Ultraviolet light cleaning & antimicrobial cleaning tag is well known		4.32
I am satisfied with airlines providing Ultraviolet light cleaning & antimicrobial cleaning		4.40
Ultraviolet light cleaning & antimicrobial cleaning to clean aircraft cabins should be utilized by more airlines		4.46
Ultraviolet light cleaning & antimicrobial cleaning to clean the lounge and airport improved my health and hygiene safety during COVID-19		4.41
Application Controlled Inflight Entertainment System (APP-IFE)	0.969	4.17
Airline providing application-controlled IFE is well known		4.16
I am satisfied with airlines providing application-controlled IFE		4.17
I am willing to experience application-controlled IFE		4.24
Application-controlled IFE enhanced my air travel experience during COVID-19		4.14
Overall satisfaction measures		
Are you satisfied with digital initiatives provided by airlines during COVID-19?		4.08
Airlines should improve their current digital technologies		4.22
As many services are being delivered through the mobile application, I am willing to spend the effort to be compatible with digital technologies provided by airlines		4.20
I am willing to upgrade my current electronic devices to be compatible with digital technologies provided by airlines		4.12
I think airlines should adopt more digital transformation to improve my flight experience		4.27
I will be more attracted to airlines who adopted digital transformation		4.18

Contactless boarding reached the second-highest overall satisfaction value of 4.32, followed by the automatic cleaning robot at 4.26 and then the e-luggage tag at 4.23. The ranking suggested that passengers are now more concerned about being infected with COVID when conducting air travel during the pandemic. It also revealed that passengers are satisfied with airlines' ability to minimize the spread of viruses while maintaining the travel experience, especially the cleanness of the cabin environment.

The lowest overall satisfaction score was satisfaction with AI customer service, with a mean score of 3.53. In detail, the questions "Airline providing AI customer service is well known" and "I am satisfied with airlines providing AI customer service" had the lowest mean value of 3.47 and 3.44, respectively. Digital documentation reached the second-lowest mean score of 3.82, where "Airline providing digital documentation is well known" (3.51) reduces the overall average mean score. Facial recognition was one of the last variables, with an average score of 3.97, slightly below 4.0.

At the end of the table, respondents' overall satisfaction measures with the airline's digital transformation are also presented. Responses from "Airlines should improve their current digital technologies", "I think airlines should adopt more digital transformation to improve my flight experience" and "As many services are being delivered through the mobile application, I am willing to spend the effort to be compatible with digital", reached the highest of 4.27, 4.22 and 4.20, respectively. This indicated that passengers

are satisfied with airlines' current performance, have high expectations of airlines' future digital transformations, and are willing to try to learn and experience the services.

4.3. Analysis of Variance

As each digital service contains four sub-questions, the mean score of each respondent's four sub-question scores was expressed as the overall satisfaction level of each digital service and was used for the ANOVA analysis. The results from the ANOVA test are shown in the Appendix A (Tables A1–A4). Table A5 in the Appendix A shows the correlation between demographic information. Since most of the correlation coefficients are between 0.00 to 0.30 (0.00 to −0.30), it can be concluded that there is a negligible correlation [40] between demographic information. Likewise, travel frequency before COVID-19, travelled during COVID-19 and travel frequency during COVID-19 were expected to be correlated, and thus, a moderate to high correlation [40] is observed.

Overall, most demographic characteristics found links between digital service variables, except for occupation and yearly income. A significant relationship was found between gender and AI customer service ($p < 0.05$) and digital documentation ($p < 0.05$). In addition, females have higher mean scores than males, which may reflect that female passengers are more attentive to airlines' digital services than male passengers.

