TERMINAL SIGNAGE

by

Vairavan Ganesh

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Thesis Committee:

Dr. Wendy S. Beckman, Chair

Dr. Paul A. Craig

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ABSTRACT

The goal of this study was to make passengers' lives easier inside an airport terminal, by examining passengers' ability to understand the terminal signs at international airports. The terminal signs currently in place were evaluated for their effectiveness through an online survey of participants, and feedback was collected from these participants on how to improve the navigation process inside an airport terminal. The results portrayed the influence of culture and the frequency of visits on wayfinding ability inside an airport terminal. The recommendations made based on the findings of this study will be helpful in reducing the stress level of passengers, reducing the overcrowding of airports, and potentially saving a substantial amount of time for airport staff and passengers.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER I- INTRODUCTION

Airport terminals continue to evolve as technology and the needs of passengers change. Historically, an airport terminal was just a shelter for passengers to switch between transportation modes, but today terminals around the world provide a range of services and high quality travel experiences for air travelers. They have become multifunctional facilities. The evolution of airport terminals includes not only the size of the building, but also the variety and complexity of mechanical and service systems incorporated within the building. Also, terminal buildings have become a convenient place to do business, including department stores, food and beverage services, and specialty retailers. Commercial designers are showing more interest in the business opportunities that are offered by airport terminal buildings. But, passengers are often concerned about reaching their departure gate before their scheduled departure time, and all of these extra services can complicate the navigation of the airport terminal.

The signs in an airport terminal are essential for passengers to locate their gate for a departing flight. If the passengers fail to decipher the navigation signs displayed at the terminal, it will be difficult for them to reach their respective destination within the available time. The lack of proper translation signs for simplistic navigation can cause difficulty among the non-native language speakers at a particular facility. In considering the effectiveness of the navigation signs, it is crucial to consider three prime factors, the first being the design. This should be in a way where anybody from any part of the world can comprehend what it is saying. Second, the location where the signs are placed is important to help passengers reach their destination swiftly. Third, the signs used should

be easy to identify, taking into consideration all the sectors of passengers from different nations.

The level of congestion at an airport can be a good indicator of the effectiveness of the signs within the terminal. As an impact of aircraft delays or due to an imbalance between supply and demand, there can be an overfilling of the terminals with passengers, resulting in congestion. The congestion may be inversely proportional to the effectiveness of the terminal signs. Proper signage can help assist in relieving some of this congestion. One of the airport administration's main aims is to process passengers quickly in order to avoid congestion at the airport. The foot traffic at the airport can cause unnecessary delays for the airport staff as well as for the passengers. It is international passengers who mostly experience challenges due to the terminal signs. Domestic passengers would usually be familiar with the navigation signs at an airport terminal and with the language in which they are presented, as they may travel very frequently through the same airport and they are proficient with the language.

In the present situation, at a major international airport, travelers can feel they are finding their way through a maze. Proper terminal signs and way finding facilities can reduce the challenges that passengers face inside the airport terminal. Also, appropriate signage improves the efficiency of passenger movement. Developing signs and way finding facilities are an on-going challenge faced by the terminal design community. Terminal design seeks to naturally enhance the way finding ability of the passengers through the airport terminal building. But in the case of a bad terminal design, the signs and way finding facilities may be the only two supporting factors to reduce passenger foot traffic congestion. It is impossible to reconstruct an entire terminal, as it involves a

lot of capital and a loss of income to the airport due to terminal closures. So considering the passengers' best interest and determining a suitable terminal sign system may provide the best solution for a bad terminal design.

Review of Literature

A study by Fuller (2002) focused on signs at airports. Airport sign language has been defined as an interface for social relations between humans and machines, which urge the traveler to 'move on.' According to Auge, "The link between individuals and their surroundings in space of non-place is established through the mediation of words, or even text," (1995, p. 94).

Here the author states that the signs at the airport create a globalized navigation system. The major functions of airport sign as stated in this study are:

- Direction and orientation
- Identification of locations
- Information: on arrival and departures; baggage delivery; government regulations; connecting transport; and special services, such as car rental; tourism and conventions.

The author differentiates the texts representing the airport signs by the Federal. Aviation Administration (Guidelines for Airport Signing and Graphics) and by the British Airport Authority (Signs Manual). The actual purpose of the study was to examine the quality of airport terminal signs along with its drawbacks (Fuller, 2002).

Fuller describes that many airports in developed countries have improved their semiotic way finding technologies with international standards. Besides explaining the principles of signage at the terminal, the author also describes the problem of recognition

and understanding of terminal signs faced by the passengers travelling across the world. From previous literature on terminal signs Fuller believed that airports are not always travelled with aid of landmarks but through signs. Also, the same idea was previously supported by Auge (1995); it is evident from his statement "The link between individuals and their surroundings in the space of non-place is established through the mediation of words or even text." But after conducting the research on terminals at Sydney International Airport and Anchorage Airport, Fuller determined that landmarks also play a crucial part in aiding passengers through their voyage inside the airport terminal. He stated that there was a huge bell frog in a café at the Sydney Airport and a stuffed polar bear at the Anchorage Airport respectively, and those two items served as a landmark for passengers travelling through those airports. For instance, in case a family member who is uneducated regarding the airport layout went missing inside the terminal; he/she would probably use such factors as these landmarks to reach their family members. Similarly, the retail shops, stuffed koalas, and native arts aided passengers inside the terminal of the Sydney International Airport and the Anchorage Airport.

The major problem with the Sydney International Airport was that signage designers outlined the signs in a way so that it was accessible only for technology savvy people. Thus, it was mandatory for the international passengers to update themselves to the latest technology in order to access the system efficiently. This is often not practically possible for the passenger community. The automated machines or any other technology based route finder machines should be designed in a way that it is easily accessible and comprehensible for the entire passenger community (Fuller, 2002).

The ultimate goal of a way finding system, as stated in a 2011 report by Harding, is to improve passengers' efficiency. The strategy for developing an effective way finding system consists of:

- Continuity
- Connectivity
- Consistency- Designing elements for consistency:
  - ✓ Terminology and message hierarchy
  - ✓ Visibility and legibility
  - ✓ Typography and symbology
  - ✓ Format and color
  - ✓ Placement

The chapter regarding the terminal design in the report written by Harding describes that the design of the terminal will have to be evaluated from the passenger's perspective in order to rectify the way finding issue. The author of this book suggests conducting surveys every year at the airport to understand and work on the issues. He also states that the terminal should include informational desks, directories and digital directories in the future to be an efficient airport. The combination of symbols and text is suggested as the best way of conveying the path to the international passengers (Harding, 2011).

Prioritization of information to the passengers to prevent stress or confusion is clearly explained in this chapter. According to Harding the sign messages are categorized under three basic lists; primary, secondary and tertiary. The primary information includes terminal, ticketing/check-in, baggage claim and gates. Secondary information includes

restrooms, parking concessions and telephones. Tertiary information includes warnings and 'NO SMOKING' messages (Harding, 2011). Finally, the usage of universal symbols, concentrating on the lights, space, and other features, would definitely aid the way finding ability of international passengers. Considering the airport's background and the demographics of incoming passengers are important before designing terminal signs.

A 2014 study by Symonds found that airports from different parts of the world provide unique way finding experiences. The major issues faced by passengers at the airport terminal are due to lack of ability to understand the signs or due to physical disability. These issues create a situation even worse at larger airports such as London's Heathrow Airport, Denver International Airport or Chicago O'Hare Airport.

The author states that way finding efficiently is not an easy matter; therefore, the airport has to consider a wide range of socio-cultural groups to design the terminal effectively. He also explains the fact that because airports have different owners, it becomes difficult to follow standard signage patterns. This study explains how airports worldwide do not follow a standard signage procedure, which causes difficulties for passengers. For example, the FAA guidelines are only followed by U.S. Airports and not worldwide. The solution for this issue, as stated in this study, is to obtain feedback from the passengers facing problems and to implement a standard international sign system (Symonds, 2014).

Symond's study (2014) describes the latest way finding and terminal signage techniques used at Hartsfield- Jackson Atlanta International Airport, which was opened in 2012. It consists of more than 8,000 signs in the terminal. The coordination between the

workers in designing the terminal was the reason behind their success, as it appears to serve the passengers in an efficient way. The features introduced in the terminal were:

- Walk this way (lighting)
- Dynamic displays (displaying multiple language)
- Architectural approach

Hartsfield –Jackson is the world's busiest airport. Hundreds of contractors were involved in building the airport (Symonds, 2014). Coordination between the administration/workers and a good relationship with the passengers definitely created a world-class travel experience for air travelers.

