User Acceptance of Intelligent Air Cargo Ecosystem in Developing Countries

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Research submitted in partial fulfilment of the requirements for the degree of Bachelor of Science in Transport and Logistics Management

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May 2022

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Dr. Varuna Adikariwattage

ABSTRACT

The information technology environment that surrounds the air cargo industry is continuously changing, and airlines are investing in a variety of innovative technologies aimed to expedite air cargo operations and management in order to stay ahead of the curve. By integrating technology-based self-service (TBSS), which includes online bookings, smartphone apps, and warehouse management systems, the air cargo sector is enhancing process efficiency and lowering costs. These technologies can help airlines minimize fleet delays as well as labor and operation costs. These innovative technologies are increasingly significant considerations in keeping competitive and prospering in the air cargo market due to their value-added benefits.

Although many studies have been done about the intelligent air cargo and few research have been done to user acceptance of airline smart systems. To fill this research gap and to answer the main question of what the major factors are influencing the user acceptance of intelligent air cargo ecosystem in developing countries, this research has been conducted. Throughout the research process initially through extensive literature survey and direct and indirect interviews from the stakeholders (shippers, freight forwarders, ground handlers, custom, carriers) in the industry data is collected pertaining to the user acceptance of intelligent air cargo.

Five key factors and twenty variables have been identified using secondary data. The TAM conceptual framework was used to create these hypotheses, and the data was examined using the factor analysis approach. SPSS as well as SPSS AMOS software were applied in the analysis.

The analysis of the data with the discussion and conclusion of the results are prepared in the thesis divided each section as chapters. In the first chapter includes the overview of the industry, the research process and time plan of the research. Second chapter is included with the summary of the literature survey conducted pertaining to theories of supply chain outsourcing. Forth Fifth and Sixth chapters are respectively the data analysis, discussion, and conclusions of the research.

The four objectives intended from the research respectively are identification of applicable technology acceptance models, application of the most appropriate model to investigate the factors influencing the intelligent air cargo ecosystem and application of

the most appropriate model to investigate the factors influencing the intelligent air cargo ecosystem.

The findings of the empirical study indicated that a user's attitude toward change and mobile literacy had no bearing on an application's perceived ease of use and utility. Users either do not believe air freight mobile applications and smart systems to be novel information technology or regard them as common, universal tools because they contain distinctive, supplemental characteristics rather than new, totally inventive technology. This could be due to the sheer number of smartphone-based applications available. Furthermore, if the mental model accurately matches the mobile application, this shows that consumers rated the app's convenience and utility positively.

The impact of exogenous factors on customer resistance was investigated in this study. It looked at how user attributes, such as perceived usefulness and simplicity of use, influenced acceptance and resistance indirectly. Air freight mobile application services must be segmented, and in-depth investigations conducted accordingly.

Key words – Technology acceptance model, Intelligent air cargo, Attitude towards change, User acceptance, Intelligent literacy

ACKNOWLEDGEMENTS

The product of this research required an immense level of groundwork and analysis. From the basic framework how to perform the research until the very end of the conclusion, I have received support help and guidance from my research supervisor Dr. Varuna Adikariwattage. I would like to covey my utmost gratitude to Dr. Varuna Adikariwattage, Senior lecturer department of Transport & Logistics, University of Moratuwa for extending me the freedom to design the research while giving the best guidance to excel in every stage of the research. My special appreciation extended to Dr. Mahinda Bandara for quipping me with competencies to analyze research data through his Research Methodology sessions.

My special thanks go to Prof. Asoka Perera, Head of the department, Prof. Amal S. Kumarage former Head of the Department and all the staff members of Department of Transport and Logistics Management, University of Moratuwa for facilitating me to conduct the research, enriching me with the required skill set to retrieve and analyze data.

Special thanks to the Lecturers in the interim presentation panels for their ideas and guidance to steer my research to the correct direction. I am also sincerely thankful for my batch mates of 17 batch and the nonacademic staff of the Department of Transport and Logistics Management facilitating me in various levels to complete my research attaining the aspired goals and deliverables.

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LIST OF ABBREVIATIONS

TRA - Theory of Reasoned Action

TPB - Theory of Planned Behavior

SN - Social norms

BI - Behavior Intention

UTAUT - Unified Theory of Acceptance and Use of Technology

IATA - The International Air Transport Association

DGR - Dangerous Goods Regulation

FTK - Freight Ton Kilometers

AFTK - Available Freight Ton Kilometers

AMP - Airport Master Planning

ICAO - International Civil Aviation Organization

DSP - Dynamic Strategic Planning

IoT- Internet of Things

RFID - Radio Frequency Identification

ITU - International Telecommunication Union

GPS - Global Positioning System

BIM - Building Information Models

CFA - Confirmatory Factor Analysis

ATC - Attitude Toward Change

IL – Intelligent Literacy

MM – Mental Model

PEOU - Perceived Ease of Use

PU - Perceived Usefulness

1 CHAPTER ONE – INTRODUCTION

1.1 Overview

Today, every retailer is on the lookout for a delivery method that is both quick and dependable. In order to satisfy this demand, airlines have both speed and capacity, which challenges integrators for the high volumes and yields achieved in the shipping and delivery of the products. However, research shows that inadequacies in the air cargo supply chain, particularly in the arena of cargo management and handling had led to significant losses for the air authorities. That being said, it can be identified that by integrating their Assets and Ground Partnerships with modern smart technologies such as Internet of Things, RFID, and related methods, particularly into the cargo management, airlines may create a very lucrative service and enjoy significant benefits. In this way, airlines are able to meet the industry's increasing need for speed and capacity while also increasing their volume and profit margins. The airline's bottom line would also be benefited greatly from the implementation of such new technological solutions into their cargo management systems. However, the implementation of such novel technologies would not be resulted in the expected outcomes of the establishment such as increase and enhance efficiency, ease of use and usefulness if such implementations are not accepted/perceived by the actual users. Thus, this research intends to analyze the user acceptance level of intelligent air cargo ecosystems in developing nations, from the Sri Lankan context. The background, research problem. Research objectives and research questions, significance of the study and the research design are introduced in this first chapter of the study.

1.2 Background of the Study

1.2.1 The Air Cargo Industry

Manufacturers and shippers are connected to forwarders, off-airport cargo consolidators, and terminal processing and cargo operations facilities via a complicated distribution network in the air freight business. Cargo transported by plane is a critical component of global trade and commerce since it goes both locally and globally. Even while aero planes carry just a tiny percentage of cargo, the goods that do make it there are often very time-sensitive and valuable. When it comes to total air cargo volume, the United States (the nation with the highest volume) accounted for only 0.4% of all commercial freight, but

35.1 percent of all the goods sent as freight in 2017. (Emmanuel, 2018). High-value machinery components and industrial infrastructure, electronic elements for manufactured products, electronic goods, jewelry, and perishables like bouquets, fruits, and fresh seafood are typical instances of air cargo. Technological instruments, highly specialized tools, and equipment that need handling are examples of specialized freight. Unit load devices (ULDs) and bulk pallets are used to transport most outgoing air cargo goods from off-airport facilities to airports. Approximately 75% of all aviation freight is transported on bulk pallets (Jonathan, 2017). Shipping companies often do not know the exact path or plane that their packages will travel. Logistics technology, database systems, and computerized flight schedules are used by freight forwarders and aircraft carriers to make such judgments (IATA, 2020). To connect sources and destinations, air cargo often utilizes a hub-and-spoke network of airports, which may be used for both local and international flights. In order to reach the United States, most international aviation cargo passes through one of the several major hubs in Europe or Asia.

1.2.2 Air Cargo Management

Air freight services have grown significantly over the last two decades because of the increasing demand from customers and businesses for quick delivery. Businesses' logistics systems would be incomplete without effective transportation. Because of its social and economic impact, it is no longer considered just another luxury item. In the logistics budgets of businesses, transportation accounts for one-third to two-thirds of all expenditures. Cost of transportation contributed for 6.5 percent of market income and 44 percent of logistics expenditures in 1982, according to an analysis by the National Council on Physical Distribution Management (NCPDM). Transporting goods by air is a remarkable business that is essential to contemporary logistics because it provides a fully integrated and complete facility that provides speedy and safe transport as well as a wide range of other advantages. Because of its relative youth, the aviation sector has been instrumental in promoting economic growth in countries across the world. Because time-based strategy is the key issue for the world's most advanced enterprises, air freight and consolidated air express play a crucial role. As a result, it provides suppliers and consumers with more flexibility, allowing for quicker deliveries in time-constrained circumstances (Enarsson, 2006). Today's time-based competitiveness may benefit from air freight services, which link suppliers, focal companies, and downstream customers in complicated international supply chains. This aids in the development of both internal

and external commerce. Air logistics is focused on meeting the needs of the client and does so by providing high-quality freight transportation services. In 2012, the global air freight market was valued at around 125 billion US dollars, and this figure is expected to climb to over 160 billion USD by 2016. There is no need to produce items in order to use air freight, according to Ran Wei (2011), since contemporary information allows air logistics to reduce delivery times and speed up capital turnover, resulting in a more integrated flow of goods (information), capital (capital), and manpower. Even though air freight operations account for just 1% of the whole global commerce in terms of weight, it carries 40% of the total world trade in terms of value notwithstanding this fact (David and Stewart 2010).

1.2.3 Novel Technologies in Cargo Management

When it concerns to air cargo management, new technology may assist increase supply chain efficiency, power up operations, minimize cycle time, achieve greater efficiency, and deliver items to customers on time if used appropriately (Jonathan, 2019). Make that the new technology and procedures are compatible with each other. Using new technology to improve customer service, cut costs, and optimize supply chains may have a significant impact. Policymakers, practitioners, and individuals must be able to work together to make the most of the new technology. Information technology's impact on company performance has been studied extensively for more than two decades, and several studies have been carried out to better understand and assess this relationship. A contemporary illustration of the dynamics of technical change and economic growth is the continual proliferation of new ICT and e-business technologies among businesses (Koehlinger, 2006).

New technologies, such as the Internet of Things, have the potential to have a significant impact on logistics providers, their corporate clients, and the end users they serve. Warehouse operations, freight distribution, and last-mile distribution are all included in these advantages. In addition, they affect operational efficiency, security and safety, customer satisfaction and new business strategies. To make the most of the Internet of Things, it's important to take a step back and study how other sectors have handled similar revolutions in technology. This may serve as a guide and inspiration for the use of IoT in logistics. Logistics and the Internet of Things go together because of the millions of shipments that are transported, monitored, and stored every day. Data created by these connections and analyzed in order to get new insights may be achieved via the

use of IoT in logistics. With the use of the Internet of Things (IoT), logistics companies may unleash operational efficiencies that allow them to deliver more personalized, dynamic, and autonomous services to their clients. Sensors, actuators, and semiconductors are all falling in price, and wireless networks are getting faster, which only adds to the business benefits of IoT. It can be clearly recognized that the integration of these novel technologies would be significant in increasing air cargo management's usability, usefulness, and efficiency.

Smart warehouses in cargo management are a major area in academic study, spurred largely by contemporary industrial demands. As far as smart warehouses and logistics are concerned, a few academics have come forth with their thoughts. For the sake of this overview, it is said that "intelligent logistics" is a word that refers to a variety of logistical activities that are more intelligently managed or regulated than traditional methods. The study of Wen et al. (2018) reveals that smart logistics have a great need for automation and intelligence technologies. Our definition of "smart warehouses" is the combination of smart technology in the warehouse sector and a set of operational management strategies that help warehouses work in a "smarter" manner. They have evolved into an integrated system of advanced technology, warehouse procedures, as well management systems for the warehouse.

By 2025, the world's data volume is expected to reach 44 billion gigabytes, according to latest estimates. This is a tenfold increase above the current value. As a result, data has emerged as the industry's most valuable store of value. This data can only be used for long-term success if organizations utilize it for business purposes, such as improving their operations. Smart logistics technologies for cargo management are already widely acknowledged and widely employed in industrialized countries across the world. If a company isn't keeping up with the times, it will eventually be overtaken by its rivals. When it comes to air cargo management, IoT has the potential to increase product visibility across the supply chain, minimize fraud, fulfil customer expectations for more openness, and open up new marketing possibilities by increasing visibility.

However, it should be noted that the currently available research on this matter in developing nations are limited as it can be recognized that no matter how lucrative and useful the novel implementations in the logistic sector, including the air-cargo sector if

the active users do not perceive the implementations well and accept the new establishments and actually work within the established solutions.

1.3 Research gap and research problem

With the identified background of the study, the evidence clearly shows that the implementations of novel technologies which are oriented on smart solution providing in the general cargo management as well as air-cargo management systems in developed countries. The studies show that one of the primary reasons these institutions have enabled expected increase in performance, perceived usefulness, and efficiency in these technologies due to the high user acceptance levels to such mechanisms. The available literature is fairly limited to the implementations of smart mechanisms in cargo management, particularly in air-cargo management in developing nations, and in the limited available studies the level of acceptance of the users of such mechanisms are seldom visited by the authors. This is identified as a clear gap of research and the research problem is established to identify the major factors which influence the user acceptance level of the implementation of intelligent air-cargo solutions in developing nations, and in the context of developing nations Sri Lankan context is considered as an emerging economy in the South Asia.

1.4 Research Questions

The identified primary research question in the study is presented as follows:

1. What are the major factors which influence the user acceptance level of the implementation of intelligent air-cargo ecosystems in Sri Lanka?

1.5 Research Objectives

Based on the identified primary research question, the research objectives of the study are as follows:

1. To identify the most appropriate model to investigate the factors influencing the intelligent air cargo ecosystem.
2. To validate the user acceptance model using the data collection and analyzing.

1.6 Significance of the Study

The conduction and the execution of the study is recognized to be significant and contributes to the existing literature as it specifically and extensively focuses its scope

into the user acceptance of novel technologies in the air—cargo systems from the context of a developing nation of Sri Lanka, where the study clearly recognized that the current literature has a very limited availability of studies in the area. This would enable academics and scholars to expand their studies on the technology acceptance when it comes to developing nations. Not only that but also the results are expected add imperative value to the policymakers and the stakeholders of the Sri Lankan air cargo sector, as the study result would explain if a novel technology/smart technology to be implemented on the Sri Lankan air-cargo systems, which factor would influence the acceptance levels of the users and then the policymakers would know the level of acceptance, and which factors they should be critically considered of. Thus, it's clear that the study would contribute to both the existing literature and the current practitioners, stakeholders, and policymakers in the industry.

1.7 Design of the study

This study depended on quantitative research. Quantitative research uses statistical analysis of numerical data and objective measurement to explain the research problem related with relationships, causes and effects. According to Ary et al. (2002) typical quantitative research includes literature review, instrument development & data collection, data analysis and conclusion stages. In this study, these crucial stages have been accomplished and the stages accomplished are shown in Figure 1.