Multiple significant relationships were found between age group and e-menu ($p < 0.05$), e-library ($p < 0.01$), contactless boarding ($p < 0.01$), e-luggage tag ($p < 0.01$), cleaning robot ($p < 0.001$), ultraviolet light leaning & antimicrobial cleaning ($p < 0.001$) and application controlled inflight entertainment system (APP-IFE) ($p < 0.05$), where the highest mean scores were observed in the 51–60 age group. This showed that passengers in the 50–61 age group are more concerned about the terminal and cabin hygiene when travelling by air and prefer contactless and/or self-services compared to other age groups. Similarly, nationality also has relationships with contactless boarding ($p < 0.01$), e-luggage tag ($p < 0.05$), cleaning robot ($p < 0.05$), cleaning robot ($p < 0.05$), ultraviolet light leaning & antimicrobial cleaning ($p < 0.05$) and APP-IFE ($p < 0.01$), where the highest mean scores were observed in the Chinese market. This indicates that in the Chinese Market, passengers are satisfied with airlines' digital transformations.

When comparing the travel frequency before and during the pandemic, significant differences were found with digital documentation ($p < 0.01$; during the pandemic), Self-check-in kiosks ($p < 0.05$; before the pandemic) and ($p < 0.001$; during the pandemic), where the highest mean values were observed with all passengers who had a travel frequency of 5–7 times (4.07, 4.08, 4.57, respectively). This suggested that the self-check-in kiosks are essential regardless of the pandemic and have become essential and satisfactory for frequent travellers. Moreover, the data also demonstrates that frequent travellers positively view airlines' digital documentation introduction, as the service's feature makes it easier for passengers to travel during the pandemic.

4.4. Multiple Linear Regression

A stepwise multiple linear regression analysis was conducted to explore the relationship between the dependent variable of "overall customer satisfaction" with the digital technology adopted by airlines and the demographic information. Table A6 in the Appendix A shows that there were 6 models that were significant from the stepwise regression. All of these six models excluded demographic information. Table 3 presents the summary results of model 6, which had the best Adjusted R Square value of 0.652. Additionally, Variance Inflation Factor (VIF) is low, between 1 to 3 [41], suggesting multicollinearity may not be an issue. Based on the results in Table 3, it is implied that 65.3% of the variance in overall customer satisfaction with digital technology adopted by airlines is significantly affected by six predictors (F-value = 114.914, $p < 0.001$): AI customer service ($\beta = 0.086$, $p < 0.005$), e-luggage tag ($\beta = 0.201$, $p < 0.001$), automatic cleaning robot ($\beta = 0.173$, $p < 0.001$), ultraviolet light and antimicrobial cleaning ($\beta = 0.144$, $p = 0.003$), application controlled inflight entertainment system ($\beta = 0.140$, $p < 0.001$) and e-library

($\beta = 0.085$, $p = 0.024$). Furthermore, the e-luggage tag was the most influential factor ($\beta = 0.201$, $p < 0.001$) that affected overall customer satisfaction.

Table 3. Results of multiple linear regression.

Dependent Variable	**Overall Satisfaction**			
R Square	0.658			
Adjusted R Square	0.652			
F-Statistic	114.914			
p-value	<0.001			
Observations	365			
Predictors	**Coefficients (β)**	**Standard Error**	**t-Stat**	***p*-value**
Intercept	0.720	0.139	5.166	<0.001
AI customer service	0.086	0.031	2.813	<0.005
E-luggage tag	0.201	0.045	4.477	<0.001
Automatic cleaning robot	0.173	0.045	3.824	<0.001
Ultraviolet light and antimicrobial cleaning	0.144	0.048	3.025	0.003
Application controlled inflight entertainment system (APP-IFE)	0.140	0.038	3.697	<0.001
E-library	0.085	0.037	2.267	0.024

5. Discussion

5.1. Open-Ended Response

The open-ended responses provided insights into the digital transformation initiatives passengers want in their current and future flight experiences. Firstly, in today's digital transformations, passengers hope that the digital transformations can be more bonded with the government's COVID-19 regulations, to cooperate with the pandemic prevention measures of various other countries. Secondly, in the post-COVID-19 era, passengers hope to have a more convenient digital method to store their information, e.g., ePassport, where they can upload their personal information to the airline's database. Thirdly, some passengers hope to replace the staff with more machines in the future, which can drive lower ticket prices. Fourthly, some elderly respondents had opposing views on digital transformation and commented that "digital transformation is essential during the pandemic, but airline's hospitality is inseparable from customers". Such opinion aligns with previous analysis [42] that, generally, passengers would prefer airlines offering a combination of customer services (traditional human services) and self-services (electronic services), but elderly passengers prefer traditional human services. Lastly, in future airline digital transformations, most passengers suggest developing a more user-friendly interface in airlines' applications to provide a better service and experience for passengers. In addition, passengers expect digital transformation to be a major development focus for airlines in the future.