People Perspective

The report of a workshop held by Building Research Board (BRB), in cooperation with the Transportation Research Board (TRB), on the future of airport passenger terminals suggested some of the key features that have to be considered by the airport management when designing terminals (National Research Council, 1989). These include:

- Markings and design of direction flow
- Location and sizing of passenger services and amenities
- Walking distances and adequate space
- Readily available and understandable information to help discuss departures and arrivals
- Systems that aids mobility to be vital part of the terminal design

- Logical circulation patterns, reinforced by clear and consistent graphics and information systems

Also, the participants of this study (National Research Council, 1989) suggested that a forum that can bring the interests of airlines, airport operators, and passengers together could potentially give an objective third-party review of terminal designs. These above-mentioned features would help in reducing the stress level of passengers, reducing the overcrowding of airports, and potentially saving a substantial amount of time for airport staff and passengers. The conclusion of the study (National Research Council, 1989) suggests that, as the demands for air travel is continuously growing and development of new aircraft and technologies are never ending, the airport designers must learn how to make modifications in the terminal design to function effectively. The participants of this study stated that there is need for more research to deal with the problems of future airport terminal buildings.

Effects of Terminal Signs on Different Cultures

The bilingual signage system has become common in today's airports. There are two main reasons an airport planner may decide to go with bilingual signs at an airport. The first reason would be due to the increase of foreign passenger traffic at that airport, and the second being the changes in the population of the community in which the airport is located. According to the United States Census Bureau (Castro, 2007) the second largest population in the United States is Spanish. Due to the increase in Spanish speaking travelers, it is not a surprise to see Spanish language in the airport sign systems of the United States.

Castro (2007) conducted a study to determine the user perspective of modern bilingual airport signage, and proposed a standard design to improve English-Spanish signage systems. The main goal of Castro's project was to develop a useful system for travelers in the United States. The study involved data collected through 3 stages. The first stage included a 15-question survey that was distributed to 45 individuals whose primary language was Spanish. This stage was designed to get opinions about the usefulness of the existing bilingual sign system. The second survey aided in collecting the correct Spanish translation for the airport functions. The translation lists used in this part of the study were taken from Miami International Airport, Hartsfield-Jackson Atlanta International Airport, the Houston Airport Authority and the Port Authority for New York and New Jersey. The last stage of the study was a design experiment followed by a feedback session from the participants.

There were three hypotheses considered in this study (Castro, 2007). The first hypothesis stated that the current bilingual (English-Spanish) system in the airport, from the perspective of Spanish speakers, is considered as necessary, but the design and content are not perceived to be satisfactory by the users. The second hypothesis specified that the translations used for the airport functions were perceived to be outdated and not really helpful to the users. A consolidated list of popularly used Spanish translations for the airport functions could be collected and produced. The third hypothesis stated a case for the existence of a better combination of signs and text, which could be considered to be more favorable to the Spanish speakers over the existing combination.

Castro utilized three steps to collect the responses as discussed above. The first phase tested hypothesis one, and consisted of 15-question survey set up online. The

survey was limited to Spanish-speaking airport users with Limited English Proficiency (LEP), because travelers with a good level of English knowledge would prefer English over Spanish signs and texts. The participants were recruited through a word of mouth strategy and the survey was distributed via an email invitation. The survey was open to collect responses for 60 days and was available to all Spanish-speaking airport users across the United States and as well as other Spanish speaking countries (who travelled in the United States for business or pleasure). The second phase of the methodology was to prove or disprove the second hypothesis. The consolidated list of translations of airport functions were collected from the 5 international airports mentioned earlier. An online survey was developed using the Spanish translations as a guide, and this time the survey was not limited to the Spanish speaking users with LEP, but understanding the airport functions in English was a requirement of the participants. For the terminology that was translated differently in each of the researched airports, multiple-choice questions were developed and the Spanish speaking users were told to select the closest match. Since the terminology had little difference from airport to airport, the participants were asked to select agree or disagree with translated airport terminal function. The survey was distributed via email similar to the first phase of the study and the same strategy was utilized by Castro (2007) to recruit participants. It was open to collect responses for 45 days.

The objective of the third phase was to observe whether a set of graphical standards exist such that the Spanish message on bilingual signs is more understandable and legible for Spanish speaking users, thus proving or disproving the third hypothesis. The participants of this study were bilingual (English- Spanish) with Spanish as their first

language, and differed by nationality, age, and gender. This was an experimental study with 38 slides; participants were allowed to see each slide for about 7 seconds only and they were told to write down in which direction they would choose to go if they were trying to reach the airport function indicated by the researcher. The third phase was conducted in groups in order to obtain maximum responses in a very short time. Also, they were encouraged to give feedback regarding the background color, placement, font, and size.

In the Castro study, hypothesis one was proven true. After analyzing the results from phase one, it became evident that the Spanish-speaking airport users felt the existing bilingual signs were not very useful but necessary. Some of the areas where improvement was needed, as identified by the participants, were in the translations, font size, placement of the message, grammatical errors, and Anglicism. The inconsistencies in the translation of airport terminology into Spanish became obvious after looking at the results of the second phase of this study (Castro, 2007). A consolidated list of translations of airport functions in Spanish was considered possibly a better solution to ease the lack of standards in the existing airport terminology in Spanish. The results from the second phase supported the second hypothesis of the study (Castro, 2007). Analysis of the results from the third experiment supported the third hypothesis. It was apparent that Spanish-speaking users favor a bilingual signage layout in which the Spanish translation is placed in proximity to the primary message and the international symbol. They also favor Spanish translations that have the same height as the primary message but are distinguished from the rest of the text by the use of background color (Castro, 2007).

A 2012 study (Leib, Dillman, Petrin, and Young) was conducted to develop knowledge on the effects of terminal signs at an airport on two different cultures. The authors of this study stated that processing the passengers quickly and effectively were the target of all airport administrators. The author also broke the way finding down into three types, recreational way finding (least urgent), resolute way finding (the efficient route), and emergency way finding. This study evaluated the way finding abilities of the passengers from two different cultures, American and Chinese.

The method used to collect the data was by a computer simulation that included 20 participants consisting of Americans, Chinese, and Taiwanese. Participants were formed into two groups: Group one represented participants from the American culture and group two was participants from Chinese or Taiwanese culture. The computer simulation presented ten rounds of sign paths, each round using three different styles of signs: 1) only symbols, 2) only text, 3) combination of both. The time taken for each participant to reach the destination was collected in each scenario. The statistical analyzing tool ANOVA was used to determine the performance of both the groups in aggregate scale (Leib et al., 2012).

The analyses of data according to Leib et al. (2012) showed that the Chinese group made 61.56% more errors than the American group. All 20 participants who participated in the study responded better to the style that was composed of a combination of sign and text. Looking at the results from the data collected, the American group appeared to respond more efficiently to the signage compared to the Chinese group. It was found that there was a statistical difference in speed between the groups,

and their priorities were clearly different. The difference among the cultures was clearly influencing the passenger's way finding abilities.

Financial Aspects

Airports are highly capital-intensive infrastructure businesses that require major support from the federal, state, city, and local governments in order to be successful. The aviation industry influences the nation's economy, it is evident from the following statement (Federal Aviation Administration [FAA], 2015, p. 1) "In 2012, U.S. civil aviation-related economic activity generated $1.5 trillion and supported 11.8 million jobs with $ 459.4 billion in earnings. Civil aviation accounted for 5.4 percent of U.S. Gross Domestic Product (GDP)." Currently, the air transportation industry is growing rapidly; people all around the world have started showing more interest towards air travel (FAA, 2015). The aviation industry in the United States is constantly growing. It is the duty of airport management to analyze the demand for the future and expand, renovate, and maintain the airport facilities. The airlines and other airport users contribute to the airport development through rents and service/facility charges. Sometimes, they also take part in decision-making processes of the airport projects (Moores, Kuhn, & Govindasamy, 2009).

There is no standard device to measure the services provided at an airport. It is difficult for anybody (passengers and airport users) to come to a conclusion about the effectiveness of the design and operating characteristics of a terminal building. As an impact of aircraft delays or due to an imbalance between supply and demand, there can be an overfilling of the terminals with passengers resulting in congestion.

It is very important to improve, modify, and repair terminal buildings; however, not every airport has the capital to continuously develop. There are various factors that hinder the growth of the airport such as regulations (state, federal, and city), airport neighbors, and financial health of the airport (National Research Council (U.S.), 1989). Airport management may struggle to keep their airport strong against future traffic, low commercial profits, and low credit. An economic downturn or a recession period not only affects the airline companies but also the airports. Statistics from a study conducted by Moores, Kuhn, and Govindasamy (2009) shows that in 2007, 13 of the top 100 ranked airports faced traffic declines, while in 2008 the number experiencing declines increased to 53. During a downturn, as airlines struggles for survival, it can become impossible for the airports and airlines to have a conversation or make a deal to resolve the terminal issue, as airport facilities are often based upon several air carriers (Moores, Kuhn, & Govindasamy, 2009).