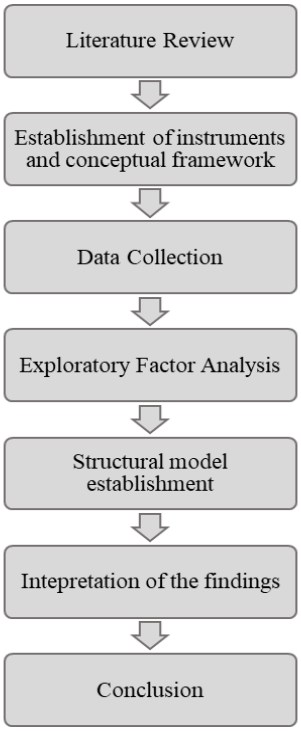

Figure 1-1 - Research design process

The first step was to pinpoint the source of the issue. The challenge is to determine if intelligent air cargo ecosystems are accepted by underdeveloped countries, with a particular emphasis on Sri Lanka. Literature relating to the management, handling, and administration of general cargo management as well as on-air cargo management was looked for during problem identification. It was determined that the Technology Acceptance Model, one of the most extensively used models for studying how users' behavioral intentions toward information technologies and applications are examined, should serve as a theoretical model after thoroughly evaluating several user acceptances models. A logistics management perspective was then applied to the research done using TAM as a theoretical framework. According to the researcher's knowledge, only a few studies have used TAM or other acceptance models as conceptual frameworks to examine the implementations of intelligent cargo management systems, although several studies have examined the user acceptance level of mobile driven intelligent solutions implemented generally without referring to TAM (Dermo, 2008; Ricketts & Wilks, 2012) and the research performed by McDonald (2013) demonstrates that independent factors influence any level of novel technology implementation in cargo management. After that, the study question was determined to be: what elements influence Sri Lankans' willingness to embrace the deployment of intelligent air cargo management ecosystems? User attitudes toward change, intelligence/technological literacy, and mental models were shown to be the most important elements influencing the adoption of innovative technologies in air cargo management facilities by examining literature from TAM studies and other investigations. A theoretical research model was suggested by including these external elements into the original TAM. Adapting scales from previously published research helped create a survey instrument for the study. The author gathered all the necessary information. Structural Equation Modelling (SEM) was used to analyze the data and construct a structural model to answer the study's major research question. Using SPSS, a confirmatory factor analysis was used to do SEM analysis. Lastly, the results and their discussion were observed and presented, highlighting the key findings and then the conclusion of the study is presented along with some identified limitation and recommendations for future studies.

1.8 Time Plan

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	
Finalization of the topic and scope													
Research proposal													
Research proposal presentation													
Literature review													
Data collection													
Data analysis													
Review and conclusions													
Interim presentation													
Final thesis													
Thesis submission													
Final presentation													
Research paper submission													

Table 1- Time plan

2 CHAPTER TWO– LITERATURE REVIEW

2.1 Chapter Overview

Recent trends and state-of-the-art findings in airport strategic planning and master planning are discussed in this section of the literature review, with a particular emphasis on air cargo facility development, in order to better understand what air cargo is, how it functions conceptually, how it should be planned, and how modern organizations are implementing new strategies in this area. Several topics emerged from this assessment that will influence future research in this area. First, leading academicians have criticized the procedures used in airport strategic development and master planning in the United States and internationally for lacking the flexibility and responsiveness necessary to deal with the sources of uncertainty at airports, which has resulted in significant over- or under-estimating of aviation interactions, which in turn has led to over- or under-building of airport facilities. Research is needed in this area to guarantee that future airport infrastructure is better prepared to satisfy future aviation requirements. Quick developments in aviation security and ecological sustainability, in addition to changes in commodity kinds, demand and technology have led to rapid changes in the air cargo business, highlighting the necessity for flexibility and adaptation in air cargo facility design. There has been a lack of study on the air freight business and airport design and development, despite the fact that passenger transportation has been thoroughly examined. Airports need to gather and use air cargo data in a more systematic fashion in order to enhance the industry's efficiency and financial sustainability. Because of this, projections might be more precise, and air freight facility development could be more focused. Therefore, in this literature review, first in the theoretical review, the theories of technology models which are widely utilized in research are analyzed and compared, which follows into the concept review, which focuses on air cargo, air cargo volumes and air cargo supply chain, followed by air cargo process analysis, focused air cargo facility management which is conducted extensively based on the available literature. This is followed by analyzing intelligent cargo management and associated technologies, which is heavily focused on the novel technologies utilized for the intelligent cargo management and the extent of the available literature on the subject.

2.2 Theoretical Models of User Acceptance in Technology

2.2.1 Acceptance of Technology

Technology acceptance, as defined by Louho et al. (2006), is the process through which individuals come to accept and make use of new technologies. The readiness of a user group to utilize IT for the tasks it is intended to serve has also been defined as an indicator of user acceptance of technology (Dillon, 2001). Acceptance may thus be seen as a consequence of user engagement in the usage of technology. Acceptance has been conceived as an outcome measure in a psychological condition which users go through when making technological choices as a vital component in deciding the success or failure of any technology (Dillon and Morris, 1996). If individuals don't adopt and make use of new technology, it has no real worth (Oye et.al, 2012). Therefore, an understanding of technology acceptability is critical since the most essential advantage associated with new advancements in technology is a rise in the supply of knowledge (Suvama and Godavari, 2012). Scholars are only interested in finding out why individuals are open to using information technology so that better techniques for creating, assessing, and forecasting how people will respond to new technology may be developed. For this reason, academics have examined a wide variety of topics relating to the adoption of technology by users, from individual user traits such as cognitive style to ideas held in the mind and the influence on conduct (Dillon 2001). Theories have been used to model and anticipate how each particular user would react to new technology when used for its intended purposes. Many of these research studies are aimed at finding ways to increase the adoption and use of new technology, as well as determining what is preventing people from doing so (Kripanont, 2007). Researchers have developed a number of theories and models for how users embrace new technology in light of fast changes in both the technology and the environment that they live in (Oye et.al, 2012). To come up with a better model, a study of current technological acceptance theories/models is necessary. In this context, the widely used technology acceptance review models of Technology Acceptance Model, Theory of Reasoned Action and the Theory of Planned Behavior are analyzed and compared.

2.2.2 Comparison of Technology Acceptance Model (TAM)s, Theory of Reasoned Action (TRA) and Theory of Planned Behavior (TPB)

The Technology Acceptance Model (TAM) and the Theory of Reasoned Action (TRA) were compared by Davis et al. (1989) and found to agree. It was from here that the three theoretically determined factors of perceived utility, perceived ease of use, and behavior intention were formulated into a model. Social norms (SN) were shown to be a poor predictor of behavior intention in this research. For example, the Theory of Reasoned Action (TRA) and the Theory of Planned Behavior (TPB) both claim that social norms (SN) play a significant role in behavior intention (BI).

Two studies, Mathieson (1991) and Yi et al. (2006), indicated that human and societal variables play a role in technology adoption. Therefore, the TAM might be expanded to include social aspects that could explain technology adoption by including TPB components. A negative correlation was found between the usage of social norm and intention to behave; however, this did not support the idea that social norm influences intention to behave. Shih and Fang (2004) also investigated the adoption of internet banking via the TPB and Disintegrated TPB and found that the research results of Venkatesh and Davis (2000) that subjective majority view was likely to have a major impact on behavioral intention to be used in mandatory surroundings, while the effect could be unimportant in a voluntary atmosphere.

Social norms measures have a weak psychometric stance and may not have any impact on customers' behavior intention, according to Davis, Bagozzi and Warshaw (1989). This is particularly true when information system applications are very personalized and individual use is voluntary. TAM was also created to address the issues of users' adoption of new system technologies (Chau and Hu 2002). Because of this, it was clear through comparisons that the Technology Acceptance Model was simple to implement in diverse research environments. The use of TAM capabilities was shown to be advantageous by Han (2003) and Lai and Zainal (2014;2015) when compared to TRA and TPB.

2.2.3 Comparison of Different Technology Acceptance Models

Venkatesh and Davis (2000) created TAM2, an extension of the TAM, because of the TAM's limitations in terms of interpretability (R2). It was hoped that the TAM2 would preserve the original TAM constructs while also including "supplemental key determinant factors of TAM's presumed usability and usage intention structures, and to

fully comprehend how the impact of these causal factors altered with expanding users' perspective with the target system" (Venkatesh & Davis, 2000). When Venkatesh and Bala (2008) included the drivers of TAMs perceived ease of use and use intention components to their TAM3 study, they were able to increase the study's robustness. As a result, TAM3 gave a full nomological network of the factors that influence the adoption of Information Technology Systems by the end user (Venkatesh and Bala, 2008).

It was found that the UTAUT model had four major predictors: performance expectations; effort expectations; social influence; and facilitation circumstances. Venkatesh et al. (2003) also found that the UTAUT model included four major moderators: gender; age; voluntariness; and expertise. As per Bagozzi (2007), the parsimonious framework and higher interpretability (R2) of UTAUT may make it a powerful model, but the method did not evaluate direct impacts that could reveal new associations and significant considerations from the study that were omitted by only subsuming under the extant predictors. Additionally, neither TAM2 nor TAM3 examined direct impacts, which might have revealed new connections and significant findings from the research.

Venkatesh and Davis (2000), Venkatesh and Bala (2008), and Venkatesh et.al (2003) were not selected because the circumstance was for product lines to be instated in the market system and the regard of subjective standard that also included society was not needed for this analysis entailing the novel technology of consideration. For example, when payment methods for information systems are highly personalized and individual use is completely voluntary, social norms measures have a poor psychometric viewpoint and may have no effect on customers' behavior intention. Rather of using UTAUT and/or TAM3, which are extensions of TAM2 that consider social norms, this research will stick with TAM2. Both TAM2 and UTAUT make use of moderators to keep their forums civil. In addition, no research on direct relationships were included in TAM2, TAM3, or UTAUT.

2.3 Theoretical Overview – Summary

As a result of the literature research, a variety of ideas, concepts, and applications for technology adoption concepts and frameworks have been discussed in this article. Different theoretical ideas, research challenges, variables, and measures are shared in the literature reviews on technology adoption models and theories. Some examples include but are not restricted to research issues and objectives; gap assessments; target market (developers vs. end-users); companies' goals; comprehension of technology adoption models and concepts predicated on available resources; and more. In order to connect to both the theoretical and practical components of technology adoption models and concepts, interested parties (such as students, professors, researchers, governments, and organizations) need to have this level of knowledge. Researchers in the future will be able to use the information from these assessments to better understand the underlying models and theories of technology adoption, both in the here-and-now and in the years to come.

2.4 Introduction

A literature assessment on the airport master plan and strategic planning literature assessment was undertaken with an eye toward air cargo facility planning and development as part of the endeavors to identify current trends and state-of-the-art research in these fields focusing fundamentally on what is air-cargo, and the literature associated with Air-cargo tracking and facility planning. Air cargo facility planning and development at airlines will benefit from this knowledge. Using these recommendations, airport operators will be able to make cost-effective, efficient, and ecologically sustainable work and development choices that address present and future technical, operational, and security issues. There were more than 40 publications assessed as part of the Literature Review. Using two levels of research, this report identifies the most important trends in air cargo facility design and development. To begin, we'll look at airport planning from a macro perspective and consult relevant literature on alternate approaches to airport design. A look at trends in airport air cargo facility planning and design, as well as environmental and regulatory challenges, operational and financial considerations, and air cargo security, is presented at the micro level of airport air cargo facility planning.

2.5 Air Cargo

Defining some of the key terms in this thesis is the purpose of this portion of the chapter. Following the definition of air freight, the various kinds of carriers and the goods they transport are discussed. Air cargo's significance to both the global economy and the obstacles that limit its expansion are also discussed in this chapter. The International Air Transport Association (IATA) (2020) defines air cargo as any and all products that are transported by an airplane. These three types of air cargo are: air freight, postal and express. Passenger planes may carry goods, either as freighters or in the cargo hold. Airlines move more than 52 million metric tons of cargo each year. Commerce by value is more than 35 percent, and volume is one percent of global trade. More than $6.8 trillion worth of merchandise is traded each day. According to these data, air freight has a considerable impact on worldwide trade competitiveness. the year 2020, according to the International Air Transport Association In the following sections, we'll go into further depth on the various air cargo kinds.

2.5.1 Air Cargo – Commodities and different types

Since the turn of the twentieth century, improvements in aircraft design have transformed the way freight and people are transported. Passenger airlines, all-cargo carriers, combination carriers, and express carriers are the four main types of air freight transport now available. In the year of our Lord (Huang 2018), Additionally, passenger airlines, all-cargo carriers, express carriers, and combination carriers are all included by Maynard, Clawson, Cocanougher & Walter (2015) in their study. The capacity of the aircraft's belly compartments is sold by passenger airlines as a means of providing cargo services. In 2015 (Maynard et al.), Traditional passenger airlines are increasingly giving cargo room in their belly compartments. Passenger airlines, on the other hand, are constrained by weight and space limits when making cargo acceptance decisions. As a result of their frequent operations, passenger aircraft are a handy choice since they can deliver at their fastest. According to Huang (in 2018).

There are no passengers aboard all-cargo vessels. In the year of our Lord (Huang 2018), To put it another way, all cargo carriers just move goods and do not provide passenger service. There are several benefits to using this factor while transporting freight. In 2015 (Maynard et al.), Because their planes are more versatile, these carriers have less restrictions on what they can carry. There is a lot of capacity for heavier and bigger supplies on wide-body or containerized cargo planes. To put it another way, High-value

commodities should be transported by freighters due to their ability to offer highly regulated transportation, direct routes, dependability, and capacity considerations, among other benefits. Ultimately this allows freighter operators to provide a high service value and earn more than 90% of the entire income of the air cargo business. These qualities. For the period 2018-2037 (World Air Cargo Forecast), Combination carriers are air carriers that operate both passenger and freight aircraft. In 2015 (Maynard et al.), In certain circumstances, air freighters are used as conjunction with passenger aircraft in combination carriers. This kind of company is frequently limited in scope, with limited services such as expedited mail or parcel delivery as well as the use of specialized cargo planes to transport pallets of freight. National carriers having their own domestic hub-and-spoke networks are often included in a combination carrier's business model. Regional entrances to international services are often their own canters. When it comes to cargo capacity, combination carriers have the ability to switch from passenger planes to freighters on routes that exhibit a high level of cargo capacity. In the year of our Lord (Huang 2018),

They provide door-to-door service for customers. Cargo hubs and a well-connected logistics network are essential for these sorts of carriers. Automated and rapid sorting and wide delivery options are the primary selling features. In the year of our Lord (Huang 2018), Larger shipments of large freight are increasingly being transported by these integrated express carriers, although smaller parcels are still the primary focus of their services. In 2015 (Maynard et al.), A wide range of cargoes are transported by many kinds of air freight carriers, each with its own capacity and characteristics. Based on the characteristics of the items and the services needed, air cargo commodities may be categorized into four categories: capital intensive, temperature sensitive, time constrained, and short product life cycle. In addition to e-commerce commodities, a wide range of items are delivered by air, such as IT components, tech goods, perishable goods such as food and Agri-products and weapons and explosives under Dangerous Goods Regulation (DGR), metal elements and live animals. Now we're in the year 2020 with Cargo. Most air cargo shipments are of great value, but they are also light and time-sensitive, according to the Guidebook for Air Cargo Facility Planning and Development. Aerospace equipment, medicines, jewelry, consumer electronics, and perishables such as flowers, fruit, vegetables, and seafood are just a few of the many examples given. In 2015 (Maynard et al.), Regardless of the method of transportation, air cargo shipments tend to

be high-value and time-sensitive cargoes. Here, we'll go into further detail on air cargo's worth.

