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Self-Service Technology in Aviation: The case study of Thailand

A thesis presented in partial fulfilment of the requirements for the degree of

Doctor of Philosophy

in

Aviation

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New Zealand.

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Abstract

As a major tourist destination, Thailand's economy relies heavily on air transport. The post-pandemic air travel sector still faces operational challenges, including airport congestion and staff shortages. These issues have accelerated the adoption of self-service technology (SST) to tackle these challenges and improve passenger experience. This thesis examines SST within aviation, passenger adoption, and its effects on ground employees, using Thailand as a case study. Chapter 1 reviews the literature on SST in aviation, identifying potential research gaps. This chapter maps the research landscape, identifying a considerable lack of studies on the new biometric check-in kiosks, and highlighting the limited research concerning the effects of SST implementation on ground employees. Chapter 2 explores how passengers adopt biometric check-in kiosks by combining the Technology Acceptance Model with the Theory of Planned Behaviour, broadening these models to incorporate less researched factors in aviation context, such as perceived risk, trust, and privacy issues. The results highlight the critical role of perceived trust and privacy concerns in influencing attitudes toward the use of this technology. Chapter 3 investigates the perceived threat of job automation from SST on airlines and airports ground employees. The findings illustrate the influence of this threat on, job insecurity, job satisfaction, and organisational commitment on turnover intentions. This thesis contributes to the aviation literature by synthesising insights from both passenger and employee perspectives. It also offers managerial implications for optimising future SST implementation strategies. Specifically, it recommends that aviation stakeholders must facilitate biometric adoption by actively communicating the technology's benefits and data privacy measures to reshape passenger attitudes and build trust. Simultaneously, mitigate ground staff job insecurity through targeted upskilling and role integration to ensure workforce retention.

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Introduction

Technology is vital in facilitating people's daily lives and solving problems for businesses, including transportation. Self-Service Technology (SST), which allows customers to perform some processes independently, has been integrated to enhance customer services (Meuter et al., 2000). Nowadays, more SSTs are introduced in many stages of the passenger journey. Airlines and airports have implemented the SST to facilitate passenger pre-flight services, including online reservation and ticketing, chatbot customer service, self-check-in and baggage drop-off, self-security identity verification (pre-security), automated border control and immigration (e-gate), and self-boarding. In 2018, Thai AirAsia reported that around half of passengers checked in by themselves (Asia Aviation, 2019). The most used self-check-in by passengers was web check-in (42.68%), followed by self-check-in kiosk (33.96%) and mobile check-in (23.36%). Implementing SST increases efficiency and performance (Abdelaziz et al., 2010). However, biometric check-in is new in Thailand and has not been officially provided to all passengers.

Moreover, the COVID-19 pandemic forced the government to impose a travel restriction policy, reducing the number of seats offered by airlines by 50% (International Civil Aviation Organization, 2023). Different measures had been implemented by airlines to ensure the viability of their businesses, for example, seeking government support, employee leave without pay, reduced working hours, and voluntary resignation (KPMG, 2020). As a result, aviation jobs were estimated to be reduced by 21% worldwide compared to the pre-pandemic situation (Airlines, 2021). Although the pandemic has ended, the implementation of SST continues as airlines and airports are still investing in information technology for passenger processing, aiming to automate the journey of passengers (SITA, 2022).

However, this drive toward passenger automation is not without human consequences. The same technologies designed to enhance passenger experience are simultaneously impacting the roles, workload, and long-term job security of the ground staff who traditionally performed these tasks. This creates a critical tension for management: the push for passenger self-service directly fuels the employee job insecurity this thesis investigates. Understanding this dual-sided impact is therefore essential.

This thesis uses Thailand as a case study to examine the implementation of SST in the aviation industry, focusing on passenger adoption and its effects on ground employees. Thailand is a major global tourist destination, receiving a large number of tourists annually, with approximately 39.9 million arrivals in 2023, placing it among the top 10 countries for international tourist arrivals (World Population Review, 2025). Thai aviation industry handle around 122 million in 2023 (Civil Aviation Authority of Thailand, 2024a). Leveraging its status as a significant tourist hub, this thesis provides practical insights for improving aviation services and employee relations within the region and beyond. The research aims to provide valuable insights for airlines and airports regarding the aspects of SST that require improvement to better accommodate both passengers and employees. Additionally, the findings will benefit airlines and airports in different countries that are considering investing in SST for their operations.

This thesis is organised into the following chapters. Chapter 1 contains a bibliometric analysis and systematic literature review to explore the current research on SST in aviation. This review provides an overview of what has been studied and identifies existing gaps in the literature, laying the groundwork for the subsequent chapters. Chapter 2 explores passenger adoption of biometric check-in kiosks at the airport, while Chapter 3 investigates the impact of SST implementation on airline and airport employees. These chapters are designed to address the research gaps identified in Chapter 1.

Overall, this thesis bridges the gaps in the SST literature within the aviation sector, particularly from the perspectives of passengers and employees, using Thailand as a case study. Furthermore, it offers valuable insights and suggestions for airlines and airports to enhance customer service and improve relationships with their employees.

Research objectives

To emphasise the significance of aviation SST in coping with the operational challenge, enhancing customer service standard, and its impact on airlines and airport ground staff, this thesis aims to achieve the following objectives:

1. To provide an overview of aviation SST literatures regarding customer services, theories and variables that have been discussed so far, and highlight future research direction(s).
2. To investigate passengers' adoptions of biometric check-in kiosks at the airport.
3. To examine the impact of SST on airport and airline ground staffs' attitudes and behaviours.

Contributions and managerial implications

This thesis contributes to the literature related to aviation SST from the passengers' and employees' perspectives. The findings provide insights from a case study of Thailand and offer some recommendations for airlines and airports wishing to introduce and improve their self-service channel to better accommodate passengers and airlines and airports ground staffs.

1. This thesis represents one of the first studies to review the SST literature, specifically within the context of aviation. It provides the first systematic literature review on aviation SST from a customer service perspective. The study highlights the foundation

of aviation SST literature, identifies the geographical regions contributing to this body of work, discusses the predominant theories and factor influencing passengers' attitudes and behaviours, and outlines current research themes. Additionally, it points out potential research gaps for scholars to further advance knowledge in the field of aviation SST (see Chapter 1).

2. Like many studies in aviation SST literature, this thesis investigates the adoption of SST in aviation context. However, this thesis is among the few to investigate the adoption of biometric check-in kiosks at airports using a research framework based on the Technology Acceptance Model and Theory of Planned Behaviour with additional variables that are under explored, including perceived privacy concerns, perceived trust, and perceived risk. Moreover, this thesis illustrates and emphasises the importance of attitudes towards using technology (i.e., biometric check-in kiosk) as a mediator in the framework, which is has often been ignored in the aviation SST literature. In addition, this thesis also offers the practical implications for aviation stakeholders considering implementing biometric technology (See Chapter 2).
3. Research on job insecurity and the threat of job automation is rarely conducted in the aviation industry, let alone focusing on the ground employees whose daily jobs are directly impacted by SST implementation. This thesis is among the first to study the impact of the SST implementation on airlines and airport ground employees. It highlights the negative impact of the threat of job automation from SST implementation and the mediating role of job insecurity in influencing the employees' intention to leave the company. Moreover, it also provides some suggestions for airlines, airports, and ground handling companies how to reduce the negative impact on employees from the implementation of such technology.

4. This thesis provides a platform for understanding the implementation of SST from the passengers' and employees' perspectives. Chapter 1 reviews the literatures in order to enhance the understanding of the aviation SST literature and identifies potential research gaps. Chapter 2 investigates the factors influencing passengers' adoptions of biometric check-in kiosks at the airport. Chapter 3 examines the impact of the perceived threat of job automation from SST on attitudes and behaviours of ground staffs. Overall, the findings of this thesis offer guidelines and suggestions for air service providers (i.e., airlines, airports, ground handling companies) to improve their service for passengers and travellers, as well as managing the passenger service provided by SST and ground staffs (see Chapters 1, 2, and 3).

A formatting note

All the chapters presented in this thesis have been reproduced as already published or submitted for publication. However, there have been some editorial changes made to all the chapters in terms of formatting (e.g. tables and figures), referencing style (this thesis uses APA 7th style), spelling and the use of third person to ensure consistency throughout the thesis. All the acknowledgements have also been removed from the chapters in the thesis. Accordingly, there may be superficial differences among the published or submitted studies reproduced in this thesis. The versions have been published, or are under review, but no changes have been made to the substance of the studies. It should also be noted that when the term “chapter” is used, this refers to the whole chapter, including the preamble, whereas the term “study” is used when only referring to the work that has been published or is under review for publication. There may be repetition in many places in this thesis. In accordance with the *Massey University Graduate Research School's Doctoral Thesis with Publication Guidelines*, it is noted that repetition in the thesis with publication pathway cannot be avoided.

STATEMENT OF CONTRIBUTION DOCTORATE WITH PUBLICATIONS/MANUSCRIPTS

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Chapter 1 – Self-service technology in aviation

Preamble

Air transport is an essential mode of transportation linking people from one point to another. For some countries whose economy relies on the tourism industry, air transport facilitates the movement of tourists across cities, countries, and regions. However, with increased air passenger volumes, airlines and airports have faced congestion and need to improve the passenger journey and travel experience. To do so, SST has been implemented alongside the traditional passenger services provided by airlines and airports ground staffs. This chapter addresses the first research objective of this thesis (i.e., providing an overview of aviation SST literature regarding customer services, theories and variables that have been discussed so far, and highlight future research direction(s) on aviation SST). The bibliometric analysis and systematic literature review of the aviation SST literature have been conducted in this chapter. The review shows that the literature mainly focused on the United States, Spain, Taiwan, South Korea, and Malaysia, while other countries received less attention. Newer SSTs, such as customer service chatbots, biometric check-in kiosks, and self-boarding, are gaining more attention. In terms of theory, the Technology Acceptance Model (TAM) is widely adopted, followed by the Theory of Planned Behaviour (TPB). In addition, three themes emerged from the review: customer adoption, customer satisfaction, and customer experience. More importantly, this chapter points out potential research gaps related to SST such as aiming for different countries, newer technology adoption, environmental impact aspect, and employee well-being. This chapter serves as a foundation for Chapters 2 (investigating passengers' adoption of biometric check-in kiosks at the airport) and 3 (examining the impact of SST implementation on attitudes and behaviours of ground staffs), using a case study of Thailand. Parts of this chapter, from section 1.0 to 1.4, have been published.

Study 1: Self-Service Technology in Aviation: A

Systematic Literature Review

Publication status and candidate contribution

This study was presented at the 27th Air Transport Research Society World Conference in Hong Kong and subsequently published in the Journal of the Air Transport Research Society (SCOPUS). The doctoral candidate is the first and corresponding author, with all supervisors listed as co-authors. The doctoral candidate is responsible for designing the study, conducting the literature review and analysis, creating visualisations, and writing the original draft, all while receiving guidance from the supervisors. It should be noted that, due to the length limitation, only the systematic literature review section of this study has been published. The bibliometric analysis (Section 1.5) and background of Thai aviation (Section 1.6) serve as a general review, which are important to help identify research gaps and lay the foundation for this thesis to explore SST in the aviation sector.

1.0. Abstract

Airlines and airports continuously improve operational efficiency and enhance service quality, especially through self-service technology (SST). Although there are several reviews on SST, the aviation industry has been comparatively overlooked. This study offers a systematic review of the existing literature on aviation SST (e.g., self-check-in kiosks and web/e-ticketing) from the customer service perspective. Starting from a rich dataset of 678 peer-reviewed journal articles listed in Scopus, after some screening processes, 98 articles remained and were included in the full-text review and analysis. Accordingly, we found that the aviation SST literature focused on some geographical locations, e.g., North America and Asia, but not others

(e.g., Africa or Oceania). Its three main research themes are customer adoption, customer satisfaction, and customer experience, in which the Technology Acceptance Model (TAM) is the dominant framework. In addition, the use of SST from the environmental perspective was rarely studied while newer SSTs such as customer service chatbots and biometric check-in will need more attention.

1.1. Introduction

The growth of affordable air transport over the past few decades can be attributed to favourable policies (e.g., open sky policy and other deregulations), technological advancements, and the development of low-cost business models (Belobaba et al., 2015; Budd & Ison, 2020; Doganis, 2013). According to the WorldBank (2023), global passenger air transport peaked in 2019, with approximately 4.5 billion passengers carried and 38 million flights operated. However, the aviation industry has been significantly affected by the COVID-19 pandemic, resulting in a decrease in flights and operational/financial difficulties for airlines (Sun et al., 2021; Sun et al., 2022). The COVID-19 pandemic caused a significant decline in global air passengers, with a 60% reduction compared to 2019 (ICAO, 2022), resulting in many airlines ceasing their operations in 2020 (Bailey, 2021; IATA, 2022b). Nevertheless, with preventive measures and vaccinations, it is projected that passenger numbers will recover and surpass pre-pandemic levels by 2024 (IATA, 2022a). Indeed, the initial recovery of the aviation sector was observed in some countries and regions such as China (Czerny et al., 2021), Europe (Su et al., 2023), and the US (Sun et al., 2022, 2023).

Technological advancements have led to a shift from traditional service encounters with human employees to technology-based self-service, such as mobile banking, online retailing, chatbot customer service, and service robots (Wang et al., 2012). Self-service technology allows customers to serve themselves using technological interfaces without direct assistance (Meuter

et al., 2000). To the best of our knowledge, the term “*self-service technology*” (SST) first appeared in the literature in 1993 in a retail banking study by Marr and Prendergast (1993). However, the concept of self-service has been studied for a long time, with early examples including grocery store self-checkout, self-service airline ticket vendors, self-service gasoline stations, and automated teller machines (ATMs) (Bateson, 1985; Erdmann & Neal, 1971; Kutler, 1982; McClurg & Andrews, 1974; Metacalf & Greenhalgh, 1968).

Introducing SST in customer services offers benefits such as labour cost reduction, increased customer satisfaction and loyalty, and access to new customer segments (Bitner et al., 2002). SST provides competitive advantages through quick and easy service accessibility (Meuter et al., 2000). However, organisations must also be cautious of potential risks and drawbacks. Excessive reliance on advanced technology and poor service design can create the perception that technology surpasses customer abilities, negatively impacting satisfaction (Zhu et al., 2007). Additionally, when SST fails at simple tasks and requires frequent personnel assistance, the perceived value of the service may decrease, leading to increased labour costs (Hilton et al., 2013).

SST in aviation began with the automatic ticket vendors at airports that allowed customers to buy tickets without airline staff (Erdmann & Neal, 1971). In 2007, the International Air Transport Association (IATA) launched the Fast Travel Program, integrating self-service channels to improve customer service and airport/airline efficiency (IATA, 2013). More SSTs are introduced to facilitate various stages of the passenger journey, from online reservation and ticketing to self-check-in, baggage drop-off, automated border control and immigration (e-gate), and self-boarding (Abdelaziz et al., 2010). Thai AirAsia reported over 50% of passengers using self-checking methods (Asia Aviation, 2019); the same figure for the global market is nearly 70% (SITA, 2023). Hence, airlines and airports continue to invest in SST for improving their customer services (SITA, 2022).

Although there are several reviews on SST, the focus is on the hospitality and tourism industry Amaro and Duarte (2013); Mohamad Suhaili et al. (2021); Shin and Perdue (2019); Shiwen et al. (2022); Solakis et al. (2022); Vakulenko et al. (2018); Vakulenko et al. (2019). Less attention is given to the aviation sector, although the recent pandemic required the sector to apply many SST services that require substantial funding that only airlines and airports can pay (but not easily applied in other sectors). Particularly, Kiliç et al. (2021) reviewed 193 airport-related papers to explore the areas of research related to innovation at airports. Alabsi and Gill (2021) examined 31 airport-related papers to discover passenger concerns about their information privacy during journeys through smart airports. Thums et al. (2023) analysed 123 airport-related papers to explore the trends and developments of digital technologies in the workplace, in this case, the airports. Consequently, one could argue that there is a lack of a comprehensive review on the customer services in aviation using SST, not only for airports but also for airlines and the whole aviation sector. This study is the first to systematically address the following research questions to fill the gaps in the literature:

- (RQ1) What has been studied in aviation SST regarding customer services?
- (RQ2) What theories and variables have been discussed and applied so far?
- (RQ3) What could be future research direction(s) in aviation SST?

The rest of the paper is organised as follows. Section 2 describes the method used and the data collection strategy. Section 3 reports the key findings of the review and Section 4 discusses and proposes some future research directions.

1.2. Methodology

1.2.1. Systematic literature review

Systematic review could help researchers build background knowledge, form a theory, and define the gap from the evaluation of existing literature in the field (Snyder, 2019). Although

systematic review was mainly conducted in the medical field, it has been increasingly implemented in other fields (Linnenluecke et al., 2020) such as business and management, including supply chain management (Carter & Easton, 2011), strategic management (Shujahat et al., 2017), marketing (Vrontis et al., 2021), and aviation, including air transport networks (de Oliveira et al., 2022), unmanned aerial vehicles (Merkert & Bushell, 2020; Wandelt, Wang, et al., 2023), airport service quality (Usman et al., 2022), aviation innovation (Pereira et al., 2021), and aircraft leasing (Wandelt, Sun, et al., 2023b).

1.2.2. Data collection for systematic literature review

Aviation SST journal articles were extracted from SCOPUS databases using multiple search terms; note that conference papers were excluded because they may not be peer-reviewed. As self-service technologies were provided mainly by airlines and airports, the context keywords were “*Airline*” and “*Airport*” in combination with other keywords. Moreover, “*Smart Airport*” was also included in the search. Hence, a total of 61 search terms were used (see Table 1-1).

Table 1-1 Keywords used in the search strategy

Context	Keywords
Airport; Airline	self-service; self-service technology; technology-based self-service; common use self-service; CUSS; check-in kiosk; self-service check-in; web check-in; mobile check-in; self-service bag drop; self bag drop; automated bag-drop; biometric; self-boarding; automated boarding gate; facial recognition; automated border control; automated immigration gate; AI; artificial intelligence; chatbot; e-ticket; electronic ticket; e-boarding pass; electronic boarding pass; parking online payment; e-transfer gate; electronic transfer gate; electronic passport; e-passport

The data of each journal article, for example, title, author, abstracts, and keyword, are exported into a spreadsheet file. A total of 1,129 papers were retrieved, and 678 papers remained after

removing duplications. However, the full-text articles have also been examined manually to screen for the following exclusion criteria:

- Articles that were non-peer-reviewed (63 articles removed)
- Articles that did not focus on customer service, for example, software engineering, programming, demand forecasting, and scheduling (446 articles removed)
- Articles that only used aviation as an example of SST (36 articles removed).

Consequently, 133 journal articles remain. They were again assessed for eligibility regarding the following inclusion criterion:

- Articles that focused on aviation SST for customer services.

Thus, 35 journal articles were further excluded because their research focuses were diverted from aviation SST for customer services. In the end, a total of 98 journal articles remained for our analysis. We reported the process following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework of Moher et al. (2009), illustrated in Figure 1-1. After that, the data for our 98 journal articles were extracted and recorded regarding:

- Characteristics of the article: author(s), year of the publication, type of research, article title, journal title, keywords, and geographical scope of the studies.
- Study methodology: research approach(es), theory or model implemented, variable(s) used in those studies.

Self-service technologies: types of self-service technologies focused by each study.

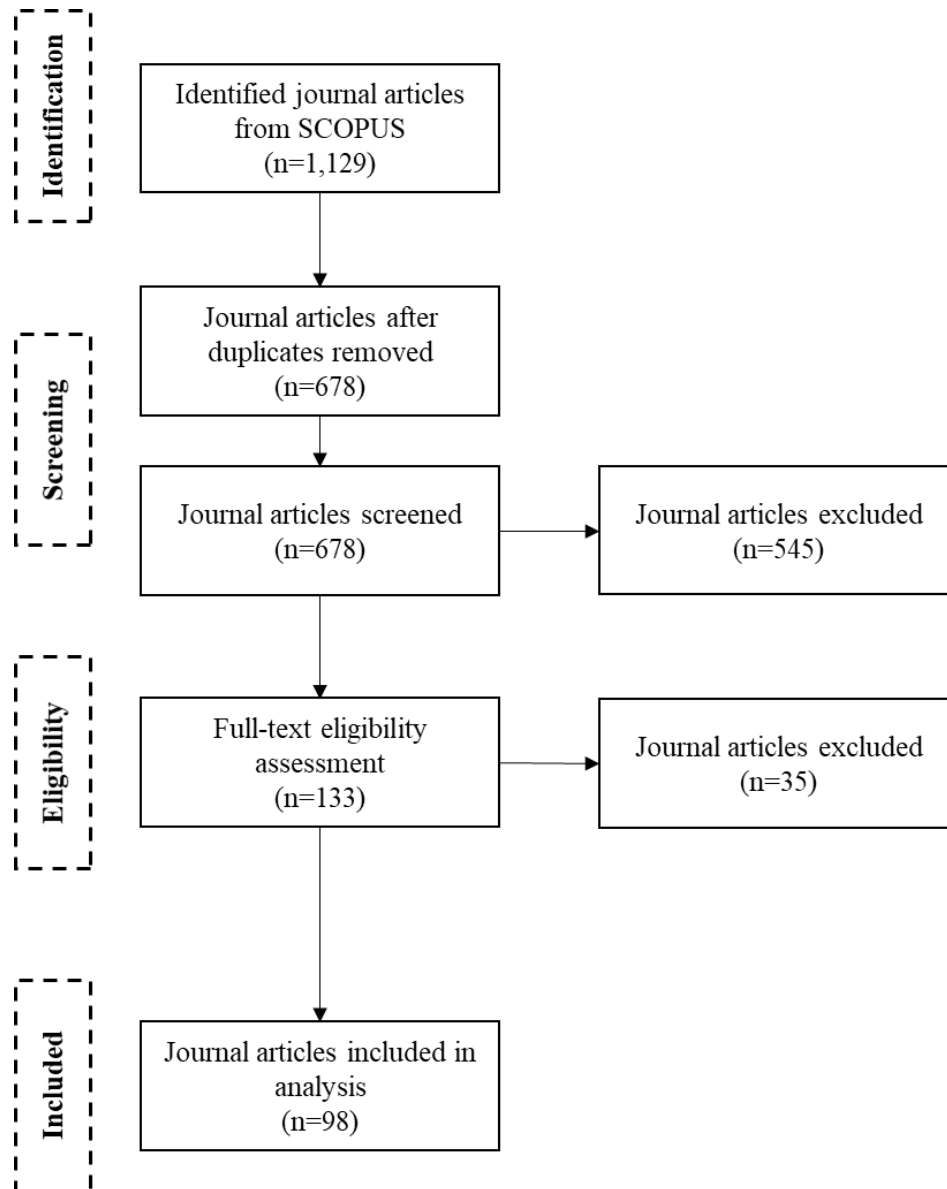


Figure 1-1: The PRISMA flowchart reporting different stages of literature review

1.3. Systematic literature review

1.3.1. Descriptive analysis

The number of journal articles included in the systematic literature review from 2000 (the oldest SST aviation research) to August 2023 (the cut-off point for data collection) was illustrated in Figure 1-2, whereas aviation SST research has gained increasing attention since 2000.

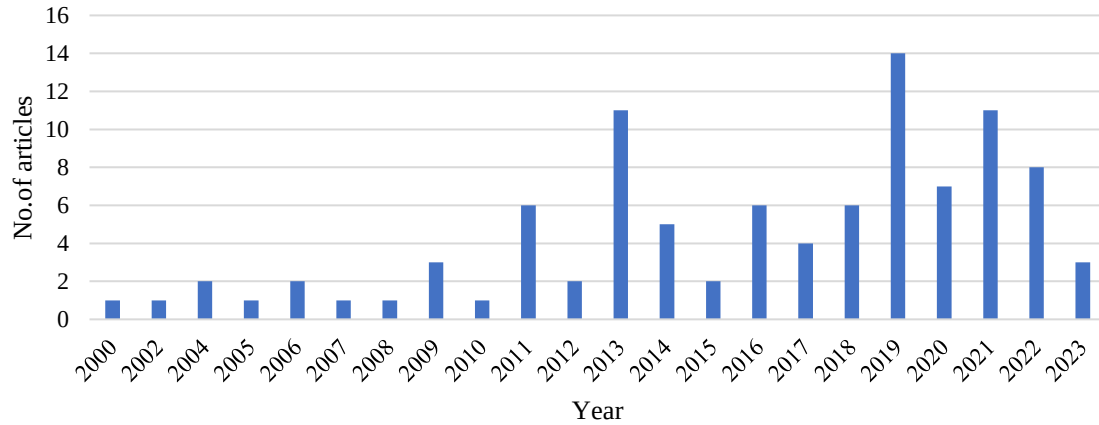


Figure 1-2: Number of SST articles

We found that almost half of the 98 articles have been conducted in Asia (e.g., South Korea, Malaysia, and Hong Kong/Taiwan but not mainland China). Meanwhile, 17 articles were conducted in Europe (e.g., Spain, Netherlands, Ireland, and the UK) and another 15 articles examined the context of the US. Other places such as South America, Oceania, and Africa received little attention (Figure 1-3).

The research design of the articles was assigned into 5 different categories following previous study (e.g., Wu et al., 2020), namely Case study, Empirical study, Review, Simulation/Optimisation, and Survey. Note that articles belong to more than one category were assigned to the one of its main focuses. Figure 1-4 illustrates that the design predominantly adopted in aviation SST studies is the survey approach which is not surprising as the nature of the research was based on customer perspectives, and the survey is a cost-saving and efficient way to do that.

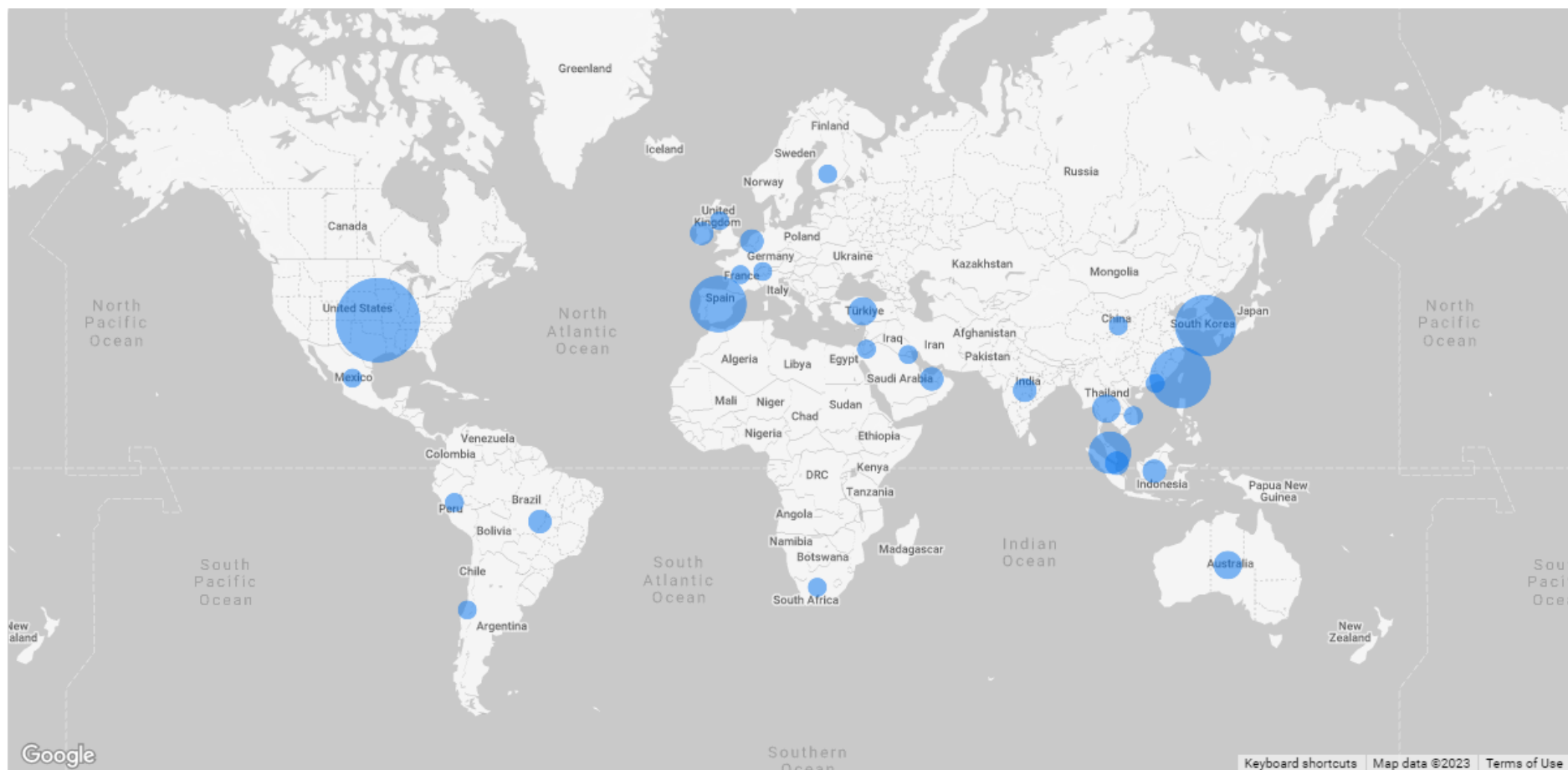


Figure 1-3: Geographical locations of the sampled countries in aviation SST research

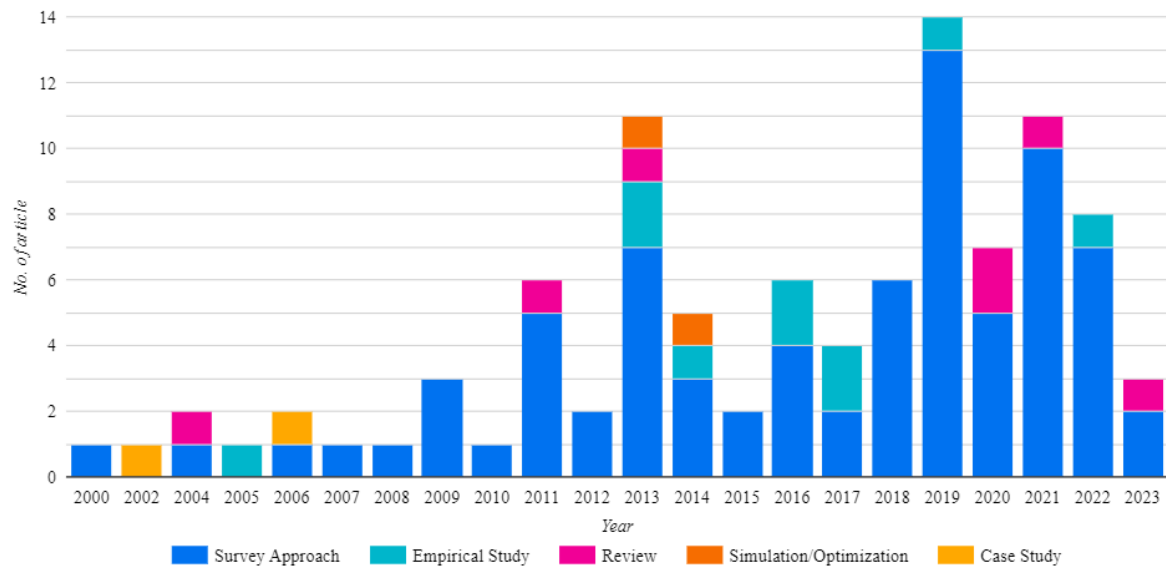


Figure 1-4: Research designs of the aviation SST literature

Table 1-2 further summarises the self-service technologies (SSTs) studied in aviation since 2000. SST studies can be categorised into three groups based on the number of articles. The most popular group includes self-check-in kiosks, web/e-ticketing, and web check-in. The moderately popular group includes automated border control and self-security identity verification. The less popular or emerging group includes mobile application ticketing and check-in, self-baggage drops, service robots, chatbots, and biometric check-in. Research primarily focused on check-in (including baggage drop-off), with 54 articles (around 55%). Mobile check-in received limited attention, while self-baggage drops, biometric check-in, automated border control, and self-security identity verification gained interest in recent years (Gures et al., 2018; Lien et al., 2021; Moon & Lee, 2022).

Many theories and frameworks have been applied to aviation SST studies since 2000, as illustrated in

Table 1-3. Accordingly, the frequently used theories/frameworks are the Technology Acceptance Model (TAM), the Theory of Planned Behaviour (TPB), and the Extended Unified Theory of Acceptance and Use of Technology (UTAUT2). There is, however, a trend to integrate different frameworks/models such as TAM/TPB, TAM/SERVQUAL, TAM/e-SQ, and TAM/ECT.

Table 1-2: Aviation SSTs being studied over time

SSTs	2000	2002	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Self-Check-in Kiosks		1			1		1	2		3	1	2	2		2	1	2	5	1	5	1	1	31
Web/e-Ticketing	1		2	1		1		1	1	2	1	5		1			1	3	1	1	1		23
Overall SST												2	1	1	1	2	1	1	2	4	4	2	21
Web Check-in (PC/Laptop/Mobile)					1					2		2			3		1	1		2			12
Self-Security Identity Verificati					1							1			1			2	2				7
Automated Border Control					1							1	2		1		1		1				7
Mobile App Ticketing												1				1			1	1	1		5
Self-baggage Drop																1		2		1	1		5
Service Robot																		1	1	1	1		4
Biometric Check-in					1													1		1			3
Mobile App Check-in					1					1							1						3
Chatbot																				2			2
Self-boarding																			1	1			2

Table 1-3: Theory/framework adopted over time

Theory/Framework	2000	2002	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Not identified		1		1	1		1	1		1		5	2		2	2	3	4	5	3	1	3	36
TAM			1					1		1		2	2	1	1	1		4	1	3			18
TPB												1						1		3			5
e-Service Quality										2		1			1								4
Technology Readiness					1					1	1									1			4
Attribution Theory												1								2			3
UTAUT2												1			1					1			3
SERVQUAL															1			2					3
SSTQUAL																	1			1	1		3
Expectancy Theory			1									1											2
Expectation Confirmation Theory												1					1						2
TAM2								1													1		2
Diffusion of Innovations											1										1		2
Self-determination Theory																				1	1		2
Service-dominant Logic																1				1			2
Stimulus-Organism-Response																		1			1		2
Theory of Trust Transfer											1										1		2

We further investigate the top independent and dependent variables used in the aviation SST literature and list them in Table 1-4 and, respectively. For the *independent variables*, the most popular ones are ‘perceived ease of use’ and ‘perceived usefulness’ - these two are the main variables of the TAM model. It is observed that most of those independent variables are desirable ones, following the original frameworks of TAM and TPB. The undesirable variables (e.g., ‘perceived risk’) are involved only in recent publications, despite that the aviation industry is increasingly raising concerns about the safety issue and the environment. For the *dependent variables*, the most popular is ‘adoption intention’, followed by ‘attitude toward SST’ and ‘satisfaction with SST’. Resembling the independent variables, the undesirable perception and behaviour received little attention.

Table 1-4: Top independent variables being studied over time

Independent variables	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Perceived Ease of Use			1	2		1		2	1	1	2	1		5	1	3	1		21
Perceived Usefulness				2				2	1	1	1	1	1	5	1	3	1		19
Attitude toward SST		1		2			1	1	2	1	1			1		4	1		15
Satisfaction with SST						1					1		3	2		1	1	1	10
SST Quality				1				1	1		1		2		1	1	1		9
Subjective Norms				1			1	1			1	1	1	1		2			9
Age						1		1	1				1	1		2	1		8
Perceived Enjoyment					1			1			1	1	1	3					8
Innovativeness	1					1			1					1		3			7
Perceived Risk				1					1		1			3	1				7

Notes: Most of the extracted variables were generalised to simplify the report. The names of variables that were unique, unclear, or had similar names with theory but different intentions remained unchanged.

