Airport Passenger Technology Readiness and Self-Service Bag Drop Technology Adoption at South African Airports

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Declaration

I declare that this research report is my own unaided work. It is being submitted to the Degree of Master of Science to the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination to any other University. I further declare that I have obtained the necessary authorisation and consent to conduct this research.

Signed 31st day of March 2020.

Signature

Abstract

Self-service bag drops (SSBDs) have received considerable attention over the last few years as they offer potential savings and efficiency gains for airports and airlines alike; however, little is known about passengers' readiness to adopt such self-service technologies (SSTs) The objective of this research was to determine passengers' Technology Readiness (TR) and SSBD adoption at South African airports using the Technology Readiness and Acceptance Model (TRAM). For user adoption testing to be viable, the associated model of user motivation must be valid. In order to validate the utility of the TRAM framework for this study, the following research steps were conducted: (1) The most widely cited, empirically replicated, and accepted model of human behaviour, the technology acceptance model (TAM), was the paradigm from which the TRAM was conceived; (2) Shortcomings identified by users of the TAM were mitigated by the introduction of the TR construct to form the TRAM; and (3) Published literature was reviewed to demonstrate that empirical support exists for the TRAM. Partial least squares structural equation modelling (PLS-SEM) was used to test the 10 linkages and two potential moderating effects in the TRAM framework. Twelve hypotheses were tested, of which 10 were accepted. The two hypotheses that were rejected were the potential moderating effects of TR. Six constructs (i.e., Technology Readiness Index [TRI], perceived ease of use [PEOU], perceived usefulness [PU], attitude, behavioural intention, and adoption) were tested, providing valuable information for airports and airlines in deciding to implement SSBDs. The research findings provide evidence that TRAM is a robust model that can be used to predict human behaviour as it relates to the adoption of self-service technologies (SSTs) in general, and SSBDs at South African airports in particular.

Keywords: airport, passenger, technology readiness, technology readiness index, technology adoption, perceived ease of use, perceived usefulness, self-service technology, self-service bag drop, partial least squares structural equation modelling, TR, TRI, TAM, PEOU, PU, TRAM, SST, SSBD, PLS-SEM

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Nomenclature / List of Acronyms

ATM	Automatic Teller Machine
AVE	Average Variance Extracted
BBP	Bank by Phone
BI	Behavioural Intentions
CB-SEM	Co-variance Based Structural Equation Model
CR	Composite Reliability
HTMT	Heterotrait - Monotrait
KMO	Kaiser-Meyer-Olkin
OLB	Online Banking
PCA	Principal Component Analysis
PEOU	Perceived Ease of Use
PLS	Partial Least Squares
PLS-SEM	Partial Least Square Structural Equation Model
PU	Perceived Usefulness
SSBD	Self-Service Bag Drop
SEM	Structural Equation Model
SST	Self-Service Technology
TAM	Technology Acceptance Model
TR	Technology Readiness
TRA	Theory of Reasoned Action
TRAM	Technology Readiness and Acceptance Model
TRI	Technology Readiness Index
VAF	Variance Accounted For
VIF	Variance Inflation Factor

Definition of Terms

Adoption is defined as the frequent use of (and likelihood of using) SSBDs.

An ***attitude*** is defined as “a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour” (Eagly & Chaiken, 1993, p. 1). This definition has been widely used in previous literature (see Curran, Meuter, & Surprenant, 2003; Liljander, Gillberg, Gummerus, & van Riel, 2006).

Behavioural Intentions are defined as a measure that refers to a person’s subjective probability that he or she will perform a specific behaviour (Davis, Bagozzi, & Warshaw, 1989; Fishbein & Ajzen, 1975).

Perceived Ease of Use (**PEOU**) is the degree to which a passenger believes that using an SSBD would be free of physical and mental effort (Davis, 1989).

Perceived Usefulness (**PU**) is the degree to which a passenger believes that using an SSBD would enhance his or her check-in process (Davis, 1989).

Self-service technologies (**SST**) are “technological interfaces that allow customers to produce a service independent of direct service employee involvement” (Meuter, 1999, p. 1).

Self-service bag drop (**SSBD**) technologies are check-in technologies that allow passengers to obtain their boarding pass and bag tag and thereafter, to physically tag their bag and inject it into the airport baggage handling system without going to the airline agent (National Academies of Sciences, Engineering, and Medicine, 2011).

Technology Readiness (**TR**) refers to people's propensity to embrace and use new technologies for accomplishing goals in home-life and at work (Parasuraman, 2000).

At the measurement level, the ***Technology Readiness Index*** (**TRI**) was developed by Parasuraman in collaboration with Rockbridge Associates, Inc. (a U.S. based company specialising in service and technology research) to measure people's general beliefs about technology (Parasuraman, 2000).

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1 INTRODUCTION

Airport passenger processes have undergone many changes over the last four decades, attributed mostly to the changes in airport technologies (Gualandi, Mantecchini, & Paganelli, 2011). The typical airport passenger processes are illustrated in Figure 1. Typically, a departing passenger arrives at the airport proceeds to an airline agent to complete the check-in process, which is followed by security screening and border control for international passengers. Thereafter, the passenger proceeds to a secure area typically with retail offerings before boarding the aircraft. Arriving passengers disembark the aircraft, proceed to border control if applicable, followed by claiming their bags.

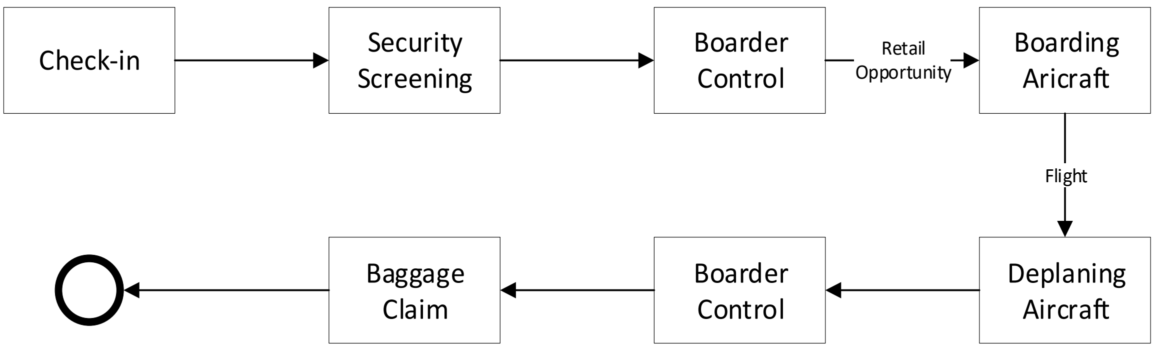


Figure 1. Typical Airport Passenger Processes

In this study, the context of the check-in process is pertinent as it has the most substantial terminal spacial requirement and highest number of airline service agents per passenger when compared to the other processes (IATA, 2019). It additionally presents the first opportunity for efficiency improvements. The check-in process for passengers from the early development of commercial aviation to the early 1980s was seemingly the same: “an airline agent sold tickets, manually allocated a seat for the passenger, checked documents, weighed bags, and printed the boarding pass” (National Academies of Sciences, Engineering, and Medicine, 2011, p. 4). The late 1980s introduced a degree of automation, which allowed the airline agent to work more efficiently with a low impact on the waiting and processing times (National Academies of Sciences, Engineering, and Medicine, 2011).

The 1990s saw the introduction of self-service technologies (SSTs) that allowed consumers to co-produce services independent of direct service employee involvement (Dabholkar, 1996; Meuter, 1999). Examples include online banking, automatic teller machines (ATMs), self-service kiosks, telephone banking, and online shopping. The introduction of self-service check-in technologies allowed passengers to perform certain aspects of the check-in process either at the airport via a kiosk or at home via the internet independent of an airline agent (Dabholkar, 1996; National Academies of Sciences, Engineering, and Medicine, 2011). Passengers with no baggage to check-in were able to avoid going to the airline agent. The limitation was that passengers with baggage still needed to go to an agent to weigh and tag their bags. The agent then injected the bags into the baggage handling system.

The proliferation of SSTs gave rise to self-service bag drops (SSBDs). The SSBD allows passengers who have obtained their boarding pass via self-service check-in technologies, to obtain and self-tag their bag, then weigh and inject the bag into the airport baggage handling system. This represents the next step in the evolution of the check-in process (National Academies of Sciences, Engineering, and Medicine, 2011). Using SSBDs, passengers with baggage to check-in can completely avoid processing by the airline agent.

SSBDs technologies result in reduced operational costs for both airports and airlines, better optimisation of terminal space, and reduced congestion at the check-in area (Best, 2015). Thus, SSBD adoption can enable more efficient utilisation of airport terminals and airline resources (National Academies of Sciences, Engineering, and Medicine, 2011).

1.1 Background

Air transport is a significant contributor to global economic activity, which according to recent estimates, places the total economic impact at USD 2.7 trillion, which equates to approximately 3.6% of global gross domestic product (GDP) (Industry High Level Group [IHLG], 2019). It is projected that the number of passengers will more than double over the next 20 years (International Air Transport Association [IATA], 2018a; IHLG, 2019) and that aviation will generate USD 5.7 trillion in GDP in 2036 (IHLG, 2019). In reviewing the regional economic impact of air transport across

Africa, Asia and Pacific, Europe, Latin America and the Caribbean, Middle East, and North America, the African air transport market is in all probability the one with the most potential for growth (IHLG, 2019).

The IHLG (2019) report highlights that while the future growth of air transport will likely depend on sustainable world economic and trade growth along with reducing airline costs and ticket prices, technological improvements will also impact future growth. The report further emphasises that new technologies and procedures should also be adopted to modernise infrastructure while minimising the potential adverse impacts of the growth on the environment. In response to the forecasted demand, airport capacity planning and infrastructure development have already commenced at the primary international airports in South Africa, as seen in the late 1990s and early 2000s (Airports Company South Africa [ACSA], 2019). Airports are also considering the implementation of SSTs, which results in passenger processing improvements. These processing improvements provide possible solutions to improve (IATA, 2016; National Academies of Sciences, Engineering, and Medicine, 2011):

i. Process cycle times;
ii. Cost-effectiveness;
iii. Service delivery;
iv. Resource utilisation; and
v. The utilisation of terminal space.

In 2007, IATA[1] launched the ‘Fast Travel’ program to assist airports around the world to provide solutions to address forecasted passenger growth with SSTs that offer passengers improved service delivery options that are cost-effective for the industry (IATA, 2016; National Academies of Sciences, Engineering, and Medicine, 2011). Fast Travel self-service areas could yield more than USD 3.9 billion worth of annual savings for the industry and enhanced passenger experiences (Copart, 2011). The Fast Travel program expands into six SST options as listed below:

i. Check-in – Enables passengers to check-in and obtain boarding passes using self-service channels (e.g., online, mobile, kiosk, and automated), thus avoiding long queues at check-in counters.
ii. Bags ready-to-go – Offers passengers the ability to print and attach their baggage tags (at SSBDs, kiosks, at home, or using electronic baggage tags), while also providing dedicated bag-drop options such as SSBDs.
iii. Document Check – Enables passengers to self-scan travel documents (i.e., passport, visa, ID card, driver's license) to ensure compliance with destination and transit requirements.
iv. Flight Re-booking – In case of flight cancellation or delay, enables airlines to pro-actively re-book passengers, offering new booking

[1] IATA is a trade association that represents 290 of the world’s airlines that together carry 82% of total air traffic (IATA, n.d.a) and 51 out of 54 airlines operating in South Africa at OR Tambo, Cape Town, and King Shaka International Airports (ACSA, 2018; IATA, n.d.b).

options and new boarding tokens using self-service channels (online/mobile/kiosk).

v. Self-boarding – Offers passengers the choice to self-scan boarding tokens at automated self-boarding gates.

vi. Bag Recovery – Offers passengers the choice to report mishandled bags using a self-service channel instead of waiting in line at a baggage service counter (online/mobile/kiosk).

IATA's vision is that by 2020 at least 80% of passengers across the world will have access to a full suite of self-service alternatives (IATA, 2016). Additionally, IATA has designated that check-in, bags ready-to-go, and flight rebooking (i, ii, iv) are mandatory initiatives, and the remaining three (iii, v, vi) optional (IATA, 2018c).

It is in line with this vision that Airports Company South Africa (ACSA), the owner and operator of three primary international airports in South Africa, OR Tambo, Cape Town, and King Shaka International Airports, have already implemented SSTs for check-in, document check, flight rebooking, and bag recovery. They have also started a project to install self-boarding gates and SSBDs for the bags ready-to-go option (ACSA, 2019).

Table 1 provides the cost-benefit potential for Fast Travel projects assuming IATA's vision that 80% of passengers have access to self-service delivery options is realized, and that passengers adopt the technologies.

Table 1

Fast Travel Cost-Benefits

Project	Saving	Adoption[a]
Check-in	USD 1,853 billion	80%
Bags ready-to-go (SSBD)	USD 666 billion	54%[b]
Document scanning	USD 228 billion	33%
Flight re-booking	USD 455 billion	80%
Self-boarding	USD 213 billion	46%
Bags recovery	USD 574 billion	80%

Note. Data source Copart (2011).
[a] Assumed adoption rate that Copart used to calculate the savings.
[b] Copart assumed a 90% adoption rate for bags ready-to-go and 60% for the number of passengers with bags to check-in, i.e., 90% of 60% = 54%.

Despite the slow initial uptake of SSTs by passengers, international airports and airlines persisted with further implementation and development of SSTs (National Academies of Sciences, Engineering, and Medicine, 2011; SITA, 2018). The continued development and implementation were encouraged by increases in labour costs, advances in technology, improved service operations, increased service efficiencies, additional functional benefits to passengers, and expanded service delivery options (Curran & Meuter, 2005; Dabholkar, 1996; Lovelock & Young, 1979).

While SSBDs offer the potential savings illustrated in Table 1 and efficiency gains for airports and airlines alike, little is known about passengers' readiness to adopt such SSTs.

1.2 Problem Statement

The traditional “high touch” approach to service delivery is no longer the only applicable service delivery method. This is because of the growing importance of “high tech” alternatives, such as SSTs (Meuter, 1999). Curran et al. (2003) argue that the proliferation of SSTs has complicated the service interaction that was traditionally dominated by interpersonal interactions due to high-tech alternatives. Curran et al. (2003) further reported that as service providers offer additional touchpoints, consumers are presented with a host of SSTs, where they no longer interact with service firm employees.

As the demand for self-service throughout airport passenger processes continued to increase, SSBD technologies have seen rapid growth. This increase resulted in innovative SSBD technologies that were developed to make the passenger more self-sufficient. Amsterdam Airport Schiphol, one of Europe’s busiest airports, reported the advantages of SSBDs were that they are always available, resulting in higher efficiencies for passengers, airlines, and the airport (“Is self-service bag drop the future of baggage processing,” 2011).

Regardless of the positive impact made by the introduction of SSTs, there are issues with adoption that have surfaced (Meuter, 1999; Meuter, Ostrom, Bitner, & Roundtree, 2003; National Academies of Sciences, Engineering, and Medicine, 2011):

i. Not all consumers choose to use these new technologies as they fail to see SSTs as an improvement over traditional services.
ii. Some consumers may harbour negative feelings towards technology.
iii. Some consumers are technology averse.

Despite the issues that surfaced, there has been little research evidence of consumer's readiness to adopt SSTs (Naidoo, 2012; Parasuraman, 2000; Smit, Roberts-Lombard, & Mpinganjira, 2018).

Two recent independent surveys of respondents relative to the passenger traffic from 20 countries across the Americas, Asia, Europe, the Middle East, and Africa that represented 70% of global passenger traffic found the following:

i. 68% of respondents want SSBD technologies (IATA, 2018b);
ii. adoption of SSBDs by passengers that have checked baggage seems to have stabilised at 20.5% (SITA, 2019).

These studies illustrate that despite the desire to have SSBD technologies, the adoption of SSBDs is not demonstrating similar adoption rates. Therefore, the readiness and perceptions of passengers towards SSBDs need to be further explored.

<u>The problem, therefore, is passengers' failure to adopt SSBD technologies.</u>

In response to this problem, researchers have proposed several theoretical models of human behaviour to better understand and describe individual attitudes and behaviours toward new technologies. These models include the theory of reasoned action (TRA; Ajzen, 2012; Davis et al., 1989; Fishbein & Ajzen, 1975); the SST attribute-based and overall affect models (Dabholkar, 1996); the SST attitude-intention models (Curran et al., 2003; Curran & Meuter, 2005); the innovation diffusion theory that was developed to understand the adoption of innovative products (Rogers, 2003); and the Technology Acceptance Model (TAM; Davis, 1986; Davis, 1989; Davis et al., 1989; Lin, Shih, & Sher, 2007; Lin & Chang, 2011).

The TAM is the most widely cited, empirically replicated, and accepted model for technology adoption (Cheng, 2019; Lin et al., 2007; Lin & Chang, 2011). TAM consists of two constructs, perceived ease of use (PEOU) and perceived usefulness (PU), which jointly influence attitude and behavioural intentions (Davis et al., 1989). In the context of this study, the definitions for PEOU and PU have been adapted to fit the study. PEOU is the degree to which an individual (passenger) believes that using a system (SSBD) would be free of physical and mental effort (Davis, 1989). PU is the degree to which an individual (passenger) believes that using a system (SSBD) would enhance his or her job performance (check-in process) (Davis, 1989).

TAM was developed to predict the adoption of computerised systems (Davis, 1989; Davis et al., 1989) and has evolved to become an important model in predicting the adoption of technology (Marangunić & Granić, 2015). However, TAM was initially conceived to determine the usage of technological systems in a work environment, which may impact its suitability to determine technology-adopting behaviour in home environments (Lin et al., 2007; Lin & Chang, 2011). The differences between work and home environments are people in work environments may unwillingly or involuntarily adopt a system due to management intervention. In contrast, consumers in home environments may be permitted to choose among various available options (Lin et al., 2007). SSBDs fall into the home environments category as passengers are free to choose from full-service counter check-in, self-service check-in, and staffed bag drop, or SSBD.

In the context of SSTs, service delivery is not possible in the absence of the consumers' active participation and co-production (Lin et al., 2007; Lovelock & Young, 1979). However, few researchers have used TAM to explore the adoption of SSTs (Lin & Chang, 2011). Furthermore, technologically savvy consumers have been found to avoid using SSTs (Meuter, Ostrom, Bitner, & Roundtree, 2003; Parasuraman, 2000). Therefore, when investigating the perception, attitude, and behaviour of consumers toward SSTs, researchers should include consumer personality attributes with regards to the propensity to use technology (Lin et al., 2007; Lin& Hsieh, 2006; Lin & Chang, 2011; Parasuraman, 2000).

To consider consumer personality attributes, Lin et al. (2007) and Lin and Chang (2011) extended TAM with the integration of Parasuraman's (2000) Technology Readiness (TR) construct to form the Technology Readiness and Acceptance Model (TRAM) as depicted in Figure 2.

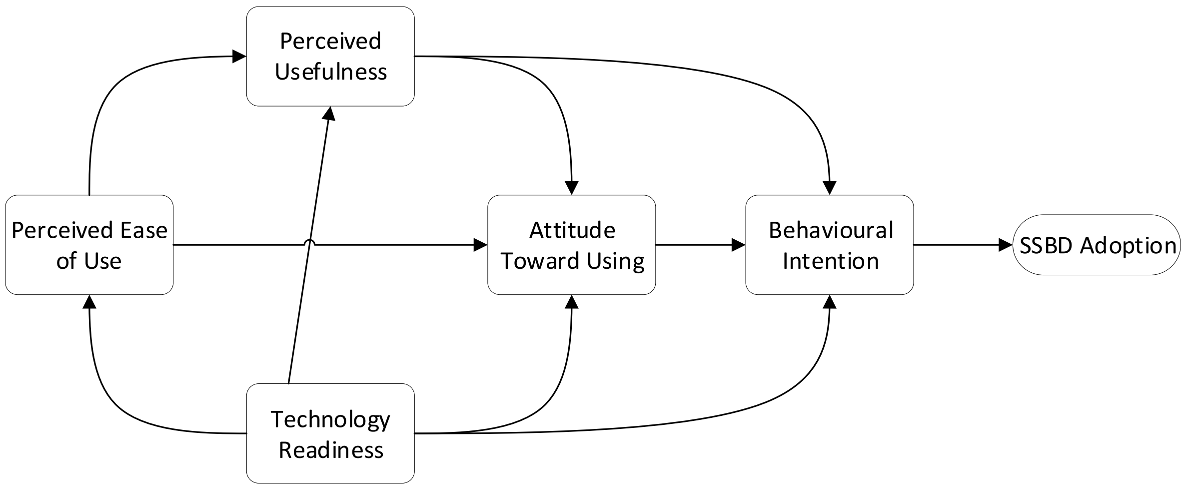


Figure 2. TRAM Model adapted from Lin and Chang (2011).

TR, as defined by Parasuraman (2000), differs from Technology Readiness Levels (TRLs) in that TR refers to people's propensity to embrace and use new technologies as opposed to TRLs that refer to the maturity of new technologies (Mankins, 2009). While TR is useful in determining consumer's common beliefs toward technology, its applicability to specific technologies is questionable (Lin et al., 2007). Lin et al. (2007) highlighted that TR is not capable of explaining why consumers with high TR do not always adopt new technologies. TRAM addresses this by supplementing TR with the TAM constructs PEOU and PU, which are specific to the system being evaluated (Lin et al., 2007).

TRAM has successfully been used by several researchers across a broad spectrum of technologies to analyse the relationships between technology adoption and personality traits (Jin, 2013). Additionally, TRAM has been used by several researchers to investigate the adoption of SSTs (e.g., Lin et al., 2007; Lin & Chang, 2011; Lundberg, 2017; Smit et al., 2018a).

Due to the comprehensiveness of TRAM and its successful usage on SSTs, the TRAM framework was a suitable fit for this study in its research on airport passengers' readiness to adopt SSBDs at South African airports.

1.3 Purpose of the Study

The purpose of this research was to assess the TR and perceptions of passengers to adopt and use SSBDs within the South African aviation environment. Airports and airlines across the world are heavily investing in the implementation of SSBD technology (ACSA, 2019; BusinessTech, 2017; IATA, 2016).

This research aimed to provide further insight into the evaluation and adoption of SSBDs by passengers in South Africa. The findings will provide airports and airlines with an understanding of passengers' readiness to adopt SSBDs. This will enable airports and airlines to ensure that the return on investment inherent with the development and implementation of SSBD technology is maximised and to provide appropriate solutions for the forecasted demand.

1.4 Research Questions

The explication of the research problem in Section 1.2 provided evidence of the potential benefits SSBDs. The adoption of SSBDs could provide potential solutions to sustain the forecasted passenger growth. It additionally highlighted that there is uncertainty with regards to the adoption of SSTs in general and, more specifically, SSBDs.

This led to the central research question that this study intended to answer.

1.4.1 Central Research Question.

How do airport passengers' overall technology readiness and perceptions towards SSBD technologies at South African airports influence the adoption thereof?

1.4.2 Sub-questions.

To answer the central research question, the following sub-questions were explored:

i. What are airport passengers' TR, PEOU, PU, attitudes, and behavioural intentions towards SSBDs at South African airports?
ii. How is the relationship between airport passengers' level of TR, PEOU, PU, attitude, and behavioural intention related to the adoption of SSBDs at South African airports?

1.5 Hypotheses

The discussion of the research problem (Section 1.2) succinctly presented the reasons for the selection of TRAM, which integrated TR with TAM to answer the central research question. Figure 3 illustrates the proposed theoretical model used for this study. The model has been adapted from Lin et al. (2007) and Lin and Chang (2011) and presents the links between TR, PU, PEOU, attitude toward SSBDs, behavioural intentions toward SSBDs, and the adoption of SSBDs.

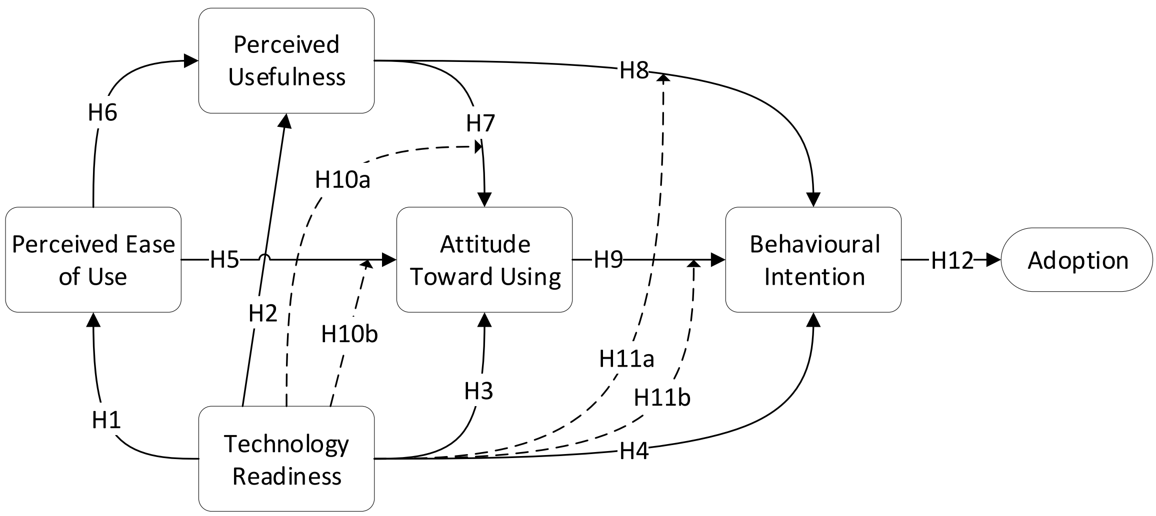


Figure 3. Path Model depicting hypotheses using TRAM adapted from Lin and Chang (2011).

Figure 3 also places the research hypotheses within the context of the model, which will be further developed as part of the literature review in Chapter 2. Only a brief context to the hypotheses is provided in this section.

The following hypotheses and alternative hypotheses were formulated for this study:

TR inclinations are positively associated with perceptions of ease of use (Lin et al., 2007; Lin & Chang, 2011). This relationship was asserted in the first hypothesis.

1. $H_0$1: TR is positively related to PEOU
   H_a1: TR is not positively related to PEOU

TR inclinations are positively associated with perceptions of usefulness (Lin et al., 2007; Lin & Chang, 2011). This relationship was asserted in the second hypothesis.

2. $H_0$2: TR is positively related to PU.
   H_a2: TR is not positively related to PU.

TR inclinations are positively associated with more positive attitudes towards SSTs (Dabholkar & Bagozzi, 2002; Parasuraman, 2000). This relationship was asserted in the third hypothesis.

3. $H_0$3: TR is positively related to attitude towards SSBDs.
   H_a3: TR is not positively related to attitude towards SSBDs.

Godoe and Johansen (2012), Lin and Hsieh (2006), and Parasuraman (2000) found that TR is positively related to behavioural intentions. This relationship was asserted in the fourth hypothesis.

4. $H_0$4: TR is positively related to behavioural intentions towards SSBDs.

   H_a4: TR is not positively related to behavioural intentions towards SSBDs.

PEOU has a direct positive relationship on attitude (Curran & Meuter, 2005; Davis et al., 1989). This relationship was asserted in the fifth hypothesis.

5. $H_0$5: PEOU is positively related to attitude towards SSBDs.

   $H_0$5: PEOU is not positively related to attitude towards SSBDs.

Research has demonstrated that PEOU has a positive influence on PU (Dabholkar, 1996; Davis, 1989; Venkatesh & Davis, 2000). This relationship was asserted in the sixth hypothesis.

6. $H_0$6: PEOU is positively related to PU.

   H_a6: PEOU is not positively related to PU.

PU has a direct positive relationship with attitude (Curran & Meuter, 2005; Davis et al., 1989). This relationship was asserted in the seventh hypothesis.

7. $H_0$7: PU is positively related to attitude towards SSBDs.

   H_a7: PU is not positively related to attitude towards SSBDs.

In addition to the direct relationship on attitude, PU also has a direct positive relationship on behavioural intention (Davis et al., 1989; Lin & Chang, 2011). This relationship was asserted in the eighth hypothesis.

8. $H_0$8: PU is positively related to behavioural intentions towards SSBDs.

   H_a8: PU is not positively related to behavioural intentions towards SSBDs.

Extensive research spanning more than four decades has demonstrated that attitudes have a direct positive influence on behavioural intentions (Curran & Meuter, 2005; Dabholkar, 1996; Dabholkar & Bagozzi, 2002; Davis et al., 1989; Fishbein & Ajzen, 1975; Lin & Chang, 2011). This relationship was asserted in the ninth hypothesis.

9. $H_0$9: Attitude towards SSBDs is positively related to behavioural intentions towards SSBDs.

   H_a9: Attitude towards SSBDs is not positively related to behavioural intentions towards SSBDs.

People with higher TR are likely to be more experienced and have a more favourable outlook on the use of technology-based systems (Lin & Chang, 2011; Walczuch, Lemmink, & Streukens, 2007). Therefore, PU may be less important to them. Kleijnen, Wetzels, and de Ruyter (2004) investigated the moderating effects of TR and found that consumers with higher TR were less concerned with PEOU. Therefore, the moderating effects of TR on the relationship between PU and attitude, and PEOU and attitude was assessed.

10. $H_0$10a: Higher TR attenuates the relationship between PU and attitude.

H_a10a: Higher TR does not attenuate the relationship between PU and attitude.

$H_0$10b: Higher TR attenuates the relationship between PEOU and attitude.

H_a10b: Higher TR does not attenuate the relationship between PEOU and attitude.

As with the moderating role that TR plays on the relationship between PU and attitude, so too, it was hypothesised that higher TR attenuates the relationship between PU and behavioural intention. Liljander et al. (2006) submitted that higher TR moderates the effect of PU on behavioural intention. Additionally, people with higher TR rely less on their attitudes when deciding to use SSTs (Kleijnen et al., 2004). Therefore, the moderating effects of TR on the relationship PU and behavioural intention and attitude and behavioural intention was assessed.

11. $H_0$11a: Higher TR attenuates the relationship between PU and behavioural intention.

H_a11a: Higher TR does not attenuate the relationship between PU and behavioural intention.

$H_0$11b: Higher TR attenuates the relationship between attitude and behavioural intention.

H_a11b: Higher TR does not attenuate the relationship between attitude and behavioural intention.

Behavioural intention plays a prominent role in a person's attitudes and perceptions and, subsequently, their intention to perform that behaviour (Ajzen, 2012; Davis et al., 1989; Fishbein & Ajzen, 1975). This relationship was asserted in the twelfth hypothesis.

12. $H_0$12: Behavioural intention towards SSBDs is positively related to the actual usage of SSBDs.

H_a12: Behavioural intention towards SSBDs is not positively related to the actual usage of SSBDs.

Now that we have discussed the hypotheses, research objectives are presented next.

1.6 Research Objectives

The research objectives set out for this study will now be presented.

i. To determine passengers' TR, PEOU, PU, attitudes, and behavioural intentions towards the use of SSBDS.
ii. To establish the relationship between passengers TR, PEOU, PU, attitude, behavioural intention, and adoption of SSBDs.