The most important factor of airport planning is to secure financing, but many airports fail to do this and even if they do, they end up struggling to complete the project due to unplanned expenses. Long term planning is also not always successful, which is explained clearly in the statement of Jean Michel Vernes, "The challenge is we are not building for 5 to 10 years we are building for 30 years. We are having to take decisions in a context, which is not very well defined" (Moores, Kuhn, & Govindasamy, 2009, p. 50). The economic downturns in a nation can lead to situations such as reduced traffic, limited access to capital, and threatened future demand. In this situation some airports might postpone or withdraw their capital projects in order to sustain the situation. Thus, the airport would be forced to reduce their fees to the airlines, but this action can spoil the

essential future projects of the airports (Moores, Kuhn, & Govindasamy, 2009). Airport management often puts a lot of effort into reducing their charges, but there are some arguments supporting the airlines; "Airport cost in isolation, not including air traffic fees, are very small in terms of economic costs of an airline; they don't have a dramatic impact. It is a matter of principle for airlines to say it is too much and that they must be reduced," (Moores, Kuhn, & Govindasamy, 2009, p. 50). Chief executive Sani Sener explains in the study (Moores, Kuhn, & Govindasamy, 2009) that in order to be successful there has to be co-operation between the airline and airport, but the reality is that airlines are trying to maximize their revenue, whereas the airports are trying to reduce their fees to the airlines during economic downturns. So clearly there can be a lack of cooperation between the airport and airlines; it is competition. If there is a disagreement with taxes or charges, airlines have the ability to choose their markets, while airports cannot just roll up an existing facility and relocate it elsewhere. Glitten explains the situation very well by his statement "airports are stuck, they can't go and find a more attractive market; they have to make their market more attractive to airlines and to passengers" (Moores, Kuhn, & Govindasamy, 2009, p. 51).

Consolidation has reduced the number of airlines and led to the evolution of bigger airlines with greater negotiating strength. But airports feel they are suffering a hangover from their state owned utility days, when airlines needed to be protected from a monopoly supplier. The charges at the airport must be fully transparent, unlike air carrier fares. Airlines protect themselves by merging, while airports such as the British Airport Authority (BAA) were told to sell some of its facilities during recession. The statement

by Neil Pakey explains this situation very well “people need to stop seeing airports as a monopoly and a cash cow,” (Moores, Kuhn, & Govindasamy, 2009, p. 51).

Airlines are showing more interest in dealing with privately owned airports, as privatized airports will be more eager to share their risks. Norwegian chief operating office Daniel Skjeldam supports privatization by his statement “Dealing with private airport groups is something we like,” (Moores, Kuhn, & Govindasamy, 2009, p. 51). Challenges can emerge overnight at an airport, threatening traffic flows. The best example would be the swine flu epidemic during the period 2002-2003 at Malaysian airport. These challenges were successfully managed only through a partnership, airport and airline. A good relationship between airports and airlines is always important for the success of air transportation industry, Malaysian airports managing director Bashir Ahmad indicates this with his statement, “we realize the seriousness of the situation and the importance of good airport-airline relationship,” (Moores, Kuhn, & Govindasamy, 2009, p. 52).

Looking at capital needs, United States airports support their infrastructure costs by collecting a passenger facility fee of up to $4.50, which is much less than the fee required to save for the new projects. This situation was clearly indicated in the statement by Prinicipato “The money that we are collecting now is for old projects and projects which are already underway. There is nothing for new projects and many airports have their PFC pledged out over 20-40 years," (Moores, Kuhn, & Govindasamy, 2009, p. 52).

Challenges Due to Erratic Signs Outside the Airport

Air travelers not only have problems in determining their destinations inside the airports, but also getting to the airports. This was evident from an article (Finally, 2010)

about Minneapolis St. Paul International Airport (MSP). Sometimes, it can be a challenge for the passengers to drive into the right terminal of the airport. Minneapolis St. Paul International Airport MSP.

MSP is an airport that has two terminals, three miles apart from each other (Finally, 2010). Passengers driving into this airport have challenges starting from the federal highway I-494 itself. Historically, due to the poor signage system towards the airport terminal, many passengers took the wrong exit and missed their flights. The two terminals at MSP were named after famous aviators Charles Lindbergh and Vice President Hubert H. Humphrey. Until the year 2000, Humphrey was a little used charter terminal (Finally, 2010). The signs were changed after Humphrey added scheduled air services. Slowly major air carriers moved into the Humphrey terminal. This created a big confusion for the passengers; they were confused in figuring out their departure terminal. The signboard with the names Lindbergh and Humphrey made no sense to the passengers travelling into MSP. After almost ten years of struggle, the airport management was able to resolve this significant customer service issue. The reason it took so long for the airport management to react is that they could not get approval for the project initially due to the state and federal regulations. This prevented the installation of a sign listing airline names, as officials worried this change could cause accidents and the traffic to slow down at the highway (Finally, 2010).

The study “Airport Terminal Signs” conducted by Kichhanagari, Motley, Fisher, and Duffy in (2001) had the potential solution to resolve the issues with terminal signs, as implementing the results of this study could reduce confusion along the roadways to and from the airport. This study was conducted to prove that an advanced information sign

system will aid passengers in finding the right terminal and also reduce the search time by as much as 50 percent. The terminals were each assigned with a letter.

In this study (Kichhanagari et al., 2001) the column followed an alphabetical format in which the airlines were listed alphabetically across the columns of each terminal signs as well as within the terminal sign. The terminal letter was mentioned after each airline name. The experiment consisted of four terminal signs in total. The participants of this study were graduate and undergraduate students from University of Massachusetts, Amherst. It was a paper and pencil experiment, conducted under two conditions (Column alphabetical condition and standard condition) with 12 trials in each condition. In one condition (standard) the first page contained the target airline and was then followed by the welcome sign with a terminal letter (refer table 1). The third and fourth page had the four terminal sign boards (refer table 3-6); each terminal sign had nine airline names arranged in three columns alphabetically. Three separated flaps were taped to each column, which covered the names in each column. In the second condition (column alphabetical), as in the first condition the target airline appeared in the first page. However, the standard welcoming sign was followed by column alphabetical information sign (refer table 2). Four terminal signs then followed this. Participants used 4 terminal signs on each trial; 48 signs were used for 12 trials.

Table 1 *Welcome Sign*

Welcome to Logan International Airport
A B C D
Match Your Airline with Your Terminal Letter

Table 2 *Column Alphabetical Information sign*

Airlines Listed Alphabetically in Columns **Identify Your Column** **Iberia** ↓ **Kuwait**	**Lanchile** ↓ **Quantas**	**Reno Air** ↓ **World**

Table 3 *Terminal Sign Board 1*

Iberia – D	Lanchile – C	Reno Air – B
Iceland Air – B	Lufthansa – D	Royal Cambodian – C
Impulse – A	Lux air – A	Royal Dutch – A

Table 4 *Terminal Sign Board 2*

Indian – D	Malaysian – A	Singapore – B
Indonesian – C	Midway – C	Southwest – D
JAT Yugoslav – B	Nepal – C	Swiss Air – B

Table 5 *Terminal Sign Board 3*

Jet Airways – A	Northwest – C	Thai Air – B
Jet Blue – B	O' Connor – D	Turkish – A
Kenya – D	Olympic – C	Uganda – C

Table 6 *Terminal Sign Board 4*

Kitty Hawk – C	Oneida – A	Virgin – C
KLM – D	Pakistan – B	WestJet – D
Kuwait – B	Quantas – A	World – C

The results (Kichhanagari et al., 2001) showed that participants performed better in column alphabetical conditions. As airports are continuously expanding and becoming more congested, integrating these elements in the ground signage system would help passengers choose the right terminal and direction with less effort and time involved. The advance information sign system can be used in a number of locations and not just for airports.

Statement of the Problem

This study examines passengers' ability to understand the terminal signs at international airports. Positive and negative feedback regarding the terminal signs will be collected through an online survey. Difficulties faced by passengers will be analyzed and suggestions for change will be developed through this survey. This will be helpful in reducing the stress level of passengers, reducing the overcrowding of airports, and potentially saving a substantial amount of time for airport staff and passengers. The results of this study will not only help in improving the terminal signs but will also contribute to signage simplicity for airport navigation worldwide. The challenge of processing the passengers belonging to a variety of cultures is a difficult task, but this

study proposes to identify the issues in it. The research questions that will be addressed in this study are:

1. How effective are the signs at the international airport terminals experienced by travelers in the last year, as measured by:

a) How difficult was it for the passengers to determine their destination gate?

b) Were the passengers able to reach the destination gate without any confusion?

c) Was it easy for the participants to decipher the signs?

d) Were the signs placed in the appropriate places of the airport terminal?