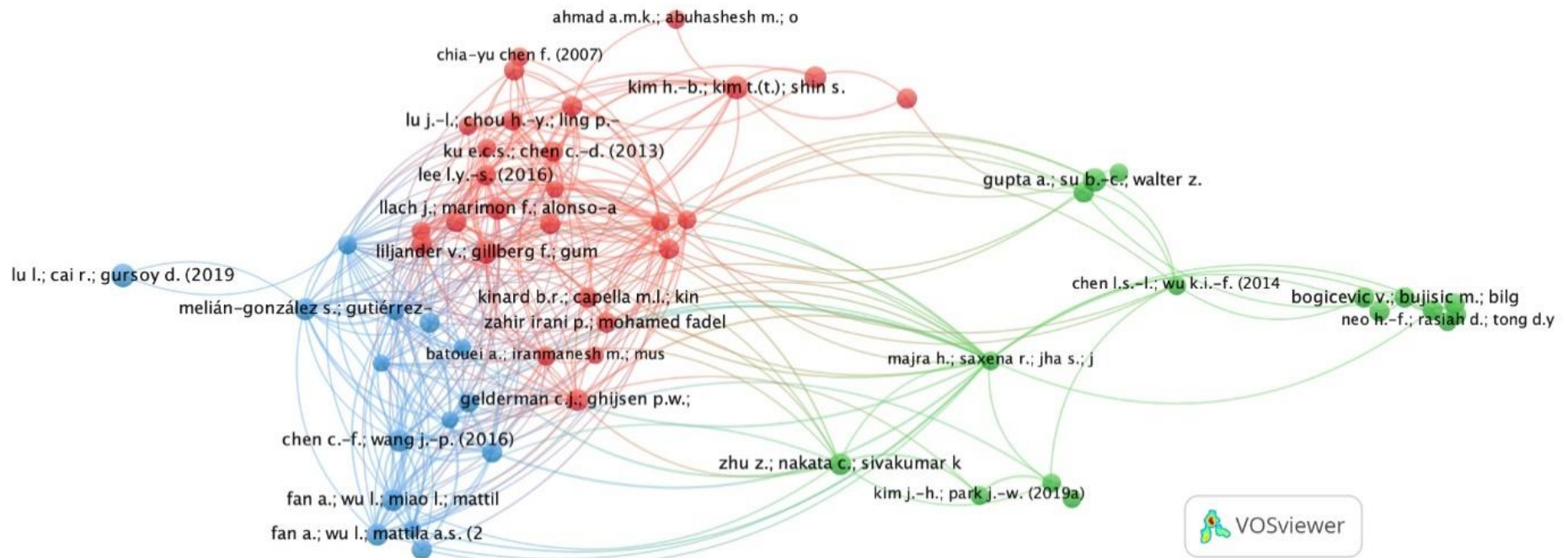
Table 1-5: Top dependent variables being studied over time

Dependent variables	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Adoption Intention	1	1		2			1	4	3	1	2	1		5	2	4	2		29
Attitude toward SST	1	1		2			1	1	2	1	1			2		3	1		16
Satisfaction with SST						3			2		1		3	2		3	1	1	16
Perceived Usefulness				2				1	1	1		1	1	4	1	2			14
Perceived Ease of Use				1		1			2					2	1	2			9
Satisfaction with SST Provider										1	1	1		1	1	2			7
Actual Use								2	1			1	1						5
Customer Loyalty								1			1		1			1			4
Perceived Value						1		1		1				1					4
Purchase Intention						1		1							1		1		4

Notes: Most of the extracted variables were generalised to simplify the report. The names of variables that were unique, unclear, or had similar names with theory but different intentions remained unchanged.

1.3.2. Content and thematic analyses

The bibliographic coupling was conducted to examine the research focuses on aviation SST. Using VOSviewer, the preliminary analysis revealed three main clusters, including 58 out of 98 journal articles (Figure 1-5). After investigating each cluster, three main themes emerged: customer SST adoption (the focus is on factor influencing customer to use SST), customer satisfaction (the focus is on factor influencing customer satisfaction from using SST), and customer experience (the focus is on the experience during the use of SST). Therefore, the thematic analysis of this literature review will focus on these themes. All 98 journal articles were reviewed and assigned to each theme. These themes were somehow inter-connected. Several articles combine different themes, whereas others focus strongly on only one theme. Therefore, the data in Figure 1-6 contained multiple counts for articles that fall into more than one theme. Overall, most of the attention has been given to the customer adoption of aviation SST (54.14%), followed by customer satisfaction (25.23%) and customer experience (19.63%). Customer adoption was an early attractive theme in aviation SST research and has continuously received attention from researchers, whilst customer satisfaction and customer experience have gained more attention in the past decade.



Notes: Customer adoption (top-middle), Customer satisfaction (left corner), and Customer experience (right corner)

Figure 1-5: The three themes of aviation SST studies

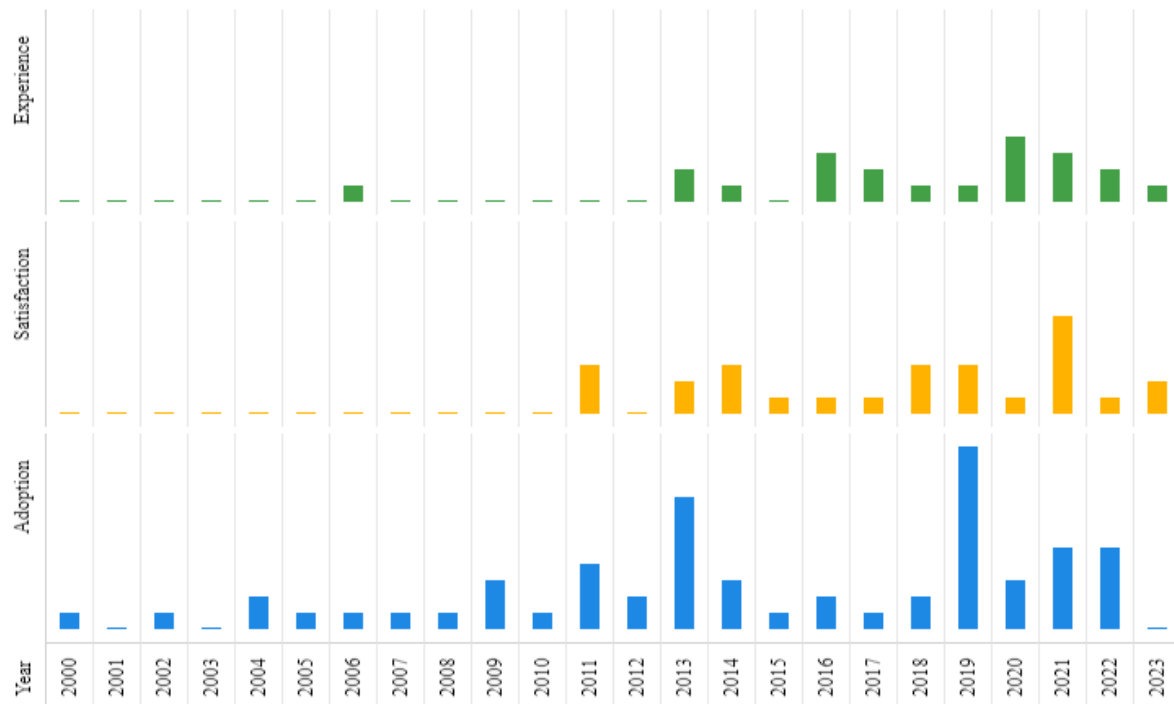


Figure 1-6: The three themes over time

1.3.2.1. Customer adoption

From the 98 selected articles, 59 were categorised into customer adoption theme. The most cited article was by Liljander et al. (2006), followed by Lu et al. (2019), H. b. Kim et al. (2009), Gupta et al. (2004), and Escobar-Rodríguez and Carvajal-Trujillo (2013), and so on. These authors studied customer adoption via Technology Readiness (TR), Diffusion of Innovations (DI), and Service Robot Integration Willingness (SRIW), under the viewpoint of the TAM/TPB/UTAUT2 frameworks (see Table 1-6). It was reasonable to see these kinds of theories being implemented in customer adoption research because they were trying to explain customer intention and actual behaviour, in this case, SST adoption (Ajzen, 1991; Davis, 1986; Fishbein & Ajzen, 1975; Venkatesh & Davis, 2000; Venkatesh et al., 2003). Also note that many articles did not state clearly which theory or framework the variables were from, maybe because they used a mixed-framework, and were categorised as “not identified”.

Table 1-6: Most applied theories/frameworks in SST adoption research

Theory/Framework	Main Reference	Articles
Technology Acceptance Model	Davis (1986)	17
Not identified	-	16
Theory of Planned Behaviour	Ajzen (1991)	5
Technology Readiness	Parasuraman (2000)	4
Extended Unified Theory of Acceptance and Use of Technology	Venkatesh et al. (2012)	3
Extended Technology Acceptance Model	Venkatesh and Davis (2000)	2
Diffusion of Innovations	Rogers (2003)	2
Stimulus-Organism-Response	Mehrabian and Russell (1974)	2
Theory of Trust Transfer	Stewart (2003)	2
Artificially Intelligent Device Use Acceptance	Gursoy et al. (2019)	1

Furthermore, the hypotheses of each article were extracted. It should be noted that some variables were studied as both an independent and dependent role. The two main independent variables from TAM, *perceived ease of use* and *perceived usefulness*, were studied in 19 and 18 articles, respectively. Followings are *attitude toward SST* (14 articles), *subjective norms* (8 articles), *age*, *perceived enjoyment*, and *perceived risk* (7 articles each), and *innovativeness* and *perceived behavioural control* (6 articles each). Several theories hypothesised that behavioural intention led to actual use (Ajzen, 1991; Davis, 1986; Venkatesh & Davis, 2000; Venkatesh et al., 2003). Therefore, *adoption intention* was also studied as an independent variable (5 articles). For dependent variables, *adoption intention* was studied the most (29 articles), followed by *attitude toward SST* (16 articles). *Perceived usefulness* and *perceived ease of use* were also studied as dependent variables in 13 and 9 articles, respectively. *Actual use* and *satisfaction with SST* were studied in 5 articles each.

1.3.2.2. Customer satisfaction

Customer satisfaction was the next popular theme among the aviation SST literature (see Figure 1-5). The study of Chen and Wang (2016) on customer satisfaction and loyalty was cited the most, followed by the study of Misopoulos et al. (2014) on customer satisfaction and dissatisfaction. Other linkages include the relationship between the efficiency of SST, hedonic quality, and customer loyalty (Llach et al., 2013), passenger satisfaction and SST (Bogicevic et al., 2017), and the moderating effect of the TAM variable on passenger satisfaction (Lee & Wu, 2011). Regarding theories and frameworks, TAM and e-SQ were the most popular, followed by SSTQUAL, the Attribution Theory, and the Expectation-confirmation Theory (see Table 1-7).

Table 1-7: Most applied theories/frameworks in customer satisfaction research

Theory/Framework	Main Reference	Articles
Not identified	-	16
Technology Acceptance Model	Davis (1986)	3
e-Service Quality	Zeithaml et al. (2000); Santos (2003)	3
SSTQUAL	Lin and Hsieh (2011)	2
Attribution Theory	Kelley and Michela (1980); Feldman (1981)	2
Expectation-confirmation Theory	Oliver (1980)	2
Unified Theory of Acceptance and Use of Technology	Venkatesh et al. (2003)	1
Kano Model	Kano (1984)	1
Means-end Theory	Zeithaml (1988)	1
Stimulus-Organism-Response Model	Mehrabian and Russell (1974)	1
Self-determination Theory	Deci and Ryan (2012)	1
SERVQUAL	Parasuraman et al. (1988)	1

Additionally, the independent and dependent variables were investigated. First, *satisfaction with SST* was studied the most as the independent variable (10 articles), followed by *SST quality* (5 articles), *perceived ease of use* and *satisfaction with SST providers* (4 articles each), and *age*, *perceived enjoyment*, *perceived usefulness*, and *perceived value* (3 articles each). As the dependent variable, *satisfaction with SST* and *satisfaction with SST providers* were studied in 15 and 7 articles, respectively, followed by *customer loyalty* and *perceived value* (4 articles each), and *perceived usefulness* (3 articles).

1.3.2.3. Customer experience

Table 1-8: Most applied theories/frameworks in customer experience research

Theory/Framework	Main Reference	Articles
Not identified	-	12
Self-determination Theory	Deci and Ryan (2012)	2
Service-dominant Logic	Vargo and Lusch (2004); Vargo and Lusch (2008)	2
SERVQUAL	Parasuraman et al. (1988)	1
Social Practice Theory	Schatzki (1996); Watson et al. (2012)	1
Resource Mapping Framework	Maglio and Spohrer (2008)	1
Expectancy Theory	Heider (2013)	1
Customer Participation Theory	Chan et al. (2010)	1
e-Service Quality	Zeithaml et al. (2000); Santos (2003)	1
Attribution Theory	Kelley and Michela (1980); Feldman (1981)	1
Social Response Theory	Nass and Moon (2000)	1

The most cited article was Zeng et al. (2020), who reviewed and suggested how COVID-19 could foster the implementation of SST and enhance the customer experience in many industries, including aviation. This is followed by Zhu et al. (2013) on customer recovery from SST service failure, Kim et al. (2017) on (negative) customer reviews of SST at tourism destinations, and Misopoulos et al. (2014) on customer experience and its influence on customer satisfaction and dissatisfaction. While some theories have been applied in a few

articles, for example, Self-determination Theory and Service-dominant Logic (2 articles each), 11 articles did not mention it. Considering the variables used in the articles, there were also no highly studied variables, either independent or dependent. Note that unlike customer adoption and satisfaction research, more than half of the customer experience research implemented other methodologies than surveys with hypotheses testing, such as literature review, interview, and text mining (see Table 1-8).

1.4. Discussions and future research directions

Aviation self-service technology research has attracted scholars since 2000, and the increasing number of journal articles illustrates that the topic has gained more attention. The objectives of this study were to offer an overview of aviation SST research, theories and factors that have been investigated from a customer service perspective and provide research gaps. 98 journal articles from 2000 until August 2023 have been reviewed following the systematic literature review process. Several important findings from the systematic literature review are emphasised and discussed.

1.4.1. The geographical issue

We found an unbalanced interest among the aviation SST literature regarding the sampled countries or regions of research. In particular, the reviewed articles concentrated more on the United States, Europe, and Asia, while South America, Africa, and Oceania received much less interest. Interestingly, research focusing on mainland China and Japan is rare even though some airports in these countries are among the top 10 best regional airports in Asia (Skytrax, 2023), and they belong to Asia. While it may be due to our sampling method, which only includes published articles in English and therefore excludes local publications published in another language, it still indicates a need for further examinations of customer services (in aviation)

using SST in those regions, or even for multiple regions, such as in Lu et al. (2011), Lee (2016), and Rubio-Andrada et al. (2023).

1.4.2. The technological issue

In terms of the technologies being studied in aviation SST, self-check-in kiosks and web/e-ticketing received the most attention as they were integrated into the traditional services in an early stage of SST implementation and widely available. However, with the advancement of new technologies, modern SSTs (e.g., chatbots, biometric check-in, self-boarding) are being integrated more widely. It is noted that while general chatbots such as ChatGPT have found their way into aviation education and research (Wandelt, Sun, et al., 2023a), airlines and airports still tailor their own chatbots specifically for customer service purposes. Consequently, future research may investigate the drivers and barriers to passenger adoption of these modern SSTs. Given that each SST has different characteristics and requirements and may be used in different contexts, it is important to both focus on a particular SST (e.g., biometric check-in) and the multiple usage of several SSTs (e.g., for the pre-flight or airport-related processes) to provide insights about customer services (Gelderman et al., 2011). Lastly, the passenger journey will be more automated in the future, meaning that passengers may have to perform most of the tasks by themselves. Hence, it is worth investigating the passenger perceptions toward the automated journey so that airline and airport can better design their process.

1.4.3. The technical issue

Although the TAM and TPB frameworks will continue its predominant role resulting from the most attention scholars have given to customer SST adoption research, it is encouraged that future study should apply newer frameworks that can incorporate two or more models (e.g., TAM/TPB, TAM/SERVQUAL, TAM/e-SQ, and TAM/ECT) into a single study to provide a broader assessment on customers service SST as suggested in Thamaraiselvan and Thanigaiarul (2019), Kasim et al. (2021), and Lien et al. (2021), among others. Moreover,

researchers may apply more context-specific frameworks, such as SRIW (Lu et al., 2019) and AIDUA (Gursoy et al., 2019) to best answer their research objectives.

With the increasing use of SST by passengers, more research has been conducted not only on the level of satisfaction but also on what led to the satisfaction of passengers. Studies have supported that the service quality of the SST increases passenger satisfaction (Lee & Wu, 2011; Moon et al., 2021; Yusra & Agus, 2018). The quality of aviation SST service was measured using different frameworks, for example, the e-SQ (Lau et al., 2011; Lee & Wu, 2011; Llach et al., 2013), SSTQUAL (Suwannakul & Khetjenkarn, 2022; Yusra & Agus, 2018), and SERVQUAL (Lestari & Ellyawati, 2019). Other than the satisfaction with SST, researchers investigated further that the quality or performance of SST could eventually lead to passenger satisfaction with SST providers, which are airlines and airports (Batouei et al., 2020; Bogicevic et al., 2017). However, the studies regarding how SST could create customer loyalty until now were still limited (Chen & Wang, 2016; Moon et al., 2021; Suwannakul & Khetjenkarn, 2022; Yusra & Agus, 2018). Understanding what aspects of SST could lead to increased customer loyalty can benefit the service providers.

Regarding the variables used, perceived ease of use, perceived usefulness, and attitude toward SST were the most studied independent variables. On the other hand, the most popular dependent variables were adoption intention, attitude toward SST, and satisfaction with SST. However, the result of the core hypotheses of TAM was not consensus. For example, while the effect of perceived ease of use on adoption intention was accepted by some research (Ko & Park, 2019; Naruetharadhol et al., 2022; Taufik & Hanafiah, 2019), it was rejected by the others (Kasim et al., 2021; Lien et al., 2021; Mohd Suki & Mohd Suki, 2017). This could result from the existing differences in passenger demographics, such as age, nationality, and purpose of travel, which required more investigations. Although the relationship between behavioural intention and actual technology usage was a core hypothesis of TAM, it was noticeable that no

study investigated this relationship in the aviation SST context. To test whether someone who stated an intention to use the technology would actually use it, the data on the actual usage must be collected separately after introducing the specific technology. In other words, passengers may state that they intend to use the SST but may or may not actually use it. This posed challenges to the data collection as it may not be feasible to contact the same passengers again. The future investigation of this relationship using longitudinal data can fill the gap in aviation SST adoption research.

Less attention was given to the undesirable ones as they were not originally introduced in the popular frameworks of TAM, TPB, and UTAUT. Future studies could investigate more about the role of, for instance, insecurity, discomfort, privacy concerns, anxiety, and avoidance intention. In addition, the environmental mindset of passengers received little attention in the aviation SST research (Miskolczi et al., 2021). Since the aviation industry is expected to recover from the pandemic within 2024 (IATA, 2022a) and the environmental challenge lies ahead, the factors related to the green mindset of the passengers, green initiatives, and green image of airlines and airports should be paid more attention.

Passengers could face failure from the SST sometimes during the service encounter and must find a way to recover from it by themselves. Unlike the traditional service encounter, human employees usually deal with service failure. However, service failure and self-recovery in aviation SST have attracted only a few research (Y. T. H. Chiu & D. M. Nguyen, 2022; Fan et al., 2016; Fan et al., 2020; Zhu et al., 2013). Future research on this topic could help companies design more suitable SST services to cope with different scenarios that passengers may encounter. Moreover, some SSTs are being integrated with human-like (or anthropomorphism) features, for example, kiosks that use human-like voice or chatbots that reply more naturally, which could be an attractive feature that passengers are looking for. The research on the anthropomorphism of the SST could reveal new information that could be used to attract more

passengers to use SST and enhance their experience. While the ultimate goal of airlines and airports is to automate passenger processing, research in forced-use situations is scarce. Research to explore the experience of such a situation can help the company manage the service and reduce the negative outcomes (Feng et al., 2019).

It is further noticed that businesses nowadays are not only concerned about their short-term profits but also about their long-term sustainable development, including the environmental, social, and governance (ESG) impacts. Many airlines have published sustainability reports, including plans and goals for improving their employee well-being. However, research in aviation SST for customer service mostly approaches from a customer point of view, for instance, customer adoption, satisfaction, and experience. Future research from an employee's perspective is needed on how the implementation of SST impacts their roles, performance, and well-being. In addition, with smarter airports and airlines, educational challenges arise on how to make sure that aviation personnel possess the skills required to safely operate together with the technology and for the jobs that may be created by future technological transformation (Sun et al., 2021).

1.4.4. Limitations

The current study has some limitations to address. Firstly, this study contained only peer-reviewed journal articles. Future studies may include conference papers or book chapters in the review process for more coverage. Moreover, the search was limited to the SCOPUS database. Incorporating publications from other databases, such as Web of Science and Google Scholar, could reveal additional insights. Finally, the review included only publications in English. Therefore, the future study may include publications in other languages for a more comprehensive review.

1.5. Bibliometric analysis

1.5.1. Bibliometric analysis

Bibliometric analysis is the quantitative method that facilitates the analysis of the scientific materials under the area of interest. Bibliometric analysis provides many possibilities for researchers, for example, to discover the future trends emerging from literature, the performance of specific journals, and the collaborative work of scholars (Donthu et al., 2021). Bibliometric analysis relies on the application of mathematical and statistical techniques to the published text of each article, such as keywords, author list, and reference list (Van Eck & Waltman, 2010). The result of bibliometric analysis is based on the network, usually constructed by the software. On the other hand, the systematic literature review relies on systematic procedures and a thorough assessment of each article, which must be performed by authors (Tranfield et al., 2003).

In complement to the improvements in the methodology and the technology (VOSviewer, Leximancer, BibExcel, Gephi, etc.), more studies implemented bibliometric analysis in many areas compared to the past, for instance, in business and management (Anugerah et al., 2022), tourism (Hasana et al., 2022), marketing (Faruk et al., 2021), and supply chain management (Fahimnia et al., 2015; Xue et al., 2022). Moreover, some works used bibliometric analysis to analyse the literature for a specific time frame. Kim and So (2022) conducted a bibliometric analysis of the customer experience literature in tourism and hospitality from January 1998 to May 2021 to understand the customer experience over time, the progression of the literature, and future trends. Ahmed et al. (2022) studied artificial intelligence and machine learning literature in finance from 2011 – 2021 and revealed evidence of increasing trends. In the business and management field of research, Mukherjee et al. (2022) analysed the international business and management literature in India from 1974 to 2021, while the analysis of Budler et al. (2021) focused on the business model literature and discussed future trends.

This study implemented science mapping or graphical mapping analysis to examine and visualise the relationships and connections among research elements (Cobo et al., 2011; Donthu et al., 2021). VOSviewer, a free software package developed by Van Eck and Waltman (2010), was used to conduct science mapping analysis. Co-citation and bibliographic coupling analysis are used to examine the similarity of the literature and reveal the research themes that arise from them (Figure 1-7). The co-citation of two documents is counted when both are cited in other documents (Small, 1973). For instance, when documents A and B are cited by documents C, D, and E, A and B are co-cited. In this case, the strength shows the number of “citing articles” that two documents are cited together (Van Eck & Waltman, 2023). The more two documents are cited together, the more possibility that they are related to each other.

On the other hand, bibliographic coupling analysis identifies the theme based on the documents they cited (Kessler, 1963). For instance, when documents X and Y cited documents W, Z, and R, it established the bibliographic coupling link between document X and Y. Therefore, the strength for bibliographic coupling is the number of “cited references” that the two documents shared (Van Eck & Waltman, 2023). In other words, the higher the similarity of the reference list of the two documents, the more possibility that they related to each other.

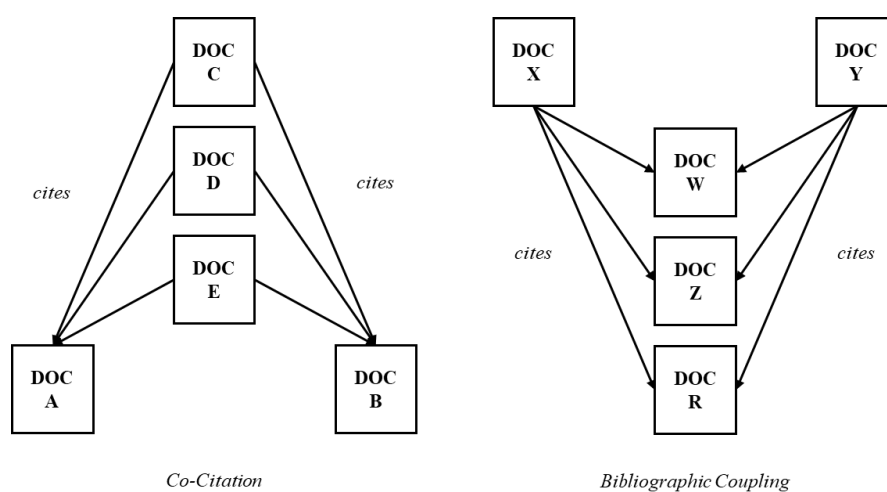


Figure 1-7: Bibliographic Coupling and Co-Citation Analysis

1.5.2. Data collection

This study collects data from SCOPUS, a globally popular and accredited collection of academic publications. Selecting the “*title, abstract, keywords*” option, the search terms for data collection include (1) “Self-service,” (2) “Self-service AND Technology,” (3) “Self-service AND Technologies,” (4) “Technology-based AND Self-service” and (5) “Common AND Use AND Self-service.” The search was conducted in August 2023. Only the journal articles published in English in the SCOPUS database were retrieved. As illustrated in Table 1-9, a total of 3,754 papers were retrieved, and 1,794 papers remained after the removal of duplications, papers that did not focus on customer services, and incomplete records (Figure 1-8).

Table 1-9: The number of journal articles from the initial search (general SST)

Search Keywords	No. of papers
self-service	1,829
self-service AND technology	889
self-service AND technologies	889
technology-based AND self-service	76
common AND use AND self-service	71
Initial dataset	3,754
Removal	1,960
Total	1,794

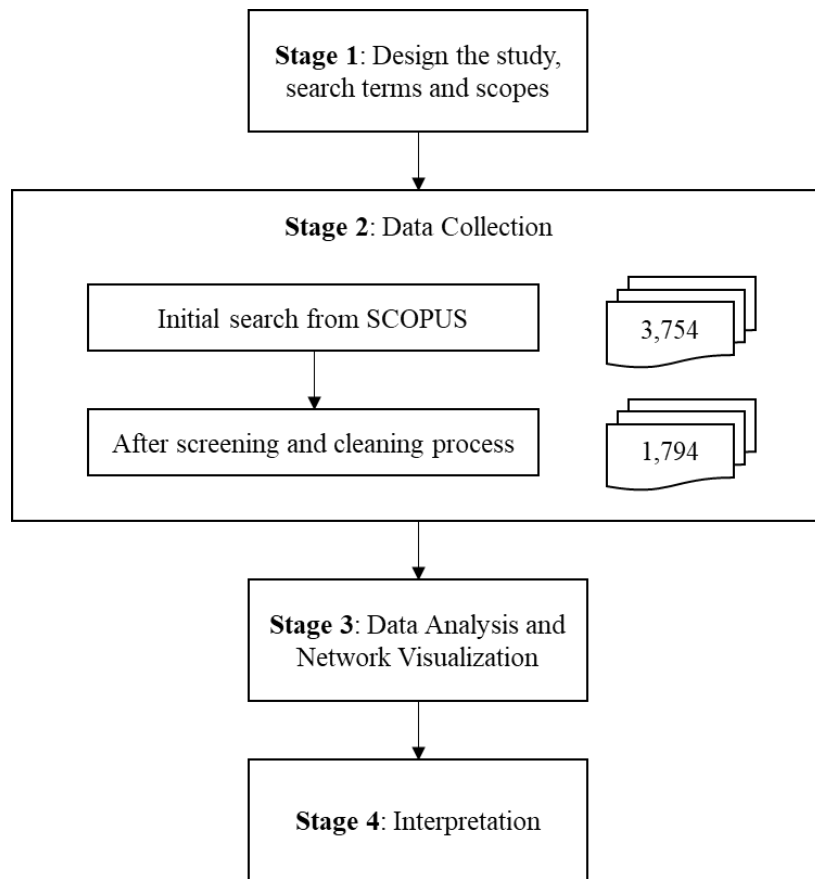


Figure 1-8: Overall Process of Bibliometric Analysis

1.5.3. Descriptive analysis

Figure 1-9 illustrates the number of SST journal articles published annually from 1954 (the oldest articles from search results) until July 2023, indicating the growth in SST research. The number of journal articles increased from around 20 to 30 in the early 2000s to more than 160 in 2022.

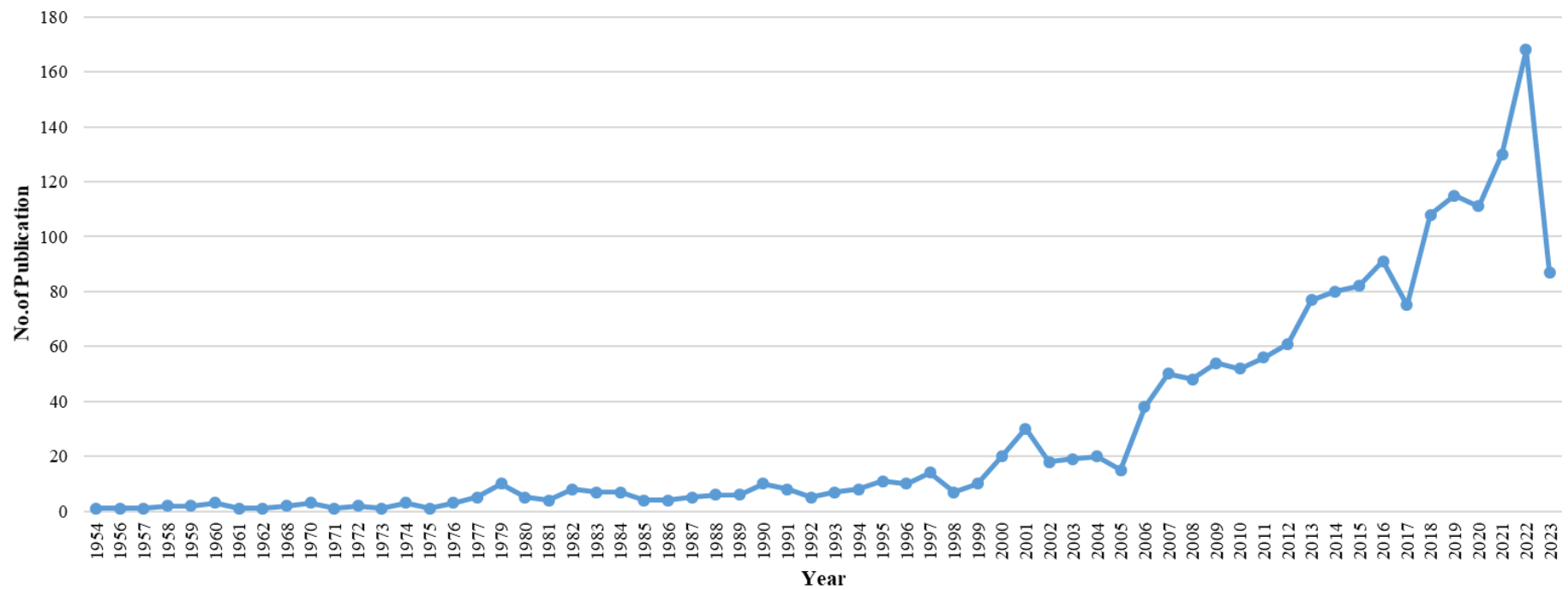


Figure 1-9: Number of SST journal articles published from 1954 - July 2023

Table 1-10: Top 10 journal articles contributing to self-service research

Source	Publication Year																										
	1987	1993	1994	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
Journal of Services Marketing					2			1		1	1	2					3	2	3	1	1	5	1	5	4	2	34
Journal of Retailing and Consumer Services								1	1		1			2		2	4	1		1	2	2	3	4	1		25
Sustainability (Switzerland)																						3	5	8	5	2	23
Service Industries Journal	1	1	1					1	2	1	2			1	3	2		1			2		1	1	1		21
International Journal of Bank Marketing		2		2		2	1				2	1	1	1				2				2			2	1	19
Journal of Service Research				1		1			1	2	1	2				1			1		1		1	2	1	1	16
Journal of Business Research						1								2		1		3	1		1		2	2		1	14
Journal of Service Management															2		1	3	1		1		2			2	12
International Journal of Hospitality Management												2				1			1		1	1		2	2	1	11
Services Marketing Quarterly									1			1			3	1	1					1		1	1	1	11
Total	1	3	1	3	2	4	1	3	5	4	7	8	1	6	8	8	9	12	7	2	9	14	15	25	17	11	186

The list of top 10 journals contributing to self-service research is shown in Table 1-10. *The Journal of Services Marketing* contributed the most articles (34 total). This journal was also among the journals, namely, *Service Industries Journal*, *International Journal of Bank and Marketing*, and *Journal of Service Research*, that have contributed to the field for over 20 years. More publications have chosen the *Journal of Retailing and Consumer Services* and *Sustainability (Switzerland)* as their publication platforms for the past decade. While the number of articles grew steadily over time for the former, it grew sharply for the latter.

Table 1-11 shows the number of articles, citations, average citations per year, and the first appearances of the top contributing author in the SST literature. This study uses different measures for the number of citations throughout the study. “Global citation” indicates the overall citation of a particular article or author as reported by SCOPUS. “Local citation” indicates the number of citations received from within the 1,794 articles included in the analysis (Fahimnia et al., 2015). Local citations could indicate the author's influence within the field, while global citations could indicate the author's overall influence. It should be noted that authors who received high global citations may not receive high local citations. The local citation was provided by VOSviewer software. In general, the top contributing authors studied the SST in retail service, banking, hotel, and logistics, focusing on customer attitude, satisfaction, and adoption. Regarding the number of articles published in SST research, Andrew Alexander was the top contributing author (9 articles), while most collaborated with Gareth Shaw (8 articles). Their research mainly focused on self-service implementation in British grocery stores and supermarkets. Similarly, Hyun-Joo Lee was the next contributing author with 8 articles published on self-service checkout and information kiosk adoption in U.S. grocery stores and supermarkets. Matthew Meuter contributed 7 articles on satisfaction and adoption of SST in a general context rather than a specific industry based on U.S. consumers. Matthew Meuter’s articles received 4,209 global citations, the highest among the top

contributing authors. Arun Kumar Kaushik contributed 7 articles in collaboration with Zillur Rahman (6 articles). Their research focused on self-service adoption in various settings in India, including hotels, retail, street vendors, and banking. Also contributing 7 articles, Ann Mattila's articles mainly focused on service failure, service recovery, and anthropomorphism of SST in the U.S. Xueqin Wang, Kum Fai Yuen, and Yiik Diew Wong published 6 articles together mainly on customer adoption of SST in the last-mile logistics, delivery, and self-collection in China and Singapore. Pratibha Dabholkar contributed 6 articles that primarily focused on conceptual model development, including important variables such as service quality, situational factors, and forced adoption. Pratibha Dabholkar's articles received 2,977 global citations, the second highest among contributing authors. The author made their first appearance in 1996 before other top contributing authors. Joel Collier published 6 articles on SST adoption in various retail settings in the U.S. Shih-Chih Chen contributed 5 articles focusing on customer satisfaction and continued adoption of different SSTs in Taiwan. Lastly, Chun Lin contributed 5 articles mainly comparing SST with human service in the hotel industry in China.

