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Aerial Port of the Future: Developing Paperless Operations

Peter J. Williams

AERIAL PORT OF THE FUTURE: DEVELOPING PAPERLESS OPERATIONS

THESIS

Peter J. Williams, Captain, USAF

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DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY

AIR FORCE INSTITUTE OF TECHNOLOGY

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Peter J. Williams, BA

Captain, USAF

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Peter J. Williams, BA

Captain, USAF

Committee Membership:

Dr. M. A. Douglas
Chair

Dr. M. D. Roberts
Member

Abstract

Air Mobility Command (AMC) is combatting manning mismatches with antiquated processes and equipment in Aerial Port operations, and has chosen to address these issues through an initiative called “Aerial Port of the Future.” This initiative is designed to understand challenges in Aerial Ports and implement technological tools, where appropriate, to aid AMC Airmen in their duties of transporting goods and personnel through military channels. Oftentimes, personnel are forced to utilize technology that may not meet their needs, and in turn may resist implementation of the imposed technology. Therefore, first, this research identifies potential technologies designed to improve Aerial Port efficiency and effectiveness. Next, through a survey of Aerial Port technicians, this study evaluates the attitudes and perceptions of personnel toward implementation and use of the selected technologies. Overall, the study provides AMC the necessary insight to increase the chances of successful implementation of “Port of the Future” technology.

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-Peter J. Williams

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I. Introduction

Background

Throughout time and human history, mankind has been able to progress in his abilities through learning and adapting to available resources and surroundings. Technology has played a leading role in that development in the form of tools, from using a rock and stick to dig a hole to robots and artificial intelligence in today's world. With all the changes in technology throughout history, many people have been opposed to those changes for one reason or another. There are many reasons to doubt and fear changes that are not fully understood, but where would the world be without innovators like Orville and Wilber Wright, who overcame much opposition to accomplish the first manned flight and lead the way for air transportation that we know and take for granted today?

Today's Air Force, like many other organizations, faces the struggle of implementing innovation in the form of new policies, procedures, practices, and technology. One of the current areas of concern is the way that Aerial Port Squadrons (APS's) and Air Mobility Squadrons (AMS's) receive and accept updated technology in their facilities and procedures. Much like regular commercial air ports, Air Force Aerial Ports are the hubs for transporting personnel and cargo around the world. Unfortunately, unlike those commercial air ports, APS's and AMS's have not been on the leading edge of acquiring and utilizing new technologies to increase effectiveness and efficiency of operations, while decreasing overall cost.

Aerial Port operations, like all flight line operations, can be very demanding both physically and mentally. These demands create a steep learning curve, driving Airmen to develop into professionals of extremely important elements of air transportation in a relatively short amount of time. Aerial Port Airmen must be subject matter experts, able to perform their responsibilities quickly, accurately, and safely. As one Airman is stressing out about how to safely lead his/her load team to load a bulky, awkward, and unusual item on an aircraft with the engines running, another one is concerned about ensuring millions of dollars' worth of cargo and vehicles are properly inspected and ready for transport on a multimillion dollar aircraft, protecting those assets and the lives of the aircrew and passengers.

These are just two simple examples of the demands placed on Aerial Port personnel day in and day out. While struggling to become professionals of their trade, Airmen are also concerned with communicating these operations with their unit and the other units affected through appropriate channels. Some of those communication channels are computer-based systems, while others are more or completely paper based. With so many paper forms being utilized, distributed, and shared, it is understandable that forms can be misplaced or lost entirely, creating lapses in communication and timely rework.

To address these types of issues, Air Mobility Command (AMC) is implementing the "Port of the Future" initiative. The initiative started in August 2016 and is an effort to improve efficiency and effectiveness in Aerial Port operations through implementation of new technology. This effort is also designed to combat challenges produced by the reductions and imbalances in manpower, along with aging equipment and facilities, by

implementing technological advances to aid the warfighter. Currently, AMC is in the beginning stages of this initiative, primarily working on broadening the project team's understanding of aerial port operations and comparable industry standards. One of the initiatives the team is evaluating is development of a paperless environment for Aerial Port personnel, with the intent of improving inventory control, increasing efficiencies, and reducing lost time.

In order for AMC leadership to make the most educated decisions regarding this specific utilization of paperless technology, there must be an analysis of the perceived utility of the proposed changes. "A system that does not help people perform their jobs is not likely to be received favorably in spite of careful implementation efforts." (Robey, 1979; p. 537). If an effort is made to increase technology use in the Aerial Port and is not easy enough to use and fails to be useful, it could fail all together, wasting millions of taxpayer's dollars through misused expenditures on the technology and spent man-hours.

Problem Statement

AMC leadership needs to evaluate and understand personnel's perceptions and attitudes toward the implementation of paperless technology in aerial port operations. A better understanding could increase the probability of successful technological implementation, advance AMC's vision of the Port of the Future, and improve mission effectiveness. This research seeks to understand how personnel's perceptions and attitudes toward identified technologies might impact the successful implementation of paperless Aerial Port operations.

Research Purpose

The purpose of this research is to ultimately understand what the best way would be to implement technology into the Aerial Port to create a paperless environment. Many sections already have laptop computers that they use as electronic technical orders (T.O.s), but these portable devices do not have any communication capabilities. As these devices are a step in the right direction to utilize existing technology, there is much more to be done in order to create the best possible working scenario for Aerial Port personnel and others that work on the flight line. In order to do this, insights from those on the flight line need to be collected and analyzed in order to understand what the best tools for them would be to get the job done in the best way possible.

Research Question

What are the perceptions and attitudes of Aerial Port personnel in regard to proposed technologies and how can those perceptions be leveraged to shape the development of paperless Aerial Port operations?

Understanding Technology Acceptance Model

This research will employ the technology acceptance model (Davis, 1989), which states that a user's perceptions of the usefulness of a technology, combined with perceptions of the ease of use of a technology will combine to produce the user's attitude toward the referent technology. A user's attitude toward the technology will influence intentions to use the technology, which will ultimately influence the user's actual use of the technology. This original model has been used extensively in research around the world and adapted to many different situations and variables. For the purposes of this

study, a variation of the original TAM will be developed and described that best suits the scenario of this study.

Investigative Questions

Below are related investigative questions that will be utilized to answer the above research question and aid in achieving the overall research purpose.

- IQ #1: What technologies are AMC considering as a part of paperless Aerial Port operations?
- IQ #2: How are personnel's attitudes related to symbolic adoption?
- IQ #3: What are personnel's perceptions of the ease of use of the identified technologies?
- IQ #4: What are the personnel's perceptions of the usefulness of the identified technologies?
- IQ #5: What are the personnel's perceptions, relative to trust, toward the identified technologies?
- IQ #6: How are usefulness, ease of use, and trust related to personnel's attitudes towards using the identified technologies?
- IQ #7: How do personnel's age, gender, and rank relate to symbolic adoption?

Methodology

The initial data collection and analysis for this study was conducted via qualitative methods to determine the proposed technologies from AMC via semi-

structured interviews. The proposed technologies were identified from those interviews and later, quantitative methods were utilized to empirically test the constructs of the TAM model hypothesized through a survey administered to Aerial Port personnel. The data collected from those surveys were analyzed via multivariate regression to gain perspective of the attitudes and perceptions across the demographical ranges of rank, Squadron (location), flight (specific operation), age and gender, providing an understanding where and why technology may or may not be useful in different locations.

Assumptions/Limitations

Although the purpose of this study is understand the attitudes and perceptions of all Aerial Port personnel regarding the implementation of technology in their duty sections, this research was limited to surveying three units in Air Mobility Command. With that, one assumption of this research is that the results are transferable to the other Aerial Ports and Small Air Terminals. This limitation and assumption is necessary because of the constraint of time and funds to either send the survey to all other units via internet or site visits to administer the survey in person.

Outcomes and Implications

As a result of this study, AMC senior leadership will have gained valuable perspective on a collection of preferences, perceptions, and attitudes of AMC personnel that they can take in consideration when planning the way forward with the development of paperless Aerial Port operations. This will allow leadership to understand how personnel feel about expensive technological implementation while allowing personnel the opportunity to provide feedback and aid in the design of the proposed changes.

This involvement can increase buy-in from those that will eventually utilize said technology and may, by maximizing the number of suggestions, produce a higher quality end product. The goal of this study is to provide AMC information to aid implementation of innovation, helping to provide Aerial Port personnel with technological tools that they perceive as useful, easy to use, and trustworthy.

II. Literature Review

Chapter Overview

The purpose of this chapter is to investigate and understand the current state of literature explaining technology acceptance in a mandatory environment as well as identify gaps in the literature that this study will cover. Theoretical models have been reviewed and analyzed for a framework for this study's proposed model and hypotheses. The models studied are: The Theory of Reasoned Action (TRA), the Theory of Planned Behavior (TPB), the Technology Acceptance Model (TAM) and the many variations thereof, the Unified Theory of Acceptance and Use of Technology (UTAUT/UTAUT 2), and the Symbolic Adoption Model.

Theory of Reasoned Action and Theory of Planned Behavior

Theory of Reasoned Action (TRA)

The Theory of Reasoned Action (TRA) is a dominant theory in the realm of predicting, explaining, and understanding human behavior. It is based on the premise that people are rational beings that utilize information available in considering whether to do something, to exhibit a certain behavior (Ajzen & Fishbein, 1980). The basic structure of the model states that intentions precede actions. The construct of Behavioral Intention (BI) is meant to capture that intention or motivation to act and implies that the stronger one's intention is to the behavior the more likely they are to perform the behavior. In TRA, BI is influenced by one's attitude toward a behavior, be it positive or negative, and one's subjective norm, or perceived social judgments of the behavior. For example, a young man wants a motorcycle, wants the freedom, fuel economy, and project a certain

image (positive attitude toward the behavior), knowing his mother will, to put it lightly, disapprove (subjective norm), leading him to base his decision with these influences in mind.

Even though the logic of this theory is sound, it does not cover all aspects of human behavior and the outcome depends on the behavior in question and the situation that is being measured. For a deeper and fuller understanding of the constructs, the antecedents of Behavioral Beliefs and Normative Beliefs were added to Attitude and Subjective Norm respectively (Hwang, Al-Arabiat, & Shin, 2015). These helped to further identify influences on these constructs.