5.2. Customer Satisfaction

In this study, out of 11 digital technology adopted by airlines, passengers' perceptions of overall satisfaction were significantly affected by six technologies: AI customer service, e-luggage tag, automatic cleaning robots, ultraviolet light and microbial cabin cleaning, APP-IFE and e-library in the Chinese market. According to [3], passengers now demand higher levels of hygiene and require airlines to provide sufficient preventive measures due to health and safety concerns regarding COVID-19. When considering the fundamental nature of these five technological initiatives observed in our study, 'contactless' is the key motive that constructs the foundation of these initiatives. Therefore, passengers being able to self complete the actions such as checking in luggage, using an e-library instead of paper-based physical catalogues for instructions while on board or in the lounge, and

using APP-IFE, along with the assurance of a high level of hygiene through the automatic cleaning robot and ultraviolet light and antimicrobial cleaning, has increased customer satisfaction. Furthermore, the results from our study are consistent with some of the existing literature. For example, the high customer satisfaction level with automatic cleaning robots; and ultraviolet light and antimicrobial cleaning support the findings from a previous study [15]. In that study, it was found that the fear of being infected by COVID-19 led to positive perceptions of contactless cleaning initiatives such as automatic cleaning robots. Additionally, in another study [3], it was reported that passengers are concerned about the disinfection of the aircraft. Hence, ultraviolet light and antimicrobial cleaning also indicated a high customer satisfaction level. Having said that, in our study, it was also discovered that some initiatives of a similar 'contactless' nature (e.g., facial recognition, e-menu) did not enhance passengers' satisfaction. Therefore, examining these digital initiatives further in future studies is suggested.

5.3. AI Based Customer Service

The statements "Airline providing AI customer service is well known" and "Satisfied that airlines providing AI customer service" reached the lowest mean value of 3.47 and 3.44, respectively. This suggests that airlines may not have provided passengers with sufficient information about their service, or AI customer service may not have performed to passengers' expectations. Customers generally believe that "AI is supposed to be smart" [43]. However, in the case of high-complexity tasks, the results provided by AI generally turn customers' high expectations into disappointment [43]. The comments in the open-ended questions also support this, including, "there is a need to make AI customer service more intelligent", "human customer service should not be completely replaced by AI customer service", and "traditional human customer services are essential".

The advantages of AI customer service are nonnegligible. Under the high efficiency of AI customer service, customers' wait time can be minimized and receive immediate responses, which are hardly achievable by human customer service [43]. However, human customer service is still better able to solve highly complex tasks. Airlines should focus on enhancing AI's machine learning, deep learning and natural language processing and allowing human customer service to handle complex tasks simultaneously to improve passengers' user experience [43].

5.4. Digital Documentation

Within all four sub-questions, the awareness of digital documentation has the lowest mean score of 3.51. This also suggested a low level of awareness of the service among respondents. Moreover, the mean scores for digital documentation satisfaction, willingness to experience digital documentation and usefulness of digital documentation in COVID-19 also show a low range of 3.78 and 3.89. In the open-ended section, no comments were provided from respondents, which suggests that there may have been a lack of awareness of the service. This also means that it may be a significant area for airlines to improve their marketing. Customer satisfaction depends to a large extent on the company's promotion, which is a result of customers' experiences with a company or its products or services surpassing customers' particular satisfaction goals [44]. Therefore, airlines should allow more passengers to be informed and increase their willingness to experience digital documentation.