Table 1-11: Top contributing authors

Authors	No. Papers	Global Citations	First Appear	Avg.Citation Per Year
Andrew Alexander	9	291	2004	15
Hyun-Joo Lee	8	430	2009	31
Gareth Shaw	8	255	2004	13
Matthew L. Meuter	7	4209	2000	183
Anna S. Mattila	7	343	2008	23
Arun Kumar Kaushik	7	274	2015	34
Pratibha A. Dabholkar	6	2977	1996	110
Joel E. Collier	6	451	2010	35
Zillur Rahman	6	265	2015	33
Xueqin Wang	6	171	2019	43

Authors	No. Papers	Global Citations	First Appear	Avg.Citation Per Year
Kum Fai Yuen	6	171	2019	43
Yiik Diew Wong	6	171	2019	43
Shih-Chih Chen	5	287	2009	21
Chun Liu	5	84	2020	28

The location of authors based on affiliation was extracted and visualised in Figure 1-10 using the web-based data visualisation tool lookerstudio.google.com. The countries were grouped according to the United Nations Statistics Division. Each colour refers to a different geographical region, and the size of the circle indicates the contributions based on the number of articles from each location. The U.S., Western Europe, and Southeast Asia have contributed more to SST research, while other parts of the world also contributed. Table 1-12 drilled down the contributions to the specific sub-region. The articles with affiliations from different locations were designated to multiple sub-regions for their contributions.

Table 1-12: Contribution based on sub-region of authors' affiliations.

Geographical region and sub-region	No. of articles	Contribution (%)
Asia	1095	32.93%
Eastern Asia	654	19.67%
Southern Asia	179	5.38%
South-eastern Asia	149	4.48%
Western Asia	110	3.31%
Central Asia	3	0.09%
Europe	1044	31.40%
Western Europe	570	17.14%
Northern Europe	207	6.23%
Southern Europe	148	4.45%
Eastern Europe	119	3.58%
North America	900	27.07%
United States	850	25.56%

Geographical region and sub-region	No. of articles	Contribution (%)
Canada	50	1.50%
Oceania	131	3.94%
Australia	110	3.31%
New Zealand	21	0.63%
South America	84	2.53%
Africa	71	2.14%

Table 1-13 ranks the top contributing organisations based on the number of articles published. *Pennsylvania State University* contributed 17 articles, the highest contribution among other organisations. *Queensland University of Technology* and *California State University* contributed 16 and 15 articles, respectively. Noticeably, several top contributing authors (Table 1-11) published their articles under the top contributing organisation. Alexander and Shaw contributed under the *University of Surrey* and *University of Exeter*, respectively. Meuter, Mattila, and Dabholkar contributed under the *California State University, Pennsylvania State University*, and the *University of Tennessee-Knoxville*, respectively. However, other organisations still need articles from several authors to be ranked in this list.

Table 1-13: Top contributing organisations

Organisation	Location	No. of articles
Pennsylvania State University	United States	17
Queensland University of Technology	Australia	16
California State University	United States	15
Purdue University	United States	13
Nanyang Technological University	Singapore	13
The University of New South Wales	Australia	10
University of North Carolina, Chapel Hill	United States	10
University of Exeter	United Kingdom	10
University of Surrey	United Kingdom	10
University of Tennessee-Knoxville	United States	10

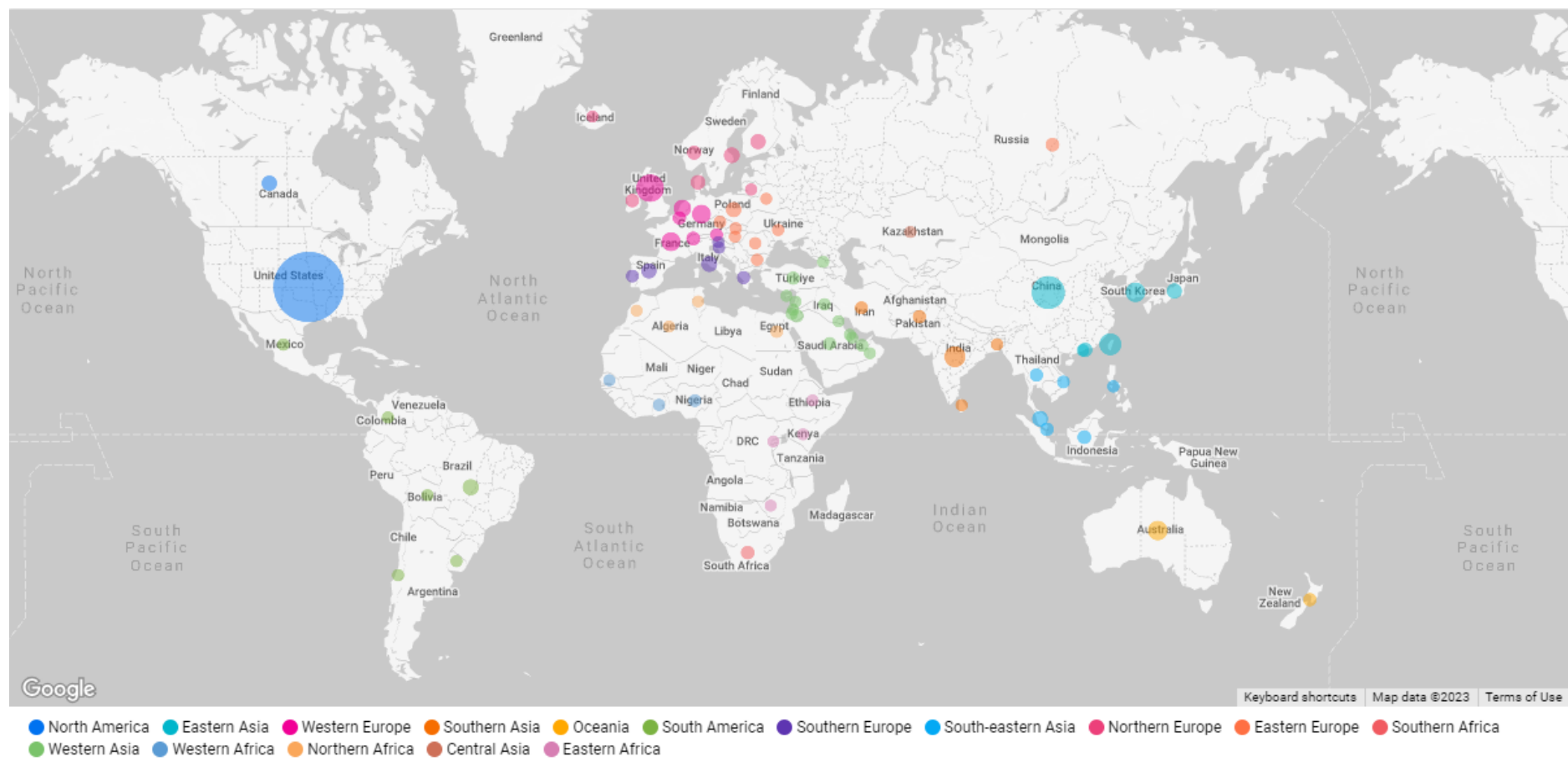


Figure 1-10: Contributing organisation based on geographical locations.

1.5.4. Citation analysis

A citation analysis was conducted to discover the prominent articles in the literature in the research field (Donthu et al., 2021). The study quality could be measured through the number of citations received (Cole et al., 1974), therefore, the original and high-quality study should receive higher citations. Moreover, citations could refer to the significance and influence of the research in the field (Aksnes et al., 2019). The most cited authors and most cited journal articles were reported in this section.

The most cited authors are listed in Table 1-14. Collating this table with the top contributing authors (Table 1-11), only two authors were on the list of most-cited authors: Matthew Meuter and Pratibha Dabholkar. This could indicate that both prolific authors published several high-quality articles and were popular in the field. Overall, this table reflected the important background knowledge, theories, and frameworks from the prolific authors cited in the field. More details about the foundation literature were elaborated in the co-citation analysis section.

Table 1-15 listed the most cited SST articles among 1,794 articles ranked by the global citation. The study by Meuter et al. (2000) was cited the most in the list both globally (1,734 citations) and locally (230 citations). Their empirical work discussed customer interaction with the SST channel and suggested factors influencing customer satisfaction and dissatisfaction using the critical incident technique.

Comparing global citations to local citations, it was noticeable that the ranking of the articles was different, and the number of global and local citations was not equal. It demonstrated that the articles were not only crucial to SST research but also attractive to and cited by articles from other fields, for example, Meuter et al. (2000), Dabholkar and Bagozzi (2002), and Dabholkar (1996). On the other hand, some of the most cited articles received little attention from SST research, for example, Verhoef et al. (2009) and Barrett et al. (2015). Their work could be more influential in other fields. It was important to note that the most cited articles

could change over time depending on the citations they received. Therefore, the newer articles may become more popular in the future.

Table 1-14: Most cited authors in the SST literature

Authors	Local Citation	First Appear in SST
Mary Jo Bitner	1197	2000
Matthew Meuter	1156	2000
Amy Ostrom	824	2000
Pratibha Dabholkar	753	1996
A Parasuraman	746	1988
Richard Bagozzi	549	2002
Fred Davis	546	1989
Valarie Zeithaml	490	1988
Viswanath Venkatesh	442	2000
Dhruv Grewal	358	2007
Robert Roundtree	349	2000
Leonard Berry	330	1988
Stephen Brown	327	2000
Icek Ajzen	305	1975
Claes Fornell	274	1981

Table 1-15: Most cited self-service technologies articles

Title	Authors	Year	Journal	Global Citation	Local Citation
Self-service technologies: Understanding customer satisfaction with technology-based service encounters	Meuter M.L.; Ostrom A.L.; Roundtree R.I.; Bitner M.J.	2000	Journal of Marketing	1734	230
Customer Experience Creation: Determinants, Dynamics and Management Strategies	Verhoef P.C.; Lemon K.N.; Parasuraman A.; Roggeveen A.; Tsiros M.; Schlesinger L.A.	2009	Journal of Retailing	1618	6
An attitudinal model of technology-based self-service: Moderating effects of consumer traits and situational factors	Dabholkar P.A.; Bagozzi R.P.	2002	Journal of the Academy of Marketing Science	1199	179
Consumer evaluations of new technology-based self-service options: An investigation of alternative models of service quality	Dabholkar P.A.	1996	International Journal of Research in Marketing	1048	175
Choosing among alternative service delivery modes: An investigation of customer trial of self-service technologies	Meuter M.L.; Bitner M.J.; Ostrom A.L.; Brown S.W.	2005	Journal of Marketing	996	126

Title	Authors	Year	Journal	Global Citation	Local Citation
The influence of technology anxiety on consumer use and experiences with self-service technologies	Meuter M.L.; Ostrom A.L.; Bitner M.J.; Roundtree R.	2003	Journal of Business Research	671	99
Service innovation in the digital age: Key contributions and future directions	Barrett M.; Davidson E.; Prabhu J.; Vargo S.L.	2015	MIS Quarterly: Management Information Systems	631	6
The effects of customer participation in co-created service recovery	Dong B.; Evans K.R.; Zou S.	2008	Journal of the Academy of Marketing Science	508	30
Self-service technology adoption: Comparing three technologies	Curran J.M.; Meuter M.L.	2005	Journal of Services Marketing	434	133
Barriers and benefits in the adoption of e-government	Gilbert D.; Balestrini P.; Littleboy D.	2004	International Journal of Public Sector Management	369	3

1.5.5. Co-citation analysis of SSTs literature

The co-citation of two documents is counted when both are cited in other documents (Small, 1973) (see explanation of Figure 1-7 for more details). Therefore, this section derives the foundation literature of self-service technology research from co-citation analysis. Due to the nature of the co-citation analysis that relied on the highly cited references, using this analysis to discover foundation literature was appropriate (Donthu et al., 2021). The bibliographic data of the articles retrieved from SCOPUS were imported into VOSviewer. Due to the large number of cited articles, the visualisation would be difficult to interpret. Therefore, the cited articles that received less than 20 citations were excluded (Van Eck & Waltman, 2014). The co-citation analysis remained 50 co-cited articles, and four clusters that formed the literature structure were discovered (Figure 1-11). Each node represented the articles co-cited by other articles, and each line represented the link between two cited articles. The result was sorted by the size of the cluster, and the representative articles of each cluster are reported in Table 1-16. Cluster 1 was the biggest, and Cluster 4 was the smallest, respectively.

Table 1-16: Representative articles of each cluster (co-citation analysis)

Cluster	Representative articles
Cluster 1: Customer self-service technology adoption	Dabholkar (1996); Dabholkar and Bagozzi (2002); Curran et al. (2003); Meuter et al. (2003); Meuter et al. (2005)
Cluster 2: Behavioural intention theories	Davis (1989); Davis et al. (1989); Fishbein and Ajzen (1977); Ajzen (1991); Venkatesh et al. (2003); Venkatesh and Davis (2000); Fornell and Larcker (1981)
Cluster 3: Customer satisfaction, customer value, and continued use of SST	Meuter et al. (2000); Weijters et al. (2007); Wang et al. (2013); Robertson et al. (2016); Vargo and Lusch (2004); Vargo and Lusch (2008)
Cluster 4: Data analysis method, and measurement development	Anderson and Gerbing (1988); Hair et al. (1998); Nunnally (1978); Nunnally and Bernstein (1994); Parasuraman et al. (1988); Parasuraman (2000); Liljander et al. (2006)

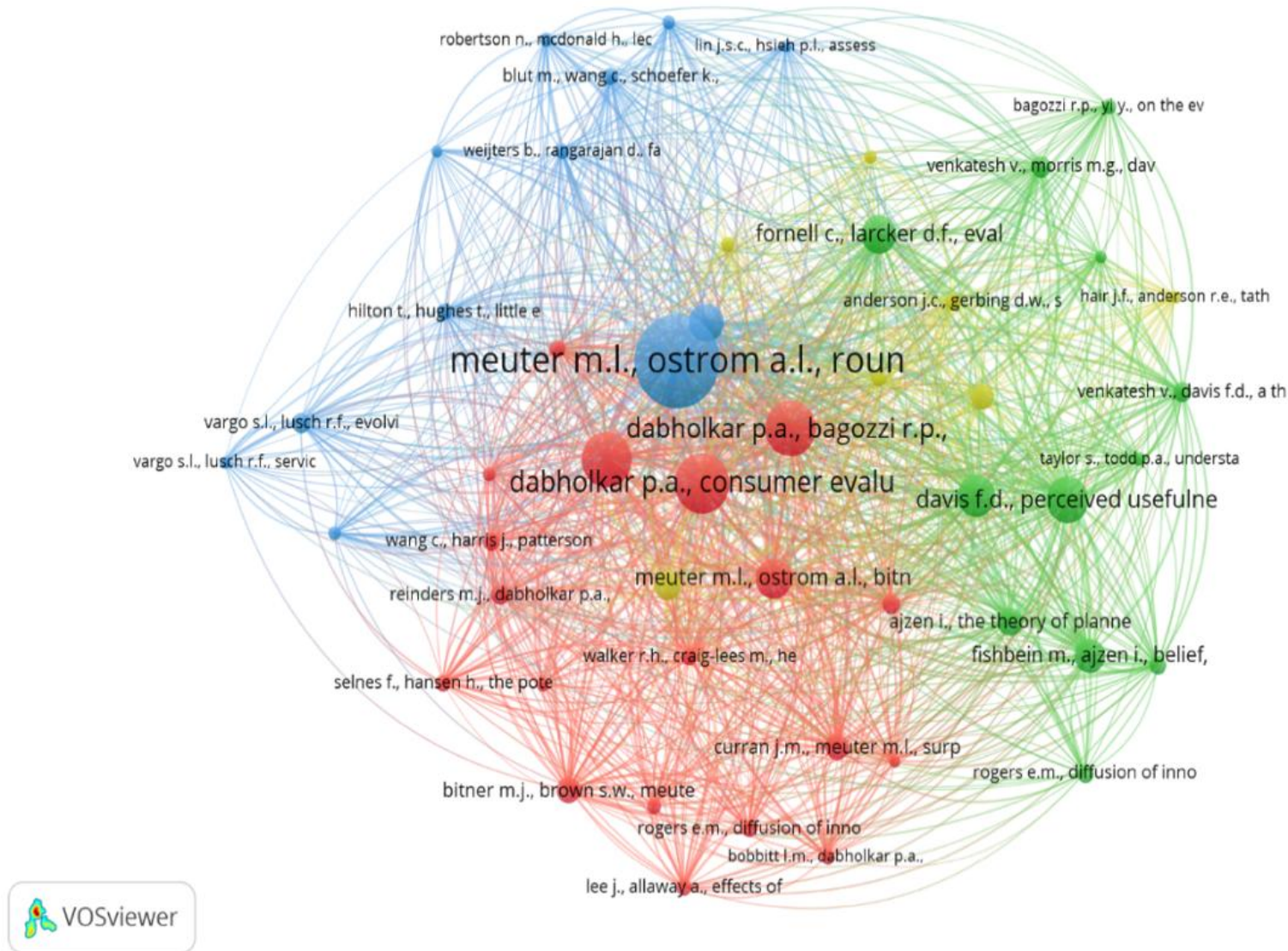


Figure 1-11: Co-citation Network of SST Foundation Literatures

Cluster 1 (Red, 19 articles) represented the articles mainly in customer self-service technology adoption. Scholars have focused on technology adoption using different models and factors. Dabholkar (1996) investigated the customer SST adoption based on the attribute model (quality of the SST) and the overall affection model (feelings of the customer toward SST). Dabholkar and Bagozzi (2002) studied the effects of customer behaviour (i.e., self-efficacy, inherent novelty seeking, need for interaction, and self-consciousness) and situational factors (i.e., perceived waiting time and social anxiety) as moderators for SST adoption. Curran et al. (2003) studied two factors that influenced individuals to adopt SST: attitude toward service providers and specific SSTs. In the same year, Meuter et al. (2003) explored the direct effects of technology anxiety and demographic characteristics (i.e., age, gender, education, and income) on SST adoption. They studied mediating effects of consumer readiness in the following publication (Meuter et al., 2005). Therefore, this cluster's main articles were influential and cited to build up the models and hypotheses to study customer SST adoption.

Cluster 2 (Green, 12 articles) illustrated the articles that laid the foundations for the behavioural intention theories that scholars referred to when studying SST from the customer perspective. The theories that were co-cited frequently included Technology Acceptance Model (TAM) (Davis, 1989; Davis et al., 1989), Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1977), Theory of Planned Behaviour (TPB) (Ajzen, 1991), the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003), and the Extended Technology Acceptance Model (TAM2) (Venkatesh & Davis, 2000), respectively. While this cluster focused on the behavioural intention theories, the authors noticed that the Structural Equation Model (SEM) (Fornell & Larcker, 1981) was in this cluster. The reason could be that most publications on customer attitude, satisfaction, and adoption employed SEM to test the hypotheses and the relationship between variables. SEM also allowed the testing of more complex models, which may be a limitation for multiple regression analysis.

Cluster 3 (Blue, 12 articles) comprised articles on the theme of customer satisfaction, customer value, and continued use of SST. In an early stage of SST research, Meuter et al. (2000) discovered factors influencing customer satisfaction and dissatisfaction in the context of SST usage. Weijters et al. (2007) studied the role of perceived waiting time in retail stores on customer satisfaction. Later, the influence of customer satisfaction on the continued use of SST was investigated (Robertson et al., 2016; Wang et al., 2013). The Service-Dominant Logic of Marketing had been introduced to SST research as a new viewpoint that customers valued the provided service rather than goods (Vargo & Lusch, 2004, 2008). The idea was used to explore customer value attained from using SST (Hilton et al., 2013).

Cluster 4 (Yellow, 7 articles) contained articles on data analysis methods and other measurement developments. Even though structural equation model publication was highly co-cited in cluster 2, the main articles related to SEM were in cluster 4 (Anderson & Gerbing, 1988; Hair et al., 1998). There were several indices that scholars must test before executing SEM to make sure that the proposed model fits with the collected data, for instance, the Chi-square test, Comparative Fit Index (CFI), Goodness of Fit Index (GFI), Tucker-Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA). Therefore, scholars referred to the guidelines and threshold provided by (Nunnally, 1978; Nunnally & Bernstein, 1994) to test the indices. Other than SEM and its indices, this cluster also included the development of the other measurements used widely in SST research, namely, the Service Quality (SERVQUAL) (Parasuraman et al., 1988) and Technology Readiness Index (TRI) (Parasuraman, 2000). Liljander et al. (2006) applied TRI in the customer SST adoption research and argued about the validity of TRI's construct.

1.5.6. Bibliographic coupling analysis of SSTs literature

Bibliographic coupling analysis identifies the research themes based on the list of references of the citing articles (Kessler, 1963). In other words, the higher the similarity of the reference list of the two documents, the more possibility that they are related to each other. Bibliographic Coupling Analysis did not rely on the number of citations received by the citing articles. The analysis could still include new and niche articles with fewer or without citations. Hence, this analysis was appropriate for discovering the present theme in the field (Donthu et al., 2021). Since the analysis focused on the recent development of research, it was recommended to include only articles within the specific period (Zupic & Čater, 2015). In addition, it was recommended to exclude the articles that had no link to other articles (Van Eck & Waltman, 2014). 719 articles published between 2018 and 2023 were included in the analysis, and 512 articles were excluded by the software due to weak links with other articles. The result remained 207 articles, and four clusters were discovered that were considered present research themes in the field of SST (Figure 1-12). Each node represented the article citing similar articles, and each line represented the link between two citing articles. The representative articles of each cluster are reported in Table 1-17.

Table 1-17: Representative articles of each cluster (bibliographic coupling analysis)

Cluster	Representative Publications
Cluster 1: Customer experience	Liu and Hung (2022), Park et al. (2022), Zou et al. (2023), Chen et al. (2021), Girija et al. (2023), Thaba et al. (2023)
Cluster 2: Customer SST adoption, continued use of SST	Chaouali and El Hedhli (2019), Giovanis et al. (2019), Lin (2022), Newman et al. (2018), Castillo S and Bigne (2021)
Cluster 3: Value Co-creation/destruction, Service failures and recovery	Manser Payne et al. (2021), Taiminen et al. (2020), Galdolage (2021), Le and Ho (2020), Lee and Cranage (2018), Y.-T. H. Chiu and D. M. Nguyen (2022), Nili et al. (2019)

Cluster	Representative Publications
Cluster 4: Customer Satisfaction	Ayodeji and Rjoub (2021), Othman et al. (2020), Djelassi et al. (2018), Nilsson et al. (2021)

Cluster 1 (Red, 74 articles) covers mainly the articles on the theme of customer experience. While companies increasingly integrated SST into their services, customers' experiences gained from SST and humans were compared (Liu & Hung, 2022; Park et al., 2022). Moreover, customer experience from different contexts was studied, for example, experience from the mobile services (Zou et al., 2023), AI-based SST (Chen et al., 2021), and COVID-19 (Girija et al., 2023; Thaba et al., 2023).

Cluster 2 (Green, 66 articles) represented the themes of customer SST adoption and continued use of SST. The continuous development of the technology led to the implementation of a newer SST. Therefore, customer SST adoption research was still focused on by scholars at large. Many newer SSTs were used as a case study, for example, the mobile banking (Chaouali & El Hedhli, 2019; Giovanis et al., 2019), an intelligent unmanned convenience store (Lin, 2022), retailer mobile application (Newman et al., 2018), and augmented reality make-up mobile application (Castillo S & Bigne, 2021). Moreover, the authors examined and found that most of the publications in cluster 2 used the structural equation model (SEM) and its variations. This could indicate that SEM was a popular analysis technique among the scholars researching customer SST adoption.

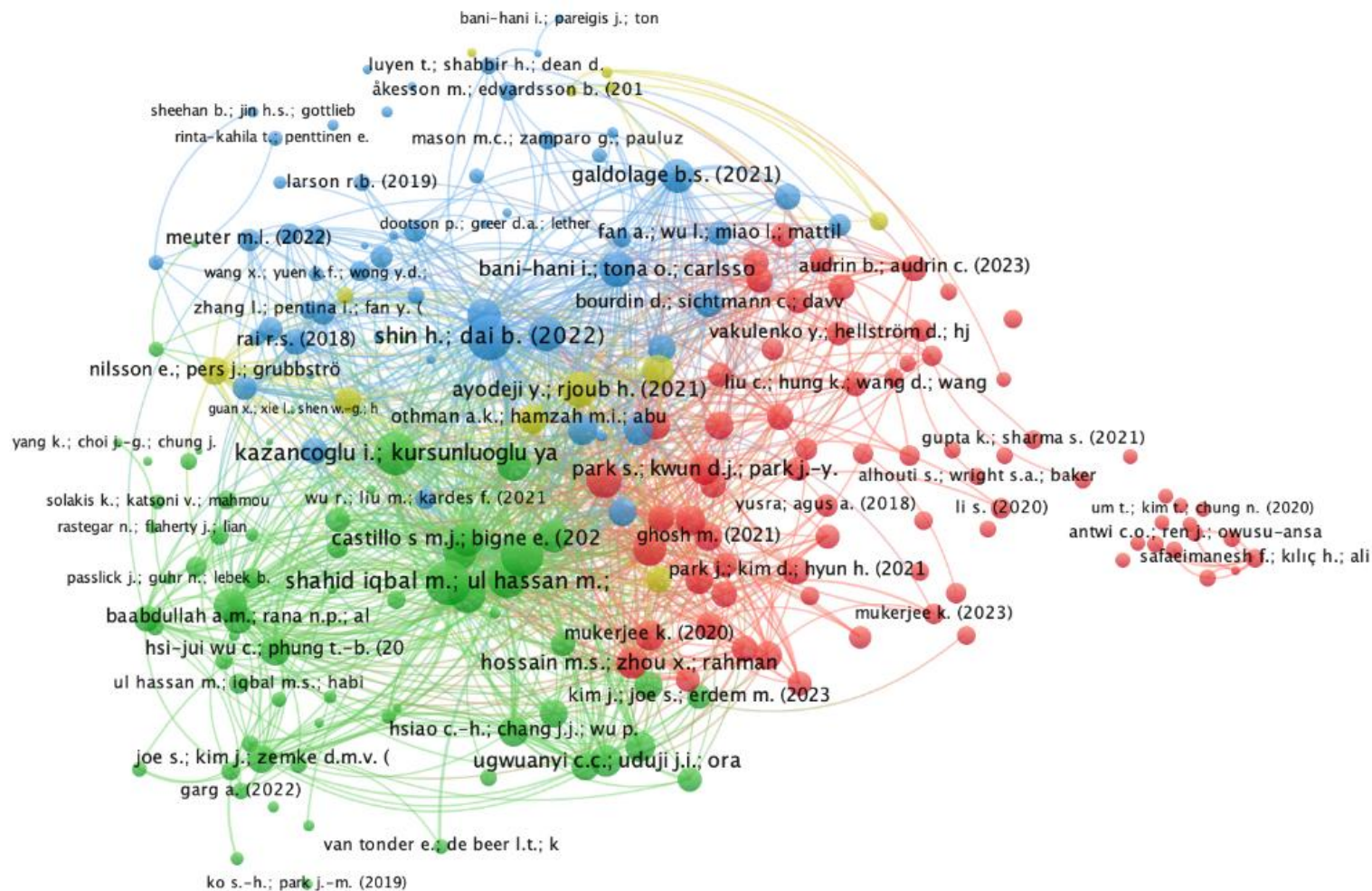


Figure 1-12: Bibliographic Coupling Network of SST Research

Cluster 3 (Blue, 55 articles) contained articles related to value co-creation and destruction, service failure, and service recovery. The topic of value co-creation gained more attention from the researchers as customers played an important part in service creation. Different contexts of value co-creation were studied, such as the mobile banking service (Manser Payne et al., 2021) and the online weight loss service (Taiminen et al., 2020). On the other hand, the opposite concept, “value co-destruction,” was explored as part of the failure of the value co-creation (Galdolage, 2021). The causes and consequences of service failure from both SST and traditional service encounters were examined (Le & Ho, 2020; Lee & Cranage, 2018). Finally, service recovery was investigated to address customer solutions to the problem or recovery from the failure (Y.-T. H. Chiu & D. M. Nguyen, 2022; Nili et al., 2019). In addition, most of these studies are rooted in the service-dominant logic theory (Vargo & Lusch, 2004, 2008), which believes customers value the services received more than the goods.

Cluster 4 (Yellow, 12 articles) represented articles related to customer satisfaction. Although the number of articles related to customer satisfaction was less, it was still an interesting topic for many researchers. These articles investigated the effect of the waiting time (Ayodeji & Rjoub, 2021), the technological optimism (Othman et al., 2020), the SST experience (Djelassi et al., 2018), and the economic compensation (Nilsson et al., 2021) on customer satisfaction.

1.5.7. Summary of bibliometric analysis

The descriptive analysis reveals a significant growth in SST research, escalating from approximately 20 - 30 articles annually in the early 2000s to over 160 in 2022. The Journal of Services Marketing emerged as the leading publication outlet, while Pennsylvania State University was identified as the top contributing organisation. Geographically, contributions were predominantly from the United States, Western Europe, and Southeast Asia.

The analysis employed two core techniques to map the field’s intellectual structure. First, a co-citation analysis identified the foundational literature, organizing it into four clusters: (1)

customer SST adoption, (2) behavioural intention theories (dominated by TAM and TPB), (3) customer satisfaction and value, and (4) data analysis methods. Meuter et al. (2000) was highlighted as the most cited article globally and locally. Second, a bibliographic coupling analysis focused on recent developments (2018 - 2023), revealing four current research themes: customer experience, adoption and continued use of modern SSTs, value co-creation/destruction and service failure, and customer satisfaction. This section complements the systematic literature review by providing a macro-level view of how SST research has evolved over time.

1.6. Background of Thai aviation

The bibliometric analysis and systematic literature review in the preceding sections have mapped the global landscape of aviation SST research. These reviews highlighted two critical gaps: a geographical concentration of research in North America and Europe with a comparative scarcity of in-depth studies in other countries such as Thailand, and a growing need for empirical inquiry into emerging aviation technologies such as biometric check-in. This section addresses these gaps by introducing the Thai aviation industry as a case study, which is currently undergoing a significant digital transformation involving these self-service technologies. In short, this section highlights that despite the development of Thai aviation and its contribution to the economy, it is necessary to analyse the impacts of aviation SST (e.g., biometric check-in and other automated operations) on the industry from different angles (e.g., passengers and employees).

1.6.1. Thailand and aviation industry

Thailand is one of the most popular tourist destinations. According to World Population Review (2025), Thailand received around 39.9 million tourists in 2023 and is among top 10 countries with high international tourist arrivals. Moreover, Thailand's Tourism Satellite

Account showed that the tourism gross domestic product in 2019 represented 17.79% of total gross domestic product of Thailand and reduced drastically to 5.62% and 2.03% for year 2020 and 2021, respectively from the impact of COVID-19 pandemic (Ministry of Tourism and Sports, 2022). This indicates that a major part of Thailand's economy relies on tourism industry, which has gradually become more accessible by aviation industry.

For the past decade, Thailand's passenger air transport has also grown continuously. In 2019, approximately 165 million passengers were carried; 53.9% were international, and 46.1% were domestic passengers, and 67 domestic and 382 international routes were operated (Civil Aviation Authority of Thailand, 2020). Similar to other countries, Thailand has also imposed travel restrictions against COVID-19 infection. Therefore, international passenger air transport services were limited, and the capacity for domestic services was reduced. Figure 1-13 shows that comparing the year 2019 with 2021, the number of international passengers reduced from 89 million to 2 million in 2021, and domestic passengers reduced from 76 million to 19 million. The proportion of passengers now switched from international to domestic: 90.5% domestic and 9.5% international passengers. As the travel restriction is relaxed, Thailand's passenger air transport is recovering. The number of total passengers carried increased to 122 million in 2023, approximately 74% percent of 2019 (Civil Aviation Authority of Thailand, 2024a).

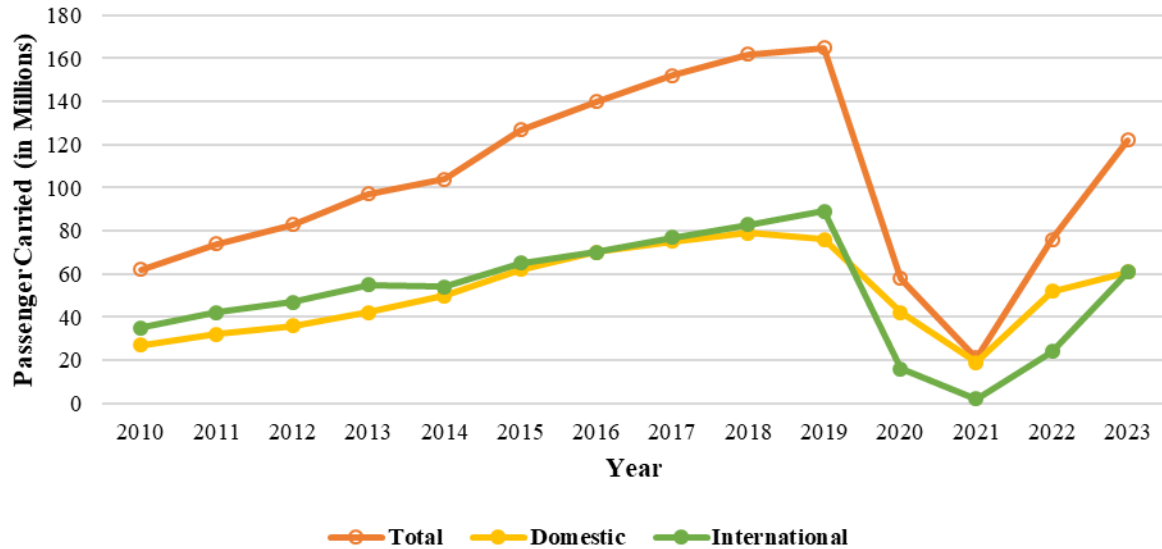


Figure 1-13: Number of Passengers Carried of Thailand

Note: Figure is generated using data from Civil Aviation Authority of Thailand (2024a).

Considering domestic air transport service, there are seven scheduled airlines registered in Thailand. THAI Airways, THAI Smile Airways, Bangkok Airways, and Thai Vietjet Air base their operations at Suvarnabhumi Airport (BKK), which has more network connections to international routes via full-service carriers (FSC). On the other hand, Thai AirAsia, Nok Air, and Thai Lion Air based their operations at Don Muang International Airport (DMK), which has network connections to international routes via low-cost carriers (LCC) and focuses more on domestic routes. Based on 2021, Thai AirAsia gained 36.85% market share or over 22 million domestic passengers, the highest among airlines providing domestic passenger air transport service. Followed by Nok Air with 14.62% market share or over 8 million domestic passengers. Thai Vietjet Air, THAI Smile Airways, Bangkok Airways, and Thai Lion Air gained 14.18%, 11.17%, 11.17%, and 11.12% market share, respectively. THAI Airways has only 0.89% domestic market share as they operate domestic routes mainly under THAI Smile Airways (Civil Aviation Authority of Thailand, 2024a). The market share of Thailand's domestic passenger air transport is illustrated in Figure 1-14.

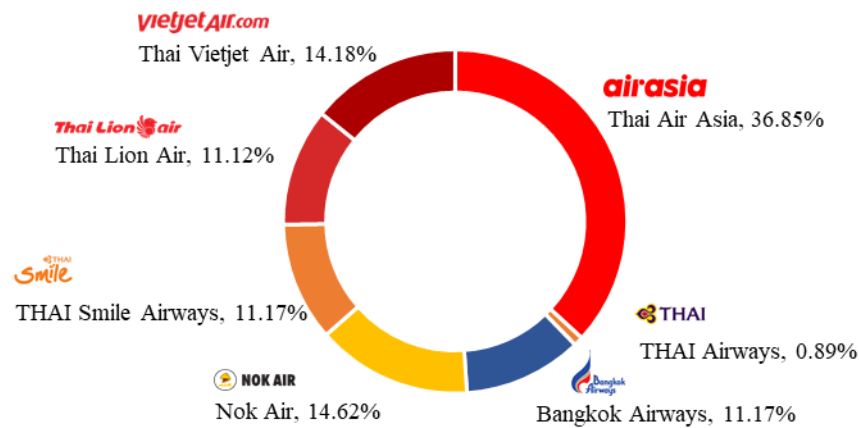


Figure 1-14: Market Share of Thailand's Domestic Passenger Air Transport

Note: Figure is generated using data from Civil Aviation Authority of Thailand (2024a).