2. How can terminal signs at an airport be further improved to make the navigation process simpler for the passengers?
3. What other facilities can be brought into the airport terminal to aid the passengers in finding their way to the destination gate?

To design a successful signage system, a thorough understanding of airport circulation pattern and functional relationship is required. Also, evaluating the existing signage system is a must, with more concentration towards the color used, content and hierarchy, and functionality and maintenance. There cannot be a single standard that can be used at the airports around the world, as proper signage depends upon each location and the populations of communities near the airport. However, the content and approach/concept in which the design has to be developed will be the same. A set of recommendations will be developed and proposed from the results of this study, which will be helpful for designers in developing an effective sign system for future terminals.

CHAPTER II- METHODOLOGY

A survey research methodology was utilized in this study. This method was appropriate for the study because it allows generalization of the results from a sample to a larger population. The survey was set up online using the tool Survey Monkey. The online survey was convenient for this research because conducting surveys in person with the passengers at an international airport would be a tedious job. Most of the time passengers would be in a hurry to reach their gate before the scheduled departure time and even if they happened to take the survey, the true responses from them might be comparatively low. Conducting the survey online was time effective and led to a higher response rate. By not asking for the name of any participant, anonymity was provided for the participants. The survey was intended to provide the opinion and attitude of the airline passenger community towards the terminal sign system at an international airport. This survey consisted of straightforward questions, with both open-ended and Likert scale data generated. This study was approved by Middle Tennessee State University's Institutional Review Board (IRB), Approval # 16-1161. The approval letter can be seen in Appendix A, and the informed consent statement can be seen in Appendix B.

Participants

The participants of this study were graduate students at Middle Tennessee State University (MTSU). The link to the survey was sent to these graduate students via email from the MTSU College of Graduate Studies. The email that was sent to the graduate students can be seen in Appendix C.

The number of MTSU graduate students in the spring 2016 semester was approximately 2,200, and the Dean of Graduate Studies sent the email containing the link

to the survey to each of these students. However, the survey was designed in a way such that participants who have not travelled internationally in the last year were automatically taken to the last page of the survey. In other words, their comments were not considered in the data analysis section. This study needed opinions only from the participants who travelled internationally, because passengers' airports in their native country would be familiar with the local language, and it is non-native passengers who struggle to understand airport signs. The lack of proper translation signs for simplistic navigation can cause difficulty among the non-native language speakers at a particular facility.

Instruments

The instrument utilized for this study included the online survey and statistical tools with which to analyze the collected data. All of these instruments were used in a way to ensure that the data collected would provide the correct information needed to draw conclusions regarding the effectiveness of terminal sign system at airports. The questions were designed to be straightforward and accurately derive the desired information. The questions were presented to the thesis committee for input and advice. Alterations were then made according to the input received. The final survey included 19 questions. The survey in its entire can be found in Appendix D.

The first few questions inquired about the participant's demographic information such as country of citizenship and education level. This was followed by questions to determine if the participant had travelled internationally. Again, the survey was designed in such a way that if a participant answered that he/she had not travelled internationally, they were automatically taken to the last page of the survey. These responses were considered as incomplete and were not taken into account for further analysis. If a

participant answer yes to the first question, stating that he/she had travelled internationally, they were allowed to answer the rest of the questions in the survey. Participants were then asked about their attitude and opinion towards the terminal sign system at the international airport that they had visited recently. Questions 8 to 13 determined the difficulty level, misperception, and experience that the participants had been through inside an airport terminal. These questions were designed to answer the first research question, which determines the effectiveness of the signs at the international airport terminals in the last year. Some of the actual signs obtained from the current aviation symbol standards section in Federal Aviation Administration (FAA) Advisory Circular No: 150/5360-12F were placed in the survey for questions 13 to 18, and the respondents were asked to determine the appropriate meaning of the signs. Non-language signs were added to make the survey more impactful and determine how well participants would understand its purpose inside an airport terminal. Part of research question one, which determines if it was easy for the passengers to decipher the signs at the airport terminal, was determined from the survey questions, which included non-language signs. The last question in the survey was a comment-based question, where participants were given an opportunity to type in their thoughts about how to improve terminal signs and make the process of finding their way simpler. Research questions 2 and 3, which identifies the improvements in signs and facilities that can be brought inside the airport terminal, were based upon participants' answers to the last question in the survey.

Procedure

An email with a brief introduction about the research study including the link to the survey was sent to the students via email from the MTSU College of Graduate

Studies. Once the participants clicked on the link, they were taken to the survey and asked for consent. There were no time limits set for any questions in the survey; participants were allowed to take sufficient time to answer the questions. The survey was active for four weeks and no follow-up reminders were sent to the students.

The collected data was transferred from Survey Monkey to Microsoft Excel spreadsheets. It was organized in a manner that allowed comparisons of the responses for each question. The responses from the participants were measured in the Likert-scale, which made the data analysis process simpler. Likert -Scale questions pair best with the Chi-Square calculation, as this will work irrespective of the number of responses.

CHAPTER III- DATA ANALYSIS

The data analysis method employed varied by type of survey question that was presented. The demographic questions asked on the survey question 2-8 are descriptively reported below and represented in bar graphs. The reported ability of the participants to understand airport signs was analyzed using Chi square two-tailed test. In addition, the participants' perceived effectiveness of airport terminal signs, as collected by the survey questions 9-13, was also analyzed using a Chi square test

Chi square test are used to determine if a relationship exist between two or more categorical variables. Chi-square tests were performed for the Likert-Scale questions, and based on the P value obtained the null hypothesis was either accepted or rejected. The null hypothesis of this study for all questions was that there is no difference between the responses of the participants; meaning the effectiveness of the terminal signs at the airport is neutral, or that they do not need to be improved nor is it substandard.

Survey

Question 2 on the survey determined the highest education level of the participants. As seen in Figure 1, a large majority of the participants (42 students) had a master's degree, 27 participants had an undergraduate degree, and 3 participants had a doctorate degree

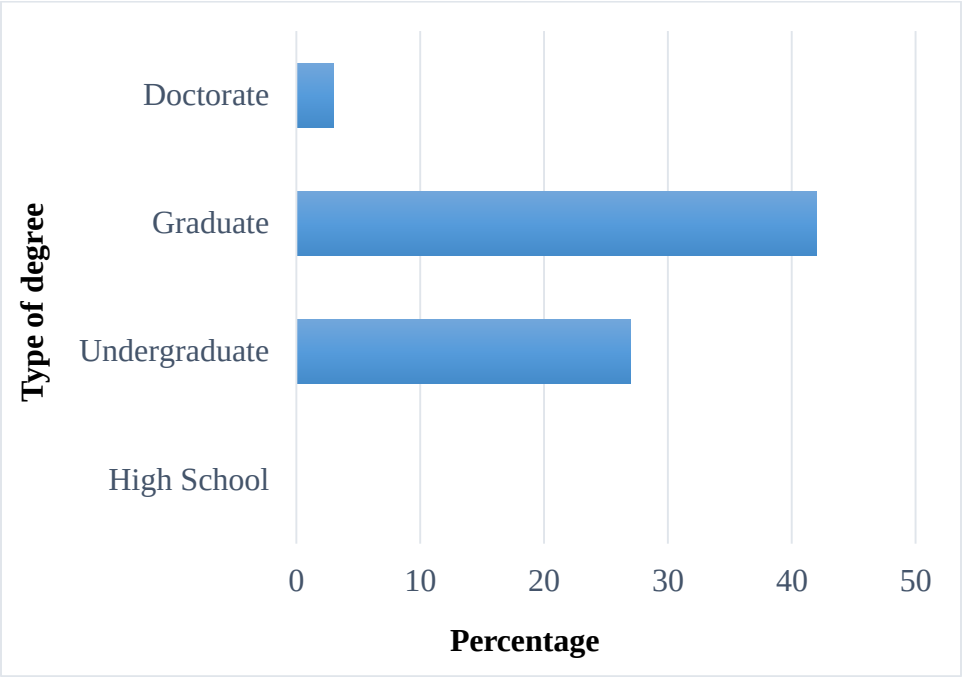

Figure 1: Highest Education Level of Participants Who Took Part in the Survey

Question 3 determined the country of citizenship of the participants. The respondents were predominantly from the United States, India, Germany, and Nigeria. Question 4 determined if the participant had travelled internationally. This question followed a loop; if a participant answered no to question 4 then he or she was taken out of the survey. Participants who had no international travel experience would not be able to answer the survey questions precisely, as the questions in the survey were based upon experience at international airports. Out of the total of 72 participants, 58 of them answered that they had travelled internationally (refer to Figure 2).