5.5. Facial Recognition

Respondents' awareness of facial recognition is low, with a mean score of 3.93. In addition, the mean score satisfaction level and usefulness in COVID-19 are also below the mean score of 4.0. Facial recognition performs by capturing multiple features of the face and compare with stored data in the system [45]. However, during the pandemic period, passengers wear face masks to protect themselves from virus infection. Masking the face brings difficulties for the facial recognition function to perform effectively but removing masks may increase the chance of being infected. Furthermore, one of the respondents

stated that "a primary issue for airlines to be concerned about is the disclosure of personal information". Cyber security is a key to providing a secure, reliable and sustainable service in airports [46]. Safety is essential in the airline industry; hence, further improvement in technology is needed. Airlines should collaborate and integrate new technologies to increase recognition accuracy even with face masks on. Lastly, airlines' commitment to cyber security should be communicated to passengers to increase their confidence in using face recognition while travelling.

5.6. Self-Check-In Kiosk

Respondent's awareness of a self-check-in kiosk is relatively higher, with a mean score of 4.01, while the specific item on satisfaction with the self-check-in kiosk is relatively lower (3.95). A self-check-in kiosk is projected to be an important non-contact service for airline operators during and post-COVID-19 era [14]. To improve the satisfaction and usage of the self-check-in kiosk, the airline operator can focus on enhancing the overall quality of the kiosks besides meeting the passengers' basic needs for smooth check-in procedures [45]. For example, it has been suggested that racks or holders be provided in a self-check-in kiosk so that passengers can put their cell phones, drinks, or other portable items, while they process the check-in procedure [14]. Literature also suggests optimizing the passengers' waiting time by considering the variation in the number of passengers using a traditional check-in desk and self-check-in kiosk to improve passengers' satisfaction [47].

5.7. Limitations of the Study

The questionnaire in this study focused on Chinese passengers. Therefore, the findings from this study may be more suited for airline services targeted at the Chinese market. Caution needs to be taken when generalizing the results from this study to airline services serving passengers of different nationalities or implementing the findings to global markets. In future, it is suggested to conduct the survey with a mix of nationalities or across different geographic regions to average any cultural bias.

The survey responses are more weighted towards female passengers. Experiences from other fields of study [48] suggest that females would generally display higher social desirability and social approval bias in self-report behaviour and are less competitive in many types of behaviour [49,50]. In future, it is suggested to have a balanced representative sample of male and female passengers.

We had a sample size of 365, near the expected sample size of 384. In future, a greater sample size can be surveyed to examine passengers' satisfaction with airlines' initiatives to adopt new technology. Further, it is suggested to compare or consider respondent characteristics specific to the flying population in future studies.

In our study, we did not consider the experience of passengers who travel through full-service network carriers, low-cost carriers and newly emerging airlines. Past studies have suggested that passengers may perceive airline service quality measures differently for low-cost carriers and full-service airlines [51]. Therefore, it is suggested to conduct a comparative study of passengers' perception of digital technology among low-cost carriers, full-service carriers, traditional carriers and emerging airlines which may provide more detailed insight into passengers' preferences and perceptions of digital technology in the airline sector.

6. Conclusions

This study investigated Chinese passengers' satisfaction with the adoption of eleven digital technologies by airlines digital during the COVID-19 pandemic. The analysis indicates that most passengers have a positive attitude towards airlines adopting new technology. In the regression model, six digital technologies offered by the airlines are statistically significant and have impacted passenger satisfaction. They are AI customer service, e-luggage tag, cleaning robot, ultraviolet light cleaning and antimicrobial cabin cleaning, APP-IFE, and e-library. During COVID-19, passengers' awareness of hygiene and

cleanliness has increased, and they are concerned about the measures that airlines have taken to minimize the spread of COVID-19. Therefore, these six digital technologies are more favourable during the pandemic because of their contactless nature and better hygiene.

Based on the feedback obtained from the survey, AI customer service, digital documentation and facial recognition are the least favourable among the eleven digital technologies offered by the airlines. There is an opportunity for airlines to improve these services further to gain the trust of the passengers. Furthermore, airlines could acquire more advanced scanning machines for facial recognition technology to increase accuracy and reduce time in the recognition process. In addition, further work can be conducted on cybersecurity, namely application security, cloud security and IoT security, for managing passengers' information in the airlines' database and protecting their privacy. Airlines can conduct security awareness training for staff outside the IT department to strengthen their basic cybersecurity principles. Further, IT staff should regularly monitor, detect, and identify threats, protect the information, and respond to and recover from cybersecurity attacks. Furthermore, antivirus software, firewalls and malware protection should be safeguarded by relevant personnel to ensure their functionalities.