2.5.2 Air Cargo – Value forces and restrain factors

Air cargo accounts for less than 1% of world commerce in tonnage, but it transports over 35% of global trade in value, or $6 trillion USD, every year. Air cargo's place in the transportation of commodities requiring a high degree of speed, dependability, and security is shown by the huge disparity between tonnage and value. (According to Boeing, 2018) It has been suggested that air cargo is a good indicator of global economic health, according to a Global Shippers Forum analysis. Even though it only accounts for two to three percent of overall exports and imports, it is believed to account for between 23 and 40 percent of total exports and imports. Air cargo is crucial to worldwide markets and commerce, and it supports high-value trade ties. Global Science and Technology Forum, 2015. Both agree that the value of the items being delivered by air is the major differentiator, not the weight, when compared to other means of transit in global commerce. The rise of e-commerce is one aspect that may help to alter this. A major growth engine for the air freight business is online trading, or e-commerce. Research firm Forrester predicted a 17 percent annual growth rate for cross-border e-commerce between 2017 and 2022, with sales totaling $627 billion USD. To put it another way, The expansion of air freight is influenced by a wide range of variables. Global and regional GDP growth, as previously said, is the primary engine of growth, and this increase and probable drop in air freight volumes is strongly linked. (According to Boeing, 2018) Other important elements are fueling the expansion. Shipper utilization and the number of destinations to and from which cargo is carried are both on the rise as new commodities are developed and brought to market. (According to Boeing, 2018) Despite the positive outlook for the air cargo business that may be painted by the industry's development drivers, there are also limitations that limit the potential expansion.

In addition to being an engine of expansion, e-commerce also has its own set of limitations. It has created difficulties in terms of safety and security, as well as customs procedures and management of capacity. To address these issues, IATA has issued a mandate for the air freight sector to identify collaborative solutions. To put it another way, even yet, there are a number of additional restraints that this historic business faces, all of which limit its potential for expansion. Trade limits have been put in place by governments to limit the number of products that a nation may export or import at a given

moment. Commerce quantities are controlled by these quotas, which are employed in international trade. Another hurdle to expansion is oil and fuel costs, which raise the cost of flying freight. (According to Boeing, 2018) Because of capacity constraints, many facilities are working at full capacity and cannot keep up with increasing loads. This year's CAAS To sum up, capacity constraints are a big problem and restraint when it comes to expansion. The following section of the chapter details air freight volumes expected in 2019.

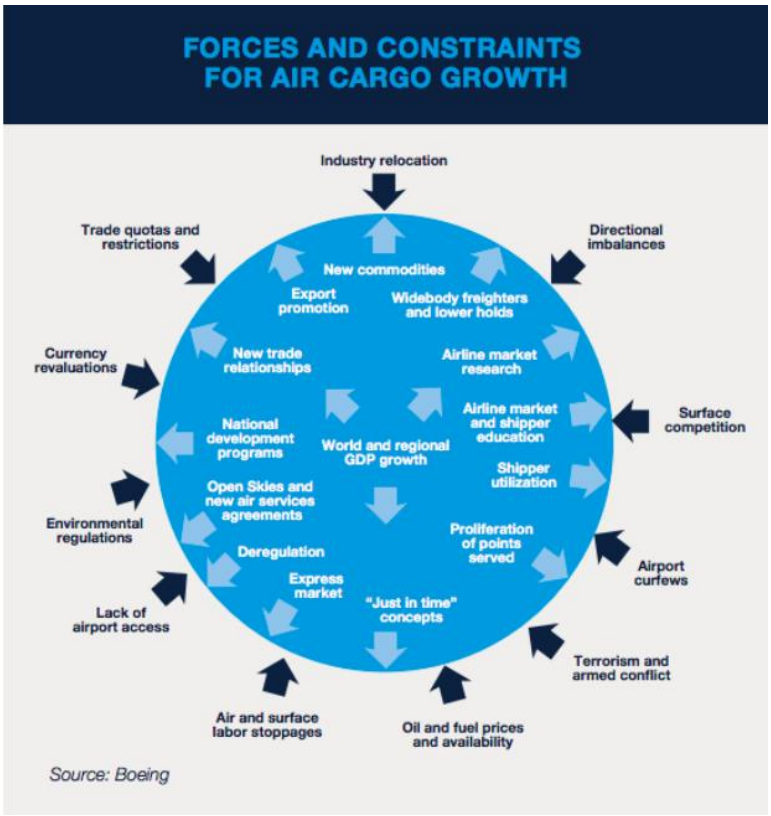

Figure 2-1- Forces and constrains for air cargo growth

2.5.3 Volumes of Air Cargo

Based on January 2020 IATA Air Freight Market Analysis, the year started on a negative note in terms of volumes. For the first time in three years, the industry-wide Freight ton kilometers (FTKs) had the lowest annual growth rate in three years. 2020 (IATA Economic Outlook). World ACD, a company that collects market statistics on the air cargo industry, estimates that revenue would be down 11.7 percent in 2020 as compared to 2019. (According to Lennane, the year is 2020.) Due to weakening global trade and economic indicators, which are both major demand drivers for air freight, prior growth has been lost, which shows how the drop in freight demand connects with it. IATA forecasts that yearly FTK growth will remain flat or perhaps decline in the foreseeable

future. The rise in capacity, which is outpacing demand, is also a factor in these statistics. The AFTKs (Available Freight Ton Kilometers) for the whole industry increased by 4% over the previous year. The yearly capacity was surpassed by demand for the 11th consecutive month in January of 2019. -2.8 percent load factor decline is the end conclusion, which explains it all. Aviation economics (IATA Economics 2019).)

In many respects, 2019 was a crucial year for the air freight business. The Air Freight Market Analysis from January of 2019 to the same analysis from December of 2019 paints a bleak picture of the future. Industry-wide FTKs fell 3.3% in 2019, the worst decrease since 2012 and the lowest since 2009's global financial crisis, according to December research. Because of rising international trade tensions, global goods commerce expanded by just 0.9 percent this year. AFTKs have grown again more (by 2.1%), resulting in a load factor fall of 2.6%. 2020 (IATA Economic Outlook). Paul claims in an essay that 2019 was the poorest year in the field since the global financial crisis, and that slower GDP growth was the primary cause of the underperformance. It's Paul 2020.

Before the COVID-19 epidemic, air freight was expected to rise at a rate of 4.2 percent per year for the following 17 years. From 256 billion Revenue Ton Kilometers (RTKs) in 2017 to gigantic 584 billion RTKs in 2037, the industry was expected to quadruple. While part of this growth would come from replacing older aircraft, much of it would be due to increasing demand projected in the years leading up to 2037. (According to Boeing, 2018) The worldwide pandemic of COVID-19, on the other hand, has drastically reduced the accuracy of these predictions. Longer than any other crises in the previous decade, COVID-19 has had a major impact on global commerce. It has had a much greater impact than the 2008 global financial crisis, which saw a five percent drop in global trade volumes at its peak. For this reason, the McKinsey Worldwide Institute predicts a reduction in global unrestricted trade demand of 13% to 22% in the last three months of 2020. However, certain projections may be made about the impact on the sector as a whole. For the logistics business, the intensity of the crisis varies depending on the product, trade routes, and method of transit. (From McKinsey & Company's 2020 strategy report.) Globe Newswire's analysis on the outlook for the global air cargo industry through 2030 predicts a 3.1% compound annual growth rate for the business, taking it from a current value of $65.4 billion in 2019 to $67.4 billion in 2020. The COVID-19 epidemic and the resulting economic downturn have been blamed for the

poor growth, according to the research. There are numerous chances for logistic companies to innovate, access new markets and improve their competitive position as a consequence of the crisis, according to McKinsey & Company's research (Research and Markets 2020). COVID-19 will have a long-term impact on the economy, and this will be reflected in increased air freight volumes. The firms who are able to adapt better to a crisis and manage the interruption and develop are the ones that will be in the lead when trade volumes resume. McKinsey & Company 2020).

2.6 Airport Air-Cargo Planning Process

An airport's long-, medium- and short-term growth strategies are outlined in an airport master plan, which is referred to as airport master planning (AMP). According to Table 2.1, a summary of research goals and main results from the airport air-cargo planning research that was analyzed is presented. According to the FAA's Advisory Circular 150/5070-6B, Airport Master Plan's, May 1, 2007, a particular defined methodology has been designed for the master planning process in the United States. Planned airport projects across the world are aided by instructions from the International Civil Aviation Organization (ICAO), as well as works by academics and practitioners who have studied the subject. The International Civil Aviation Organization (ICAO) and the International Air Transport Association (IATA) both follow the same broad set of principles (IATA, 2004; de Neufville and Odoni, 2003). Priority is generally given to developing plans than making decisions in an AMP. The most important stages of AMP are:

I. Determine the current state of affairs.
II. Preparation of aviation predictions is the primary goal.
III. Decide on the size and kind of facilities that will be needed.
IV. Come up with and evaluate the pros and cons of various options.
V. Create a comprehensive Master Plan based on the most cost-effective development option; and
VI. Plan out an airport's layout in a detailed report (ALP).

Academics and practitioners alike have grown to question the AMP approach's ability to cope with the various uncertainties inherent in airports. Aviation demand forecasting is the major way for dealing with uncertainty in AMPs. It is possible to make estimations about passenger traffic, freight volume, and even the total number of air transport movements in a given year's forecast for the aviation demand. For example, under the

Airport Master Plan (AMP), future demand for new or expanded facilities at an airport may be determined by comparing predictions to current circumstances. When it comes to airport construction, forecasting has a direct impact. As a result of forecasting's inability to accurately predict demand, airports have come under increased scrutiny for over- or underbuilding their facilities. Forecasts fail because of forecaster bias or uncertainty, according to Kwakkel, Walker, and Marchau (2010). Because of their political goal or because they are a proponent of the project, forecasts may be biassed toward making the project look more advantageous than it is. If forecasters utilize inaccurate assumptions to construct their predictions or neglect to examine economic, public policy, or political aspects that might impact projections, they may be unable to predict the future accurately. Factors mentioned as increasing forecasting uncertainty include greater rivalry among airports to recruit airlines, as well as an uptick in volatility in air traffic demand. To put it another way: (Kwakkel; Walker; Marchau; & Kwakkel) Further complicating aviation demand forecasting is the fact that demand forecasting generally depends on a single prediction, which raises the possibility of underestimating the range of possible future aviation demand development. In addition to the inherent difficulties in predicting, there are further concerns in formulating long-term growth plans for an airport. Regulatory shifts, technology advancements, and population shifts are just a few of the unknowns (Kwakkel et al., 2010).

Referred Study	**Objectives of the study**	**Findings**
Burghouwt (2007)	Airline network growth and airport planning might be adversely affected by a deregulated EU air transport industry.	Airline and airport infrastructure planning have both undergone significant modifications as a result of deregulation.
De Neufville (2001)	The new framework in which airport planners operate is discussed in light of the changes in European aviation and the ramifications for airline network behavior.	A very volatile market necessitates adaptability in airport design. Finding out how much of a role flexible planning has at European

		airports is still up for debate.
De Neufville and Odoni (2003)	In-depth look of airport development in the twenty-first century	Airport planners must use a modular, adaptable methodology to airport systems design and planning in the years to come due to significant changes in traffic volume, dispersion throughout the nation and economic sectors, physical airport structure, administration, and business practises.
Karlsson (2003)	An explanation of the incorporation of "real options" analysis into public and private system designs and how it will alter planners' approach to dealing with uncertainty and danger.	Understanding that uncertainty is not necessarily a danger to be avoided, but rather an opportunity to be seized, is one of the benefits of using "real alternatives." take a proactive approach to risk; include system design flexibility
Kwakkel (2007)	A dynamic strategic planning (DSP) strategy is used to address the development and management of airports in this book.	This relies on the benefits it has in comparison to the competition. DSP is a strategy that gives airports the flexibility to adapt to changing situations in the future.

De Neufville (2003)	The airport at Pease International Trade Port is examined in terms of how DSP is used.	While DSP is clearly needed, it might be challenging for airport planners to implement it effectively. To make sure that the advantages outweigh the costs, tools like decision analysis and options analysis should be employed.
Karlsson (2003)	Discusses airport strategic planning's struggle in dealing with ambiguity (ASP).	There are too many unknowns for AMP and ASP to handle well. Developing innovative solutions to cope with the uncertainty of the future is a major concern in air transportation research.
Kwakkel (2008)	Describes the strategies for reducing traffic during peak hours.	Robustness in the planning of these actions is critical to alleviating aircraft constraints. As a strategic planning challenge, this study proposes a novel approach for dealing with unplanned and unanticipated changes in real time. A Simple Temporal Network model of the ground handling domain is used in conjunction with Hunsberger's decoupling

		technique in order to achieve this goal
Van Leeuwen, Oei, Buzing, and Witteveen (2007)	Schiphol Airport's old master planning method was not as strong as DSP and Adaptive Policymaking (APM).	Both DSP and APM look at additional elements that might interfere with the plan's effectiveness in addition to demand concerns, which gives them a wider view on uncertainty than AMP does. Rather of making predictions about what will happen, APM and DSP wait for some of the ambiguity to clear up on its own and then respond accordingly.

Table 2 - Air cargo planning process

AMP may fail because of these uncertainties. Schiphol Airport in Amsterdam is a prime illustration of AMP's shortcomings. Improved facilities were suggested in a 1995 airport master plan to meet the anticipated growth in commercial service over the planned period from 1995 to 2015. To avoid exceeding permissible noise levels due to a substantial miscalculation of demand, the airport was forced to shut operations for a period of time in 1999. It was also discovered in 2005 that the airport's passenger capacity had exceeded its 20-year planned timeframe fifteen years early. The airports of Denver, Boston Logan, and Montreal Mirabel all failed the AMP test (Kwakkel et al., 2010). There have lately been a number of new techniques to planning that may be better equipped to cope with these kinds of unknowns. Dynamic Strategic Planning (DSP) and Adaptive Policy Approach (APA) are two more options for airport master planning (Karlsson, 2003; Kwakkel, 2008). When a result of DSP, it is possible to make plans that can be quickly changed as the scenario and conditions change throughout time. There are various phases to the dynamic strategic plan, which merely commits to the first stage and then offers other advancements in the next two and later stages, respectively. As a result of DSP's

flexibility, it is feasible to prepare for a variety of conceivable scenarios. Van Leeuwen handled peak-hour demand planning outside of the DSP process (Van Leeuwen et al 2007).