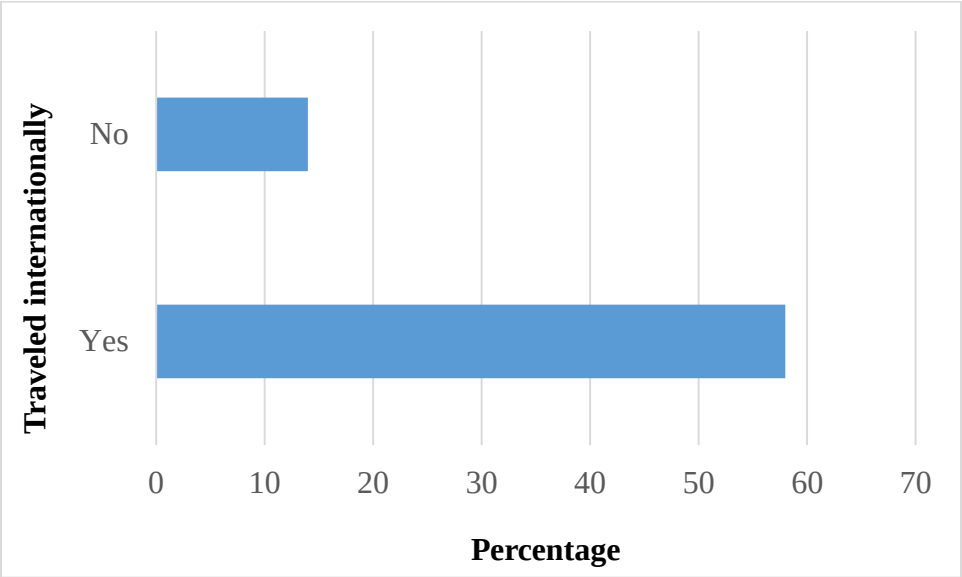

Figure 2: Number of Participants Who Had Traveled Internationally

Question 5 collected the names of the international airports that the participants had been to in the last year, and they were told to answer the following survey questions based on this named airport. The answers included Nashville International Airport (BNA), London Heathrow Airport (LHR), Hartsfield-Jackson Atlanta International Airport (ATL), and several others. A complete list of the airports mentioned by the participants can be seen in Appendix E. Questions 6 and 7 collected the respondents' year of visit and number of visits to the international airport answered in question 5. The data collected from the respondents for question 7 is represented below in Figure 3. The majority of the participants had travelled more than 5 times through the same international airport.

Question 8 determined the time of arrival of the participants at the international airport before their scheduled departure time. The responses of the participants are represented below in Figure 4. The data shows that majority of the participants arrived at the airport 2 to 3 hours prior to their scheduled departure time.

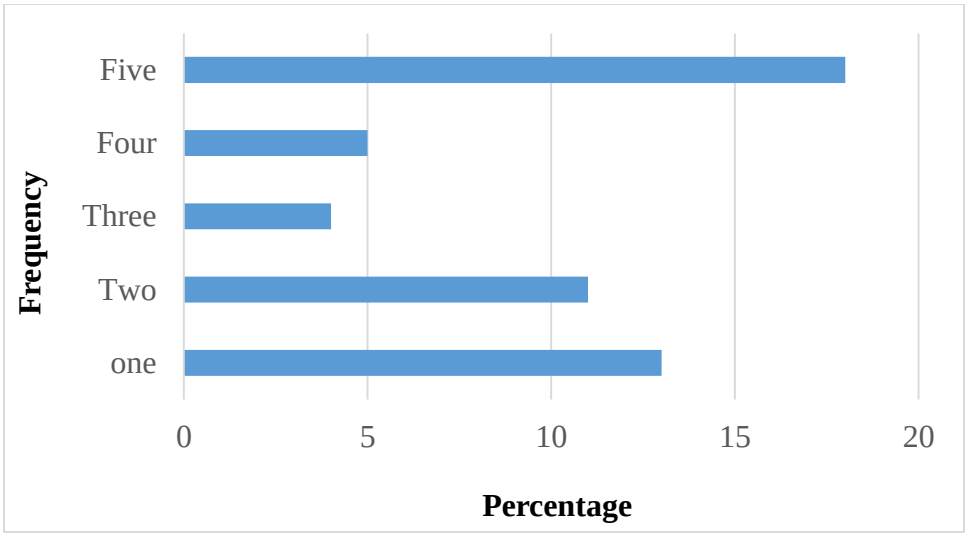

Figure 3: Number of Times the Participants Had Visited the Airport Overall

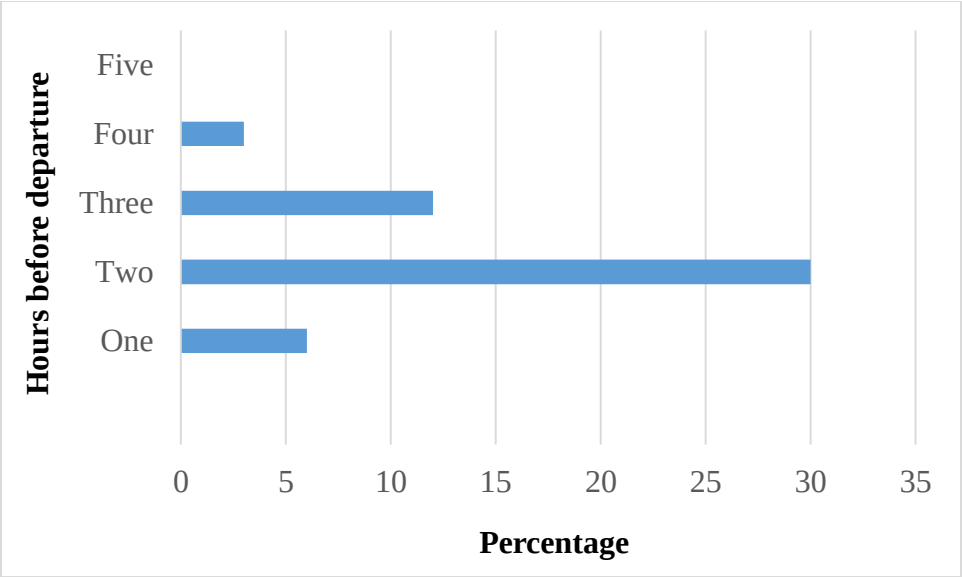

Figure 4: Participants' Time of Arrival at the Airport before the Scheduled Departure Time

Participants' Perceived Effectiveness of Airport Terminal Signs

The total number of responses to question 9, which questioned the effectiveness of the terminal signs at the airport, was 50 (refer to Figure 5). Again, the null hypothesis of this study predicts that there was no difference in the responses between each category. In the Chi-square calculation the null is what is called the Expected Frequency. So the answers in the expected column is represented as 10 for each category, since there were 5 responses possible (see Figure 5). The Observed Frequency is what the people who answered the question responded. The observed data for question 9 was imported from Survey Monkey. Chi square is calculated by comparing the observed frequency with the expected frequency. In the case of this question, Chi squared is 51.800 with 4 degrees of freedom. The two-tailed P value is 7.3E-11, which is less than 0.0001. By conventional criteria, this difference is considered to be extremely statistically significant.

A small P value is evidence that the data is different than the distribution expected. In this case, the null hypothesis would be rejected. It is clearly evident from the responses that the participants feel the current terminal signs system at international airports are effective.

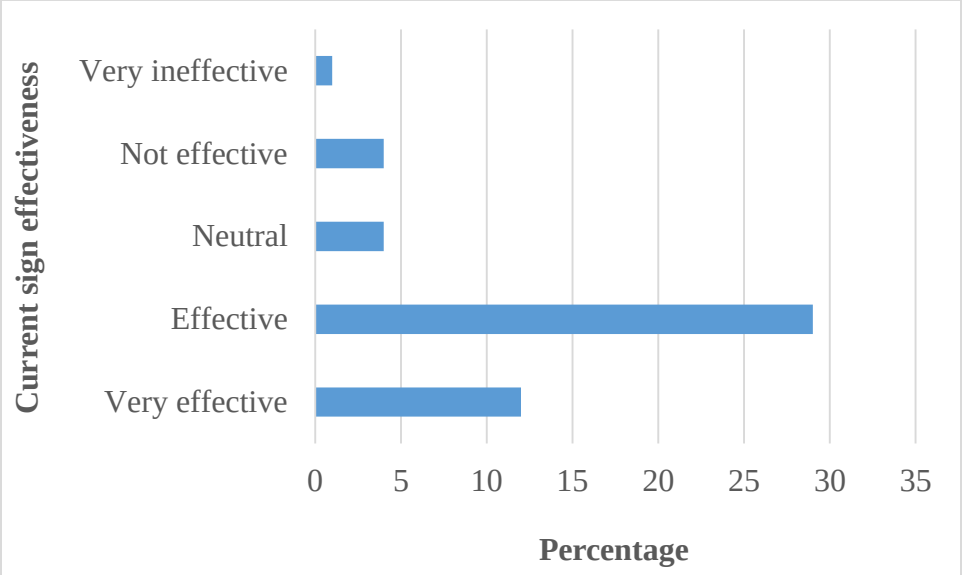

Figure 5: Effectiveness of Airport Terminal Signs

The number of responses for question 10, which determined how frequently the participants were confused inside an airport terminal, was 51 (refer to Figure 6). So the expected frequency was represented as 10.2 for each category. Chi squared for this question is 43.01 with 4 degrees of freedom. The two-tailed P value is 4.9E-9, which is less than 0.0001. By conventional criteria, this difference is considered to be extremely statistically significant. The null hypothesis is rejected due to the small P value. The responses from participants clearly implies that they were rarely confused inside an airport terminal.