As the airline industry is fast-changing and competitive, airlines that operate in this dynamic environment need to review and set strategic objectives to maintain business vitality constantly. Digitalization is a global trend in the airline industry, and airlines have adopted a series of digital services or products for passengers. As conducted in this study, understanding passengers' perceptions of these digital technologies will assist airlines in developing customer-centric business strategies.

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Appendix A

Table A1. ANOVA results for 12 variables show the relationship between gender, age, nationality and education.

Variables.		Gender		Age						Nationality		Education			
		Male	Female	≤20	21–30	31–40	41–50	51–60	>60	Chinese	Non-Chinese	Senior Higher or Lower	Certificate/ Diploma	Bachelors	Masters and Higher
AI Customer Service	Mean	3.3	3.6	3.38	3.4	3.6	3.6	3.6	3.1	3.5	3.4	3.5	3.6	3.5	3.7
	p-value	**0.005** **		0.35						0.3		0.7			
Digital Documentations	Mean	3.7	3.9	3.92	3.8	3.8	3.8	4.0	3.3	3.8	3.8	3.8	4.0	3.8	4.0
	p-value	**0.028** *		0.33						0.8		0.4			
Check-in Kiosk	Mean	4.0	4.0	4.13	4.0	4.0	4.0	4.1	3.5	4.0	3.9	3.9	3.9	4.0	4.3
	p-value	1.0		0.29						0.5		**0.045** *			
Facial Recognition	Mean	3.8	4.0	4.11	3.7	4.1	4.0	4.0	3.4	4.0	3.7	3.9	4.1	4.0	3.8
	p-value	0.1		0.23						0.1		0.7			
E-Menu	Mean	4.0	4.2	4.18	4.0	4.2	4.2	4.2	3.3	4.2	3.9	4.0	4.3	4.1	4.1
	p-value	0.2		**0.032** *						0.1		0.5			
E-Library	Mean	4.0	4.1	4.09	3.7	3.9	4.2	4.4	3.7	4.1	3.8	4.1	4.2	4.1	3.8
	p-value	0.2		**0.001** **						0.1		0.2			
Contactless Boarding	Mean	4.3	4.3	4.35	4.1	4.2	4.4	4.6	3.9	4.4	4.1	4.4	4.2	4.3	4.4
	p-value	0.3		**0.006** **						**0.025** *		0.7			
E-Luggage Tag	Mean	4.2	4.2	4.22	4.0	4.2	4.3	4.5	3.5	4.3	3.9	4.2	4.2	4.2	4.3
	p-value	0.7		0.01						**0.018** *		0.9			
Cleaning Robot	Mean	4.2	4.3	4.42	4.0	4.1	4.3	4.6	3.5	4.3	4.0	4.3	4.4	4.2	4.2
	p-value	0.1		**<0.001** ***						**0.014** *		0.9			
Ultraviolet	Mean	4.4	4.4	4.52	4.1	4.3	4.5	4.6	3.9	4.4	4.1	4.4	4.3	4.4	4.5
	p-value	0.5		**<0.001** ***						**0.022** *		0.9			
APP-IFE	Mean	4.1	4.2	4.35	4.1	4.1	4.2	4.4	3.4	4.2	3.9	4.2	4.1	4.2	4.3
	p-value	0.4		**0.044** *						**0.03** *		0.9			
General Satisfaction	Mean	4.1	4.2	4.29	4.0	4.1	4.2	4.3	4.0	4.2	3.8	4.2	4.2	4.2	4.2
	p-value	0.6		0.19						**0.001** **		0.937			

* Significance level $p < 0.05$; ** Significance level $p < 0.01$; *** Significance level $p < 0.001$.

Table A2. ANOVA results for 12 variables show the relationship between occupation, yearly income and travel during COVID-19.