1.7 Significance of the Study

The readiness and perceptions of passengers to adopt and use SSBDs within the South African aviation environment are essential for many reasons.

i. To provide an understanding of passengers' readiness to utilise SSBDs.
ii. To ensure that the return on investment inherent with the development and implementation of SSBD technology is maximised.
iii. Higher adoption rates of SSBD can enable more efficient processing of passengers at airports.
iv. Improved customer satisfaction for customers that prefer self-service over conventional interactions with service staff.

1.8 Methodology

The study used quantitative approaches to determine the technology readiness and acceptance of airport passengers to SSBD technology in South Africa. A predetermined structured questionnaire was designed and administered by physical issue and electronic distribution.

1.8.1 Instrument.

Previously published research questions based on Likert type and semantic differential scales with desirable properties were adapted to measure TR, PEOU, PU, attitude, and behavioural intention. A licence was obtained from A. Parasuraman and Rockbridge Associates, Inc. to use their 16-item Technology Readiness Index (TRI) 2.0© scales to measure the four dimensions of TR, i.e., optimism, innovativeness, discomfort, and insecurity. This was done to enable the reproducibility of the questionnaire and enable objective confirmation. The questionnaire additionally included a few qualitative variables that were used to assess passenger preferences, reasons for not using an SSBD, and other demographic data to support the analysis. A copy of the instrument is attached in Appendix A of the report.

As recommended by Fowler (2014), the questionnaire was pretested to assess the time required to complete the questionnaire and to test if the instructions and questions were clear. Ten passengers were approached randomly at OR Tambo International airport and asked to participate in the pre-test. The questionnaire was then updated based on the feedback received. Thereafter, a pilot test was conducted to assess the conceptual model validity based on the scale development process defined by Carpenter (2018). The factorability of the pilot study was assessed by evaluating the Principal Components Analysis (*PCA*) outputs which included the Kaiser-Meyer-Olkin $(KMO > 0.5)$ values, Bartlett's test for sphericity $(p < 0.05)$, and the rotated component matrix as recommended by Carpenter (2018). Additionally, Cronbach's alpha test was used to determine the reliability of the various constructs (Nunnally, 1978).

Nunnally (1978) recommended that for a construct to be reliable, it must generate a Cronbach's alpha value higher than 0.7, whereas others, such as Siriram and Snaddon (2005) have used values above 0.6. All higher-order constructs (TR, PU, PEOU, attitude) reported $KMO > 0.5$ indicating adequate sampling adequacy. Additionally, all higher-order variables reported Bartlett's test for sphericity significance < 0.05, indicating that the data was suitable for PCA analysis, Cronbach's alpha were all above 0.6, and finally all the rotated component scores were over 0.4 and therefore retained.

1.8.2 Population and Sample.

The target population for this study is all air travel passengers using the services of commercial airlines operating at three primary South African international airports. However, the population size is very large, and the demographics are not published. Using the inverse square root method, a sample size of 160 was set (Kock & Hadaya, 2018).

For this study, non-probability convenience and respondent-driven sampling were used to select respondents from the target population.

1.8.3 Data Collection and Analysis.

Ethical clearance was obtained from the University of the Witwatersrand School of Mechanical, Industrial, and Aeronautical Engineering Ethics Committee before data collection. A copy of the approval is included in Appendix B.

An informed consent letter was presented with the survey questionnaire with the first question being an acknowledgement that the informed consent letter was received and that by proceeding to the first question, the respondent thereby grants consent which may be revoked at any time prior to the completion of the survey. The survey was anonymous, and no personal data from any of the respondents were recorded.

The data was collected in two ways. Electronic questionnaires were distributed via SurveyMonkey, and physical questionnaires were administered at OT Tambo International Airport. To ensure that a representative sample was obtained, physical questionnaires were administered over several weeks at different times of the day.

Considering the guidelines published by Hair, Risher, Sarstedt, and Ringle (2019) for choosing between covariance based structural equation modelling (CB-SEM) and partial least square structural equation (PLS-SEM), it was determined that PLS-SEM was better suited for this study. The IBM SPSS Statistics for Windows (IBM Corp, 2017) and SmartPLS (Ringle, Wende, & Becker, 2015) statistical analysis tools were utilised to conduct the analysis and provide suitable reports for interpretation of data for this research.

A mixture of descriptive and inferential statistical techniques was utilised to analyse the data where regression analysis was the primary statistical technique used to test the hypotheses set out for the study.

1.9 Limitations of the Study

The main limitation of the study was the use of non-probability sampling of passengers as opposed to a random sample. A limitation of this technique is that the sample may not be representative of the target population (Fowler, 2014). Additionally, the survey questionnaire was only available in English. Therefore, certain subgroups of the target population were excluded from the sample. The survey was conducted over one-month on different days of the week at different times to minimise bias.

Due to time constraints, the study adopted a cross-sectional survey approach as opposed to a longitudinal survey approach. The cross-sectional survey approach provided a snapshot of the respondents over four weeks. Rindfleisch, Malter, Ganesan, and Moorman (2008) highlight that the two main validity concerns of the cross-sectional approach are common method variance bias and causal inference. The collection of surveys over four weeks from multiple respondents mitigated this limitation to an extent.

1.10 The Organisation of the Research Report

This research report consists of six Chapters. The following describes the contents of each Chapter.

Chapter 1: Provides the introduction and background to the study. The formulation of the problem statement, the purpose of the study, the research questions, the hypotheses, and the research objectives of the study are outlined. In addition, the significance of the study, the limitations and delimitations, and a summary of the research methodology for study are presented.

Chapter 2: Presents a review of the literature, which comprises of a review of several theoretical models of human behaviour that lead to the selection of TRAM as the model that is used for this study. The TR construct, and the measurement thereof are reviewed, followed by a review of TRAM and how the model integrates TR into TAM. The research questions and hypotheses are presented. The measurement and structural model are developed for conceptualising, measuring, and analysing the hypothesised relationship between TR, PEOU, PU, attitude, and behavioural intentions towards SSBDs.

Chapter 3: Centres on the research methodology and design followed to achieve the research objectives. Emphasis is placed on the research paradigm, research design, population, and sampling methodology, and includes sample size. The research instrument design, structural equation model, data collection, and data analysis are also discussed.

Chapter 4: Presents the research results and hypothesis tests are conducted.

Chapter 5: Presents the discussion and interpretation of the results, including hypothesis test results, along with an assessment of the central research question.

Chapter 6: The conclusion of the results of this study, implications of the research, limitations, and recommendations for future research are presented.

2 LITERATURE REVIEW

The purpose of this chapter is to analyse the relationship between the proposed Technology Readiness and Acceptance Model (TRAM), self-service technologies (SSTs), and the adoption thereof. The adoption process and influential factors that impact adoption are also investigated. The objective of the analysis is to:

i. obtain an understanding of SSTs;
ii. provide an understanding of the theory and research pertaining to user acceptance processes;
iii. identify existing evidence to support the selection of the proposed model; and
iv. determine the extent to which the proposed model answers the central research question: “How do airport passengers’ overall technology readiness and perceptions towards SSBD technologies at South African airports influence the adoption thereof?”

The review begins with a historical overview of previous research conducted in the area of self-service, the role of technology, and the need for interpersonal interaction. Thereafter a review of the Technology Acceptance Model (TAM) with its constructs is provided. Thereafter focus is shifted to the Technology Readiness (TR) construct and its four dimensions.

Last, TRAM is specified with an analysis of the individual constructs and causal relationships that prior studies have addressed in comparison to the proposed model. Additionally, the theory relevant to the central research question and the hypotheses for the study is examined.

2.1 Self-Service Technologies

The growing usage of SSTs prompted the need for more research to better understand the self-service encounter, including the evaluation and adoption thereof.

Under the constant increasing wage inflation, companies are continuously looking at ways to reduce operating expenses and innovative solutions to optimise resources (Dabholkar, 1996; Lovelock & Young, 1979). Dabholkar (1996) and Lovelock and Young (1979) additionally highlighted that one of the key ways to reduce operating expenses is to get the consumer to become an active participant in the delivery of the service. Other benefits that can be realised by allowing consumers to become active participants in the service delivery process are that companies are better suited to handle demand fluctuations, improve service quality, enhance overall operations, and increase efficiencies (Lin & Hsieh, 2006; Meuter, 1999). However, Dabholkar (1996) and Lovelock and Young (1979) cautioned that self-service directly affect consumers, and their acceptance of the change is not implicit.

Meuter (1999) is credited with coining the term SST that refers to "technological interfaces that allow customers to produce a service independent of direct service employee involvement" (p. 1). In his seminal work on consumer adoption of self-service technologies, he cited the studies of Langeard, Bateson, Lovelock, and Eiglier (1981) and Bateson (1985) as the two early studies that paved the way for future self-service research.

Self-service at airports featured in both these studies, and Langeard et al. (1981) found that depending on the situation, a significant group of the respondents chose to use self-service whereas Bateson (1985) found that "the propensity to participate may well transcend particular services" (p. 73). Additionally, the importance of self-service options to long-term productivity was recognised (Bateson, 1985). It should be noted that the studies by both Langeard et al. (1981) and Bateson (1985) made no distinction between the three broad classifications of self-service:

i. SSTs (e.g., using an automatic teller machine, self-service check-in kiosk, or mobile application);
ii. labour-intensive self-service situations (e.g., filling your own fuel at a service station, or ordering and collecting meals at the counter in a restaurant); and
iii. combined SST with labour-intensive self-service (e.g., ordering a meal at a kiosk and collecting the meal at the counter).

In the context of air transport, the need for airports to optimise space coupled with the need for airlines to reduce their operating expenses supported the drive towards SSTs for passengers specifically at check-in (Castillo-Manzano & López-Valpuesta, 2013; National Academies of Sciences, Engineering, and Medicine, 2011). With the increasing number of passengers that are being forecasted, efficiencies associated with the check-in of baggage are of paramount importance to airports in South Africa, such as OR Tambo, Cape Town, and King Shaka International Airport. This is mainly because the spacial requirements per passenger at check-in are higher than any other processing area (IATA, 2019), and delays at check-in impact the on-time performance of the airport (Otieno & Govender, 2016).

According to a recent study on the airport kiosk market, the increasing demand for more efficient airports is likely to see the airport kiosk market expand at a compound annual growth rate of 11.4% between 2019 – 2029 (International Airport Review, 2019). The study placed the estimated investment in kiosks growing from USD 1.5 billion in 2019 to USD 5.2 billion in 2029 and noted that SSBDs are likely to see the highest portion of the investment.

The use of SSTs offers broad appeal in that they can result in reduced operational costs, standardise service delivery, and offer increased service delivery options (Curran & Meuter, 2005; Dabholkar, 2000; Kokkinou & Cranage, 2013). However, the significant investment in both time and money to design, implement, and operate SSTs, firms must understand the consumers’ decision of whether or not to adopt and use an SST (Curran et al., 2003; Curran & Meuter, 2005; National Academies of Sciences, Engineering, and Medicine, 2011).

An important aspect relating to the adoption and use of SSTs is investigating consumers’ preferences for interpersonal interaction with the service staff as a part of service delivery (Bateson, 1985; Dabholkar, 2000; Langeard et al., 1981). The need for interaction is a personality trait that refers to the consumers’ need to retain personal contact with the service staff during a service encounter (Dabholkar, 1992). The literature reviewed has revealed conflicting information in this regard.

Bateson (1985), Dabholkar (2000), and Langeard et al. (1981) all found that the need for interpersonal contact with the service staff as part of service delivery is significant to the consumer. Dabholkar (1992) looked at whether consumers viewed SST options favourably and what determined their attitudes. He found that both attitudes towards using digital products in general and the need for human interaction impact attitude towards utilisation of SSTs for service delivery. Dabholkar (1992) further determined that while attitudes towards SSTs are adversely affected by the need for interpersonal interaction, prior usage of digital products had a positive effect on attitude toward SSTs.

Conversely, Curran and Meuter (2005) found that the need for interpersonal interaction with service staff did not have a negative influence on consumers' attitudes toward the adoption of SSTs. A critical incident study that explored consumers' experiences with SSTs found that some consumers found avoiding interpersonal contact with a human was an appealing aspect of SSTs that led to satisfaction with the SST (Meuter, Ostrom, Roundtree, & Bitner, 2000). Similarly, Taufik and Hanafiah (2019) in their paper, *Airport Passengers' Adoption Behaviour Towards Self-Check-in Kiosk*, introduced the need for interpersonal interaction into TAM as a moderator and found that the need for interpersonal interaction with airport check-in agents did not affect passenger adoption and behaviour of SST.

The preceding conflicting arguments illustrate that the trend favouring the need for interpersonal interaction in relation to SSTs may have changed with time. The need for interaction appears to have been moderated as consumers became more familiar with technology in general and SSTs in particular. Based on the conflicting arguments, the impact of the need for interpersonal interaction on the adoption of SSBDs was not discreetly measured in this study. Instead, the direct and moderating effects of Technology Readiness (TR) on attitudes (H10) and behavioural intention (H11) were studied. This is discussed further in Section 2.4.

To better understand and describe individual attitudes and behaviours toward new technologies, researchers have proposed several theoretical models of human behaviour. These models include the theory of reasoned action (TRA; Ajzen, 2012; Davis et al., 1989; Fishbein & Ajzen, 1975); the SST attribute-based and overall affect models (Dabholkar, 1996); the SST attitude-intention models (Curran et al., 2003; Curran & Meuter, 2005); the innovation diffusion theory that was developed to understand the adoption of innovative products (Rogers, 2003); and the technology acceptance model (TAM; Davis, 1986; Davis, 1989; Davis et al., 1989; Lin et al., 2007; Lin & Chang, 2011). The TAM model is next discussed.

2.2 Technology Acceptance Model

The TAM is the most widely cited, empirically replicated, and accepted model for technology adoption (Cheng, 2019; Lin et al., 2007; Lin & Chang, 2011). TAM was developed to describe the essential motivational processes that mediate between a system, user behaviour, and actual usage of computerised systems, as depicted in Figure 4. Additionally, TAM explains how these processes are causally related to each other, the system, and behavioural intentions (Davis, 1986; Davis, 1989).

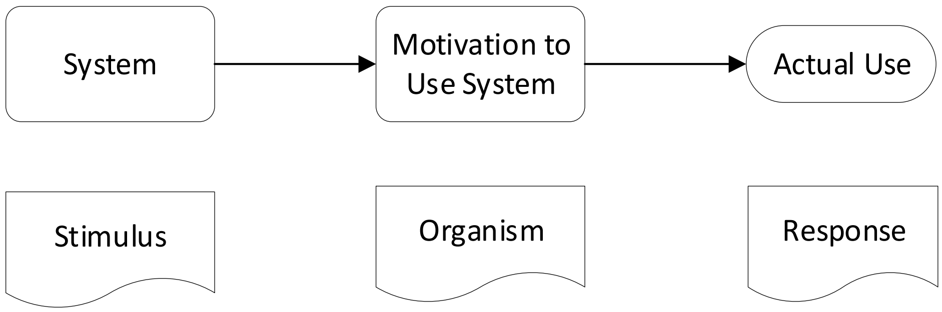


Figure 4. TAM Conceptual Framework adapted from Davis (1986).

TAM, as illustrated in Figure 5, was adapted from the well-established theoretical model of human behaviour, the TRA, as a theoretical model of the effect of system characteristics on technology adoption (Davis, 1986; Davis, 1989; Davis et al., 1989). Davis et al. (1989) more importantly, highlighted that the objective of TAM is to explain the elements of technology adoption that are capable of explaining user behaviour across a wide range of consumer digital technologies across different demographics.

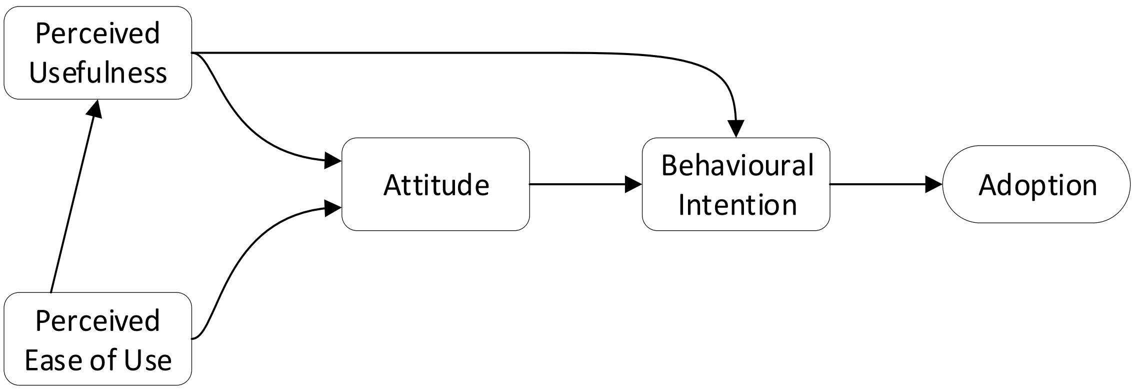


Figure 5. Technology Acceptance Model adapted from Davis et al. (1989).

A fundamental purpose of TAM is "to provide a basis for tracing the impact of external factors on internal beliefs, attitudes, and intentions" (Davis et al., 1989, p. 985). TAM consists of two cognitive responses, *perceived usefulness* (PU) and *perceived ease of use* (PEOU), which together result in an affective response, *attitude* toward using, which together with PU result in a subjective probability, *behavioural intention*, which translates into the behavioural response, *adoption* (Davis et al., 1989). Further, PEOU has a contributory effect on PU, and PU has a more significant impact on usage than PEOU (Adams, Nelson, & Todd, 1992; Davis, 1986; Davis, 1989; Davis et al., 1989).

2.2.1 Perceived Usefulness (PU) and Perceived Ease of Use (PEOU).

In the context of this study, the definition of PU and PEOU was adapted from the original definitions of Davis (1989) to fit this study. PU is the degree to which an individual (passenger) believes that using a system (SSBD) would enhance his or her job performance (check-in process) (Davis, 1989; Davis et al., 1989). PEOU is the degree to which an individual (passenger) believes that using a system (SSBD) would be free of physical and mental effort (Davis, 1989; Davis et al., 1989).

PEOU and PU in TAM are postulated a priori and are meant to be a general determining factor of user acceptance (Davis, 1989; Davis et al., 1989). According to Davis et al. (1989), PU and PEOU are distinct but related variables that are determined statistically with methods such as structural equations or linear regression. They attribute this as a strength of TAM as it enables one to compare the influence of each belief in determining attitude. This then allows the investigator to devise strategies to increase adoption by manipulation of external variables, for example.

PU is a function of PEOU and external variables such as system functionality (Davis, 1989; Davis et al., 1989). For example, an SSBD with a credit card payment terminal for the payment of excess baggage fees compared to the same SSBD without a credit card payment terminal. The SSBD with the payment terminal would likely be seen as more useful, regardless of the ease of use parity. PEOU, on the other hand, is a function of external variables such as system features (Davis, 1989; Davis et al., 1989). For example, the SSBD touch screen user interface and other features for people with disabilities that are expressly intended to enhance usability.

PEOU influences attitude via two mechanisms, i.e., self-efficacy and instrumentality (Davis, 1989; Davis et al., 1989). Self-efficacy relates to a consumer's self-confidence in their ability to operate a technological system and thus influences their motivation to use the system (Nath, Bhal, & Kapoor, 2013). PEOU has emerged as a critical consideration during the system development lifecycle to enhance usability, especially when defining system requirements (Nath et al., 2013).

In the context of SSTs, Dabholkar and Bagozzi (2002) commented that PU, while appropriate for products such as software systems, may not apply to SSTs. They propose that the PU scale be adapted to performance, reliability, and accuracy instead. As an alternative approach, the present study altered the PU scale to reflect the benefit the SSBD produces and how this would benefit the passenger.

The scales that were developed and used to operationalise the PU and PEOU constructs for this study resulted from an extensive measure development and validation procedure conducted by Davis (1986). These are discussed in more detail in the research methods section (Chapter 3, Section 3.3.1).

2.2.2 Attitude.

An attitude is defined as “a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour” (Eagly & Chaiken, 1993, p. 1). This definition has been widely used in previous SST literature (see Curran et al., 2003; Liljander et al., 2006).

To evaluate consumers' attitudes and intentions towards SST, Curran et al. (2003) developed the attitude-intention model (see Figure 6) by integrating research from services marketing, management science, and psychology.

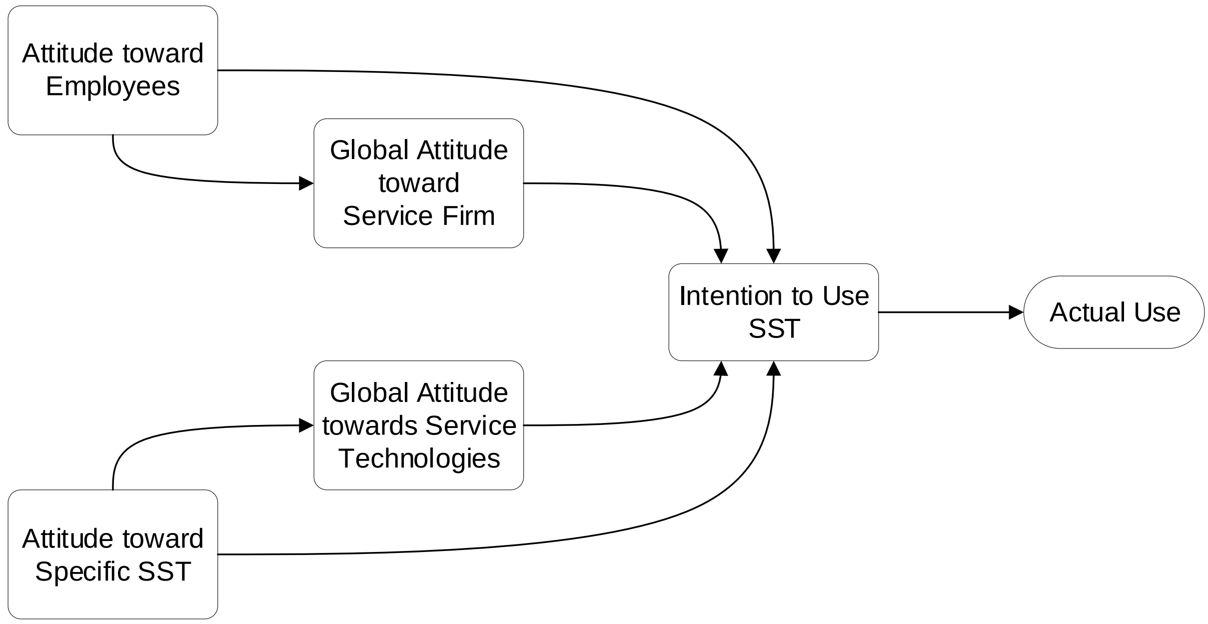


Figure 6. SST Attitude-Intention Model 1 adapted from Curran et al. (2003).

The SST attitude-intention model (Figure 6) has three basic tenets (Curran et al., 2003, p. 212):

i. many attitudes can be at work simultaneously in a given situation,

ii. attitudes can exist in a hierarchy, and

iii. attitudes can influence behavioural intentions.

Curran et al. (2003) determined that attitudes toward specific SSTs can be adequately measured and that consumers formulated attitudes toward specific SSTs. Additionally, they found that attitudes towards different technologies used for the same service are separate and distinct from each other. These are of particular interest in this study as SSBDs are one of three alternatives available to passengers wishing to check-in their baggage.

Understanding the precursors of technology acceptance is another promising approach to increasing the chance of success with SST introductions (Curran & Meuter, 2005). Consequently, Curran and Meuter (2005) developed a modified TAM that consists of the formation of consumer attitudes toward the adoption of SSTs by extending existing theories of attitude-behaviour relationships. Their SST attitude-intention model (see Figure 7) included four antecedent predictors, i.e., ease of use, usefulness, need for interaction, and risk.

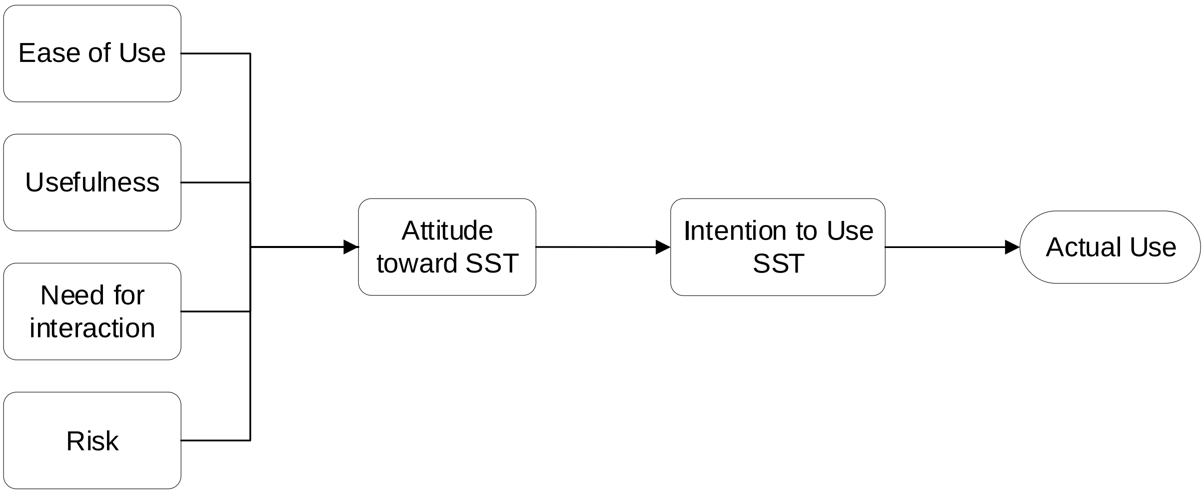


Figure 7. SST Attitude-Intention Model 2 adapted from Curran and Meuter (2005).

A survey approach was adopted to target consumers of the banking industry to test their model. The technologies evaluated were automatic teller machines (ATM), bank by phone (BBP), and online banking (OLB). The surveys measured the four antecedent constructs, PEOU, PU, risk, and need for interaction discussed above, as well as attitude toward the SSTs and intention to use each SST. The model was run for each of the three technologies, and the results are shown in Table 2.

Table 2.

SST Attitude/Intention Model Results

	Hypotheses	ATM	BBP	OLB
1	Attitudes toward different technologies used for the delivery of the same service will be separate and distinct from one another.	Supported	Supported	Supported
2	Attitude toward a more widely adopted technology will be more positive than those less widely adopted.	Supported	Supported	Supported
3	Attitude toward a specific SST will influence a consumer's intentions to use that SST.	Supported	Supported	Supported
4	PEOU will be positively related to attitude toward the SST.	Supported	Not supported	Not supported
5	PU of the technology will be positively related to attitude toward the SST.	Supported	Supported	Not supported
6	The need for interaction with employees will be negatively related to attitude toward the SST.	Not supported	Not supported	Not supported
7	The perceived risk of using the SST will be negatively related to attitude toward the SST.	Not supported	Not supported	Supported

Note. Data source Curran and Meuter (2005).

The first and third hypotheses support the earlier findings of Curran et al. (2003) as they confirm that attitudes towards different technologies used to deliver the same service are separate and distinct from each other and that attitudes toward a specific SST influence a consumer's intention to use that SST. Additionally, attitudes toward more widely adopted SST is more favourable than less widely adopted SSTs.

Aligned with the findings of Meuter et al. (2000) and Taufik and Hanafiah (2019), the need for interpersonal interaction did not have a negative influence on the attitude toward any of the SSTs. They observed that PU was supported for ATMs and BBP, PEOU was only supported for ATMs, and the perceived risk was only supported for OLB.

One of the shortcomings of the SST attitude-intention model (see Figure 7) is that it did not assess the impact of PEOU on PU. Davis et al. (1989) found in their comparison of the TAM and the TRA that as users became more familiar with the system under consideration, that the direct effect of PEOU on behavioural intention disappeared and that instead, PEOU's indirect effect through PU was significant. Davis (1989) quite aptly states: "Although difficulty of use can discourage adoption of an otherwise useful system, no amount of ease of use can compensate for a system that does not perform a useful function" (pp. 333-334). Also, while three different SSTs were assessed, they were all in the banking sector, and results for other SSTs in different sectors may yield completely different results.

Despite the shortcomings of this adaptation of TAM, Curran and Meuter's (2005) augmentation of TAM to include some individual difference variables was a necessary step that paved the way for other researchers (e.g., Lin et al., 2007; Lin & Chang, 2011) to adapt and expand TAM.

2.2.3 Behavioural Intention and Adoption.

The behavioural intention construct is a measure that refers to a person's subjective probability that he or she will perform a specific behaviour (Davis et al., 1989; Fishbein & Ajzen, 1975). The construct was initially defined by Fishbein and Ajzen (1975) as a culmination of both attitudes and subjective norms that are informed by a person's behavioural and normative beliefs with feedback from the actual behaviour. Subjective norm is a perceived social influence that refers to a person's perception of what most people important to him or her think he or she should do (Fishbein & Ajzen, 1975).

In contrast, Davis et al. (1989) postulated that behavioural intentions in TAM are jointly determined by attitude and PU as opposed to attitude and subjective norms. Subjective norms were not included in TAM due to its unreliable theoretical and psychometric status (Davis et al., 1989). Additionally, behavioural intentions are a causal determinant of actual behaviour (Davis et al., 1989; Fishbein & Ajzen, 1975; Wentzel, Diatha, & Yadavalli, 2013).

In TAM, the adoption construct is defined as the frequent use of (and the likelihood of using) the system being evaluated (Davis et al., 1989). In the context of this study, this construct was operationalised by the measurement of self-service frequency. This was measured for each of the three alternative ways that a passenger can check-in baggage.

2.2.4 Outcomes on Studies Using TAM.

As a seminal reference for TAM (Davis et al., 1989) conducted a longitudinal study on the acceptance of technology whereby they compared and contrasted TAM with TRA. The study yielded some valuable insights:

i. Concerning how well behavioural intention predicted usage, they found a strong correlation. Additionally, they confirmed that consistent with the theories, intentions wholly mediated the effects of other TAM or TRA constructs on usage.
ii. Looking at the individual determinants of behavioural intention within TAM:
    a. They found that the relative weight of PU was higher than attitude;
    b. PU increases as individuals become more familiar with the technology;
    c. PEOU was found to be a significant secondary determinant of behavioural intention;
    d. PEOU has a weaker effect on behavioural intention than PU;
    e. PEOU was more prominent than attitude during initial trialling of a technological system; and

f. attitude appears to mediate the influences of beliefs on intentions less than hypothesised by TAM.

2.2.5 TAM Criticisms.

TAM has evolved over more than a quarter of a century to become a prominent model in predicting human behaviour towards the adoption of technology (Lin & Hsieh, 2006; Marangunić & Granić, 2015). However, as pointed out in the introduction (Chapter 1), TAM has also received some criticism that warranted the integration of TR to form TRAM. The main concerns are:

i. TAM was initially developed to model adoption in situations that mandated use (e.g., work environments) as opposed to voluntary use (e.g., home environments). This may affect the applicability of TAM for systems such as SSTs, which typically rely on voluntary adoption (Lin et al., 2007; Lin & Chang, 2011).
ii. TAM does not consider the consumers' personality attributes (Lin et al., 2007; Lin & Chang, 2011; Walczuch et al., 2007). Dabholkar and Bagozzi (2002), Lin and Hsieh (2012), and Parasuraman (2000) posit that consumer personality traits are at the centre of the adoption of technology.