It is possible to plan in the face of great uncertainty by using a strategy known as Adaptive Policymaking (APM). Fixed, stagnant policies are unlikely to succeed in a continually changing environment. Incremental, adaptable, and conditional are the hallmarks of an adaptive strategy. Phase one of the APM process consists of developing the adaptive policy and phase two consists of putting it into action and, if required, adjusting it. Vulnerabilities found during the planning process might be addressed with mitigation measures, while unclear vulnerabilities could be hedged to increase the adaptability of the fundamental policy. Flexible and adaptive methods to airport strategy planning may be better able to cope with the various uncertainties faced by airports. As of right now, there is no one adaptable technique that can be used in airport design. Airport Strategic Planning (ASP) may be able to benefit from the principles of both APM and DSP, which are still in their infancy (Kwakkel, 2008). Following up on their first study, Kwakkel et al. (2010) delved more into the idea of developing a long-term alternative planning strategy. In order to effectively cope with the uncertainty encountered by airports, this article has proposed four characteristics that the alternative planning strategy should satisfy. These are some of the things that we look for: The planning approach should consider many different types of uncertainties, in addition to demand uncertainties.

I. The approach to planning should consider a wide range of possible futures.
II. The final strategy should be able to withstand a wide range of future scenarios.
III. The final plan should be able to be changed (Kwakkel et al., 2010).

Burghouwt has proposed Flexible Strategic Planning (FSP) as an alternative to standard AMP in addition to the DSP and APM (2007). FSP is comparable to DSP in many ways, but it also contains the idea of airports preparing ahead of time. FSP focuses on genuine choices, adaptability in planning situations, contingency planning, observation, experimenting, and diversity in order to develop a flexible strategic plan for an airport. Three adaptive planning techniques are compared and the concept for an enhanced Airport System Planning (ASP) approach is presented by Kwakkel et al. (2010), using

the strengths of each approach. The new strategy, named Adaptive Airport Strategic Planning (AASP), contains the following phases.

- **Phase 1: Setting the stage** – Analyze the airport's current state, identifying the desired outcomes, challenges, and policy choices for the proposed work.
- **Phase 2: Base policy assembling** – The core policy must be defined, as well as the circumstances essential for it to be successful.
- **Phase 3: Robustness** – Determine the policy's vulnerabilities and opportunities, and then define the steps that should be taken to prepare for or respond to them. To mitigate, hedge, size and shape are all examples of these behaviors.
- **Phase 4: Planning for contingency** – Ex Increase the scope of the policy by integrating adaptable aspects in your contingency planning. To guarantee that a policy continues to move in the correct direction and at the appropriate pace, a set of critical values (causes) of variables (signposts) are defined. An important variable to keep an eye on is demand; if it changes, the strategy should be adjusted accordingly.
- **Phase 5: Implementation** - Immediate measures are put in place together with the creation of a monitoring system (as shown in Step 4). Trigger information is gathered, policies are begun, updated, discontinued, or extended.

Any new planning strategy must be put to the test by first developing a methodology that can be used to compare its results to the existing Airport Master Planning strategy. Research in this field is highly suggested in the future (Kwakkel, 2008).

2.7 Summary of Theoretical Findings

An overview of airport strategic planning and master planning on a macro level was then followed by a closer examination of particular micro-level developments in air freight operations. Many of the articles that were studied were critical of the present airport strategic and master planning techniques. Strategic planning and master planning as it is now practiced, according to FAA and ICAO criteria, has become excessively rigid and focused on developing plans rather than making decisions. It is necessary to take a more adaptive, adaptable approach to airport strategic planning and master planning because of the uncertainties that present at these facilities. We found that, when compared to the study done on passenger air travel, there is a dearth of literature and research explicitly focused on the air freight market. Technology, product type, and demand are all factors

that influence the air freight sector. In addition, as security and environmental requirements grow, the economy will continue to be challenged. In light of these developments, air freight businesses and airports will have to adjust. To further increase air freight firms' efficiency and financial sustainability, this literature search suggested numerous topics for additional investigation. These are the locations where you'll find me:

- Forecasting future airport infrastructure needs based on air freight data collecting.
- Cargo handling and load planning efficiency may be improved by operational research.
- Air cargo businesses are doing research on revenue management systems in an effort to boost their profits.
- The air cargo supply chain has to be better understood in order to increase the cooperation between freight forwarders and shippers and to optimize the transportation of goods.

2.8 A Review of Intelligent Cargo Tracking Systems (tentative)

2.8.1 Introduction

Using the Internet of Things (IoT), a supply chain logistics management system is shown that uses an intelligent cargo tracking system. In 1999, Professor Kevin Ashton of MIT Auto-ID presented the idea of Internet of Things (IoT) in the study of Radio Frequency Identification (RFID). Research at the time concentrated mostly on RFID to gather object information by surfing the Internet address or database record in order to accomplish object identification. Since then, the Internet of Things (IOT) has grown to include a wide range of applications, including environmental monitoring, healthcare, smart homes, logistics, and forest fire prevention. Internet of Things (IoT) is a term coined by the International Telecommunication Union (ITU) in 2005 and has since been extensively utilized in freight information management. There are numerous implementations of the IOT that use sensors such as RFID, infra-red, Bluetooth, Global Positioning System (GPS), laser scanner and cameras to connect all items in order to achieve smart recognition of objects, tracking, location, monitoring, and planning in an internet-like structure referred to as supply chain logistics.

Using BIM, a digital representation of a facility's physical and functional qualities may be generated and managed in a streamlined manner. Building information models (BIMs)

become a shared knowledge resource for facility decision-making from the initial theoretical phases through design, construction, and operation until their ultimate deconstruction (Wessel, 2014). Cargo Information Modelling is proposed in this study. As part of a cargo's lifespan, this model contains all the information necessary for logistics chain management. The term "intelligent agent" (IA) refers to a self-aware computer programme that uses sensors, actuators, and software to interact with its environment in order to accomplish tasks. In addition, intelligent agents may acquire or use knowledge to attain their objectives (Wessel, 2014). A multi-agent system (MAS) is a collection of intelligent agents that work together to solve problems in the real world. If an individual agent or monolithic system is unable to address an issue, a multi-agent system may take over. They're made up of people and the places they live in. Software agents are often discussed in multi-agent system research (Woolridge, 1995). Reflex agents are defined in this work as model-based reflex agents, such as cargo containers or vehicles.

2.8.2 Cargo Information Modelling

It is the creation and administration of a digital form for the functional and physical features of a cargo that is called cargo information modelling (CIM). It is possible to track and trace cargo from its origin to its destination by using the information generated by this model-based procedure. This knowledge may then be shared with other interested parties. Physical, chemical, geometric, and shape properties are only a few examples of cargo information. Cargo information is broken down into five categories here:

- Information about the order, such as the order number, price, and the specifics of the order.
- Vehicle identity, date, location, position coordinates, status, etc. are all included in the cargo conveyance state information.
- What the management of a cargo company needs to know about a shipment's specifics such as its origin and destination, as well as the kind of cargo and its weight and value.
- Customized identification, including a custom name, phone number, location coordinates, position coordination, status, and so on.
- Identifying information for transportation companies, such as the firm name, telephone number and address.

Cargo may be in a variety of states, including a warehouse state, a loaded state, a conveyance state, an unloaded state, and an arrival state. Figure 2 depicts a Cargo's transition from one state to another.

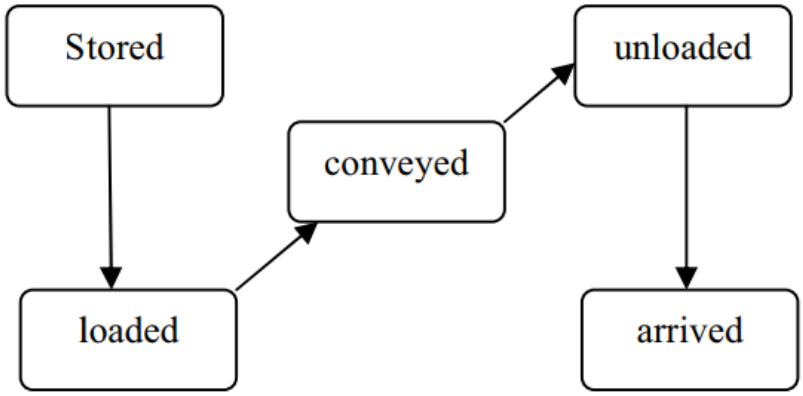

Figure 2-2 - cargo information modelling

Cargo tracking may be made easier with the help of cargo information modelling. Using a cargo database or RFIDs, you can keep track of your shipment. Cargo data storage, sensing, tracking, tracing, and processing, as well as the transmission and exchange of cargo-related data, necessitates the use of intelligent tags and RFID. Depending on the standard used, various types of cargo information may be categorized. To begin, cargo data may be separated into two categories: static and dynamic. Data that may be recorded immediately into a cargo database comprises the identity of a cargo as well as its date, type, amount, value, and manufacturing date. It is possible to save cargo data in RFIDs at the beginning of the manufacturing or conveyance process and then read and write it into a cargo database after the data has been retrieved. For a second, cargo data may be broken down into two categories, direct data about the cargo itself, and indirect data relating to the cargo, such as information about orders, cargo owners, transportation companies, and repositories, among other things. Text, images, and video files all fall under the umbrella of "cargo information."

3 CHAPTER THREE– METHODOLOGY

3.1 Overview

The empirical study's methodology and research approach are laid forth in this chapter. The philosophical foundations, logical argumentation processes, and criteria for assessing research outcomes make up the methodological framework, which serves as teaching and guidance for the selection of research methodologies (Scotland, 2012). A questionnaire survey is designed in this chapter based on positivism, logical reasoning, and the quantitative method. Using data from past empirical investigations, the measuring scales are developed. The data collecting and analysis process is then explained, followed by the discussion of how the data quality is assessed. The last section of this chapter examines the limits of the research methods used.

3.2 Research Philosophy

Basic assumptions such as epistemological, ontologies, and axiology influence researchers' selection of study methodologies and criteria in social science research. As a result of these differences in assumptions, there are a variety of study approaches. The "Research Onion," developed by Saunders et al. in 2012, is a broad guideline for developing research procedures and tactics (Figure 3.1). A methodological framework is constructed in the first phase by choosing a research philosophy in accordance with research concerns (Saunders et al, 2012).

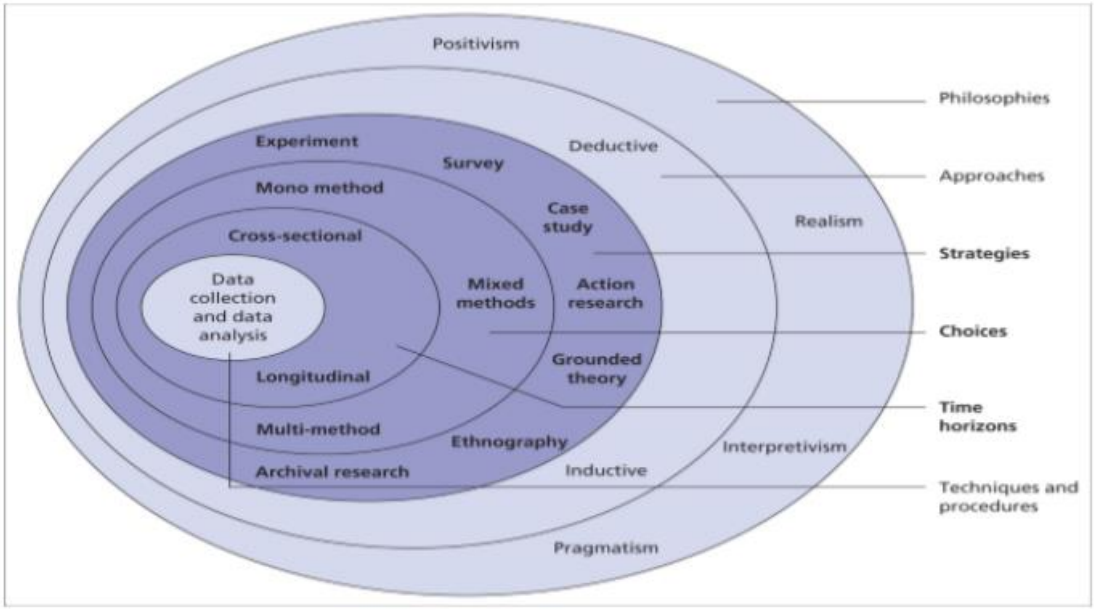

Figure 3-1 - Research Onion framework (Saunders et.al, 2012)

Positivism and interpretivism are the two prominent research ideologies in consumer behavior data analysis. They differ substantially in terms of epistemology, metaphysical, and axiological premises." (Hunt, 1991). According to positivism, the external world exists regardless of whether individuals think it does, which is known as a "positive" presupposition (epistemology). As a result, positivism encourages an objective approach to studying social processes from an outsider's viewpoint. Positivism, on the other hand, holds that only realities that can be seen may be utilized to build recognized knowledge (ontology). Furthermore, positivism embraces the value-free principle due to its objectivity, which means that the researcher is removed from the investigation and serves as a total outsider (Saunders, 2011). This means that positivism may be used if the researcher regards the things they are studying as being in the real world and is looking for objective rules in social processes (Collis & Hussey, 2013). The interpretivist view, on the other hand, holds that the world's existence is subjectively and objectively interpreted (epistemology). The nature of social phenomena, on the other hand, is subjective, numerous, and ever-changing, therefore knowledge may be formed via subjective meanings (ontology). When it comes to interpreting social phenomena and creating new information, researchers must become engaged with their investigations. A scholar is a part of his or her study in this manner (Saunders, 2011). As a result, interpretivism may be used by researchers who see their study objects as having their own unique existences and want to get a deeper understanding of social processes (Collis & Hussey, 2013).

The positivist philosophy was used in this investigation. Due to positivism's emphasis on the use of already-developed ideas and data that can be analyzed statistically (Saunders, 2011). In this study, the TAM model was used to create hypotheses, which restricted the researcher's ability to make objective interpretations. Accordingly, the research adopts a positivist approach.

3.3 Research Approach

3.3.1 Descriptive, Exploratory and Casual Research Frameworks

The first step in designing a research project is to choose a research technique. Here, we'll summarize three classifications of research: exploratory, descriptive, or causative, quantitative, or qualitative, and deductive or inductive (Table 3.1). The following is a thorough breakdown of the selection process.