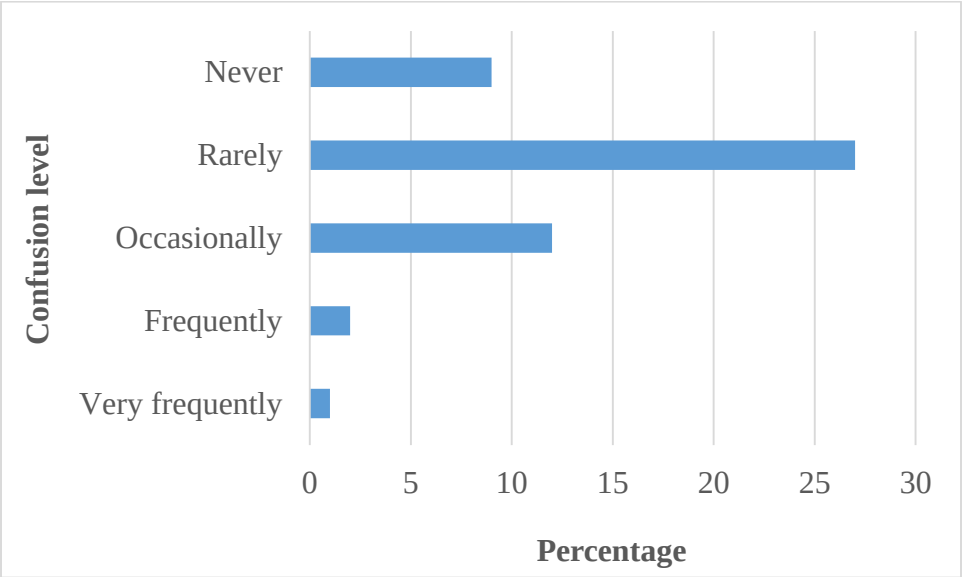

Figure 6: Level of Confusion Inside the International Airport Terminal

The number of responses for question 11, which determined the time of arrival of the participants at the airport, was 51 (refer to Figure 7). So, the expected frequency was represented as 10.2 for each category. Chi squared is 117.5 with 4 degrees of freedom. The two-tailed P value is 8.8E-25, which is less than 0.0001. By conventional criteria, this difference is considered to be extremely statistically significant, thereby it rejects the null hypothesis. The participants arrived well in advance at their terminal gate.

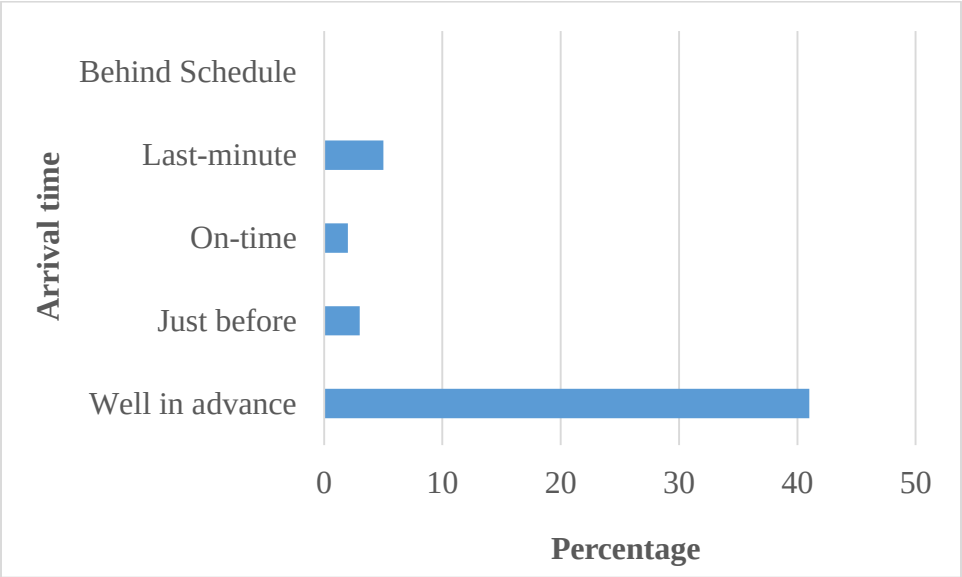

Figure 7: Time of Arrival of Participants at the Airport before the Scheduled Departure Time

The number of responses for question 12, which determined the difficulty level of participants in finding the right terminal gate, was 51 (refer to Figure 8). So, the expected frequency was represented as 10.2 for each category. Chi squared is 34.9 with 4 degrees of freedom. The two-tailed P value is 2.2E-7, which is less than 0.0001. By conventional criteria, this difference is considered to be extremely statistically significant. The participants found the terminal signs to be easy to decipher and it easy to find their way inside the airport, which again rejects the null hypothesis.

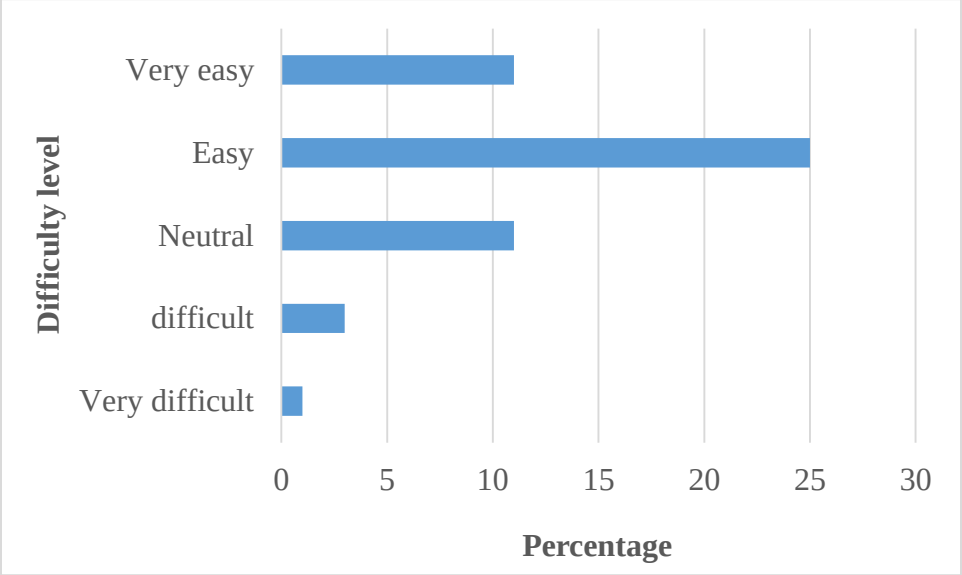

Figure 8: Level of Difficulty to Decipher the Terminal Signs

The number of responses for question 13, which determined the satisfaction level of the participants with the current standard terminal sign system, was 50 (refer to Figure 9). So, the expected frequency was represented as 10 for each category. Chi squared is 33.8 with 4 degrees of freedom. The two-tailed P value is 3.8E-7, which is less than 0.0001. By conventional criteria, this difference is considered to be extremely statistically significant. The small P value makes it evident that the expected frequency generated through theory is wrong and rejects the null hypothesis. Participants seem to be somewhat to very satisfied with the current standard of terminal signs.