Thailand aims to become a regional aviation hub by 2037, with the future capacity to receive 2.1 million flights, 270 million passengers, and minimum connecting time for international transit of 45 minutes. To achieve this goal, there are many aspects needed to be improved such as airspace and navigation, secondary airports, aircraft management, and passenger capacity management at the airports.

1.6.2. Passenger capacity and journey

1.6.2.1. Passenger capacity

Airports of Thailand Public Company Limited (AOT) responsible for 6 major international airports:

- (BKK) Suvarnabhumi Airport
- (DMK) Don Mueang International Airport
- (CNX) Chiang Mai International Airport
- (CEI) Mae Fah Luang Chiang Rai International Airport
- (HDY) Hat Yai International Airport
- (HKT) Phuket International Airport

Responding to the regional aviation hub goal, AOT has planned to develop their airports in an alignment with the goal. These developments include building new terminal, new runway, and terminal expansion and renovation (Airport of Thailand, 2024). Table 1-18 shows the passengers capacity adjustments of each airport. In addition to these development projects, all AOT's airports have been integrated with SST that helps reducing airport congestions and bottlenecks at the passenger terminal. The next sub-sections provide the overall picture of the changes in passenger journey from the implementation of SST and follows by the current state of SST implementation of Thai airports.

Table 1-18 Thailand's major airport developments projects

Airports	Current capacity	Adding capacity	Project
BKK	60	15 (by 2024)	New terminal, operating 3 rd
		15 (by 2025)	runway, existing terminal
		15 (by 2026)	expansion
		15 (by 2027)	
DMK	30	20 (by 2030)	New terminal, existing terminal renovation
CNX	8	12 (by 2028)	New terminal, existing terminal renovation
HKT	12.5	5.5 (by 2029)	Existing terminal expansion
CEI	3	3 (by 2029)	New terminal
HDY	N/A	N/A	N/A

Note: Table is compiled using the data from Airport of Thailand (2024).

1.6.2.2. Changes in passenger journey

According to Knutson et al. (2010), the experience of the service was generated before, during, and after the use of the service. Therefore, the journey of passengers traveling by air could be categorised into three stages: pre-flight, in-flight, and post-flight.

To begin with, the pre-flight stage. Traditionally, customers searched for the most suitable flight, either price-wise or time-wise. The ticketing and reservation were available through the

airline ticketing office, call centre, and travel agent. Customers can either collect the ticket from the ticket office or have it delivered to their address. If the customers would like to change the details of the ticket, they must contact the staff only. On the traveling date, customers arrived at the departure airport. At this point, they will be called “passengers” by the airline’s staff. Passengers proceeded to the airline check-in counter, where the airline staff performed the check-in task for passengers, including luggage (if any), and gave them their boarding pass. After that, passengers must go through the security check, where identity and prohibited items are inspected by the airport security officers. Passengers traveling on an international flight must proceed to passport control and immigration, where the immigration officers check the validity of their documents. Then, passengers can board the aircraft at the boarding gate. Passengers’ boarding passes and identities were checked again prior to boarding the aircraft and departure. During the in-flight stage, passengers can enjoy the in-flight services, including meals, beverages, and entertainment. Upon arrival at the destination (post-flight stage), domestic passengers can pick up their luggage and finish their journey, while international passengers must pass through passport control (immigration and customs) before claiming their luggage.) The lost and found counters of airlines were available in case passengers could not find their luggage or their luggage was damaged. Traditional passenger journeys are illustrated in Figure 1-15.

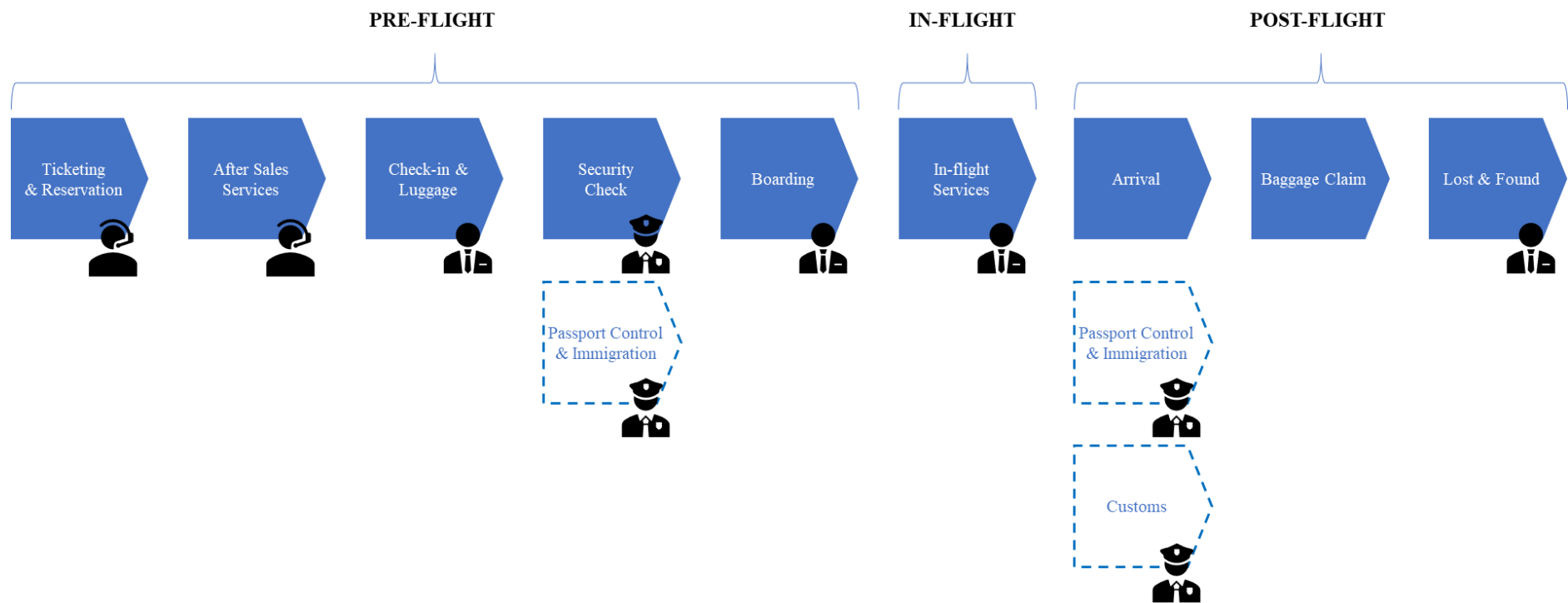


Figure 1-15: Traditional Passenger Journey

Note: Figure is generated using data from Airport of Thailand (2024) and SITA (2023).

According to the survey by SITA (2023), the top three concerns of the passengers while booking an air ticket were delays and cancellations (32%), pricing problems (18%), and airport congestion and waiting time (17%). Therefore, passenger journeys nowadays have been improved to enhance the experience and quality of service. Some processes have been integrated with “self-service” features. Starting with the pre-flight stage. While traditional ticketing and reservation were still active, online ticketing and reservation were provided by airlines either via website or mobile application as a more convenient channel for customers. Payment could be made online, and tickets were delivered through customers’ email addresses. After-sales services were enhanced through chatbots, which were programmed to deal with frequent queries, such as change of flight, name amendment, or rescheduled refunds. Although it could not answer every query at this stage, the ability to deal with many customers at the same time and seven days a week was the advantage of it.

Self-check-in kiosks were installed at many airports, offering alternative check-in and boarding pass collection channels for passengers who preferred to perform the task by themselves rather than getting into the long queue. Moreover, passengers could check in online through airline websites or mobile applications, where the electronic boarding pass was delivered via email or available in the application. If passengers were traveling with luggage, they could check in their luggage at a self-service bag drop kiosk. At the security check, passengers could scan their boarding pass to get into the screening area by themselves. However, they must pass through the security screening for prohibited items performed by security officers. Citizens traveling abroad could proceed to e-gate, where facial recognition and fingerprints were checked without confronting an immigration officer. When the time came, passengers could board the aircraft by themselves through the self-boarding gate. International arrival passengers could proceed to e-gate for passport control; however, the eligibility depends on the agreements between countries. Figure 1-16 illustrates the passenger journey nowadays.

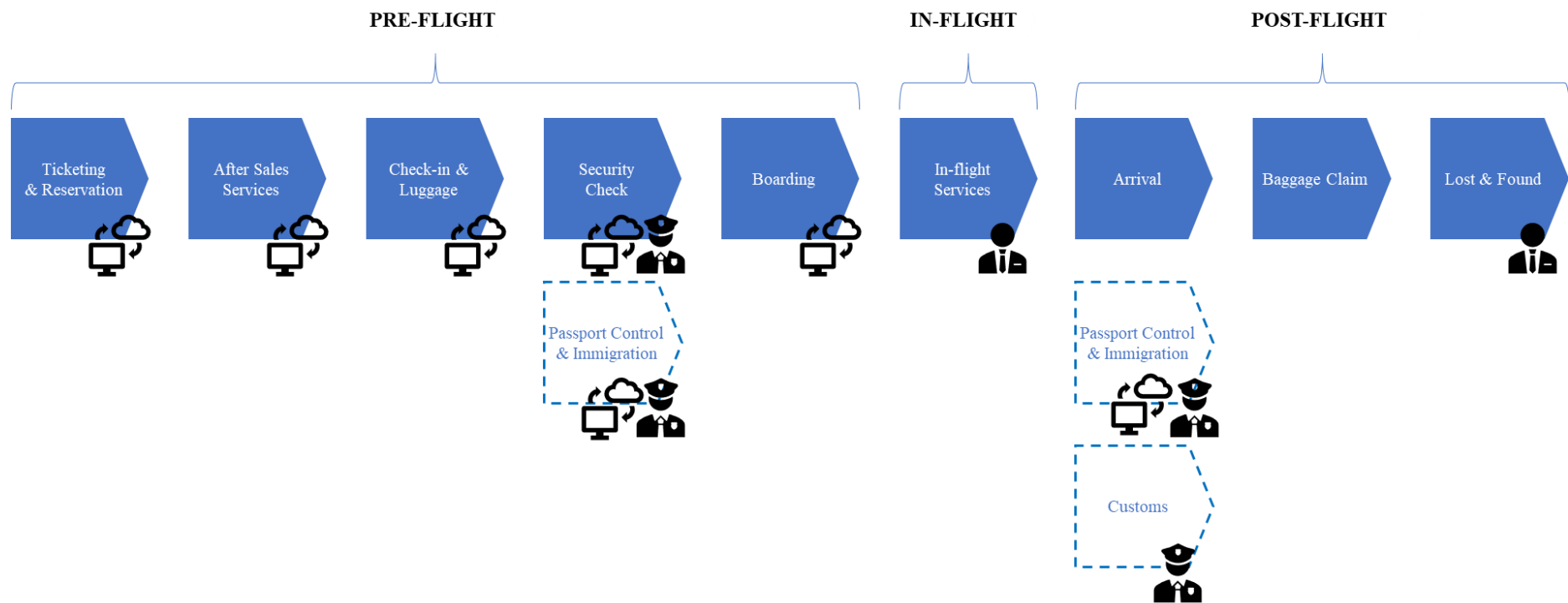


Figure 1-16: Current State of Passenger Journey

Note: Figure is generated using data from Airport of Thailand (2024) and SITA (2023).

1.6.2.3. Passenger journey in Thai airport

Keeping up with the current services of world aviation, airlines and airports in Thailand are also implementing SST to facilitate passengers. While some SST are provided by airlines, others are provided by airports and related institutions. Table 1-19 lists the SSTs provided by six major international airports under AOT.

Table 1-19: SSTs implemented by major international airports under AOT

SSTs	BKK	DMK	CNX	CEI	HDY	HKT
General Kiosks (Information)	Yes	Yes	Yes	Yes	Yes	Yes
Self-check-in Kiosks	Yes	Yes	Yes	Yes	Yes	Yes
Self-service Bag Drop Kiosks	Yes	Yes	Yes	Yes	Yes	Yes
Self-Security Identity Verification	Yes	Yes	Yes	Yes	Yes	Yes
Automated Border Control	Citizen	Citizen	No	No	No	Citizen
Self-boarding Gate	Yes	Yes	Yes	Yes	Yes	Yes

Note: Table is compiled using the data from Airport of Thailand (2023a).

To enhance customer experience and move toward smart airports, AOT recently installs multiple SSTs in every airport they are operating. The kiosks for self-check-in and self-baggage drop are shared by many airlines that allow passengers to perform these tasks by themselves. For example, there were 23 airlines that allowed passengers to check in through a self-check-in kiosk at Suvarnabhumi Airport (Airport of Thailand, 2023a). Automated border control is the responsibility of the immigration bureau and is not installed at every airport under AOT at this stage. Thus far, only Thai citizens have been able to pass passport control and immigration through automated border control.

Table 1-20 lists the SSTs implemented by airlines registered in Thailand. Online tasks that customers or passengers could perform using their own devices, except chatbots, are allowed by all airlines. Most of them allow passengers to check in through self-check-in kiosks, except Nok Air (DD). In February 2023, THAI Airways (TG) was selected by AOT to be the pilot airline trialling the biometric check-in on the daily flight to Singapore until the end of May

2023 (THAI Airways, 2023). However, the service has not been officially provided to other passengers. The self-boarding machine is installed at AOT-operated airports, but the boarding process is still performed by airline staff.

Table 1-20: SSTs implemented by airlines registered in Thailand

SSTs	FD	TG	WE	PG	DD	SL	VZ
Self-check-in Kiosks	Yes	Yes	Yes	Yes	No	Yes	Yes
Self-service Bag Drop Kiosks	Yes	Yes	Yes	Yes	No	No	No
Internet/Web (PC/Laptop) Check-in	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Web/e-Ticketing	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mobile App Ticketing	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mobile App Check-in	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Biometric Check-in	No	Trial	No	No	No	No	No
e-Boarding Pass	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Chatbot	Yes	Yes	No	No	No	No	Yes
Self-boarding	No	No	No	No	No	No	No

Note: Table is compiled using the data from airlines' websites. (Airport of Thailand, 2023a) (Airport of Thailand, 2023a) (Airport of Thailand, 2023a) (Airport of Thailand, 2023a) (Airport of Thailand, 2023a) (Airport of Thailand, 2023a) (Airport of Thailand, 2023a)

1.6.3. SST from passenger's perspective

While SST provides some benefits to passengers, most of the studies and reports show that SST integrated service can benefit passengers mainly from a shorter waiting times at the airport. For example, self-check-in kiosk helps reducing the queue at the check-in counter by allowing passengers to check-in by themselves via kiosk, thus reducing the overall waiting time for check-in process (Seetanah et al., 2020). Moreover, a simulation study based on a real data showed that passengers spend around 5 minutes to finish checking-in via self-check-in kiosk while some passengers spend up to 10 minutes at check-in counter (Tyagi & Lodewijks, 2022). In addition, the shorter waiting time and faster process offer by self-service check-in channels allow passenger to arrive at the airport later than recommended arrival time for check-in (Tyagi & Lodewijks, 2022), for instance, passengers who booked a flight that depart in an

early morning (Artur & Tomasz, 2017). However, passengers with check baggage need to get in another queue either at the bag drop kiosk or check-in counter to process their baggage, making passengers feel like they have to spend more time (Abdelaziz et al., 2010; Ivannikova et al., 2021).

There are some other benefits that SST provides to passengers apart from reducing the time spent on passenger processing. In case of self-ticketing, it offers passengers some obvious benefits such as, the flexibility to book the ticket from anywhere and anytime, and the ability to compare the ticket price and flight departure time between airlines before making decision. Additionally, it reduces companies' expenses by minimizing the number of ticketing agents, allowing the savings to be passed on to passengers who book their own tickets via one of the SST channels, resulting in lower prices (Lau et al., 2011). More importantly, SST also help airports and airlines to achieve their contactless policy during COVID-19 pandemic. Passengers can finish most of the processes by themselves using SST channels while avoid contacting with staffs, reducing the risk of infections (Drljača et al., 2020).

Although, the SST offers many benefits to passengers, the implementation cannot be successful if the technology received only minimal usage (Davis et al., 2024). Despite the fact that SST has been around for quite a while, the industry has invested considerable effort in convincing passengers to utilise it (Drennen, 2011; Taufik & Hanafiah, 2019). It should be noted that, not all passengers are willing to use the SST service. Some passengers do not trust that SST can deliver service and are afraid of system failure (Colby, 2019). For other passengers, the reason not to use SST could be from gender aspect (Rubio-Andrada et al., 2023), age differences and purpose of travel (Wittmer, 2011), or some other underexplored factors.

1.6.4. SST from employee's perspective

The implementation of SST not only change the passenger experience, but also impact the airlines and airport employees. SST helps reducing workloads of employees, for example, at

check-in counter as some passengers are willing to perform check-in and baggage drop-off by themselves via different SST channels provided by airlines and airports. Research shows that while check-in kiosks help reduce workload, some employees receive more negative feedback from passengers who struggle with the technology or experience system failures, resulting in stressful working conditions for employees. (International Transport Workers' Federation, 2024). It also reveals that employees were not afraid that the check-in kiosk would replace their jobs during an early stage of implementation because the past versions of kiosks may not have capabilities to accommodate different passengers' needs (International Transport Workers' Federation, 2024).

Later, COVID-19 has caused a crisis in the global aviation industry. Aviation, relying primarily on the demand of tourism, was hit hard. The pandemic forced the government to impose a travel restriction policy, causing the number of seats offered by airlines to reduce by 50% (International Civil Aviation Organization, 2023). Airlines and airports had implemented different measures to ensure the viability of the business, for example, seeking government support, employee leave without pay, reduced working hours, voluntary resignation. As a result, the number of jobs supported by aviation dropped by 50% worldwide, while direct aviation employment declined by 21% in 2021 (Air Transport Action Group, 2021). COVID-19 has accelerated the development and implementation of SST in airport around the world to overcome the operational challenges such as cost reduction, managing passenger service during staff shortages, and fulfilling the contactless policy (Airports Council International, 2021). That means, more advanced and better SST that meets more passengers' needs are being implemented at the airports. It has been reported that ground employees dealing directly with passengers believe that their jobs are at risk and may be replaced, in this case, by self-check-in kiosks, given that these kiosks function well (International Transport Workers' Federation, 2024). It further shows that many ground employees feel less satisfied in their job and find

their work less enjoyable because it requires less skills since the implementation of self-service machine.

1.7. Links for subsequent chapters

The systematic literature review and background analysis in Chapter 1 provides a comprehensive overview of the aviation SST research, identifying several critical research gaps that form the foundation for this thesis. The review reveals that existing literature is geographically concentrated, many countries are less researched including Thailand. Furthermore, a gap was identified concerning newer SSTs, with the review calling for more attention on emerging technologies like biometric check-in kiosks. Finally, the analysis highlighted the limited research concerning the effects of SST implementation on airlines and airports ground staff.

These identified gaps provide the direct motivation for the two empirical studies in this thesis as illustrated in Figure 1-17. Chapter 2 will address the passenger-focused gaps by investigating the adoption of biometric check-in kiosks, using Thailand as a specific case study. Chapter 3 will then address the employee-focused gap by examining the impact of perceived threat of job automation from SST on the job insecurity and well-being of airline and airport ground staff.

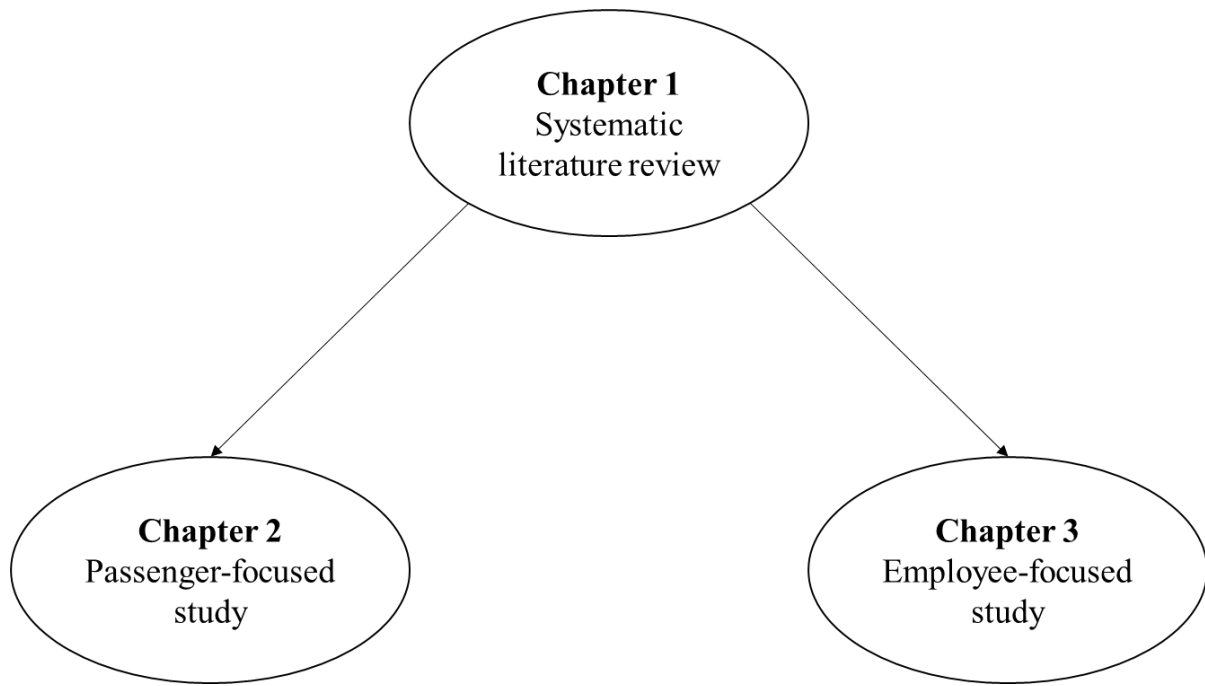


Figure 1-17: Links between Chapters

STATEMENT OF CONTRIBUTION DOCTORATE WITH PUBLICATIONS/MANUSCRIPTS

We, the student and the student's main supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the student's contribution as indicated below in the Statement of Originality.

Student name:	PHUTAWAN HO WONGYAI		
Name and title of main supervisor:	DR. THANH NGO		
In which chapter is the manuscript/published work?	Chapter 2		
Describe the contribution that the student and members of the supervisory team have made to the manuscript/published work: ¹ The doctoral candidate is responsible for designing the conceptual framework and survey instrument, collecting the data, conducting the formal analysis, and writing the original draft, all while receiving guidance from the supervisors. Phutawan Ho Wongyai: Writing – original draft, Methodology, Formal analysis, Conceptualization. Thanh Ngo: Writing – review & editing, Supervision, Conceptualization. Hanjun Wu: Writing – review & editing, Methodology. Kan Wai Hong Tsui: Writing – review & editing.			
Please select one of the following three options:			
☒	The manuscript/published work is published or in press Please provide the full reference of the research output: Wongyai, P. H., Ngo, T., Wu, H., & Tsui, K. W. H. (2025). Passengers' acceptance of biometric check-in kiosks: The case of Thai airports. <i>Tourism and Hospitality Research</i> , Advance online publication. https://doi.org/10.1177/14673584251385493		
☐	The manuscript is currently under review for publication Please provide the name of the journal:		
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Chapter 2 – Self-service technology from passengers’ perspectives

Preamble

Chapter 1 highlights some notable research gaps in the literature on SST. These include a lack of studies focusing on newer technologies for aviation passenger service, underrepresented countries in aviation SST research, and insufficient discussion of certain variables that influence customer adoption of aviation SST. Therefore, Chapter 2 investigates the passengers’ adoptions of biometric check-in kiosks at airports using Thailand as a case study. SST has been increasingly implemented during the COVID-19 pandemic to minimise human contact and reduce crowdedness at airports, thereby decreasing the risk of infection. Although aviation industry has recovered from the pandemic, however, the congestion in check-in areas at major airports remains a significant challenge. In response, Thailand’s airports have recently trialled biometric check-in kiosks, which are now available for all passengers traveling with the national carrier (Thai Airways) who wish to utilise this service. As of May 2024, the results of the trial have not yet been published. Therefore, this chapter is essential as it sheds light on air passengers’ intentions to adopt biometric check-in kiosks, addressing the second research objective of this thesis. This chapter uses a survey approach based on a framework derived from the TAM, the TPB, and three previously underexplored factors: perceived privacy concerns (PC), perceived trust (PT), and perceived risk (PR). This chapter utilises covariance-based structural equation modelling (CB-SEM) to test the hypotheses of Chapter 2. The key findings of this chapter offer valuable insights by confirming most of the relationships proposed by the TAM and TPB while highlighting the important roles of PC and PT. Furthermore, this chapter illustrates the crucial mediating role of attitudes toward technology usage in technology

adoption—a factor often overlooked by researchers. This chapter also contributes to the limited literature on passengers’ adoption of biometric check-in kiosks at airports. It is the first study to investigate this issue in the context of Thailand and is one of the few studies to integrate PC, PT, and PR into the comprehensive framework. Additionally, based on the research gap identified in Chapter 1, this thesis is to examine the impact of SST implementation on airline and airport employees in Chapter 3, an area that remains underexplored in the SST literature.

Study 2: Passengers' Acceptance of Biometric Check-in

Kiosks: The Case of Thai Airports

Publication status and candidate contribution

This study has been published in a *Tourism and Hospitality Research*, a well-known journal in service research (SCOPUS Q1, ABDC Rating B). The doctoral candidate is the first and corresponding author, with Dr. Thanh Ngo, Dr. Hanjun Wu, and Professor Kan Wai Hong Tsui are listed as co-authors. The doctoral candidate is responsible for designing the conceptual framework and survey instrument, collecting the data, conducting the formal analysis, and writing the original draft, all while receiving guidance from the supervisors.

2.0 Abstract

Although the air transport industry is recovering from the COVID-19 pandemic, operational challenges remain, including airport congestion due to staff shortages. In response, airports have invested in self-service technologies (SST) to streamline operations, enhance passenger experiences, and address labour shortages. Building on the technology acceptance model and the theory of planned behaviour, this study explores passengers' acceptance of biometric check-in kiosks. The framework is extended to include the perceived privacy concerns, trust, and risk, which have received little attention in research into aviation SST. In total, 577 valid surveys were collected at two major airports in Thailand. Key findings demonstrate that passengers' intentions to use biometric check-in kiosks are significantly driven by their attitudes and perceived behavioural control. Importantly, this research reveals that perceived usefulness, ease of use, trust, and privacy concerns are pivotal in shaping passenger attitudes. These insights underscore the necessity for airlines and airports to enhance positive passenger

attitudes by ensuring the perceived usefulness and ease of use, while critically addressing privacy concerns and building trust. Such findings are vital for optimizing the design and promotion of biometric check-in kiosks, thereby enhancing operational efficiency and the overall passenger experience.

2.1 Introduction

Air transport has grown over the past decade. The number of global passengers increased from 3 billion in 2012 to nearly 4.5 billion in 2019 (International Civil Aviation Organization, 2023). However, global air transport faced a downturn caused by the COVID-19 pandemic. Travel restriction policies were enforced by many countries to reduce the infections. The reduction in flight frequencies was inevitable, and 54 airlines ceased their operation (International Air Transport Association, 2022). With travel restrictions lifted, the passenger traffic in 2024 was 3.8% higher than that in 2019, marking a new high (International Air Transport Association, 2025). Airport congestion, however, is still an ongoing issue because of staff shortages resulting from furlough and downsizing during the COVID-19 pandemic (Vance, 2022). Consequently, congestion in the departure lounge is expected to continue.

The aviation sector has invested in technologies to improve passengers' experience, operational efficiency, and minimise environmental impact (Mattig, 2024). According to the SITA (2023), airlines invested more into information technology for passenger services in 2022 than in 2021, and these services were among airlines' top three information technology investments. Passengers were offered self-service channels such as mobile ticketing, online check-in, self-check-in kiosks, self-service bag drops, and e-boarding passes. Recently, advanced options like service chatbots, biometric check-in, self-identity verification, and self-boarding have been introduced. These technologies allow passengers to perform some tasks without assistance from airport and airline employees, and are generally known as "self-service technologies

(SST)” (Meuter et al., 2000). SST can benefit the companies by reducing costs, increasing customer satisfaction, and strengthening customer loyalty (Bitner et al., 2002). Moreover, when customers expect quick and accessible services, companies equipped with SST can gain a significant advantage (Meuter et al., 2000). However, organisations must carefully decide on the integration of SST into their existing services. The implementation of SST that has not been designed appropriately or requires advanced information technology skills could adversely affect customer satisfaction (Zhu et al., 2007). SST that cannot complete the basic functions or fails to perform the tasks could result in a frequent need for staff assistance and increased labour costs (Hilton et al., 2013).

Biometric kiosks have been widely implemented in tourism and hospitality industry. It is recognised for the potential in streamlining hotel check-in process, and reducing waiting time, which improving overall experience of the guests (Kang et al., 2007). Moreover, it helps enhancing travel experience by providing more secure and personalised services to tourists, for example, using biometric data as a means of authorisation and personalisation for return customers (Neo & Teo, 2022). From the business perspectives, biometric kiosks help reducing operating cost and reducing workload of staffs (Mills et al., 2010). To streamline the passengers’ journey at airports, SST has been upgraded with biometric systems, including biometric check-in, pre-security identification, automated border control, and self-boarding gates (OAG, 2022). Biometric check-in kiosks capture the biometric data of passengers at check-in points and reduce the need to present identification documents and boarding passes at security checkpoints and boarding gates (SITA, 2021b). Some airports have introduced biometric check-in kiosks, such as Brisbane Airport, Hamad International Airport, and Sao Paulo International Airport (Negri et al., 2019). In the case of Thailand, THAI Airways was selected to be the pilot airline trialling biometric check-in kiosks on the daily flights to Singapore from February 2023 until the end of May 2023 (THAI Airways, 2023). The trial has

been extended to cover all passengers travelling with THAI Airways who wish to try this service. At the time of writing, the project's results are yet to be published. Hence, this study is crucial, as it provides insights into passengers' intention to adopt biometric check-in kiosks.

This study offers several contributions to fill some research gaps. First, studies have adopted different theories to investigate users' adoption of new technology, such as the technology acceptance model (TAM) (Davis, 1986), the theory of planned behaviour (TPB) (Ajzen, 1991), and the unified theory of acceptance and use of technology (Venkatesh et al., 2003). However, only a handful of studies have been conducted on passengers' usage of biometric technology in aviation until now because of the limited implementation of such technology (e.g., Chi et al., 2025; Kasim et al., 2021; Kim et al., 2020; Kim et al., 2023; Kneale et al., 2014; Morosan, 2016; Untaru et al., 2024). Studies on biometric check-in kiosks are even rarer (Negri et al., 2019). Unlike biometric applications in security or border control, which are often mandatory and driven by compliance, the use of biometric check-in kiosks is voluntary. Thus, the factors that service providers need to consider to increase passenger adoption are different. This allows for an exploration of factors influencing discretionary technology adoption in a high-stakes, service-oriented context such as air travel. Therefore, among the few, this study fills this research gap by investigating passengers' intentions to use (INTU) biometric check-in kiosks.

Although biometric technology can enhance operational efficiency at airports, it is crucial to address privacy-related concerns, risks, and trust to promote greater adoption of this technology (Khan & Efthymiou, 2021). Previous research suggested that passengers' INTU biometric technology at airports are significantly affected by their perceived privacy concerns (PC) (Kasim et al., 2021; Morosan, 2016) and perceived risks (PR) (Kim et al., 2020). In addition, perceived trust (PT) also influences passengers' intentions to adopt such technologies (Thommesen & Andersen, 2009). Despite the importance of these factors, the role of PC, PT, and PR have received little attention in the aviation SST research (Wongyai et al., 2024) and

have not been integrated into a cohesive framework. To address this gap, the authors propose an integrated framework that combines these three factors with the TAM and TPB to examine their impacts on passengers' attitudes toward using (ATT) and INTU biometric check-in kiosks. This integration offers an alternative theoretical lens, illustrating the interplay between security and trust-related perceptions and well-established drivers of technology acceptance. Thus, this study enriches the theoretical understanding of technology adoption in privacy-sensitive contexts. Additionally, this study investigated passengers at two major international airports in Thailand, which recently implemented this system. To the authors' knowledge, this study is the first to investigate passengers' INTU biometric check-in kiosks in Association of Southeast Asian Nations (ASEAN) countries. This contextual focus is particularly significant, as the socio-cultural and economic characteristics of ASEAN countries, including rapidly expanding digital economies and evolving privacy perceptions, may lead to unique technology adoption dynamics that differ from those observed in more developed Western markets or even other countries in Asia (e.g., South Korea and Japan). The result of this study, however, could be extended to other emerging countries sharing similar culture and economic characteristics, or by countries aiming to design, implement, and promote biometric solutions in aviation effectively. This can enhance operational efficiency, reduce passenger processing times, and improve the overall passenger service experience, contributing to a more seamless travel experience.

The next section provides a literature review covering the theoretical frameworks and development of the hypotheses. Next, the methodology section describes the survey instrument and data collection process, and a brief explanation of the method used for data analysis is provided. The results of structural equation modelling are then presented, followed by a discussion of the findings. Lastly, the implications and limitations of this study are provided.

2.2 Literature review

2.2.1 Theoretical frameworks

Scholars have designed frameworks to study the behavioural intention. The popular frameworks are the TAM and TPB which postulate that before acting, a person's behavioural intention is formed by a positive attitude (Ajzen, 1991; Davis, 1986). The TAM theorises that an attitude is influenced by two core cognitive variables: perceived ease of use (PEOU) and perceived usefulness (PU). PEOU measures how easy an individual finds the technology to use, whereas PU measures the belief that technology will improve the process. The cognitive variables were influenced by external stimuli, such as the colour and layout of the system (Davis, 1986). The TPB, on the other hand, presumes that behavioural intentions are driven by subjective norms (SN) and perceived behavioural control (PBC). SN refer to the perceived social pressure to either engage in or refrain from a certain behaviour, whereas PBC is the ease or difficulty of carrying out an action, which is believed to be a result of previous experiences and the expected barriers and limitations (Ajzen, 1991). Some studies have integrated the TPB and TAM to achieve more explanatory power (Kasim et al., 2021; Lien et al., 2021; Thamaraiselvan & Thanigaiarul, 2019).

It is crucial to understand the factors that influence the adoption of new technology, as the benefits are realised only when the technology is used (Davis et al., 2024). Previous research has adopted the abovementioned theories to explain the use of SST in aviation (please also refer to Appendix). Studies have supported the positive effect of PEOU and PU on passenger's attitudes towards SST and, ultimately, intentions to buy air tickets from the websites (H.-B. Kim et al., 2009; López-Bonilla & López-Bonilla, 2015) and to use check-in kiosks (Lee et al., 2014). SN and PBC were also found to play significant roles in the use of the aviation SST (Ruiz-Mafe et al., 2013; Thamaraiselvan & Thanigaiarul, 2019). Moreover, performance expectancy in using SST influenced the INTU, while the effect of effort expectancy was not

significant (Escobar-Rodríguez & Carvajal-Trujillo, 2013; Melián-González et al., 2021). Other variables were also examined and found to have a positive impact on INTU aviation SST, such as social influence on the adoption of chatbots (Melián-González et al., 2021) and facilitating conditions for e-ticketing adoption (Escobar-Rodríguez & Carvajal-Trujillo, 2013). Scholars have also included several other variables to better specify the TAM and TPB models to suit their contexts. Extrinsic and intrinsic motivation have positive effects on the INTU aviation SST, whereas passengers' evaluations of SST mediated both effects (Moon & Lee, 2022). Similarly, the hedonic motivation influenced passengers' INTU the service chatbot (Melián-González et al., 2021) and airline e-ticketing services (Naruetharadhol et al., 2022). A greater perception that using aviation SST created joy led to a positive attitude of passengers (López-Bonilla & López-Bonilla, 2013) and increased their INTU (Gures et al., 2018). Moreover, passengers intended to use websites and mobile ticketing applications more when they perceived them as trustworthy (H.-B. Kim et al., 2009; Mohd Suki & Mohd Suki, 2017). The same relationship was found in the case of self-baggage drops (H. Shin et al., 2022). Furthermore, the INTU self-check-in kiosks decreased when passengers needed the service from employees (Lee et al., 2014; Lu et al., 2009).