Type of research	Basis of classification
Exploratory, descriptive or causal research	Purpose of the research
Quantitative or qualitative research	Process of the research
Deductive or inductive research	Logic of the research

Table 3 - Research types and clarifications

Exploratory, descriptive, and causal research are all types of study covered by Babin & Zikmund (2016). In the early stages of a project, when there is no solid proof and further study is needed, exploratory research is always utilized to identify the issue and clarify the research (Babin & Zikmund, 2016). To answer the research question, a descriptive study must offer the relevant variables in an exact and valid manner (Jackson, 2011). People, items, organizations, and surroundings may be described in greater detail in this kind of inquiry. In descriptive research, accuracy is essential. There is still a need for more study to determine the exact cause and effect of these findings. When causal conclusions must be drawn, the causal investigation is used (Babin & Zikmund, 2016). Alternatively, it might be a continuance of exploring or descriptive studies (Williams, 2007). As a result of this study's focus on determining the link between TAM model components and user acceptability, causal research was employed.

3.3.2 Quantitative and Qualitative Research Frameworks

The quantitative approach, the qualitative approach, and the mixed technique are all forms of social research methodologies. As a result, these approaches vary from one other in more than only the way they represent research data, i.e., numbers or words, but in their underlying assumptions. Since numbers have single, definite, objective, and exact meanings, positivism encourages the use of quantitative methods, which are compatible with its epistemological and ontological. While this is happening, researchers cannot freely interpret the meanings of numbers, hence employing numbers guarantees the value-free principle relied upon by positivism is maintained (Saunders, 2011). The exterior properties of sociological phenomenon, such as extent, level, volume, and strength, may be adequately described using numbers. Consequently, the quantitative technique facilitates the identification of the link between distinct items since the relationship is an external attribute that can be quantified (McCusker & Gunaydin, 2015).

The seven study hypotheses clearly illustrate the link between user adoption of technology and seven elements. These hypotheses may be tested using the quantitative technique.

Contrast this with qualitative research, which focuses on the complexity, subjectivity, and changeable nature of social processes via the interpretivist lens. Texts may be used to explain social processes from an interpretivist viewpoint since they have diverse, subjective, complicated, and variable interpretations (McCusker & Gunaydin, 2015). A lack of objective, precise, and rigorous testing of the researcher's research hypotheses is why this study does not employ the qualitative technique.

3.3.3 Inductive or Deductive Research

Researchers use deduction and induction, two polar opposing logical thinking processes, to link ideas with data. To sum it all up, empirical study may be categorized into two types: deductive and inductive approaches (Heit & Rotello, 2010). When hypotheses are tested in each context, deductive research may be used to verify or refute them. Theories are often used to establish research hypotheses, and then the researcher gathers data to see whether the hypothesis holds up under scrutiny. Here, theories are simplified to concrete rules (confirmation or disconfirmation of hypotheses) that may be applied to specific situations (Yvonne Feilzer, 2010). In contrast, an inductive technique may be used to investigate novel phenomena or to build new hypotheses. " Research hypotheses are seldom a constraint on empirical observation. Instead, it is based on a set of precise research questions that steer it. It is via this process that the scholar can identify the themes that emerge from a collection of data and Research hypotheses are developed based on the TAM theory, which is used to explain user adoption of intelligent air cargo ecosystems in the Sri Lankan setting. To answer the research questions mentioned in the introductory chapter, it will be necessary to test these research hypotheses. Deductive reasoning may be used to this research because of this. Because of these two reasons, this research does not employ an inductive technique. In the first place, new ideas or hypotheses will not be investigated here. The findings of an inductive study, on the other hand, lack logical precision and objective (Heit & Rotello, 2010).

3.3.4 Research Approach of the Study

In this study, the approach used is Confirmatory factor analysis. As a strong and versatile statistical approach, confirmatory factor analysis (CFA) is finding use throughout the spectrum of social sciences including the logistics management and administration. For example, a confounding variable is a group of observable variables that have similar response patterns and are linked to a "factor" that cannot be directly assessed (Gallagher and Brown, 2017). The factor loadings, or the amount of variance in the data that each component can explain, determine the order in which they are listed. With CFA, the scholars and practitioners in the field would be able to model the link/association(s) between the observable (or manifest) indicators and the latent (or hidden) variables underneath them (factors). An example of CFA is structural equation modelling (SEM) in which covariances and correlations between latent constructs are represented rather than structural connections between latent constructs i.e., regressions (Gallagher and Brown, 2017). Comparing exploratory factor analysis (EFA) to CFA, the latter is more data-driven and requires academics to identify all predicted measuring framework parameters explicitly (e.g., the number of factors and pattern of indicator factor correlations). Factor analysis is a method of reducing a large amount of data into a more manageable and intelligible data set (Asparouhov, & Muthén B. ,2009). Finding hidden patterns, showing how they overlap, and highlighting qualities that appear in numerous patterns are all possible with this technique. Creating a collection of variables for related items in the list is another usage for this tool (these sets of variables are identified as dimensions). Psychological research, socioeconomic circumstance, and other relevant themes might be effective data sources for this programme.

Thus, with the primary research objective is identified to identify the user attitude and the level of acceptance/resistance to the implementation of intelligent air cargo ecosystems in Sri Lankan air industry, the confirmatory factor analysis has been selected and the study is based on the said methods. The research follows the following design framework.

3.4 Conceptual Framework and Hypothesis Development

Prior studies on attitude toward transition and change, mobile/technology literacy, mental models and perceived utility and simplicity of use all contributed to the model employed in this study (Figure 3.1). Because the primary goal of this study is to examine the influence of user characteristics on the deployment of intelligent air cargo systems in

the Sri Lankan context, other TAM factors (e.g., attitude and behavioral control) are not included in research model. Arrows indicate the direction of the research hypothesis. There are only two possibilities where resistance is affected by perceived utility and perceived ease of usage.

It is common for those who embrace change to have a favorable reaction to new information technology and work hard to highlight the advantages. Users who are resistant to change, on the other side, will not utilize or embrace new technology, no matter what advantages it may have (Rosenberg et al., 1960). Hence, in order to have a better understanding of this problem, we will test the subsequent hypotheses on the link between attitude toward change, perceived utility, and perceived ease of use of the user.

1. **H1: A positive user attitude toward change has a positive effect on its perceived usefulness**
2. **H2: A positive user attitude toward change has a positive effect on its ease of use.**

Mobile literacy enables better user communication, enhances the effectiveness of business Having a firm grasp of mobile technology allows employees to communicate more effectively, which in turn boosts efficiency in the workplace. This is especially true when the level of technology and talent are on an equal footing (Martin, 2008). Increases in mobile literacy reduce stress and decreases the inclination of users to degrade their own performance, which in turn enhances performance requirements (Eastin and LaRose, 2000). New technology is easier for those who have a high level of mobile literacy. This enhances application performance since the new technology and system can be accessed more quickly by users (Mohammadyari and Singh, 2015). Internet use on mobile devices is influenced by a user's mobile skills (Choi, 2004). When it comes to the adoption of mobile skills, Lee (2005) found that self-efficacy did not directly impact the intention to use, but it did influence the desire to use via the perception of how easy it was to use Self-efficacy is a person's belief that they are capable of taking the appropriate steps in the future to deal with a given scenario (Sanchez and Hueros, 2010). Self-efficacy was shown to be an antecedent factor that influenced the perception of ease of use in a study by Lee et al. (2004) of mobile internet users. Mobile literacy seems to be a synonym for mobile skill or the idea of self-efficacy, according to this study. Mobile/technology literacy is likely to rise as a result, making it easier to comprehend

the convenience and effectiveness of airline cargo management apps. As a result, we'd want to put out and test the following hypotheses.

3. **H3: In implementing intelligent air cargo ecosystems, high levels of mobile/technology literacy have a positive effect on perceived usefulness.**
4. **H4: In implementing intelligent air cargo ecosystems, high levels of mobile/technology literacy have a positive effect on perceived ease of use.**

App convenience is heavily influenced by user mental models for smartphones, and mental models are in turn influenced by app convenience, boosting app pleasure and, as a result, enhancing customer loyalty (Jung, 2014). The intelligent air cargo management system's purpose, structure, and manner of usage all play a role in a user's mental picture of the application. Prior to being able to assure that an application is used correctly and efficiently as intended by the user, a user's mental model for that programme must represent its structure and function. It also has to show how to use the implementation of the intelligent systems correctly (Jung, 2014). The user's degree of comfort and usefulness is strongly influenced by the application's efficiency and effectiveness. As a result, we'd want to put out and test the subsequent hypotheses.

5. **H5: In implementing intelligent air cargo ecosystems, better user mental models have a positive effect on perceived usefulness.**
6. **H6: In implementing intelligent air cargo ecosystems, better user mental models have a positive effect on perceived ease of use.**

The most key TAM characteristics, perceived utility, and ease of use, have a significant impact on how people utilize technology. If one feels that using an information technology mechanism would enhance his or her performance, this is known as "perceived usefulness," and if one believes that using an information system will be "perceived easy," then this is known as "perceived effort" (Davis et al., 1989). TAM's perceived ease of use directly influences perceived usefulness as an antecedent variable. A new technology's usefulness increases in direct proportion to how easy it is to use. New technology adoption and resistance have been studied using a single model presented by several scholars (Bagozzi and Lee, 1999; Gatignon and Robertson, 1989). Research on technological breakthroughs, as well as on the deployment of those new and emerging technologies, must take the acceptance and resistance of a user into account, according to these research (Bagozzi and Lee, 1999). The more people feel that a new

technology is valuable and that it can be utilized with minimum effort, the more likely it is that the technology will be adopted. Users' rejection or objection to new technology is more probable if they find it difficult to use or of little use. High effectiveness and use efficiency enhance the chance that new technology or services are embraced by users if they are perceived to be less helpful or convenient than they really are (Lee et al., 2012). As a result, we'd like to put up the following ideas.

7. **H7: Perceived ease of use has a positive effect on implementing intelligent air cargo ecosystem's perceived usefulness.**
8. **H8: Perceived usefulness has a positive effect on implementing intelligent air cargo ecosystem's acceptance.**
9. **H9: Perceived usefulness has a negative effect on a user's resistance in implementing intelligent air cargo ecosystems.**
10. **H10: Perceived ease of use has a positive effect on a user's acceptance in implementing intelligent air cargo ecosystems.**
11. **H11: Perceived ease of use has a negative effect on a user's resistance in implementing intelligent air cargo ecosystems.**

3.5 Research Strategy

3.5.1 Questionnaire Survey

As noted in the literature, questionnaire surveys have been used to gather primary data in studies of various technology models and their practical implementations. Method of questioning large groups of people to get insight into their opinions, beliefs, opinions, experience, and backgrounds is known as a questionnaire survey (Collis & Hussey, 2013). That's why we should collect data on all seven study ideas on a massive scale. The following are some of the advantages of conducting this survey as a questionnaire. As a first step, it ensures that the data is completely objective. As a result of this separation, researchers avoid interfering with study participants throughout the data gathering procedure. The data gathering method was also less likely to be affected by researchers since the questionnaire items are highly organized and consistent (Fricker & Schonlau, 2002). Because the survey results are in a standard and organized form, data analysis is simple, and the use of statistical techniques further reduces researchers' meddling in the data collection process (Melkert & Vos, 2010). Researchers may interview many people at once and acquire a big sample for relatively modest expenses using a questionnaire

survey, which is third (Collis & Hussey, 2013). The following drawbacks of a questionnaire survey should be recognized. Data gathering is standardized, which means that researchers are constrained in their ability to acquire in-depth information. Subjects in research studies are unable to communicate their actual feelings since they must passively answer a predetermined set of questions (Couper, 2008). Because of this, it is impossible to guarantee the authenticity and trustworthiness of survey data. It is difficult to capture the essence of sociological phenomenon using a series of organized questions. Respondents, on the other hand, may not take the questionnaire properly or misinterpret the questions (Hoonakker & Carayon, 2009). Accordingly, the design of the measuring scales must be done meticulously in order to improve the quality of information.

3.5.2 Scale of Measurement

It is clear from Table 3 that all the variables in the theoretical framework of the study have already been studied by other researchers. So, the measures used in previous research might be employed in this thesis with minor adjustments. The following steps were used in creating the first draught of the questionnaire. To begin, the author looked at past empirical research' questionnaire scales. In addition, the author drew from these research applicable questionnaire scales. For the third step, the author carefully compared and picked the most suitable measures of the same variables. Finally, these measures were adjusted by the author in light of the study's research setting.