TRA was not meant for specific situations, but for a general theory, basing a specific behavior on beliefs. Its design is strong for behavioral intentions but not for use of objects (Hwang et al., 2015). The external variables such as age, gender, personality traits are not central to the theory, being mediated by the main variables. One of the main limitations of this theory is that the behavior in question must be under volitional control, which is the measure of will or willpower the subject has toward that behavior (Hwang et al., 2015). This limitation led to the later development of the Theory of Planned Behavior (TPB).

Theory of Planned Behavior (TPB)

The TRA's requirement for volitional control limited the number of behaviors that could be understood by this model. To widen the theory's scope, the construct of Perceived Behavioral Control (PBC) was added. PBC has been defined as ‘‘people's perceptions of the ease or difficulty of performing the behavior of interest,’’ meaning that the higher it is, the stronger the person's ability to control the behavior is (Ajzen, 1991; p.

183). As with Attitude and Subjective Norm, PBC influences BI and Behavioral Performance. The antecedent in this case is Control Beliefs, meant to capture the wide range of influences that affect people's abilities to control different behaviors in different scenarios. (Ajzen, 1991). Both TRA and TPB have been widely used and supported in the way they give insight to why people make the decisions they do.

TRA and TPB have been cited tens of thousands of times in many different contexts, many of those not necessarily in regard to technology acceptance, while others have had technology acceptance in question. Those studies compared results from each model to identify which of the two can help determine likelihood of performing a certain behavior more accurately. Some recent studies involving technology have used these models to understand Cloud Use in classrooms (Shiau & Chau, 2016) and the adoption of Internet of Things in India (Mital, Chang, Choudhary, Papa, & Pani, 2017).

Shiau and Chau (2016) compared six individual models, including TPB and TRA to understand the variances in BI in students using Cloud computing technology. In their findings they discovered that TPB/TRA could explain 62% of the variance in BI. Meanwhile, both TAM and innovation diffusion theory (IDT) explained 66% and Motivational Model (MM) explained 69%. These models all exceeded the ability of their proposed unified model of the six theories in the study which explained 61.8% of the variance of BI (Shiau & Chau, 2016). While TRA and TPB were not the most accurate at explaining variance out of the six theories used, the results show that TPB and TRA are valid models to use if trying to understand those constructs in the context of students and that technology in question. Other cultures and environments are also able to use TRA

and TPB to understand BI because of the parsimonious and unambiguous natures of the models.

The study conducted on the adoption of Internet of Things (IOT) in India also utilized TRA and TPB to understand the likelihood of using technology, in this case, smart devices. The findings demonstrated that there was a good reliability of the constructs for TRA, being attitude, subjective norm, and intention as 0.747, 0.820, and 0.825 respectively (Mital et al., 2017). They also identified that there was no multi-collinearity and that the goodness of fit of 0.43 explained well the intentions to use IOT (Mital et al., 2017). In this study, TPB was also able to explain intentions of use well but only with the shared constructs with TRA.

In this context, the construct of perceived behavioral control had a non-significant effect on determining intentions to use the technology (Mital et al., 2017). With these results we see that in not every scenario are all constructs in the different models equally impactful. This is another reason why theoretical models have been adapted to fit certain situations in a more complete manner. The evolution of theories and models, such as how TPB spurred from TRA and the development of the Technology Acceptance Model (TAM), were results of efforts to explain BI in emerging technological applications.

The Technology Acceptance Model (TAM)

Before TPB, TRA was used to develop the Technology Acceptance Model (TAM), which has been used extensively in research to identify people's behavioral intentions to utilize technological advances. The original TAM, like TRA, utilized two constructs. Instead of Attitude and SN, it evaluates Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) as antecedents of Attitude (Davis, Bagozzi, & Warshaw,

1989). The first, PU, is a way of understanding one's belief that the technology will increase their performance and the latter, PEOU, is a way to understand and measure one's belief of the required effort to use the technology (Davis et al., 1989). This model is meant to be a broad, all-encompassing tool to understand and predict the utilization of technology among a wide range of people and technologies. On one hand being parsimonious and on the other hand theoretically sound (Davis et al., 1989).

The TAM assumes that a positive attitude toward a technology will mean a greater intent to utilize it. It also assumes that people will be more willing to learn how to use a technology if they perceive an increase in their performance. Thereby, this increased use will allow them to accomplish more of their duties than before, increasing their visibility to their employers. Hence, the increased productivity will help them stand out above their peers or at least keep up with other's performances (Davis et al., 1989).

Even if the technology can increase an individual's performance, the technology must be easy enough for the individual to learn how to use it. This connection of these constructs has been observed and verified in countless studies as well as the fact that PU and PEOU fully mediate external variables. As with other models, the results always depend on the situation. There are many antecedents that can have an impact on PU and PEOU and the more information gathered about those can lead to better implementation of technology among populations.

As the TAM has been used so abundantly, many researchers have used students as subjects of study which has been viewed as questionable to many researchers (Nah, Tan, & Teh, 2004). They have noted that, in a general sense, there is a stronger relationship between the variables in question among students as compared to other demographics

(Nah et al., 2004). With technology spreading faster and farther around the world, the constructs in TAM have been observed to have different impacts depending on the populations and cultures. In developing countries, it has been noted that PEOU has more of an important role in technology acceptance while in developed countries PU is deemed more important (Ashraf, Thongpapanl, & Auh, 2014).

With this wide area of study possible for TAM, its strength in its parsimony has greatly influenced its success rate, being easily applied and tested with many constructs and variables. The social influence factor of Subjective Norm that was included in the TRA was originally left out of TAM, but for this model to continue in its evolution, that construct has been re-added along with other antecedents and mediators into later variations known as TAM 2 and TAM 3 (Venkatesh, & Davis, 2000).

The expansion of the model to create TAM 2 adds antecedents of Subjective Norm, Image, Job Relevance, Output Quality, and Result Demonstrability onto PU while adding the mediators of Experience and Voluntariness to Subjective Norm (Venkatesh, & Davis, 2000). These were an attempt to cover the topics of extrinsic motivations, social influences, and to acknowledge mandatory environments where the user does not have much of a choice to use the technology or not (Venkatesh, & Davis, 2000). To make the model even more inclusive and to aid companies to intervene with their employees to better adopt technological innovations, it has been expanded again (TAM 3) to add antecedents to PEOU and additional mediations from experience to all antecedents, not just to those pertaining to PU (Venkatesh & Bala, 2008).

TAM 3 was developed to cast a more inclusive net to understand behavioral intention and overcome TAM 2's limitation of solely focusing on antecedents and mediators of PU (Venkatesh & Bala, 2008). Variables were inserted as determinants of PEOU, namely: Computer Self-efficacy, Perceptions of External Control, Computer Anxiety, Computer Playfulness, Perceived Enjoyment, and Objective Usability. There was also an extension of the moderating role that Experience plays in that it will moderate relationships between: PEOU and PU, computer anxiety and PEOU, and PEOU and BI (Venkatesh & Bala, 2008). This model provides a "complete nomological network of the determinants of IT adoption and use" and gives a greater sense of "comprehensiveness and potential for actionable guidance." (Venkatesh & Bala, 2008; p. 301).

The iterations of TAM have been utilized to estimate and predict user acceptance of technology in many cultures across many forms of technology. As mentioned before, studies conducted in India regarding the acceptance of the Internet of Things (Mital et al., 2017) and Cloud computing in classrooms (Shiau & Chau, 2016) utilized TPB and TRA, they also employed TAM to aid in the understanding of BI in those settings. In those studies, they discovered that TAM explained equally well, if not better, the BI of the subjects in question. Each study was conducted in a different country, India and Taiwan, and participants were different types of populations, general population and college students respectively.

Other studies on the topic of technology acceptance that have utilized the different models of TAM are: E-Government adoption in China (Xie, Song, Peng, & Shabbir, 2017), Online Shopping in Pakistan and Canada, and the United States (Ashraf et al.,

2014; Gefen, Karahanna, & Straub, 2003), Healthcare in the United States (Holden & Karsh, 2009), Statistical Package for Social Sciences (SPSS) in Pakistan (Lodhi & Masood, 2016), Public Bike sharing in China (Hazen, Overstreet, & Wang, 2015), and Advanced Driver Assistance Systems (Rahman, Lesch, Horrey, & Strawderman, 2017). These are just a handful of examples of the wide array of areas that TAM can be employed to understand BI. All of these studies either utilized TAM to develop a unique model that fits the scenario at hand or used the original to compare to other predictive models to compare which one captures variability the most. In each case, TAM, or the variation used, explained as much if not more than the variance compared to TRA, TPB, and the versions of the Unified Theory of Acceptance and Use of Technology (UTAUT).

The Unified Theory of Acceptance and Use of Technology (UTAUT & UTAUT2)

Amidst all the developments and iterations of TAM, another model was introduced by comparing the top eight acceptance models. The Unified Theory of Acceptance and Use of Technology (UTAUT) was developed to address limitations from previous models and to accommodate significant variables supported in the literature (Venkatesh, Morris, G. Davis, & F. Davis, 2003). The limitations addressed were the typical simplicity of the technology in question, that most studies were cross-sectional and conducted after the technology had already been adopted in a voluntary environment, and again, the use of students as the respondents possibly skewing the results (Venkatesh et al., 2003).

Differing from TAM, UTAUT has four constructs: performance expectancy, effort expectancy, social influence, and facilitating conditions. These constructs are

mediated by the external variables of age, gender, experience, and voluntariness of use (Venkatesh et al., 2003). To tailor the model to fit a consumer context, UTAUT was adapted into UTAUT 2 with the addition of three other constructs: hedonic motivation (enjoyment of using technology), price value (is the technology worth the money), and habit (learned automatic behaviors) (Venkatesh, Thong, & Xu, 2012). With this version being adapted for the consumer context, the mediator of voluntariness of use was omitted on the assumption that the purchase is not mandatory.

Similarly, to the aforementioned theories, UTAUT (2) have also been employed to understand BI and actual use in a multitude of cultures and countries covering a wide range of emerging technologies. One of which is was a study of Tablet Personal Computer Integration in Higher Education (Moran, Hawkes, & Gayar, 2010) in the United States. This study concluded that the proposed model could account for 55% of the variance of BI in those surveyed, again being students (Moran et al., 2010). Those results are slightly lower than the typical experienced in other studies.