Limited studies have been dedicated to passengers' adoption of biometric technology at airports. However, there are recent studies in the broader tourism and hospitality industries that explore the adoption of biometric technology. In the restaurant context, a study has shown that customers' intentions to adopt payment through facial recognition are driven by all factors posited by the TPB, with ATT influenced by consumer innovativeness (Hwang et al., 2024). Moreover, the intention to adopt such a system is formed by the mechanism proposed by the TAM, with ATT shaped by the alignment between consumers' self-perception and external image (Kim et al., 2025). For business events, performance expectancy and trust impact the guests' intention to adopt facial recognition check-in (Ciftci et al., 2024). It has been

highlighted that tourists' emotions, trust, and self-efficacy are important factors influencing the intention to adopt biometric technology at any point in their journey (David-Negre & Gutiérrez-Taño, 2024). While hotels, restaurant, and aviation share the same service encounter foundation, the more stressful and severe consequences of failure in passenger aviation service call for more research attention.

In the case of airport biometric security, older passengers tend to use it less and take a longer time to finish than younger passengers, although their PEOU and satisfaction are similar (Kneale et al., 2014). Some other variables have been highlighted as influencing the INTU biometric security at airports, such as effort expectancy, performance expectancy (Morosan, 2016), PC (Kasim et al., 2021; Morosan, 2016), perceived benefits, and PR (Kim et al., 2020). Additionally, PT is vital in accepting biometric technologies (Thommesen & Andersen, 2009), especially trust in privacy protection (Kim et al., 2023). The perception that biometric security helps reducing infection has been shown to drive the adoption intention during COVID-19 pandemic (Untaru et al., 2024). In the case of airport biometric boarding gate, a recent study has shown innovativeness and convenience as the drivers of the adoption intention, while passengers' anxiety is the barrier (Chi et al., 2025). Regarding airport biometric check-in, Negri et al. (2019) showed that almost 83% of passengers would use this channel, with a higher possibility found for male, leisure, and younger passengers. Therefore, there is a need for more research into the adoption of aviation biometric technology, especially technologies focused on the first step of the journey, such as biometric check-in. In addition, PC, PR, and PT have mostly been investigated separately. Although Lancelot Miltgen et al. (2013) integrated these three factors into their model, they did not consider the role of ATT, which plays a vital role in the relationship between belief and intention (Davis et al., 2024). This study fills this research gap by incorporating these factors into a comprehensive framework to investigate passengers' INTU biometric check-in kiosks at the airport.

2.2.2 Hypothesis development

TAM posits that the INTU is formed jointly by ATT and PU (Davis et al., 1989). The influence of ATT is grounded on the idea that an intention is partly formed when individuals feel positively about it. Whereas, the influence of PU relies on the idea that individuals develop intentions regarding behaviours that they think will improve their performance, regardless of their feelings (Davis et al., 1989). Studies have shown evidence to support these relationships in the context of aviation SST (Lien et al., 2021; López-Bonilla & López-Bonilla, 2015). In this study, the authors also argue that PEOU could influence INTU, i.e., individuals are likely to use the system that they find it easy to use. This relationship has been supported for the case of airport self-check-in kiosks (Kim et al., 2023; Ko & Park, 2019; Taufik & Hanafiah, 2019).

TAM additionally proposes that PU and PEOU jointly shape ATT, whereas PEOU also influences PU. The favourable outcomes, or better performance, usually enhance an individual's emotional response towards the methods employed in obtaining those outcomes. Moreover, when the use of system is considered effortless, individuals are more likely to find it useful and reinforce positive attitudes (Davis et al., 1989). Previous aviation SST studies have found evidence supporting these relationships (Lee et al., 2014; López-Bonilla & López-Bonilla, 2015; Lu et al., 2009). Following the literature, therefore, this study investigated these relationships in the context of biometric check-in kiosks at airports and set the following hypotheses:

H1: Passengers' PEOU positively influences ATT.

H2: Passengers' PEOU positively influences PU.

H3: Passengers' PU positively influences ATT.

H4: Passengers' PU positively influences INTU.

H5: Passengers' PEOU positively influences INTU.

H6: Passengers' ATT positively influences INTU.

According to the TPB, SN, and PBC are proposed to have an impact on behavioural intention (Ajzen, 1991). Individuals regularly align their behaviours with the beliefs and expectations of their loved ones, friends, and community (Park, 2000). Therefore, the stronger individuals believe that people around them expect them to engage in a certain behaviour, the stronger the behavioural intention formed. Furthermore, to perform a certain behaviour, individuals have to be confident that they can do it (Ajzen, 1991). Thus, the stronger individuals believe in their abilities, the greater the behavioural intention formed. A recent study in restaurant context has supported the significant role of TPB in explaining customers' intentions to pay using facial recognition method (Hwang et al., 2024). Evidence from previous studies has shown that passengers' INTU aviation SST are impacted by an increase in the perception of social pressure (Kasim et al., 2021; H.-B. Kim et al., 2009; Ruiz-Mafe et al., 2013) and the perception that passengers have adequate resources to have control over the system (Lien et al., 2021; Lu et al., 2009; Ruiz-Mafe et al., 2013; Thamaraiselvan & Thanigaiarul, 2019). The following hypotheses were also formed:

H7: Passengers' SN positively influence INTU.

H8: Passengers' PBC positively influence INTU.

Information privacy is one of the concerns of passengers about using information technology systems at the airport (Graham, 2023). According to Westin (1967), privacy is defined as the ability of a person, a set of people, or an organisation to determine the accessibility and disclosure of their information by other parties. The survey by InternetSociety showed that 75% of participants were concerned that their personal information would be provided to a

third-party organisation without their consent (Internet Society, 2019). Concerns about the privacy of biometric data could also influence a person's fear of using biometric technology. These concerns included data storage, illegal data acquisition, and locating persons (Labati et al., 2016; Morosan, 2012; Schouten & Jacobs, 2009). Several studies have attempted to understand the role of PC on users' acceptance of biometric technology (e.g., Breward et al., 2017; Hino, 2015; Morosan, 2011, 2016). A study established that increased PC of users could create a negative ATT biometric technology (Breward et al., 2017). Additionally, the INTU biometric technology could increase when the user perceives there is sufficient privacy (Hino, 2015).

According to the systematic literature review by Wongyai et al. (2024), few studies have mentioned the PC in the context of aviation SST. A study on the biometrics used at airport immigration showed that when passenger PC were alleviated, a positive ATT could be formed (Morosan, 2011). Other studies have shown that PC have an impact on passengers' INTU biometric technology at airports (Kasim et al., 2021; Morosan, 2016). Nevertheless, PC have received little attention in studies on the acceptance of aviation biometric technology. Therefore, this study proposed the following hypotheses:

H9: Passengers' PC negatively influence ATT.

H10: Passengers' PC negatively influence INTU.

Trust is the beliefs and the disposition of a person to rely on another person or entity, although a negative outcome could be anticipated (McKnight et al., 1998). Trust is divided into two main constructs. "Trusting intention" is when a person is eager to rely on another person, whereas "trusting beliefs" reflect the belief that another person is good-natured, talented, sincere, or foreseeable in a specific situation (McKnight et al., 1998). Based on this model, the theory of trust transfer was developed (Stewart, 2003). In the context of the internet, this theory suggests

that trusting beliefs significantly influence the intention to buy. A study revealed that the higher the PT, the more positive ATT will be (Shaker et al., 2023). Moreover, the positive effects of PT on the INTU are widely supported in different contexts (Choi & Ji, 2015; Dhagarra et al., 2020; Pavlou, 2003; Shaker et al., 2023). Additionally, several studies on biometric technology confirmed the positive relationships between PT and ATT (Moriuchi, 2021; Nakisa et al., 2023) and between PT and INTU (Hino, 2015; Lancelot Miltgen et al., 2013).

PT has been found to play a significant role in research into the adoption of aviation SST. The effects of PT on ATT (H.-B. Kim et al., 2009; Lee, 2016; Thamaraiselvan & Thanigaiarul, 2019) and INTU (H.-B. Kim et al., 2009; Mohd Suki & Mohd Suki, 2017; H. Shin et al., 2022) were found to agree with the studies mentioned above. However, the current studies on the use of biometric technology in aviation have paid little attention to the role of PT. This study proposed the following hypotheses:

H11: Passengers' PT positively influences ATT.

H12: Passengers' PT positively influences INTU.

The belief that the use of products or services could lead to unfavourable outcomes is known as PR (Bauer, 1967). PR was later redefined to fit the context as “the potential for loss in the pursuit of a desired outcome of using an e-service” (Featherman & Pavlou, 2003, p. 454). This was supported by previous research that higher PR hindered INTU (Featherman & Pavlou, 2003; Pavlou, 2003), and the effect was emphasised in the context of online banking (Bashir & Madhavaiah, 2015; Martins et al., 2014). Moreover, PR was found to negatively shape ATT (Crespo et al., 2009; van der Heijden et al., 2003).

When using aviation SST, passengers may be concerned that their transactions, such as buying tickets and check-in, could fail, which could cost them time and money. PR was found to be a significant factor in e-ticketing (Lee et al., 2019), online check-in and self-check-in kiosks

(Lee, 2016; Lu et al., 2009; Thamaraiselvan & Thanigaiarul, 2019), and biometric security (Kim et al., 2020). The effect of PR on biometric technology remains underexplored in aviation SST research. Hence, this study incorporated the role of PR into the framework and proposed the following hypotheses:

H13: Passengers' PR negatively influences ATT.

H14: Passengers' PR negatively influences INTU.

Figure 2-1 depicts all the hypotheses established in this study.

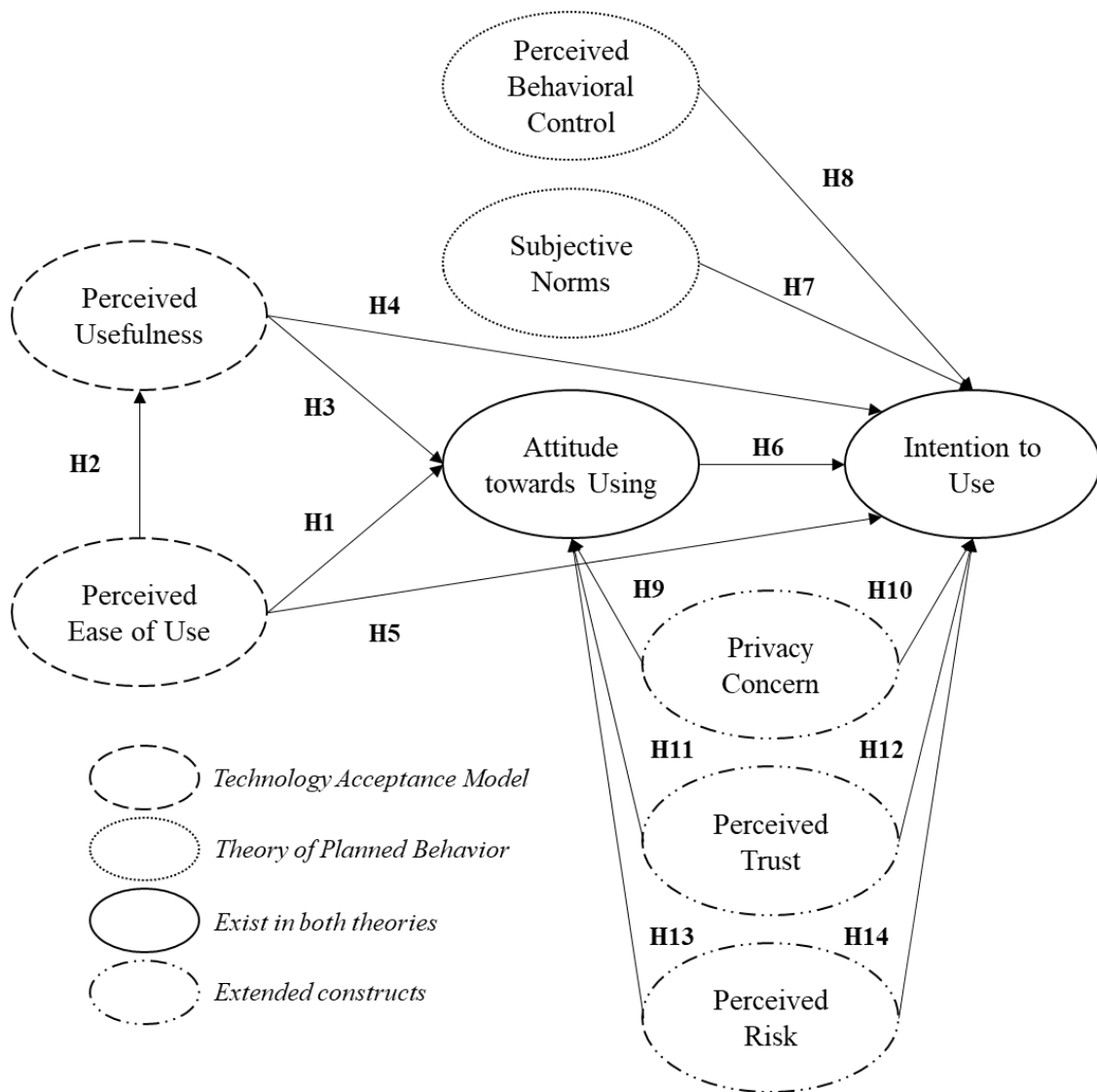


Figure 2-1: Conceptual framework.

2.3 Methodology and Data

2.3.1 Survey instrument

Questionnaires were available in English and Thai¹, and consisted of three parts: (1) an introduction to biometric check-in, (2) participants' opinion, and (3) participants' characteristics. This study adopted the TAM (Davis, 1986; Davis et al., 1989) as the main model because of its explanatory power and its popularity as it has been used by a number of previous studies (Kasim et al., 2021; Ko & Park, 2019; Lien et al., 2021; López-Bonilla & López-Bonilla, 2015; Lu et al., 2009; Mohd Suki & Mohd Suki, 2017; Taufik & Hanafiah, 2019), along with the TPB (Ajzen, 1991). Moreover, additional factors were included to specify the model for explaining the adoption of biometric check-in kiosks, namely, PC, PT, and PR. The measurement items were adopted from the TAM and TPB models and the existing literature. All items are scored using a seven-point Likert-type scale, ranging from 1 (strongly disagree) to 7 (strongly agree).

PEOU and PU are measured using items from Davis (1989) and Venkatesh and Davis (2000). An example on an item for measuring PEOU is "I find the biometric check-in kiosk to be easy to use", and one for measuring PU is "Using biometric check-in kiosk enhances my convenience on check-in." To measure ATT, the measurements have been borrowed from H.-B. Kim et al. (2009), Ruiz-Mafe et al. (2013), and Kasim et al. (2021), for example, "I think using biometric check-in kiosks is a positive experience." Measurement items for INTU have been adopted from Venkatesh and Davis (2000) and Dhagarra et al. (2020), for example, "Assuming I have access to a biometric check-in kiosk, I intend to use it." The items from H.-B. Kim et al. (2009), Ruiz-Mafe et al. (2013) and Lee (2016) are used to measure PBC, such as "I have the resources, knowledge, and skills to use a biometric check-in kiosk to process my

¹ These were made from an independent translation by a lecturer from the university.

check-in.” To measure SN, the measurement items from Venkatesh et al. (2003), Mohd Suki and Mohd Suki (2017) and Moriuchi (2021) are used. An example item is “People who are important to me think that I should use a biometric check-in kiosk.” In addition to the core constructs of TAM and TPB, PT is measured with items from Choi and Ji (2015), Mohd Suki and Mohd Suki (2017), and H. Shin et al. (2022), for example, “I believe biometric check-in kiosk is trustworthy.” The items measuring PC are borrowed from Malhotra et al. (2004), Dinev and Hart (2005) and Kasim et al. (2021). An example item is “I am concerned that my information could be shared or sold with using biometric check-in.” Lastly, PR is measured using items from Featherman and Pavlou (2003), Martins et al. (2014), and Lee (2016), for example, “the biometric check-in kiosk might not perform well and create problems with the check-in process.”

2.3.2 Data collection and descriptions

This study surveyed passengers at Suvarnabhumi Airport and Don Muang International Airport in Thailand between March and April 2024. These two airports served approximately 45 million international and 28 million domestic passengers in 2023, representing over 70% of the traffic at Airports of Thailand-operated airports (Airport of Thailand, 2023b). Moreover, Suvarnabhumi Airport was ranked 11th of the top 50 global airport mega-hubs (OAG, 2023). The self-administered questionnaires were hosted on Qualtrics and distributed only within the airport’s departure hall because of airport security. To ensure the anonymity of the participants, identifying details were not collected, such as name, address, phone number, and national identification number.

This study collected 612 responses. The data was screened to exclude incomplete responses and outliers to reduce possible bias in the dataset, leaving 577 responses for analysis. The skewness values varied from -1.04 to 0.22, and the kurtosis values ranged from -0.58 to 1.83. These results suggested that the data distribution adheres to normality, as the skewness and

kurtosis values remain within the acceptable range of -2 to +2 (George, 2016). The characteristics of the respondents are illustrated in Table 2-1.

Table 2-1: Demographic details of the respondents ($N = 577$).

Characteristics	Subcategories	Frequency	Percentage
Age	18–35 years old	321	55.6
	36–50 years old	177	30.7
	51–64 years old	68	11.8
	More than 65 years old	11	1.9
Gender	Male	200	34.7
	Female	311	53.9
	Non-binary/third gender	53	9.2
	Prefer not to say	13	2.3
Educational level	Less than diploma	70	12.1
	Diploma	105	18.2
	Bachelor's degree	320	55.5
	Postgraduates	82	14.2
Nationality (Thai vs. other)	Thai	346	60
	Other	231	40
Nationality (Region)	Africa	3	0.5
	Asia	415	71.9
	Europe	131	22.7
	North America	12	2.1
	Oceania	11	1.9
	South America	5	0.9
Departure airport	Suvarnabhumi Airport	139	24.1
	Don Muang International Airport	438	75.9
Frequency of flying	1–2 times a year	165	28.6
	3–4 times a year	221	38.3
	More than 4 times a year	191	33.1
Use of biometric technology in daily life	Yes	538	93.2
	No	39	6.8

Note: Nationalities are grouped into regions because of the length of the list.

2.3.3 Data analysis

Two-stage data analysis, a recommended approach where the measurement and structural model are analysed separately, was implemented in this study (Anderson & Gerbing, 1988;

Kline, 2023). First, the measurement model was analysed using confirmatory factor analysis (CFA) to ensure the fitness of the model and the data. The convergent and discriminant validity of the measurement model were tested. In addition, the common method bias (CMB) was also tested to make sure that survey's bias was accounted for. Lastly, the structural model was analysed using covariance-based structural equation modelling (CB-SEM).

2.4 Empirical results

2.4.1 Assessment of the measurement model

The measurement model achieved adequate fit according to the CFA results. Firstly, the relative chi-square statistic ($CMIN/df = 2.108, p < 0.01$) value is less than 3, indicating a good fit between the covariance structure of the proposed model and the covariance matrix as observed in the dataset (Collier, 2020). Next, the model demonstrated a good fit by a root mean square error of approximation (RMSEA) value of 0.044, which is below the threshold of 0.05 (Kline, 2023), indicating a close approximation of the population covariance structure. Moreover, the standardised root mean square residual (SRMR) for the model is 0.036, indicating low average discrepancy between the observed and predicted correlations (Kline, 2023). Hence, the model demonstrates a good fit to the data. Other than the above-mentioned statistics, some of the commonly used relative fit indices are also provided to justify the model fit. The proposed model is compared with a null model to determine how better it is in explaining the data compared to a model that assumes zero covariances among variables (Kline, 2023). The model has a comparative fit index (CFI) of 0.957, an incremental fit index (IFI) of 0.957, a normed fit index (NFI) of 0.921, and a Tucker-Lewis index (TLI) of 0.952, surpassing the recommended threshold of 0.9 (Collier, 2020). Overall, these relative fit indices indicate that the proposed model provides a better fit to the data compared to the null model, demonstrating a good model fit. The constructs have acceptable reliability, with the values of Cronbach's α and composite reliability (CR) ranging from 0.89 to 0.95 (Hair et al., 2014). The

average variance extracted (AVE) exceeded the threshold of 0.5, thereby assuring the convergent validity of each construct (Fornell & Larcker, 1981). Table 2-2 shows the CFA statistics of the item-construct loading in the model.

Table 2-2: Confirmatory factor analysis

Constructs	Items	Item-construct		α	CR	AVE
		loading				
		Std. loading	<i>t</i> -value			
Attitude towards using	ATT1	0.796	21.61	0.911	0.911	0.672
	ATT2	0.830	22.93			
	ATT3	0.832	22.99			
	ATT4	0.834	23.08			
	ATT5	0.807	-			
Intention to use	INTU1	0.805	22.90	0.913	0.908	0.664
	INTU2	0.813	23.23			
	INTU3	0.797	22.39			
	INTU4	0.821	23.46			
	INTU5	0.838	-			
Perceived behavioural control	PBC1	0.749	19.41	0.912	0.911	0.673
	PBC2	0.840	22.46			
	PBC3	0.890	24.12			
	PBC4	0.821	25.74			
	PBC5	0.796	-			
Subjective norm	SN1	0.830	15.40	0.897	0.893	0.629
	SN2	0.850	15.63			
	SN3	0.891	16.04			
	SN4	0.755	17.74			
	SN5	0.608	-			
Perceived trust	PT1	0.828	22.20	0.921	0.917	0.688
	PT2	0.825	22.10			
	PT3	0.881	24.01			
	PT4	0.810	27.42			
	PT5	0.800	-			

Constructs	Items	Item-construct		α	CR	AVE
		loading				
		Std. loading	t-value			
Perceived usefulness	PU1	0.779	21.23	0.895	0.892	0.624
	PU2	0.833	23.32			
	PU3	0.763	20.51			
	PU4	0.748	19.97			
	PU5	0.822	-			
Perceived privacy concern	PC1	0.918	34.53	0.959	0.956	0.813
	PC2	0.928	35.42			
	PC3	0.918	34.52			
	PC4	0.853	37.70			
	PC5	0.890	-			
Perceived ease of use	PEOU1	0.810	21.04	0.902	0.903	0.651
	PEOU2	0.814	21.18			
	PEOU3	0.819	21.34			
	PEOU4	0.806	20.93			
	PEOU5	0.783	-			
Perceived risk	PR1	0.885	34.30	0.959	0.958	0.820
	PR2	0.884	34.18			
	PR3	0.922	38.80			
	PR4	0.914	37.73			
	PR5	0.921	-			

Notes: α is Cronbach's alpha; CR is composite reliability; AVE is average variance extracted.

This study used the heterotrait-monotrait ratio of correlation (HTMT), which is an improved technique for assessing discriminant validity (Collier, 2020). According to Table 2-3, the HTMT ratios for all constructs were below 0.85, which confirmed the discriminant validity of the constructs (Henseler et al., 2015).

Assessing the impact of CMB in survey research is crucial as it can result in measurement error and biased findings. Rather than answering the questions according to their actual feelings, the participants might try to satisfy social expectations or keep their responses consistent, leading

to potential CMB (Podsakoff et al., 2003). The Harman's single-factor method suggests that a single factor accounting for the majority of variance may indicate a significant issue with CMB (Collier, 2020). Other studies are being even stricter in arguing that such single-factor test is simply nondiagnostic and do not account for potential bias, so that this method should be avoided at all costs (Hulland et al., 2018; Podsakoff et al., 2024). Given that the Harman's result showed that 33.56% of variance was explained by a single unrotated factor, although not dominant, the authors believe that the common latent factor (CLF) method is more appropriate for this study. The CLF is a popular technique (Collier, 2020) and has recently been used by several researchers (e.g., Akgün et al., 2023; Akgunduz et al., 2022; Kumar et al., 2022). To detect the potential CMB, the measurement models with and without CLF were compared to test whether they differed significantly. The results showed that the difference between the initial model (CMIN = 1899.75, df = 901) and the model containing CLF (CMIN = 1847.85, df = 900) was significant, as the CMIN difference exceeded 3.84 for a one-point difference in the degrees of freedom (Collier, 2020). Hence, the CLF was also incorporated into the structural model analysis to control for the existing CMB.

Table 2-3: Discriminant validity (HTMT)

Constructs								
ATT								
0.788	INTU							
0.614	0.693	PBC						
0.368	0.361	0.174	SN					
0.610	0.616	0.570	0.362	PT				
0.827	0.752	0.639	0.364	0.550	PU			
0.039	0.095	0.011	0.337	0.025	0.066	PC		
0.748	0.709	0.664	0.305	0.567	0.794	0.049	PEOU	
0.061	0.084	0.033	0.393	0.005	0.057	0.776	0.018	PR

Notes: ATT is attitude towards using; INTU is intention to use; PBC is perceived behavioural control; SN is subjective norm; PT is perceived trust; PU is perceived usefulness; PC is perceived privacy concern; PEOU is perceived ease of use; PR is perceived risk.

2.4.2 Structural model and hypothesis testing

The structural model achieved adequate fitness according to the model fit statistics (CMIN/df = 2.059, $p < 0.01$, RMSEA = 0.043, SRMR = 0.0473, CFI = 0.958, IFI = 0.958, NFI = 0.922, TLI = 0.954). The goodness-of-fit indices ensured the fit between the input data and the structural model, indicating that all the established hypotheses could be tested using the current model with CLF.

According to Table 2-4, ATT was significantly shaped by PEOU and PU. Meanwhile, PEOU also significantly influenced PU, and INTU was significantly driven by ATT, and PBC. However, the effects of SN, PEOU, and PU were insignificant. Therefore, the results of this study supported most of the hypotheses posited in the literature on the TAM/TPB (i.e., H1–H3 and H8), except for H4, H5, and H7; in particular, this study found no statistical evidence that PEOU, PU, and SN had a direct impact on INTU.

Importantly, the analysis showed that ATT was positively and significantly shaped by PT and negatively impacted by PC, according to Table 2-4. However, the PR had an insignificant influence on ATT. Hence, H9 and H11 were supported, although there was insufficient evidence to support H13. Finally, INTU was not affected by PC, PT, or PR, providing insufficient evidence to support H10, H12, and H14.

Table 2-4: Hypothesis testing

Hypotheses	Structural path	β	Std. Error	<i>t</i> -value	Decisions
H1	PEOU $\rightarrow$ ATT	0.136*	0.07	1.931	Supported
H2	PEOU $\rightarrow$ PU	0.574***	0.07	8.204	Supported
H3	PU $\rightarrow$ ATT	0.517***	0.073	7.09	Supported
H4	PU $\rightarrow$ INTU	0.115	0.073	1.57	Not supported
H5	PEOU $\rightarrow$ INTU	0.049	0.069	0.709	Not supported
H6	ATT $\rightarrow$ INTU	0.347***	0.069	5.041	Supported
H7	SN $\rightarrow$ INTU	0.036	0.06	0.604	Not supported

Hypotheses	Structural path	β	Std. Error	t-value	Decisions
H8	PBC $\rightarrow$ INTU	0.201***	0.076	2.639	Supported
H9	PC $\rightarrow$ ATT	-0.052*	0.028	-1.862	Supported
H10	PC $\rightarrow$ INTU	0.015	0.027	0.541	Not supported
H11	PT $\rightarrow$ ATT	0.126**	0.052	2.431	Supported
H12	PT $\rightarrow$ INTU	0.074	0.054	1.377	Not supported
H13	PR $\rightarrow$ ATT	0.007	0.032	0.207	Not supported
H14	PR $\rightarrow$ INTU	-0.021	0.036	-0.578	Not supported
Squared multiple correlation (R^2):					
PU		0.329			
ATT		0.425			
INTU		0.351			

Notes: Unstandardised β coefficients were reported; * $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$. ATT is attitude towards using; INTU is intention to use; PBC is perceived behavioural control; SN is subjective norm; PT is perceived trust; PU is perceived usefulness; PC is perceived privacy concern; PEOU is perceived ease of use; PR is perceived risk.

This study also examined whether a mediation effect exists, as illustrated in Table 2-5. The direct effect of the independent variables (e.g., PC, PT, and PR) on the dependent variables (ATT and INTU) was compared with the indirect effect through the mediator (Collier, 2020). The results revealed that the indirect effect of PEOU on ATT through PU was positive and statistically significant. Moreover, the indirect effects of PU, PEOU, and PT on INTU through ATT were also significant. Note that the indirect effects of PU, PEOU, and PT on INTU were classified as “full mediation” because the direct effect was insignificant. Lastly, the indirect effects of PC and PR on INTU through ATT were insignificant.

Table 2-5: Mediation tests.

Relationships	Direct Effect	Indirect Effect	Confidence interval		t-value	Conclusions
			Low	High		
PEOU → PU → ATT	0.136* (0.070)	0.296*** (0.085)	0.149	0.493	3.482	Partial mediation
PU → ATT → INTU	0.115 (0.073)	0.179*** (0.065)	0.071	0.332	2.754	Full mediation
PEOU → ATT → INTU	0.049 (0.069)	0.216*** (0.074)	0.099	0.402	2.919	Full mediation
PC → ATT → INTU	0.015 (0.028)	-0.018 (0.15)	-0.058	0.004	-0.120	No mediation
PT → ATT → INTU	0.074 (0.054)	0.044** (0.028)	0.001	0.117	1.571	Full mediation
PR → ATT → INTU	-0.021 (0.036)	0.002 (0.014)	-0.022	0.035	0.143	No mediation

Note: Unstandardised β coefficients are reported; the values in parentheses are standard errors; * $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$; bootstrap, 5000 samples; 95% confidence intervals. ATT is attitude towards using; INTU is intention to use; PT is perceived trust; PU is perceived usefulness; PC is perceived privacy concern; PEOU is perceived ease of use; PR is perceived risk.

2.5 Discussion

As Table 2-4 illustrates, 7 out of 14 hypotheses were supported, mostly aligning with the TAM and TPB (Ajzen, 1991; Davis, 1986). First, PEOU and PU influenced ATT. The effect of PU on ATT was stronger than that of PEOU. These findings aligned with a prior study on self-check-in kiosks (Lee et al., 2014). Although the TAM proposes that INTU is influenced by PU, and several past studies support that it is also influenced by PEOU, the results of this study did not support these relationships. The result aligns with a prior study showing that PEOU and PU do not have significant influence on INTU in the context of adopting biometric security at the airport (Kasim et al., 2021). These show that passengers may realise the easiness and benefits from biometric check-in kiosks, but these may not help forming an adoption intention. The possible explanation could be that air travel is a high-stakes service which could cost passengers time and money when mistakes happened. Therefore, passengers choose the safest and the most familiar check-in channel, traditional check-in counter, regardless of any advantages the biometric check-in kiosks may offer. Another explanation could be that almost 70% of participants have graduated at least bachelor's degree and more than 80% of participants are 50 years old or younger. These could imply that the participants are relatively familiar with technology usage and realise the advantages of using the technology, therefore, PEOU and PU may no longer be primary factors influencing the usage of the new technology.

After examining the model in more detail, the authors found that PEOU and PU indirectly influenced INTU through ATT (Table 2-5). This implies that even without direct effects, both perceptions shape passengers' ATT biometric check-in kiosks, which, in turn, shape their INTU. Although this mediating role of ATT has rarely been tested in aviation SST research, this finding aligns with prior study on the general use of information technology, showing that ATT fully mediates the impacts of PEOU and PU on INTU (Y. J. Kim et al., 2009).

Additionally, this study also identified the indirect effect of PEOU on ATT through PU. This means that the perception that biometric check-in kiosks are easy to use influences passengers' perceptions that the kiosks are useful, which, in turn, positively shape their ATT. A previous study also supported a similar partial mediating role of PEOU and ATT in the context of airline e-commerce (H.-B. Kim et al., 2009). The results confirmed the influence of PBC on INTU, which aligned with the TPB (Ajzen, 1991) and other studies on the adoption of aviation SST (Lien et al., 2021; Lu et al., 2009; Ruiz-Mafe et al., 2013). Moreover, the results are consistent with previous studies, which showed that SN did not play a significant role in driving INTU (Lien et al., 2021; Mohd Suki & Mohd Suki, 2017; Ruiz-Mafe et al., 2013). This result is surprising as more than 70% of the participants are Asian, which is generally considered to share a collectivism culture. A recent study has concluded that a sense of collectivism in Asian people is fading, given that the political and economic situation are improved (Kim, 2024). Although the study did not show the evidence of complete shift to individualism culture, it may be worth to re-examine the role of subjective norm in the future.

It should be noted that three factors (i.e., PC, PT, PR) that were incorporated into this study's model have been given less attention in aviation SST adoption research. The results showed that PT significantly impacted ATT, aligning with previous studies (H.-B. Kim et al., 2009; Thamaraiselvan & Thanigaialar, 2019). Although the direct impact of PT on INTU was not significant, its indirect impact through ATT was disclosed, indicating the fully mediating role of ATT. This implies that passengers' PT of biometric check-in kiosks positively shapes ATT, which, in turn, forms their INTU. This finding confirmed the proposed effect of trust on attitude and, subsequently, on intention (Lee, 2016).

Moreover, higher PC negatively influenced ATT, consistent with previous research on biometrics in banking (Breward et al., 2017) and aviation (Morosan, 2011). Unlike the earlier airport biometrics studies (Kasim et al., 2021; Morosan, 2016), this study did not find a

significant influence of PC on INTU. The result also showed an insignificant effect of PR on INTU, which is similar to prior work on the self-check-in kiosks, which found that INTU is not significantly influenced by PR (Lee et al., 2014; Lu et al., 2009). One possible explanation for this finding can be related to cognitive dissonance theory (Harmon-Jones & Mills, 2019), which suggests that passengers might acknowledge concerns about privacy and perceptions of risks associated with using biometric check-in kiosks, yet they may still decide to maintain their initial intention whether or not to use it.

2.6 Conclusion

This study investigated passengers' INTU biometric check-in kiosks at two Thai airports using the TAM and TPB with three additional variables: PC, PR, and PT. The results showed that 7 out of 14 hypotheses are supported. The key findings include the following: (i) the effects of PC and PT on ATT biometric check-in kiosks were significant; (ii) the effects of SN and PC on the intention to adopt biometric check-in kiosks were insignificant; and (iii) the PR did not play an important role in this study; (iv) the indirect effect tests showed that the PU of biometric check-in kiosks mediated the relationship between PEOU and ATT biometric check-in kiosks; and (v) ATT biometric check-in kiosks mediated the impact of PEOU, PU, and PT on adoption intention. To enhance the adoption of biometric check-in kiosks, airports should actively promote the ease of use and benefits of the kiosks, while also addressing privacy-related concern and build trust among passengers. A more integrated layout combining kiosks and baggage drop-off machines could streamline the check-in process, improving the overall passenger experience. The following subsections detail these findings' implications.

2.6.1 Theoretical implications

This study has several theoretical implications. Although the TAM framework has been implemented widely, their results were not in consensus. Moreover, some perceptions (e.g.,

PC, PT, and PR) are underexplored in studies on technology acceptance, and are often investigated separately. To fill the gap, the authors established an integrated research framework based on the TAM and TPB with additional variables: PC, PT, and PR to examine passengers' intentions to adopt biometric check-in kiosks at airports, which is currently lacking. This integrated framework advances former research by providing a more comprehensive and nuanced theoretical lens for understanding technology acceptance, particularly within privacy-sensitive and voluntary contexts. This study also provides more insights to the scarce literature about the passengers acceptance of biometric check-in kiosks, especially in the context of ASEAN countries.