Two dependent variables (i.e., user's acceptance and resistance toward the implementation of intelligent air-cargo system in the Sri Lankan context) and five independent indicators (i.e., variables that impact technological acceptance and/or resistance), as well as four control factors, are included in the questionnaire (see figure 3.2 and table 3.2 for details) which are the gender, age, type of job, and the level of job. For each dependent and independent factor, Likert-5-Point measures were used to assess the degree of agreement from 1 (completely disagree) to 5 (Completely agree) with statements that characterize the attitudes and experiences of Sri Lankans towards the adoption of intelligent air cargo systems. There were seven variables that were converted into integers between one and five in this manner. In the meantime, Single-choice questions were used to gauge the four different types of control variables. The following are the results of the measurements:

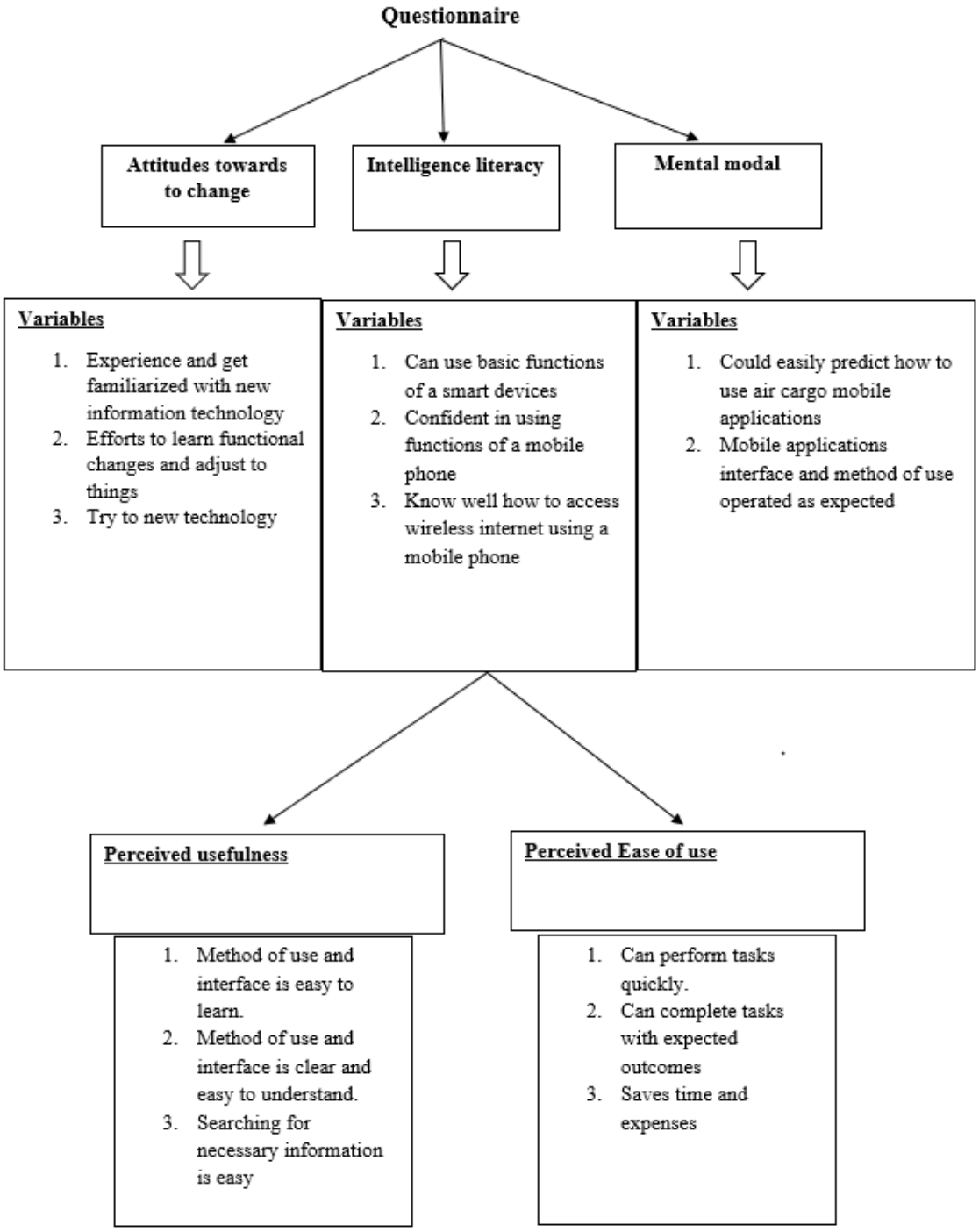

Figure 3-2 - Measurement of Scale: Graphical illustration

Measure	Variable	Adapted from
Attitude toward change	1. Experience and get familiarized with new information technology 2. Efforts to learn functional changes and adjust to things 3. Try to new technology	Moore and Benbasat (1991) Hweng (2014)
Intelligent Mobile literacy	1. Can use basic functions of a smart devices 2. Confident in using functions of a mobile phone 3. Know well how to access wireless internet using a mobile phone	Jung (2014)
Mental model	1. Could easily predict how to use air cargo mobile applications 2. Mobile applications interface and method of use operated as expected	Kim et.al (2016)
Perceived ease of Use	1. Method of use and interface is easy to learn.	Yang et.al (2019)

	2. Method of use and interface is clear and easy to understand. 3. Searching for necessary information is easy	
Perceived usefulness	1. Can perform tasks quickly. 2. Can complete tasks with expected outcomes 3. Saves time and expenses	

Table 4 - Measurement of scale

3.6 Data Collection

When we talk about primary data, we're referring to the work done by the researcher themselves to address a particular problem, while secondary data is derived from previously conducted study and then applied to a new circumstance. If a researcher has a particular research topic in mind, secondary data may fall short of providing the detail and specificity needed to provide a response to the inquiry (Johnston, 2017). Primary data will be used in this study, according to this theory, giving the researcher full control over the contents of their data collection.

Therefore, the primary data collection of the study is conducted through a questionnaire, selecting key stakeholders of the airline industry who are associated with air-cargo operations and management. In order to identify and approach these set of individuals the author had used several personal and professional connections, and also approached their related industry participants and at the end of the pre-determined period allocated for the data collection 452 individual responses were recorded for the questionnaire. It should be noted here that all the responses were collected via online as the questionnaire

was deployed online. However, the proximity of the deployment of the questionnaire was fairly limited due to the prevailing circumstances of the country and hence all the responses can be directly tied to the author.

For this study, a convenience sampling methodology was utilized, which is a non-random selection technique where study participants are chosen based on their closeness and easy accessibility to the research location (Fink, 2003). In spite of this method's limitations, the author was able to discover and get access to respondents who were eligible for this study.

3.7 Data Analysis Procedure

Initially the conceptual framework for the study is developed with the assistance of the existing literature and the primary technology acceptance model for the study to be based on is determined with its assistance. After determining this, the key indicator variables to measure the level of acceptance or resistance of the users towards implementing intelligent air cargo air systems are defined, and the supporting literature to claim these variables into the study are also recognized. This is followed by establishing the hypotheses based on the constructed conceptual framework and the identified relationships. Once the hypotheses are constructed, the reliability of the variables are measured, and the confirmatory factor analysis is conducted, initially measuring the goodness of fit of the variables, validating the created model and finally estimating the established hypotheses to recognize the user’s acceptance level of intelligent air cargo systems in the Sri Lankan context.

3.8 Ethical Issues

There are several ethical problems to consider while conducting a study that includes human participants, which necessitates a thorough investigation of the study's procedures (Collis & Hussey, 2013). In order to deal with ethical concerns, this research used the following techniques. Firstly, there was no place for respondents to provide their identities or other personally identifiable information in the online version of the questionnaire. Because the author had no idea who had sent the questionnaire, respondents' confidentiality was completely safeguarded. Because of this, they had all the information they needed. However, because the poll was conducted online, the author is unable to exert any kind of pressure on those who participate. As a result, everyone's involvement was completely up to them. Third, to prevent data leaking, the study's main

data was tightly and meticulously managed. After receiving the survey results, the author had completely transferred the data to a password-protected location for the digital data was also used and accessed only by the author. Finally, no commercial interests were engaged in this investigation, which was entirely self-funded.

3.9 Limitations of the Methodology

This research has the following methodological issues. There are various drawbacks to embracing positivity. Individuals' behavior is seen as completely logical by positivists, who ignore the subjective and non - observable aspects that influence human conduct. Furthermore, positivism ignores individual variations in favor of emphasizing collective traits (Collis & Hussey, 2013). As a result of taking a deductive strategy, this study is unlikely to add new information since the research hypotheses are already well-known and understood (Yvonne Feilzer, 2010). It's also less in-depth than the qualitative technique since statistics don't have the complexity and richness to depict social processes in their full complexity and richness (McCusker & Gunaydin, 2015). Fourth, the questionnaire survey used a convenience sample approach, which may have resulted in sampling biases and poor representativeness of the population (Fink, 2003).

4 CHAPTER FOUR – DATA ANALYSIS RESULTS

This chapter reports the empirical findings generated by the questionnaire survey. It starts with an introduction of the demographic profile of the survey respondents. Following this, it used the Confirmatory Factor Analysis on the survey items in order to evaluate and improve the data validity. Meanwhile, the data reliability was tested by a Cronbach's α test. After the survey data is verified to be valid and reliable, this study evaluated the 7 variables and associated 11 research hypotheses were tested.

4.1 Preliminary Analysis

4.1.1 Respondent profile Analysis

The four control variables identified in the chapter 03; gender, age, type of job (related to the air-cargo industry)

4.1.1.1 Gender

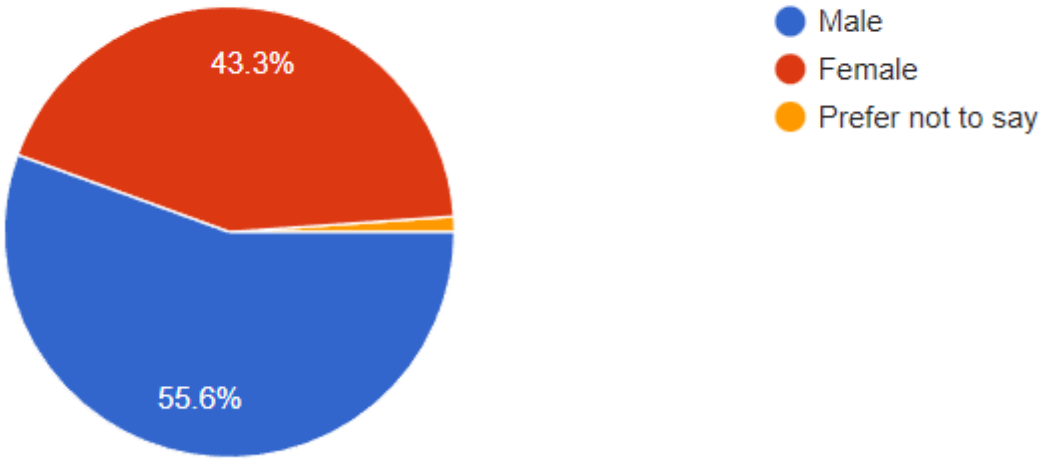

Figure 4-1- Respondent profile analysis: Gender

Based on the results from the respondent's gender in the figure 4.1 it can be identified that the majority of the respondent profile is consisted with male stakeholders of the Sri Lankan air-cargo sector consisting of 55.6%, while the female contributing to 43.3%

4.1.1.2 Age

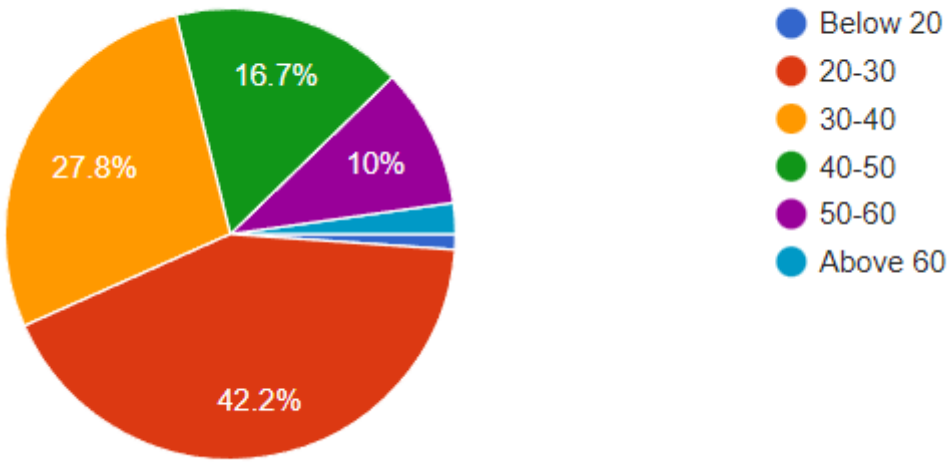

Figure 4-2 -Respondent profile analysis: Age

The above figure 4.2 reveal that the majority of the respondents who have contributed to the study are within the age range of 20-30 years followed by 30–40-year age group and the 40–50-year age group accounting for 96.7% of the total respondents where only 3.7% represent stakeholders above age 50 who have participated in the study. It can be identified that since the majority of the study represent 20-50 age category the results could be somewhat biased as still in the Sri Lankan context the decision-making personnel in the air-cargo sector are above the age group 50 and the representation of their participation in the user acceptance testing of implementing intelligent air-cargo systems are limited. While this is identified as one of the limitations of the study, still it is recognized that the majority of the air-cargo industry are included into the study to retrieve their perception and come into conclusions.

4.1.1.3 Type of job

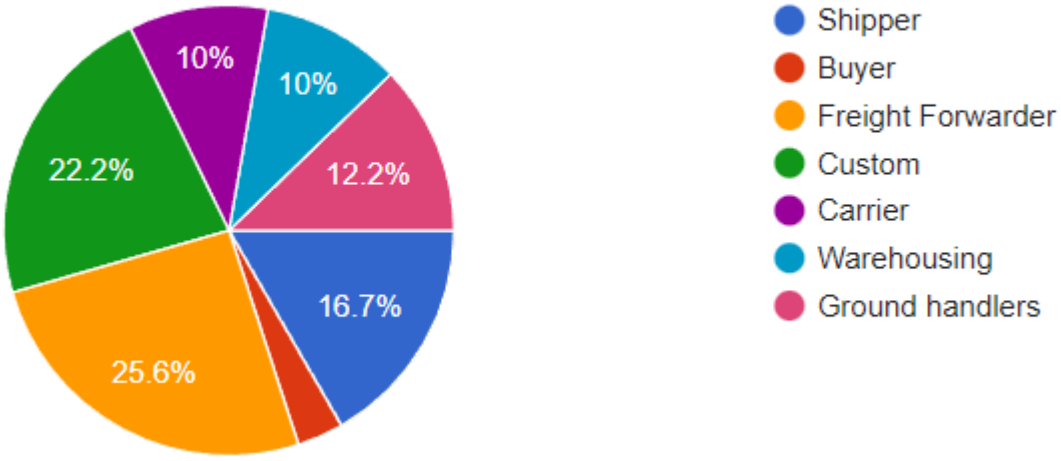

Figure 4-3 -Respondent profile analysis: Type of Job

The above results in figure 4.3 show that the majority who have contributed to the study are freight forwarders, followed by custom workers and shippers. The participation of the buyers in the study is limited, and this is expected because as it was identified in the literature review in chapter 02 that the buyer's influence to actually make a difference to the air-cargo management is significantly limited which makes sense with the respondent profile.

4.1.1.4 Job level

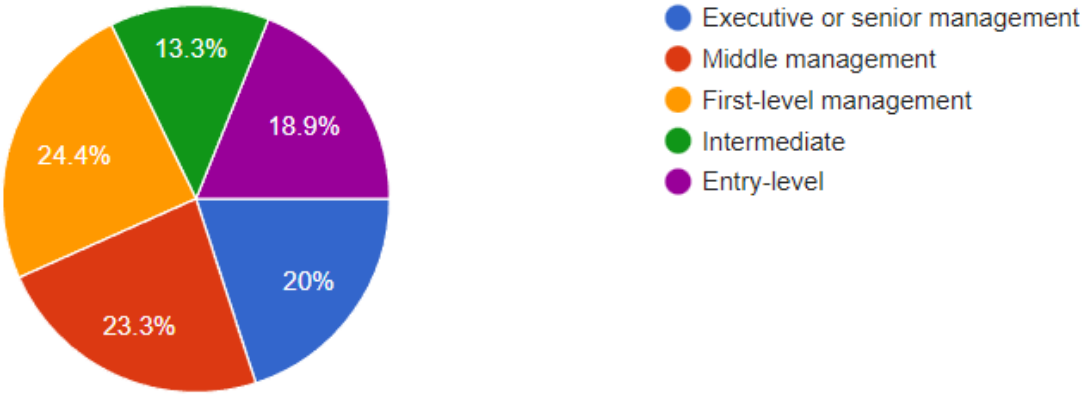

Figure 4-4 - Respondent profile analysis: Job level

The figure 4.4 reveal that in all the considered levels of jobs/occupations in the study, all of these levels were fairly contributed to the respondent profile. The majority of the responses are from the first level management, followed by the middle management and the executive or senior management. The fact the author was able to retrieve responses from all the layers of management within the air-cargo sector which covers nearly 70% of the responses is identified to be reliable within the results as these layers are effectively in the decision-making process with the operations of the sector and the implementation of an intelligent air-cargo solution and the overall user acceptance of it would be heavily relied upon their decision making.