Variables		Occupation						Yearly Income						Travelled during COVID-19	
		Student	**Business Owner**	**Employee**	**Self-Employee**	**Retired**	**Other**	**≤30,000**	**30,001–50,000**	**50,001–70,000**	**70,001–90,000**	**90,001–120,000**	**>120,000**	**Yes**	**No**
AI Customer Service	Mean	3.33	3.48	3.55	3.32	3.70	3.66	3.44	3.50	3.55	3.51	3.79	3.50	3.55	3.52
	p-value	0.26						0.55						0.79	
Digital Documentations	Mean	3.96	3.87	3.83	3.56	3.84	3.77	3.80	3.81	3.73	3.89	3.97	3.84	3.94	3.78
	p-value	0.58						0.86						0.17	
Check-in Kiosk	Mean	4.17	4.10	4.04	3.73	3.86	3.91	4.04	3.85	4.06	3.96	4.24	4.01	4.31	3.91
	p-value	0.23						0.29						**<0.001** **	
Facial Recognition	Mean	3.96	3.96	3.97	3.79	3.92	4.00	3.84	3.98	3.95	3.98	4.20	3.94	3.82	4.00
	p-value	0.97						0.70						0.14	
E-Menu	Mean	4.09	4.25	4.15	3.91	4.03	4.17	4.05	4.07	4.13	4.29	4.38	4.08	4.14	4.12
	p-value	0.67						0.38						0.90	
E-Library	Mean	3.90	4.06	4.11	3.79	4.12	4.19	3.95	4.10	4.03	4.09	4.21	4.11	3.87	4.13
	p-value	0.36						0.78						**0.021** *	
Contactless Boarding	Mean	4.20	4.40	4.34	4.13	4.33	4.38	4.20	4.35	4.28	4.35	4.49	4.34	4.28	4.33
	p-value	0.66						0.61						0.66	
E-Luggage Tag	Mean	4.10	4.24	4.29	4.01	4.13	4.26	4.13	4.23	4.25	4.12	4.36	4.33	4.23	4.23
	p-value	0.61						0.69						0.98	
Cleaning Robot	Mean	4.19	4.21	4.26	4.31	4.34	4.33	4.10	4.25	4.33	4.27	4.45	4.33	4.21	4.28
	p-value	0.95						0.39						0.49	
Ultraviolet	Mean	4.29	4.49	4.41	4.30	4.32	4.45	4.21	4.41	4.40	4.43	4.60	4.48	4.44	4.38
	p-value	0.81						0.21						0.52	
APP-IFE	Mean	4.22	4.27	4.25	3.80	4.05	4.05	4.08	4.17	4.23	3.95	4.32	4.28	4.17	4.17
	p-value	0.20						0.47						0.99	
General Satisfaction	Mean	4.14	4.20	4.20	4.06	4.05	4.22	4.05	4.14	4.22	4.13	4.30	4.29	4.21	4.16
	p-value	0.84						0.39						0.62	

* Significance level $p < 0.05$; ** Significance level $p < 0.01$.

Table A3. ANOVA results for 12 variables show the relationship between travel frequency before and during COVID-19.