Notwithstanding these limitations, TAM is psychometrically reliable as researchers were able to overcome many of the criticisms by incremental contribution and extension by outlining the influence of external factors in describing internal beliefs, attitudes, and intentions (Davis, 1989; Lin et al., 2007; Lin & Chang, 2011; Marangunić & Granić, 2015).

To consider consumer personality attributes, Lin et al. (2007) extended TAM with the integration of the Technology Readiness (TR) construct to form the Technology Readiness and Acceptance Model (TRAM). Therefore, an essential next step is to review the literature on the TR construct, followed by looking at the integrated TRAM model.

2.3 Technology Readiness (TR)

The TR construct was devised by Parasuraman (2000), who defined TR as: “people’s propensity to embrace and use new technologies for accomplishing goals in home life and at work” (p. 308). Parasuraman (2000) further states that the construct can be viewed as an overall state of mind resulting from a combination of mental enablers and inhibitors that together determine a person’s inclination to use new technologies. At the measurement level, the Technology Readiness Index (TRI) was developed by Parasuraman in collaboration with Rockbridge Associates, Inc. (a U.S. based company specialising in service and technology research) to measure people’s general beliefs about technology (Parasuraman, 2000).

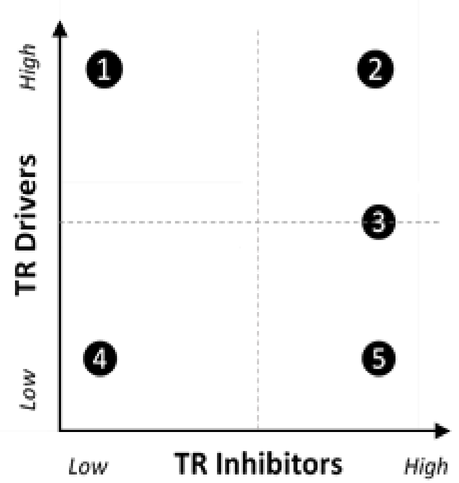
2.3.1 TR Dimensions.

The TR construct is multidimensional and comprised of four sub-dimensions:

i. The optimism sub-dimension represents a constructive view of technology and a conviction that technology offers people improved control, flexibility, and efficiency (Parasuraman, 2000).
ii. The innovativeness sub-dimension represents an inclination to be a technology pioneer and thought leader (Parasuraman, 2000).
iii. The discomfort sub-dimension represents a perceived absence of control over technology and the sentiment of being overpowered by it (Parasuraman, 2000).
iv. The insecurity sub-dimension represents a mistrust of technology and scepticism about technologies' ability to work correctly (Parasuraman, 2000).

Optimism and innovativeness are TR drivers, while discomfort and insecurity are TR inhibitors (Parasuraman, 2000). Additionally, a person can possess different combinations of each of the four dimensions that can lead to a paradox that consists of active drivers tempered by potent inhibitors (Parasuraman & Colby, 2015).

To demonstrate the multidimensionality of the TR construct, Parasuraman and Colby (2001) conducted a TR-based segmentation analysis in the United States using $K - means$. The $K - means$ analysis yielded five segments based on the distinct combinations of technology-related beliefs associated with each. Parasuraman and Colby's (2001) segmentation matrix is illustrated in Figure 8.



Legend		TR Drivers	TR Inhibitors
❶	Explorers	High	Low
❷	Pioneers	High	High
❸	Paranoids	Moderate	High
❹	Sceptics	Low	Low
❺	Laggards	Low	High

Figure 8. TR Segments adapted from Parasuraman and Colby (2015).

Tsikriktsis (2004) replicated Parasuraman and Colby's (2001) TR based segmentation in the United Kingdom and was able to find support for explorers, pioneers, sceptics, and laggards but not for the paranoids. It is possible that the paranoids segment did not exist in the United Kingdom due to cultural differences (Tsikriktsis, 2004).

The TR multidimensional characteristic has caused discrepancies in conceptualisations of TR, and it is uncertain whether TR is best understood as a four-dimensional, two-dimensional (drivers, inhibitors), or one-dimensional (overall composite) construct (Blut & Wang, 2019). Several studies have treated TR as a four-dimensional construct and examined the individual effect of each dimension (Pires, da Costa Filho, &

da Cunha, 2011; Rahman, Taghizadeh, Ramayah, & Alam, 2017; Walczuch et al., 2007).

Other studies have used a two-dimensional model to conceptualize TR regarding drivers and inhibitors (Blut & Wang, 2019; Jin, 2013). Neither of these approaches considers that consumers possess a combination of all four dimensions. Another approach is the single dimension that combines the four dimensions into one (Liljander et al., 2006; Smit et al., 2018). While this is methodologically convenient, the differential effects of each dimension may not be evident, and therefore, the resultant explanation of technology adoption may be inaccurate (Blut & Wang, 2019).

Some studies have, however, modelled TR as a hierarchical component model (also known as higher-order-models) (Ali, Nawanir, Nasidi, & Bamgbade, 2016; Blankestijn, 2017; Vize, Coughlan, Kennedy, & Ellis-Chadwick, 2012). This approach may provide a better solution as it considers the multidimensionality and the differential effects at the same time.

Figure 9 illustrates the relationships between the four sub-dimensions of TR, attitude, behavioural intention, and actual use towards using SSTs,

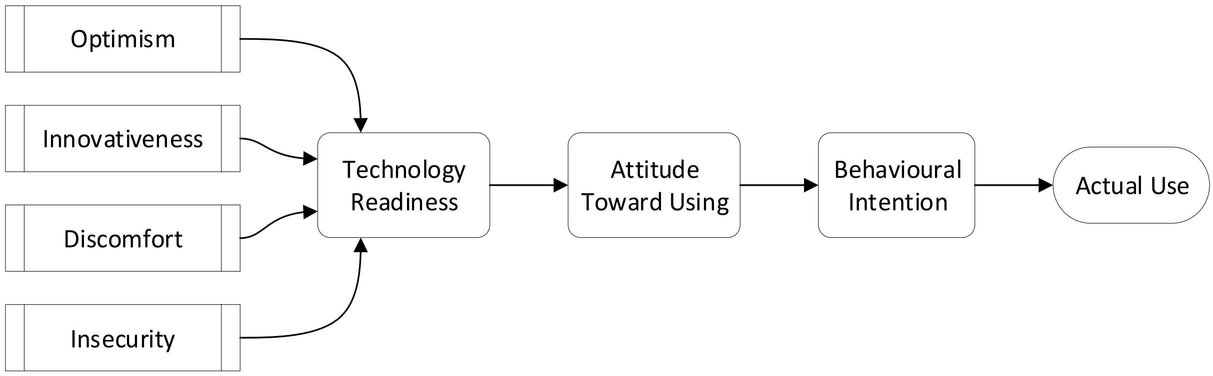


Figure 9. Relationships between TR, attitude, behavioural intention, and actual use adapted from Liljander et al. (2006).

The original 36-item scale to measure TR, TRI 1.0, was developed almost two decades ago and has been used by 127 researchers in 30 countries, including South Africa (Parasuraman & Colby, 2015). The streamlined 16-item index, TRI 2.0© published by Parasuraman and Colby (2015), broadened the applicability of TRI 1.0 as it is more succinct and is less of an encumbrance on surveys measuring other constructs alongside with TR.

Parasuraman and Colby (2015) demonstrated that TRI 2.0© is a robust predictor of technology-related behavioural intentions and actual behaviour. The TRI 2.0© was recently used by Smit et al. (2018) in their study on TR and mobile self-service technology adoption in the South African airline industry. In the context of SSTs, Lin and Hsieh (2006) found that TR plays a vital role in assessing the adoption of SSTs.

Consumer differences that are relevant to TR include demographic factors and personality traits (Parasuraman, 2000). Smit, Roberts-Lombard, and Mpinganjira (2018a) have investigated demographic factors and generational cohorts concerning SSTs and found that young, affluent, educated males may be more likely to use such service options. As the results obtained by (Smit et al., 2018) were based on a convenience sample of 315 respondents, the findings cannot be generalised. In today's transformed social, cultural, and economic world, older consumers, women, less educated, and lower-income groups all have access to technology and some level of familiarity with using simple technologies (Dabholkar & Bagozzi, 2002). Accordingly, Dabholkar and Bagozzi (2002) found that demographic factors and personality traits are not of an analytical interest in understanding why consumers adopt SSTs. This study adopted the same approach and did not consider demographic factors and personality traits.

2.3.2 TR Criticisms.

The TR construct has also received some criticism. Lin et al. (2007) found evidence from fieldwork indicating that while TR is a valid measure of consumers' general beliefs towards technology, it does not explain the reason that consumers with a high level of TR do not always adopt the latest technologies. This view was reinforced by Elliott, Hall, and Meng (2013), who raised the concern that consumers with high levels of TR did not always adopt SSTs in their study. Elliott et al. (2013) further found that by assimilating mediating constructs into TR, one can overcome and explain why consumers with high levels of TR do not always adopt the latest technologies.

Notwithstanding these limitations, TR is psychometrically reliable with researchers being able to overcome many of the criticisms through the utilisation of the revised TRI 2.0© (Parasuraman & Colby, 2015) and the integration of TR with TAM (Lin et al., 2007; Lin & Chang, 2011; Smit et al., 2018). The next step is to review the literature on the integrated TRAM model.

2.4 Technology Readiness and Acceptance Model (TRAM)

The TRAM model illustrated in Figure 10 was conceived by Lin et al. (2007) in their study on SSTs, whereby they integrated TR into TAM to form TRAM. The underlying principle behind TRAM was to develop a more comprehensive technology adoption model that overcame the drawbacks of both TAM and TR. Empirical testing of TRAM has yielded results that confirm that TRAM substantially broadens the explanatory power and the applicability of both the TR construct and TAM, especially when trying to understand technology adoption of SSTs (Lin et al., 2007; Lin & Chang, 2011; Smit et al., 2018).

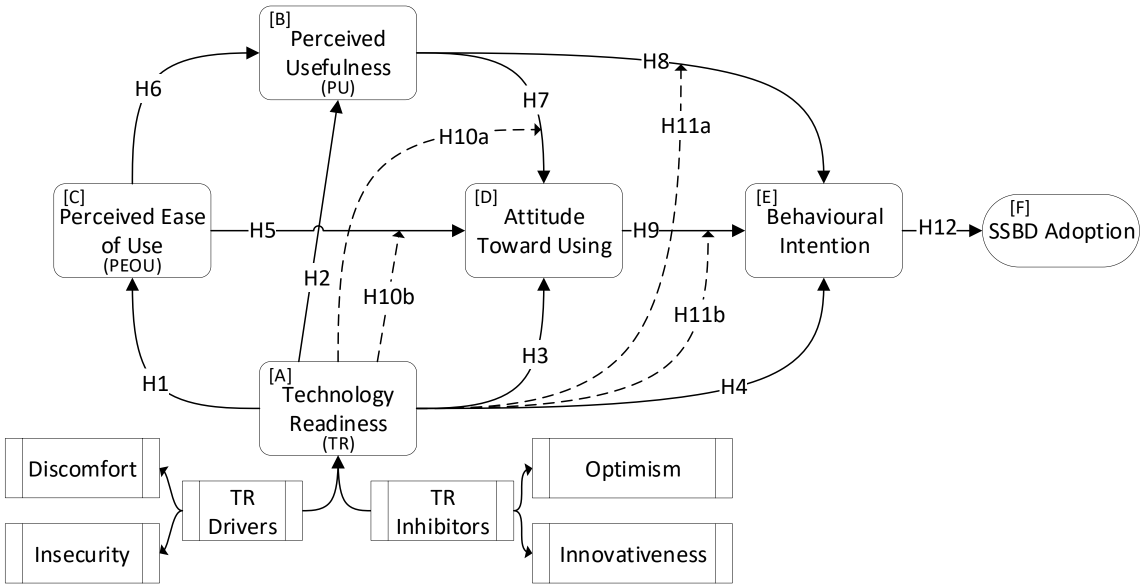


Figure 10. TRAM Model adapted from and Lin and Chang (2011).

Lin et al. (2007) postulated that TAM and TR are interrelated, though TRI is not specific to the system being considered, and PU and PEOU are system-specific. Therefore, in addition to heterogeneous system characteristics, consumers' general beliefs about technology derived from prior experience may be employed to anchor PU and PEOU (Lin et al., 2007; Lin & Chang, 2011).

2.4.1.1 Proposition 1 – TR and PEOU.

TR inclinations are positively associated with perceptions of ease of use (Lin et al., 2007; Lin & Chang, 2011; Walczuch et al., 2007). More specifically, consumers with higher TR drivers, optimism and innovativeness, have been found to perceive SSTs easier to use (Lee & Allaway, 2002). Conversely, consumers with higher TR inhibitors, discomfort and insecurity, perceive technologies as complex, resulting in lower PEOU (Walczuch et al., 2007). Since a person can possess different combinations of the four dimensions that can lead to a paradox that consists of TR drivers tempered by TR inhibitors; it was averred that consumers with higher TR would be more likely to perceive an SSBD as easy to use. This relationship was asserted in the first hypothesis (and alternative hypothesis).

$H_0$1: TR is positively related to PEOU

H_a1: TR is not positively related to PEOU

2.4.1.2 Proposition 2 – TR and PU.

Consumers' general beliefs about technology based on prior experience may be employed to anchor PU (Lin et al., 2007). Furthermore, Lin et al. (2007) surmised that when consumers evaluate technology adoption intentions, cognitive information of TR is retrieved before assessing PU. Research has reported that TR inclinations are positively associated with perceptions of usefulness (Lin et al., 2007; Lin & Chang, 2011; Walczuch et al., 2007).

Lin and Chang (2011) reported that high personal discomfort and insecurity with technology lead to lower PU of a specific technology. Whereas, Walczuch et al. (2007) found that optimists perceive specific technology as being more useful because they worry less about possible adverse outcomes. Since a person can possess different combinations of the four dimensions that can lead to a paradox that consists of TR drivers tempered by TR inhibitors; it was averred that consumers with higher TR would be more likely to perceive an SSBD as useful. This relationship was asserted in the second hypothesis (and alternative hypothesis).

$H_0$2: TR is positively related to PU.

H_a2: TR is not positively related to PU.

2.4.1.3 Proposition 3 – TR and Attitude.

TR drivers, innovativeness and optimism, are positively associated with more positive attitudes towards SSTs (Dabholkar & Bagozzi, 2002; Parasuraman, 2000). In the context of SSTs, Liljander et al. (2006) found that optimism and innovativeness were positively related to attitude toward using self-service check-in technologies. In contrast, TR inhibitors, insecurity and discomfort, had the opposite effect, i.e., they were negatively related (Liljander et al., 2006). Therefore, it was averred that TR would augment the positive attitude towards SSBDs. This relationship was asserted in the third hypothesis (and alternative hypothesis).

$H_0$3: TR is positively related to attitude towards SSBDs.

H_a3: TR is not positively related to attitude towards SSBDs.

2.4.1.4 Proposition 4 – TR and Behavioural Intention.

Godoe and Johansen (2012) and Parasuraman (2000) found that TR is positively related to behavioural intentions. Additionally, consumers with low TR drivers (optimism and innovativeness) are more likely to lack the motivation to use SSTs because they do not anticipate benefits (Yen, 2005). In the context of SSTs, Lin and Hsieh (2006) and Lin and Chang (2011) found that TR is positively related to behavioural intentions toward SSTs.

Therefore, it was averred that TR would have a positive impact on behavioural intentions towards SSBDs. This relationship was asserted in the fourth hypothesis (and alternative hypothesis).

$H_0$4: TR is positively related to behavioural intentions towards SSBDs.

H_a4: TR is not positively related to behavioural intentions towards SSBDs.

2.4.1.5 Proposition 5 – PEOU and Attitude.

The TRA states that a person's perceptions about the consequences of performing a behaviour determine the person's attitude toward the behaviour (Fishbein and Ajzen, 1975; Davis et al., 1989). PEOU is an essential determinant of attitude (Curran & Meuter, 2005; Davis et al., 1989). Therefore, it was averred that when PEOU increases, passengers' attitude towards SSBDs would be more positive. This relationship was asserted in the fifth hypothesis.

$H_0$5: PEOU is positively related to attitude towards SSBDs.

$H_0$5: PEOU is not positively related to attitude towards SSBDs.

2.4.1.6 Proposition 6 – PEOU and PU.

Research has demonstrated that PEOU has a positive influence on PU because the easier it is to use technology, the more useful it can be (Dabholkar, 1996; Davis, 1989; Venkatesh & Davis, 2000). Davis et al. (1989) found that as users became more familiar with the system under consideration, that the direct effect of PEOU on behavioural intention disappeared and that instead, PEOU's indirect effect through PU was significant. Therefore, it was averred that PEOU would augment PU because the easier it is to use technology, the more useful it can be.

This relationship was asserted in the sixth hypothesis.

$H_0$6: PEOU is positively related to PU.

H_a6: PEOU is not positively related to PU.

2.4.1.7 Proposition 7 – PU and Attitude.

The TRA states that a person's perceptions about the consequences of performing a behaviour determine the person's attitude toward the behaviour (Fishbein and Ajzen, 1975; Davis et al., 1989). PU is an essential determinant of attitude (Curran & Meuter, 2005; Davis et al., 1989). Therefore, it was averred that when PU increases, passengers' attitude towards SSBDs would be more positive.

This relationship was asserted in the seventh hypothesis.

$H_0$7: PU is positively related to attitude towards SSBDs.

H_a7: PU is not positively related to attitude towards SSBDs.

2.4.1.8 Proposition 8 – PU and Behavioural Intention.

In addition to the direct relationship on attitude, PU also has a direct positive relationship on behavioural intention (Davis et al., 1989; Lin & Chang, 2011). PU influences behavioural intentions via extrinsic rewards that are independent of a user's attitude toward the behaviour (Davis et al., 1989). Nysveen, Pedersen, and Thorbjørnsen (2005) found that PU increases behavioural intention because it increases a consumer's performance. Therefore, it was averred that when PU increases, passenger's behavioural intention towards SSBDs would be more positive.

This relationship was asserted in the eighth hypothesis.

$H_0$8: PU is positively related to behavioural intentions towards SSBDs.

H_a8: PU is not positively related to behavioural intentions towards SSBDs.

2.4.1.9 Proposition 9 – Attitude and Behavioural Intention.

Attitudes have a direct positive influence on behavioural intentions (Curran & Meuter, 2005; Dabholkar, 1996; Dabholkar & Bagozzi, 2002; Davis et al., 1989; Fishbein & Ajzen, 1975; Lin & Chang, 2011). Davis et al. (1989) postulated that the attitude → behavioural intention relationship indicates that all else being equal, people form intentions to perform behaviours toward which they have a positive affect. This relationship has been extensively investigated and is well-founded in technology adoption research (Curran & Meuter, 2005; Dabholkar, 1996; Dabholkar & Bagozzi, 2002; Davis et al., 1989; Fishbein & Ajzen, 1975; Lin & Chang, 2011).

Therefore, it was averred that attitude toward SSBDs was expected to have a positive effect on passengers' behavioural intention toward SSBDs. This relationship was asserted in the ninth hypothesis.

$H_0$9: Attitude towards SSBDs is positively related to behavioural intentions towards SSBDs.

H_a9: Attitude towards SSBDs is not positively related to behavioural intentions towards SSBDs.

2.4.1.10 Proposition 10 – Moderating Effects of TR on PU/PEOU and Attitude.

People with higher TR are likely to be more experienced and have a more favourable outlook on the use of technology-based systems (Lin & Chang, 2011; Walczuch et al., 2007). Therefore, PU may be less relevant to them. Kleijnen et al. (2004) investigated the moderating effects of TR in the context of mobile services and found that consumers with higher TR were less concerned with PEOU. Therefore, the moderating effects of TR on the relationship between PU and attitude, and PEOU and attitude was assessed. This relationship was asserted in the tenth hypothesis.

H_010a: Higher TR attenuates the relationship between PU and attitude.

H_a10a: Higher TR does not attenuate the relationship between PU and attitude.

H_010b: Higher TR attenuates the relationship between PEOU and attitude.

H_a10b: Higher TR does not attenuate the relationship between PEOU and attitude.

2.4.1.11 Proposition 11 – Moderating Effects of TR on PU/Attitude and Behavioural Intention.

As with the moderating role that TR plays on the relationship between PU and attitude, so too, it was hypothesised that higher TR attenuates the relationship between PU and behavioural intention. Liljander et al. (2006) submitted that higher TR moderates the effect of PU on behavioural intention. Additionally, people with higher TR rely less on their attitudes when deciding to use SSTs (Kleijnen et al., 2004). Therefore, the moderating effects of TR on the relationship PU and behavioural intention and attitude and behavioural intention was assessed. This relationship was asserted in the eleventh hypothesis.

$H_0$11a: Higher TR attenuates the relationship between PU and behavioural intention.

H_a11a: Higher TR does not attenuate the relationship between PU and behavioural intention.

$H_0$11b: Higher TR attenuates the relationship between attitude and behavioural intention.

H_a11b: Higher TR does not attenuate the relationship between attitude and behavioural intention.

2.4.1.12 Proposition 12 – Behavioural Intention and Adoption.

Behavioural intention is a measure that refers to a person's subjective probability that he or she will perform a specific behaviour (Davis et al., 1989; Fishbein & Ajzen, 1975).

A key element of TAM (and subsequently TRAM) is that behavioural intention plays a prominent role in a person's attitudes and perceptions and, subsequently, their intention to perform that behaviour (Ajzen, 2012; Davis et al., 1989; Fishbein & Ajzen, 1975). Additionally, behavioural intention is a superior predictor of actual use than attitude when an intention has been formed (Warshaw & Davis, 1985). However, measuring behavioural intention when an individual has not made a decision or formed an intention increases the risk of intention instability (Warshaw & Davis, 1985).

Fishbein and Ajzen (1975) additionally caution that intention instability reduces the ability of behavioural intention to predict future behaviour. In cases where individuals have not yet formed a behavioural intention, their attitude may instead be a better predictor of actual use than their behavioural intention (Davis, 1986). Turner, Kitchenham, Brereton, Charters, and Budgen (2010) conducted a systematic review of 79 empirical TAM studies and found that behavioural intention is likely to be correlated with actual usage. Therefore, behavioural intention was averred to have a positive effect on actual usage. This relationship was asserted in the twelfth hypothesis.

$H_0$12: Behavioural intention towards SSBDs is positively related to the actual usage of SSBDs.

H_a12: Behavioural intention towards SSBDs is not positively related to the actual usage of SSBDs.

2.5 Summary

The potential benefits of SSBDs could be significant if the technology is adopted. The rate at which SSBDs are forecasted to grow by to streamline passenger processing called for an assessment of passenger behavioural intentions toward SSBD adoption. Passengers TR to adopt and use SSBDs is subject to vary due to the interplay between TR drivers (innovativeness and optimism) and TR inhibitors (insecurity and discomfort). However, TR, on its own, has not demonstrated that it does not adequately predict behavioural intentions (Lin et al., 2007).

TAM, on the other hand, is the most widely cited, empirically replicated, and accepted model for technology adoption. Despite the broad appeal of TAM, its application has also received some criticism. The main concerns are that TAM was initially developed to model adoption in situations that mandated use (e.g., work environments), and it does not consider the consumers' personality attributes (Lin et al., 2007; Lin & Chang, 2011; Walczuch et al., 2007).

In response to these challenges, Lin et al. (2007) combined TR with TAM to form TRAM. Empirical testing of TRAM has yielded results that confirm that TRAM substantially broadens the explanatory power and the applicability of both the TR construct and TAM, especially when trying to understand technology adoption of SSTs (Lin et al., 2007; Lin & Chang, 2011; Smit et al., 2018)

Research evidence illustrates that the adoption of SSTs cannot be assumed (Dabholkar, 1996; Lovelock & Young, 1979). Two recent independent surveys of respondents relative to the passenger traffic from 20 countries across the Americas, Asia, Europe, the Middle East, and Africa that represented 70% of global passenger traffic found the following:

i. 68% of respondents want SSBD technologies (IATA, 2018b);
ii. adoption of SSBDs by passengers that have checked baggage seems to have stabilised at 20.5% (SITA, 2019).

These studies illustrate that despite the desire to have SSBD technologies, the adoption of SSBDs is not demonstrating reciprocal adoption rates. Therefore, it was beneficial to conduct this study to investigate the relationship between TR, PEOU, PU, attitude, and behavioural intention to better understand the adoption of SSBDs in South

Africa. The research methodology undertaken by this research is discussed next.

3 METHODOLOGY

In the previous chapter, the underlying theoretical framework, the Technology Readiness and Acceptance Model (TRAM) were presented. This chapter describes and justifies the research methodology employed to use TRAM to answer the central research question:

> How do airport passengers' overall technology readiness and perceptions towards self-service bag drops (SSBD) technologies at South African airports influence the adoption thereof?

The present study consisted of a three-stage approach that involved a pre-test, pilot test, and the main study. According to Leedy and Ormrod (2016), a research methodology is a general approach that the researcher chooses to carry out a research project. They go on to state that this approach, to an extent, prescribes the particular tools the researcher selects.

Creswell and Creswell (2018) advance three alternative research approaches as follows:

i. Qualitative – an approach for discovering and interpreting the meaning individuals or groups assigned to a social or human problem. The process of research involves developing questions and procedures, collecting data, analysis through inductively building from particulars to general themes, and the researcher making interpretations of the meaning of the data (Creswell & Creswell, 2018).

ii. Quantitative – an approach for testing objective theories by examining the relationships among constructs. These constructs can be measured, typically on instruments, so that numerical data can be analysed using statistical procedures (Creswell & Creswell, 2018).

iii. Mixed methods – an approach involving collecting both qualitative and quantitative data, integration of the two forms of data, and the use of distinct designs that may involve theoretical frameworks (Creswell & Creswell, 2018).

Additionally, Creswell and Creswell (2018) state that the research approach involves the intersection of philosophy, research designs, and specific methods. The research framework illustrated in Figure 11 explains the interaction of these three components.

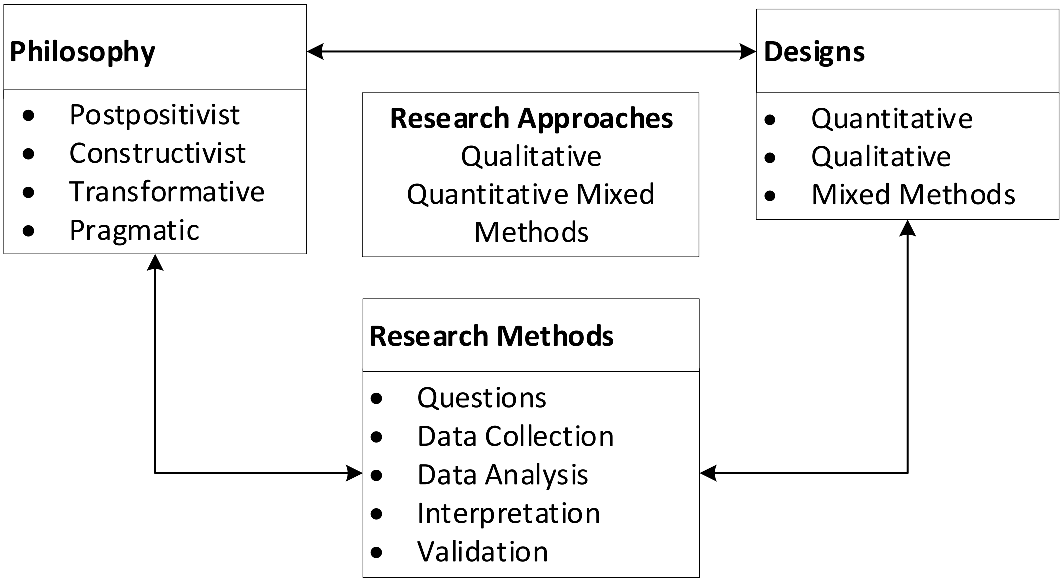


Figure 11. Research Framework adapted from *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*, 5th edition, p. 26, J. W. Creswell and J. D. Creswell. Copyright 2018 by Sage Publishing, Inc.

3.1 Research Philosophy

Research philosophies (also called research paradigms or worldviews) influence the application of research and need to be identified as they help to explain the choice between qualitative, quantitative, and mixed method approaches (Creswell & Creswell, 2018). Researchers develop research philosophies based on their discipline orientations, research communities, advisors, mentors, and past research (Creswell & Creswell, 2018). Table 3 presents a high-level summary of the characteristics of four philosophies that are widely discussed in the literature.

Table 3

Characteristics of the Four Philosophies

Philosophy	Characteristics
Postpositivism	Determination
	Reductionism
	Empirical observation and measurement
	Theory verification
Constructivism	Understanding
	Multiple participant meanings
	Social and historical construction
	Theory generation
Transformative	Political
	Power and justice-oriented
	Collaborative
	Change-oriented
Pragmatism	Consequences of actions
	Problem-centred
	Pluralistic
	Real-world practice oriented

Note. Data source Creswell and Creswell (2018, pp. 27-28).

The research philosophy adopted for this study is postpositivism, which is sometimes called the scientific method. Postpositivism is a deterministic philosophy wherein causes likely determine effects (Creswell & Creswell, 2018; Trochim & Donnelly, 2006). Additionally, it is reductionistic in that the intent is to reduce ideas into a smaller discrete set that can be tested (Creswell & Creswell, 2018; Trochim & Donnelly, 2006). For example, the constructs that comprise hypotheses and research questions. The knowledge that advances through postpositivism is based on observation and measurement of the objective reality that exists in the world (Creswell & Creswell, 2018; Trochim & Donnelly, 2006). Thus, in the scientific method, the accepted approach to research by postpositivists, the research starts with a theory, data is collected that either supports or refutes the theory; lastly, necessary revisions are made and additional tests conducted (Creswell & Creswell, 2018; Trochim & Donnelly, 2006; Zikmund, Babin, Carr, & Griffin, 2013).

Based on the scientific method, this research followed the following approach:

i. A literature survey was conducted. The literature was used to support the selection of TRAM and to develop the research instrument (questionnaire);
ii. The research instrument (questionnaire) was then tested through a pre-test and pilot test;
iii. The results from the pilot test were used to compute the reliability and validity of the questionnaire;
iv. The main study research instrument (questionnaire) was then deployed;
v. The conceptual structural equation model was developed and evaluated;
vi. Results from the conceptual model evaluation were used to develop a modified structural equation model;
vii. The research results were then analysed statically;

viii. Several hypotheses were proposed and tested to investigate the relationships between passengers' Technology Readiness (TR), perceived ease of use (PEOU), perceived usefulness (PU), attitudes, and behavioural intention toward adoption of self-service bag drops (SSBDs) in South Africa; and

ix. Finally, recommendations for future research were made.

3.2 Research Design

Subsequent to establishing the research approach, the development of an appropriate research design is next discussed. The research design is a general strategy for solving a research problem (Leedy & Ormrod, 2016). In addition to selecting which of the three alternative research approaches, (i.e., qualitative, quantitative, or mixed methods), the type of study within these three choices is also decided (Creswell & Creswell, 2018). Table 4 presents a high-level summary of the alternative research designs, according to Creswell and Creswell (2018).