One of those other studies compared TAM, TPB, and UTAUT regarding Advanced Driver Assistance Systems (ADAS) (Rahman et al., 2017) in the United States. The goal of the ADAS study was to determine and understand which model could best explain driver acceptance of these technologies to aid in the implementation of these systems in more vehicle makes and models. After conducting the study, it was determined that all of the tested models explain user BI very well but to varying degrees, having a statistically significant difference. In this case the models performed from least predictive to most: UTAUT with an adjusted $R^2 = 0.71$, TPB with an adjusted $R^2 = 0.80$, then TAM with and adjusted $R^2 = 0.82$. In this instance, UTAUT did not predict user

adoption as confidently as the other models, however, other studies have continued to expound on UTAUT (2) to create other unique models to predict user intentions.

One of those was to understand Adoption of Mobile Banking in Jordan (Alalwan, Dwivedi, & Rana, 2017). That study extended UTAUT2 with the construct of trust and discovered that the proposed model accounted for an exceptional amount of variance with an $R^2 = 0.65$ compared to the original model giving an $R^2 = 0.59$ (Alalwan et al., 2017). Those results again show the necessity of tailoring models to specific scenarios to gain increased ability to predict user intentions. An additional study such as this was designed to understand acceptance of Human Resource Information Systems (HRIS) (Virdyananto, Dewi, Hidayanto, & Hanief, 2017).

The HRIS study combined UTAUT with the Task Technology Fit (TTF) model and the Symbolic Adoption (SA) model to create a unique hybrid to encompass important factors that pertain to the specific system and organization in question. Those results show that TTF has a significant impact on SA as well as the construct of Social Influence from UTAUT. Although those results were significant, for the purposes of this current study, the method to understand how the technology fits into the current working environment in Aerial Ports will utilize constructs from the original TAM and not those from TTF. This is because the fit of the technology is not in question but the end user's attitude toward its usefulness and ease of use. SA on the other hand as was used to determine the behavior of users will be employed in the proposed model of this study and will discussed in the next section.

Symbolic Adoption

The variable of Behavioral Intention that is included in the previous models above is a limiting factor in mandatory environments because of the assumption that there must be the presence of volitional control for BI to be relevant (Nah et al., 2004). For this reason, BI is replaced with Symbolic Adoption (SA), which is defined as "one's mental acceptance of an innovation, distinct from actual adoption which refers to actual use of technology" (Klonglan & Coward, 1970; Nah et al., 2004; p. 39).

In the setting for this study however, the use of the technology will be mandatory to a certain extent while maintaining the ability to be optional to a degree because of the requirement to have manual (paper) procedures as a backup in case of operational disruptions such as a loss of electrical power or other potential technological difficulties. This paper option makes it relatively easy for Airmen to find or make up any reasonable explanation to not use the technology if it fails to make operations run more smoothly than desired. This makes SA even more important, as stronger SA before actual adoption can lead to infusion that can be measured, from person to person, to help target and mitigate resistance (Nah et al., 2004).

The SA model is very similar to TAM apart from the addition of the constructs Perceived Fit (PF) and Perceived Compatibility (PC). These constructs are used to measure how the technology fits into the organization and how compatible it is with the individual's particular way of doing business. For this study, the SA model developed from TAM, will be adapted and utilized to fit the context of a mandatory military environment before technological changes are actually implemented in certain locations and compared to the perceptions of Airman that already utilize the proposed technology

in their day to day operations. The measure of Airmen's SA will determine the likelihood of accepting the technology and utilizing it to its best potential.

In the propositional study of the SA model, the topic of research was the Acceptance of Enterprise Systems (ERP) where the authors discussed a common limitation of the use of TRA, TPB, and TAM in that they are not often utilized to understand BI in a mandatory environment such as a business organization (Nah et al., 2004). This scenario is very similar to that of the Aerial Ports, thus, for this current study SA will be the dependent variable. The constructs of PC and PF are specifically "relevant and influential in the ERP context" (Nah et al., 2004; p. 42) because they pertain to how the technology is "consistent with the existing values, past experiences, and needs for potential adopters" (Rogers, 1995; p. 224) and that the "ERP software is perceived by a user to meet his/her organization's needs." (Nah et al., 2004; p. 41). Since these factors of an ERP are not so relevant with the technology to be implemented in the Aerial Ports at this stage of the Port of the Future initiative, those have been replaced with the construct of trust.

Proposed Model

To gain perspective of Airmen's attitudes and perceptions of the proposed technology, the proposed model will be a hybrid of the aforementioned theoretical models. The underlying premise of these models is that the characteristics that define an individual impact their intention and eventual use of technology. The constructs of PU and PEOU have been proven to show a strong correlation to the actual use or adoption in studies past. Those constructs will be used with this study as well as the construct of Trust, making the proposed model a combination of the original TAM, SA, and UTAUT.

The proposed model will also use the variables of age, rank, and gender as controls to understand how those factors may influence one's SA.

Hypotheses

The relationship of an individual's attitude to their BI and SA has been studied extensively with a mixture of results depending on the dependent variable chosen. BI has been shown to be affected by attitude in voluntary settings while SA has had a similar relationship in mandatory settings (Nah et al., 2004). As such, attitude measurements in previous studies have shown to be crucial in providing an accurate prediction of individual's acceptance of technology in mandatory environments (Brown, Massey, & Montoya-Weiss, 2002). In such types of studies attitude has been identified as "a predisposition to respond favorably or unfavorably to a computer system, application, system staff member, or a process related to the use of that system of application" (Melone, 1990; p. 81). If attitude is defined as such, being either a favorable or unfavorable response to the technology, then it is hypothesized that:

> **H1:** Attitude toward system use will be positively related to Symbolic Adoption.

The constructs of PEOU and PU have been studied extensively and proven many times to be statistically significant as antecedents of attitude. Even though there have been instances where both constructs have been proven to have direct effects on both attitude and SA, there have also been instances that have detailed that PU does not have a direct impact on SA but is mediated by attitude (Nah et al., 2004). In the environment being studied here, Aerial Port personnel do not have the time to waste on a technology that is not useful nor easy to use.

Many times, when innovations are implemented into environments such as this, the end user does not have an option to use the technology or not, even if the previous process is more efficient or effective. This may be a result from the fact that the leadership that is forcing the implementation does not want to see the money spent on the project to be a complete waste because of individual refusing to use it. If a technology is not useful to help accomplish a task and is difficult to use, then the nature thing is to not employ that item. Thus, in this study it is hypothesized that:

H2a: Perceived Ease of Use will be positively related to Symbolic Adoption.

H2b: Perceived Ease of Use will be positively related to Attitude toward system use.

H3a: Perceived Usefulness will be positively related to Attitude toward system use.

H3b: Perceived Usefulness will be positively related to Symbolic Adoption

Trust

Trust in this context will be a measure of personnel's confidence in the system regardless of perceived risks. In previous studies it has been defined as the "extent to which a person expects that a new technology is credible and reliable" (McKnight, Choudhury, & Kacmar, 2002; Ashraf et al., 2014; p. 71). Trust oftentimes is used in studies pertaining to online customer and buyer relationships, in this context however, it applies to the confidence users have in cyber security protocols protecting the confidentiality of the information, the way the technology meets operational needs (fit), if the hardware and software are reliable to function properly, and that there is access to required support such as maintenance, upgrades, and troubleshooting.

These aspects of trust stem from multiple models such as the TTF Model which refers to how the technology meets the needs of the user and if it works as designed. Trust also falls in line with the construct of Facilitating Conditions from UTAUT/2 addressing the perceptions of users in regards to the resources and support available (infrastructure) to perform the behavior. This also addresses leadership's influence by putting the technological initiative in a positive light and aiding in its implementation. An Airman's ability to trust the available tools is vital to successful operations, the tool must be an asset, if it is not it will result in the lack of trust and will negatively impact their attitude and eventual use of the technology. Just as how trust has been proven to be important in online transactions (Gefen, Karahanna, & Straub, 2003), it is the same with Aerial Port personnel using semi-optional technology and thus is hypothesized that:

H4a: Trust will be positively related to Attitude toward system use.

H4b: Trust will be positively related to Symbolic Adoption.

Since the constructs of PEOU, PU, and Trust are hypothesized to have a direct positive relation to Attitude and that Attitude in turn has a direct positive relationship with SA, it is hypothesized that:

H5a: Attitude will be a mediator for the construct of Perceived Ease of Use to the dependent variable Symbolic Adoption

H5b: Attitude will be a mediator for the construct of Perceived Usefulness to the dependent variable Symbolic Adoption

H5c: Attitude will be a mediator for the construct of Trust to the dependent variable