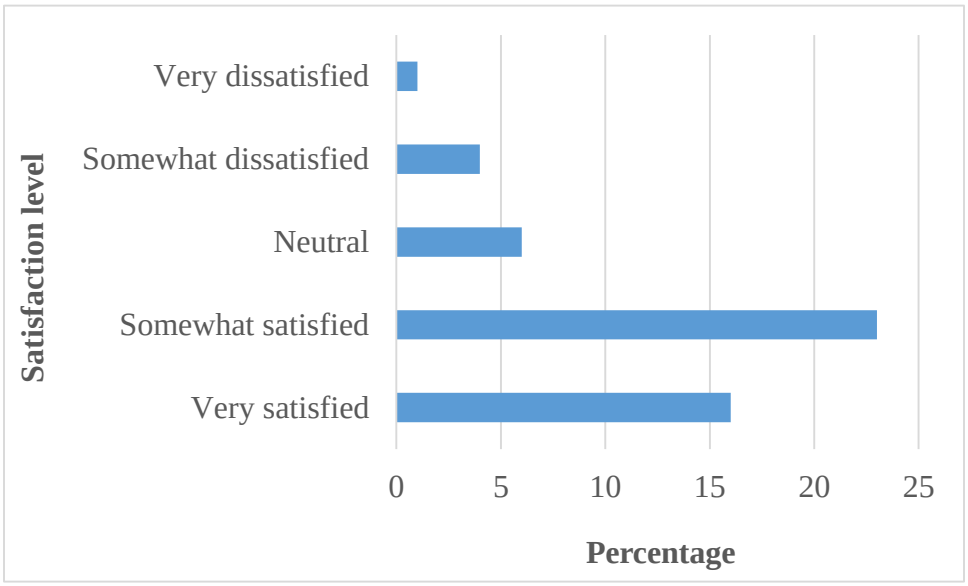

Figure 9: Level of Satisfaction with the Current Terminal Signs

Participants' Knowledge about Existing Signs

The questions from 14-18 requested the participants to identify the meaning of the terminal signs displayed. Each question had three options to choose from. The number of responses for question 14, which determined the ability of the participants to identify the meaning of the current standard sign, was 51 (refer to Figure 10). So the expected frequency was represented as 17 for each category. For this question Chi squared is 11.4, with 2 degrees of freedom. The two-tailed P value is 0.0033. By conventional criteria, this difference is considered to be very statistically significant. This rejects the null hypothesis. Most of the participants incorrectly identified the meaning of the sign shown in question 14; the right answer was "immigration" and only 14 out of 51 participants answered it correctly.

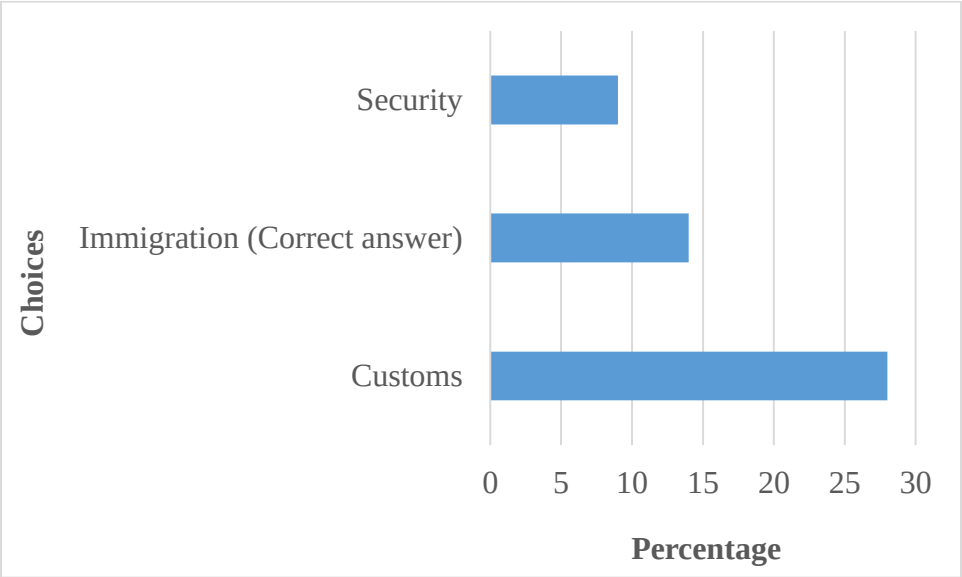

Figure 10: Identify the Correct Meaning of the Terminal Sign in the Survey Question 14

The number of responses for question 15, which determined the participants' ability to decipher the standard sign that was displayed, was 51 (refer to Figure 11). So the expected frequency was represented as 17 for each category. Chi squared is 19.1 with 2 degrees of freedom. The two-tailed P value is 3.4E-5, which is less than 0.0001. By conventional criteria, this difference is considered to be extremely statistically significant. The null hypothesis is rejected due to the small P value, and again most of the participants incorrectly identified the meaning of the sign shown in question 15. The correct answer was "cross walk" and only 20 out of 51 participants answered it correctly.

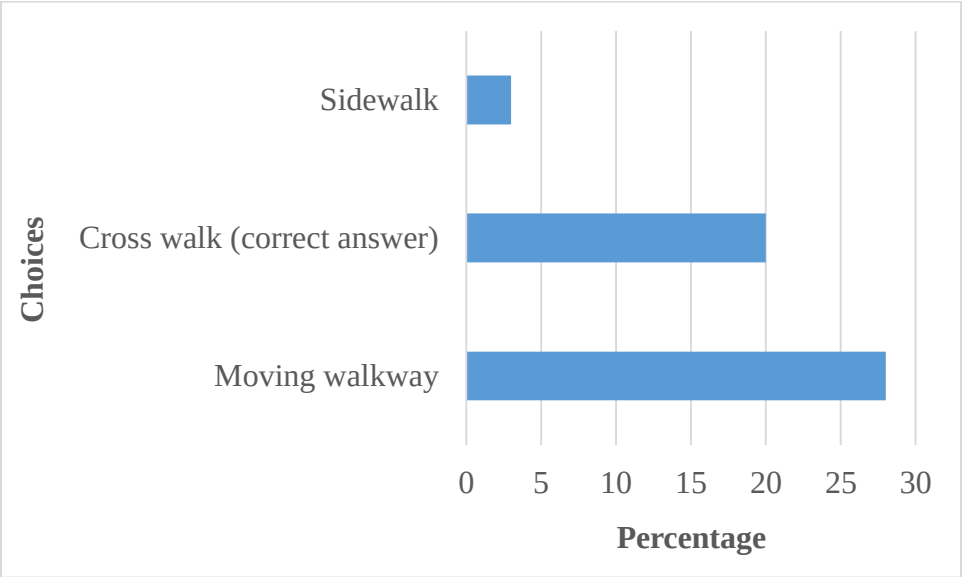

Figure 11: Identify the Correct Meaning of the Terminal Sign in the Survey Question 15

The number of responses for question 16, which determined the ability of the participant to decipher the standard sign depicted, was 50 (refer to Figure 12). So the expected frequency was represented as 16.67 for each category. Chi squared is 72.2 with 2 degrees of freedom. The two-tailed P value is 1.1E-16, which is less than 0.0001. By conventional criteria, this difference is considered to be extremely statistically significant. A large number of participants identified the correct meaning of the sign shown in question 16. The correct answer was “ticket purchase”.

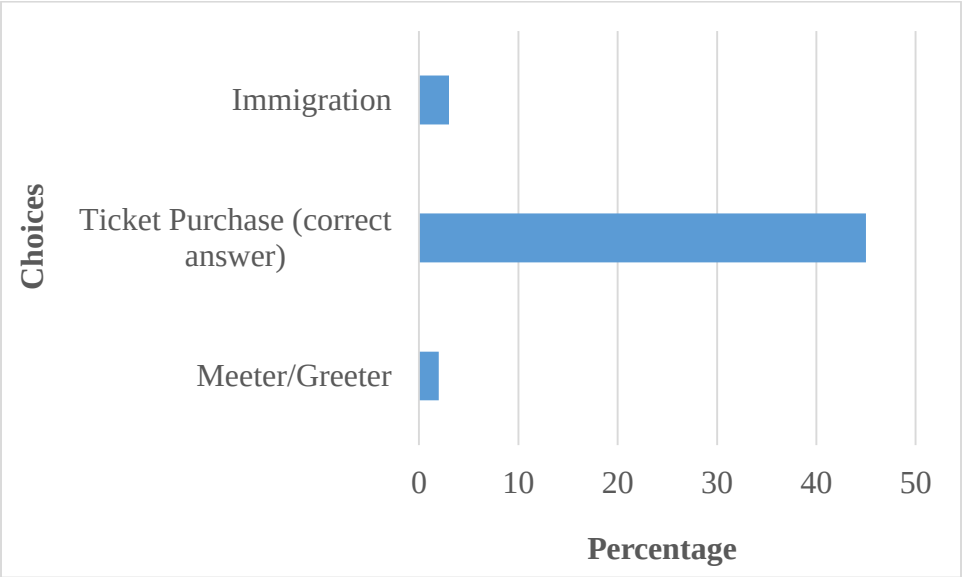

Figure 12: Identify the Correct Meaning of the Terminal Sign in the Survey Question 16

The number of responses for question 17, which determined the ability of the participant to identify the meaning of the current standard sign displayed, was 51 (refer to Figure 13). So the expected frequency was represented as 17 for each category. Chi squared is 74.2 with 2 degrees of freedom. The two-tailed P value is 3.7E-17, which is less than 0.0001. By conventional criteria, this difference is considered to be extremely statistically significant. Again, most of the participants identified the correct answer for the sign shown in question 17. The correct answer was “lost and found”.