Table 4

Summary of Alternative Research Designs

Quantitative	Qualitative	Mixed Methods
Experimental designs	Narrative research	Convergent
Surveys	Phenomenology	Explanatory sequential
Longitudinal designs	Grounded theory	Exploratory sequential
	Ethnographies	

Quantitative	Qualitative	Mixed Methods
	Case studies	Intricate designs with embedded core designs

Note. Data source Creswell and Creswell (2018, p. 32).

Survey research provides a quantitative description of trends, attitudes, or opinions of a population by studying a sample of that population (Fowler, 2014). Additionally, survey research includes cross-sectional studies using questionnaires or for data collection (Fowler, 2014).

As discussed in the literature review (Chapter 2), due to the comprehensiveness of TRAM and its successful usage on similar technologies, the TRAM framework was a suitable fit for this study in its research on airport passengers' readiness to adopt SSBDs at South African airports. Due to the nature of the TRAM framework, its measurement necessitated the use of a structured questionnaire to determine TR, PU, PEOU, attitudes, and behavioural intention of the respondents (Davis, 1986; Lin et al., 2007; Lin & Chang, 2011; Parasuraman & Colby, 2015). Therefore, a quantitative research design in the form of a structured questionnaire was suitable for this study.

The TRAM framework and its application in the South African environment to establish the relationship between passengers TR, PEOU, PU, attitude, behavioural intention, and adoption of SSBDs has been taken into consideration in the design of the research instrument (Davis et al., 1989;

Lee & Naidoo, 2018; Lin et al., 2007; Lin & Chang, 2011; Parasuraman, 2000; Parasuraman & Colby, 2015; Smit et al., 2018). This is further discussed in Section 3.3.1 (Research Instrument).

3.3 Research Methods

The third and final element in the framework depicted in Figure 11 is the specific research methods that involve data collection, analysis, and interpretation. As discussed in the research design, the use of the TRAM framework requires the use of a structured questionnaire as the research instrument. Additionally, the information needed to meet the research objectives are primarily dictated by the TRAM framework.

3.3.1 Research Instrument.

The research instrument (questionnaire) for this study was based on the TRAM studies conducted by Lin et al. (2007), Lin and Chang (2011), and Smit et al. (2018). The type of scales used to measure the various items was a mix of continuous seven-point Likert type scales, e.g., very strongly disagree to very strongly agree, bipolar semantic scales, and categorical scales. A copy of the questionnaire is attached in Appendix A.

For convenience, the TRAM model is depicted in Figure 12. The hypotheses are also indicated on the different links.

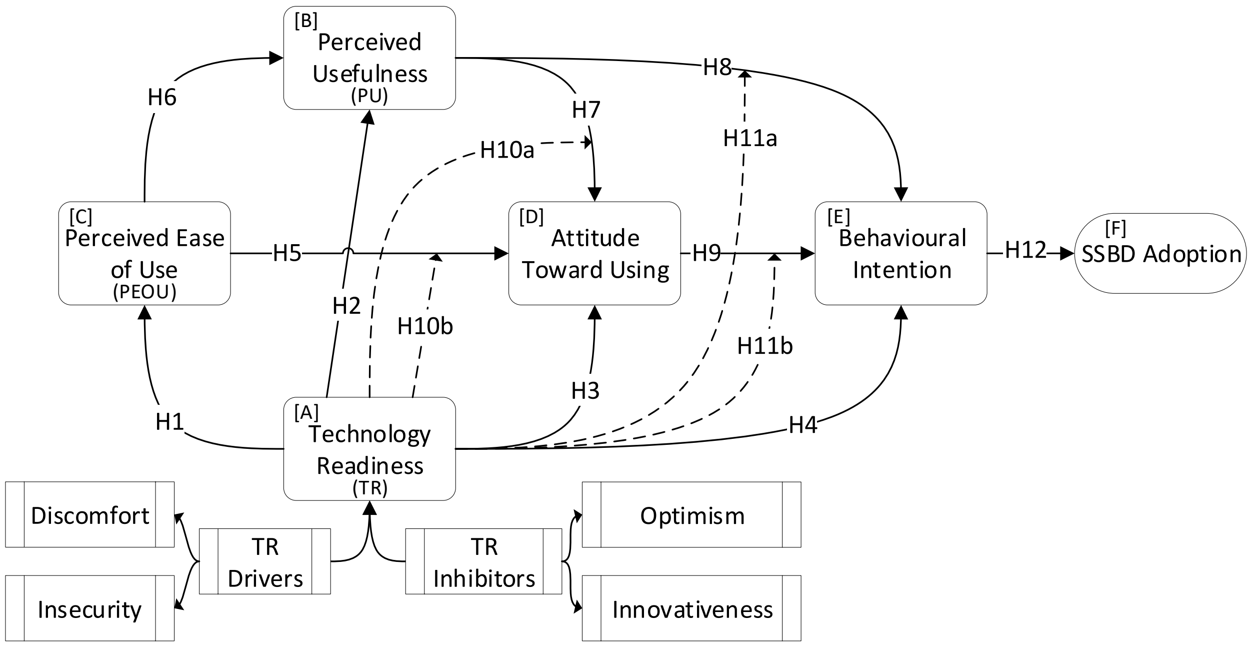


Figure 12. TRAM Model adapted from Lin and Chang (2011).

Each of the sections of the model and questionnaire is next discussed.

3.3.1.1 [A] Technology readiness (TR).

From Figure 12, this section refers to [A] Technology Readiness, and in the questionnaire, this relates to questions 1.1 to 1.16. This section made use of seven-point Likert type scales adapted to Parasuraman and Colby's (2015) refined 16 item TRI 2.0©. A free academic license was received from A. Parasuraman, C. Colby, and Rockbridge Associates, Inc. to use the TRI 2.0© questionnaire. A copy of the approval is included in Appendix C. The scales were labelled: (1) very strongly disagree, (2) strongly disagree, (3) disagree, (4) neutral, (5) agree, (6) strongly agree, and (7) very strongly disagree. Respondents were asked to indicate their degree of agreement or disagreement with the presented statements. This section consisted of 16 statements, which together covered the four dimensions of TR (i.e., optimism, innovativeness, discomfort, and insecurity).

The optimism dimension was measured with four subscales pertaining to respondents' positive beliefs towards technology (questions 1.1 to 1.4). The optimism dimension was intended to determine how respondents believe that technology can improve their lives, making them more efficient.

The innovativeness dimension was measured with four subscales relating to respondents' tendencies to be at the forefront of trying new technologies (questions 1.5 to 1.8). The innovativeness dimension was intended to determine the degree to which the respondent believed that they are technology leaders.

The discomfort dimension was measured with four subscales that sought to uncover consumers' fear of technology (questions 1.9 to 1.12). This discomfort dimension aimed to determine the degree to which respondents felt overwhelmed by technology and their general concerns about technology.

The insecurity dimension was measured with four subscales pertaining to respondents' general distrust of technology relating to concerns that they are not able to get it to work correctly (questions 1.13 to 1.16). The insecurity dimension aimed to determine respondents' distrust and scepticism about technology.

3.3.1.2 [B] Perceived usefulness (PU) and [C] perceived ease of use (PEOU).

From Figure 12, this section refers to [B] PU and [C] PEOU, and in the questionnaire, this relates to questions 2.1 to 2.12. This section included the two cognitive responses, PU and PEOU. This section made use of seven-point Likert type scales. The scales were labelled: (1) very strongly disagree, (2) strongly disagree, (3) disagree, (4) neutral, (5) agree, (6) strongly agree, and (7) very strongly disagree. Respondents were asked to indicate their degree of agreement or disagreement with the presented statements. This section consisted of 12 statements, which together covered the two cognitive responses, PU and PEOU of TAM.

The PU (questions 2.1 to 2.6) and PEOU (questions 2.7 to 2.12) subscales are both measured with six items each that resulted from an extensive measure development and validation procedure by (Davis, 1986).

As explained by Davis (1986), the measure development process generated 14 contender subscales for each construct based on their descriptions, the subscales were then pre-tested to refine their wording and to trim each construct down to 10 subscales each and to assess the reliability using Cronbach's alpha and validity using the multitraitmultimethod approach. High levels of convergent and discriminant validity of the 10-item subscales were obtained, and Cronbach's alpha reliabilities were 0.91 for PEOU and 0.97 for PU. Finally, Davis (1986) conducted an item analysis to streamline the subscales to six items each. The six-item PEOU and PU constructs were reassessed, and Cronbach's alphas of 0.97 and 0.93 were obtained for PU and PEOU, respectively.

The six items for PU are (Davis, 1986, p. 286):

PU1 Using 'system being evaluated' in my job would enable me to accomplish tasks more quickly.

PU2 Using 'system being evaluated' would improve my job performance.

PU3 Using 'system being evaluated' in my job would increase my productivity.

PU4 Using 'system being evaluated' would enhance my effectiveness on my job.

PU5 Using 'system being evaluated' would make it easier to do my job.

PU6 I would find 'system being evaluated' useful in my job.

The six items for PEOU are (Davis, 1986, p. 285):

PEOU1 Learning to operate 'system being evaluated' would be easy for me.

PEOU2 I would find it easy to get 'system being evaluated' to do what I want it to do.

PEOU3 My interaction with 'system being evaluated' would be clear and understandable.

PEOU4 I would find ‘system being evaluated’ to be flexible to interact with.

PEOU5 It would be easy for me to become skilful at using ‘system being evaluated’.

PEOU6 I would find ‘system being evaluated’ easy to use.

This research altered the PU scale to reflect the benefits SSBDs produce and how this would benefit the respondent. This is in line with Dabholkar and Bagozzi (2002), who stated that PU, while appropriate for products such as software systems, may not apply to self-service technologies (SSTs). They proposed that the PU scale be adapted to performance, reliability, and accuracy. A comparison of the adapted PU statements to the original PU statements is shown in Table 5.

Table 5

Original PU Compared to Altered PU

Original PU	New PU
Using ‘system being evaluated’ in my job would enable me to accomplish tasks more quickly (Davis, 1986).	Self-service tagging and self-service bag drop enables (will enable) me to accomplish tasks more quickly.
Using ‘system being evaluated’ would improve my job performance (Davis, 1986).	Self-service tagging and self-service bag drop improves (will improve) my task completion performance.
Using ‘system being evaluated’ in my job would increase my productivity (Davis, 1986).	Self-service tagging and self-service bag drop increases (will increase) my productivity.

Original PU	New PU
Using 'system being evaluated' would enhance my effectiveness on my job (Davis, 1986).	Self-service tagging and self-service bag drop enhances (will enhance) my effectiveness in completing tasks.
Using 'system being evaluated' would make it easier to do my job (Davis, 1986).	Self-service tagging and self-service bag drop makes (will make) it easier to complete tasks.
I would find 'system being evaluated' useful in my job (Davis, 1986).	I find (will find) self-service tagging and self-service bag drop useful.

3.3.1.3 [D] Attitudes towards using.

From Figure 12, this section refers to [D] Attitudes towards using, and in the questionnaire, this relates to questions 4.1 to 4.12. This section measured attitudes towards the three alternative methods that baggage can be checked-in (i.e., SSBDs, self-service check-in and staffed bag drops, and counter check-in). Seven-point bipolar semantic differential scales with endpoints of extremely bad/good, unpleasant/pleasant, dislike/like, and dissatisfied/satisfied were used for all attitude measures. These measures were adapted from Curran et al. (2003) and Dabholkar (1996).

Respondents were asked to complete 12 statements that relate to respondents' attitudes towards the different interfaces they may encounter when checking-in baggage.

3.3.1.4 [E] Behavioural intentions and [F] SSBD adoption.

From Figure 12, this section refers to [E] behavioural intention and [F] SSBD adoption, and in the questionnaire, this relates to questions 3.1 to 3.6. This section measured behavioural intentions and adoption for SSBDs, self-service check-in and staffed bag drops, and counter check-in. The measures for self-service frequency (questions 3.1 to 3.3) and intentions (questions 3.4 to 3.6) were adapted from Curran et al. (2003). The scales for self-service frequency (questions 3.1 to 3.3) were labelled: (1) never, (2) rarely, less than 10%, (3) occasionally, ±30%, (4) sometimes, 50%, (5) frequently, ±70%, (6) usually, ±90%, and (7) every time. The seven-point Likert type scales for self-service intentions (questions 3.4 to 3.6) were labelled: (1) extremely unlikely, (2) quite unlikely, (3) slightly unlikely, (4) neutral, (5) slightly likely, (6) quite likely, and (7) extremely likely.

Having discussed the quantitative aspects of the model, we will next focus on the qualitative section of the research instrument.

3.3.1.5 Preferences and reasons for non-usage of SSBDs.

In this section, the qualitative aspects relating to preferences and reasons for not using SSBDs are discussed. The questionnaire captured qualitative data to analyse the respondents' preferences and reasons for non-usage of SSBDs. Self-service preference for SSBDs, self-service check-in and staffed bag drops, and counter check-in were measured on a rank order scale from the first order of preference to the third order of preference (questions 3.7 to 3.9). The reasons for SSBD non-usage questions (questions 3.10 to 3.16) contained five statements for respondents to select one or more of the reasons they had not used an SSBD and also provided a free text box for respondents to capture any other reasons.

3.3.1.6 Demographic data.

This section consisted of 15 questions designed to gather information about the respondents' age, gender, and nationality along with other air travel behavioural characteristics such as the class of airline ticket, the number of flights in the last 12 months, quantum, and type of baggage. Questions were a combination of nominal, ordinal, interval, ratio, and free-text inputs.

Having presented the research instrument, the next section will lead to the constructs of the structural equation model intended for use.

3.3.2 Conceptual Structural Equation Model.

Hair, Black, Babin, & Anderson (2014) describe SEM as second-generation multivariate statistical analysis utilising the combination of factor analysis as well as regression. Partial least squares structural equation modelling (PLS-SEM) is based on the ordinary least square evaluation and, when estimating coefficients, minimises the sum of squares between the differences of fitted and observed values (Chin, 2010; Hair, Hult, Ringle, & Sarstedt, 2017).

Lin et al. (2007) and Lin and Chang (2011) used covariance-based structural equation modelling (CB-SEM) in their TRAM research. However, they did not specify if the direction of the relationship is either from the measures to the construct (formative measurement) or from the construct to the measures (reflective measurement). Furthermore, researchers have only recently acknowledged that there are two subtypes of formative measurement, i.e., causal-formative and composite models (also known as composite-formative) (Bollen & Diamantopoulos, 2017; Henseler, 2017).

Table 6 presents guidelines that Hair et al. (2017) recommend for choosing between PLS-SEM and CB-SEM.

Table 6

Choosing Between PLS-SEM and CB-SEM

Use PLS-SEM when	Use CB-SEM when
a) The goal is predicting key target constructs or identifying key “driver” constructs. b) Formatively measured constructs are part of the structural model. Note that formative measures can also be used with CB-SEM, but doing so requires constructing specification modifications (e.g., the construct must	g) The goal is theory testing, theory confirmation, or the comparison of alternative theories. h) Error terms require an additional specification, such as the covariation. i) The structural model has circular relationships.

Use PLS-SEM when	Use CB-SEM when
include both formative and reflective indicators to meet identification requirements).	j) The research requires a global goodness-of-fit criterion.
c) The structural model is complex (many constructs and many indicators).	
d) The sample size is small.	
e) The data are not normally distributed.	
f) The plan is to use latent variable scores in subsequent analyses.	

Note. Data source Hair et al. (2017).

Therefore PLS-SEM was better suited than CB-SEM for this study as items a, b, c, and d were applicable. Additionally, several researchers have used PLS-SEM with the TRAM framework (e.g., Blankestijn, 2017; Jayabalana et al., 2019; Nugroho & Fajar, 2017; Sivathanu, 2019; Walczuch et al., 2007; Wiegard, Guhr, Loi, & Breitner, 2012). Another significant advantage of PLS-SEM in this context is that it permits the unrestricted use of single-item and formative measures (Hair et al., 2017).

Constructs and measures are defined before the discussion of the relationships between the two. Constructs, also referred to as latent variables, describe unobservable data and are proxies for the phenomena named by the construct (Aguirre-Urreta & Marakas, 2014; Freeze & Raschke, 2007). Measures, also known as indicators, scales, or subscales, are the observed scores gathered through self-report, interviews, and surveys (Freeze & Raschke, 2007). The measurement model relates the measures to constructs based on the researchers' interpretation of the data (Aguirre-Urreta & Marakas, 2014).

The literature review identified several technology acceptance model (TAM) researchers who modelled PEOU, PU, attitude, behavioural intention, and adoption reflective first order constructs (e.g., Alambaigi & Ahangari, 2016; Freeze & Raschke, 2007; Gefen & Straub, 1997; Khaled Amin, Azhar, Amin, & Akter, 2015; Sevim, Yüncü, & Eroğlu Hall, 2017). As no research evidence was available to support the formative measurement of the constructs, all the TAM constructs were accepted as reflective first-order constructs.

In contrast, the literature review concerning TR identified several different approaches, as discussed in the literature review (Chapter 2, section 2.3.1). For example, Pires et al. (2011), Rahman et al. (2017), and Walczuch et al. (2007) modelled the four dimensions of TR (i.e., optimism, innovativeness, discomfort, and insecurity) individually, and Blut and Wang (2019) and Jin (2013) used a two-dimensional model to conceptualize the TR drivers (i.e., optimism and innovativeness) and the TR inhibitors (i.e., discomfort and insecurity). Neither of these approaches considers that consumers possess a combination of all four dimensions.

Another approach is the single dimension that combines the four dimensions into the combined TR construct (Liljander et al., 2006; Lin et al., 2007; Lin & Chang, 2011; Smit et al., 2018). While this is methodologically convenient, the differential effects of each dimension may not be evident, and therefore, the resultant explanation of technology adoption may be inaccurate (Blut & Wang, 2019).

Some studies have, however, modelled TR as a hierarchical component model (also known as higher-order-models) (Ali et al., 2016; Blankestijn, 2017; Vize et al., 2012). The approach taken by these researchers may provide a better solution as it considers the multidimensionality and the differential effects at the same time; however, they did not specify if any of the constructs and measures were formative or reflective as recommended by Chin (2010).

Therefore, the approach adopted in this study was to first analyse the measures (subscales) for each of the four TR dimensions (constructs) to determine if they were tapping into the same causal factor (Chin, 2010; Hair et al., 2017). This was achieved using the simple test recommended by Chin (2010, p. 664): “if the underlying construct was to change in magnitude, would all its items change as well?” The results of this test are presented in Table 7 where the TR measures are referenced as TR_opt1 to TR_opt4 for the optimism dimension, TR_inn1 to TR_inn4 for the innovation dimension, TR_dis1 to TR_dis4 for the discomfort dimension, and TR_ins1 to TR_ins4 for the insecurity dimension. The question asked is: If the TR dimension (i.e., optimism, innovation, discomfort, and insecurity) increases or decreases, would the measures change as well?

Table 7

Technology Readiness Measures

Reference	Sub-scale Item	Increase	Decrease
TR_opt1	New technologies contributes to a better quality of life.	Yes	Yes
TR_opt2	Technology gives me more freedom of mobility (ability to perform tasks on the go).	Yes	Yes
TR_opt3	Technology gives people more control over their daily lives.	Yes	Yes
TR_opt4	Technology makes me more productive in my personal life.	Yes	Yes
TR_inn1	Other people come to me for advice on new technologies.	Yes	Yes
TR_inn2	In general, I am among the first in my circle of friends to acquire new technology when it appears.	Yes	Yes
TR_inn3	I can figure out new high-tech products and services without help from others.	Yes	Yes
TR_inn4	I keep up with the latest technological developments in my areas of interest.	Yes	Yes
TR_dis1	When I get technical support from a provider of a high-tech product or service, I feel as if I am being taken advantage of by someone who knows more than I do.	Yes	Yes
TR_dis2	Technical support lines are not helpful because they do not explain things in terms I understand.	Yes	Yes
TR_dis3	Sometimes, I think that technology systems are not designed for use by ordinary people.	Yes	Yes

Reference	Sub-scale Item	Increase	Decrease
TR_dis4	There is no such thing as a manual for a high-tech product or service that is written in plain language.	Yes	Yes
TR_ins1	People are too dependent on technology to do things for them.	Yes	Yes
TR_ins2	Too much technology distracts people to a point that is harmful.	Yes	Yes
TR_ins3	Technology lowers the quality of relationships by reducing personal interaction.	Yes	Yes
TR_ins4	I do not feel confident doing business with a place that can only be reached online.	Yes	Yes

Therefore, the TR measures for each dimension were modelled as reflective. These results matched the approach of several other TRAM researchers (e.g., Ali et al., 2016; Blankestijn, 2017; Vize et al., 2012). These researchers additionally specified TR as a reflective-reflective, second-order hierarchical component model.

However, one of the researchers that adopted this approach reported that the Average Variance Extracted (AVE) for discomfort $(AVE = 0.42)$ and insecurity $(AVE = 0.43)$ were less than 0.5, whereas Hair et al. (2017) state that convergent validity is significant when the loading estimates are statistically significant and have an $AVE > 0.5$ (Blankestijn, 2017). Blankestijn (2017) retained these dimensions on the basis that their reliabilities exceeded 0.65. Based on this research evidence, it was decided to specify the TR construct as a reflective-reflective, second-order hierarchical component model, as illustrated in the conceptual structural equation model (see Figure 13).

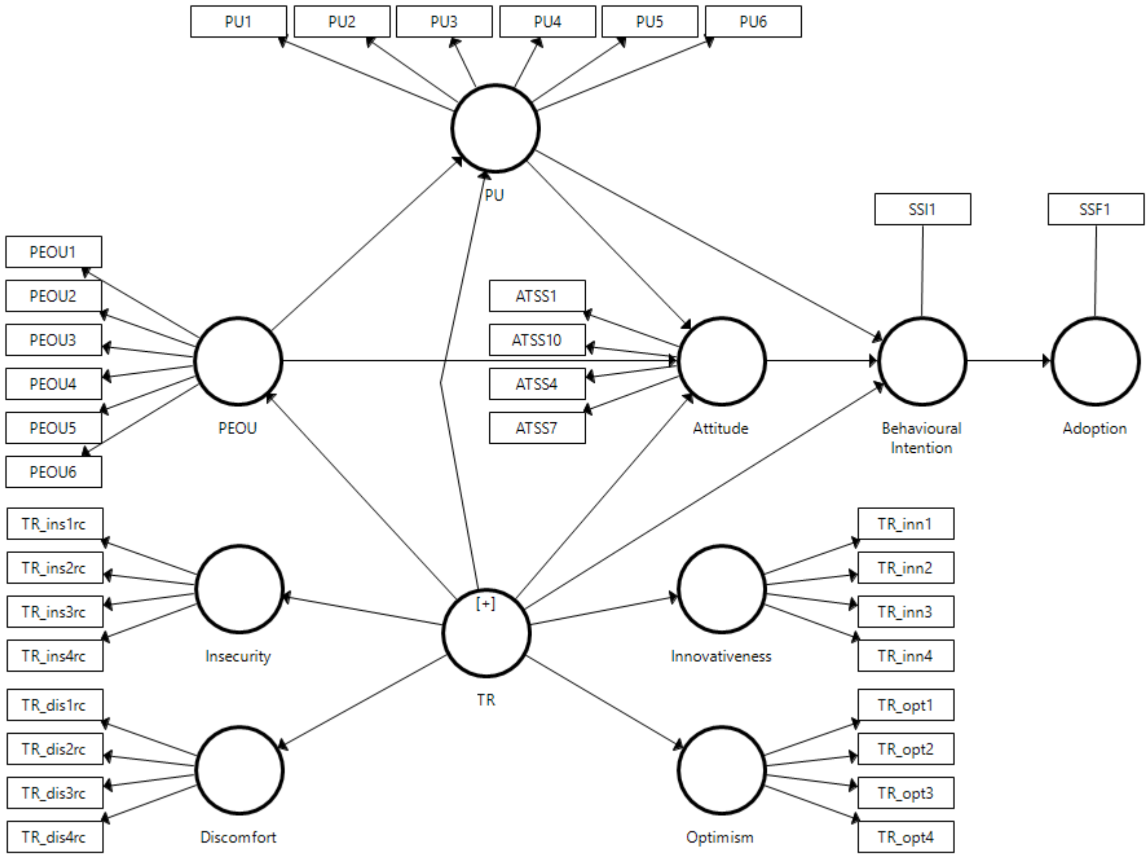


Figure 13. Conceptual TRAM Structural Equation Model

Having presented the research instrument and the conceptual structural equation model, the following section details the pre-test for the questionnaire.

3.3.3 Pre-test.

Subsequent to the design of the questionnaire, a pre-test was conducted as recommended by Fowler (2014). The pre-test was conducted by administering the initial draft questionnaire to a convenience sample of 10 passengers at OR Tambo International Airport. The respondents were asked to complete the questionnaire and to give comments in terms of comprehension, language, clarity, length, and time needed to complete the survey.

3.3.4 Pilot Test.

Next, a pilot test was conducted to assess the conceptual model validity based on the scale development process defined by Carpenter (2018). As pointed out by Carpenter (2018) and Johanson and Brooks (2010), the purpose of the measurement scale is to capture concepts that are not directly observable. Johanson and Brooks (2010) indicated that a pilot study should have at least 30 responses, while Carpenter (2018) indicated that sample size could range between 5 – 100 responses. Considering the time horizon and limitations of this research, a pilot sample size of 30 was deemed adequate as other researchers conducting similar studies conducted pilot studies with a sample of 30 responses (e.g., Kaur & Gupta, 2012; Roy, Balaji, Quazi, & Quaddus, 2018).

The factorability of the pilot study was assessed by evaluating the Principal Components Analysis (PCA) outputs which included the Kaiser-Meyer-Olkin $(KMO > 0{,}5)$ values, Bartlett's test for sphericity $(p < 0{,}05)$, and the rotated component matrix as recommended by Carpenter (2018). Additionally, Cronbach's alpha test was used to determine the reliability of the various constructs. Nunnally (1978) recommended that for a construct to be reliable, it must generate a Cronbach's alpha value higher than 0.7, whereas others, such as Siriram and Snaddon (2005) have used values above 0.6. Only TR, PU, PEOU, and attitude were analysed as behavioural intention and adoption were measured on single-item scales. The single-item scales were adapted from Curran et al. (2003), who reliably used them as single-item measures in their study*, Intentions to Use Self-Service Technologies: A Confluence of Multiple Attitudes*. The results of the pilot test are provided in Chapter 4, the research results section.

Having discussed the pre-test and pilot test, the following section will provide a more in-depth insight into the population and sampling methodology.

3.3.5 Population and Sample.

3.3.5.1 Population.

The target population for this study is all air travel passengers using the services of commercial airlines operating at three primary South African international airports. However, the population size is very large. For example, in 2018, the number of passengers that departed through OR Tambo International Airport was 10,686,913; Cape Town International Airport was 5,437,295; King Shaka International Airport was 3,007,573 (ACSA, 2019). While there are no published population demographics that describe the population, it is assumed that the passengers who use them differ widely in such characteristics as age, gender, national origin, and socioeconomic status. Additionally, the variability from one airport to the next is not known.

3.3.5.2 Sample.

Having discussed the population, the sample is next discussed.

Other researchers using TRAM used non-probability sampling methods such as convenience, quota, and intercept sampling methods (e.g., Lin et al., 2007; Lin & Chang, 2011; Smit et al., 2018). Based on this research evidence, the same methodology was considered.

Non-probability sampling consists of three primary categories (Battaglia, 2011). The essence of the three primary categories is as follows: Convenience sampling in which participants are chosen based on their convenience and availability (Battaglia, 2011). Intercept sampling is a type of convenience sampling whereby respondents are intercepted at a mall, for example (Toepoel, Steinmetz, & Vehovar, 2016).

Quota sampling is to set a target number of completed interviews with specific subgroups based on the demographics of the population of interest (Battaglia, 2011).

Purposive sampling is the application of expert knowledge to select in a non-probabilistic manner a sample that represents a cross-section of the population (Battaglia, 2011).

In addition to the three primary categories, Battaglia (2011) highlighted three more recent developments. These are:

i. Web surveys that are typically administered to a panel that has been pre-recruited as a convenience sample of household adults with known demographic profiles (Battaglia, 2011).
ii. The purchasing of email addresses from companies that accumulate email addresses that seem to be associated with persons living in households (Battaglia, 2011).
iii. Respondent-driven sampling that is described as a form of snowball sampling, which relies on referrals from an initial sample of respondents to nominate additional respondents (Battaglia, 2011).

Battaglia (2011) additionally highlighted that snowball samples are sometimes used to select samples of respondents in a situation when no complete list of such respondents exists, and the costs of doing a probability sample would be prohibitive.

Furthermore, in most non-probability samples, a level of natural randomisation is still present (Toepoel et al., 2016). In line with this research evidence, this research adopted convenience and respondent-driven sampling.

3.3.5.3 Sample size.

Other TRAM researchers obtained a sample size of 300 to 410; however, their research analysis was based on CB-SEM, whereas in this research, the analysis will be conducted with PLS-SEM. For PLS-SEM, smaller sample sizes are required (Hair et al., 2017). Running a statistical power analysis using the G*Power program recommended by Faul, Erdfelder, Buchner, and Lang (2009), a sample size of 37 observations would be required to detect R^2 values of around 0.25 with a significance level of 5% and a statistical power of 80%.

However, Kock and Hadaya (2018) caution against the use of the R^2 method as it could lead to inaccurate estimations of the minimum required sample size. They alternatively recommend the inverse square root and gamma-exponential methods for minimum sample size estimation when the analysis will be conducted using partial least square structural equation modelling (PLS-SEM).

Kock and Hadaya (2018) recommend that a minimum sample size of 146 for the gamma-exponential method and 160 for the inverse square root method when the value of the path coefficient with the minimum absolute magnitude is not known in advance. Accordingly, as the value of the path coefficient with the minimum absolute magnitude was not known in advance, the minimum sample required for this research was set at 160 as per Kock and Hadaya (2018).

3.3.6 Data Collection.

Having established the population and sample requirements, the next step was to select the mode of data collection that would cost-effectively produce the best quality data.

Fowler (2014) lists the possible advantages when using the questionnaire method for the collection of data as follows:

i. The responses are controlled and focused.
ii. The questionnaire is less time consuming than conducting interviews.
iii. Cost implications can be managed.

Fowler (2014) lists the possible disadvantages when using the questionnaire method for the collection of data as follows:

i. There is a general low return rate, and respondents need to be followed up.
ii. The respondents are limited in their response to the questions that have been structured.

To mitigate nonresponse Fowler (2014) recommended the use of multimode surveys. Toepoel et al. (2016) added that based on research evidence, the level of randomisation could be further increased by spreading the non-probability sample as broadly as possible, which in practice, predominantly means combining various recruitment channels. Other researchers that used TRAM used physically administered and computer-administered methods (e.g., Lin et al., 2007; Lin & Chang, 2011; Smit et al., 2018). Therefore, in this research, the modes that were selected were computer-administered surveys as they are the most cost-effective and physically administered surveys as the response rate is generally higher than computer-administered methods (Fowler, 2014).