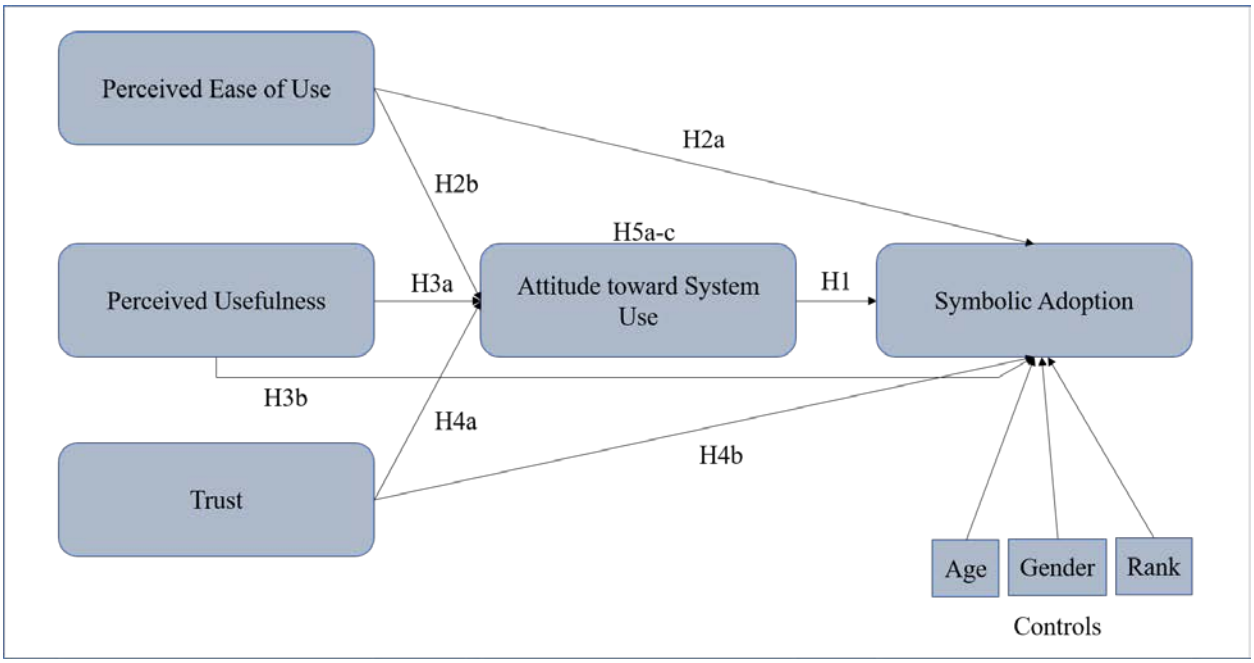

Figure 1. Proposed Model

Symbolic Adoption

The proposed model utilizes the moderators that were proposed in UTAUT2 as controls on SA. Just as UTAUT2 dropped voluntariness from the original model as a moderator, it has been dropped as a control in this study because of it being a mandatory environment. In UTAUT, the moderators of age, gender, and experience (in this case rank), were not hypothesized to apply to all the constructs and variables, in this study those variables are looked at to understand if there is a direct relationship with SA. In prior studies is has been illustrated that technological adoption can be affected by differences in age and gender and that those moderators are complementary (Venkatesh et al. 2003). With that, rank has been added as a control as well because in the Aerial Port scenario, experience in that environment and having seen past implementations and

different operational duties could influence how one feels toward adopting proposed technology. Hence, age, gender, and rank will be evaluated as controls on SA.

Summary

There are many theoretical models that have the ability to help explain variables that may be present in efforts to implement technology at an individual and/or an organizational level. Some of the prominent theories have been studied and adapted in an attempt to match the environment in question of a semi-mandatory military transportation organization. Hypothesis of the proposed model have been expressed and the following chapter will explain how those will be explored.

III. Methodology

Chapter Overview

The purpose of this chapter is to introduce and define the methodology employed to collect data and analyze the data to test the proposed hypotheses. Since the approach is both qualitative and quantitative in nature, the specific method to collect data will be semi-structured interviews and an investigative survey, respectively. Semi-structured interviews served as the best means to identify proposed technologies and a survey provided pertinent data as to the attitudes and perspective of AMC personnel relative to the problem statement as guided by the framework of the outlined research and investigative questions. The pool of interview participants was limited to a handful of key individuals holding certain unique positions, authority, and perspectives at AMC while the survey was administered to as large of a population as possible of civilian and active duty Aerial Port personnel.

Qualitative Phase (Interviews)

This study initiated with a qualitative phase with the goal of identifying and understanding which type of technology would be proposed from AMC for Aerial Port personnel to utilize (Appendix A). Semi-structured interviews were conducted with five personnel from AMC Headquarters (HQ) located at Scott Air Force Base, specifically individuals that work in the Air Passenger Movement and Fleet Service Policy Branch (HQ AMC/A4TP) and the Military Airlift/Air Transportation Systems Management Branch (HQ AMC/A4TI) that both fall under the authority of the Directorate of Logistics, Engineering, and Force Protection (HQ AMC/A4). Additionally, an interview was

conducted with the AMC Chief Scientist who is spearheading the Port of the Future initiative.

The office building that all but one of these interviews was conducted in is a secure facility that does not allow personal technological devices such as cellular telephones and personal computers/tablets. This limited the amount of data that was able to be digitally recorded in those interviews because only a pen and paper were available to take notes with; nevertheless, it was sufficient to meet the goal of these interviews. In the interviews, it was discovered that the goal of AMC's Port of the Future initiative is much more than giving the units handheld devices. Instead, it is to implement state of the art technology similar to those utilized by commercial warehouses and logistics companies such as Amazon, UPS, FedEx, etc. The ultimate goal of the initiative is to maximize automation where applicable and capitalize on the benefits of current and future technological logistics systems.

Quantitative Phase (Surveys)

The quantitative phase of this study was completed through the administration of a survey to active duty military and civilian personnel throughout three of AMC's biggest Aerial Port organizations. Since there are many variations in missions, operations, and facilities that can exist throughout AMC units, it was important to capture the differences in attitudes and perceptions this potential technological initiative affects them all.

Participants

To get buy in from these units, each of these squadrons' leadership was contacted and explained the purpose of this research, all of which agreed to support this study. To optimize the ability of personnel to take the survey, the squadron leadership was sent a

hyperlink via e-mail that they were able to forward to all personnel in their organizations. With their help, the survey progressed because they followed up with periodic reminders to their personnel.

First, personnel from the APS at Dover AFB were invited to take the on-line version of the survey. This organization was chosen for the study because it has been a test base for previous Aerial Port of the Future initiatives. This is because of its size in both personnel and equipment, for its considerable operations tempo, and strategic posture; all of which combine to make it known as the "Super Port". Furthermore, it has a unique perspective because of the broad spectrum of operations that are relevant to an APS. The total number of survey responses collected from this unit was 35 with a response rate of 7.3%.

Secondly, personnel from the APS at Travis AFB were also invited to participate in the survey. In this instance, participants were able to complete a paper-based survey. No differences exist between the paper-based and the online version of the survey. The paper-based option was available to those at Travis AFB because the researcher was able to visit the organization in person. There was a total of 111 participants and a response rate of 23.5%.

Lastly, personnel at the AMS at Joint Base Pearl Harbor/Hickam were invited to take this survey. The results from this unit are meant to be the control group because they have previously tested and are presently utilizing the technology in question. The survey administered there differed from that sent to the other squadrons, containing only 29 questions about the attitudes and perceptions of the personnel. The questions were solely regarding the tablet and hand-held scanner, as that is the technology that they ultimately

adopted. There was a total of 45 participants and a response rate of 23.1%. From these three units that contributed in the survey, there was a total of 189 participants and an average response rate of 18%. A summary of the demographics by rank, gender, and age of those that participated in the survey can be seen in Table 1.

Table 1: Demographics Summary

Rank Ranges	Age Ranges	Female	Male	Unknown**	Total
Amn - SrA	19 - 34	20	68	0	88
SSgt - TSgt	23 - 47	5	35	1	41
MSgt - Up	31 - 33	3	6	0	9
Civ	41 - 56	2	15	0	17
Unknown**	NA	0	3	8	11
Total	19 - 56	30	127	9	166

*Only responses used in analysis are represented
**Unknown: Questions left unanswered by participants

With that, since both technologies that have been identified rely heavily on high-speed Wi-Fi internet to function properly, this survey has specified that the participants were to assume that to be the case. The reason is that not all Aerial Ports have such installed in their buildings and even more so that do not have Wi-Fi that is able to reach all corners of what can sometimes be miles worth of flight line. The focus is to gain perspective of attitudes and perceptions of personnel pertaining to the hardware combinations in question and not the quality of the Wi-Fi connection. The hardware is to be considered as a package deal and not each individual piece of hardware to be examined separately.

Constructs

Variations of the survey questions have been used in numerous studies to predict user attitudes and behavior. Those pertaining to PU and PEOU were adapted from the original TAM (Davis, 1989), with 6 and 7 items respectively. The questions about trust and attitude were derived from (Fishbein & Ajzen 1980; Ashraf et al., 2014; Holden et al., 2009; and Venkatesh et al., 2012) with 7 and 5 items respectively. The questions utilized to measure Symbolic Adoption were adapted from (Nah et al., 2004) with a total of 4 items in that construct. The questions were measured using a 7-point Likert-scale (see Appendix B and C). The items within the constructs added up to be 29 questions per technology package, making the survey a total of 58 questions with a demographics section to analyze the controls of age, gender, and rank.

Analysis

To verify the reliability of the model constructs and the survey questions, a pilot test was done. The situation and constructs were explained to those participants and their feedback will be incorporated into any revisions required to secure validity. Also, the coefficient alpha was used for the 58 multiple-choice questions to assess the internal consistency reliability of the indirect components of the survey. A multivariate regression analysis and CFA was employed to understand the relationship between the constructs and the controlling variables.

Summary

In summary, semi structured interviews were conducted with AMC Headquarters personnel to identify the potential technologies to be implemented. The subsequent

survey was then conducted with Aerial Port personnel at multiple squadrons to measure individual's attitudes and perceptions of those technologies. At the conclusion of collecting the data, statistical analysis will be conducted to understand which technology will have a higher probability of successful implementation.

IV. Analysis and Results

Chapter Overview

The purpose of this chapter is to outline the results of the qualitative phase of the interviews and the statistical analysis from the quantitative phase of this study collected via survey. The latter is accomplished by describing the tests that were utilized to measure the strength of the constructs individually and the overall strength of the proposed model, including the investigative questions and the corresponding hypotheses. This will be done for both of the proposed models that were tested, namely: (1) tablet with Bluetooth connected handheld scanner and (2) laptop with built-in scanner and carrying harness.

Qualitative Phase: Analysis and Results

Investigative Question #1: What technologies are AMC considering as a part of paperless Aerial Port operations?

The initial phase of this research was to identify which technology, if any, would be proposed to be implemented in AMC Aerial Ports and Small Air Terminals. The first investigative question was answered with the semi-structured interviews that were conducted with HQ AMC personnel that had been tasked to work on the Port of the Future initiative. Through those interviews it was discovered that a unit within AMC has already experimented with two different types of hardware. Those different technologies that they looked at were laptops with built-in scanners carried with a wraparound shoulder harness and a handheld tablet with a Bluetooth connected barcode scanner with a carrying holster.

Those technological tools were identified to be a solid step forward in the process of implementing technology to improve effectiveness and efficiency and move the initiative in the right direction. With that initial question answered the research was able to progress to the quantitative phase to understand what personnel's perceptions and attitudes are toward those different hardware options.