Prior research on the adoption of aviation SST have often ignored the role of attitudes in forming the behavioural INTU the technology. To the authors' knowledge, this is the first study in the field of aviation SST research to illustrate that the effects of PU and PEOU on INTU are fully mediated by ATT biometric check-in kiosks. This contribution highlights the original TAM's mechanism and emphasise that the attitude becomes crucial when users interact with systems involving personal biometric data. This study supports the mechanism that ATT biometric check-in kiosks is an important factor forming INTU this technology, and therefore, urging a deeper consideration of affective responses in future aviation SST research.

Lastly, previous research on the acceptance of technology has examined the role of PC, PR, and PT on the acceptance of biometric technology in general (Lancelot Miltgen et al., 2013); however, they did not include the users' attitude in their analysis. Therefore, this study offers an alternative perspective, emphasizing that PC and PT significantly shape passengers' ATT biometric technology (in this case, biometric check-in kiosks). This means that high PC among passengers leads to adverse ATT biometric check-in kiosks, whereas positive ATT are more likely for passengers with high PT. However, PR of using biometric check-in kiosks did not have a significant effect on INTU in this study's results.

2.6.2 Practical implications

This study provides practical implications for aviation stakeholders considering implementing biometric technology. First, PEOU and PU played an essential role in shaping passengers' favourable attitudes, subsequently driving INTU biometric check-in kiosks. Hence, service providers are suggested to actively communicate how biometric check-in kiosks facilitate passenger processing and that they are useful and easy to use. According to a recent report, approximately 91% of Thailand's population used Facebook and LINE as social media platforms in 2023 (Pinchuck, 2024). Therefore, posting tutorials on social media demonstrating how to use biometric check-in kiosks could boost public understanding, reshape their attitudes, and increase their awareness and adoption intention. For example, Dubai International Airport and Emirates collaborate on the biometric technology implementation, aiming to quicken the passenger processing and enhance passenger experience (Emirates, 2022). Emirates provides tutorial on the use of biometric technologies, including biometric check-in kiosks, on their websites and Facebook page.

Moreover, the use of biometric check-in at airports should be fully integrated to enhance users' experience and efficiency, ensuring that passengers can easily access and utilise these systems. In the case of Thailand's airport operations, biometric check-in kiosks and baggage drop-off machines are separate, which means passengers must queue at two different stations to check in and process their baggage. While this layout is commonly implemented at global airports such as Dubai International Airport, Singapore Changi Airport, and Hong Kong International Airport, this could lead the passengers to think that the kiosks are not useful and could shape negative ATT. To improve this, airports, and airlines should rearrange the layout of check-in and bag drop processes, streamlining the passenger's journey. One suggestion is to pair the two machines together, allowing passengers to complete the check-in process without having to

wait in multiple queues. This would allow the check-in process through biometric check-in kiosks to be much easier for passengers and positively shape their ATT.

Second, this research highlights the importance of addressing concerns about privacy and building trust related to biometric check-in kiosks adoption. Data breaches could cause damage to both organisations and individuals. A recent report from SITA illustrates that airlines are projected to spend \$37 billion and airports nearly \$9 billion on IT over the next two years (SITA, 2024). This investment will be largely allocated to improving cybersecurity, which is a leading concern for most airlines (66%) and airports (73%). However, in January 2024, Thai organisations have faced 14 major data breaches that involved the personal information of its citizens (Resecurity, 2024). This has raised concerns among Thailand's public about data security. Therefore, airports and airlines should communicate how the passengers' biometric data are stored and treated. Many airports have considered or implemented new cybersecurity measures, such as the detection of fraud using artificial intelligence and the establishment of centralised security operation centre (SITA, 2024). In addition, more than 80% of surveyed airlines have implemented cloud protection, multi-factor authentication (MFA), and single-sign-on (SSO) authentication to enhance cybersecurity (SITA, 2024). Airports and airlines could implement these measures, ensuring the protection of privacy and that other entities will not have unauthorised access to or use the data for illegal purposes. Moreover, it is important for airports and airlines to demonstrate the reliability of biometric check-in kiosks to promote passengers' trust, thus ensuring that they will deliver the promised outcome. Hence, the continuous improvement and periodical review of the system are necessary to minimise service failures and build confidence among passengers.

As the study on this system is rare, this research provides valuable insights that service providers may find useful in relieving airport congestions, staff shortages, and enhance passenger experience through an increased adoption of biometric check-in kiosks. Specifically,

this research is useful for service providers operating in ASEAN countries as they share similar cultures and, to the knowledge of the authors, this is the first study on biometric check-in kiosks in the region. Additionally, this research emphasises the role of passengers' attitudes, which was often ignored in the previous aviation SST research in forming an adoption intention. Therefore, this research provides different approach to boost passengers' intentions to adopt biometric check-in kiosks based on the adjustment of passengers' attitudes.

2.6.3 Limitations and future research

Some limitations of this study have been observed, and these could be opportunities for future research. First, the data used in this study are cross-sectional, limiting the ability to investigate the changes of passengers' actual use of biometric check-in kiosks over time. Moreover, passengers were asked to complete all the questions in one survey, indicating potential CMB in their answers. Although a statistical remedy was used in this study, it would benefit future research to use a time-lag method if feasible (see Venkatesh and Bala (2008), for example). Furthermore, the questionnaires of this study do not capture sufficient details on the cultural context nor biographical characteristics of the participants; future research may investigate more deeply into those contexts, such as individualism versus collectivism, to gain more insights into how they may affect the use of biometric technology at airports. Lastly, future research could expand the data collection beyond Thai airports, producing more generalizable results regarding the acceptance of biometric technology.

STATEMENT OF CONTRIBUTION DOCTORATE WITH PUBLICATIONS/MANUSCRIPTS

We, the student and the student's main supervisor, certify that all co-authors have consented to their work being included in the thesis and they have accepted the student's contribution as indicated below in the Statement of Originality.

Student name:	PHUTAWAN HO WONGYAI		
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In which chapter is the manuscript/published work?	Chapter 3		
Describe the contribution that the student and members of the supervisory team have made to the manuscript/published work: ¹ The doctoral candidate is responsible for designing the conceptual framework and survey instrument, collecting the data, conducting the formal analysis, and writing the original draft, all while receiving guidance from the supervisors. Phutawan Ho Wongyai: Writing – original draft, Methodology, Formal analysis, Conceptualization. Thanh Ngo: Writing – review & editing, Supervision, Conceptualization. Hanjun Wu: Writing – review & editing, Methodology. Kan Wai Hong Tsui: Writing – review & editing. Thu-Huong Nguyen: Writing – review & editing.			
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Chapter 3 – Self-service technology from employees’ perspectives

Preamble

Chapter 2 addresses the research gaps concerning the adoption of SST from the airline passengers’ perspectives. In contrast, Chapter 3 focuses on the research gaps identified in Chapter 1, specifically the lack of studies examining the impact of SST from the airlines and airports ground staff’s perspectives. Therefore, this chapter aims to investigate the effects of SST on airport and airline ground employees, aligning with the third research objective of this thesis mentioned in Introduction. Chapter 3 is grounded in the rationale that airlines and airports are increasingly moving towards automating the passenger journey. This includes integrating self-service channels such as self-ticketing, self-check-in, and self-boarding. While this shift can enhance efficiency, it also poses a potential threat to employees’ current jobs (i.e., job insecurity). Previous aviation literature on job insecurity has primarily focused on flight crews, with little attention given to ground employees who are directly affected by the implementation of SST. As such, this chapter examines how the perceived threat of job automation stemming from SST influences job insecurity, job satisfaction, organisational commitment, and turnover intention among ground staff in Thailand’s airports and airlines. The findings indicate that airport and airline ground employees perceive SST as a threat to their jobs, which consequently affects their job satisfaction and intentions to stay with their organisations. This chapter offers insights and recommendations for airlines, airports, and ground handling companies to better understand their employees’ concerns and take measures to alleviate feelings of job insecurity while effectively managing the interplay between SST and their workforce.

Study 3: Service Automation via Self-Service Technology: The Impact on Airports' and Airlines' Ground Staff

Publication status and candidate contribution

This study has been submitted to a highly ranked tourism and hospitality journal. The doctoral candidate is the first and corresponding author, with all supervisors listed as co-authors. The doctoral candidate is responsible for designing the conceptual framework and survey instrument, collecting the data, conducting the formal analysis, and writing the original draft, all while receiving guidance from the supervisors.

3.0 Abstract

Businesses are investing more in technology and automation to replace some of the routine tasks performed by human employees; the aviation business is no exception. This study examines the impact of self-service technologies (SST) on airlines' and airports' ground staff in Thailand, focusing on the influence of the perceived threat of job automation derived from the implementation of SST on job insecurity, job satisfaction, organisational commitment, and staff turnover intention. Using the survey data from 193 airport and airline staff and partial least squares structural equation modelling, this study reveals that perceived threats of job automation via SST significantly increase job insecurity, which reduces job satisfaction and increases turnover intention. In addition, job insecurity plays a mediating role affecting the impact of the threat of job automation via SST on job satisfaction and turnover intention. Lastly, job satisfaction enhances organisational commitment, which reduces turnover intention. The findings of this study provide insights to airlines, airports, and ground handling companies to better accommodate their ground staff and manage services between them and SST.

3.1 Introduction

The COVID-19 pandemic caused a crisis in the global aviation industry. The pandemic forced the governments to impose travel restriction policies, causing the number of seats offered by airlines in 2020 to reduce by 50% compared with 2019 (International Civil Aviation Organization, 2023). Airlines implemented different measures to ensure the viability of their business, such as seeking government support, giving employees leave without pay, reducing working hours, and voluntary resignation (KPMG, 2020). As a result, aviation jobs were estimated to have reduced by 21% worldwide compared with the pre-pandemic situation (Airlines, 2021). Following the removal of pandemic-era travel bans, passenger volumes in 2024 surpassed 2019 levels by 3.8%, establishing a new peak (International Air Transport Association, 2025). Despite this recovery in demand, airports continue to face persistent congestion due to personnel shortages caused by COVID-19 layoffs and workforce reductions (Vance, 2022). Thailand also recovers from the pandemic downturn with the number of passengers carried in 2024 surpassed 70% of 2019 level and its government also aim to develop Thailand to be a regional aviation hub (Civil Aviation Authority of Thailand, 2024b). The plan includes, for example, terminal expansion, regulatory compliance, and integration of self-service technology in passenger service.

Technology and innovation are advancing quicker than people, companies, and society can adjust to them (Kane, 2017). This technological advancement can be generalised as STARA, standing for “smart technology, artificial intelligence, robotics, and algorithms” (Brougham & Haar, 2018). Examples of STARA in aviation include online check-ins, service chatbots, biometric check-in kiosks, automated bag drops, and e-boarding gates. The global aviation industry has implemented these systems for a long time and has gained more attention since the COVID-19 pandemic (SITA, 2021a). To continue operating during the pandemic and

reduce physical contact between staff and passengers, airlines and airports integrated these systems into passenger processing, allowing passengers to avoid contacting staff (AirAsia, 2023; SITA, 2021a).

Companies are attracted to implementing new technologies and realising their benefits, such as product and service improvements, operations optimisation, and reducing the time spent on routine tasks (Hupfer, 2020). Reflecting this trend, 66% of leading global companies attempted to automate routine processes by 2020 (Schwarz, 2020), while the use of virtual customer service agents was projected to surge from 15% in 2018 to 70% by 2022 (Goasduff, 2019). A study showed that around 47% of jobs, including those of workers in the transport business, were in risky situations as automation can perform a broader range of cognitive and nonroutine tasks than before (Frey & Osborne, 2017). Moreover, one-third of the job descriptions could be replaced by automation in the case of 60% of occupations (Manyika et al., 2017). The proportion of tasks performed by humans and machines was expected to change from 67% to 33% in 2020 to 53–47% in 2025 (Agenda, 2021). In addition, the survey from the Organisation for Economic Co-operation and Development showed that workers started to be concerned about wage reduction and job losses in the next 10 years as a result of implementing artificial intelligence and automation (Organisation for Economic Co-operation and Development, 2023). This phenomenon also happens in aviation industry as airlines and airports are still investing in information technology for passenger processing, aiming to automate passengers' journey (SITA, 2024). Therefore, aviation ground staff providing routine tasks such as check-in and ticketing are at risk of replacement.

Previous research has explored technological changes' impact on employees. For example, employees' awareness of technological changes could lead to less commitment to the organisation and job satisfaction (JS), while increasing stress and the intention to resign (Brougham & Haar, 2018). Moreover, a more negative impact on employees' health and JS

was found for jobs with a high risk of replacement by automation (Nazareno & Schiff, 2021). Additionally, several studies revealed that technological changes shaped the employees' perceptions of job insecurity (e.g., Givord & Maurin, 2004; Lingmont & Alexiou, 2020; Nam, 2019; Vieitez et al., 2001).

Prior research on JS in the service industry has discussed the critical role of JS and JI. The two terms measure people's beliefs about the future of their present job from positive and negative viewpoints (Zeytinoglu et al., 2013). Studies have shown that the more service employees believed their jobs were secure, the higher their satisfaction with their job (Zeytinoglu et al., 2013) and the stronger their intention to stay with the organisations (Zeytinoglu et al., 2012). The COVID-19 pandemic also highlighted the fragility of employment in the aviation sector, with studies finding that JI reduced flight attendants' self-esteem and JS (Y. Shin et al., 2022), and that airline employees would be less satisfied if they believed they could lose their jobs (Han et al., 2022). High JS could lead to positive outcomes such as organisational commitment (e.g., Chen & Kao, 2011; Firdaus et al., 2022; Jung et al., 2022; Limpanitgul et al., 2013), job performance (e.g., Firdaus et al., 2022; Han et al., 2022; Ng et al., 2011), and loyalty (Han et al., 2023), whereas low JS could influence the decision by service employees to leave their organisations (e.g., Chen & Kao, 2011; Chung & Jeon, 2020; Jung et al., 2022; Suifan et al., 2017).

Although numerous studies have explored JS and insecurity among aviation employees, most have concentrated on flight attendants (e.g., Firdaus et al., 2022; Han et al., 2023; Y. Shin et al., 2022). This focus has created a research gap concerning airport and airline ground staff (hereafter referred to as "ground staff"), whose roles are increasingly susceptible to replacement by SST. Unlike flight attendants, many of the core functions of ground staff, such as check-in, baggage handling, and ticketing, are highly automatable (Brady & Lin, 2023; Singh, 2018) and can be considered as a source of JI. Therefore, to address this research gap,

this study aimed to investigate how the perceived threat of job automation by SST (TSS hereafter) influences the attitudes (i.e., JI, JS, and OC) and behaviours (i.e., turnover intention (TI)) of ground staff.

This study makes two key contributions to the aviation literature. First, this study investigates the relationships between JI, JS, TI, and implementation of SST as a threat to ground staff, which has received little attention from researchers. Moreover, this study focuses on ground staff, whereas previous aviation research focused heavily on cabin crew, pilots, and security officers. In terms of managerial implications, the findings of this study can help aviation stakeholders to develop strategies to mitigate negative employee outcomes and effectively manage the passenger services provided by SST and staff, thereby enhancing service quality of companies.

The following section offers a review of relevant literature that encompasses the theoretical frameworks and the development of the hypotheses of this study. Following that, the methodology section outlines the survey instrument and the process of data collection, along with an overview of the data for analysis. The findings from the structural equation model are then presented, leading into a discussion of the results. Finally, the implications and limitations of this research are discussed.

3.2 Literature review

3.2.1 Perceived threat of job automation

Implementing technology not only leads to better customer service but also brings positive benefits to the workplace (Bitner et al., 2000). Seventy percent of employees in the finance industry reported that they make better and faster decisions with the help of artificial intelligence (Lane et al., 2023). Retail staff reported that they have been able to finish their job faster and accommodate more customers since the use of SST in their workplaces (Di Pietro et

al., 2014). Moreover, customer service employees revealed that their work became more appealing, since the service chatbot could answer customers' frequently asked questions and navigate routine tasks, leaving them with exciting and challenging queries (Milanez, 2023). Aviation SST allows passengers with high technology self-efficacy to check in and board the aircraft by themselves, reducing the number of passengers that staff have to deal with (Brady & Lin, 2023). For example, Thai AirAsia reported that around half of passengers in 2018 performed check-in tasks by themselves through online check-ins, self-service check-in kiosks, and mobile check-ins (Asia Aviation, 2019).

On the other hand, the integration of technology also negatively impacts the workplace (Frey & Osborne, 2017). The adoption of automation stimulates perceptions of a threat of skilled workers being replaced since the technologies are gradually being developed to perform more cognitive tasks (Organisation for Economic Co-operation and Development, 2023). In other words, advanced technology executes more tasks requiring skills and experience. Moreover, robots are integrated into several hotel brands' services, such as concierge, butler, delivery, and luggage-carrying robots (SocialTables, 2017). In addition, airlines and airports continuously invest in SST, aiming to automate passenger processing (SITA, 2022). For instance, AirAsia introduced and encouraged seamless air travel at Kuala Lumpur International Airport. Currently, passengers only contact staff during security screening, immigration (for international passengers), and boarding (AirAsia, 2023). This trend of automation and its potential for job displacement is supported by a study by Frey and Osborne (2017), who classified several service jobs, such as waiters/waitresses, hotel clerks, tour guides, and transportation attendants (excluding flight attendants), as having a high risk of being automated.

The perceived threat of job automation has recently gained more research attention. It is defined as an employee's evaluation of technological changes that can negatively impact their present

job (Brougham & Haar, 2018, 2020). According to the social exchange theory (SET), the employment relationship is a transaction based on reciprocity, where employees offer contributions (e.g., loyalty, work performance) in exchange for inducements (e.g., salary, benefits, and crucially, job security) (Blau, 1986; Cropanzano & Mitchell, 2005). From this perspective, the perception that technology is designed to perform the tasks currently performed by employees signals a breach of the psychological contract regarding long-term job stability (Ashford et al., 1989; Lingmont & Alexiou, 2020). Sverke et al. (2002) indicated that the heightened perceptions of automation-related job threats are associated with increased JI. In other words, the perception that technology is designed to perform the tasks currently performed by employees leads them to believe that they may lose their jobs in the future. Previous studies support that perceived threat of job automation has a negative impact on JI of employees in various industries (Brougham & Haar, 2018, 2020; Dengler & Gundert, 2021), including the service industry, such as hotel employees (Zhang & Jin, 2023). Moreover, automation has the potential to replace job functions that some workers consider to be fundamental to their professional identity and source of meaning (Nazareno & Schiff, 2021). For example, the barista's main job function (making coffee) is replaced by an automated coffee machine or, in the case of this study, the ground staff's main job functions (checking in, providing information) are replaced by self-check-in channels. Studies show that the perceived threat of job automation lowers employees' JS in various industries (Nazareno & Schiff, 2021), including hospitality (Lestari et al., 2023). In addition, the perceived threat of job automation also increases employees' intention to resign from the company (Brougham & Haar, 2020; Lingmont & Alexiou, 2020) and to look for other job opportunities (Presbitero & Teng-Calleja, 2023).

However, the effect of the perceived threat of job automation has not been explored in the context of aviation, in which the integration of SST in airports and airline operations has become prevalent. Therefore, this study proposes the following hypotheses:

H1: TSS positively influences the JI of ground staff.

H2: TSS negatively influences the JS of ground staff.

H3: TSS positively influences the TI of ground staff.

3.2.2 Job insecurity

The situation where individuals believe they have less power to keep their jobs during unfavourable circumstances is defined as “job insecurity” (Greenhalgh & Rosenblatt, 1984). Job security is also described as perceptions of a job’s continuity and existence (Davy et al., 1997; De Witte, 1999) and concerns about the threat to the present jobs of employees (Heaney et al., 1994). Radical changes in the working environment can shape the employees’ perceptions of JI, such as merging and acquisitions, structure adjustment, minimising the company’s size, and technological changes (Ashford et al., 1989; Roskies & Louis-Guerin, 1990). It should be noted that JI is different from job loss. The loss of a job is a sudden event, whereas the feeling of insecurity about one’s job is a persistent state that involves prolonged uncertainty regarding the future (Sverke et al., 2002).

The perception of JI can lead to negative consequences on employees. According to research on stress, coping strategies can be triggered by individuals to deal with the core relational theme, namely the good or bad things that may cause the emotions to be positive or negative (Smith & Lazarus, 1993). An increase in JI is symptomatic of the concerns about the continuity and existence of one’s present job, which has been included in lists of stressors (Landsbergis, 1988; Smith & Lazarus, 1993). Hence, JI has been shown to indicate a core relational theme that triggers different coping strategies (Davy et al., 1997). Individuals may use behavioural

withdrawal as one of the coping strategies to escape from the stress derived from JI (Ashford et al., 1989). In other words, employees may think about leaving the company (turnover) if they believe that their JI is high. In the case of this study, the increased JI stemming from the widespread implementation of SST in aviation passenger services could lead employees to consider finding another job. Prior studies have also supported that increased JI influences employees' intention to leave the company (e.g., Ashford et al., 1989; Brougham & Haar, 2020; Cheng & Chan, 2008; Mensah et al., 2020; Sverke et al., 2002). Similarly, Zeytinoglu et al. (2012) found that increasing job security influences the intention to stay among employees in the service sector.

JI not only influences the behavioural withdrawal of employees but also their psychological withdrawal (Smith & Lazarus, 1993), which can result in reduced satisfaction with their current jobs and their commitment to the organisation. Meta-analyses have found that JS and OC are impacted negatively by JI (Cheng & Chan, 2008; Sverke et al., 2002) and positively by job security (Hur, 2022). The relationship linking JI, JS, and OC has been affirmed by empirical studies in general (e.g., Caballer et al., 2011; De Cuyper & De Witte, 2006; König et al., 2011; Sora et al., 2009), in the production industry (Stankevičiūtė et al., 2021), and in the hospitality and tourism industry (Vujičić et al., 2015). These relationships have received less attention in the aviation industry, especially from the ground staff's perspective.

As mentioned earlier, the perceived threat of job automation can impact employees' JI. Some of the studies discussed previously also support the assumption that JI affects both JS and TI. Therefore, it is expected that JI will likely play a mediating role in the impacts of the perceived threat of job automation on JS and TI. Hence, this study proposes the following hypotheses:

H4: JI negatively influences the JS of ground staff.

H4a: JI mediates the relationship between TSS and JS.

H5: JI negatively influences the OC of ground staff.

H6: JI negatively influences the TI of ground staff.

H6a: JI mediates the relationship between TSS and TI.

3.2.3 Job satisfaction

JS is defined as “a pleasurable or positive emotional state resulting from the appraisal of one’s job or job experience” (Locke, 1976, p. 1300). Similarly, Spector (1997, p. 2) defined JS as “simply how people feel about their jobs and different aspects of their jobs”, which can involve positive or negative feelings. JS is a personalised and subjective outcome that depends on one’s expectations of and experiences from a job. When the gap between expectations and experiences is small, satisfaction tends to be high, and when the gap is large, satisfaction is low (Pan, 2015). It is crucial to maintain employees’ levels of satisfaction, especially in the service industry, as they have direct contact with customers during the service encounter, which reflects the service quality of the company (Lawler, 1973, 2005). Airport and airline services are good examples (Firdaus et al., 2022; Sung & Hu, 2021).

The impact of employees’ JS has been studied in various industries, including the hospitality industry, as well as the airport and airline sectors. An increase in JS significantly led to higher commitment to the organisation among hotel employees (Dusek et al., 2016; Mensah et al., 2020) and airline employees (e.g., Chen & Kao, 2011; Firdaus et al., 2022; Jung et al., 2022; Kim & Back, 2012; Limpanitgul et al., 2013). Moreover, employees tend to continue working for the companies when they are satisfied with their jobs (Sung & Hu, 2021). Additionally, an increase in JS significantly reduces the intentions of hotel employees to resign from their current jobs (Dusek et al., 2016; Mensah et al., 2020) and airline employees (e.g., Chen, 2006; Chen & Kao, 2011; Chung & Jeon, 2020; Jung et al., 2022; Suifan et al., 2017). As mentioned earlier, the perceived threat of job automation can impact employees’ JS, and some of the

studies discussed previously also support the assumption that JS affects TI. Therefore, it is expected that JS will likely play a mediating role in the impacts of the perceived threat of job automation on TI.

According to Chung and Jeon (2020), there are two ways in which JS can be viewed: (i) facet JS and (ii) general JS. An employee's positive emotions towards different aspects of their work, such as the task, salary, working environment, and other factors, are referred to as facet JS. General JS is an overall or average assessment that includes various elements of the job. This study approaches JS from the general view because it aims to understand the overall attitude of employees towards their work and its relationship with perceived TSS, OC and TI. Although facet satisfaction offers details on specific aspects such as salary and the working environment, it was not required for the objective of this study. Therefore, this study proposes the following hypotheses:

H7: JS positively influences the OC of ground staff.

H8: JS negatively influences the TI of ground staff

H8a: JS mediates the relationship between TSS and TI.

3.2.4 Organisational commitment

Employees' commitment to the organisation is an important concept among their job-related attitudes (Firdaus et al., 2022; Hur, 2022). According to Mowday et al. (1979), OC is defined as the extent to which an individual identifies with and actively participates in the organisation. Similarly, OC refers to an employee's mental state towards the organisation, which also influences the decision to continue being a part of that organisation (Meyer & Allen, 1991). Hence, employees who exhibit a strong sense of commitment are less likely to engage in counterproductive work behaviour (i.e., actions that are against the company's policies or

interests) and are more inclined to engage in suitable actions that benefit their organisations (Dyne & Ang, 1998). For example, employees who are highly committed to the organisation tend to uphold its values and objectives, display a willingness to fulfil their expected duties (Dogan & Kilic, 2007), foster better collaboration with colleagues and customers (Limpanitgul et al., 2013), exhibit loyalty, and spread positive word-of-mouth (Cho et al., 2009).

The strong relationship between OC and TI of employees is well understood and established (Cohen, 2007). Prior research on hotel employees revealed that increasing OC significantly reduced their intention to leave (e.g., Dusek et al., 2016; Mensah et al., 2020; Yılmaz et al., 2022). As similar relationship has been found among airline employees (e.g., Chen, 2006; Chen & Kao, 2011; Suifan et al., 2017). As discussed previously, JS impacts OC, which, in turn, impacts TI; therefore, JS is expected to have an indirect impact on TI, through OC. The following hypotheses are proposed:

H9: OC negatively influences the TI of ground staff

H9a: OC mediates the relationship between JS and TI.

All hypotheses stated above are illustrated in Figure 3-1.

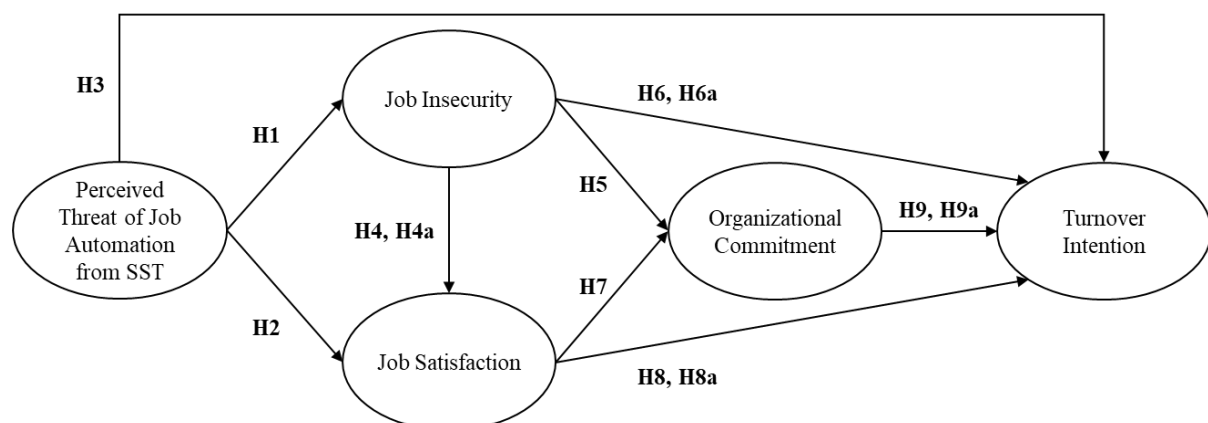


Figure 3-1: Conceptual framework.

3.3 Methodology and Data

This study used a survey method for data collection. Surveys are commonly used to explore human perceptions and behaviour in many fields, including organisational behaviour (e.g., Brougham & Haar, 2020; De Cuyper et al., 2019; Lingmont & Alexiou, 2020), tourism and hospitality (e.g., Kala & Chaubey, 2024; Shimul et al., 2024; Zhang et al., 2023), and aviation (e.g., Chuaychoo & Tunjoy, 2022; Kim et al., 2022; K. Lee et al., 2022). Moreover, because of the nature of the work of ground staff, who are usually busy, the survey method provides more opportunities to collect data from the participants, offering greater time efficiency compared with other data collection methods, such as interviews (Jones et al., 2013). The collected data were analysed using structural equation modelling, which enabled this study to examine more complex models and chains of relationships (such as the relationships between TSS and the attitudes of airport and airline staff) that cannot be analysed simultaneously using multiple regression analysis (Hair et al., 2021).

3.3.1 Survey instrument

The questionnaire established for this study was written in English and Thai², and contains two main parts: (1) employees' opinions and (2) demographic information of the participants. Based on the review of the existing literature on the threat of job automation and JI, a conceptual framework was developed. Subsequently, measurement items were developed and adjusted to ensure their suitability for the context of the study. A seven-point Likert-type scale was used to score all the measurement items, where 1 = strongly disagree and 7 = strongly agree.

² It was compiled by using an independent translation by a lecturer from the first author's university, who is proficient in both Thai and English.

Perceived TSS was measured via the measurement items developed by Brougham and Haar (2018). An example of these item is “I am personally worried about my future in my organisation due to self-service technology replacing employees.” To measure employees’ JI, measurements from Caballer et al. (2011) and Vander Elst et al. (2014) were adopted, such as “I think I could lose my job in the near future.” Items such as “I feel fairly-well satisfied with my present job,” were borrowed from Chen and Kao (2011) and Ku et al. (2014) to evaluate employees’ JS levels. The OC measurements were adopted from Limpanitgul et al. (2013) and Han et al. (2022). An example of these items is “I really feel as if this organisation’s problems are my own.” Finally, the TI of employees was measured by using items from Chen and Kao (2011) and Dusek et al. (2016), e.g., “I will probably look for a new job this year.”

3.3.2 Data collection

The participants of this study are ground-based passenger service agents who are currently employed by airlines, airports, or ground handling companies in Thailand. SST is replacing many of the tasks currently performed by these employees, for example, checking in passengers and luggage, and boarding them at the gates. To ensure the anonymity of the participants, identifying information was not collected (e.g., name, address, email, phone number, the name of the organisation, and national identification number). This study used the inverse square root technique, which is a recommended approach for determining the minimum sample size required for the partial least squares structural equation modelling (PLS-SEM) (Hair et al., 2021; Kock & Hadaya, 2018). Given the commonly accepted statistical power of 0.8 and minimum path coefficient of 0.2, this study required at least 155 samples at a significance level of 95%. For recruiting participants for this study, a snowball sampling technique was used. This technique is based on a referral network, where an initial small number of participants were invited to the study and then asked to refer others within their networks, which is useful for gaining participants in hard-to-reach populations (Parker et al., 2019; Yingling & McClain,

2015). Fifteen employees were recruited through one of the authors' professional networks, and more colleagues of these participants were referred and included in the sample. The self-administered questionnaire was hosted on Qualtrics Experience Management and was distributed online, where the participants could complete it whenever they were available.

The data collection period spanned from July 2024 to November 2024, and 249 responses were gathered. In total, 193 valid responses remained after all the incomplete responses and outliers were removed during the screening process, surpassing the minimum sample size required for analysis. The collected data demonstrate a normal distribution, with skewness values ranging from -0.843 to 0.914 and kurtosis values between -1.037 and 0.947 . These values fall within the acceptable range of -2 to $+2$ (George, 2016). The demographic information of the participants is presented in Table 3-1. The participants for this study skews to a younger group aged between 18 and 35 years old (88%), females (66.3%), and participants holding a bachelor's degree or above (more than 92.7%).

Table 3-1: Demographics of the participants.

Characteristics	Categories	Frequency	Percentage
Age	18–35 years old	170	88.1
	36–50 years old	18	9.3
	51–64 years old	5	2.6
Gender	Male	62	32.1
	Female	128	66.3
	Prefer not to say	3	1.6
Educational level	Below diploma	1	0.5
	Diploma	10	5.2
	Bachelor's degree	179	92.7
	Postgraduate	3	1.6
Organisation	Airlines	84	43.5
	Airports	10	5.2

Characteristics	Categories	Frequency	Percentage
Job position	Ground handling companies	99	51.3
	Entry level	147	75.6
	Supervisor or higher	46	24.4

3.3.3 Data analysis

The study began by assessing the measurement model to ensure the reliability and validity of the constructs and its indicators before proceeding to the structural model assessment where the hypotheses were tested. This two-step approach is recommended by Anderson and Gerbing (1988), and has been proven to be more effective than one-step SEM (Kline, 2023). This approach has often been applied in aviation studies (e.g., Han et al., 2023; Kim et al., 2022; Y. Shin et al., 2022). The PLS-SEM was analysed using the *SEMinR* package built by Ray et al. (2021). PLS-SEM is better suited for evaluating frameworks from a predictive standpoint and is effective for analyses with small sample sizes (Hair et al., 2021). Moreover, the PLS-SEM linearly combines indicators to compute weighted composite scores, which are determinate and suitable for follow-up and more complex analyses such as those involving mediation and moderation (Sarstedt et al., 2020).

3.4 Empirical results

3.4.1 Assessment of the measurement model

In our assessment of the measurement model, three indicators were excluded (Table 3-2), namely JS1: “*Most days, I feel enthusiastic about my job,*” OC2: “*I really feel as if this organisation’s problems are my own,*” TI1: “*I will not renew my contract when the current contract is due*”, as these had low factor loadings (below 0.7). The removal of these indicators enhanced the overall reliability and validity of the model (Table 3-3) (Hair et al., 2021). Therefore, the adjusted measurement model was used instead.

Table 3-2: Item-construct loading comparison.

Constructs and indicators	Codes	Loading (1)	Loading (2)
Job insecurity (JI)			
It is possible that I will soon lose my job.	JI1	0.729	0.723
I am not sure that I can keep my job.	JI2	0.720	0.720
I feel insecure about the future of my job.	JI3	0.787	0.791
I think I could lose my job in one year.	JI4	0.867	0.866
Job satisfaction (JS)			
Most days I feel enthusiastic about my job	JS1	0.631	(Removed)
I feel well satisfied with my present job.	JS2	0.795	0.796
I find real enjoyment in my work.	JS3	0.844	0.833
I feel that I am happier in my work than most other people.	JS4	0.827	0.847
I like my job better than the average worker does.	JS5	0.829	0.847
Organisational commitment (OC)			
I would be very happy to spend the rest of my career with this organisation.	OC1	0.757	0.757
I really feel as if this organisation's problems are my own.	OC2	0.567	(Removed)
I feel a strong sense of belonging to my organisation.	OC3	0.806	0.804
I feel emotionally attached to this organisation.	OC4	0.858	0.864
I feel like part of the family at my organisation.	OC5	0.905	0.917
This organisation has a great deal of personal meaning for me.	OC6	0.881	0.887
Turnover intention (TI)			
I will not renew my contract when the current contract is due.	TI1	0.692	(Removed)
I am planning to get another occupation and life after leaving the job.	TI2	0.798	0.777
There is a good chance that I will leave in the next year or so.	TI3	0.841	0.854
I frequently think about leaving this job.	TI4	0.803	0.837
I will probably look for a new job this year.	TI5	0.816	0.843

Constructs and indicators	Codes	Loading (1)	Loading (2)
Perceived threat of job automation by SST (TSS)			
I think my job could be replaced by self-service technology.	TSS1	0.822	0.821
I am personally worried that what I do now in my job will be able to be replaced by self-service technology.	TSS2	0.911	0.911
I am personally worried about my future in my organisation due to self-service technology replacing employees.	TSS3	0.935	0.936
I am personally worried about my future in aviation industry due to self-service technology replacing employees.	TSS4	0.909	0.909

Notes: Loading (1) is the item–construct loadings for the original measurement model. Loading (2) is for the adjusted measurement model.