Due to budget limitations, the physical administration of surveys was limited to 100, and the balance had to be collected using computer-administered methods. Therefore, a total of 100 convenience sampling surveys were collected by the physical administration of questionnaires at OR Tambo International airport over a period of four weeks at different times of the day to obtain a mix in the type of passenger. The remainder were collected with SurveyMonkey via social media and e-mail collectors and relied primarily on respondent-driven sampling. The use of the social media collector to post the survey on multiple social media platforms was intended to increase the randomisation. LinkedIn, for example, has more than 430 million professionals globally (Frisch, 2017).

Fowler (2014) cautioned that the collection of data in multimode surveys is the comparability of data across the modes. Accordingly, the data obtained from the physically administered questionnaire was compared to the data obtained via the electronic questionnaire to test for bias between the two methods.

Having discussed the population, sampling, and data collection methodologies, the next section presents the ethical considerations.

3.3.7 Ethical Considerations.

Ethical clearance was obtained from the University of the Witwatersrand School of Mechanical, Industrial, and Aeronautical Engineering Ethics Committee before data collection. A copy of the approval is included in Appendix B.

An informed consent letter was presented with the survey questionnaire that provided information on the survey, along with the potential risks and benefits. The survey respondents were not offered any compensation for their participation in completing the survey.

The first question on the questionnaire was an acknowledgement that the informed consent letter was received and that by proceeding to the first question, the respondent thereby grants consent, which may be revoked at any time prior to the completion of the survey. The survey was anonymous, and no personal data from any of the respondents were recorded.

3.3.8 Analysis Procedures.

IBM SPSS Statistics for Windows (IBM Corp, 2017) and SmartPLS (Ringle et al., 2015) software statistical analysis tools were utilised to conduct the analysis and provide suitable reports for interpretation of data for this research. A mixture of descriptive and inferential statistical techniques was utilised to analyse the data where regression analysis was the primary statistical technique used to test the hypotheses set out for the study. The findings from the analysis were used to determine if the research problem and research objectives set out for the study were achieved.

To facilitate the analysis process, a codebook was generated to identify each construct in the study using a codename. The first step in the analysis process was to screen the data for completeness, validity, and outliers (Zikmund et al., 2013). Zikmund et al. (2013) recommend that data that is incomplete be disqualified, except in the case of 50 – 100% completion, where the imputation of the missing data is recommended.

Multiple imputation was selected as the method for dealing with missing data as it is a better alternative than listwise deletion and simple imputation (Van Buuren, 2012 as cited by van Ginkel, Linting, Rippe, & van der Voort, 2019). Additionally, it is the most sophisticated method for dealing with this problem (van Ginkel et al., 2019).

The means, standard deviations, and reliability of the data are assessed to ensure that the constructs and measures are suitable for the in-depth statistical analysis. This ensured that the need to have internal consistency and unidimensionality in the non-demographic sections of the data set were met (Tavakol & Dennick, 2011).

The TRAM framework and associated hypotheses within the structural equation model were evaluated using SmartPLS Version 3.2.9 (Ringle et al., 2015). The PLS-SEM statistical analysis followed the methodology by Hair et al. (2017) as follows:

i. Assess the reliability and validity of the outer model.
ii. Assess the inner structural model for collinearity issues.
iii. Assess the significance and relevance of the structural model relationships.
iv. Assess the level of R^2.
v. Assess the predictive relevance of Q^2.

Internal consistency reliability of the model represents the internal reliability and consistency of the measurement scale adopted (Trochim & Donnelly, 2006). Cronbach's alpha has been the most commonly used score to assess the internal reliability of a measurement scale (Zikmund et al., 2013). However, Chin (2010) argues that within the context of PLS modelling, Cronbach's alpha score tends to underestimate the internal reliability. Hair et al. (2017) state that a new score through composite reliability (*CR*) should instead be reported. Both scores range from 0 to 1, and the lower bound for an acceptable level of internal consistency reliability of 0.7 should be adopted (Chin, 2010; Hair et al., 2017).

The validity of the outer model was evaluated through the lenses of convergent and discriminant validity. Convergent validity refers to the extent that a measured construct related to other measured constructs that constitute a single higher-order latent variable (Hair et al., 2017). Discriminant validity, on the other hand, aims to ensure that measured constructs do not represent or cross-load on other items that it was not supposed to represent (Hair et al., 2017). Hair et al. (2017) provide an evaluation method in order to ensure that both convergent and discriminant validity are evaluated. Each of the measured constructs factor loadings onto their respective latent variables needs to exceed a score of 0.7 (Hair et al., 2017). In addition, the Average Variance Extracted (AVE) needs to be at least 0.5 (Fornell & Larcker, 1981).

Furthermore, it is recommended that if latent scores report an AVE less than 0.5, consideration by researcher needs to be taken if the construct or measured subscales should be deleted to ensure that content validity is not affected (Hair et al., 2017). Discriminant validity was assessed by evaluating the Heterotrait-Monotrait (*HTMT*) criterion matrix, which measures the associations of measured subscales onto latent scores (Henseler, Ringle, & Sarstedt, 2015; Henseler, Hubona, & Ray, 2016). The upper bound for the HTMT should not exceed 0.9 to confirm discriminant validity in the PLS model (Henseler et al., 2015; Henseler et al., 2016).

The inner model was assessed by evaluating the variance inflation factor (VIF). The presence of collinearity in the inner model can create a higher path coefficient, thus creating an inference that might not be true (Chin, 2010). Hair et al. (2017) recommend that the upper bound for VIF should be a score of 10. Furthermore, the path coefficients and coefficient of determination (R^2) was evaluated using the bootstrap technique to validate the significance at a 95% significance level (Hair et al., 2017). The estimated value of the path coefficients was evaluated in terms of the sign, magnitude, and significance (Hair et al., 2017). The R^2 values were evaluated using the categorisation recommended by Chin (1998). Whereby, values of 0.67, 0.33, and 0.19, are described as substantial, moderate, and weak effects of an exogenous latent variable on an endogenous latent variable.

Lastly, Stone-Geisser's Q^2 was evaluated to assess the predictive relevance of the model (Chin, 2010; Hair et al., 2017). Stone-Geisser's Q^2 was obtained by running the blindfolding algorithm in SmartPLS Version 3.2.9 (Ringle et al., 2015). According to Hair et al. (2017) $Q^2 > 0$ is indicative that the model has predictive power, $0.02 < Q^2 < 0.15$ is regarded as small, $0.15 \leq Q^2 < 0.35$ is medium, and $Q^2 \geq 0.35$ is large.

3.3.9 Post-Hoc Tests.

In addition to the core research propositions tested, the structural equation model was evaluated to test for the presence of possible mediation, and a

TR segmentation analysis was performed to understand the study sample better.

3.3.9.1 Test of mediating effects.

The possible mediating effects of the following relationships are assessed:

i. PEOU → PU → Attitude;
ii. TR → PEOU → Attitude;
iii. TR → PU → Attitude;
iv. TR → PU → Behavioural Intention
v. TR → Attitude → Behavioural Intention.

To test the mediating effect, the study followed Preacher and Hayes (2008) bootstrap method. Bootstrapping is non-parametric and can be applied to small sample sizes with more confidence; it is therefore well suited for the PLS-SEM method implemented in SmartPLS (Hair et al., 2017).

According to Hair et al. (2017), the following conditions must be fulfilled to establish the mediating role of a construct between an independent variable and the dependant variable:

i. Presence of significant direct effect of the independent variable on the dependent variable; and
ii. Presence of a significant indirect effect of the independent variable on the dependent variable via the mediating variable.

Hair, Hult, Ringle, and Sarstedt (2014) have recommended that the extent of mediation could be determined by calculating the variance accounted for (VAF). According to Hair et al. (2014), VAF is computed using the formula:

$$VAF = \frac{Specific\ Indirect\ Effects}{Total\ Effects}$$

Where:

i. $VAF < 0.20$ indicates no mediation.

ii. $0.20 \leq VAF \leq 0.80$ indicates partial mediation.

iii. $VAF > 0.80$ indicates full mediation.

3.3.9.2 TR segmentation.

To demonstrate the multidimensionality of the TR construct as discussed in the literature review (Chapter 2, section 2.3.1), a TR segmentation scheme using the $K - means$ technique that Parasuraman and Colby (2001) used to create a cluster analysis of the respondents was conducted by C. L. Colby of Rockbridge Associates, Inc., a U.S. based company specialising in service and technology research. Included with the academic license to use the TRI 2.0©, they offered to do this at no cost. All other analysis was done by the author of this research.

3.3.10 Limitations.

This study adopted a non-probability sampling technique, which included snowball and convenience sampling methods. A limitation of this technique is that the sample may not be representative of the target population (Fowler, 2014). Additionally, the survey questionnaire was only available in English as the are no published population demographics that describe the population and the language variability from one airport to the next is not known. Therefore, certain subgroups of the target population were excluded from the sample. The survey was conducted over one-month on different days of the week at different times to minimise bias.

Due to time constraints, the study adopted a cross-sectional survey approach as opposed to a longitudinal survey approach. The cross-sectional survey approach provided a snapshot of the respondents over a four-week period. Rindfleisch et al. (2008) highlighted that the two main validity concerns of the cross-sectional approach are common method variance bias and causal inference. Rindfleisch et al. (2008) go on to state that these two issues are closely related because common method variance bias inhibits the researcher’s ability to draw causal inferences and creates alternative explanations. The collection of surveys over four weeks from multiple respondents mitigated this limitation to an extent.

4 RESULTS

The sections herein present the results of the research based on the research design and approach discussed in the methodology (Chapter 3). This chapter begins by providing results of the pre-test and pilot test. Next, descriptive analytics on the sample population based on the structure of the survey instrument are presented, which is then followed by presenting the results for the adopted analytical approach, which informed the research questions and hypotheses.

4.1 Pre-test

Subsequent to the design of the questionnaire, a pre-test was conducted by administering the initial draft questionnaire to a convenience sample of ten passengers at OR Tambo International Airport.

The feedback from the pre-test provided several insights:

i. the instructions contained a few ambiguous statements;
ii. the questions were well understood;
iii. the time needed to complete the survey ranged from 7 to 15 minutes; and
iv. two respondents advised that the survey was too long.

Having considered the feedback concerning the time to complete the survey, it was decided that the time to complete was reasonable and did not warrant the shortening of the questionnaire. The questionnaire was thereafter updated by rewording of the ambiguous statements.

4.2 Pilot Test

A sample of 30 respondents was selected to conduct the pilot study as per recommendations by Carpenter (2018). The results of the Principal Components Analysis (PCA) and Cronbach's alpha test are presented in Table 8 for Technology Readiness (TR), perceived usefulness (PU), perceived ease of use (PEOU), and attitude. The constructs that were assessed reported $KMO > 0.5$ indicating adequate sampling adequacy. Also, they reported Bartlett's test for sphericity significance $(p < 0.05)$, indicating that the data was suitable for PCA analysis, and Cronbach's alpha were all above 0.6.

Table 8

PCA and Cronbach's Alpha Test Results

Construct	KMO Measure	Bartlett's Test of Sphericity	Cronbach's Alpha
TR	0.7	0.000	0.7
PU	0.8	0.000	0.9
PEOU	0.8	0.000	0.9
Attitude	0.7	0.000	0.8

Note. $KMO > 0.5$; $p < 0.05$; $Cronbach's\ alpha > 0.6$

The rotated component matrix for TR is depicted in Table 9. The rotation converged in eight rotations, and the four sub-dimensions of TR were extracted. All the rotated component scores were more than 0.4 and were retained.

Table 9

TR Rotated Component Matrix

	Component			
	1	2	3	4
TR_opt1	0.918			
TR_opt2	0.852			
TR_opt3	0.631			
TR_opt4	0.661			
TR_inn1		0.640		
TR_inn2		0.794		
TR_inn3		0.591		
TR_inn4		0.756		
TR_dis1rc			0.665	
TR_dis2rc			0.735	
TR_dis3rc			0.756	
TR_dis4rc			0.556	
TR_ins1rc				0.822
TR_ins2rc				0.914
TR_ins3rc				0.511
TR_ins4rc				0.610

PU did not report any components. The rotated component matrix for PEOU is depicted in Table 10. The rotation converged in three rotations and was made up of two components. While this result was not as expected, it was attributed to the small sample size. All the rotated component scores were above 0.4. As such, the questions were not removed.

Table 10

PEOU Rotated Component Matrix

	Component	
	1	2
PEOU1	0.657	
PEOU2	0.761	
PEOU3		0.930
PEOU4	0.900	
PEOU5		0.922
PEOU6	0.679	

The rotated component matrix for attitude is depicted in Table 11. The rotation converged in five rotations and was made up of three components, as was anticipated, i.e., SSBDs, staffed bag drop, and counter check-in. All the rotated component scores were more than 0.4 and were retained.

Table 11

Attitude Rotated Component Matrix

	Component		
	1	2	3
ATSS1	0.888		
ATSS2		0.733	
ATSS3			0.919
ATSS4	0.627		
ATSS5		0.916	
ATSS6			0.766
ATSS7	0.833		
ATSS8		0.910	
ATSS9			0.727

As the PCA provided suitable results, no changes were made to the hypothesised structure of each higher-order variable for the PLS model.

The single-item scales used to operationalise behavioural intentions and adoption were adapted from Curran et al. (2003), who reliably used them in their research on SSTs. According to de Neufville and Field (2013) and Hair et al. (2014), redundancy of observation is beneficial when the scales are observably unreliable. Fuchs and Diamantopoulos (2009), in their research regarding the use of single-item scales for construct measurement, supported this view. They added that single-item scales could have satisfactory psychometric properties and are, therefore, a viable substitute to multi-item scales for construct measurement purposes. Therefore, as these scales were observably reliable and known to have been reliably used by Curran et al. (2003), they were accepted as psychometrically reliable.

4.3 Main Survey Response and Test for Bias

The first step in the analysis process was to screen the data for completeness, validity, and outliers. A total of 231 responses were received with a completion rate of 83% (191). Zikmund et al. (2013) recommend that data that is incomplete be disqualified, except in the case of 50 – 100% completion, where the imputation of the missing data is recommended. Accordingly, 24 responses with less than 50% completion were disqualified, and 17 that were completed between 50 to 100% were imputed using the multiple imputation method in SPSS Version 25.0 (IBM Corp, 2017). Table 12 presents a summary of the survey response completion rate.

Table 12

Summary of Survey Completion Rate

Description	Responses	
Responses	231	
Completion rate	190	(83%)
Disqualified	24	(10%)
Imputed	17	(7%)
Sample (*N*)	207	(90%)

Based on the sample and data collection methods adopted for this research, the number of individuals approached during the administration of surveys is unknown. Hence a response rate cannot be reported. This approach was also followed by other TRAM researchers (e.g., Lin & Hsieh, 2007; Lin & Chang, 2011; Smit et al., 2018) who used non-probability sampling methods.

The data obtained from the physically administered questionnaire was compared to the data obtained via the electronic questionnaire to test for bias between the two methods. The findings are presented in Table 13. Except for the first-order insecurity construct (INS), there was no significant difference between the physically administered questionnaire and the electronic questionnaire $(p < 0.05)$. As the TR construct did not show any significant differences, it was affirmed that no bias exists between the two data sets.

Table 13

Independent Sample Test

		Levene's Test for Equality of Variances		*t*-test for Equality of Means			
		F	Sig.	t	df	Sig. 2-tailed	M
OPT	Equal variances assumed	3.94	0.05	1.76	205	0.08	0.26
	Equal variances not assumed			1.74	192.94	0.08	0.26
INN	Equal variances assumed	1.41	0.24	1.34	205	0.18	0.22
	Equal variances			1.33	191.69	0.19	0.22

		Levene's Test for Equality of Variances		*t*-test for Equality of Means			
		F	Sig.	t	df	Sig. 2-tailed	M
	not assumed						
DIS	Equal variances assumed	2.28	0.13	-0.42	205	0.67	-0.06
	Equal variances not assumed			-0.42	184.54	0.68	-0.06
INS	Equal variances assumed	8.05	0.01	-2.41	205	0.02	-0.40
	Equal variances not assumed			-2.38	184.42	0.02	-0.40
TR	Equal variances assumed	0.51	0.48	0.04	205	0.97	0.00
	Equal variances not assumed			0.04	197.57	0.97	0.00
PU	Equal variances assumed	0.16	0.69	0.51	205	0.61	0.08
	Equal variances not assumed			0.51	204.98	0.61	0.08
PEOU	Equal variances assumed	0.09	0.77	-0.17	205	0.86	-0.03
	Equal variances not assumed			-0.17	204.03	0.86	-0.03
BI	Equal variances assumed	3.34	0.07	-1.30	205	0.19	-0.20

		Levene's Test for Equality of Variances		*t*-test for Equality of Means			
		F	Sig.	t	df	Sig. 2-tailed	M
	Equal variances not assumed			-1.29	189.69	0.20	-0.20
Adoption	Equal variances assumed	3.18	0.08	0.58	205	0.56	0.10
	Equal variances not assumed			0.58	186.56	0.56	0.10
Attitude	Equal variances assumed	2.38	0.12	2.68	205	0.01	0.25
	Equal variances not assumed			2.66	192.16	0.01	0.25

Note. $p < 0.05$ is significant.

4.4 Descriptive statistics for the qualified sample

As depicted in Table 14, there was an equal distribution of male and female research survey respondents. Eight percent of the qualified sample did not report gender.

Table 14

Gender Statistics

Gender	Frequency	Percent
Male	95	46%
Female	95	46%

Gender	Frequency	Percent
Missing	17	8%
Total	207	100%

As depicted in Table 15, the majority of the survey respondents reported their age between 31 and 51 (61%). This was followed by the age category 52 – 70, whereby this represented 18% of the sample population. 8% of the survey respondents did not report their age.

Table 15

Age Statistics

Category	Frequency	Percent
18 - 22	7	3%
23 - 30	16	8%
31 - 39	63	30%
40 - 51	64	31%
52 - 70	38	18%
>71	2	1%
Missing	17	8%
Total	207	100%

As depicted in Table 16, thirty-five percent of the survey respondents indicated that their primary reason for using air travel was business-related, a further 27% reported their primary reason for air travel as being leisure-related. In contrast, 30% reported their primary reason as being both leisure and business-related, and 8% of the respondents failed to provide a reason for their primary travel.

Table 16

Primary Reason for Travel

Category	Frequency	Percent
Leisure	55	27%
Business	73	35%
Both	62	30%
Missing	17	8%
Total	207	100%

As depicted in Table 17, the majority of the survey respondents reported that they purchase Economy class tickets when travelling (69%). In comparison, 15% indicated that they purchased either a Premium economy or Business class ticket.

Table 17

Primary Class of Ticket I Purchase When I Travel

Category	Frequency	Percent
Business	14	7%
Premium economy	17	8%
Economy	143	69%
Low-cost carrier	16	8%
Missing	17	8%
Total	207	100%

As presented in Table 18, just over 80% of the survey respondents reported their country of residence as being SA, and 8.2% failed to provide their country of residence.

Table 18

Country of Residence

Country	Frequency	Percent
SA	166	80.2%
Australia	4	1.9%
Brazil	4	1.9%
China	1	0.5%
Dubai	1	0.5%
France	1	0.5%
Germany	1	0.5%
Ghana	1	0.5%

Country	Frequency	Percent
Great Britain	1	0.5%
Italy	1	0.5%
Qatar	1	0.5%
UAE	2	1.0%
USA	6	2.9%
Missing	17	8.2%
Total	207	100%

As illustrated in Table 19, 57% of the respondents indicated that they have been on 1 to 10 flights in the last 12 months, 20.8% reported a higher frequency of between 11 to 20 flights in the last 12 months and 13.6% reported their frequency of travel more than 21 times in the last 12 months.

Table 19

Number of Flights in the Past 12 Months

Category	Frequency	Percent
None	1	0.5%
1 to 10	118	57.0%
11 to 20	43	20.8%
21 to 40	20	9.7%
>41	8	3.9%
Missing	17	8.2%
Total	207	100%

As presented in Table 20, just over 55% of the survey respondents indicated their type of travel in the last 12 months as being domestic, while close to 28.5% reported their type of travel as being international related.

Table 20

Type of Travel

Category	Frequency	Percent
Domestic	114	55.1%
Regional	17	8.2%
International	59	28.5%
Missing	17	8.2%
Total	207	100%

Furthermore, the respondents were asked to rank the four airlines that they used in the last 12 months based on the frequency of use. The results are presented in Table 21 and show that SAA was ranked as the most used airline, followed by Mango, Kulula, and BA.

Table 21

Most Frequently Used Airlines

Rank	Airline
1st	SAA
2nd	Mango
3rd	Kulula
4th	BA

In addition, Table 22 shows that the respondents reported that OR Tambo was the most frequented airport, followed by Cape Town, King Shaka, and Dubai International airport in the last 12 months.

Table 22

Most Frequently Used Airports

Rank	Airport
1st	OR Tambo
2nd	Cape Town
3rd	King Shaka
4th	Dubai

Additionally, the questionnaire included two sections to capture qualitative data. The majority of respondents reported that they preferred SSBDs, over self-service check-in and staffed bag drops, and counter check-in as indicated in Table 23.

Table 23

Passenger Check-in Preferences

Rank	Check-in Method
1st	Self-service bag drop
2nd	Staffed bag drop
3rd	Counter check-in

The survey responses indicated that 57% $(n = 118)$ of passengers had not used an SSBD. The results for the passengers that had not used an SSBD who reported the reasons for not using are reported in Table 24.

Table 24

Responses to Survey Question: "If you have not self-tagged and dropped your luggage at a self-service bag drop, please select one or more reasons."

Rank	n	Response
1st	90	I was not aware that I could self-tag and drop my bag at a self-service bag drop.
2nd	51	The airports that I use do not offer self-service tagging and bag drop.
3rd	49	The airlines that I use do not offer self-service tagging and bag drop.
4th	34	I prefer face to face interaction with airline service staff.
5th	19	I am not confident that I am able to do everything on my own.
6th	11	I do not see the benefit of self-tagging and self-service bag drop.

Note. $N = 207$, $n > 207$ because passengers were allowed to input more than one response.

In addition to the responses in Table 24, the survey allowed passengers to input a free text response. The free text input was completed by eight passengers and is presented in Table 25. The responses were grouped to form themes. A total of five themes emerged, with two of the themes being similar to the reasons that were presented in the survey (i.e., prefer interpersonal contact with an airline agent and do not see the benefit of

SSBDs). However, three passengers reported some form of technical challenge with the SSBD, and two passengers cited not having a home printer as the reason for not having used an SSBD.

Table 25

Free Text Responses to Survey Question: "If you have not self-tagged and dropped your luggage at a self-service bag drop, please select one or more reasons."

Themes		Response
1	Group check-in.	I usually travel with a large group.
2	No home printer.	No printer.
2	No home printer.	I don't have a home printer
3	Prefer interpersonal contact with an airline agent.	Just for peace of mind, they should have an assistant.
4	Technical difficulties.	Scanning the bar code of my passport is sometimes a problem.
4	Technical difficulties.	The machine rejected my ref.
4	Technical difficulties.	The queue at self-service is longer than counter check-in. I use airport terminal to check-in, and often it's not working so I go to counter anyway.
5	Do not see the benefit of SSBDs.	Fly business class, where staffed counters are freely available.

Note. $N = 207, n = 8$

4.5 Outer Model Analysis of the Conceptual Model

The conceptual TRAM PLS-SEM with R^2 values and path coefficients is illustrated in Figure 14.

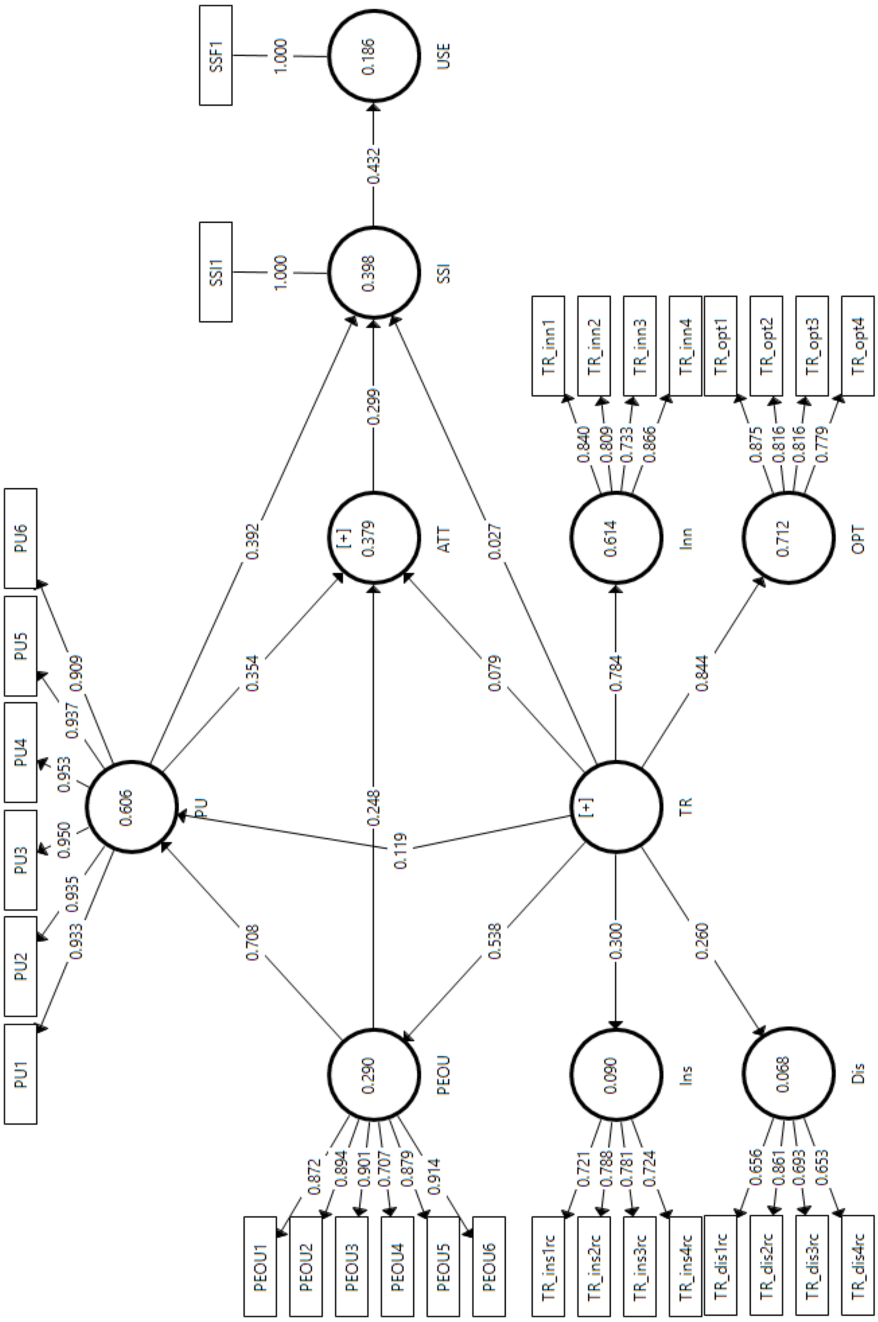


Figure 14. Conceptual TRAM PLS-SEM with R^2 values and path coefficients.

The outer model was first assessed for reliability by evaluating Cronbach's alpha and composite reliability scores. As summarised in Table 26, Cronbach's alpha for all the latent variables exceeded the adopted lower bound limit of 0.6 used by other researchers such as Siriram and Snaddon (2005). Furthermore, all latent variables exceeded the minimum lower bound of 0.7 composite reliability as prescribed by Hair et al. (2017).

Table 26

Cronbach's Alpha, Composite Reliability, and AVE Scores

Construct	Cronbach's Alpha	Composite Reliability	AVE
Discomfort	0.70	0.81	0.52
Innovativeness	0.83	0.89	0.66
Insecurity	0.75	0.84	0.57
Optimism	0.84	0.89	0.68
Technology readiness	0.78	0.80	0.30
Perceived ease of use	0.93	0.95	0.75
Perceived usefulness	0.97	0.98	0.88
Attitude	0.93	0.95	0.83
Behavioural intention	1.00	1.00	1.00
Adoption	1.00	1.00	1.00

Convergent validity of the PLS outer model was assessed by evaluating the Average Variance Extracted (AVE) and the factor loadings for each of the constructs and measured subscales, respectively. The convergent validity of TR, as measured by AVE was calculated to be 0.30, which is significantly less than 0.50, which Hair et al. (2017) recommend as the minimum acceptable value. Therefore, the convergent validity of the outer model was not confirmed.

Based on the findings of Blankestijn (2017) as noted in the research methods section 3.3.2, it was decided to investigate the discomfort and insecurity dimensions of the conceptual model before proceeding with the analysis. The R^2 values for discomfort and insecurity were 0.068 and 0.090, respectively, and were, therefore, considered extremely weak (Chin, 1998).

Based on these findings, the next section presents a review of the TR construct and the modified structural equation model.

4.6 Modified Structural Equation Model

Using the approach adopted in this study (Section 3.3.2) for the subscales of the TR dimensions, the four TR dimensions of the TR construct were analysed to determine if they were tapping into the same causal factor (Chin, 2010; Hair et al., 2017). This was achieved using the simple test recommended by Chin (2010, p. 664): “if the underlying construct was to change in magnitude, would all its items change as well?” The results of this test are presented in Table 27.

The question asked is: If TR increases or decreases, would the TR dimensions (i.e., optimism, innovation, discomfort, and insecurity) change as well?

Table 27

Technology Readiness Dimensions

Dimension	Increase	Decrease
Optimism	Yes	Yes
Innovativeness	Yes	Yes
Discomfort	No	No
Insecurity	No	No

This confirmed that the TR dimensions are not reflective constructs. The next test was to establish if the dimensions were represented by another higher-order construct, i.e., TR drivers and TR inhibitors. The questions asked were:

i. If TR drivers increase or decrease, would the TR dimensions (i.e., optimism and innovation) change as well?

ii. If TR inhibitors increase or decrease, would the TR dimensions (i.e., discomfort and insecurity) change as well?

The results of these tests are presented in Table 28 and Table 29.

Table 28

Technology Readiness Drivers

Dimension	Increase	Decrease
Optimism	Yes	Yes
Innovativeness	Yes	Yes

Table 29

Technology Readiness Inhibitors

Dimension	Increase	Decrease
Discomfort	Yes	Yes
Insecurity	Yes	Yes

This confirmed that the TR dimensions are reflective constructs of the TR drivers and TR inhibitors.

The test was repeated with the question if TR increases or decreases, would the TR inhibitors and TR drivers change as well? The results are presented in Table 30.

Table 30

Technology Readiness Inhibitors and Drivers

Dimension	Increase	Decrease
TR Drivers	Yes	Yes
TR Inhibitors	No	No

Therefore, TR drivers and TR inhibitors are formative constructs of TR. Accordingly, the model was reviewed and remodelled with TR as a reflective-reflective-formative third-order hierarchical construct, as illustrated in Figure 15. The revised model resolved the problem with the low AVE for TR (see Table 31) and the low R^2 values for the TR inhibitors, discomfort and insecurity (see Figure 16). The remainder of the results is presented for the final model.