Quantitative Phase: Analysis and Results

The analysis of the data collected through the survey was accomplished by means of SPSS, AMOS, and Microsoft Excel. To analyze the proposed model for each technology in question, two distinct steps were taken as recommended by Anderson and Gerbing (1988). The first step was to assess construct and discriminant validity. In this case, because the constructs are already established through past studies, a confirmatory factor analysis (CFA) was conducted instead of an exploratory factor analysis (EFA). After the constructs were evaluated, the proposed hypotheses were tested utilizing a structural equation model.

Measurement Model Results

To begin the analysis, the data set was first prepared and cleaned. Survey responses were removed that were missing substantial amounts of data, such as not completing either section of the survey, as well as responses that were deemed to be obviously biased because the same answer was given for each question. After the data was scrubbed, the convergent and discriminant validity were evaluated by means of a Confirmatory Factor Analysis (CFA) employing AMOS software, one for each technology in question and segregated into survey types. Those responses from the APSs

at Travis and Dover AFB were combined into a single data set while the responses from the AMS at Hickam remained a standalone for comparison of the datasets. All constructs in the proposed model (PEOU, PU, Trust, ATT, and SA) were included in the CFAs.

The results of the measurement model for the tablet and handheld scanner option from the combined dataset of Travis and Dover provided fit indices of $\chi^2 = 600.437$, df = 311, p-value < .001, while the comparative fit index (CFI) was 0.941. The incremental fit index (IFI) was 0.942 and the standardized root mean residual (SRMR) was 0.064. Along with that the root mean square error of approximation (RMSEA) was 0.085 with a 90% confidence interval with a lower bound of 0.075 and upper bound of 0.095. The χ^2 statistic is the sole fit indices that indicates anything less than an adequate model fit (Hu & Bentler, 1999). This is because the normed χ^2 statistic is 1.931 compared to the recommended maximum of 3.0 (Kline, 2011).

Factor loadings and the average variance extracted (AVE) for each construct were assessed next to test for convergent validity for the combined dataset pertaining to tablets. One variable failed to exceed the factor loading recommended threshold of 0.6 (Hair, Black, Babin, & Anderson, 2010) even though all items loaded onto the corresponding constructs with a p-value <0.001. The second item in the Trust construct (T2) had an extremely low factor loading value of 0.081 and hence has been removed from further analysis from all datasets. Even with T2 included, all constructs had AVEs above the recommended 0.50 threshold, meaning that the construct explains the variance better than what is due to measurement error (Hair et al., 2010). The factor loadings and AVEs can be seen in Table 2.

The next measurement was for internal consistency utilizing the Cronbach's α for each construct. The results show that all the constructs for tablet use in Travis and Dover had alpha levels that exceeded the recommended minimum of 0.70 (Nunnally & Bernstein, 1994). Those results can be seen in Table 3. After such, the assessment of the discriminant validity was accomplished by comparing the Cronbach's α of each construct to that of the correlations between the other constructs. There is ample evidence of discriminant validity in this model since all the constructs passed this test except for one, that of ATT and SA, as seen in Table 4. Because those construct have been established in the literature as separate items, they have been considered as such in this study as well despite the numbers for the tablet data.

After the convergent and discriminant validity was accomplished for the dataset of tablets from Travis and Dover, the same steps were accomplished to analyze the results pertaining to laptops. Again, AMOS was utilized and all constructs were included in this analysis. The CFA for the laptops measurement model gave the following fit indices results: $\chi 2$ (751.711, df = 311, p-value < 0.001); comparative fit index (CFI) (0.928); incremental fit index (IFI) (0.929); standardized root mean residual (SRMR) (0.0438); and root mean square error of approximation (RMSEA) (0.105, 90% CI (0.096, 0.115)). The fit indices of this model, much like the tablet data, indicate adequate model fit, however, the χ^2 statistic is 2.417 which is higher than the previous fit but is still below the recommended 3.0 (Kline, 2011).

The factor loadings and the average variance extracted (AVE) for each construct were assessed for the laptops next to test for convergent validity for the combined dataset. With T2 taken out, all items loaded onto the corresponding constructs with a p-

value <0.001 and the factor loadings exceeded the recommended threshold of 0.6 (Hair et al., 2010). Even with T2 included, all constructs had AVEs above the recommended 0.50 threshold, meaning that the construct explains the variance better than what is due to measurement error (Hair et al., 2010). The factor loadings and AVEs can be seen in Table 5.

Again, the measurement for internal consistency was calculated utilizing the Cronbach's α for each construct. The results show that all the constructs for laptop use in Travis and Dover had alpha levels that exceeded the recommended minimum of 0.70 (Nunnally & Bernstein, 1994). Those results can also be seen in Table 5. Then, those were also utilized to assess the discriminant validity for the data pertaining to laptop usage. The Cronbach's α for each construct in this case was greater than the correlations of all the constructs, showing that the discriminant validity is supported. This serves as evidence of discriminant validity since all the constructs passed this test as seen in Table 4.

Table 2: Tablet Means, standard deviations, reliability, AVE, and correlations

Construct	Mean	SD	CR	AVE	PU	PEOU	TRUST	ATT	SA
PU	5.33	1.79	0.98	0.92	**0.98**				
PEOU	5.30	1.49	0.95	0.75	0.63†	**0.95**			
TR	4.60	1.56	0.93	0.70	0.64†	0.74†	**0.93**		
ATT	5.27	1.59	0.94	0.75	0.78†	0.744†	0.70†	**0.94**	
SA	5.16	1.79	0.97	0.90	0.79†	0.78†	0.73†	0.97†	**0.98**

Notes: † $p < .001$
Cronbach's α shown on diagonal

Table 3: Results of Tablets CFA

Constructs and scale items	Factor loadings	Constructs and scale items	Factor loadings
Perceived Usefulness (AVE = 0.919)		Trust (AVE = 0.703)	
PU1	0.93	TR1	0.81
PU2	0.97	TR2*	0.08
PU3	0.97	TR3	0.72
PU 4	0.98	TR4	0.87
PU 5	0.94	TR5	0.81
		TR6	0.92
Attitude (AVE = 0.747)		TR7	0.89
ATT1	0.83		
ATT2	0.87	Perceived Ease of Use (AVE = 0.745)	
ATT3	0.79	PEOU1	0.68
ATT4	0.87	PEOU2	0.78
ATT5	0.95	PEOU3	0.90
		PEOU4	0.92
Symbolic Adoption (AVE = 0.895)		PEOU5	0.94
SA1	0.95	PEOU6	0.89
SA2	0.95	PEOU7	0.91
SA3	0.93		
SA4	0.96		

Notes: All t-values were significant with $p < .001$.
* indicates item was subsequently removed from the analysis

Table 4: Laptop Means, standard deviations, reliability, AVE, and correlations

Construct	Mean	SD	CR	AVE	PU	PEOU	TRUST	ATT	SA
PU	4.15	1.97	0.98	0.92	**0.98**				
PEOU	4.61	1.75	0.97	0.84	0.83†	**0.97**			
TR	4.15	1.61	0.95	0.75	0.80†	0.82†	**0.95**		
ATT	4.19	1.94	0.97	0.86	0.84†	0.78†	0.78†	**0.97**	
SA	4.11	2.01	0.98	0.92	0.85†	0.77†	0.78†	0.97†	**0.98**

Notes: † $p < .001$
Cronbach's α shown on diagonal

Table 5: Results of Laptops CFA

Constructs and scale items	Factor loadings	Constructs and scale items	Factor loadings
Perceived Usefulness (AVE = 0.919)		Trust (AVE = 0.703)	
LPU1	0.96	LTR1	0.85
LPU2	0.96	LTR2*	-0.12
LPU3	0.97	LTR3	0.80
LPU 4	0.97	LTR4	0.89
LPU 5	0.93	LTR5	0.88
		LTR6	0.88
Attitude (AVE = 0.747)		LTR7	0.89
LATT1	0.89		
LATT2	0.92	Perceived Ease of Use (AVE = 0.745)	
LATT3	0.88	LPEOU1	0.86
LATT4	0.96	LPEOU2	0.87
LATT5	0.98	LPEOU3	0.97
		LPEOU4	0.97
Symbolic Adoption (AVE = 0.895)		LPEOU5	0.92
LSA1	0.98	LPEOU6	0.91
LSA2	0.99	LPEOU7	0.90
LSA3	0.93		
LSA4	0.93		

Notes: All t-values were significant with $p < .001$.
* indicates item was subsequently removed from the analysis

Structural Model Results

The fit of the structural model was analyzed primarily to identify if the hypotheses were acceptable for testing. The results for the Travis and Dover dataset pertaining to tablets were: (χ^2 = 600.437; df = 311; normed χ^2 = 1.931; p < 0.001; CFI = 0.94; IFI = 0.94; SRMR = 0.064; RMSEA = 0.085 with a 90% CI of (0.075, 0.095)). Similarly, the results for the same locations for the laptop dataset were: (χ^2 = 751.711; df = 311; normed χ^2 = 2.42; p < 0.001; CFI = 0.928; IFI = 0.929; SRMR = 0.0438; RMSEA = 0.105 with a 90% CI of (0.096, 0.115)). Both of the models results deemed acceptable for hypothesis testing, additionally, the exogenous and endogenous variables were tested for both direct and mediating effects.

The hypotheses testing was accomplished through structural equation modeling, again, using AMOS. As suggested by Zhao, Lynch, & Chen, (2010), bootstrap tests on the indirect effects were used to evaluate the mediating hypothesis. To calculate the effect of the mediation pathway with a 95% confidence interval, Shrout and Bolger's (2002) bias-corrected bootstrap method was used with 5,000 re-samples for each technology package's dataset.

The controls of age, gender, and rank on SA were also analyzed from the Travis/Dover dataset and were not found to have significant impact. The results for the tablets show: Age on SA (γ = -0.012, z = 0.007, CR = -1.911, p = 0.056), Gender on SA (γ = -0.014, z = 0.123, CR = -0.115, p = 0.909), and Rank on SA (γ = 0.028, z = 0.026, CR = 1.063, p = 0.288). The result for laptops were: Age on SA (γ = -.005, z = 0.006, CR = -0.717, p = 0.474), Gender on SA (γ = -0.081, z = 0.119, CR = -0.679, p = 0.497), and

Rank on SA ($\gamma = 0.008$, z = 0.026, CR = 0.311, $p = 0.756$). Since these results do not demonstrate significance to the model, they have been removed from the final version.