Variables		**Travel Frequency before COVID-19**						**Travel Frequency during COVID-19**					
		0	**1**	**2 to 4**	**5 to 7**	**8 to 10**	**>10**	**0**	**1**	**2 to 4**	**5 to 7**	**8 to 10**	**>10**
AI Customer Service	Mean	3.5	3.5	3.6	3.6	3.9	3.1	3.5	3.7	3.7	3.6	3.0	3.4
	p-value	0.3						0.4					
Digital Documentations	Mean	3.8	3.8	3.8	4.1	4.1	3.5	3.8	4.2	4.0	4.1	2.7	3.9
	p-value	0.2						**0.004** **					
Check-in Kiosk	Mean	3.7	4.0	4.1	4.4	4.2	4.2	3.9	4.4	4.3	4.6	4.2	4.1
	p-value	**0.005** **						**<0.001** ***					
Facial Recognition	Mean	4.0	3.9	3.9	4.1	3.6	4.2	4.0	3.7	3.9	4.0	3.5	4.0
	p-value	0.7						0.8					
E-Menu	Mean	4.1	4.2	4.1	4.3	4.3	3.8	4.1	4.2	4.3	4.4	4.0	3.5
	p-value	0.4						0.1					
E-Library	Mean	4.1	4.2	4.0	4.1	4.3	3.6	4.1	4.0	3.9	4.3	3.1	3.6
	p-value	0.2						0.0					
Contactless Boarding	Mean	4.3	4.4	4.3	4.4	4.6	4.2	4.3	4.4	4.4	4.2	4.1	4.2
	p-value	0.8						0.9					
E-Luggage Tag	Mean	4.2	4.2	4.2	4.5	4.4	4.0	4.2	4.1	4.4	4.3	4.2	4.1
	p-value	0.3						0.7					
Cleaning Robot	Mean	4.2	4.2	4.4	4.3	4.3	3.8	4.3	4.4	4.4	4.2	3.7	3.7
	p-value	0.2						0.1					
Ultraviolet	Mean	4.3	4.5	4.4	4.5	4.4	4.2	4.4	4.6	4.5	4.5	3.8	4.2
	p-value	0.5						0.2					
APP-IFE	Mean	4.1	4.1	4.2	4.5	4.4	4.0	4.2	4.1	4.3	4.5	3.8	4.0
	p-value	0.2						0.5					
General Satisfaction	Mean	4.1	4.2	4.2	4.3	4.5	4.0	4.1	4.3	4.3	4.3	3.8	3.9
	p-value	0.6						0.3					

** Significance level $p < 0.01$; *** Significance level $p < 0.001$.

Table A4. ANOVA results for 12 variables show the relationship between ticket class and awareness of digital transportation.

Variables		Class				Awareness of Digital Transformation				
		Economy	Premium Economy	Busniess	First	Complete Unaware	Slightly Unaware	Neutral	Slightly Aware	Completely Aware
AI Customer Service	Mean	3.5	3.6	3.6	3.9	3.3	3.5	3.6	3.8	4.1
	p-value	0.5				**0.005** **				
Digital Documentations	Mean	3.8	3.9	3.9	4.3	3.5	3.8	4.0	4.1	4.4
	p-value	0.3				**<0.001** ***				
Check-in Kiosk	Mean	4.0	4.1	4.2	4.2	3.8	3.9	4.1	4.2	4.5
	p-value	0.5				**0.01** **				
Facial Recognation	Mean	3.9	4.0	4.0	3.8	3.8	4.0	3.9	4.1	4.2
	p-value	0.9				0.3				
E-Menu	Mean	4.1	4.1	4.3	4.1	3.9	4.1	4.2	4.3	4.2
	p-value	0.6				0.2				
E-Library	Mean	4.1	4.1	4.0	4.2	3.9	4.1	4.2	4.1	4.1
	p-value	1.0				0.3				
Contactless Boarding	Mean	4.3	4.4	4.3	3.9	4.2	4.3	4.4	4.4	4.4
	p-value	0.5				0.2				
E-Luggage Tag	Mean	4.2	4.3	4.3	3.9	4.0	4.3	4.3	4.3	4.4
	p-value	0.8				0.1				
Cleaning Robot	Mean	4.2	4.3	4.5	4.1	4.1	4.3	4.4	4.3	4.6
	p-value	0.3				0.3				
Ultraviolet	Mean	4.4	4.5	4.7	3.9	4.3	4.4	4.4	4.5	4.6
	p-value	**0.028** *				0.3				
APP-IFE	Mean	4.2	4.1	4.3	4.0	4.0	4.2	4.2	4.3	4.3
	p-value	0.7				0.3				
General Satisfaction	Mean	4.2	4.1	4.3	4.2	4.0	4.2	4.2	4.3	4.4
	p-value	0.6				0.0				

* Significance level $p < 0.05$; ** Significance level $p < 0.01$; *** Significance level $p < 0.001$.

Table A5. Correlation analysis of demographic information.