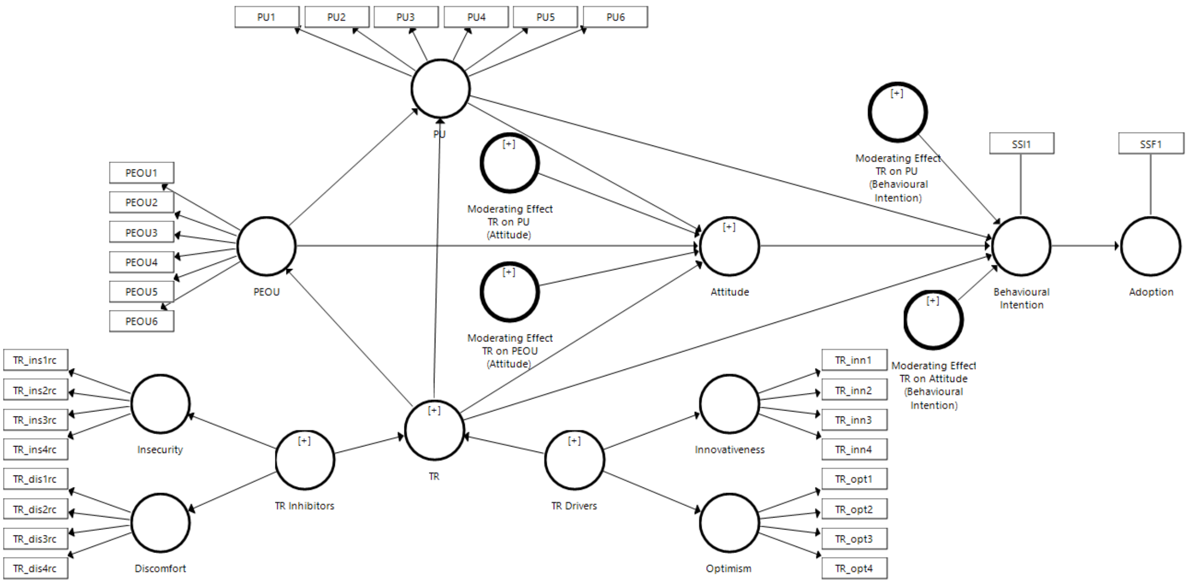


Figure 15. Modified TRAM Structural Equation Model.

4.7 Outer Model Analysis of the Modified Model

The process as prescribed by Chin (2010) and Hair et al. (2017) to evaluate the structural equation model presented in the methodology (Chapter 3, section 3.3.8) was followed.

The outer model was first assessed for reliability by evaluating Cronbach's alpha and composite reliability scores. As summarised in Table 31, Cronbach's alpha for all the latent variables exceeded the adopted lower bound limit of 0.6 used by other researchers such as Siriram and Snaddon (2005). Furthermore, all latent variables exceeded the minimum lower bound of 0.7 composite reliability as prescribed by Hair et al. (2017).

Table 31

Cronbach's Alpha, Composite Reliability, and AVE Scores

Construct	Cronbach's Alpha	Composite Reliability	AVE
Discomfort	0.70	0.82	0.53
Innovativeness	0.83	0.89	0.66
Insecurity	0.75	0.84	0.57
Optimism	0.84	0.89	0.68
TR drivers	0.84	0.88	0.62
TR inhibitors	0.80	0.85	0.60
Technology readiness	0.78	0.78	0.50
Perceived ease of use	0.93	0.95	0.75
Perceived usefulness	0.97	0.98	0.88
Attitude	0.93	0.95	0.83
Behavioural intention	1.00	1.00	1.00
Adoption	1.00	1.00	1.00

Convergent validity of the PLS outer model was assessed by evaluating the AVE and the factor loadings for each of the constructs and measured subscales, respectively. The factor loadings for the subscales are summarised in Table 32. The measured subscales factor loadings were all above the prescribed threshold (≥ 0.7) proposed by Chin (2010). Furthermore, all AVE scores were reported ≥ 0.5 as per the minimum threshold proposed by Hair et al. (2017). Therefore, the convergent validity of the outer model was confirmed.

Table 32

Factor Loadings

Factor	Original Sample (*O*)	*t* values	*p* values
TR_dis1rc <- Discomfort	0.7	11.99	0.00
TR_dis2rc <- Discomfort	0.8	18.67	0.00
TR_dis3rc <- Discomfort	0.7	16.39	0.00
TR_dis4rc <- Discomfort	0.7	11.48	0.00
TR_ins1rc <- Insecurity	0.8	21.22	0.00
TR_ins2rc <- Insecurity	0.8	22.81	0.00
TR_ins3rc <- Insecurity	0.8	20.71	0.00
TR_ins4rc <- Insecurity	0.7	10.32	0.00
TR_inn1 <- Innovativeness	0.8	29.79	0.00
TR_inn2 <- Innovativeness	0.8	24.70	0.00
TR_inn3 <- Innovativeness	0.7	17.41	0.00
TR_inn4 <- Innovativeness	0.9	43.55	0.00
TR_opt1 <- Optimism	0.9	41.71	0.00
TR_opt2 <- Optimism	0.8	20.03	0.00

Factor	Original Sample (*O*)	*t* values	*p* values
TR_opt3 <- Optimism	0.8	19.88	0.00
TR_opt4 <- Optimism	0.8	14.86	0.00
PEOU1 <- PEOU	0.9	34.27	0.00
PEOU2 <- PEOU	0.9	47.41	0.00
PEOU3 <- PEOU	0.9	45.20	0.00
PEOU4 <- PEOU	0.7	10.63	0.00
PEOU5 <- PEOU	0.9	29.96	0.00
PEOU6 <- PEOU	0.9	60.20	0.00
PU1 <- PU	0.9	65.28	0.00
PU2 <- PU	0.9	62.32	0.00
PU3 <- PU	1.0	78.87	0.00
PU4 <- PU	1.0	113.56	0.00
PU5 <- PU	0.9	62.65	0.00
PU6 <- PU	0.9	45.70	0.00
ATSS1 <- Attitude	0.9	45.66	0.00
ATSS4 <- Attitude	0.9	34.86	0.00
ATSS7 <- Attitude	0.9	60.71	0.00
ATSS10 <- Attitude	0.9	59.53	0.00
SSI1 <- Behavioural Intention	1.00		
SSF1 <- Adoption	1.00		

The discriminant validity of the outer model was assessed by evaluating the Heterotrait-Monotrait (*HTMT*) criterion matrix for all the measured variables. As summarised in Table 33, no inter-item correlations exceeded 0.9 (Henseler et al., 2015; Henseler et al., 2016). It was therefore confirmed that no discriminant validity issues existed with the outer model.

Table 33

Heterotrait-Monotrait (HTMT) Criterion Matrix

	Adoption	Attitude	Behavioural Intention	Discomfort	Innovativeness	Insecurity	Optimism	PEOU	PU
Adoption									
Attitude	0.670								
Behavioural Intention	0.432	0.556							
Discomfort	0.035	0.094	0.063						
Innovativeness	0.293	0.297	0.294	0.159					
Insecurity	0.058	0.088	0.186	0.731	0.104				
Optimism	0.207	0.439	0.314	0.141	0.513	0.118			
PEOU	0.459	0.599	0.565	0.114	0.512	0.121	0.515		
PU	0.437	0.613	0.588	0.132	0.399	0.120	0.513	0.807	

4.8 Inner Model Analysis of the Modified Model

Variance Inflation Factor (VIF) was evaluated to establish if the inner model had any collinearity issues. As summarised in Table 34, the VIF scores ranged from 1.2 – 8.6, well below the upper bound limit of 10 (Hair et al., 2017). It was therefore confirmed that no collinearity issues were present in the inner model.

Table 34

VIF Scores

Measured Subscale	VIF
PEOU1	3.022
PEOU2	3.914
PEOU3	4.237
PEOU4	1.748
PEOU5	3.523
PEOU6	4.354
PU1	5.933
PU2	6.082
PU3	8.257
PU4	8.562
PU5	6.256
PU6	4.267
SSF1	1.229
SSI1	1.229
TR_dis1rc	1.337
TR_dis1rc	1.504
TR_dis2rc	1.430

Measured Subscale	VIF
TR_dis2rc	1.684
TR_dis3rc	1.321
TR_dis3rc	1.445
TR_dis4rc	1.222
TR_dis4rc	1.485
TR_inn1	2.016
TR_inn1	2.319
TR_inn2	1.847
TR_inn2	1.997
TR_inn3	1.461
TR_inn3	1.566
TR_inn4	2.080
TR_inn4	2.299
TR_ins1rc	1.404
TR_ins1rc	1.721
TR_ins2rc	1.641
TR_ins2rc	1.936
TR_ins3rc	1.671
TR_ins3rc	1.762
TR_ins4rc	1.246
TR_ins4rc	1.474
TR_opt1	2.326
TR_opt1	2.425
TR_opt2	1.871
TR_opt2	2.187
TR_opt3	1.860
TR_opt3	2.010
TR_opt4	1.581
TR_opt4	1.761

4.9 Construct descriptive analysis

After evaluating for reliability and validity of the research model, descriptive statistics for the higher-order constructs were analysed and are presented in Table 35. The histograms for the TR dimensions, optimism (OPT), innovation (INN), discomfort (DIS), insecurity (INS), TR, PU, PEOU, and behavioural intention (BI) are included in Appendix D.

Table 35

Construct Descriptive Statistics

Construct	M	SD	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	SE	Statistic	SE
Optimism	5.46	1.06	-0.87	0.17	1.96	0.34
Innovation	4.58	1.19	-0.34	0.17	0.32	0.34
Discomfort	4.32	1.06	-0.18	0.17	0.55	0.34
Insecurity	3.63	1.21	0.03	0.17	-0.25	0.34
TR Drivers	5.02	0.95	-0.44	0.17	1.03	0.34
TR Inhibitors	3.97	0.99	-0.19	0.17	0.32	0.34
TR	4.50	0.70	0.10	0.17	0.49	0.34
PU	5.27	1.20	-0.55	0.17	0.85	0.34
PEOU	5.24	1.06	-0.02	0.17	0.35	0.34
Attitude	4.74	1.03	0.41	0.17	0.74	0.34
BI	5.26	1.711	-1.10	0.17	0.33	0.34
Adoption	3.81	1.20	0.38	0.17	0.64	0.34

Note: N = 207.

4.9.1 Technology Readiness (TR).

The Technology Readiness Index (TRI) was developed by Parasuraman in collaboration with Rockbridge Associates, Inc. (a U.S. based company specialising in service and technology research) to measure people's general beliefs about technology (Parasuraman, 2000). The TRI (i.e., overall mean TR) was 4.5, which is to the right of the midpoint of the 7-point Likert scale used to measure TR. Table 36 presents Parasuraman's (2000) classification of TR using a 5-point Likert scale and the interpolated 7-point Likert equivalents that are calculated by dividing Parasuraman's (2000) classification by five and then multiplying it by seven.

Table 36

Technology Readiness Classification

	Low TR		Medium TR		High TR
5-point Likert	2.3	2.6	2.9	3.2	3.5
	0.45	0.52	0.58	0.64	0.70
7-point Likert	3.2	3.6	4.0	4.5	4.9

Reading from Table 36, it can be seen that the respondents had a medium to high TR. Moreover, the skewness value of 0.10 implies that the distribution of the TRI scores is almost symmetric about the mean. The kurtosis (0.49) indicates a moderately sharper than a normal distribution. The fact that the skewness and kurtosis are less than ±1 suggests that the distribution does not deviate markedly from a standard normal distribution (Hair et al., 2017).

The TR responses (i.e., optimism, innovation, discomfort, insecurity, TR drivers, TR inhibitors) were further evaluated as part of the post-hoc analysis, whereby a $K - means$ was used to create clusters that represent the TR segmentation of the sample that was analysed. The results are presented in Section 4.12.2.

4.9.2 Perceived Ease of Use (PEOU).

The mean PEOU was 5.24, which is to the right of the midpoint of the 7-point Likert scale. The skewness value of -0.02 implies that the distribution of PEOU is almost perfectly symmetric about the mean, and the kurtosis (0.35) implies a moderately sharper than a normal distribution. The fact that the skewness and kurtosis are less than ±1 suggests that the distribution does not deviate markedly from a standard normal distribution (Hair et al., 2017).

This result represents the degree to which a passenger believes that using an SSBD would be free of physical and mental effort is 75%.

4.9.3 Perceived Usefulness (PU).

The mean PU was 5.27, which is to the right of the midpoint of the 7-point Likert scale. The skewness value of -0.55 implies that the distribution of

PU is moderately skewed to the left of the mean, and the kurtosis (0.85) implies it is moderately sharper than a normal distribution. The fact that the skewness and kurtosis are less than ±1 suggests that the distribution does not deviate markedly from a standard normal distribution (Hair et al., 2017).

This result represents the degree to which a passenger believes that using an SSBD would enhance his or her check-in process is 75%.

4.9.4 Attitude

These results represent the degree to which a passengers' exhibit a psychological tendency that was expressed by some degree of favour or disfavour on a semantic differential scale from -3 to 3. For the descriptive analysis, this was converted to a seven-point scale.

The mean attitude was 4.73, which is to the right of the midpoint of the 7-point scale (i.e., 0.73 on the semantic differential scale). The skewness value of 0.47 implies that the distribution of attitude is approximately symmetric, and the kurtosis (0.83) implies it is moderately sharper than a normal distribution. The fact that the skewness and kurtosis are less than ±1 suggests that the distribution does not deviate markedly from a standard normal distribution (Hair et al., 2017).

This result represents that the attitudes towards SSBDs were neutral to positive.

4.9.5 Behavioural Intention.

These results represent the measure that refers to passengers' subjective probability that he or she will perform a specific behaviour.

The mean behavioural intention was 5.26, which is to the right of the midpoint of the 7-point Likert scale. The skewness value of -0.53 implies that the distribution of behavioural intention is approximately symmetric, and the kurtosis (1.06) implies it is sharper than a normal distribution. The fact that the kurtosis is more than one suggests that the distribution deviates from a standard normal distribution (Hair et al., 2017).

The results indicate that passengers are more than slightly likely to continue (or start) using SSBDs.

4.9.6 SSBD Adoption.

These results represent the measure that refers to passengers' usage of SSBDs. This construct was measured as the frequency of usage.

The mean adoption was 3.81, which is to the left of the midpoint of the 7-point Likert scale. The skewness value of 0.38 implies that the distribution of attitude is approximately symmetric, and the kurtosis (0.64) implies it is moderately sharper than a normal distribution. The fact that the skewness and kurtosis are less than ±1 suggests that the distribution does not deviate markedly from a standard normal distribution (Hair et al., 2017).

The results indicate that passengers checking in baggage use SSBDs 30 to 50% of the time. The results highlight that the relatively high behavioural intention $(M = 5.26)$ has not translated into higher adoption $(M = 3.81)$.

This finding is similar to the results obtained by research studies that illustrated that despite passengers desire to have SSBD technologies (IATA, 2018b), the adoption of SSBDs is not demonstrating similar adoption rates (SITA, 2019). The discrepancy could indicate that other external factors result in the lower adoption, or contrary to TAM, behavioural intention does not translate into the behavioural response, adoption. This will be further evaluated with the hypothesis testing.

4.10 Hypothesis testing

The results of the bootstrap test for the coefficient of determination (R^2) is summarised in Table 37 and indicates that R^2 for all the endogenous constructs are significant $(p \leq 0.05)$. The bootstrap test for R^2 indicated that the predictive power of the hypothesised model was significant at the 95% level. All the R^2 values of the endogenous constructs in the model were greater than 0.1, as recommended by Hair et al. (2017).

Table 37

Significance of $\boldsymbol{R^2}$ Bootstrap Test Results

	Original Sample (O)	T Statistics (|O/STDEV|)	P Values
Adoption	0.186	4.052	0.000
Attitude	0.385	6.815	0.000
Behavioural Intention	0.405	8.146	0.000
Discomfort	0.743	16.967	0.000
Innovativeness	0.701	14.081	0.000
Insecurity	0.787	24.975	0.000
Optimism	0.731	20.816	0.000
PEOU	0.295	4.353	0.000
PU	0.606	10.364	0.000
TR	0.999	458.403	0.000

The structural equation model is shown in Figure 16, and Table 38 presents a summary of the research hypothesis.

4.10.1 Structural Equation Model.

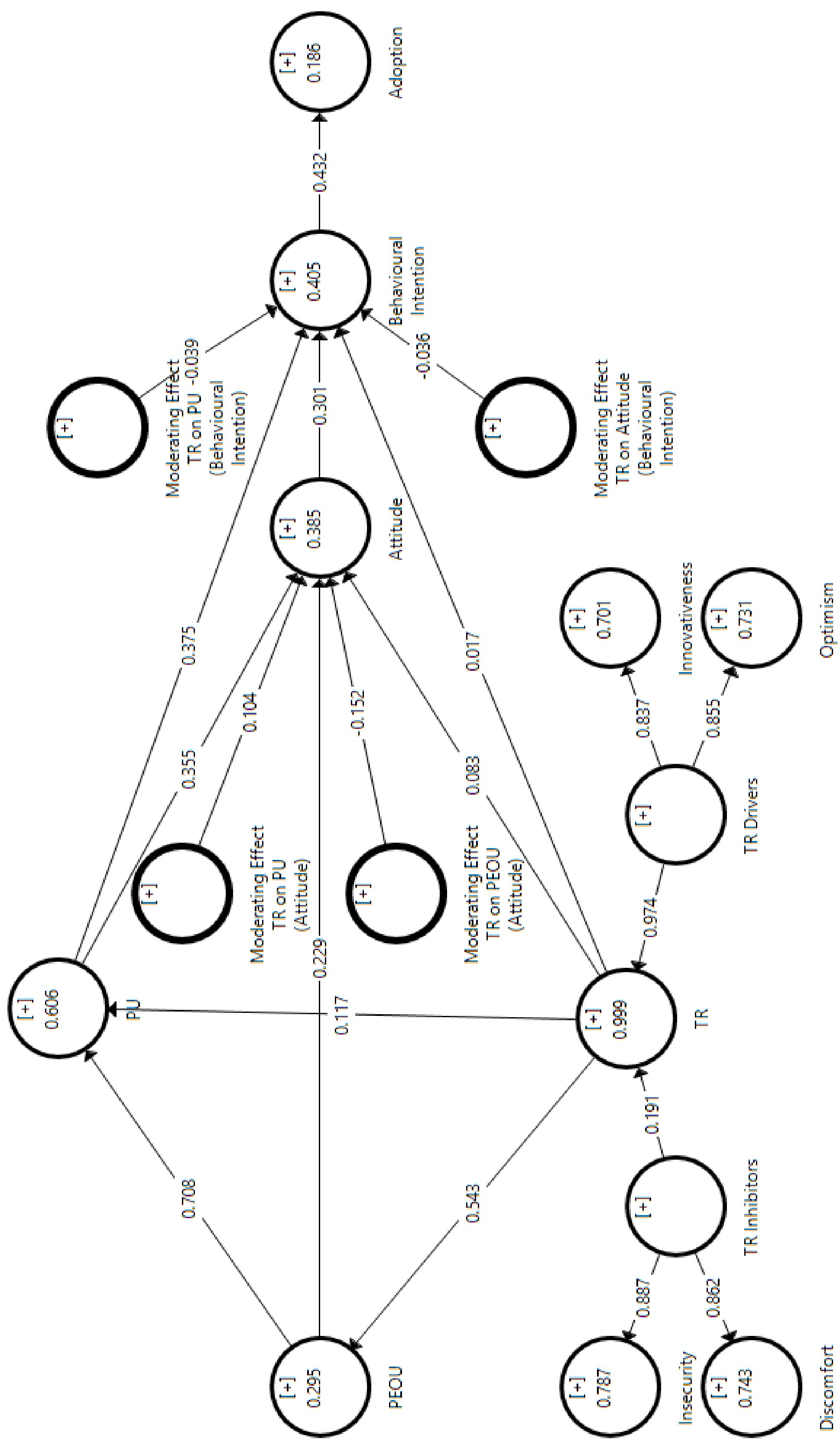


Figure 16. TRAM PLS-SEM with R^2 values and path coefficients.

4.10.2 Hypotheses.

Table 38

Summary of Hypotheses

Hypothesis	Supported	Total Effect	*t*	*p*
H1	Supported	0.543	8.674	<0.05
H2	Supported	0.502	8.674	<0.05
H3	Supported	0.386	5.612	<0.05
H4	Supported	0.322	4.075	<0.05
H5	Supported	0.481	6.662	<0.05
H6	Supported	0.708	12.191	<0.05
H7	Supported	0.355	4.034	<0.05
H8	Supported	0.482	5.770	<0.05
H9	Supported	0.301	4.464	<0.05
H10a	Not supported	0.104	0.670	>0.05
H10b	Not supported	-0.152	0.664	>0.05
H11a	Not supported	0.031	0.689	>0.05
H11b	Not supported	-0.046	0.700	>0.05
H12	Supported	0.432	8.002	<0.05

Note. $p < 0.05$ supported.

4.10.2.1 Proposition 1 – TR and PEOU.

Proposition one in this research sought to establish if TR has a positive and significant relationship with PEOU. This was represented through the following hypotheses:

$H_0 1$: TR is positively related to PEOU

H_a1: TR is not positively related to PEOU

The results of the PLS-SEM model reported a positive and significant total effect of 0.543 (t=8.674, *p*<0.05). The alternative hypothesis was, therefore, rejected as there was a significant relationship between TR and PEOU at the 95% significance level. This infers that in the presence of TR, PEOU increases. Furthermore, PEOU reported a coefficient of determination (R^2) of 0.295 was classified as weak-moderate.

4.10.2.2 Proposition 2 – TR and PU.

Proposition two in this research sought to establish if TR has a positive and significant relationship with PU. This was represented through the following hypotheses:

H_02: TR is positively related to PU

H_a2: TR is not positively related to PU

The results of the PLS-SEM model reported a positive and significant total effect of 0.502 (*t*=8.674, *p*<0.05). The alternative hypothesis was, therefore, rejected as there was a significant relationship between TR and PU at the 95% significance level. This infers that in the presence of TR, PU increases. Furthermore, PU reported a coefficient of determination (R^2) of 0.606 was classified as strong.

4.10.2.3 Proposition 3 – TR and Attitude.

Proposition three in this research sought to establish if TR has a positive and significant relationship with attitude towards SSBDs. This was represented through the following hypotheses:

$H_0$3: TR is positively related to attitude towards SSBDs.

H_a3: TR is not positively related to attitude towards SSBDs.

The results of the PLS-SEM model reported a positive and significant total effect of 0.386 (t=5.612, p<0.05). The alternative hypothesis was, therefore, rejected as there was a significant relationship between TR and attitude towards SSBDs at the 95% significance level. This infers that in the presence of TR, attitude towards SSBDs increases. Furthermore, attitude reported a coefficient of determination (R^2) of 0.385 was classified as weak-moderate.

4.10.2.4 Proposition 4 – TR and Behavioural Intentions.

Proposition four in this research sought to establish if TR has a positive and significant relationship with behavioural intentions towards SSBDs. This was represented through the following hypotheses:

$H_0$4: TR is positively related to behavioural intentions towards SSBDs.

H_a4: TR is not positively related to behavioural intentions towards SSBDs.

The results of the PLS-SEM model reported a positive and significant total effect of 0.322 (t=4.075, $p<0.05$). The alternative hypothesis was, therefore, rejected as there was a significant relationship between TR and behavioural intentions towards SSBDs at the 95% significance level. This infers that in the presence of TR, behavioural intentions towards SSBDs increases. Furthermore, behavioural intentions reported a coefficient of determination (R^2) of 0.405 was classified as moderate-weak.

4.10.2.5 Proposition 5 – PEOU and Attitude.

Proposition five in this research sought to establish if PEOU has a positive and significant relationship with attitude towards SSBDs. This was represented through the following hypotheses:

$H_0$5: PEOU is positively related to attitude towards SSBDs.

H_a5: PEOU is not positively related to attitude towards SSBDs.

The results of the PLS-SEM model reported a positive and significant total effect of 0.481 (t=6.662, $p<0.05$). The alternative hypothesis was, therefore, rejected as there was a significant relationship between PEOU and attitude towards SSBDs at the 95% significance level. This infers that in the presence of PEOU, attitude towards SSBDs increases.

4.10.2.6 Proposition 6 – PEOU and PU.

Proposition six in this research sought to establish if PEOU has a positive and significant relationship with PU. This was represented through the following hypotheses:

$H_0 6$: PEOU is positively related to PU.

$H_a 6$: PEOU is not positively related to PU.

The results of the PLS-SEM model reported a positive and significant total effect of 0.708 (t=12.191, $p<0.05$). The alternative hypothesis was, therefore, rejected as there was a significant relationship between PEOU and PU at the 95% significance level. This infers that in the presence of PEOU, PU increases.

4.10.2.7 Proposition 7 – PU and Attitude.

Proposition seven in this research sought to establish if PU has a positive and significant relationship with attitude towards SSBDs. This was represented through the following hypotheses:

$H_0 7$: PU is positively related to attitude towards SSBDs.

$H_a 7$: PU is not positively related to attitude towards SSBDs.

The results of the PLS-SEM model reported a positive and significant total effect of 0.355 (t=4.034, $p<0.05$). The alternative hypothesis was, therefore, rejected as there was a significant relationship between PU and attitude towards SSBDs at the 95% significance level. This infers that in the presence of PU, attitude towards SSBDs increases.

4.10.2.8 Proposition 8 – PU and Behavioural Intentions.

Proposition eight in this research sought to establish if PU has a positive and significant relationship with behavioural intentions towards SSBDs. This was represented through the following hypotheses:

$H_0$8: PU is positively related to behavioural intentions towards SSBDs.

H_a8: PU is not positively related to behavioural intentions towards SSBDs.

The results of the PLS-SEM model reported a positive and significant total effect of 0.482 (t=5.770, p<0.05). The alternative hypothesis was, therefore, rejected as there was a significant relationship between PU and behavioural intentions towards SSBDs at the 95% significance level. This infers that in the presence of PU, behavioural intentions towards SSBDs increases.

4.10.2.9 Proposition 9 – Attitude and Behavioural Intentions.

Proposition nine in this research sought to establish if Attitude towards SSBDs has a positive and significant relationship with behavioural intentions towards SSBDs. This was represented through the following hypotheses:

$H_0$9: Attitude towards SSBDs is positively related to behavioural intentions towards SSBDs.

H_a9: Attitude towards SSBDs is not positively related to behavioural intentions towards SSBDs.

The results of the PLS-SEM model reported a positive and significant total effect of 0.301 (t=4.464, $p<0.05$). The alternative hypothesis was, therefore, rejected as there was a significant relationship between Attitude towards SSBDs and behavioural intentions towards SSBDs at the 95% significance level. This infers that in the presence of Attitude towards SSBDs, behavioural intentions towards SSBDs increases.

4.10.2.10 Proposition 10 – Moderating Effects of TR on PU/PEOU and Attitude.

Proposition ten in this research sought to establish if TR acts as a moderating variable in the relationships between PU → attitude and PEOU → attitude. This was represented through the following hypotheses:

$H_0$10a: Higher TR attenuates the relationship between PU and attitude.

H_a10a: Higher TR does not attenuate the relationship between PU and attitude.

$H_0$10b: Higher TR attenuates the relationship between PEOU and attitude.

H_a10b: Higher TR does not attenuate the relationship between PEOU and attitude.

Moderation can be tested as the relationships between each of the independent variables, dependent variables, and moderating variables through research propositions one through nine, as described in the previous chapter was validated.

The results of the PLS-SEM model reported a positive but not significant moderating effect of 0.104 (t=0.670, $p>0.05$) of TR between PU → attitude. The alternative hypothesis was, therefore, accepted as there was no significant moderating effect of TR on the relationship between PU and Attitude towards SSBDs at the 95% significance level.

Similarly, the PLS-SEM model reported a negative but not significant moderating effect of -0.152 (t=0.664, $p>0.05$) of TR between PEOU → attitude. The alternative hypothesis was, therefore, accepted as there was no significant moderating effect of TR on the relationship between PEOU and Attitude towards SSBDs at the 95% significance level.

4.10.2.11 Proposition 11 – Moderating Effects of TR on PU/Attitudes and Behavioural Intention.

Proposition eleven in this research sought to establish if TR acts as a moderating variable in the relationships between PU → behavioural intention and PEOU → behavioural intention. This was represented through the following hypotheses:

$H_0$11a: Higher TR attenuates the relationship between PU and behavioural intention.

H_a11a: Higher TR does not attenuate the relationship between PU and behavioural intention.

$H_0$11b: Higher TR attenuates the relationship between attitude and behavioural intention.

H_a11b: Higher TR does not attenuate the relationship between attitude and behavioural intention.

Moderation can be tested as the relationships between each of the independent variables, dependent variables, and moderating variables through research propositions one through nine, as described in the previous chapter was validated.

The results of the PLS-SEM model reported a positive but not significant moderating effect of 0.031 (t=0.689, $p>0.05$) of TR between PU → behavioural intention. The alternative hypothesis was, therefore, accepted as there was no significant moderating effect of TR on the relationship between PU and behavioural intention towards SSBDs at the 95% significance level.

Similarly, the PLS-SEM model reported a negative but not significant moderating effect of -0.046 (t=0.700, $p>0.05$) of TR between PEOU →

behavioural intention. The alternative hypothesis was, therefore, accepted as there was no significant moderating effect of TR on the relationship between PEOU and behavioural intention towards SSBDs at the 95% significance level.

4.10.2.12 Proposition 12 – Behavioural Intention and Adoption.

Proposition twelve in this research sought to establish if behavioural intention towards SSBDs has a positive and significant relationship with adoption. This was represented through the following hypotheses:

$H_0$12: Behavioural intention towards SSBDs is positively related to the actual usage of SSBDs.

H_a12: Behavioural intention towards SSBDs is not positively related to the actual usage of SSBDs.

The results of the PLS-SEM model reported a positive and significant total effect of 0.432 (t=8.002, p<0.05). The alternative hypothesis was, therefore, rejected as there was a significant relationship between behavioural intentions towards SSBDs and adoption at the 95% significance level. This infers that in the presence of behavioural intentions towards SSBDs, adoption increases. Furthermore, adoption reported a coefficient of determination (R^2) of 0.186 and was classified as weak.

4.11 Model Predictive Relevance

Stone-Geisser's Q^2 value (Table 39) evaluates the structural model's predictive relevance. The Q^2 values obtained ranged from 0.18 to 0.52, which indicates that the model's predictive relevance is medium to large (Hair et al., 2017).

Table 39

Stone-Geisser's Q^2 Blindfolding Test Results

	Q^2
Adoption	0.18
Attitude	0.30
Behavioural Intention	0.33
Discomfort	0.38
Innovativeness	0.45
Insecurity	0.44
Optimism	0.48
PEOU	0.22
PU	0.52
TR	0.23

Note. $Q^2 > 0$ is indicative that the model has predictive power, $0.02 < Q^2 < 0.15$ is regarded as small, $0.15 \leq Q^2 < 0.35$ is medium, and $Q^2 \geq 0.35$ is large (Hair et al., 2017).

4.12 Post-hoc Analysis

In addition to the core research propositions tested, the structural equation model was evaluated to test for the presence of possible mediation, and a TR segmentation analysis was performed to understand the study sample better.

4.12.1 Test of Mediating Effects.

The results of the five mediation effects that were tested are presented in Table 40.