Investigative Question #2: How are personnel's attitudes related to symbolic adoption?

To answer this investigative question it was hypothesized in H1 that Attitude toward system use will be positively related to Symbolic Adoption. This was confirmed with the results for the Travis/Dover tablet data being: ($\gamma = .976$, z = .105, $p = 0.001$). Similarly, this hypothesis was also confirmed for the Travis/Dover laptop data with the results being: ($\gamma = .976$, z = 0.078, $p = 0.001$).

Investigative Question #3: What are personnel's perceptions of the ease of use of the identified technologies?

Hypotheses H2b states that Perceived Ease of Use will be positively related to Attitude toward system use and that was verified by the results of: ($\beta = 0.311$, z = 0.082, $p = 0.001$) for the tablet data. However, H2b was not confirmed with the laptop dataset: ($\beta = 0.129$, z = 0.109, $p = 0.235$). Hypothesis H2a postulated that PEOU will be positively related to SA. The tablet and the laptop dataset results show that this hypothesis is not supported with the following results respectively: ($\gamma = .13$, z = 0.067, $p = 0.05$) and ($\gamma = -0.034$, z = 0.068, $p = 0.618$).

Investigative Question #4: What are the personnel's perceptions of the usefulness of the identified technologies?

Hypothesis H3a predicted that PU will be positively related to Attitude toward system use. The results show that this hypothesis is supported for both technologies:

tablets being (β = 0.386, z = 0.065, *p* = 0.001) and laptops being (β = 0.544, z = 0.098, *p* = 0.001) for the Travis/Dover dataset. However, contrary to the previous hypothesis, the results for H3b demonstrated that PU was not deemed to have a significant direct relationship with SA with the results for tablets being (γ = 0.072, z = 0.056, *p* = 0.203) and the results for the laptop data was (γ = 0.094, z = 0.067, *p* = 0.162).

Investigative Question #5: What are the personnel's perceptions, relative to trust, toward the identified technologies?

Hypothesis H4a postulated that Trust will be positively related to Attitude toward system use in an effort to answer IQ5. This hypothesis for tablets was not supported while it was supported for the laptops: (β = 0.147, z = 0.087, *p* = 0.09), (β = 0.267, z = 0.115, *p* = 0.02) respectively. Similarly, hypothesis H4b states that Trust will be positively related to SA. This hypothesis was not supported by either dataset for the technologies with the results being: tablets (γ = 0.037, z = 0.066, *p* = 0.577) and laptops (γ = 0.065, z = 0.073, *p* = 0.372).

Investigative Question #6: How are usefulness, ease of use, and trust related to personnel's attitudes towards using the identified technologies?

To answer IQ6 it was hypothesized by H5a-c that Attitude will be a mediator for the constructs of PEOU (a), PU (b), and Trust (c) to the dependent variable SA. These hypotheses were supported by all the results for the tablet dataset being: PU to ATT to SA (γ = 0.377, 95% CI (0.291, 0.47), *p* =0.001), PEOU to ATT to SA (γ = 0.303, 95% CI (0.198, 0.418), *p* =0.001), and Trust to ATT to SA (γ = 0.143, 95% CI (0.043, 0.257), *p* = 0.005). The laptop dataset also supported these hypotheses except for one item (H5a):

PEOU to ATT to SA (γ = 0.126, 95% CI (-0.091, 0.374), *p* = 0.349). The other two, H5b and H5c, however, did support the hypothesis with the results being: PU to ATT to SA (γ = 0.53, 95% CI (0.297, 0.801), *p* =0.001) and Trust to ATT to SA (γ = 0.26, 95% CI (0.059, 0.525), *p* = 0.024). The results of these tests are summarized in Tables 6 – 7 and Figures 2 - 3.

Table 6: Structural Equation Model Tablet Results

Structural path	Hypothesis	Effect	SE	t-value	*p*-value	LCL	UCL	Supported
ATT → SA	H1	0.976	0.105	9.275	0.001	---	---	Yes
PEOU → ATT	H2a	0.311	0.082	3.796	0.001	---	---	Yes
PEOU → SA	H2b	0.13	0.067	1.959	0.05	---	---	Yes
PU → ATT	H3a	0.386	0.065	5.98	0.001	---	---	Yes
PU → SA	H3b	0.072	0.056	1.272	0.203	---	---	No
TRUST → ATT	H4a	0.147	0.087	1.695	0.09	---	---	No
TRUST → SA	H4b	0.037	0.066	0.558	0.577	---	---	No
PEOU → ATT → SA	H5a	0.303	0.112	---	0.001	0.198	0.418	Yes
PU → ATT → SA	H5b	0.377	0.091	---	0.001	0.291	0.47	Yes
TRUST → ATT → SA	H5c	0.143	0.111	---	0.005	0.043	0.257	Yes

Note: *Bootstrap upper and lower confidence intervals for the indirect effects

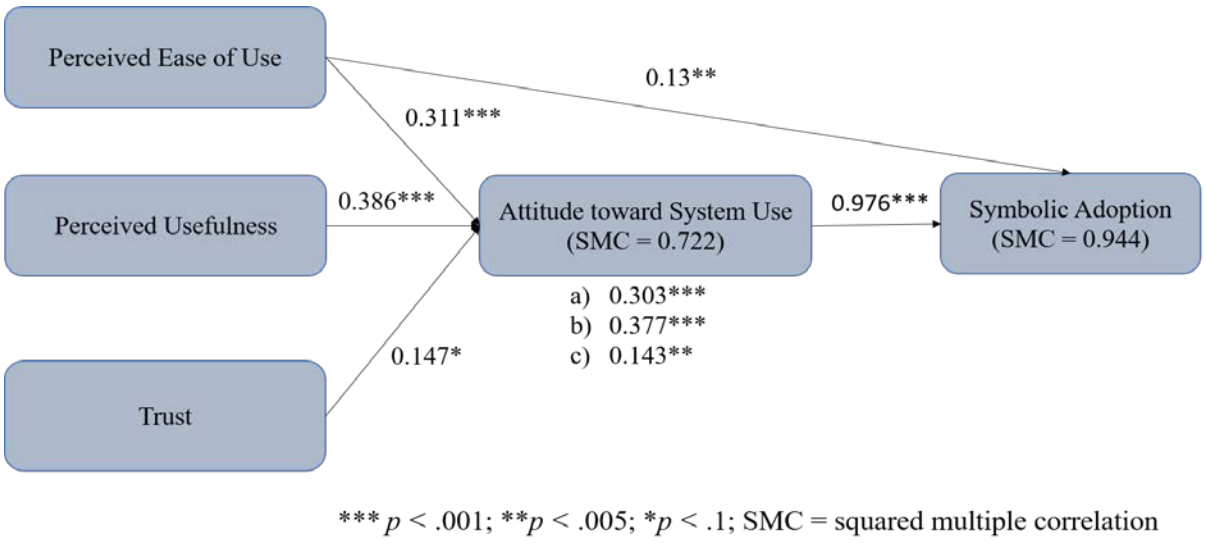

Figure 2. Final Tablet SEM Model

Table 7: Structural Equation Model Laptop Results

Structural path	Hypothesis	Effect	SE	t-value	*p*-value	LCL	UCL	Supported
ATT → SA	H1	0.976	0.078	12.567	0.001	---	---	Yes
PEOU → ATT	H2a	0.129	0.109	1.187	0.235	---	---	No
PEOU → SA	H2b	-0.034	0.068	0.499	0.618	---	---	No
PU → ATT	H3a	0.544	0.098	5.562	0.001	---	---	Yes
PU → SA	H3b	0.094	0.067	1.399	0.162	---	---	No
TRUST → ATT	H4a	0.267	0.115	2.32	0.02	---	---	Yes
TRUST → SA	H4b	0.065	0.073	0.893	0.372	---	---	No
PEOU → ATT → SA	H5a	0.126	0.144	---	0.349	-0.091	0.374	No
PU → ATT → SA	H5b	0.53	0.152	---	0.001	0.297	0.801	Yes
TRUST → ATT → SA	H5c	0.26	0.143	---	0.024	0.059	0.525	Yes

Note: *Bootstrap upper and lower confidence intervals for the indirect effects

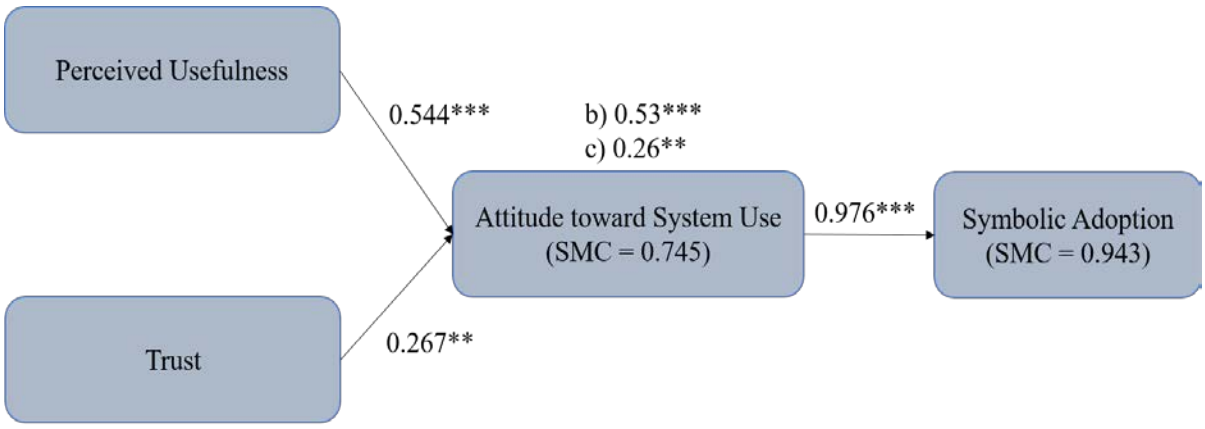

Figure 3. Final Laptop SEM Model

Summary

This chapter outlined the results of the qualitative phase of this study by means of interviews and the statistical analysis from the quantitative phase of this study collected via survey. The latter was accomplished by describing the tests that were utilized to measure the strength of the constructs individually and the overall strength of the proposed model, including the investigative questions and the corresponding hypotheses. This was done for both of the proposed models that were tested, namely: (1) tablet with Bluetooth connected handheld scanner and (2) laptop with built-in scanner and carrying harness. The results were all displayed as well as the final models for each technology in question.