The results of assessing the measurement models are shown in Table 3-2, Table 3-3, and Table 3-4. The constructs' reliability was evaluated by following the criteria recommended by Hair et al. (2021). These criteria state that (1) factor loadings exceed 0.7 demonstrate satisfactory indicator reliability, and (2) if Cronbach's alpha (α), reliability coefficient (ρ_{HA}), and composite reliability (ρ_{HC}) all surpass a minimum threshold of 0.7, they indicate acceptable internal consistency. In this study, all measures met these requirements. First, all factor loadings exceeded 0.7, showing that more than 50% of the variance of the indicators is explained by the construct. Second, the internal consistency and reliability were confirmed, as all three measures (α , ρ_{HA} , and ρ_{HC}) surpassed the 0.7 threshold. The average variance extracted of the constructs were all above 0.5, illustrating an acceptable convergent validity (Fornell & Larcker, 1981; Hair et al., 2022).

Table 3-3: The measurement model's reliability.

Constructs	α		ρ_{A}		ρ_{C}		AVE	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
JI	0.783	0.783	0.805	0.809	0.859	0.859	0.605	0.605
JS	0.848	0.850	0.868	0.851	0.891	0.899	0.623	0.690
OC	0.886	0.901	0.911	0.908	0.915	0.927	0.646	0.719
TI	0.850	0.848	0.857	0.859	0.893	0.897	0.627	0.686
TSS	0.917	0.917	0.929	0.930	0.941	0.941	0.801	0.801

Notes: (1) is the reliability values for the original measurement model and (2) is for the adjusted measurement model. Notes: α , Cronbach's alpha; ρ_{A} , reliability coefficient; ρ_{C} , composite reliability; AVE, average variance extracted; JI, job insecurity; JS, job satisfaction; OC, organisational commitment; TI, turnover intention; TSS, perceived threat of job automation by SST

Discriminant validity was also examined to ensure that the constructs are distinctive (Hair et al., 2021). This study used the heterotrait–monotrait ratio of correlation, which is a better approach for assessing discriminant validity. According to this method, discriminant validity is affirmed when the heterotrait–monotrait values are below 0.85 (Henseler et al., 2015). As shown in Table 3-4, the heterotrait–monotrait ratios in this study are all below this threshold, demonstrating that the constructs are distinct from each other.

It is vital to evaluate the potential impact of common method bias (CMB) when conducting survey research, as it can introduce measurement errors and consequently lead to biased results (C. K. Lee et al., 2022; Schiffinger & Braun, 2020). The participants in this study may strive to conform to social expectations or ensure consistency in their responses rather than providing answers that reflect their genuine feelings, which can contribute to the occurrence of CMB (Podsakoff et al., 2003). To reduce the potential for CMB, some procedural remedies recommended by Podsakoff et al. (2024) were implemented in this study, as discussed in Section 3.3.2, including maintaining the participants' anonymity, shortening the questionnaire, and organising the order of the questionnaire items to discourage participants from inferring

causal relationships between constructs. Furthermore, the variance inflation factor values varied between 1.039 and 1.678, remaining below the recommended threshold of 3.3, which suggests that CMB is not a considerable concern in this study (Kock, 2017).

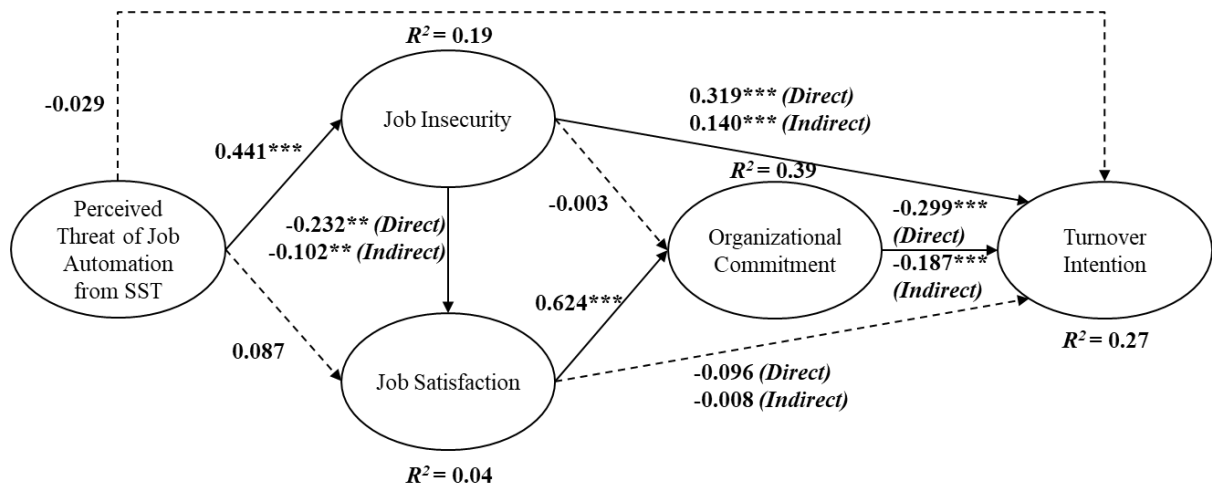
Table 3-4: Discriminant validity (heterotrait–monotrait ratio).

Constructs	TSS	JI	JS	OC	TI
TSS					
JI	0.509				
JS	0.077	0.225			
OC	0.066	0.153	0.706		
TI	0.137	0.431	0.391	0.435	

Notes: JI, job insecurity; JS, job satisfaction; OC, organisational commitment; TI, turnover intention; TSS, perceived threat of job automation by SST.

3.4.2 Assessment of the structural model

Figure 3-2 presents the results of testing the hypotheses for the relationships in the PLS-SEM model. First, TSS positively and significantly influences JI ($\beta = 0.441^{***}$), which supports H1. However, there is insufficient evidence to support H2 and H3 regarding the influence of TSS on JS ($\beta = 0.087$) and TI ($\beta = -0.029$). Next, JI demonstrates a significant negative effect on JS ($\beta = -0.232^{**}$) and a positive effect on TI ($\beta = 0.319^{***}$), but it does not significantly impact OC ($\beta = -0.003$). Therefore, H4 and H6 are supported, but H5 is not supported. Additionally, JS positively and significantly affects OC ($\beta = 0.624^{***}$), although its influence on TI ($\beta = -0.096$) is insignificant, supporting H7. However, there is no statistical evidence to support H8. Furthermore, the negative impact of OC on TI ($\beta = -0.299^{***}$) is significant, which supports H9. Lastly, the results of the mediation analysis with 1000-bootstrap resampling indicate the significant indirect effects of TSS on JS ($\beta = -0.102^{**}$) and TI ($\beta = 0.140^{***}$) through JI, and the indirect effects of JS on TI ($\beta = -0.187^{***}$) through OC. A summary of the results of testing the hypotheses is also provided in Table 3-5.



Notes: β = coefficient. $** p < 0.05$ and $*** p < 0.01$.

Figure 3-2: Hypothesis test.

Table 3-5: Hypothesis test

Hypotheses	Paths	β	<i>t</i> -statistic	2.5% CI	97.5% CI	Decisions
<i>Direct effects</i>						
H1	TSS → JI	0.441***	7.66	0.332	0.552	Supported
H2	TSS → JS	0.087	1.068	−0.067	0.244	Not supported
H3	TSS → TI	−0.029	−0.37	−0.183	0.119	Not supported
H4	JI → JS	−0.232**	−2.382	−0.415	−0.035	Supported
H5	JI → OC	−0.003	−0.049	−0.147	0.124	Not supported
H6	JI → TI	0.319***	4.08	0.175	0.481	Supported
H7	JS → OC	0.624***	10.41	0.498	0.736	Supported
H8	JS → TI	−0.096	−1.195	−0.251	0.070	Not supported
H9	OC → TI	−0.299***	−3.766	−0.445	−0.135	Supported
<i>Indirect effects</i>						
H4a	TSS → JI → JS	−0.102**	−2.368	−0.188	−0.017	Supported
H6a	TSS → JI → TI	0.140***	3.518	0.074	0.226	Supported
H8a	TSS → JS → TI	−0.008	−0.676	−0.039	0.010	Not supported
H9a	JS → OC → TI	−0.187***	−3.587	−0.290	−0.086	Supported

Notes: β = coefficient. ** $p < 0.05$ and *** $p < 0.01$. $R_{JS}^2 = 0.04$, $R_{JI}^2 = 0.19$, $R_{OC}^2 = 0.39$, and $R_{TI}^2 = 0.27$. JI, job insecurity; JS, job satisfaction; OC, organisational commitment; TI, turnover intention; TSS, perceived threat of job automation by SST.

3.5 Discussion

According to the results in Section 4, 8 out of the 12 hypotheses are statistically significant and supported. First, when airport and airline ground staff in Thailand believe that SST may replace their responsibilities in providing passenger services, they tend to perceive an increased risk of JI. Recent studies also supported that the perceived threats of SST significantly contribute to increased feelings of JI (Brougham & Haar, 2020; Lingmont & Alexiou, 2020).

Although previous studies established that the perceived threat of automation could reduce satisfaction about one's job (Lestari et al., 2023) and increase the chance of looking for another job (Presbitero & Teng-Calleja, 2023), the results in Table 3-5 showed no support for its direct impact. The possible explanation could be that Thailand receives around 62 million passengers through Suvarnabhumi Airport and around 30 million through Don Muang International Airports, which is approximately 75% of the total passengers carried in Thailand (Civil Aviation Authority of Thailand, 2024b). Most of these passengers may still choose to check in at the counters where airline ground staff provide a one-stop service for them. This finding may suggest that ground staff may still see many passengers waiting in line and crowded passenger processing areas, making them feel that their tasks and workload remain practically the same. Hence, they could feel the same level of JS because they are still performing their main job functions and may not think that the SST is a threat that will replace their job. However, it is recommended that future study should include the factor such as perceived crowdedness, or perceived daily workload to confirm finding.

Next, this study reported similar result to a previous meta-analysis on JI which found that an increase in the beliefs that staff could lose their jobs leads to a decreased satisfaction in their jobs and an increased intention to leave their companies (Cheng & Chan, 2008; Sverke et al., 2002). In contrast, the findings of this study do not support the impact of JI on the OC of ground

staff in Thai airlines and airports. This study has found that JI plays a mediating role in the impacts of TSS on JS and TI. In other words, the stronger the perception that SST is threatening the existence of their jobs, the greater the insecurity airport and airline staff feel, which subsequently leads to lower satisfaction with their jobs and increased intention to find another job. These findings align with the literature in stress research that stressors (i.e., JI) can induce a staff to use coping strategies, including behavioural withdrawal (i.e., TI) (Ashford et al., 1989) and psychological withdrawal (i.e., JS) (Smith & Lazarus, 1993).

Additionally, this study found that airport and airline staff who reported higher satisfaction with their jobs also reported higher commitment to their organisations. A similar relationship has been supported in the case of hotel employees (Dusek et al., 2016; Mensah et al., 2020) and airline employees (e.g., Chen & Kao, 2011; Firdaus et al., 2022; Jung et al., 2022; Kim & Back, 2012; Limpanitgul et al., 2013). Moreover, a higher commitment toward their organisations has been found to reduce airport and airline staff's intention to leave. This finding is in line with previous studies on the service industry, which shows the crucial role of OC on TI (e.g., Mensah et al., 2020; Suifan et al., 2017; Yilmaz et al., 2022). Lastly, although previous studies established that higher satisfaction with one's job can lead to reduced intention to resign (e.g., Chung & Jeon, 2020; Jung et al., 2022; Suifan et al., 2017), the findings of this study showed that this relationship is fully mediated by OC. Simply put, airport and airline staff who feel more satisfied with their jobs demonstrate commitment to their organisations and subsequently have less intention to resign.

3.5.1 Theoretical contributions

This study offers three key theoretical contributions to the literature on JI and the threat of job automation. First, research on JI and the threat of job automation has rarely been conducted in the aviation industry, let alone studies focusing on the ground staff whose daily jobs are directly impacted by SST's implementation. To fill this gap, this study is among the few, if not the first,

that have studied the impact of SST on airport and airline ground staff, especially in the case of Thailand, where a considerable amount of SST has been integrated into passenger processing (e.g., check-in and baggage drop-off), but most passengers still wait in line to get service from the ground staff.

Second, prior research into the impact of TSS on JI, JS, and TI is lacking. This study's findings bridge this gap by incorporating these relationships into the conceptual framework, deepening our understanding of the impact of SST on airport and airline ground staff. Moreover, this study examines the impact of OC on TI in the aviation sector. This topic has been widely discussed in the context of hotels and restaurants but has rarely been addressed in aviation, particularly in contexts where a significant number of ground personnel are employed by outsourcing companies. Therefore, the empirical evidence demonstrating that OC has a significant negative effect on TI broadens the applicability of the OC–TI relationship.

Third, although the previous studies demonstrated that JI mediates the relationship between TSS and TI (Brougham & Haar, 2020), this study found that JI also mediates the effects of the TSS on JS, thus enriching the literature on JI and TSS. Specifically, the findings of the study extend the social exchange theory by confirming that the perceived TSS acts as the initial organisational action that breaches the employees' psychological contract regarding the stability of the job (Ashford et al., 1989; Lingmont & Alexiou, 2020). This breach is internalised as JI, which then becomes the critical psychological state that triggers the expected negative reciprocity from the social exchange theory, leading not only to behavioural withdrawal (e.g., higher TI) but also to psychological withdrawal (e.g., lower JS). This mechanism is particularly relevant when considering the context of the Thai aviation industry and this study's specific sample. More than half of the participants (51.3%) were recruited from ground handling companies, which often operate on an outsourced basis. This employment model often implies a less stable, more transactional psychological contract (Yang et al., 2025).

Therefore, when this workforce observes the rapid implementation of new SST, the findings of this study show that even if passenger queues remain long, this future-oriented threat is sufficient to activate the JI that damages employees' attitudes and retention.

3.5.2 Practical and managerial implications

This study offers several practical implications drawn from its key findings. First, this study highlighted that the concerns of SST replacing airport and airline ground staff's current jobs influence the perception that they could lose their jobs. This subsequently leads to lowered JS and increased intentions to leave the organisations. Therefore, airports, airlines, and ground handling companies in Thailand should clarify for their staff which passenger services will be handled by SST and which will remain the responsibility of employees. This can help show the division of work between SST (e.g., servicing younger passengers and technology-savvy passengers) and ground staff (e.g., servicing passengers traveling in groups and passengers with special needs). This can also help promote positive attitudes among airport and airline staff, such as a belief that SST helps relieve some of their workload, and reduces the concern that SST is taking over their jobs.

Second, given the critical role of perceived JI stemming from the implementation of SST, the management of Thailand's airports and airlines must try to mitigate it. Airports, airlines, and ground handling companies in Thailand may include additional training to the existing mandatory training and recurrent programmes (e.g., customer services, safety and security, and regulations and procedures). This additional training should aim at developing higher cognitive skills, such as problem-solving and decision-making, which will prepare airport and airline staff for potential future work adjustments (Akpur, 2024). Examples of such additional training include management trainee programmes, design thinking and innovation management workshops, and leadership programme. Companies invest in leadership development through various initiatives. For instance, Cathay Pacific offers a management trainee programme to

build its employees' leadership skills (Cathay Pacific, 2024), and Emirates provides the Global Operational Leadership Development (GOLD) program to help its airport service managers improve their operations and leaderships (Emirates, 2025). In the aspect of innovation, Singapore Airlines has introduced the UPLIFT 2 initiative, which is designed to cultivate key behaviours that foster a more agile and innovative corporate culture (Singapore Airlines, 2025). In addition, airports and airlines should ensure that career paths and growth opportunities for employee are clearly defined, making them feel secure about their futures within the companies. Companies can also provide resources to help employees plan their careers. Examples include Singapore Airlines' Career Planning Microsite (Singapore Airlines, 2025) and the Turkish Airlines Aviation Academy (Turkish Airlines, 2024).

Lastly, improving the staff's positive perceptions of their jobs and workplace is also essential. This study shows that JS can improve the staff's OC, leading to lower intention to find another job. To foster this positive climate, airports and airlines in Thailand must proactively seek for and act on employee feedback. For example, Southwest Airlines partnered with Qualtrics to create a real-time system for collecting and analysing data on employees' experiences, allowing the company to promptly address concerns and strengthen the staff's engagement (Qualtrics, 2023). Airports and airlines in Thailand may start by addressing staff feedback from performance evaluations, annual surveys, or exit surveys (i.e., a survey of staff who are resigning from the company). Good organisational communication can build a positive climate where the management cares about their employees (Men, 2014; Qian et al., 2019). Aviation operators may add an extra section in an annual survey to ask for feedback specifically about the advantages, disadvantages, and any concerns associated with the implementation of SST from ground staff to gain more insights into this topic.

Thai airport and airline managers must know that their staff will perform their best in every task to ensure that passengers will be highly satisfied, resulting in a positive image and good

reputation for airports and airlines. Therefore, it is important for managers to recognise and reward their staff's hard work. This could be tangible (e.g., fair salary increases or a yearly bonus) or intangible (e.g., employee of the month programmes or direct compliments by the management team). Staff that are employed by particular airlines usually have perks such as buying air tickets at an industry discount price (usually a 90% discount on the fare) (Hassan, 2024). However, in the case of Thailand, this incentive is often unavailable to outsourced ground staff. To reward outstanding performance among their outsourced partners, airports and airlines should formally collaborate with the outsourcing companies to extend specific airline benefits, such as complimentary or heavily discounted travel vouchers, to high-performing outsourced staff. A case study at Jomo Kenyatta International Airport found that offering rewards can boost motivation among outsourced ground staff, who typically work at the first point of passenger contact (Mutua & Joseph Mwangi, 2017).

Moreover, airports and airlines can occasionally assign their staff a challenging project that could help improving passenger services, breaking them away from routine tasks. This project would allow staff to develop not only cognitive but also affective skills, which could enhance the relationships among team members and improve the working atmosphere. This approach has been implemented by Air Asia as a growing opportunity for their employees (Asia Aviation, 2024). Similarly, All Nippon Airways integrates “stretch assignments” (challenging tasks that go beyond their current job descriptions) to develop their employees' skills (All Nippon Airways, 2025). These approaches could help increase staff's JS and OC and, in turn, help reduce TI.

3.6 Conclusion

Technology and automation have become more advance in the sense that it can now perform some tasks instead of people. SST has been implemented at many airports worldwide to help

improve staff shortages, reduce the crowdedness of the departure terminal, and enhance passenger services. SST can also be viewed as a threat to the existence of the job, as it can replace the airport and airline staff who perform check-in, baggage drop-off, and boarding tasks. However, empirical research on the impact of SST in the aviation industry remains scanty, especially research on ground staff. This study addresses this gap by examining the impact of SST on airports' and airlines' ground staff. The framework includes TSS, JI, JS, OC, and TI. Using the PLS-SEM to analyse the impact of perceived TSS on ground staff's attitudes and behaviour, we found that 7 out of 11 hypotheses are supported. The key findings of this study include: (i) TSS increases the JI felt by airport and airline ground staff; (ii) JI from SST reduces JS and increases TI; (iii) JI from SST plays a mediating role in the impacts of TSS on JS and TI; (iv) JS enhances OC; and (v) OC lowers TI.

This study has certain limitations that present opportunities for future research. To begin with, the data were collected solely from Thai airport and airline ground staff using snowball sampling method. This can introduce bias in sample group proportion as there is high tendency that the people will recruit participants with similar characteristics (Rocha et al., 2017). Therefore, the generalisability of results is limited, and it should be carefully extended to airports and airlines in other countries because of the cultural differences. Future research could and explore how the threat of job automation posed by SST influences ground staff differently across Asian and European cultures. Researchers may utilise different sampling method is less biased and most suitable for the study's population. Moreover, the application of the study's findings to other industries must be made with caution because of differences in the industrial structures and operations. Future research may benefit from collecting data from different industries, such as tourism and logistics, to gain more insights through comparisons and to achieve a broader understanding of the impact of SST on ground staff's attitudes and behaviour. In addition, although this study used various procedural and statistical methods to mitigate

CMB, future research could consider additional strategies, if these are feasible. Future research should adopt the techniques recommended by Podsakoff et al. (2024). These include, but are not limited to, collecting data at different time points or from different sources (e.g., family members or partners) to reduce common rater effects (the way a person rates one item systematically influences how they rate others).

General Discussion

Linking back to the research objectives

Overall, each chapter of this thesis addresses the research objectives stated in the Introduction, providing a comprehensive overview of aviation SST literature, investigating the passengers' adoption of biometric check-in kiosks at airports, and examining the impact of SST implementation on airport and airline ground staff. Chapter 1 reviews the previous literature on aviation SST, showing the foundation of the aviation SST literature, key theories and factors influencing passengers' attitudes and behaviours, and the themes of aviation SST research (customer adoption, customer satisfaction, and customer experience). Chapter 1 also points out some potential research gaps related to SST such as aiming for less researched countries, newer technology adoption, environmental impact aspect, and employee well-being. Chapter 2 investigates the passengers' adoptions of biometric check-in kiosks at airports, bridging the gap pointed out by Chapter 1 that research into newer technology adoption is lacking and empirical studies only concentrate in some countries. The key findings of Chapter 2 offer valuable insights, for example, most of the relationships proposed by the TAM and TPB are supported while highlighting the important roles of perceived privacy concerns and perceived trust on the biometric check-in kiosks.

Furthermore, Chapter 2 illustrates the crucial mediating role of attitudes toward technology usage in technology adoption (i.e. SST) —a factor often overlooked by researchers. Chapter 3 examines how the perceived threat of job automation stemming from SST influences job insecurity, job satisfaction, organisational commitment, and turnover intention among airport and airline ground staff. This chapter fills the research gap identified in Chapter 1 that prior research on employee wellbeing after the SST implementation is lacking. One of the key

findings of Chapter 3 indicate that airport and airline ground staff perceive SST as a threat to their jobs, which consequently affects their job satisfaction and intentions to stay with their organisations.

Managerial and Practical Implications

Table 1 lists key implications retrieved from each chapter in this thesis and highlights how these implications can help airports, airlines, and ground handling companies improve the service provided to passengers and better manage the service provided by ground staff and SST.

Table 1: Summary of implications in this PhD thesis

Chapter 1
• Lacking a study into newer aviation SST ✓ Future study can investigate into newer aviation SST such as biometric check-in kiosks, chatbot, and self-boarding). ✓ Future study can also investigate into automated passenger journey.
• TAM and TPB are predominant, but the integration with other frameworks is lacking ✓ Future study can incorporate newer or existing frameworks to provide new insight.
• Lacking a study into the impact of SST on employee ✓ Future study can approach SST research from employee's perspective.
• Lacking a study from many countries ✓ Future study should consider some countries from the regions that receive less attention (e.g., South America, Africa, and Oceania). ✓ Although Asia has gained some attention, a case study from some Asian countries is still lacking (e.g., China, Japan, and Thailand). ✓ Cross-cultural study can give valuable insights into aviation SST research, which is also lacking.
Chapter 2
• Lacking communication about the use of biometric check-in kiosks

✓ Actively communicate the use and benefits of the system through social media platforms. ✓ Increase awareness and boost adoption by posting tutorials of how to use such system.
• Redundancy queuing from two separate machines (check-in and bag-drop) ✓ Rearrange the layout of these two machines to streamline passenger journey ✓ Pair two machine together, creating only one queue
• Lacking communication about data privacy policy ✓ Ensure the policy for protection of privacy is established and communicated to the user.
• Need to develop trust from passengers ✓ Minimise service failures and build confidence through continuous improvement and periodical review of the system
Chapter 3
• Concerns about jobs being replaced by SST ✓ Clarify the scope of the services SST and employees can provide
• Job insecurity is playing a critical role ✓ Prepare employees for potential future work adjustments through additional training aiming to develop higher cognitive skills ✓ Establish clear career paths and growing opportunities for employees
• Job satisfaction and organisational commitment can reduce negative outcomes ✓ Address employees' feedback from different channels, building a positive climate from management side ✓ Reward and recognition which can be tangible or intangible ✓ Develop team relationship, working atmosphere by occasional challenging project assignment

Among the listed implications, the following key implications are worth discussing and recommending to the service providers as they are obvious and appear repeatedly across the chapters of this thesis.

Service design is a key to a successful SST implementation

Collectively, all the chapters in this thesis support that the service design is a key to a successful SST implementation. Chapter 1 illustrates three themes of SST research related to customer services: customer adoption, customer satisfaction, and customer experience, which are all related mainly to the service design and attributes of the SST itself. Chapter 2 also supports this point showing that passengers consider some features of SST (e.g., ease of use, usefulness, and privacy) when deciding whether to use it. Chapter 3 shows SST implementation from airport and airline ground staff's perspectives, highlighting the concerns that the current air transport ground services through SST may be a threat to their job (e.g., self-check-in kiosks, self-service bag drop, and self-boarding gates). Therefore, this thesis recommends that aviation service providers (e.g., airlines, and airports) move beyond viewing passenger adoption and employee security as separate issues and instead adopt an integrated, human-centric implementation model. This plan directly synthesises the findings from Chapters 2 and 3. This implementation involves a phased strategy where the technology rollout is simultaneously paired with a proactive service role redesign.

- **Redesign and Retrain:** Before full deployment, some of ground staff are retrained and re-designated from “Check-in Agents” to “Passenger Experience Ambassadors” or “SST Support Specialists.” Their new, higher-value role shifts from routine processing (which can be automated by SST) to service recovery, complex problem-solving, and technology assistance, as suggested in Chapter 3.
- **Deploy with Visible Support:** During the SST rollout, these new Ambassadors are visibly stationed at the kiosks, not at traditional check-in counters. Their primary task is to encourage passenger adoption by actively teaching them, demonstrating the system's ease of use, and handling any errors.

This integrated plan is effective because it simultaneously solves the core problems identified in this thesis. Firstly, it addresses the passenger perspective (Chapter 2). The visible presence of expert human support directly tackles the key barriers to adoption suggested in this thesis within the integrated TAM-TPB framework. It enhances PEOU and PBC by providing on-the-spot training. Most importantly, it builds PT by assuring passengers that a human is ready to intervene if the technology fails. Moreover, it addresses the employee perspective (Chapter 3). This strategy reframes the SST from a threat to a tool. It directly mitigates the JI that this study found was the central driver of low job satisfaction and high turnover intention. By creating a new, essential, and higher-skilled role, the narrative is shifting from SST replacing jobs (negative) to an evolving role (positive), repairing the psychological contract and creating positive reciprocity. In other word, the implementation secures the employee's future rather than replacing it, fostering the organisational commitment needed for high-quality human service.

Significance of effective communication about SST among service providers, passengers, and employees

From the implications of Chapters 2 and 3, communication can help in SST implementation. Chapter 2 suggests that aviation service providers (i.e., airports, airlines, and ground handling companies) should actively communicate with passengers on the use of SST, leading to public understanding and increasing passenger's awareness of the system and consequently leading to higher adoption of the system. Moreover, it is also important to communicate about the data protection and privacy policy during the digital era, reducing concerns of the passengers using the system (Hesselmann et al., 2022; Meng & Feng, 2022). Service providers must implement trust-building communication. Instead of making SSTs fully "self-service," the retrained ground staff should be stationed the kiosks to guide passengers, troubleshoot errors, and

demonstrate data-privacy protocols, which will directly build PT and alleviate PC, thereby fostering a positive attitude and facilitating adoption.

Furthermore, Chapter 3 emphasises that clear communication between service providers and their ground staff is essential. This communication must define the distinct service scopes of both SST and employees, demonstrating how they will be integrated. The goal is to reduce the negative attitudes and fears of job replacement among staff. The retraining of ground staff becomes a powerful human resource policy. Communication to staff must shift from “automation is coming” to “your role is evolving.” By retraining staff for this new, and higher-value role, management directly mitigates the perception of job insecurity. This policy reframes SST as a tool that enables employees to perform a more complex service role, rather than a threat that makes them obsolete.

Conclusion

Air transport is important to economic development, especially to those countries whose economy rely heavily on tourism. With an increasing in passenger numbers and tourists, airlines and airports face with the operational challenges on how to manage the congestion at the departure hall area and how to enhance passengers' travel experience. SST has been implemented as one of the tools to cope with these challenges in the aviation sector around the globe. While SST implementation is still new in some countries, there are concerns relating to the replacements of job by technological automation. Therefore, this thesis examines the implementation of SST in the aviation industry, focusing on passengers' adoption on SST and its impact on ground staff using Thailand's aviation sector as a case study. Three research objectives of this thesis are: (i) provide an overview of aviation SST literature regarding customer services, theories and variables, and identify future research direction on SST; (ii) investigate passengers' adoptions of SST (i.e., biometric check-in kiosks); and (iii) examine the impact of SST on airport and airline ground staff. Therefore, this thesis is structured to with three individual but related-chapters addressing these research objectives.

Chapter 1 addresses the first research objective of the thesis. The bibliometric analysis and systematic literature review of the aviation SST literature have been conducted in this chapter. The review shows that the literature mainly focused on the United States, Spain, Taiwan, South Korea, and Malaysia, while other countries received less attention. Newer SSTs, such as customer service chatbots, biometric check-in kiosks, and self-boarding, are gaining more attention from scholars and researchers. In terms of the theories used for SST research, the TAM theory is widely adopted, followed by the TPB theory. In addition, three themes related to SST contained in prior literature, including customer adoption, customer satisfaction, and customer experience. More importantly, this chapter points out some potential research gaps

such as aiming for different countries, newer technology adoption, environmental impact aspect, and employee well-being.

Chapter 2 investigates the passengers' adoptions of biometric check-in kiosks at Thailand's airports, addressing the second research objective of this thesis. This chapter uses a survey approach based on a framework derived from the TAM, the TPB, and three previously underexplored factors: PC, PT, and PR. This chapter utilised covariance-based structural equation modelling (CB-SEM) to test 14 hypotheses. These hypotheses examine the relationships between these core TAM/TPB constructs and the extended factors (PC, PT, and PR) on passengers' attitudes toward using and their intention to use biometric check-in kiosks. This chapter confirms most of the relationships posited by the TAM and TPB theories and highlights the important roles of PC and PT on passengers' attitudes toward using and their intention to use the technology. Furthermore, this chapter illustrates the crucial mediating role of attitudes toward technology usage in technology adoption—a factor often overlooked by researchers.

Chapter 3 examines the effects of SST on airport and airline ground staff's attitudes and behaviour, aligning with the third research objective of this thesis. Particularly, this chapter examines how the perceived threat of job automation stemming from SST at Thailand's airports, airlines and ground handling companies influences the staff's job insecurity, job satisfaction, organisational commitment, and turnover intention. The findings indicate that ground staff perceive SST as a threat to their jobs, which consequently affects their job satisfaction and intentions to stay with their organisations. This chapter offers insights and recommendations for airlines, airports, and ground handling companies to better understand their employees' concerns and take measures to alleviate feelings of job insecurity while effectively managing the interplay between SST and their workforce.

Chapter 2 and 3 of this thesis offer crucial practical implications for implementing SST in the Thai aviation industry, addressing both passenger and employee perspectives. For passengers (Chapter 2), it is essential to actively communicate the benefits and ease of use of biometric check-in kiosks through platforms like social media to boost adoption. Airports should also integrate check-in and baggage drop-off processes to streamline the passenger journey and enhance perceived usefulness. Addressing privacy concerns and building trust are important, requiring clear communication about data handling and robust cybersecurity measures. From an employee perspective (Chapter 3), the implementation of SST creates a perceived threat of job automation, leading to job insecurity and reduced job satisfaction. To mitigate this, airlines and airports must clearly define and communicate the scope of SST services, showing how they complement human roles rather than replacing them. Investing in employee training to develop higher cognitive skills and establishing clear career paths are vital to prepare staff for future work adjustments and reduce turnover intention. Additionally, fostering a positive work environment through feedback, recognition, and challenging projects can enhance job satisfaction and organisational commitment.

This thesis makes several contributions to the aviation SST literature. To begin with, it represents one of the first studies to review and explore the SST literature, specifically within the context of aviation. It provides the first systematic review on aviation SST literature from a customer service perspective. It also highlights the foundation of aviation SST literature, identifies the geographical regions contributing to this body of work, discusses the predominant theories and factors on SST research, and points out potential research gaps. Secondly, this thesis integrates PC, PT, and PR into its framework to examine SST in aviation. Thirdly, this thesis is among the first to study the impact of the SST implementation on airlines and airport ground employees using Thailand's aviation sector as a case study, for example, highlighting the negative impact of the threat of job automation from SST implementation and the mediating

role of job insecurity in influencing the employees' intention to leave the company. This finding provides empirical support for social exchange theory. It confirms that the perceived threat of job automation acts as an organisational action that breaches the employees' psychological contract regarding job stability, which is then internalised as job insecurity, leading to negative employee outcomes. Together, the contributions from each chapter of this thesis provide a platform for understanding the implementation of SST from the passengers and aviation employees' perspectives in the 21 centuries.

Limitations and future research

This thesis has limitations which suggest to future research opportunities. Firstly, only peer-review journal articles from the Scopus database were included in the review in Chapter 1. Future research can compile articles from multiple databases to increase coverage. Another limitation of Chapters 2 and 3 is the use of a case study of Thailand, thereby limiting the generalizability of their findings. This raises some key questions for future researchers:

- To what extent are these findings specific to Thailand, and how would they differ in more advanced economies with greater technological acceptance?
- How does national culture or the level of technological development moderate the adoption of SST, or the impact on ground staff?
- Do the relationships observed in this study hold true across different sizes of airports and airlines?

Moreover, Chapters 2 and 3 rely on surveys which require participants to complete them in one setting due to the limitations in tracking. Therefore, CMB may be present in the findings of Chapters 2 and 3, although statistical remedies were used. Future research may apply both procedural (e.g., temporal, proximal, and psychological separation) and statistical remedies (e.g., marker variable and common latent factor method) to better avoid and control for CMB. Moreover, collecting data in one setting limits the ability to test whether the intention leads to the actual behaviour. Future research can divide the survey into two parts, one before and one after (perhaps a week or two later), to see whether intention translates into actual behaviour. In addition, researchers could use an experimental design to test the effect of different factors on the behavioural intention, or even the actual behaviour. This design has gained more popularity in service research (e.g., Juvan et al., 2025; Liu & Roehl, 2025; Xiong et al., 2025).

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Appendices

Appendix A – Articles included in the systematic literature review

Table A1:

List of 98 articles included in the systematic review.