Table 40

Mediating Effects

Mediation Path	Specific Indirect Effects	Total Effects	VAF	T Statistics	P Values
PEOU → PU → Attitude	0.25	0.48	0.52	3.90	0.000
TR → PEOU → Attitude	0.13	0.39	0.32	2.37	0.018
TR → PU → Attitude	0.04	0.39	0.11	1.96	0.051
TR → Attitude → Behavioural Intention	0.03	0.32	0.08	1.18	0.238
TR → PU → Behavioural Intention	0.04	0.32	0.14	2.00	0.046

Note. $p < 0.05$ is significant.

Based on the specific indirect effects, PU acts as a mediator between the relationship PEOU→Attitude $(b = 0.25, p \leq 0.05)$. PEOU acts as a mediator between the relationship TR→Attitude $(b = 0.13, p \leq 0.05)$, PU does not act as a mediator between the relationship's TR→Attitude $(b = 0.04, p > 0.05)$ but mediates the TR→ Behavioural Intention relationship $(b = 0.04, p \leq 0.05)$. At the same time, attitude is not a mediator between the relationship TR→ Behavioural Intention $(b = 0.04, p > 0.05)$.

Following the methodology proposed by Hair et al. (2014), the magnitude of the mediation was evaluated to assess the mediation effects variance accounted for (VAF). Whereby a $VAF < 0.20$ indicates no mediation, $0.20 < VAF \leq 0.80$ indicates partial mediation, and a $VAF > 0.80$ indicates full mediation. Hair et al. (2014) noted that the VAF would be less than 20% when the indirect effect is significant but minimal such that it can be said there is no mediation. Therefore, even though specific indirect effects reported significance at the 95% confidence level for PEOU → PU → Attitude, TR → PEOU → Attitude, and TR → PU → Behavioural Intention; only PEOU → PU → Attitude and TR → PEOU → Attitude displays a $VAF > 0.20$. Therefore, indicating that PU acts as a partial mediator between the relationship PEOU → Attitude and PEOU acts as a partial mediator between the relationship TR → Attitude.

4.12.2 TR Segmentation.

C. L. Colby of Rockbridge Associates, Inc. created aggregate scores for the four TR dimensions and used $K - means$ to create six segments of which one was a throw-away due to small sample size.

He was able to create a segmentation that resembles Rockbridge Associates, Inc.'s baseline study and fits the theory of how the market is segmented. Furthermore, the TRI for each of the segments were within 15% of the TRI obtained by Parasuraman and Colby (2015). The results are presented in Table 41.

The respondents comprised of approximately 30% hesitators, 28% explorers, 20% sceptics, 11% avoiders, and 10% pioneers.

Table 41

Final Cluster Centres and TR Segments

		Pioneers	Avoiders	Sceptics	Hesitators	Explorers
Optimism	2.3	6.4	4.4	5.6	5.1	6.2
Innovation	3.3	5.9	3.1	3.5	4.7	5.5
Discomfort	2.7	5.1	4.6	3.3	3.9	3.0
Insecurity	2.3	5.9	5.5	3.8	4.9	3.4
TR Drivers	2.8	6.1	3.8	4.5	4.9	5.8
TR Inhibitors	2.5	5.5	5.0	3.5	4.4	3.2
TRI	4.1	4.3	3.4	4.5	4.2	5.3
TR Drivers	Deleted	High	Low	Low	Moderate	High
TR Inhibitors	Deleted	High	High	Low	High	Low
TRI Overall	Deleted	#3	#5	#2	#4	#1
Size of Cluster	5	21	22	41	61	57

Note. N = 207.

5 DISCUSSION OF RESULTS

As discussed in the introduction (Chapter 1) and literature review (Chapter 2), the central research question and associated sub-questions capture the hypothesised relationship between TR, PEOU, PU, attitudes, behavioural intentions, and SSBD adoption. This chapter presents a discussion and interpretation of the results.

The central research question that was explored:

> How do airport passengers' overall technology readiness and perceptions towards SSBD technologies at South African airports influence the adoption thereof?

To answer the central research question, the following sub-questions were first explored:

i. What are airport passengers' TR, PEOU, PU, attitudes, and behavioural intentions towards SSBDs at South African airports?
ii. How is the relationship between airport passengers' level of TR, PEOU, PU, attitude, and behavioural intention related to the adoption of SSBDs at South African airports?

Next, an assessment of the research problem is presented. Lastly, an evaluation of the measurement (outer) and structural (inner) models are discussed.

5.1 Research Hypotheses

A structural equation model using the TRAM framework developed by Lin et al. (2007) and expanded Lin and Chang (2011) was developed to answer the second sub-question. This section presents the relationships between airport passengers' level of TR, PEOU, PU, attitude, behavioural intention, and adoption of SSBDs at South African airports.

To consider the factors driving the adoption of SSBDs. The model, illustrated in Figure 17 for ease of reference, consists of 10 linkages that were found to be statistically significant. The linkages are next discussed.

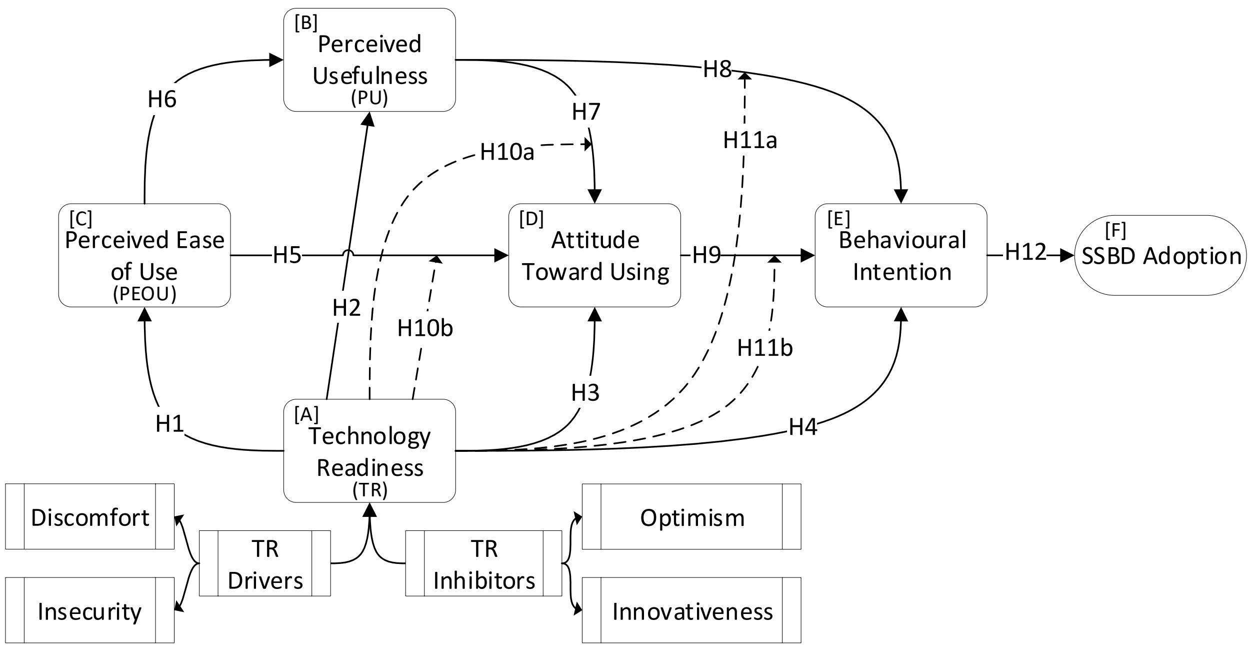


Figure 17. TRAM Model adapted from Lin and Chang (2011).

5.1.1.1 H1: TR and PEOU.

This linkage is statistically significant, indicating that TR has a positive effect on PEOU; this linkage confirms the initial hypothesis that TR is positively related to PEOU of SSBDs. This finding corroborates the stance taken by previous TRAM researchers who found that consumers with higher TR propensities were more likely to perceive an SST as easy to use (Lin et al., 2007; Lin & Chang, 2011; Smit et al., 2018). This finding confirms that passengers' evaluation of SSBDs is motivated by their TR such that their perception of ease of use toward SSBDs is more effective and efficient.

5.1.1.2 H2: TR and PU.

This linkage is statistically significant, indicating that TR has a positive effect on PU; this linkage confirms the initial hypothesis that TR is positively related to PU of SSBDs. This finding confirms the stance taken by previous TRAM researchers who found that consumers with higher TR propensities were more likely to perceive an SST as useful (Lin et al., 2007; Lin & Chang, 2011; Smit et al., 2018). This linkage confirms that passengers' evaluation of SSBDs is motivated by their TR such that their perception of usefulness toward SSBDs is more effective and efficient.

5.1.1.3 H3: TR and Attitude Toward SSBDs.

This linkage is statistically significant, indicating that TR has a positive effect on attitude; this linkage confirms the initial hypothesis that TR is positively related to attitude towards SSBDs. This finding is consistent with the findings of previous researches, which found that the TR is positively associated with attitudes toward using SSTs (Liljander et al., 2006; Lin & Chang, 2011; Parasuraman, 2000).

Research has further found that the TR drivers of optimism and innovativeness result in more positive attitudes towards SSTs (Dabholkar & Bagozzi, 2002; Lin & Chang, 2011; Parasuraman, 2000; Walczuch et al., 2007), while the TR inhibitors of discomfort and insecurity have the opposite effect (Liljander et al., 2006; Parasuraman, 2000). This finding confirms that TR enhances the positive attitude toward SSBDs. Additionally, the post-hoc analysis found that this linkage is not mediated by PU and partially mediated by PEOU. This linkage confirms that passengers' attitude towards SSBDs is influenced by their TR.

5.1.1.4 H4: TR and Behavioural Intention.

This linkage is statistically significant, indicating that TR has a positive effect on behavioural intention; this linkage confirms the initial hypothesis that TR is positively related to behavioural intention towards SSBDs. This finding supports the stance taken by Lin and Chang (2011) and Lin and Hsieh (2006) that TR is positively related to behavioural intention.

Furthermore, Yen (2005) found that consumers with low TR drivers are more likely to lack the incentive to use SSTs because they do not expect benefits.

Additionally, the post-hoc analysis found that this linkage is not mediated by PU or attitude. This linkage confirms that passengers' behavioural intention towards the adoption of SSBDs is influenced by their TR.

5.1.1.5 H5: PEOU and Attitude Toward Using

This linkage is statistically significant, indicating that PEOU has a positive effect on attitude towards using; this linkage confirms the initial hypothesis that PEOU is positively related to attitude towards SSBDs. This finding is in line with past technology acceptance model (TAM) research spanning more than 30 years that has been redolent that PEOU is an important determinant of attitude (Curran & Meuter, 2005; Davis, 1989; Davis et al., 1989; Kleijnen et al., 2004; Nysveen et al., 2005). Furthermore, other researchers have found that when PEOU increases, consumers' attitudes toward SSTs will be more positive (Kleijnen et al., 2004; Lin & Chang, 2011). Additionally, the post-hoc analysis found that this linkage is partially mediated by PU. This linkage confirms that passengers' PEOU of SSBDs in an important determinant of passengers' attitudes towards SSBDs.

5.1.1.6 H6: PEOU and PU.

This linkage is statistically significant, indicating that PEOU has a positive effect on PU; this linkage confirms the initial hypothesis that PEOU is positively related to PU. This finding confirms the findings of Dabholkar (1986) and Davis et al. (1989), where PEOU influenced PU because the easier technology is to use, the more useful it can be. This finding additionally accords with the TAM relationship initially hypothesised (and confirmed) by Davis (1986) and has been supported by several other researchers (e.g., Adams, Nelson, & Todd, 1992; Davis, Bagozzi, & Warshaw, 1989; Davis, 1989; Lin, C., Shih, & Sher, 2007; Lin, J. C. & Chang, 2011; Smit, Roberts-Lombard, & Mpinganjira, 2018; Venkatesh & Davis, 2000).

Additionally, Lin and Chang (2011) found that consumers who perceived SSTs easier to use also perceived them as more useful. This linkage confirms that passengers' PEOU of SSBDs in an important determinant of passengers' perceived usefulness of SSBDs.

5.1.1.7 H7: PU and Attitude Toward Using.

This linkage is statistically significant, indicating that PU has a positive effect on attitude towards using; this linkage confirms the initial hypothesis that PU is positively related to attitude towards SSBDs. This finding is in line with past technology acceptance model (TAM) research spanning more than 30 years has been redolent that PU is an important determinant of attitude (Curran & Meuter, 2005; Davis, 1989; Davis et al., 1989; Kleijnen et al., 2004; Nysveen et al., 2005). Furthermore, other researchers have found that when PU increases, consumers' attitudes toward SSTs will be more positive (Kleijnen et al., 2004; Lin & Chang, 2011). This linkage confirms that passengers' PU of SSBDs in an important determinant of their attitude towards SSBDs.

5.1.1.8 H8: PU and Behavioural Intention.

This linkage is statistically significant, indicating that PU has a positive effect on behavioural intention; this linkage confirms the initial hypothesis that PU is positively related to behavioural intention. The results are consistent with prior findings and show that PU increases behavioural intention (Lin et al., 2007; Lin & Chang, 2011; Nysveen et al., 2005). This linkage confirms that passengers' PU of SSBDs in an important determinant of their behavioural intention towards SSBD adoption.

5.1.1.9 H9: Attitude Toward Using and Behavioural Intention.

This linkage is statistically significant, indicating that attitude towards using has a positive effect on behavioural intention; this linkage confirms the initial hypothesis that attitude is positively related to behavioural intentions towards SSBDs. This linkage also supports the view of Fishbein and Ajzen (1975) that people tend to perform a behaviour in accordance with their attitude.

This linkage confirms that passengers' attitude is an important determinant of their behavioural intention towards SSBD adoption.

5.1.1.10 H10: Moderating Effects of TR on PU/PEOU and Attitude.

This moderating effects of TR on PU/PEOU and attitude were not statistically significant, indicating that TR did not attenuate the relationship between PU/PEOU and attitude; this confirms the alternative hypothesis that higher TR does not attenuate the relationship between PU/PEOU and attitude. This finding differs from the research findings of Lin and Chang (2011), who found that while TR did not attenuate the relationship between PU and attitude, it did attenuate the relationship between PEOU and attitude.

Lin and Chang (2011) reasoned that the reason that TR attenuated PEOU was that customers with higher TR are less concerned with an SST's PEOU as they are quite willing and eager to use SSTs. The results obtained in this study do not support this reasoning.

5.1.1.11 H11: Moderating Effects of TR on PU/Attitude and Behavioural Intention.

This moderating effects of TR on PU/attitude and behavioural intention were not statistically significant, indicating that TR did not attenuate the relationship between PU/attitude and behavioural intention; this confirms the alternative hypothesis that higher TR does not attenuate the relationship between PU/attitude and behavioural intention. This finding matches the research findings of Lin and Chang (2011), who found that TR did not attenuate the relationship between PU/attitude and behavioural intention. However, it is contrary to Kleijnen et al. (2004), who found that people with higher TR rely less on their attitudes when deciding to use SSTs.

5.1.1.12 H12: Behavioural Intention and SSBD Adoption.

This linkage is statistically significant, indicating that behavioural intention has a positive effect on adoption; this linkage confirms the initial hypothesis that behavioural intention is positively related to the actual usage of SSBDs. The results are consistent with Ajzen (2012), Davis et al. (1989), and Fishbein and Ajzen (1975) and confirms that behavioural intention plays a prominent role in a person’s attitudes and perceptions and, subsequently their intention to perform that behaviour. Additionally, behavioural intention is a superior predictor of actual use than attitude when an intention has been formed (Warshaw & Davis, 1985).

However, the results also illustrated that behavioural intention only accounts for 18.6% of the variance in adoption; therefore, 81.4% of the variance in adoption is explained by other external factors. Turner, Kitchenham, Brereton, Charters, and Budgen (2010) highlight that behavioural intention is more frequently measured than actual usage and that it is possible that different results could be obtained "if the users being questioned have (a) used the technology being tested previously and (b) a choice in whether to use the technology" (p. 464). This is of particular importance in the context of this study as SSBDs have not been installed at the three primary international airports in South Africa, which could explain the low coefficient of determination ($R^2 = 0.186$).

This linkage confirms that while passengers' behavioural intention in a determinant of their actual usage and SSBD adoption, its affect was weak.

5.2 Post-hoc Analysis

In addition to the core research propositions tested, the structural equation model was evaluated to test for the presence of possible mediation, and a TR segmentation analysis was performed to understand the study sample better.

5.2.1 Mediating Effects.

The post-hoc analysis considered five possible mediating effects based on the model illustrated in Figure 17. The mediating effects are discussed next.

5.2.1.1 Does PU mediate the relationship between PEOU and attitude?

Based on the specific indirect effects, PU acts as a partial mediator between the relationship PEOU→Attitude. This finding is in line with the findings of Davis et al. (1989), who found that PU partially mediates the relationship between PEOU and attitude. Davis et al. (1989) additionally found that the effect of PEOU on attitude reduced as consumers became more familiar with the system being evaluated. This finding reinforces the view that PU mediates the relationship between PEOU and attitude and that PEOU’s affect via PU may be more significant than its direct affect.

5.2.1.2 Does PEOU mediate the relationship between TR and attitude?

Based on the specific indirect effects, PEOU acts as a partial mediator between the relationship TR→Attitude. This finding is in line with the findings of Lin et al. (2007), who found that PEOU partially mediates TR. This also reaffirms that TR plays a significant role in TRAM as it relates to attitude.

5.2.1.3 Does PU mediate the relationship between TR and attitude?

Based on the specific indirect effects, PU does not mediate the relationship between TR→Attitude. This finding is not in line with the findings of Lin et al. (2007), who found that PU partially mediates TR. It does, however, support the findings of Lin et al. (2007) as it reaffirms that TR plays a significant role in TRAM as it relates to attitude.

5.2.1.4 Does attitude mediate the relationship between TR and behavioural intention?

Based on the specific indirect effects, attitude does not mediate the relationship between TR→Behavioural Intention. This finding reaffirms that TR plays a significant role in TRAM as it relates to behavioural intention.

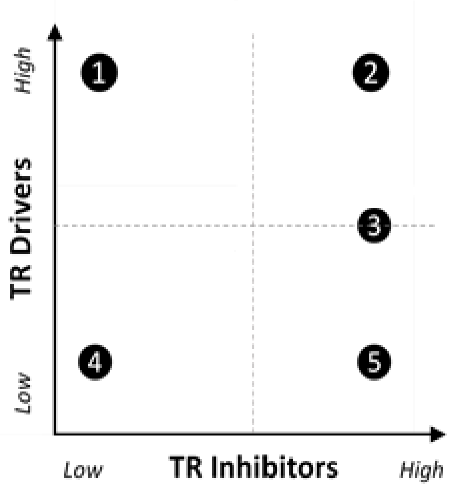
5.2.1.5 Does PU mediate the relationship between TR and behavioural intention?

Based on the specific indirect effects, PU does not mediate the relationship between TR→Behavioural Intention. This finding is not in line with the findings of Lin et al. (2007), who found that PU partially mediates TR. It does, however, support the findings of Lin et al. (2007) as it reaffirms that TR plays a significant role in TRAM as it relates to behavioural intention.

5.2.2 Technology Readiness (TR) Segmentation Analysis.

The Technology Readiness Index (TRI) was developed by Parasuraman in collaboration with Rockbridge Associates, Inc. (a U.S. based company specialising in service and technology research) to measure people's general beliefs about technology (Parasuraman, 2000).

The TR responses were further evaluated as part of the post-hoc analysis conducted by C. Colby of Rockbridge Associates, Inc., whereby a $K - means$ was used to create clusters that represent the TR segmentation of the sample that was analysed. The clusters are plotted in Figure 18.



Legend		TR Drivers	TR Inhibitors
1	Explorers	High	Low
2	Pioneers	High	High
3	Hesitators	High	Moderate
4	Sceptics	Low	Low
5	Avoiders	Low	High

Figure 18. TR Segmentation

1. Explorers (28% of passengers) have high levels of motivation and low levels of resistance (Parasuraman & Colby, 2015).
2. Pioneers (10% of passengers) hold both strong positive and negative views about technology (Parasuraman & Colby, 2015).
3. Hesitators (30% of passengers) stand out due to their low level of discomfort (Parasuraman & Colby, 2015).

4. Sceptics (20% of passengers) have a disconnected view of technology, with low levels of motivation and resistance (Parasuraman & Colby, 2015).
5. Avoiders (11% of passengers) have high levels of resistance and low levels of motivation (Parasuraman & Colby, 2015).

5.3 Central Research Question

The hypotheses demonstrate that airport passengers' overall technology readiness and perceptions towards SSBD technologies at South African airports have a positive influence on the adoption thereof. However, the recorded use of SSBDs in this research was only between 30 to 50% of the time (refer to paragraph 4.9.6).

Additionally, the TR segmentation revealed that there were more explorers and pioneers than sceptics and avoiders. Furthermore, PU was found to have a high predictive relevance ($Q^2 = 0.52$) and an important determinant of attitude and behavioural intention.

5.4 Evaluation of the Measurement Model (Inner Model)

While PLS-SEM is a regression-based approach, it is nonparametric. This signifies that it does not make any assumptions regarding the distribution of the data or the residuals, as is the case in regression analysis (Sarstedt & Mooi, 2014). This property has important implications for testing the significances of the model coefficients as the technique does not assume any specific distribution. Instead, the research had to derive a distribution from the data using bootstrapping, which was then used as the basis for significance testing.

The results of the bootstrap test for R^2 indicated that the coefficient of determination (R^2) for all the endogenous constructs are significant $(p \leq 0.01)$. Additionally, the bootstrap test for R^2 indicated that the predictive power of the hypothesised model was significant at the 95% level. All the R^2 values of the endogenous constructs in the modified model were greater than 0.1, as recommended by Hair et al. (2017).

Additionally, the R^2 values for the four dimensions of TR and the third-order construct for TR can be described as substantial $(R^2 > 0.67)$.

5.5 Evaluation of the Structural Model (Outer Model)

Stone-Geisser's Q^2 was obtained by running the blindfolding algorithm in SmartPLS Version 3.2.9 (Ringle et al., 2015). Stone-Geisser's Q^2 was evaluated to assess the predictive relevance of the model (Chin, 2010; Hair et al., 2017). The Q^2 values obtained ranged from 0.18 to 0.52, which indicates that the model's predictive relevance is medium to large (Hair et al., 2017).

The Q^2 value for PU (0.52) was the highest and is considered to be large, according to Hair et al. (2017). PU is of particular importance in the TRAM framework because regardless of a passengers' PEOU, they are not likely to adopt something that they do not perceive as useful (Davis, 1989).

5.6 Summary

The main objective of this research was to understand how airport passengers' overall technology readiness and perceptions towards SSBD technologies at South African airports influence the adoption thereof. The results presented in Chapter 4 and the discussion above verified and validated the research objectives. The hypotheses were statistically tested through a structural PLS-SEM model, considering the theorised complexity of the TR construct, and established all ten hypotheses as statistically significant. The research results provide for a rich set of implications and insights for academia, airports, and airlines, which is discussed in the next chapter.

6 CONCLUSION AND RECOMMENDATIONS

This study considered factors driving the adoption of self-service bag drops (SSBDs) in South Africa. A structural equation model based on the Technology Readiness and Acceptance Model (TRAM) was designed and tested. Ten linkages were found to be statically significant in the model (Figure 17). The implications of these findings are first discussed. Next, the theoretical implications of the research are presented. Thereafter, the limitations of the study are discussed. Last, recommendations for future work are suggested.

6.1 Conclusion

Using the TRAM framework tested in this research, it may be concluded that all the linkages in the model support the adoption of SSBDs. The findings additionally showed that behavioural intentions account for 18.6% of the variance in adoption, confirmed that TR did not moderate the relationships between PEOU/PU and attitude (H10) or PU/attitude and behavioural intention (H11), PU acts as a partial mediator between the relationship PEOU and attitude, and PEOU acts as a partial mediator between the relationship TR and attitude.

The results of this study have several implications for airports and airlines implementing SSBDs. First, increased PU and PEOU will have a positive influence on passengers' attitudes, which positively influences their behavioural intentions to adopt SSBDs. Accordingly, in the design and implementation of SSBDs, SSBD suppliers, airports, and airlines should pay attention to practical and straightforward functions while also increasing useful features.

Second, TR influences PU, PEOU, attitude toward using SSBDs, and behavioural intentions. Therefore, airports and airlines implementing SSBDs should give increased attention to passenger TR. Airports and airlines can tailor their services based on the TR segments among their passengers. Particular attention should be targeted towards the hesitators as they were the largest segment. Airports and airlines should encourage the use of SSBDs by reinforcing the TR drivers (optimism and innovativeness) that encourage the use of technological services, while also reducing TR inhibitors (discomfort and insecurity) to lower disinclination to use technology.

Third, TR does not moderate PEOU/PU and attitude or PU/attitude and behavioural intention. Therefore, it should not be taken for granted that passengers with higher TR will adopt SSBDs because they are more willing and eager to use SSTs. Furthermore, passengers with higher TR will not rely less on their attitudes when deciding to use SSBDs.

Fourth, PU acts as a partial mediator between the relationship PEOU and attitude. Therefore, efforts made enhancing PEOU will not be wasted, as they will have an indirect effect on attitude via PU. Likewise, the indirect effect of TR via PEOU will have a positive impact on attitude.

The increasing rate at which airports and airlines are turning to SSBDs requires an assessment of the passengers' TR. The propensity to adopt technology varies due to the paradox between TR inhibitors (discomfort and insecurity) and TR drivers (optimism and innovativeness). Therefore, airports and airlines should continuously make efforts to understand the TR of passengers when implementing SSBDs.

6.2 Implications of the Research

The research findings provide evidence that TRAM is a robust model that can be used to predict human behaviour as it relates to the adoption of self-service technologies (SSTs) in general, and SSBDs in particular. The research contributes towards much-needed research, as called for by Naidoo (2012), Parasuraman (2000), and Smit et al. (2018).

The most significant research implication that this study highlighted was the need to assess whether the latent variables of higher-order constructs are reflective or formative, as recommended by Chin (2010). The assessment of the conceptual model identified the Average Variance Extracted (AVE) for TR was significantly less than 0.5 and that the coefficient of determination for the TR inhibitors, discomfort and insecurity, was very weak $(R^2 < 0.2)$. Further analysis of the TR construct and its sub-dimensions identified that the sub-dimensions were not reflective. A revised model was designed and re-assessed. The revised model results yielded an AVE of 0.5 for TR and the coefficient of determination for the TR inhibitors, discomfort and insecurity became significant $(R^2 > 0.67)$.

This research makes an essential contribution by modelling TR as a third-order, reflective-reflective-formative construct. No research evidence could be found that showed other researchers had modelled TR in this way. Additionally, this study will contribute much-needed information to airports and airlines that are planning to implement SSBDs in South Africa. Furthermore, the research methods have been detailed sufficiently to allow replication of the study in other markets, or with adjustment, different technologies.

6.3 Limitations

Although the sample included a diverse mix of passengers, it was not truly random. Additionally, the survey questionnaire was only available in English.

Due to time constraints, the study adopted a cross-sectional survey approach as opposed to a longitudinal survey approach. The cross-sectional survey approach provided a snapshot of the respondents over four weeks. Therefore, validity concerns relating to common method variance bias and causal inference cannot be excluded. Therefore, the conclusions must be tempered, taking cognisance of the limitations of the survey method used for data collection.

The study did not account for SSBD external factors such as average time per transaction and queue waiting times that may have an influence on the variables under study. The focus of the present study was on passenger TR influencing the adoption of SSBDs. It thus did not address SSBD specific challenges such as for overweight baggage and unacceptable baggage types. It can also be assumed that oversize and fragile baggage are checked-in using the counter check-in.

Finally, the current quantitative TAM research approach can explain the majority of, but not all of, the variance in customer intention (Venkatesh, Morris, Davis, & Davis, 2003). Thus, there may be individual unexplained variations in behavioural intention that was not adequately addressed.

6.4 Recommendations for Future Work

While this research contributed to the body of knowledge concerning TR and the adoption of SSTs such as SSBDs, further research may involve, for example:

i. Replicating this study with a random sampling technique.
ii. Administering the survey in different languages in line with the target population demographics.
iii. Conducting a longitudinal study that would reduce the drawbacks of the cross-functional approach.
iv. Investigating other external factors (constructs) that may influence the PU of SSBDs, for example:

a. Wang, Harris, and Patterson (2012) found that perceived waiting time impacts on a consumer's actual choice between SSTs and personal service. Therefore, longer queue lengths and perceived waiting time at alternative check-in modes may encourage SSBD adoption by passengers. This may be especially true for the TR hesitators segment that accounted for 30% of the study sample and displayed very low discomfort with technology.

b. The impact of passenger charges, i.e., if passengers are charged more to use alternative check-in modes, the adoption of SSBDs could increase.

v. Investigating other external factors (constructs) that may influence the PEOU of SSBDs, for example:

a. Considering the average time per transaction (Dabholkar, 1996; Dabholkar & Bagozzi, 2002).

vi. Finally, Baron, Patterson, and Harris (2006) have called for qualitative research to investigate the unexplained variation in behavioural intention. To supplement TAM research, qualitative investigations that aim at exploring and capturing the intricacies of consumer behaviours that cannot be directly observed or measured by quantitative research should be explored.

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Appendix A

Survey Questionnaire

2019 Self-Service Bag Drop Passenger Survey

A Study Conducted by

University of Witwatersrand
School of Mechanical, Industrial and Aeronautical Engineering

And

Embry Riddle Aeronautical University
College of Aeronautics

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This survey asks questions about passenger self-service tagging and self-service bag drop.

What is self-service tagging and self-service bag drop?

Step 1: The passenger makes use of internet/web/mobile/app to obtain a boarding pass prior to arriving at the airport.

Step 2: The passenger prints and attaches bag tag at home or uses a kiosk at the airport to check-in, print and attach bag tag.

Step 3: The passenger proceeds to a self-service bag drop at the airport to drop bag.

We are very interested in your opinions about self-service bag drops **whether you have used this service or not.** There are no right or wrong answers. When completing the survey, some of the questions may seem quite similar. However, we would appreciate your answering all the questions, even if you feel that you have already responded to a similar question. The survey should take approximately 10-15 minutes to complete.

Your participation in the survey is voluntary and you are free to withdraw at any time. All participants are anonymous.

Ticking Agree indicates that I have read the informed consent and I agree to participate in the study. Agree

Technology Readiness

Technology Readiness is generally accepted as the propensity to embrace and use new technology for accomplishing goals.

Please indicate on the scale below, where 1 is "Very Strongly Disagree" and 7 is "Very Strongly Agree" the extent to which you agree or disagree.