V. Conclusions and Recommendations

Chapter Overview

The purpose of this chapter is to discuss the conclusions of this research including the significance that this research holds for AMC and subordinate units in making decisions on which technology to implement regarding personnel's attitudes to maximize user acceptance. This chapter is also meant to outline recommendations for action from all those units as well as provide recommendations for future research. These future research recommendations may not only benefit AMC and the subordinate units that may be affected but may also benefit future students' research that wish to aid AMC in the Port of the Future initiative.

Discussion

The results of the tablet dataset illustrate that ATT has a strong impact on SA. This finding aligns with the findings of Nah et al., (2004) that ATT is the main component in determining SA, in this case with an SMC of 0.944. The final model of this dataset also demonstrates the importance of ATT in a mediating role, being impacted by all antecedents. These results lead one to believe that in general, personnel will have a positive attitude about using the tablets as long as they are easy to use, and to a lesser degree, useful, then trustworthy. The final model also leads to believe that PU and Trust are not the most important aspects in order for personnel to have positive attitudes and accept the technology.

The results from the laptop data differs from that of the tablet results by eliminating PEOU completely. There is no evidence of direct or indirect influence on

ATT or SA on the participants, showing that with a significant statistical difference, they do not worry about how easy a laptop may be to use. This may be because personnel may already be comfortable with using a laptop and have confidence in their abilities to use one as laptops have been around longer than tablets. At the same time, participants want this hardware to be useful and they want to trust it. Similarly to the tablet data, ATT has a strong impact on SA, while mediating the independent variables. If personnel have positive attitudes because the laptops are useful and work correctly, they will have a higher probability of accepting and utilizing the technology provided.

The results of both of these models have great potential in the aiding leadership at all levels in implementing technology in their organizations. One of the most important aspects for any organization is the attitude of their workforce. These models show one way to strongly influence those attitudes in a way that impacts personnel on many levels. If leadership of organizations can gain perspective from their personnel on what they desire and actually deliver it, personnel will have better attitudes and want to use the tools provided to them.

If leadership decides to disregard personnel's opinions on technology, organizations can face unnecessary, self-inflicted challenges. Attitudes toward the technology provided may not be the only opinion that is negatively impacted by poor leadership decisions regarding technology. Personnel may lose confidence in their leadership and organization that can lead to poor attitudes, declining efficiencies, low retention rates, and wasted money on technology that is not being used as much as intended or maybe not at all.

Conclusions of Research

The statistical results reveal that both hardware options would be acceptable in Airmen's eyes if they function properly with quality internet. Some sections may benefit from having a laptop with a harness more than having a tablet and vice versa. This would be left up to the local leadership of each unit to make that determination and would benefit extremely by taking into consideration the opinions and recommendations from the personnel in those sections.

The results show that tablets have a slightly more accepting opinion from the end users over the laptops. This may be because of the more compact nature of tablets making them easier to carry around. This coincides with the information that the AMS at Hickam gave to AMC stating that the laptops were more cumbersome and heavy, making it more physically demanding and awkward, with the laptops sometimes getting in the way. The tablets are easier to set down or hand off to someone else as well as the scanner having a holster that is easily clipped onto a belt or waistline. Additionally, the report from Hickam gave a comparison of cost and quality of the laptops compared to the tablets and found that not only are the laptops more expensive, they were also more fragile and had to be sent in for repairs that could take weeks to get them back in working order.

In addition to the analysis conducted on the constructs and the models, the data from Travis/Dover was utilized to compare the participant's opinions across the hardware packages. This was accomplished using a One-Sample t-Test. There was a significant difference in every construct comparing the technologies in favor of the tablets. Meaning that, even though both technological tools would be accepted with a high likelihood of

SA, the tablets would have the best probability of successful implementation. The results of those t-tests are summarized in Table 8.

Table 8: Travis/Dover Tablet vs. Laptop One-Sample t-Test

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Tablet PU	33.855	128	.000	5.32942	5.0179	5.6409
Laptop PU	23.986	128	.000	4.15300	3.8104	4.4956
Tablet PEOU	40.541	128	.000	5.30318	5.0444	5.5620
Laptop PEOU	29.990	128	.000	4.61429	4.3099	4.9187
Tablet Trust	33.503	128	.000	4.60399	4.3321	4.8759
Laptop Trust	29.341	128	.000	4.14926	3.8694	4.4291
Tablet ATT	37.669	128	.000	5.27417	4.9971	5.5512
Laptop ATT	24.459	128	.000	4.18710	3.8484	4.5258
Tablet SA	32.797	128	.000	5.16143	4.8500	5.4728
Laptop SA	23.200	128	.000	4.10887	3.7584	4.4593

The tablet SA results from the Travis/Dover data were also compared to those received from the 735th AMS at Hickam, who has already implemented tablets into their organization after experimenting with them and the laptops. This comparison was done using a t-Test of two samples assuming unequal variances and shows SA compared to current adoption levels. The results show that there was not a statistical difference between the locations and states of implementation. The results are summarized in Table 9.

Table 9: Travis/Dover SA versus Hickam Tablet Adoption

	Travis/Dover	*Hickam*
Mean	5.16	5.12
Variance	3.19	2.77
Observations	129	37
Hypothesized Mean Difference	0	
df	62	
t-Stat	0.14	
P(T<=t) one-tail	0.45	
t Critical one-tail	1.67	
P(T<=t) two-tail	0.89	
t Critical two-tail	2.00	

t-Test: Two-Sample Assuming Unequal Variances

Significance of Research

The significance of this research is that it will help AMC and subordinate units in deciding what technology they may want to try and use on a permanent basis as things develop for the Port of the Future. It also helps spell out what the people want to see to maximize potential buy in and adoption of technology and can help to minimize the waste of dollars spent on less than adequate equipment. This research can also decrease the amount of lost man-hours from Airmen having to troubleshoot potential errors that can reduce productivity. As AMC units implement the correct technology for their personnel and mission set, they could also increase efficiency and effectiveness AMC wide, increasing the velocity of military transportation.

These tools, if implemented correctly, could help in the confidence level of Airmen in their duty performance while also increasing their confidence in AMC and the Air Force as a whole. This could improve retention rates, balance out the degree of overuse of the “rock star” airman and put more responsibilities on the “average” airmen. The publicity of increasing technology in the Ports, not just with this small step, but with

the other impressive steps resulting from the Port of the Future initiative, more Airmen may want to join the ranks of the "Port Dawgs" and thus increase the morale and improve the overall culture and attitude of the Aerial Ports.

On the other hand, if not carried out appropriately, implementation can have the opposite effect, making airmen agitated that they must use technological tools that do not work, forcing them to lose time and waste energy on worthless activities when they have too much to do already. This could, in turn, decrease morale, decrease retention rates, increase safety incidents, decrease efficiencies and effectiveness of the mission and influence negative attitudes towards leadership and the organization. Again, as stated earlier in this research, "A system that does not help people perform their jobs is not likely to be received favorably in spite of careful implementation efforts." (Robey, 1979; p. 537).

Another potential benefit of this research is that these technologies could pay for themselves by saving money spent on paper, toner, copy machines, maintenance, and reordering costs of these products. These products will not be completely done away with but can be reduces dramatically if the technology that is purchased to replace them is high quality and reasonably priced. Additionally, this research has provided models that can be used along with those from the previous literature, in the research to understand attitudes and perceptions of personnel on innovations in mandatory environments including military settings.

Recommendations for Action

Too often, people and organizations want amazing results but refuse to spend the necessary money to obtain them. Because of this research, it is recommended that AMC

be willing to spend the appropriated amount of money for top of the line Wi-Fi and hardware, maximizing the likelihood that these investments work properly. With that, some sections may want different hardware than others, therefore, it is also recommended that leadership take that into consideration as well before making the purchase. Not only will this improve the likelihood that the technology will work properly but also to maximize user buy in and acceptance.

If these investments are on quality products, that are durable, with the highest performance for the money, then the Wi-Fi availability is a must. The hardware will be deemed useless unless it is accompanied with high speed reliable internet that reaches everywhere the job requires. The units must be free to purchase quality internet that does not have dead spots that can cause reasons to reconnect. If it is slow and unreliable then there is no reason to pursue this implementation of technology because it will be a waste of money and time. Reliable high speed Wi-Fi is the foundation that this initiative will be built on, if done improperly, it will all crumble and fail with minimal tribulations.

If the infrastructure is built to sustain these technologies, then either technology could have a high potential of adoption because the SMC was high with a .94. This evidence implies that if there is quality hardware paired with quality internet, the technology will be used. One of the factors in common between the final models is that each included PU as an important factor, suggesting that if the technology is not deemed useful by the users, there will be a negative impact on their attitudes toward it and their willingness to use it. Another important factor is that most of the airmen in today's Air Force are technologically savvy, having their own tablets, laptops, and smartphones for years, giving them much experience with handheld devices.

Recommendations for Future Research

This research could be expounded by sending the survey out to all the AMC units as originally intended but could not because of the constraint of time. The leadership of AMC has already expressed consent and support in this realm of research and the results could be impacted with a more complete sampling of the population. This approach can also be utilized to understand attitudes and perceptions of personnel regarding other technology that may be implemented in the Aerial Port of the Future initiative or other technology innovations in the Air Force and the DoD. This model could also be adapted with other constructs to test for other potential factors that could impact symbolic adoption. Finally, more information could be collected and analyzed after more units have adopted technology to see if and to what extent these products have either increased or decreased productivity.

Summary

This chapter explained the conclusions of this research including the significance that this study holds for AMC and subordinate units in making decisions on which technology to implement regarding personnel's attitudes to maximize user acceptance. This chapter also outlined recommendations for action from all those units as well as provided recommendations for future research. These future research recommendations may not only benefit AMC and the subordinate units that may be affected but may also benefit future students that wish to aid AMC in the Port of the Future initiative.