Year	Title	Author(s)	Journal
2000	Privacy policies of air travel web sites: A survey and analysis	Nyshadham E.A.	Journal of Air Transport Management
2002	Online kiosks: The alternative to mobile technologies for mobile users	Slack F.; Rowley J.	Internet Research
2004	An empirical study of consumer switching from traditional to electronic channels: A purchase-decision process perspective	Gupta A.; Su B.-C.; Walter Z.	International Journal of Electronic Commerce
2004	Information exchanges associated with Internet travel marketplaces	Smith A.D.	Online Information Review
2005	Barriers to online booking of scheduled airline tickets	Klein S.; Köhne F.; Öörni A.	Journal of Travel and Tourism Marketing
2006	Biometrics: The next frontier in service excellence, productivity and security in the service sector	Heracleous L.; Wirtz J.	Managing Service Quality

Year	Title	Author(s)	Journal
2006	Technology readiness and the evaluation and adoption of self-service technologies	Liljander V.; Gillberg F.; Gummerus J.; van Riel A.	Journal of Retailing and Consumer Services
2007	Passenger use intentions for electronic tickets on international flights	Chia-Yu Chen F.	Journal of Air Transport Management
2008	Do airline self-service check-in kiosks meet the needs of passengers?	Chang H.-L.; Yang C.-H.	Tourism Management
2009	Investigating passengers intentions to use technology-based self check-in services	Lu, J.-L.; Chou, H.Y.; Ling, P.C.	Transportation Research Part E: Logistics and Transportation Review
2009	Modeling roles of subjective norms and eTrust in customers' acceptance of airline B2C eCommerce websites	Kim H.-b.; Kim T.(T.); Shin S.W.	Tourism Management
2009	The impact of social presence on technology based self-service use: The role of familiarity	Kinard B.R.; Capella M.L.; Kinard J.L.	Services Marketing Quarterly
2010	How motivation, opportunity and ability can drive online airline ticket purchases	Bigné E.; Hernández Blanca B.; Ruiz C.; Andreu L.	Journal of Air Transport Management
2011	Acceptance of self-service check-in at Zurich airport	Wittmer A.	Research in Transportation Business and Management
2011	Determinants of passengers' choice of airline check-in services: A case study of American, Australian, Korean, and Taiwanese passengers	Lu J.-L.; Choi J.K.; Tseng W.-C.	Journal of Air Transport Management

Year	Title	Author(s)	Journal
2011	Choosing self-service technologies or interpersonal services- The impact of situational factors and technology-related attitudes	Gelderman C.J.; Ghijsen P.W.; van Diemen R.	Journal of Retailing and Consumer Services
2011	Airline e-ticketing service: How e-service quality and customer satisfaction impacted purchase intention	Lau T.-C.; Kwek C.-L.; Tan H.-P.	International Business Management
2011	Moderating effects of technology acceptance perspectives on e- service quality formation: Evidence from airline websites in Taiwan	Lee F.-H.; Wu W.-Y.	Expert Systems with Applications
2011	From self-service to super-service: A resource mapping framework for co-creating value by shifting the boundary between provider and customer	Campbell C.S.; Maglio P.P.; Davis M.M.	Information Systems and e- Business Management
2012	Do offline factors trigger customers' appetite for online continual usage?: A study of online reservation in the airline industry	Al-Hawari M.A.; Mouakket S.	Asia Pacific Journal of Marketing and Logistics
2012	The Effect of Technology Readiness on Customers' Attitudes toward Self-Service Technology and Its Adoption; The Empirical Study of U.S. Airline Self-Service Check-In Kiosks	Lee W.; Castellanos C.; Chris Choi H.S.	Journal of Travel and Tourism Marketing
2013	Check-in services and passenger behaviour: Self service technologies in airport systems	Castillo-Manzano J.I.; López- Valpuesta L.	Computers in Human Behavior

Year	Title	Author(s)	Journal
2013	Airlines, apps, and business travel: A critical examination	Budd L.; Vorley T.	Research in Transportation Business and Management
2013	An analysis of the relationship between travel preferences and intentions to use registered traveler biometric systems in air travel	Morosan C.	Journal of Hospitality and Tourism Technology
2013	Determinants of online booking loyalties for the purchasing of airline tickets	Llach J.; Marimon F.; Alonso-Almeida M.D.M.; Bernardo M.	Tourism Management
2013	Customer decision-making processes and motives for self-service technology usage in multi-channel hospitality environments	Kelly P.; Lawlor J.; Mulvey M.	International Journal of Electronic Customer Relationship Management
2013	Fitting facilities to self-service technology usage: Evidence from kiosks in Taiwan airport	Ku E.C.S.; Chen C.-D.	Journal of Air Transport Management
2013	Key drivers of consumer purchase of airline tickets: A cross-cultural analysis	Ruiz-Mafe C.; Sanz-Blas S.; Hernandez-Ortega B.; Brethouwer M.	Journal of Air Transport Management
2013	Online drivers of consumer purchase of website airline tickets	Escobar-Rodríguez T.; Carvajal-Trujillo E.	Journal of Air Transport Management

Year	Title	Author(s)	Journal
2013	Self-Service Technology Versus Traditional Service: Examining Cognitive Factors In The Purchase Of The Airline Ticket	López-Bonilla J.M.; López-Bonilla L.M.	Journal of Travel and Tourism Marketing
2013	The antecedents of travellers' e-satisfaction and intention to buy airline tickets online: A conceptual model	Zahir Irani P.; Mohamed Fadel Bukhari S.; Ghoneim A.; Dennis C.; Jamjoom B.	Journal of Enterprise Information Management
2013	Fix It or Leave It? Customer Recovery from Self-service Technology Failures	Zhu Z.; Nakata C.; Sivakumar K.; Grewal D.	Journal of Retailing
2014	Uncovering customer service experiences with Twitter: The case of airline industry	Misopoulos F.; Mitic M.; Kapoulas A.; Karapiperis C.	Management Decision
2014	Antecedents of intention to use CUSS system: moderating effects of self-efficacy	Chen L.S.-L.; Wu K.I.-F.	Service Business
2014	Empirical analysis of a self-service check-in implementation in Singapore Changi Airport	Lee C.K.M.; Ng Y.; Lv Y.; Taezoon P.	International Journal of Engineering Business Management
2014	The use of e-passports for inbound airport border security screening: The passenger perspective	Kneale D.K.; Baxter G.S.; Wild G.	Aviation
2014	Biometric technology and privacy: a perspective from tourist satisfaction	Neo H.-F.; Rasiah D.; Tong D.Y.K.; Teo C.-C.	Information Technology and Tourism

Year	Title	Author(s)	Journal
2015	Self-consciousness profiles in the acceptance of airline e-ticketing services	López-Bonilla J.M.; López-Bonilla L.M.	Anatolia
2015	Services innovation impact to customer satisfaction and customer value enhancement in airport	Chen J.K.C.; Batchuluun A.; Batnasan J.	Technology in Society
2016	Structuring Technology Applications for Enhanced Customer Experience: Evidence from Indian Air Travellers	Majra H.; Saxena R.; Jha S.; Jagannathan S.	Global Business Review
2016	Customer participation, value co-creation and customer loyalty - A case of airline online check-in system	Chen C.-F.; Wang J.-P.	Computers in Human Behavior
2016	Does anthropomorphism influence customers' switching intentions in the self-service technology failure context?	Fan A.; Wu L.; Mattila A.S.	Journal of Services Marketing
2016	Managing airport service quality – The impact of self-service technologies	Otieno P.S.; Govender K.	Investment Management and Financial Innovations
2016	An empirical examination of U.S. travelers' intentions to use biometric e-gates in airports	Morosan C.	Journal of Air Transport Management
2016	Hospitality Industry Web-Based Self-Service Technology Adoption Model: A Cross-Cultural Perspective	Lee L.Y.-S.	Journal of Hospitality and Tourism Research
2017	Customer Roles in Self-Service Technology Encounters in a Tourism Context	Kelly P.; Lawlor J.; Mulvey M.	Journal of Travel and Tourism Marketing

Year	Title	Author(s)	Journal
2017	The impact of traveler-focused airport technology on traveler satisfaction	Bogicevic V.; Bujisic M.; Bilgihan A.; Yang W.; Cobanoglu C.	Technological Forecasting and Social Change
2017	Flight ticket booking app on mobile devices: Examining the determinants of individual intention to use	Mohd Suki N.; Mohd Suki N.	Journal of Air Transport Management
2017	What makes tourists feel negatively about tourism destinations? Application of hybrid text mining methodology to smart destination management	Kim K.; Park O.-J.; Yun S.; Yun H.	Technological Forecasting and Social Change
2018	Assessing the self-service technology usage of Y-Generation in airline services	Gures N.; Inan H.; Arslan S.	Journal of Air Transport Management
2018	The influence of perceived service quality towards customer satisfaction and Loyalty in Airasia self check-in system	Yusra; Agus A.	Journal of Social Sciences Research
2018	Air passengers' willingness to pay for counter check-in services	Kuo C.-W.; Jou R.-C.	Transportation Research Part A: Policy and Practice
2018	Moderating effect of privacy concerns and subjective norms between satisfaction and repurchase of airline e-ticket through airline-ticket vendors	Liang C.-C.; Shiao W.-L.	Asia Pacific Journal of Tourism Research
2018	The requirement of accessibility: European automated border control systems for persons with disabilities	Oostveen A.-M.; Lehtonen P.	Technology in Society

Year	Title	Author(s)	Journal
2018	Analyzing customer satisfaction in self-service technology adopted in airports	Yau H.K.; Tang H.Y.H.	Journal of Marketing Analytics
2019	Adding or destroying value? User experiences of tourism self-service technologies	Kelly P.; Lawlor J.	Journal of Hospitality and Tourism Insights
2019	The effect of TBSS relational benefit on relational commitment and willingness to buy again: Focusing on customers using technology-based self service of airlines	Ko S.-H.	International Journal of Innovative Technology and Exploring Engineering
2019	The effect of airport self-service characteristics on passengers' perceived value, satisfaction, and behavioral intention: Based on the SOR model	Kim J.-H.; Park J.-W.	Sustainability (Switzerland)
2019	The effect of airport self-service characteristics on passengers' technology acceptance and behavioral intention	Kim J.-H.; Park J.-W.	Journal of Distribution Science
2019	Effect of customer readiness on technology-based self-service quality and usage intention	Ko S.-H.; Park J.-M.	International Journal of Innovative Technology and Exploring Engineering
2019	Understanding the attitudes and purpose for the usage of self-service technologies (SSTs) at the airports	Thamaraiselvan Thanigaiarul S.	N.; International Journal of Recent Technology and Engineering
2019	Effect of E-Service quality on repurchase intention: Testing the role of e-satisfaction as mediator variable	Lestari V.T.; Ellyawati J.	International Journal of Innovative Technology and Exploring Engineering

Year	Title	Author(s)	Journal
2019	A study on passenger experience using smart security system in Dubai airport	Kamalrudin M.; Abdulla Almarri G.	International Journal of Recent Technology and Engineering
2019	Acceptance of biometric technology in airport check-in	Negri N.A.R.; Borille G.M.R.; Falcão V.A.	Journal of Air Transport Management
2019	Airport passengers' adoption behaviour towards self-check-in Kiosk Services: the roles of perceived ease of use, perceived usefulness and need for human interaction	Taufik N.; Hanafiah M.H.	Heliyon
2019	Determining intention to buy air e-tickets in Malaysia	Lee K.-F.; Haque A.; Maulan S.; Abdullah K.	Management Science Letters
2019	Developing and validating a service robot integration willingness scale	Lu L.; Cai R.; Gursoy D.	International Journal of Hospitality Management
2019	Integrating qualitative comparative analysis and support vector machine methods to reduce passengers' resistance to biometric e-gates for sustainable airport operations	Kim C.; Costello F.J.; Lee K.C.	Sustainability (Switzerland)
2019	Understanding forced adoption of self-service technology: the impacts of users' psychological reactance	Feng W.; Tu R.; Lu T.; Zhou Z.	Behaviour and Information Technology
2020	Components of airport experience and their roles in eliciting passengers' satisfaction and behavioural intentions	Batouei A.; Iranmanesh M.; Mustafa H.; Nikbin D.; Ping T.A.	Research in Transportation Business and Management

Year	Title	Author(s)	Journal
2020	Revolution of artificial intelligence and the internet of objects in the customer journey and the air sector	Saadi H.; Touhami R.; Yagoub M.C.E.	Journal of Information Technology Management
2020	A study on the customer attitudes toward the airport IT service: Focusing on handling process and acceptance intention	Park H.-Y.	Journal of Distribution Science
2020	E-WOM and airline e-ticket purchasing intention: Mediating effect of online passenger trust	Ahmad A.M.K.; Abuhashesh M.; Obeidat Z.; AlKhatib M.J.	Management Science Letters
2020	From high-touch to high-tech: COVID-19 drives robotics adoption	Zeng Z.; Chen P.-J.; Lew A.A.	Tourism Geographies
2020	When does technology anthropomorphism help alleviate customer dissatisfaction after a service failure?—The moderating role of consumer technology self-efficacy and interdependent self-construal	Fan A.; Wu L.; Miao L.; Mattila A.S.	Journal of Hospitality Marketing and Management
2020	The intention of passengers towards repeat use of biometric security for sustainable airport management	Kim C.; Lee K.C.; Costello F.J.	Sustainability (Switzerland)
2021	Customer service vs self-servicequality experiment: which one is a better strategy forairlines in indonesia	Soelasih Y.; Sumani	Academy of Strategic Management Journal
2021	Self-service technology adoption by air passengers: a case study of fast air travel services in Taiwan	Lien C.-H.; Hsu M.K.; Shang J.-Z.; Wang S.W.	Service Industries Journal
2021	Role of Technology Readiness in Airline Passengers' Perceptions of Self-service Technology Quality	Suwannakul E.	African Journal of Hospitality, Tourism and Leisure

Year	Title	Author(s)	Journal
2021	Passengers' perceptions on the use of biometrics at airports: A statistical model of the extended theory of planned behavior	Kasim K.O.; Winter S.R.; Liu D.; Keebler J.R.; Spence T.B.	Technology in Society
2021	Passengers intentions towards self-services check-in, Kuwait airport as a case study	AlKheder S.	Technological Forecasting and Social Change
2021	Airport self-service technologies, passenger self-concept, and behavior: An attributional view	Antwi C.O.; Ren J.; Owusu-Ansah W.; Mensah H.K.; Aboagye M.O.	Sustainability (Switzerland)
2021	"Find a flight for me, Oscar!" Motivational customer experiences with chatbots	Jiménez-Barreto J.; Rubio N.; Molinillo S.	International Journal of Contemporary Hospitality Management
2021	Technology-enhanced airport services—attractiveness from the travelers' perspective	Miskolczi M.; Jászberényi M.; Tóth D.	Sustainability (Switzerland)
2021	Self-check-in kiosk quality and airline non-contact service maximization: how to win air traveler satisfaction and loyalty in the post-pandemic world?	Moon H.G.; Lho H.L.; Han H.	Journal of Travel and Tourism Marketing
2021	Investigation into waiting time, self-service technology, and customer loyalty: The mediating role of waiting time in satisfaction	Ayodeji Y.; Rjoub H.	Human Factors and Ergonomics In Manufacturing

Year	Title	Author(s)	Journal
2021	Predicting the intentions to use chatbots for travel and tourism	Melián-González S.; Gutiérrez-Taño D.; Bulchand-Gidumal J.	Current Issues in Tourism
2022	Technology social practices by Millennials and Gen Z at airport departure terminals	Pant P.	Tourism Management Perspectives
2022	Relationship between self-service technologies' service quality, satisfaction, attitudinal and behavioral loyalty of airline passengers	Suwannakul E.; Khetjenkarn S.	ABAC Journal
2022	Self-service technologies (SSTs) in airline services: multimediating effects of flow experience and SST evaluation	Moon H.Y.; Lee B.Y.	International Journal of Contemporary Hospitality Management
2022	Invasive Yet Inevitable? Privacy Normalization Trends in Biometric Technology	Paik S.; Mays K.K.; Katz J.E.	Social Media and Society
2022	Understanding Consumer Buying Intention of E-Commerce Airfares Based on Multivariate Demographic Segmentation: A Multigroup Structural Equation Modeling Approach	Naruetharadhol P.; Wongsachia S.; Zhang S.; Phonthanukitithaworn C.; Ketkaew C.	Sustainability (Switzerland)
2022	Impact of innovation characteristics of airport self-bag-drop service on attitude, trust, and behavioural intention: using trust transfer theory	Shin H.; Kang S.-E.; Lee C.-K.	Asian Journal of Technology Innovation

Year	Title	Author(s)	Journal
2022	Service failure and self-recovery in tech-based services: self-determination theory perspective	Chiu Y.-T.H.; Nguyen D.M.	Service Industries Journal
2022	Tourists' Attitudes toward the Use of Artificially Intelligent (AI) Devices in Tourism Service Delivery: Moderating Role of Service Value Seeking	Chi O.H.; Gursoy D.; Chi C.G.	Journal of Travel Research
2023	Machine learning and mixed reality for smart aviation: Applications and challenges	Jiang Y.; Tran T.H.; Williams L.	Journal of Air Transport Management
2023	Passengers satisfaction with the technologies used in smart airports: An empirical study from a gender perspective	Rubio-Andrada L.; Celemín-Pedroche M.S.; Escat-Cortés M.-D.; Jiménez-Crisóstomo A.	Journal of Air Transport Management
2023	Achieving sustainable customer loyalty in airports: The role of waiting time satisfaction and self-service technologies	Ayodeji Y.; Rjoub H.; Özgit H.	Technology in Society

Appendix B – Summary of the relevant literature (study 2)

Reference	Context	Framework	Extension	Highlights
H.-B. Kim et al. (2009)	Airline e-commerce	TAM	Subjective norms, eTrust	Subjective norms and eTrust influence attitude and intention to use the system.
López-Bonilla and López-Bonilla (2015)	Airline e-ticketing	TAM	Self-consciousness	Individuals with high private self-consciousness and low social anxiety are more likely to adopt the system.
Lee et al. (2014)	Airport self check-in kiosks	TAM	Perceived service quality, risk of usage, need of service	Perceived service quality influences the attitude. Need of service negatively influences actual usage.
Ruiz-Mafe et al. (2013)	Airline e-ticketing	TPB	Cultural difference	The effects of subjective norms and perceived behavioural control on intention to purchase e-ticket are non-significant for Dutch, but significant for Spanish people.
Thamaraiselvan and Thanigaiarul (2019)	Airline self check-in channels	TAM, TPB	Perceived playfulness, risk, trust, word of mouth	Perceived playfulness, risk, trust, and word of mouth influence attitudes toward using the systems.
Escobar-Rodríguez and Carvajal-Trujillo (2013)	Airline e-ticketing	UTAUT2	-	Habit, performance expectancy, and facilitating conditions influence adoption intention.

Reference	Context	Framework	Extension	Highlights
Melián-González et al. (2021)	Travel and tourism chatbot	UTAUT2	Perceived innovativeness, inconvenience, anthropomorphism, automation	Intention to use chatbot is positively influenced by perceived innovativeness and anthropomorphism, while negatively affected by inconvenience and automation.
Moon and Lee (2022)	Aviation self-service technology in general	S-O-R	Flow experience, SST evaluation	Flow experience shapes SST evaluation of passengers and, in turn, influence adoption intention.
Naruetharadhol et al. (2022)	Airline e-ticketing	TAM	Price sensitivity, hedonic motivation	Customers' price sensitivity and hedonic motivation influence the adoption intention.
López-Bonilla and López-Bonilla (2013)	Airline e-ticketing vs. traditional ticketing	TAM	Reliability, enjoyment, comfort, control, delivery speed	Customers give more value to reliability, enjoyment, control and speed of service for the use of e-ticketing.
Gures et al. (2018)	Aviation self-service technology in general	N/A	Functionality, enjoyment, speed	The function of SST, enjoyment from using it, and speed of service influence the use of aviation SST.

Reference	Context	Framework	Extension	Highlights
Mohd Suki and Mohd Suki (2017)	Airline application ticketing	TAM	Perceived value, perceived trust, subjective norm, airline image	Perceived value has positive effect on perceived usefulness. Perceived trust influence adoption intention. However, subjective norm and airline image does not play a significant role.
H. Shin et al. (2022)	Airport self-bag-drop service	IDT, TTF	Relative advantage, compatibility, trialability, trust in service provider, trust in the system	The attitude and trust in service providers and system are shaped by relative advantage and trialability. While compatibility influences attitude and trust in the system, it does not influence the trust in service providers. Trust in service providers also influence trust in the system, and subsequently influence adoption intention.
Lu et al. (2009)	Airport self check-in kiosks	TAM	Perceived service quality, perceived risk, need for service	Perceived service quality positively influence attitude whereas perceived risk and need for service negatively impact the adoption intention.
Hwang et al. (2024)	Restaurant facial recognition payment	TPB	Functional motivation, hedonic motivation, cognitive motivation, social motivation, personal norm	Attitude is shaped by functional, hedonic, and social motivations. Adoption intention is also formed by personal norm.

Reference	Context	Framework	Extension	Highlights
Kim et al. (2025)	Restaurant facial recognition payment	TAM	Actual self-image congruence, ideal self-image congruence, social self-image congruence	Attitude is shaped by actual, ideal, and social self-image congruence.
Ciftci et al. (2024)	Business events facial recognition check-in	UTAUT2	Perceived health risk, perceived personalisation, privacy concerns, trust in the system	Perceived personalization influences trust in the system, and in turn, influence the adoption intention.
David-Negre and Gutiérrez-Taño (2024)	Facial recognition in general tourism	N/A	Self-efficacy, personal innovation, trust in the system, anticipated emotion	Self-efficacy, personal innovation, and trust in the system influence the adoption intention. These relationships are moderated by anticipated emotion. Trust in the system mediates the effect of self-efficacy and personal innovation on the adoption intention.
Kneale et al. (2014)	Airport biometric security	N/A	Age, reliability, ease of use, clearance time	Older passengers tend to use it less and take a longer time to finish than younger passengers

Reference	Context	Framework	Extension	Highlights
Morosan (2016)	Airport biometric security	UTAUT2	Information sensitivity, privacy concerns, compatibility	Privacy concerns has low impact on the adoption intention. Information sensitivity and compatibility has no significant impact.
Kasim et al. (2021)	Airport biometric security	TAM, TPB	Privacy concern	Privacy concerns positively moderate the effect of attitudes on adoption intention, while negatively moderate the effect of subjective norms and perceived usefulness on adoption intention.
Kim et al. (2020)	Airport biometric security	N/A	Perceived risk, perceived benefits	The intention to use and reuse the system are influenced negatively by perceived risk and positively by perceived benefits.
Kim et al. (2023)	Airport biometric security	TAM	Technology familiarity, social influence, trust in information protection, gender	Technology familiarity influences perceived ease of use. Trust in information protection influences the adoption intention, however the effect is stronger for women than men.
Untaru et al. (2024)	Airport biometric security	N/A	Perceived convenience, perceived security, functional value, perceived viral disease risk, mental health	Attitude is shaped by perceived security and perceived convenience. Mental health is influenced by perceived security, functional value, perceived viral disease risk, and attitude. Mental health also influences the adoption intention.

Reference	Context	Framework	Extension	Highlights
Chi et al. (2025)	Airport biometric boarding gate	TAM, AST, BRT	Media exposure, engagement, awareness, innovativeness, convenience, insecurity, anxiety	Media exposure increases the engagement with the technology. Engagement with the technology and convenience shape the attitude. While attitude, innovativeness, and convenience drive the adoption intention, anxiety decrease it.
Negri et al. (2019)	Airport biometric check- in kiosk	N/A	Queue time, process time, demographics	The model shows that almost 83% of passengers would use this channel, with a higher possibility found for male, leisure, and younger passengers.
Lancelot Miltgen et al. (2013)	General biometric technology	IDT, TAM, UTAUT	Innovativeness, compatibility, trust in the system, privacy concern, perceived risks	Compatibility, innovativeness, and trust in the system positively influence the adoption intention. Privacy concern increases perceived risk, which in turn, reduce the adoption intention.
Lien et al. (2021)	Aviation self- service technology in general	TAM, TPB	Benefits of fast air travel service	Benefits of fast air travel service influence perceived behavioural control, perceived usefulness, and perceived ease of use.
Taufik and Hanafiah (2019)	Airport self check-in kiosks	TAM	Need for human interaction	There moderating effect of the need for human interaction on the direct effects of perceived ease of use and perceived usefulness on passenger adoption is not significant.

Reference	Context	Framework	Extension	Highlights
Ko and Park (2019)	Airline automated ticketing machine	TRI, TAM	Perceived cost reduction, perceived initiative	Perceived usefulness, perceived ease of use, and perceived initiative influence passenger adoption whereas perceived cost reduction has no significant influence.
Lee (2016)	Airline online check-in system	TAM, TPB	Word-of-mouth, customization	Word-of-mouth and customization are proposed as two important drivers of technology adoption for Asian passengers.
Lee et al. (2019)	Airline e-ticketing	TAM	Perceived risk	The effects of perceived risk and perceived usefulness on adoption intention are significant. However, perceived risk has much stronger effects than perceived usefulness.
Moriuchi (2021)	Facial recognition payment	UTAUT, TOM	Trust, self-efficacy	Self-efficacy moderates the relationship between performance expectancy and adoption intention. Trust mediates the effects of UTAUT's cognitive variables on attitudes.
Nakisa et al. (2023)	General facial authentication	TAM	Personal innovativeness, perceived enjoyment, perceived risk, trust	Perceived innovativeness influences perceived usefulness whereas perceived enjoyment influences perceived ease of use. Trust shapes attitudes towards using the technology. However, perceived risk does not play an important role.

Reference	Context	Framework	Extension	Highlights
Hino (2015)	Fingerprint authentication in e-shopping	UTAUT	Perceived privacy, perceived credibility, age, gender	Perceived privacy and perceived credibility have an impact on adoption intention. These effects are found to be moderated by users' past experiences.
Morosan (2011)	Registered traveler biometric system	TAM	Perceived security, perceived privacy, perceived innovativeness	Perceived security influences perceived usefulness and perceived privacy, whereas perceived innovativeness influence perceived ease of use. Perceived privacy also shapes attitudes towards using the technology.
Breward et al. (2017)	Banking biometric authentication	NVT	Familiarity, trust, perceived control, account security, convenience, privacy concern, security concern	Familiarity and trust influence account security and convenience. Trust and perceived control negatively influence security concern, whereas perceived control also negatively influence privacy concern. Account security and convenience drive adoption intention, whereas privacy and security concerns play the barrier role.

Note: This table shows the highlighted findings of each studies, some well-established relationships may not be shown here; TAM is technology acceptance model; TPB is theory of planned behaviour; UTAUT is unified theory of acceptance and use of technology; UTAUT2 is extended unified theory of acceptance and use of technology; S-O-R is stimulus-organism-response theory; IDT is innovation diffusion theory; TTF is trust transfer theory; AST is agenda setting theory; BRT is behavioural reasoning theory; TRI is technology readiness index; TOM is theory of mind; NVT is net valence theory.

Appendix C– Survey for study 2

Information for participants

My name is Phutawan Ho Wongyai, a doctoral student in School of Aviation, Massey Business School, Massey University, New Zealand. This research is part of my dissertation.

You are invited to take part in this research. Before deciding to participate, please review this information. We appreciate your consideration whether or not you are participating in this research.

The aim of this project is to improve our comprehension of passengers' intention to use biometric check-in in Thailand by responding to the research question: "What are the factors that impact passengers' decision to use biometric check-in?" Your participation in this research will facilitate us in gathering valuable understandings and viewpoints on biometric check-in. The outcomes of this study can provide practical suggestions to service providers and a more profound understanding of biometric check-in. Massey University Human Ethics Committee has authorised this research.

We expect that the survey will be completed if you decided to participate. However, this is a voluntary participation where participants can exit at any time without consequence. Your information will be anonymous and will only be used in the dissertation and academic publication.

Should you have further questions, please do not hesitate to contact me:

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If you feel that the research's ethical conduct is questionable, you can contact Professor Fiona Te Momo, Chairperson of the Massey University Human Ethics Committee by sending an email to humanethics2@massey.ac.nz

Biometric Check-in Kiosk

Airport of Thailand Public Company Limited (AOT) has planned to provide a biometric check-in channel to enhance passengers' experience. As of now, THAI Airways International has started the trial period of the biometric check-in channel. The technology has not been officially implemented.

During the pre-flight passenger processing, passengers scan their faces and travel documents at the biometric check-in kiosk to complete the check-in process by themselves. Passenger will be required only to scan their face at the “pre-security area” and “boarding gate.” No travel documents are needed at these two points.



Biometric check-in kiosk Picture from THAI Airways Intl'

(https://www.thaiairways.com/en/news/news_announcement/news_detail/biometric-trial.page?)

Passengers' opinion: 1 (strongly disagree) to 7 (strongly agree).

Construct	Code	Measurement
Perceived Ease of Use	PEOU1	I find the biometric check-in kiosk to be easy to use.
	PEOU2	My interaction with biometric check-in kiosk is clear and understandable.
	PEOU3	I find it easy to get biometric check-in kiosk to do what I want it to do.
	PEOU4	Interacting with biometric check-in kiosk does not require a lot of mental effort.
	PEOU5	I find the biometric check-in kiosk to be flexible to interact with.
Perceived Usefulness	PU1	Using biometric check-in kiosk enables me to accomplish pre-flight passenger processing more quickly.

Construct	Code	Measurement
	PU2	Using biometric check-in kiosk improves pre-flight passenger processing.
	PU3	Using biometric check-in kiosk enhances convenience on pre-flight passenger processing.
	PU4	Using biometric check-in kiosk would make pre-flight passenger processing easier.
	PU5	I find biometric check-in kiosk useful in pre-flight passenger processing.
Attitude	ATT1	Using biometric check-in kiosk is a good idea.
Toward	ATT2	I like the idea of using biometric check-in kiosk.
Using	ATT3	I think using biometric check-in kiosk is a positive experience.
	ATT4	Using biometric check-in kiosk would be pleasant.
	ATT5	It would be desirable to use biometric check-in kiosk.
Intention to	INTU1	Assuming I have access to biometric check-in kiosk, I intend to use it.
Use	INTU2	Given that I have access to biometric check-in kiosk, I predict that I would use it.
	INTU3	I expect to use biometric check-in kiosk in the future.
	INTU4	I intend to use biometric check-in kiosk in the future.
	INTU5	I plan to use biometric check-in kiosk in the future.
Perceived	PBC1	I have resources, knowledge and skills to use biometric check-in kiosk.
Behavioural		
Control	PBC2	I believe that I have the necessary technology knowledge to carry out the pre-flight passenger processing using biometric check-in kiosk.
	PBC3	I am able to master the procedure in using biometric check-in kiosk.
	PBC4	I am competent in using biometric check-in kiosk.
	PBC5	I can use biometric check-in kiosk for pre-flight passenger processing.
Subjective	SN1	People who influence my behaviour think that I should use biometric check-in kiosk.
Norms		

Construct	Code	Measurement
Perceived Trust	SN2	People who are important to me think that I should use biometric check-in kiosk.
	SN3	People whose opinions I value prefer that I should use biometric check-in kiosk.
	SN4	Family and friends have influence on my decision to use biometric check-in kiosk.
	SN5	I will use biometric check-in kiosk if my colleagues use it.
	PT1	Biometric check-in kiosk is faster and more reliable than traditional pre-flight passenger processing.
	PT2	I believe biometric check-in kiosk is dependable.
	PT3	I believe biometric check-in kiosk is reliable.
	PT4	I believe biometric check-in kiosk is trustworthy.
Perceived Privacy Concern	PT5	I trust biometric check-in kiosk in overall.
	PC1	I am concerned that my information could be breached when using biometric check-in.
	PC2	I am concerned that my information could be shared or sold with using biometric check-in.
	PC3	I am concerned that the information I submit to biometric check-in kiosk could be misused.
	PC4	I am concerned about threats to my personal privacy today.
Perceived Risk	PC5	I am concerned about submitting information to biometric check-in kiosk because it could be used in a way I did not foresee.
	PR1	The biometric check-in kiosk might not perform well and create problems with pre-flight passenger processing.
	PR2	The biometric check-in kiosk might not perform well and handle pre-flight passenger processing incorrectly.
	PR3	The probability that something is wrong with performance of biometric check-in kiosk is high.
	PR4	I am concerned that biometric check-in kiosk will crash during the pre-flight passenger processing.
	PR5	Using biometric check-in kiosk would add uncertainty to pre-flight passenger processing.

Demographic Information

1. Do you use any forms of biometric technologies in daily life (such as fingerprint and facial recognition)?
 - ☐ Yes
 - ☐ No
2. Age
 - ☐ 18 – 35 years old
 - ☐ 36 – 50 years old
 - ☐ 51 – 64 years old
 - ☐ More than 65 years old
3. Gender
 - ☐ Male
 - ☐ Female
 - ☐ Prefer not to say
4. Education
 - ☐ Less than diploma
 - ☐ Diploma
 - ☐ Bachelor's degree
 - ☐ Post graduates
5. Nationality
 - ☐ Thai
 - ☐ Other (Please specify)
6. Destination that you are travelling to
 - ☐ Domestic
 - ☐ International

7. Type of flight that you are travelling
- ☐ With connection (Connecting flight)
 - ☐ No connection (Non-stop or direct flight)
8. Purpose of travel
- ☐ Business purpose
 - ☐ Leisure purpose
 - ☐ Visiting friends, family, and relatives
9. Are you travelling in group or alone?
- ☐ In group
 - ☐ Alone
10. Frequency of flying
- ☐ 1 – 2 times a year
 - ☐ 3 – 4 times a year
 - ☐ More than 4 times a year
11. Do you have membership with current airlines?
- ☐ Yes
 - ☐ No

Appendix D - Survey for study 3

Information for participants

My name is Phutawan Ho Wongyai, a doctoral student in School of Aviation, Massey Business School, Massey University, New Zealand. This research is part of my dissertation.

You are invited to take part in this research. Before deciding to participate, please review this information. We appreciate your consideration whether or not you are participating in this research.

This project aims to improve our comprehension of employees' job insecurity from the presence of self-service technology (SST), such as self-service check-in, self-service bag drop, and ticketing application. The research question of this study is "What are the impacts of SST on job insecurity, job satisfaction, and organisational commitment of airport and airline ground employees?" Your participation in this research will help us gather valuable understandings and viewpoints. The outcomes of this study can provide practical suggestions to service providers. Massey University Human Ethics Committee has authorised this research.

We expect that the survey will be completed if you decided to participate. However, this is a voluntary participation where participants can exit at any time without consequence. This survey is anonymous, and your information will be confidential. It will only be used in the dissertation and academic publication.

Should you have further questions, please do not hesitate to contact me:

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Supervisor:

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Prof. Dr. Kan Tsui, email address: kan.tsui@usq.edu.au

Dr. Thu-Huong Nguyen: thu-huong.nguyen@vu.edu.au

If you feel that the research's ethical conduct is questionable, you can contact Professor Fiona Te Momo, Chairperson of the Massey University Human Ethics Committee by sending an email to humanethics2@massey.ac.nz

Employees' opinion: 1 (strongly disagree) to 7 (strongly agree).

Construct	Code	Measurement
Threat of self-service technology	TSS1	I think my job could be replaced by self-service technology.
	TSS2	I am personally worried that what I do now in my job will be able to be replaced by self-service technology.
	TSS3	I am personally worried about my future in my organisation due to self-service technology replacing employees.
	TSS4	I am personally worried about my future in aviation industry due to self-service technology replacing employees.
Job insecurity	JI1	It is possible that I will soon lose my job.
	JI2	I am not sure that I can keep my job.
	JI3	I feel insecure about the future of my job.
	JI4	I think I could lose my job in one year.
Job satisfaction	JS1	Most days I feel enthusiastic about my job. (removed)
	JS2	I feel well satisfied with my present job.
	JS3	I find real enjoyment in my work.
	JS4	I feel that I am happier in my work than most other people.
	JS5	I like my job better than the average worker does.
Organisational commitment	OC1	I would be very happy to spend the rest of my career with this organisation.
	OC2	I really feel as if this organisation's problems are my own. (removed)
	OC3	I feel a strong sense of belonging to my organisation.

Construct	Code	Measurement
Turnover intention	OC4	I feel emotionally attached to this organisation.
	OC5	I feel like part of the family at my organisation.
	OC6	This organisation has a great deal of personal meaning for me.
	TI1	I will not renew my contract when the current contract is due. (removed)
	TI2	I am planning to get another occupation and life after leaving the job.
	TI3	There is a good chance that I will leave in the next year or so.
	TI4	I frequently think about leaving this job.
	TI5	I will probably look for a new job this year.

Demographic Information

1. Age

- ☐ 18 – 35 years old
- ☐ 36 – 50 years old
- ☐ 51 – 64 years old
- ☐ More than 65 years old

2. Gender

- ☐ Male
- ☐ Female
- ☐ Prefer not to say

3. Education

- ☐ Less than diploma
- ☐ Diploma
- ☐ Bachelor's degree
- ☐ Post graduate

4. Which organisation are you currently employed?

- ☐ Airline
 - ☐ Airport
 - ☐ Ground handling company (outsourcing company)
 - ☐ Other (Please specify)
5. How many hours on average you have to work per week?
- ☐ Please specify _____
6. How long have you been working with this organisation?
- ☐ Please specify _____
7. Organisational tenure (the current duration of your contract in years)
- ☐ Please specify _____
8. Current level of position
- ☐ Entry level
 - ☐ Supervisor
 - ☐ Manager