4.1.2 Missing data analysis

Statistical analysis of any given dataset should begin with a review of the data set's missing elements, such as missing values, before moving on to any other types of examination. For several reasons, respondents in lengthy surveys may overlook on questions or respondents may be irritated by a question and choose not to answer it. Nevertheless, missing data does not mean that the data set is of no value (Field, 2005). Before beginning any statistical study, missing data in a collection of data should be addressed. Missing data may be addressed in a variety of ways, including:

- Listwise deletion: Statistics excludes the topic with missing data in this method of data collection.
- Pairwise deletion: Only one variable is excluded from the analysis when a subject has missing information for a variable in this method.
- Replacement of missing data using the average score: This strategy uses the average score to replace missing data.

In datasets when the percentage of missing data falls below 10%, one of these procedures is employed to deal with missing data. Regression replacement or multiple restoration are two alternative methods for dealing with missing data (Howell, 2009). In this study however only two data elements were identified to be missing hence it was recognized that no additional measures were required to input to the variable data.

4.1.3 Reliability

Internal consistency analysis is used to determine whether or not an instrument's measurements are consistent with what it is measuring (Ary et al., 2002). Cronbach's alpha, or coefficient alpha (Ary et al., 2002; Pallant 2001), is one of the approaches for analyzing internal consistency (Ary et al., 2002). In the study, 05 primary independent measures were utilized to identify the user acceptance level of implementing intelligent air-cargo systems, and the reliability of these five measures included with their individual number of items is tested as follows using the Cronbach's alpha in table 4.1:

	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Number of Items
User Attitude towards change (ATC)	0.950	0.950	3
Intelligence literacy (IL)	0.863	0.863	3
Mental models (MM)	0.877	0.878	2
Perceived ease of use (PEOU)	0.942	0.938	3
Perceived usefulness (PU)	0.945	0.944	3

Table 5 - Reliability Testing

Based on the results on the Cronbach's alpha it is identified that the selected measures are statistically reliable across their individual items utilized with and hence was decided to continue with the confirmatory factor analysis to test the established hypotheses.

4.2 Confirmatory Factor Analysis

CFA is performed to validate the measurement model. Measurement model can be assessed with convergent validity and discriminant validity. In order to verify the convergent validity Factor Loadings, Composite Reliability and Average variance Extracted values were considered. In order to create the measurement model, SPSS

AMOS statistical software was used. By running the algorithm, the measurement model in figure 4.5 was created.

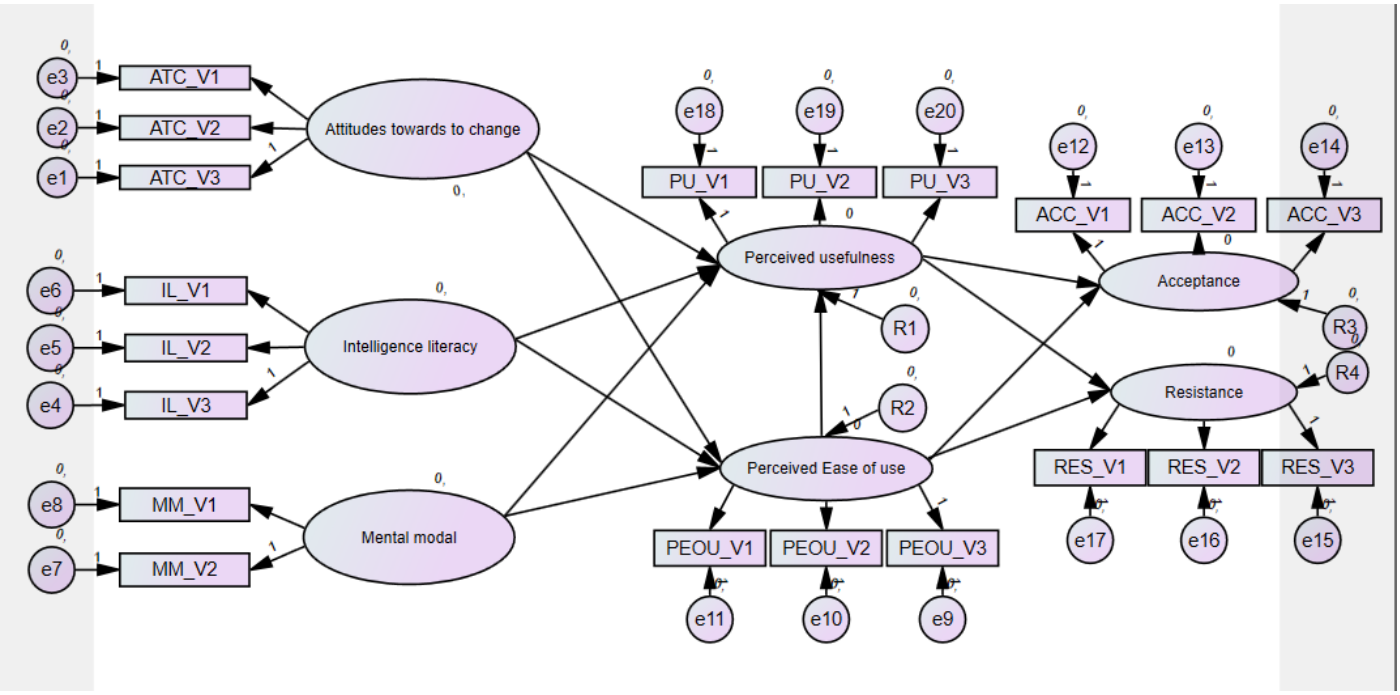

Figure 4-5 - Measurement model

4.2.1 Goodness of fit test results

In the process of verifying the measurement model's suitability index several measurement indexes were used and the results are shown in the table 4.2.

Absolute goodness of fit index		**Increment goodness of fit index**	
X^2 (CMIN)	531.878	Normal fit index	0.764
DF	159	Incremental fit index	0.822
P	0.000	Relative fit index	0.718
CMIN/DF	3.3.45	Comparative fit index	0.820

Root mean square residual	0.616	Adjusted goodness of fit index	0.935
Goodness of fit index	0.837	Parsimony goodness of fit index	0.942
Adjusted goodness of fit index	0.640	Parsimony comparative fit index	0.813
Parsimony goodness of fit index	0.686	Root mean square error of approximation	0.616

Table 6 - Goodness of fit results

Based on the above results, although some measures like the Goodness of fit index, Adjusted goodness of fit index and the root mean square residuals were bit smaller than the standard accepted values, the remaining values which would demonstrate the goodness of fit showed that they are to be accepted, where also at the same time each measurement variable's standardized coefficient of regression would be above 0.7 and indicating that the internal consistency of the variables were secured.

4.3 Factor Loadings

Factor loadings should be higher than 0.7 for convergent validity. The results of confirmatory factor analysis factor loadings are given in table ANX1 and INT1 items did not match this requirement, so these items were extracted from the data set for further analyses.

	ATC	**IL**	**MM**	**PEOU**	**PU**
ATC_V1	0.711				
ATC_V2	0.946				
ATC_V3	0.814				
IL_V1		0.945			
IL_V2		0.968			
IL_V3		0.871			

MM_V1			0.874		
MM_V2			0.898		
PEOU_V1				0.855	
PEOU_V2				0.833	
PEOU_V3				0.712	
PU_V1					0.895
PU_V2					0.872
PU_V3					0.788

Table 7 Factor Loadings

Based on the factor loading results all the measures and their subsequent items are associated with values higher than 0.7, hence identified that all of the variables have had an adequate convergent validity.

After this, the average variance extracted (AVE) is analyzed and the results are shown in the table 4.4 as follows:

	AVE	**Composite Reliability**	**R-Squared**	**Cronbach's Alpha**
ATC	0.647	0.848	0.056	0.950
IL	0.689	0.849	0.212	0.863
MM	0.719	0.971	0.589	0.877
PEOU	0.556	0.889	0.399	0.942
PU	0.714	0.883	0.204	0.945

Table 8 - Average Variance Explained

Based on the above results and since the average extracted value of the created constructs exceed 0.5, it is identified that the extracted measures are associated with composite reliability.

4.3.1 Discriminant Validity

Discriminant validity was performed to show that all of the constructs were different from each other. Fornell & Larcker (1981); Gefen & Straub (2005) stated that discriminant validity is evaluated by considering the correlation among the constructs. Square root of AVE values of each construct should higher than all of the correlation

values of constructs. The table 4.5 shows that all of the constructs were different from each other. The diagonal shows the square root of AVE values of each construct, and these values were higher than the other correlation values among the constructs.

	ATC	IL	MM	PEOU	PU
ATC	**0.908**				
IL	-0.205	**0.890**			
MM	-0.473	0.409	**0.878**		
PEOU	-0.538	0.428	0.588	**0.747**	
PU	-0.554	0.306	0.748	0.587	**0.787**

Table 9 -Validity Analysis

Discriminant validity was used to demonstrate that each of the constructs was distinct from others. Fornell & Larcker (1981) and Gefen & Straub (2005) said that discriminant validity is tested by looking at the correlations between the constructs in the model. All of the correlation values of the constructs should be greater than the square root of the AVE values of each one. All of the constructions differed from one another, as can be seen in table 4.5. The diagonal indicates the square root of the values of the average variance extracted of each construct and these values were greater than the other values of correlation among the construct, which leads to the resolution that the discriminant validity was confirmed within the dataset.

After validating the measurement model via convergent and discriminant validity, the SPSS bootstrapping algorithm was run to find out the t values to investigate the relations between latent variables. The Figure 4.6 shows the path coefficients and t scores over the arrows meanwhile showing the significant and non-significant relations. Also, near the latent variables code, the total variance explained information is also shown.

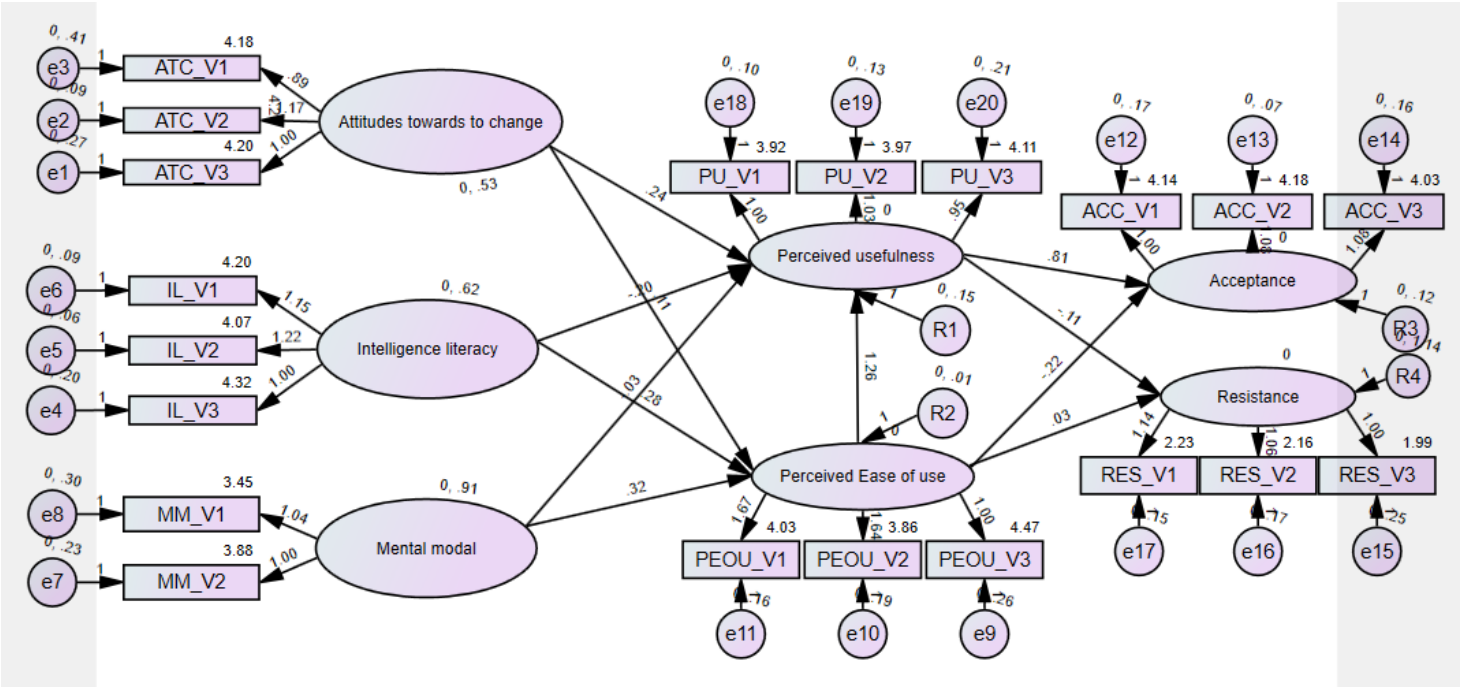

Figure 4-6 Structural Model

4.4 Results of the Confirmatory factor analysis and the hypothesis testing

Once the goodness of fit of the measures were verified, followed by the verification of the convergent and discriminant validity of the data, the established hypotheses were estimated, and the results are presented as follows in the table 4.6:

Measure	Hypothesis	Estimate	Standard Error	p-value	Supported/not supported
ATC -> PU	H1	0.236	0.208	0.255	Supported
ATC -> PEOU	H2	0.108	0.037	0.05**	Supported
IL -> PU	H3	-0.198	0.508	0.697	Not Supported
IL -> PEOU	H4	0.284	0.057	0.000***	Supported
MM –> PU	H5	-0.027	0.579	0.963	Not Supported
MM -> PEOU	H6	0.321	0.053	0.000***	Supported
PEOU -> PU	H7	1.256	1.774	0.479	Supported
PU -> ACC	H8	0.812	0.136	0.000***	Supported

PU -> RES	H9	-0.107	0.283	0.705	Supported
PEOU -> ACC	H10	0.220	0.180	0.223	Supported
PEOU -> RES	H11	-0.026	0.440	0.954	Supported

Table 10 - Hypothesis testing results

In the hypothesis testing it was identified that all the hypotheses were able to be measured correctly, and every one of them had a measurement result. Several significant relationships (p-value above 0.05) were identified by the hypothesis testing where the positive strong associations which supported the original hypothesis between ATC -> PEOU, IL -> PEOU, MM -> PEOU and the PU -> ACC. When it comes to the individual measures of influence studied by this research it can be identified that the results are on par with the literature as the hypotheses H1 and H2 where the effect of the user attitude towards change is consistent with the results of Park (2007) however, only the ATC's impact on PEOU is identified to be significant. However, the results of the intelligence literacy are not consistent with studies like Callum et.al, (2014) or Jones (2016) where IL is identified to be having a negative relationship with PU, although it maintains a positive association with PEOU, thereby dismissing the hypothesis H3. When it comes to the mental model, again the study results are not quite consistent with the literature as it differs from studies like Hwang et.al (2019) which have identified that the impact of intelligence literacy reflects a user's capability of using a mobile application in a useful manner and hence respond positive to its usefulness, and as it can be clearly seen the results showcase the opposite of this, but however is on par with its relationship with the PEOU. The hypothesis H5 is hence also dismissed. Apart from this, hypotheses H7, H8, H9, H10, H11 are identified to be supported by the conducted hypothesis testing and are also consistent with the studies of Yang et.al, 2019.