	Gender	Age	How Many Times Do You Travel by Air in a Year?	Nationality	Occupation	Yearly Income (A$)	Education	Have You Travelled during COVID-19?	If You Have Travelled during COVID-19, How Often Did You Travel?	Which Class Do You Prefer When You Travel by Air?	Are You Aware of Airline's Digital Transformations before and during COVID-19?
Gender	1										
Age	0.051	1									
How many times do you travel by air in a year?	−0.147 **	-0.141 **	1								
Nationality	0.073	−0.096	0.071	1							
Occupation	0.108 *	0.467 **	−0.172 **	−0.086	1						
Yearly Income (A$)	−0.081	0.248 **	0.216 **	−0.121 *	0.129 *	1					
Education	−0.116 *	−0.199 **	0.330 **	0.028	−0.234 **	0.165 **	1				
Have you travelled during COVID-19?	0.190 **	0.328 **	−0.544 **	−0.089	0.251 **	−0.037	−0.328 **	1			
If you have travelled during COVID-19, how often did you travel?	−0.175 **	−0.243 **	0.668 **	0.123 *	−0.200 **	0.120 *	0.319 **	−0.830 **	1		
Which class do you prefer when you travel by air?	−0.068	−0.105 *	0.421 **	0.131 *	−0.089	0.224 **	0.234 **	−0.392 **	0.458 **	1	
Are you aware of airline's digital transformations before and during COVID-19?	−0.017	−0.088	0.243 **	0.075	−0.082	0.102	0.169 **	−0.276 **	0.285 **	0.266 **	1

Correlation is significant at the 0.01 level **. Correlation is significant at the 0.05 level *.

Table A6. Coefficients and collinearity statistics of six regression models generated from stepwise regression.

Model		Unstandardized Coefficients [a]		Standardized Coefficients [a]	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	1.567	0.132		11.844	<0.001		
	E-Luggage Tag	0.616	0.031	0.726	20.124	<0.001	1.000	1.000
2	(Constant)	1.123	0.131		8.553	<0.001		
	E-Luggage Tag	0.382	0.039	0.450	9.786	<0.001	0.513	1.951
	Automatic Cleaning Robot	0.337	0.039	0.396	8.600	<0.001	0.513	1.951
3	(Constant)	1.033	0.129		8.031	<0.001		
	E-Luggage Tag	0.270	0.044	0.318	6.093	<0.001	0.375	2.668
	Automatic Cleaning Robot	0.288	0.039	0.338	7.341	<0.001	0.480	2.084
	Digital Application Controlled In-flight Entertainment System	0.185	0.038	0.236	4.890	<0.001	0.438	2.283
4	(Constant)	0.888	0.134		6.650	<0.001		
	E-Luggage Tag	0.248	0.044	0.293	5.636	<0.001	0.367	2.722
	Automatic Cleaning Robot	0.264	0.039	0.311	6.729	<0.001	0.465	2.151
	Application Controlled In-flight Entertainment System	0.178	0.037	0.227	4.762	<0.001	0.437	2.290
	AI Customer Service	0.104	0.030	0.122	3.438	<0.001	0.788	1.269
5	(Constant)	0.742	0.140		5.308	<0.001		
	E-Luggage Tag	0.222	0.044	0.261	5.006	<0.001	0.354	2.823
	Automatic Cleaning Robot	0.197	0.044	0.231	4.444	<0.001	0.357	2.800
	Application Controlled In-flight Entertainment System	0.151	0.038	0.193	3.996	<0.001	0.415	2.409
	AI Customer Service	0.102	0.030	0.119	3.407	<0.001	0.788	1.270
	Ultraviolet Light & Antimicrobial Cleaning	0.152	0.048	0.164	3.172	0.002	0.361	2.768
6	(Constant)	0.720	0.139		5.166	<0.001		
	E-Luggage Tag	0.201	0.045	0.237	4.477	<0.001	0.340	2.941
	Automatic Cleaning Robot	0.173	0.045	0.203	3.824	<0.001	0.338	2.958
	Digital Application Controlled In-flight Entertainment System	0.140	0.038	0.179	3.697	<0.001	0.408	2.449
	AI Customer Service	0.086	0.031	0.101	2.813	0.005	0.746	1.341
	Ultraviolet Light & Antimicrobial Cleaning	0.144	0.048	0.156	3.025	0.003	0.359	2.782
	E-Library	0.085	0.037	0.103	2.267	0.024	0.459	2.177

[a] Dependent Variable: Overall satisfaction.

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