	TECHNOLOGY READINESS INDEX 2.0©	**Very Strongly Disagree**	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**Very Strongly Agree**
		1	**2**	**3**	**4**	**5**	**6**	**7**
1.1	Technology contributes to a better quality of life.	1	2	3	4	5	6	7
1.2	Technology gives me more freedom of mobility (ability to perform tasks on the go).	1	2	3	4	5	6	7
1.3	Technology gives people more control over their daily lives.	1	2	3	4	5	6	7
1.4	Technology makes me more productive in my personal life.	1	2	3	4	5	6	7
1.5	Other people come to me for advice on new technologies.	1	2	3	4	5	6	7
1.6	In general, I am among the first in my circle of friends to acquire new technology when it appears.	1	2	3	4	5	6	7
1.7	I can figure out new high-tech products and services without help from others.	1	2	3	4	5	6	7
1.8	I keep up with the latest technological developments in my areas of interest.	1	2	3	4	5	6	7
1.9	When I get technical support from a provider of a high-tech product or service, I feel as if I am being taken advantage of by someone who knows more than I do.	1	2	3	4	5	6	7
1.10	Technical support lines are not helpful because they do not explain things in terms I understand.	1	2	3	4	5	6	7
1.11	Technology systems are not designed for use by ordinary people.	1	2	3	4	5	6	7
1.12	There is no such thing as a manual for a high-tech product or service that is written in plain language.	1	2	3	4	5	6	7
1.13	People are too dependent on technology to do things for them.	1	2	3	4	5	6	7
1.14	Too much technology distracts people to a point that is harmful.	1	2	3	4	5	6	7
1.15	Technology lowers the quality of relationships by reducing personal interaction.	1	2	3	4	5	6	7
1.16	I do not feel confident doing business with a place that can only be reached online.	1	2	3	4	5	6	7

Technology Acceptance

Technology Acceptance is intended to measure the effects of system characteristics on user acceptance.

Please indicate on the scale below, where 1 is *"Very Strongly Disagree"* and 7 is *"Very Strongly Agree"* the extent to which you agree or disagree.

What is self-service tagging and self-service bag drop?

Step 1: The passenger makes use of internet/web/mobile/app to obtain a boarding pass prior to arriving at the airport.

Step 2: The passenger prints and attaches bag tag at home or uses a kiosk at the airport to check-in, print and attach bag tag.

Step 3: The passenger proceeds to a self-service bag drop at the airport to drop bag.

	TECHNOLOGY ACCEPTANCE	**Very Strongly Disagree**	**Strongly Disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**	**Very Strongly Agree**
	Perceived USEFULNESS with regards to self-service tagging and bag drop. ***Please circle your response***	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2.1	Self-service tagging and self-service bag drop enables (will enable) me to accomplish tasks more quickly.	1	2	3	4	5	6	7
2.2	Self-service tagging and self-service bag drop improves (will improve) my task completion performance.	1	2	3	4	5	6	7
2.3	Self-service tagging and self-service bag drop increases (will increase) my productivity.	1	2	3	4	5	6	7
2.4	Self-service tagging and self-service bag drop enhances (will enhance) my effectiveness in completing tasks.	1	2	3	4	5	6	7
2.5	Self-service tagging and self-service bag drop makes (will make) it easier to complete tasks.	1	2	3	4	5	6	7
2.6	I find (will find) self-service tagging and self-service bag drop useful.	1	2	3	4	5	6	7
	Perceived EASE of USE with regards to self-service tagging and bag drop.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2.7	Learning to obtain and self apply bag tags and drop bags at a self-service bag drop is (will be) easy for me.	1	2	3	4	5	6	7
2.8	I find (will find) it easy to get self-service tagging and self-service bag drops to do what I want them to do.	1	2	3	4	5	6	7
2.9	I find (will find) usage of self-service tagging and self-service bag drop to be clear and understandable.	1	2	3	4	5	6	7
2.10	I find (will find) it not to be cumbersome to use self-service tagging and self-service bag drop.	1	2	3	4	5	6	7
2.11	It is (will be) easy for me to remember how to obtain and apply my bag tag, and drop my bag at a self-service bag drop.	1	2	3	4	5	6	7
2.12	I find (will find) self-service tagging and self-service bag drops easy to use.	1	2	3	4	5	6	7

Self-Service Frequency and Intentions

Adoption of self-service tagging and bag drops is generally accepted as the frequent use thereof.

Please indicate on the scale below, where 1 is *"Very Strongly Disagree"* and 7 is *"Very Strongly Agree"* the extent to which you agree or disagree.

	SELF-SERVICE FREQUENCY	Never	Rarely, less than 10%	Occasionally, ± 30%	Sometimes, ± 50%	Frequently, ± 70%	Usually, ± 90%	Every time
		1	2	3	4	5	6	7
3.1	When checking-in luggage I frequently make use of the self-service tagging and <u>self-service bag drop</u>.	1	2	3	4	5	6	7
3.2	When checking-in luggage I frequently make use of the self-service check-in and <u>staffed bag drop</u>.	1	2	3	4	5	6	7
3.3	When checking-in luggage I frequently make use of the <u>counter check-in</u>.	1	2	3	4	5	6	7

	SELF-SERVICE INTENTIONS	Extremely Unlikely	Quite Unlikely	Slightly Unlikely	Neutral	Slightly Likely	Quite Likely	Extremely Likely
		1	2	3	4	5	6	7
3.4	When checking-in luggage I intend to continue (start) using self-service tagging and <u>self-service bag drop</u>.	1	2	3	4	5	6	7
3.5	When checking-in luggage I intend to continue (start) using self-service check-in and <u>staffed bag drop</u>.	1	2	3	4	5	6	7
3.6	When checking-in luggage I intend to continue (start) using the <u>counter check-in</u>.	1	2	3	4	5	6	7

	SELF-SERVICE PREFERENCE Please indicate your preference between the three options below.	<u>Self-Service Bag Drop</u>	<u>Staffed Bag Drop</u>	<u>Counter Check-In</u>
3.7	My 1st order of preference when checking luggage in for a flight is…	1	2	3
3.8	My 2nd order of preference when checking luggage in for a flight is…	1	2	3
3.9	My 3rd order of preference when checking luggage in for a flight is…	1	2	3

If you have not self-tagged and dropped your luggage at a self-service bag drop, please select one or more reasons		
3.10	I was not aware that I could self-tag and drop my bag at a self-service bag drop.	1
3.11	The airlines that I use do not offer self-service tagging and bag drop.	2
3.12	The airports that I use do not offer self-service tagging and bag drop.	3
3.13	I am not confident that I am able to do everything on my own.	4
3.14	I do not see the benefit of self-tagging and self-service bag drop.	5
3.15	I prefer face to face interaction with airline service staff.	6
3.16	Other (please state): *e.g. I do not have a home printer, I usually travel with a large group, I usually have out of gauge luggage and need to see the agent, etc.*	7

3

Attitudes Towards Self-Service

Attitudes towards service are generally accepted as psychological tendency by evaluating a specific type of service with a degree of preference or non-preference.

Please indicate on the scale below for each of the sets of questions.

	Questions **Please mark Neutral (0) if you have not used an option.**	**Extremely Bad**	**Very Bad**	**Bad**	**Neutral**	**Good**	**Very Good**	**Extremely Good**
		3	2	1	0	1	2	3
4.1	When using the self-service tagging and self-service bag drop, I generally feel…	3	2	1	0	1	2	3
4.2	When using the self-service check-in and staffed bag drop, I generally feel…	3	2	1	0	1	2	3
4.3	When using the counter check-in, I generally feel…	3	2	1	0	1	2	3
	Questions	**Extremely Unpleasant**	**Very Unpleasant**	**Unpleasant**	**Neutral**	**Pleasant**	**Very Pleasant**	**Extremely Pleasant**
4.4	It is generally pleasant/unpleasant to use the self-service tagging and self-service bag drop.	3	2	1	0	1	2	3
4.5	It is generally pleasant/unpleasant to use the self-service check-in and staffed bag drop.	3	2	1	0	1	2	3
4.6	It is generally pleasant/unpleasant to use the counter check-in.	3	2	1	0	1	2	3
	Questions	**Dislike Extremely**	**Dislike Very Much**	**Dislike**	**Neutral**	**Like**	**Like Very Much**	**Like Extremely**
4.7	I like/dislike using the self-service tagging and self-service bag drop.	3	2	1	0	1	2	3
4.8	I like/dislike using the self-service check-in and staffed bag drop.	3	2	1	0	1	2	3
4.9	I like/dislike using the counter check-in.	3	2	1	0	1	2	3
	Questions	**Extremely Dissatisfied**	**Very Dissatisfied**	**Dissatisfied**	**Neutral**	**Satisfied**	**Very Satisfied**	**Extremely Satisfied**
4.10	I am overall satisfied/dissatisfied and enjoy the quality of service when using the self-service tagging and self-service bag drop.	3	2	1	0	1	2	3
4.11	I am overall satisfied/dissatisfied and enjoy the quality of service when using the self-service check-in and staffed bag drop.	3	2	1	0	1	2	3
4.12	I am overall satisfied/dissatisfied and enjoy the quality of service when using the counter check-in.	3	2	1	0	1	2	3

Demographic Data

Demographic Data

Please select one of the appropriate boxes, against the number that best describes you.

5.1	What is your gender?	Male		Female		Other	
5.2	What was your age in years at your last birthday?	18-22	23-30	31-39	40-51	52-70	71+
5.3	My primary reason for air travel is:	Leisure		Business			
5.4	The primary class of ticket I purchase when I travel is:	First Class	Business	Premium Economy	Economy	Low Cost Carrier	
5.5	What is your country of residence?	South Africa	Other (Please state)				
5.6	How many flights have you been on in the last 12 months? (Each flight checked-in counts as one flight)	None	1 to 10	11 to 20	21 to 40	41+	
5.7	Most of the flights in South Africa that I have been on in the last 12 months have been, domestic, regional (flights within Africa), or international.	Domestic	Regional	International			
		(If the spit is equal, mark multiple categories)					
5.8 & 5.9	The four airlines and airports that I have used most frequently in the last 12 months for flights to or in South Africa. (e.g. 1st Emirates, 2nd SAA, etc.; 1st Dubai Int, 2nd Cape Town, 3rd Lanseria, 4th King Shaka, etc.)	Airline	1st 2nd 3rd 4th	Airport	1st 2nd 3rd 4th		
5.10	I usually arrive at the airport for a domestic flight ____ minutes before departure.	0 - 30	31 - 60	61 - 90	91 - 120	121- 150	150+
5.11	I usually arrive at the airport for a regional or international flight ____ minutes before departure.	0 - 30	31 - 60	61 - 90	91 - 120	121 - 150	150+
5.12	How many pieces of luggage do you usually check-in?	None	1	2	3	4	5+
5.13	What type of baggage do you usually check-in?	Standard	Overweight	Out of Gauge			
5.14	How many people do you normally travel with?	None	1	2	3	4	5+
5.15	I have self-tagged my bag and used a self-service bag drop.	Yes	No				

Thank you very much for your time, we appreciate your assistance.

Appendix B

Ethical Clearance Certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

SCHOOL OF MECHANICAL, INDUSTRIAL AND AERONAUTIAL ENG. ETHICS COMMITTEE
CONSTITUTED UNDER THE UNIVERSITY HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)

CLEARANCE CERTIFICATE **PROTOCOL NUMBER: MIAEC 170/19**

PROJECT TITLE Airport Passenger Technology Readiness and Self-Service Bag Drop Technology Adoption at South African Airports

INVESTIGATOR Mr. Mohammed Atcha

SCHOOL/DEPARTMENT OF INVESTIGATOR Mechanical, Industrial and Aeronautical Engineering

DATE CONSIDERED 6 September 2019

DECISION OF THE COMMITTEE Approved unconditionally

EXPIRY DATE Date of submission of the project report

ISSUE DATE OF CERTIFICATE 08 Oct 2019 **CHAIRPERSON** ____________
(Dr. Emwanu)

cc: Supervisor: Prof. Raj Siriram

DECLARATION OF INVESTIGATOR

To be completed in duplicate and ONE COPY returned to the Chairperson of the School/Department ethics committee.

I fully understand the conditions under which I am are authorized to carry out the abovementioned research and I guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee.

____
Signature

Date 09 / 10 / 2019

Appendix C

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RE: [EXTERNAL] RE: Request for a Free Academic License to Use the TRI 2.0

Charles Colby <ccolby@rockresearch.com>
Sun 2019/10/27 17:10
To: Atcha, Mohammed H. <ATCHAM@my.erau.edu>
Cc: 1966116@students.wits.ac.za <1966116@students.wits.ac.za>; parsu@miami.edu <parsu@miami.edu>

1 attachments (32 KB)
TR Index 2.0 List for Academic Subscribers.docx;

Hello, Thank you for sending the forms in. You now have a license to use the TRI 2.0 for your academic study. For your convenience, I am attaching a list of scale items and recommendations on using the scale. Let me know if you have questions.

Regards,

ROCKBRIDGE

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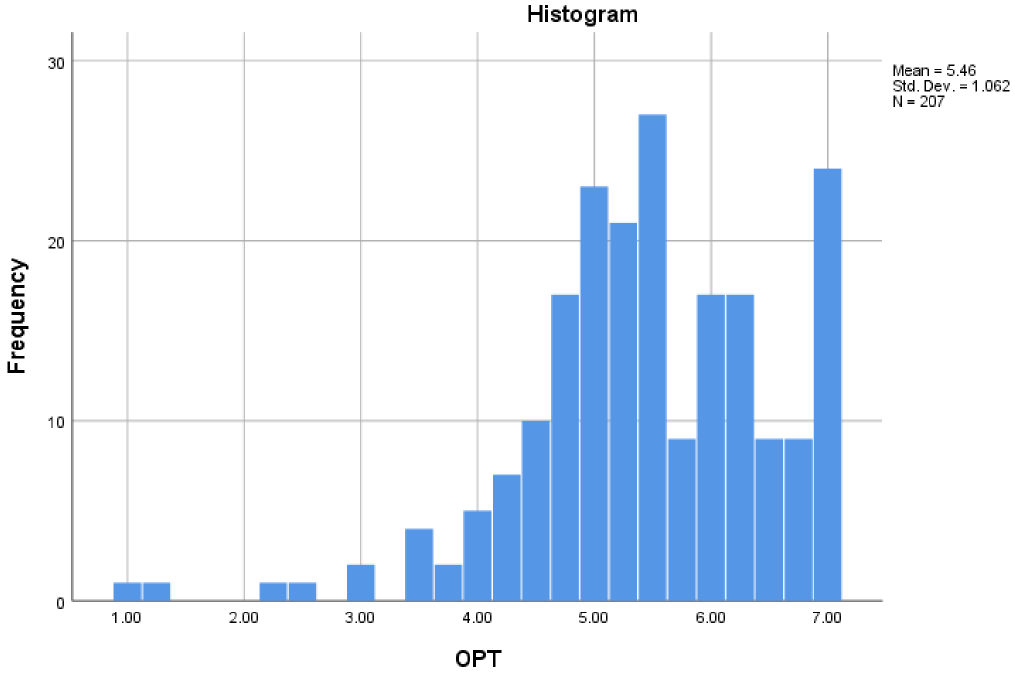
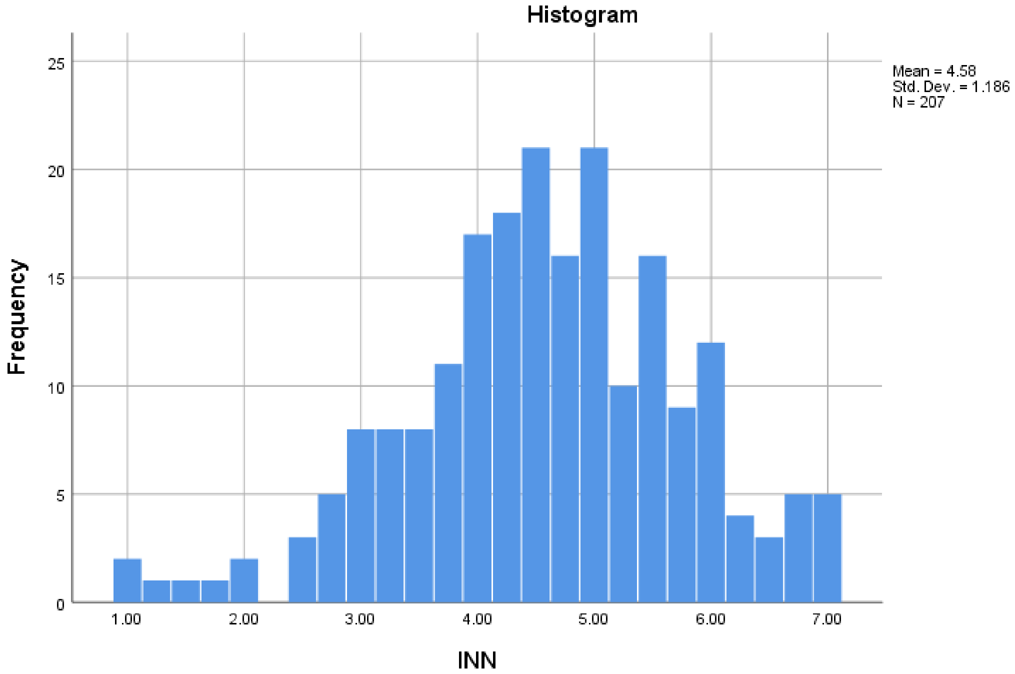
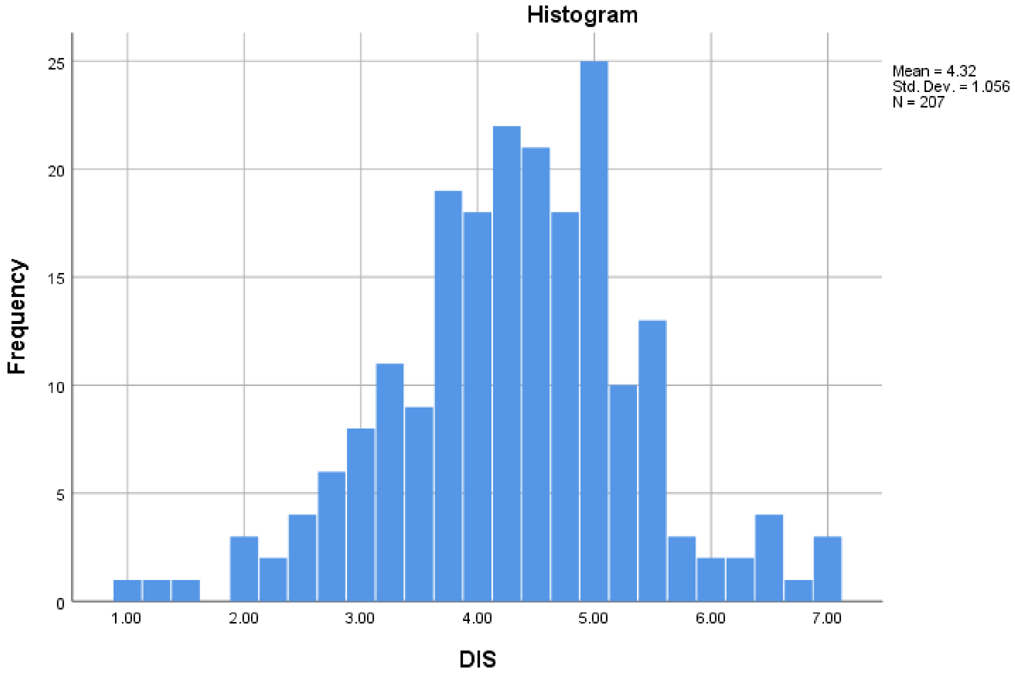
AMERICAN INNOVATION INDEX

Appendix D

Histograms for the Constructs



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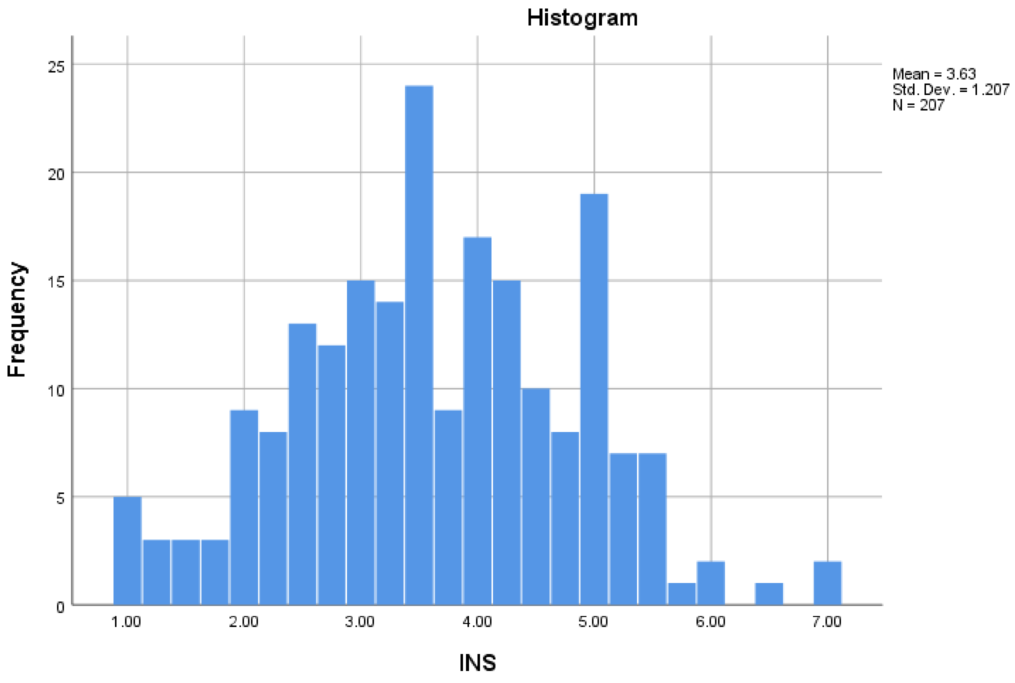
Mean = 4.32
Std. Dev. = 1.056
N = 207
Frequency
0
5
10
15
20
25
1.00
2.00
3.00
4.00
5.00
6.00
7.00
DIS


Histogram
Mean = 3.63
Std. Dev. = 1.207
N = 207
Frequency
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5
10
15
20
25
1.00
2.00
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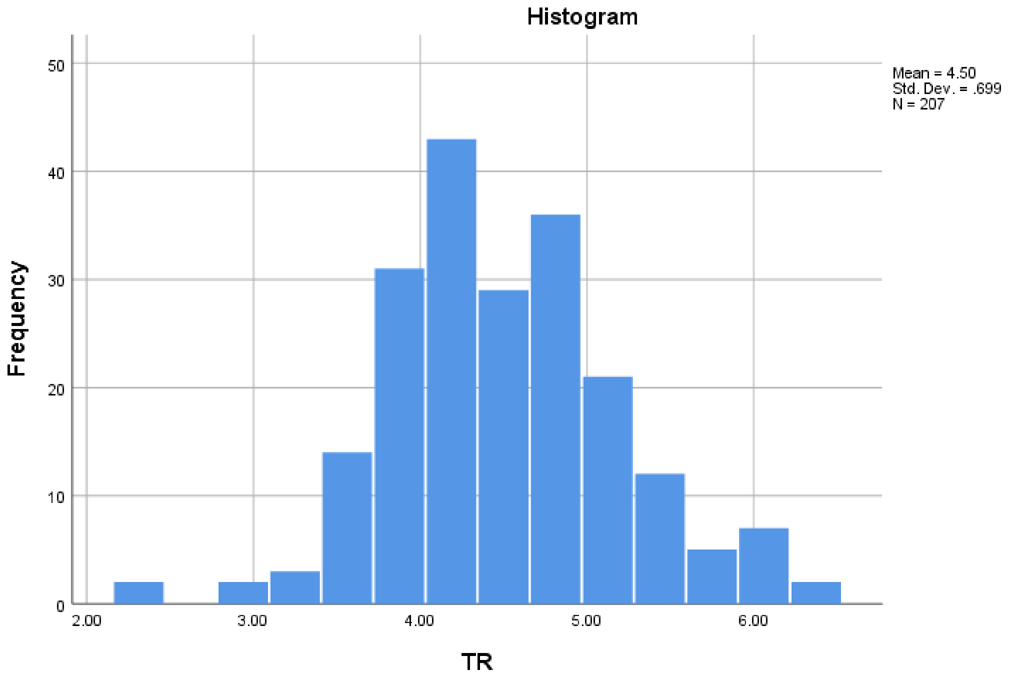
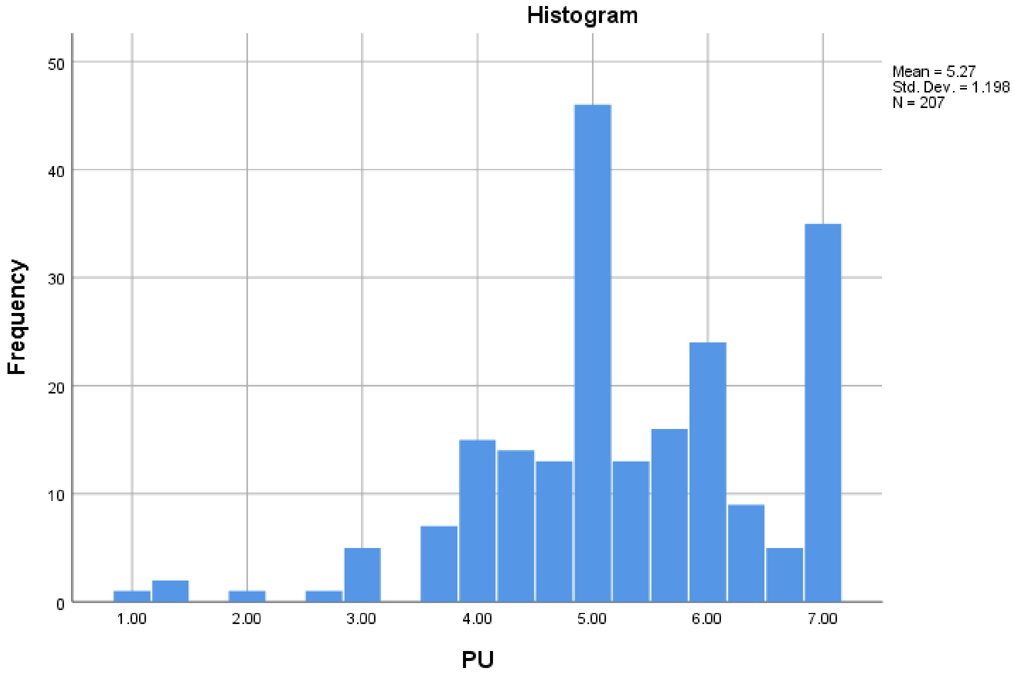
5.00
6.00
7.00
INS


Histogram
Mean = 4.50
Std. Dev. = .699
N = 207
Frequency
50
40
30
20
10
0
2.00
3.00
4.00
5.00
6.00
TR


Histogram
Mean = 5.27
Std. Dev. = 1.198
N = 207
Frequency
50
40
30
20
10
0
1.00
2.00
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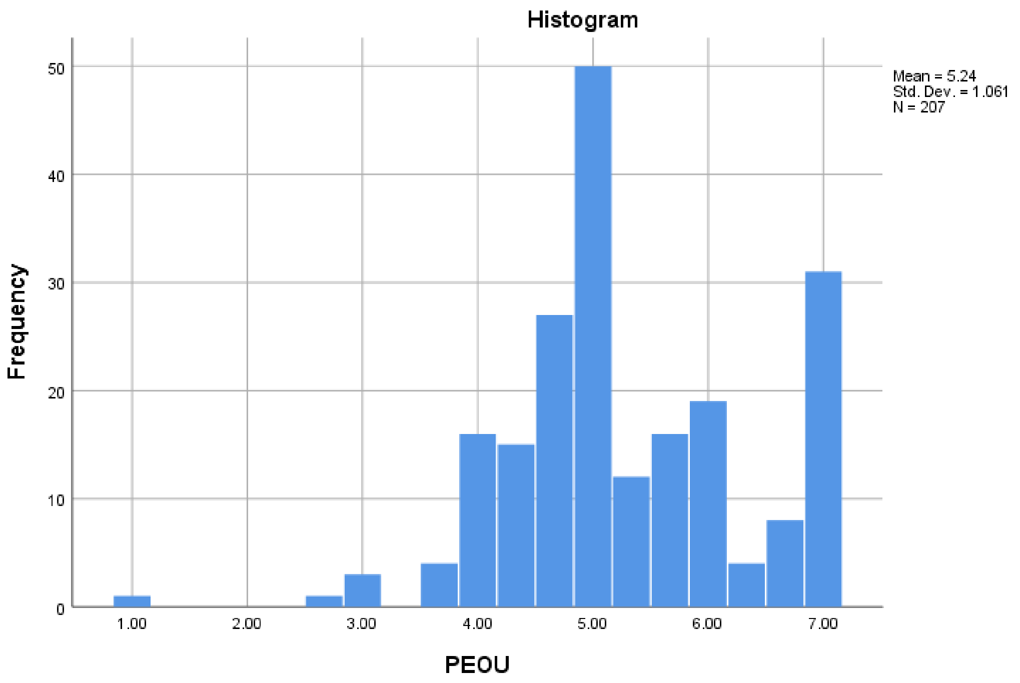
4.00
5.00
6.00
7.00
PU


Histogram
Mean = 5.24
Std. Dev. = 1.061
N = 207
Frequency
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20
30
40
50
1.00
2.00
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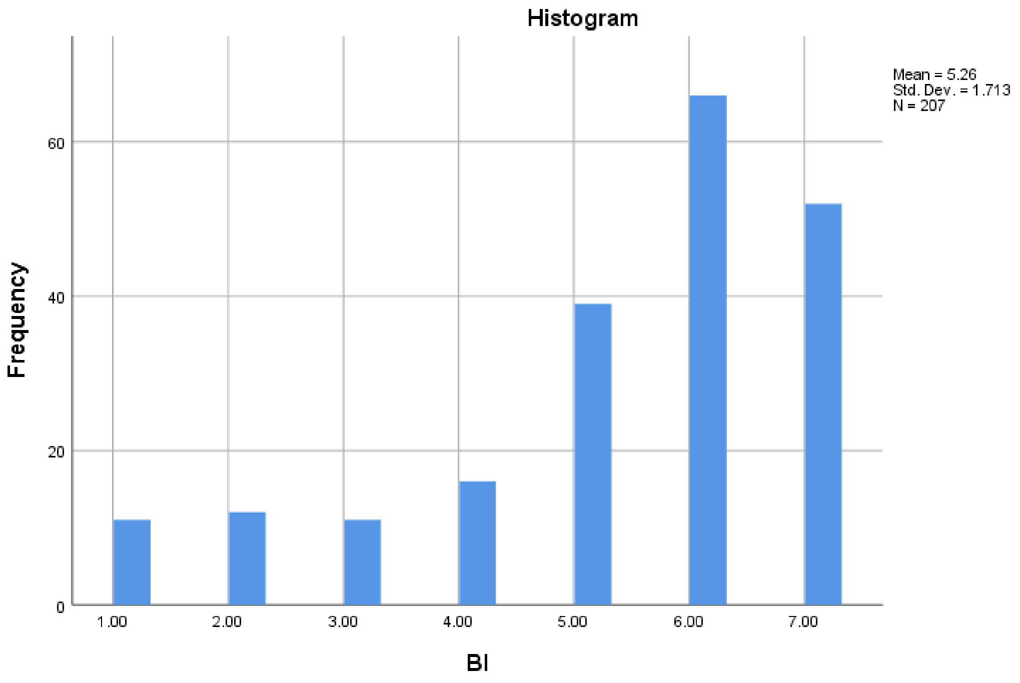
5.00
6.00
7.00
PEOU


Histogram
Mean = 5.26
Std. Dev. = 1.713
N = 207
Frequency
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20
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60
1.00
2.00
3.00
4.00
5.00
6.00
7.00
BI