This concludes the findings and results of the study and based on these results, the discussion of the results are conducted, and conclusions are gained in the chapter 05.

5 CHAPTER FIVE – DISCUSSION AND IMPLICATIONS

5.1 Introduction

This study looked at the factors that impact the acceptability and opposition to the introduction of intelligent air-cargo systems. An effort was made here to identify user attributes that may be measured using an innovation resistance model. It was determined that the deployment and use of intelligent air-cargo systems had an impact on TAM variables, as well as their connection. Structural equation modelling was also used to evaluate their impact on user innovation resistance and adoption. The findings of the empirical study indicated that while the perceived ease of use of the implementing intelligent air-cargo ecosystem was positively influenced by intelligence literacy and mental models, they had no effect on the perceived utility of the system. Some people may not recognize these "intelligent" air-cargo ecosystems as cutting-edge technology since they just have additional functions rather than a completely new, ground-breaking piece of equipment. That's perhaps because smartphones and smart frameworks have become so commonplace. Since users' willingness to embrace change reflects their experience with an intelligent air freight system, this suggests that they found the app to be both simple to use and beneficial. They found that in Sri Lanka, attitudes toward change matter more than the perceived utility of newly implemented novel technology when it comes to the level of acceptance of an intelligent air cargo system. This is a key finding of the study because it shows that in Sri Lankan contexts, attitudes toward change matter more than perceived utility.

5.2 Theoretical and Practical Implications

5.2.1 Theoretical Implications of the Study

The following academic conclusions may be drawn from the findings of this study. First, this research focused on user characteristics as a factor in the adoption and resistance of intelligent air freight ecosystems. Research on intelligent air cargo focuses on service quality factors such as system quality and information, but this research looks at the characteristics of users after an intelligent air cargo system is installed, which is something that hasn't been done before. In other words, one of the most significant achievements of this research is that it built and presented a model to better understand the influence of user characteristics of the intelligent air cargo ecosystem on the adoption of and opposition to such technologies. Second, this study has academic value since it

aimed to broaden the scope of TAM theoretically. Analysis of the elements that influence a user's willingness or reluctance to utilize intelligent air cargo ecosystems was done using TAM, and user characteristics based on the innovation resistance theory were applied to the key TAM variables. Lastly, research on new intelligent air cargo ecosystem solutions has mostly concentrated on Internet of Things, RFID, consumer attributes and customer satisfaction and their link to behavior up to this point. This has changed today. It didn't give much attention to the issue of opposition from users. Since both viewpoints of acceptance and resistance were merged into one model in this study, the author examined their effect on exogenous factors.

5.2.2 Practical Implications

There are published studies that investigate the user acceptance level of intelligent air-cargo ecosystems and high-level understanding of the users' conceptions of such technology solutions; however, most of this research did not take TAM as a structure, even though TAM is broadly used to ascertain technology use and conceptions of end users. There are studies looking at how new mechanisms adopted in logistics management affect users' perceptions, but just a few studies employ TAM as a theoretical model to investigate how assessments are perceived. This research proposes a measurement and a structural model to examine the user acceptability level of applying a revolutionary solution for cargo management, which is intelligent air cargo ecosystems. Understanding the factors that lead to user acceptability of an intelligent air freight environment was the primary goal of this research. TAM was expanded by looking at the individual variances in the stakeholder profile of the research based on their attitude and emotional response to technology usage. For the purpose of this research, two aspects were examined: perceived utility, perceived ease of use, and individual factors: user attitude, intelligent literacy, and the mental models of Sri Lankan air cargo system users.

Firstly, the relationships between individual differences and belief components were analyzed, and then the relationships between these two constructs and a person's intention to be assessed were investigated. In this part, we looked at the first three factors that may be used to gauge how easy it is to use and how beneficial it is. Table 5.1 shows the outcomes of testing the hypothesis about these correlations.

	Independent measure	Dependent Measure	Supported/Not Supported
H1	ATC	PU	Supported
H2	ATC	PEOU	Supported
H3	IL	PU	Not Supported
H4	IL	PEOU	Supported
H5	MM	PU	Not Supported
H6	MM	PEOU	Supported

Table 11 - Hypothesis testing results

These results clearly indicate that when it comes to the perceived ease of use, all the three measures were identified to be supporting the hypotheses that the three measures; attitude towards change, intelligence literacy and the mental models were having positive impacts with the perceived ease of use, while only attitude towards change having a positive impact on the perceived usefulness. In the Sri Lankan context, it is identified that while all three of the measures are making an impact on the perceived ease of use, only the attitude makes a positive impact on the perceived usefulness, which is an important result any decision maker should be highly considered of when implementing an intelligent air-cargo solution as the usefulness is vividly identified to be positively impacted by the attitude on direct terms.

It has been shown in previous studies that perceived ease of use can have a positive impact on the perceptions of usefulness and intention to use air cargo ecosystems. This study tested this hypothesis, and the results clearly show that perceived ease of use strongly and substantially influences the perceptions of use and intention to use air cargo ecosystems. Park (2009), Hsu et al. (2009), and the initial TAM found that perceived ease of use had a substantial impact on perceived usefulness (Davis et al., 1989). When the newly installed intelligent air-cargo ecosystem is simple to use, then users are more likely to have greater utility judgments of such apps. This relationship is significant. The results of Lee et al. (2009), Hsu et al. (2009), and Yi & Hwang (2009) show that perceived ease of use has a favorable impact on intention (2003). Perceived ease of use seems to be a factor of behavioral intention toward actual usage when there is such a strong correlation. Here, it can be shown that when the tool is simple to use, the user's

behavioral intent toward the tool improves. The acceptability of intelligent air-cargo ecosystems in Sri Lanka was influenced greatly, according to empirical studies, by users' perceptions of their utility. The findings of Lee et al. (2005) and the original TAM are comparable to this one (Davis et al., 1989). According to Davis et al. (1989), perceived utility was shown to be an important factor in consumers' decision to utilize a specific technology, and this finding was confirmed in this research.

Focusing on the results of the hypotheses constructed to test the relationships between the perceived ease of use with the acceptance/resistance of intelligent air-cargo ecosystems and the perceived usefulness with the acceptance/resistance of intelligent air-cargo ecosystems, it can be identified that all the hypotheses related this argument, hypothesis H8 – H11 were identified to be supporting. This can be identified to be significant when it comes to the user acceptance of intelligent air-cargo ecosystems in the Sri Lankan context, as although some of the utilized individual dimensions were not supporting to have a positive impact on the perceived usefulness of an intelligent air-cargo ecosystem, they had a positive impact on the perceived ease of use of an intelligent air-cargo ecosystem, and this has caused for the perceived ease of use to have a positive as well as a significant impact upon the perceived usefulness. This shows that in the Sri Lankan context, the overall ease of use needs to be focused on when implementing mechanisms like intelligent air-cargo ecosystems in the Sri Lankan context, as in an overall sense they make a positive impact upon the perceived usefulness of it. This is a perfect segue into discussing the next set of results of this research, as both perceived ease of use and perceived usefulness showed that they impact positively to accept the implementation of intelligent air cargo systems but also, they have shown that with the presence of perceived ease of use and perceived usefulness, the respondents consider not resisting the implementations. Although this sounds as the same argument phrased differently, in the Sri Lankan context, the results show given that the perceived ease of use makes a positive impact on the perceived usefulness of intelligent air cargo ecosystems the while the users actively accept such implementations and despite any bureaucratic detrimental impact if fallen upon, they would not resist to such an implementation. Since Sri Lankan air industry is very common for the presence of such detrimental impacts for usually emerging technologies, this finding is significant and crucial from a practical point of view.

5.2.3 Summary of the practical implications

This research has the following practical consequences in addition to the academic ones. It has been established that an individual stakeholder's cognitive processes have an impact on their behavior belief and technological acceptance/resistance in the intelligent air freight ecosystems, which has been confirmed by this study. According to the research results, users who had a positive attitude toward change had a substantial impact on the usefulness, acceptability, and resistance to intelligent air freight ecosystems via ease of use. Enterprises need to analyze basic user environments, designs, and system architectures in order to assist the development of user mental models. A user's perceived ease of use and utility in intelligent air cargo ecosystems had a good influence on acceptance and an adverse influence on resistance, according to the findings of this study. As a result, it seems that airlines should spend a significant amount of money in generating high-quality content that will make apps easier to use and increase public awareness of the utility of the system's architecture. Every day, a growing number of clients and rental companies are taking use of air freight services. It is thus imperative that officials at Sri Lanka's national airline keep improving their cargo management systems to make them more convenient for passengers. Cargo management in air cargo ecosystems that employ intelligent air cargo ecosystems will need ongoing airline efforts to offer new features that improve consumer comfort.

6 CHAPTER SIX- CONCLUSION

6.1 Summary of the Conclusion

This research has the following practical consequences in addition to the academic ones. It has been established that an individual stakeholder's cognitive processes have an impact on their behavior belief and technological acceptance/resistance in the intelligent air freight ecosystems, which has been confirmed by this study. According to the research results, users who had a positive attitude toward change had a substantial impact on the usefulness, acceptability, and resistance to intelligent air freight ecosystems via ease of use. Enterprises need to analyze basic user environments, designs, and system architectures in order to assist the development of user mental models. A user's perceived ease of use and utility in intelligent air cargo ecosystems had a good influence on acceptance and an adverse influence on resistance, according to the findings of this study. As a result, it seems that airlines should spend a significant amount of money in generating high-quality content that will make apps easier to use and increase public awareness of the utility of the system's architecture. Every day, a growing number of clients and rental companies are taking use of air freight services. It is thus imperative that officials at Sri Lanka's national airline keep improving their cargo management systems to make them more convenient for passengers. Cargo management in air cargo ecosystems that employ intelligent air cargo ecosystems will need ongoing airline efforts to offer new features that improve consumer comfort.

6.2 Limitations and Future Study

1. External factors, on the other hand, can play a different function depending on the service kinds offered in an air freight mobile application environment.
2. As a result, future research should segment the categories of air freight software product services and conduct an in-depth investigation accordingly.
3. Second, we measured resistance as a single dimension rather than using lower-level constructs for resistance when looking at the influence link between exogenous factors and consumer resistance.
4. More scientifically meaningful study may be carried out if a valid, multi-dimensional measurement tool for consumer resistance could be devised and deployed.

5. Alternative models, in such an influential connection, should be considered since user attributes may have a direct impact on the acceptance and resistance of a mobile application service.

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8 APPENDIXES

User Acceptance of Intelligent Air Cargo Ecosystem in Developing Countries

ajan.eshwara@gmail.com (not shared) Switch account

* Required

User Acceptance of Intelligent Air Cargo Ecosystem in Developing Countries

I am Ajan Eshwara, an undergraduate of the Department of Transport and Logistics Management, Faculty of Engineering, University of Moratuwa, conducting my final year undergraduate research on "User Acceptance of Intelligent Air Cargo Ecosystem in Developing Countries" This survey is aimed to understand the intelligent literacy and attitude towards to change of an IoT based smart systems.

Your responses to the questionnaire item will be kept strictly confidential and it is for purely academic purposes. Your name will not be mentioned anywhere on the document, so kindly provide an impartial opinion to make the research successful. Averagely it will take 5-10 minutes of your valuable time to complete the questionnaire.

I greatly appreciate the corporation you give me by completing this survey questionnaire. If you you have any queries, Please email me at ajan.eshwara@gmail.com or 171412M@uom.lk
Further, if you want to contact me via mobile, my mobile number is +94713319400

Rating the factors affecting to the acceptance of intelligent air cargo ecosystem

1 - "Strongly Disagree"
2 - "Disagree"
3 - "Neutral"
4 - "Agree"
5 - "Strongly Agree"

1. Have you ever used or operate a IoT system/ IoT based smart device? *

- ◯ Yes
- ◯ No

2. If yes, what are they?

Your answer

3. I have experiences of using smart devices *

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

4. I have a ability of using basic functions of a smart devices *

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

5. I have a confident of using functions of a Smart devices? *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

6. I like to learn functional changes and adjust to things in Smart devices? *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	StronglyAgree

7. I have a ability of access wireless internet using a mobile phone *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	StronglyAgree

8. I like to try IoT based new technologies? *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

9. I can easily predict how to use air cargo mobile applications? *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

10. I can operate mobile application's interface and method of use as expected *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

11. I can perform tasks quickly using smart devices? *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	StronglyAgree

12. If no, why?

Your answer

13. I can complete tasks with expected outcomes *

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	StronglyAgree

14. If no, why?

Your answer

15. Do you think Compared with the conventional manual system, does smart system Saves time and expenses? *

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

16. If no, why?

Your answer

If an IoT devices is introduce to your working section,

17. Do you think will you be able to understand the user interface clearly? *

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

18. Do you think will you be able to learn the user interface easily? *

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

19. Do you think will you be able to Search necessary information is easy? *

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

20. I like to actively promote the use of air cargo applications *

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

21. I like to make efforts to understand air cargo application services *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

22. I like to make reservations, issue bills, and make inquiries using air cargo applications. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

23. I feel aversion to the use of air cargo applications *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

24. I think air cargo applications are not satisfactory or convenient to use *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

21. I like to make efforts to understand air cargo application services *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

22. I like to make reservations, issue bills, and make inquiries using air cargo applications. *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

23. I feel aversion to the use of air cargo applications *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

24. I think air cargo applications are not satisfactory or convenient to use *

	1	2	3	4	5	
Strongly Disagree	○	○	○	○	○	Strongly Agree

25 I have an intention to oppose the use of air cargo applications *

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

26. Gender *

- ◯ Male
- ◯ Female
- ◯ Prefer not to say

27. Age *

- ◯ Below 20
- ◯ 20-30
- ◯ 30-40
- ◯ 40-50
- ◯ 50-60
- ◯ Above 60