Appendix A: Interview Questions

Name:

Organization/Position:

Year of Experience (in Aerial Port/in current position):

In this research, we are examining attitudes and perceptions of proposed technology to be utilized by Aerial Port personnel in regards to AMC's Port of the Future initiative. First we want to identify what would that technology be. As we narrow down those possibilities, we can use the proposals in a survey administered to the potential end users to understand what their attitudes and perceptions of those ideas are.

The goal behind obtaining this information is to aid in AMC in promoting the vision of future aerial port operations and give AMC leadership insight to what the personnel want to see. This is in an effort to match visions from both sides of the spectrum in hopes of providing an end product that is trusted, easy to use, and overall useful.

Proposed Technology

1. What capabilities do you anticipate the Aerial Ports having with this technology?
2. Would this effort be for all aerial port operations or just those performed on the flight line?
3. What hardware do you think would be best to accomplish this?
4. What software do you think would be best to accomplish this?
5. What would the sustainment picture for both the hardware and software look like?

Appendix B: Paper Survey

Aerial Port of the Future Survey: Developing Paperless Operations Wi-Fi Connected Devices

The Air Force Institute of Technology and Air Mobility Command are inviting you to complete this survey with the goal of identifying and understanding the attitudes and perceptions of Aerial Port personnel toward proposed technological tools. This technology is to be utilized in a step forward in AMC's Port of the Future initiative to help increase effectiveness and efficiency. Those have been identified as either:

1) A tablet with a Bluetooth connected hand-held bar code scanner with holster or,

2) A laptop with built-in bar code scanner with an optional carrying harness to aide in transportability.

Both options in this survey are to be assumed to be Wi-Fi connected.

The intent of these technologies is to help Aerial Port personnel in inventory management, cargo in-check, portable digital forms, T.O.'s, G.A.T.E.S. and other internet access, etc. This survey has two sections, one on your thoughts of each hardware option.

The information you provide will be used to aid AMC leadership by giving insight into what Aerial Port personnel want to see. This is an effort to match visions from both sides of the spectrum in hopes of providing an end product that is trusted, easy to use, and overall useful.

Please read the information below before deciding whether or not to participate.

- This survey is voluntary.
- Your decision not to participate or withdraw from participation will not jeopardize your relationship with the Air Force Institute of Technology, Air Mobility Command, The U.S. Air Force, or the Department of Defense.
- You have the right not to answer any question, and to stop the survey at any time or for any reason.
- The survey is expected to take approximately 20 minutes.
- Your responses will be kept strictly confidential with one exception. We cannot provide confidentiality to a participant regarding comments involving criminal activity/behavior, or statements that pose a threat to yourself or others.

- Do NOT discuss or comment on classified or operationally sensitive information.
- You will not be compensated for this survey.
- This project will be completed by February 2018. All survey responses will be stored in a secure server until 1 year after that date. The survey responses will then be destroyed.

  Thank you so much for participating in this survey. Your feedback is important.

1. **What is your age in years?**_____
2. **What is your gender?** **O** Male **O** Female
3. **What is your current rank?**_____
4. **What is your current duty section/flight?**_____
5. **What is your current work shift?**_____

The following questions are in regards to your thoughts on a Wi-Fi connected tablet with a Bluetooth bar code scanner with holster similar to the images above. On the scale next to each question, please indicate how much you agree or disagree with the following statements pertaining to your current duty position.

Using a Wi-Fi connected tablet and bar code scanner in my job. . .	Disagree						Agree
Will enable me to accomplish tasks more quickly.	1	2	3	4	5	6	7
Will improve my job performance.	1	2	3	4	5	6	7
Will increase my productivity.	1	2	3	4	5	6	7
Will make it easier to do my job.	1	2	3	4	5	6	7
Will be useful.	1	2	3	4	5	6	7

With respect to using a Wi-Fi connected tablet and bar code scanner. . . .	Disagree						Agree
I believe it will be easy for me to remember how to perform my regular job assignments.	1	2	3	4	5	6	7
I believe learning to operate them will be easy for me.	1	2	3	4	5	6	7
I believe I will find it easy to get it to do what I want it to do.	1	2	3	4	5	6	7
I believe my interaction with it will be clear and understandable.	1	2	3	4	5	6	7
I would find it flexible to interact with.	1	2	3	4	5	6	7
It would be easy for me to become skillful at using it.	1	2	3	4	5	6	7
I would find it easy to use.	1	2	3	4	5	6	7

With respect to using a Wi-Fi connected tablet and bar code scanner, I believe. . . .	Disagree						Agree
They will be compatible with other technologies I use.	1	2	3	4	5	6	7
They will be subject to frequent problems which will make it harder to do my work.	1	2	3	4	5	6	7
That a specific organization will be available for assistance with difficulties.	1	2	3	4	5	6	7
That they will have consistent high quality.	1	2	3	4	5	6	7
They will be well maintained.	1	2	3	4	5	6	7
They will perform consistently.	1	2	3	4	5	6	7
That I can trust them to help me accomplish my job.	1	2	3	4	5	6	7

In regards to using a Wi-Fi connected tablet and barcode scanner…	Disagree						Agree
It is a good idea.	1	2	3	4	5	6	7
I like the idea of using them to perform my job.	1	2	3	4	5	6	7
They will make work more interesting.	1	2	3	4	5	6	7
Working with them will be fun.	1	2	3	4	5	6	7
I will like working with them.	1	2	3	4	5	6	7

With respect to using a Wi-Fi connected tablet and bar code scanner . . .	Disagree						Agree
I am excited about using them in my workplace.	1	2	3	4	5	6	7
I can’t wait to see the full roll-out of them.	1	2	3	4	5	6	7
I intend to use them to perform my job once it has been rolled out.	1	2	3	4	5	6	7
I would want to use them frequently upon their roll-out.	1	2	3	4	5	6	7

The following questions are now about your thoughts of using a Wi-Fi connected Laptop with a built-in (not hand-held) scanner and an optional carrying harness as seen in the images above. On the scale next to each question, please indicate how much you agree or disagree with the following statements pertaining to your current duty position.

Using a Wi-Fi connected laptop/scanner with optional carrying harness in my job. . .	Disagree						Agree
Will enable me to accomplish tasks more quickly.	1	2	3	4	5	6	7
Will improve my job performance.	1	2	3	4	5	6	7
Will increase my productivity.	1	2	3	4	5	6	7
Will make it easier to do my job.	1	2	3	4	5	6	7
Will be useful.	1	2	3	4	5	6	7

With respect to using a Wi-Fi connected laptop/scanner with optional carrying harness. . . .	Disagree						Agree
I believe it will be easy for me to remember how to perform my regular job assignments.	1	2	3	4	5	6	7
I believe learning to operate them will be easy for me.	1	2	3	4	5	6	7
I believe I will find it easy to get it to do what I want it to do.	1	2	3	4	5	6	7
I believe my interaction with it will be clear and understandable.	1	2	3	4	5	6	7
I would find it flexible to interact with.	1	2	3	4	5	6	7
It would be easy for me to become skillful at using it.	1	2	3	4	5	6	7
I would find it easy to use.	1	2	3	4	5	6	7

With respect to using a Wi-Fi connected laptop/scanner with optional carrying harness, I believe. . . .	Disagree						Agree
They will be compatible with other technologies I use.	1	2	3	4	5	6	7
They will be subject to frequent problems which will make it harder to do my work.	1	2	3	4	5	6	7
That a specific organization will be available for assistance with difficulties.	1	2	3	4	5	6	7
That they will have consistent high quality.	1	2	3	4	5	6	7
They will be well maintained.	1	2	3	4	5	6	7
They will perform consistently.	1	2	3	4	5	6	7
That I can trust them to help me accomplish my job.	1	2	3	4	5	6	7

In regards to using a Wi-Fi connected laptop/scanner with optional carrying harness…	Disagree						Agree
It is a good idea.	1	2	3	4	5	6	7
I like the idea of using them to perform my job.	1	2	3	4	5	6	7
They will make work more interesting.	1	2	3	4	5	6	7
Working with them will be fun.	1	2	3	4	5	6	7
I will like working with them.	1	2	3	4	5	6	7

With respect to using a Wi-Fi connected laptop/scanner with optional carrying harness. . .	Disagree						Agree
I am excited about using them in my workplace.	1	2	3	4	5	6	7
I can’t wait to see the full roll-out of them.	1	2	3	4	5	6	7
I intend to use them to perform my job once it has been rolled out.	1	2	3	4	5	6	7
I would want to use them frequently upon their roll-out.	1	2	3	4	5	6	7

Appendix C: Online Survey Sample

Tablet with Bluetooth Scanner and Holster

1. Using the WiFi connected tablet and bar code scanner in my job enables me to accomplish tasks more quickly.

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree or Disagree	Somewhat Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

Additional Comments (Optional)

2. Using the WiFi connected tablet and bar code scanner improves my job performance.

Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree or Disagree	Somewhat Agree	Agree	Strongly Agree
○	○	○	○	○	○	○

Additional Comments (Optional)

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Air Mobility Command
404 W. Martin St.
Scott AFB, IL 62225
779-2417 and john.newton.1@us.af.mil
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14. ABSTRACT

Air Mobility Command (AMC) is combatting manning mismatches with antiquated processes and equipment in Aerial Port operations, and has chosen to address these issues through an initiative called "Aerial Port of the Future." This initiative is designed to understand challenges in Aerial Ports and implement technological tools, where appropriate, to aid AMC Airmen in their duties of transporting goods and personnel through military channels. Oftentimes, personnel are forced to utilize technology that may not meet their needs, and in turn may resist implementation of the imposed technology. Therefore, first, this research identifies potential technologies designed to improve Aerial Port efficiency and effectiveness. Next, through a survey of Aerial Port technicians, this study evaluates the attitudes and perceptions of personnel toward implementation and use of the selected technologies. Overall, the study provides AMC the necessary insight to increase the chances of successful implementation of "Port of the Future" technology.

15. SUBJECT TERMS
Aerial Port of the Future
Technology Acceptance Model
Symbolic Adoption
Technology Implementation

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U	**U**	**U**	**UU**	72	**19b. TELEPHONE NUMBER** *(Include area code)* (937) 255-6565, ext 4737 (matthew.douglas@afit.edu)