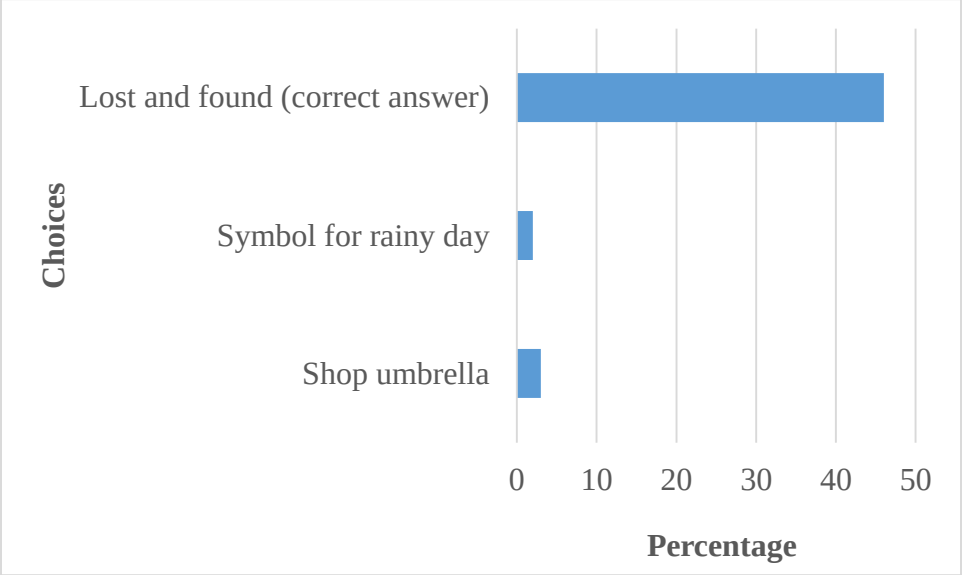

Figure 13: Identify the Correct Meaning of the Terminal Sign in the Survey Question 17

The number of responses for question 18, which determined the participants' ability to identify the meaning of current standard terminal sign displayed, was 49 (refer to Figure 14). So the expected frequency was represented as 16.3 for each category. Chi squared is 53.9 with 2 degrees of freedom. The two-tailed P value is 9.7E-13, which is less than 0.0001. By conventional criteria, this difference is considered to be extremely statistically significant. Most of the participants got the answer correct by identifying the appropriate meaning for the sign shown in question 18. The correct answer was "flight information".

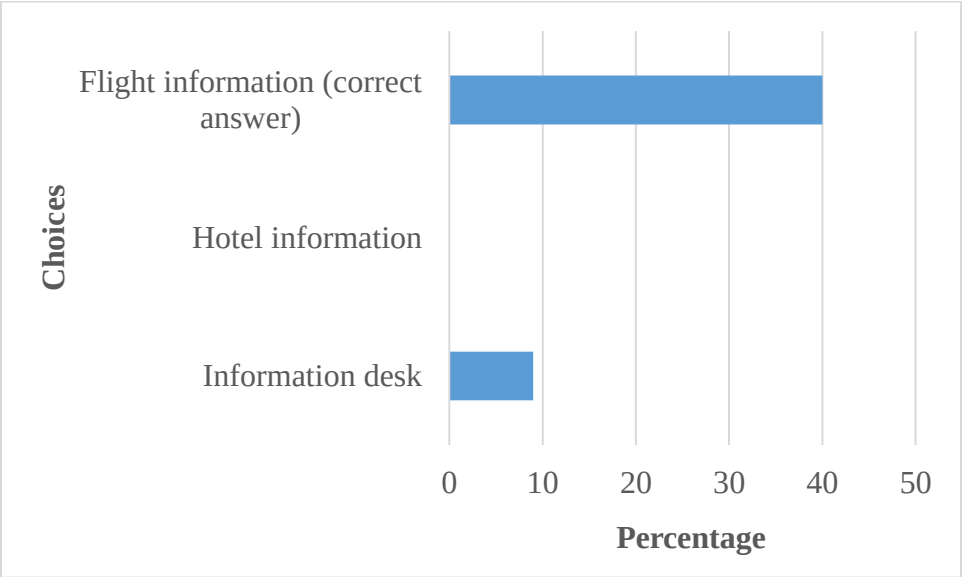

Figure 14: Identify the Correct Meaning of the Terminal Sign in the Survey Question 18

On further examination of the data, out of the 58 participants who had traveled internationally, approximately 30-40 answered that the current terminal sign system at international airports are effective, easy to decipher, and not confusing. Out of these 30-40 participants only one participant identified the meaning of all five signs in the survey correctly, others had one or two answers wrong. The one participant who identified the meaning of all five signs correctly mentioned in the survey that he or she has travelled through Nashville International Airport in the United States, and has travelled there more than five times overall. The most recent visit, as mentioned by that one participant, was two months ago.

Question 19 requested the participants to comment on how the terminal signs can be improved or modified to make the way finding process simpler inside an airport. The

participants made several comments; all of these comments were grouped based upon their similarity. The original comments from all the participants are attached under Appendix F.

Suggestions summarized from survey question 19 are:

- Publish a legend or sign key of each symbol of the sign system and have it available for viewing at several locations within the airport or attach it to the ticket. A total of four responses fell in this category.
- Develop universal symbols and color codes for signs, which a layman could understand. Four responses supported this suggestion. Four other responses from the participants supported this suggestion.
- Develop a smart phone application similar to a map application, so that passengers can put in their destination terminal and route. One participant suggested this solution.
- Provide approximate distance or time taken to reach the terminal while printing the tickets at the counter. One participant suggested this solution.
- Include short description of the signs in the English language. Four responses supported this suggestion.
- Appoint more staff (multi-linguistic talent preferred) to work at the terminal and help confused passengers to determine their way. One participant suggested this solution.

To obtain additional perspectives, the countries of citizenship of the participants and their ability to identify the meaning of the sign displayed in the question was compared and averages were taken (refer to Figure 15). It was evident that the United States citizens

(native students) had more knowledge about the signs and their definitions than other citizens (international students), as native students were able to identify 4 out of 5 questions correctly.

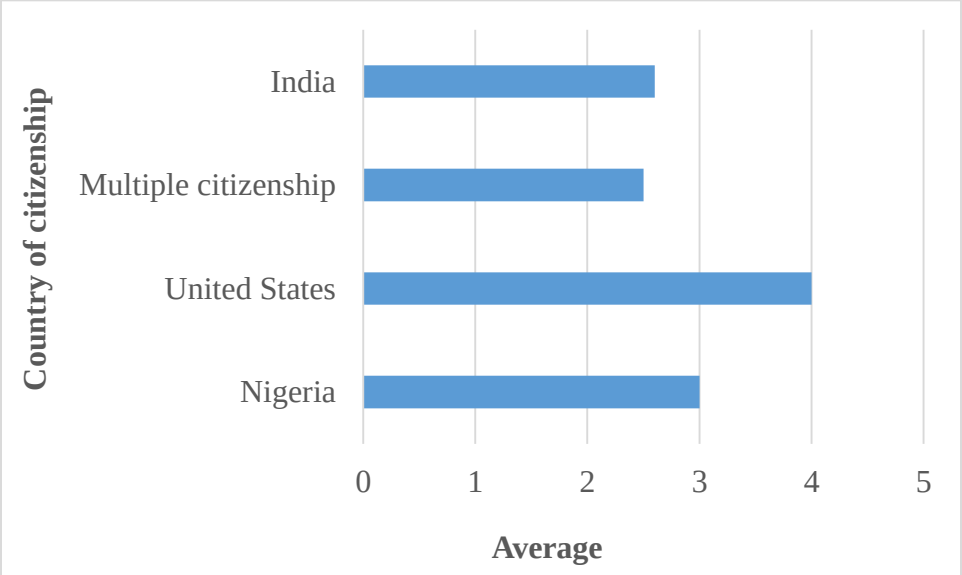

Figure 15: Comparison between Countries of Citizenship of the Participants and their Responses

When comparing the frequency of visits to the airport reported by the participants with their ability to identify the definition of the presented signs, it was found that participants who traveled three or more times identified most of the sign's definitions correctly (see Figure 16). However, there was not a significant difference seen between the groups.

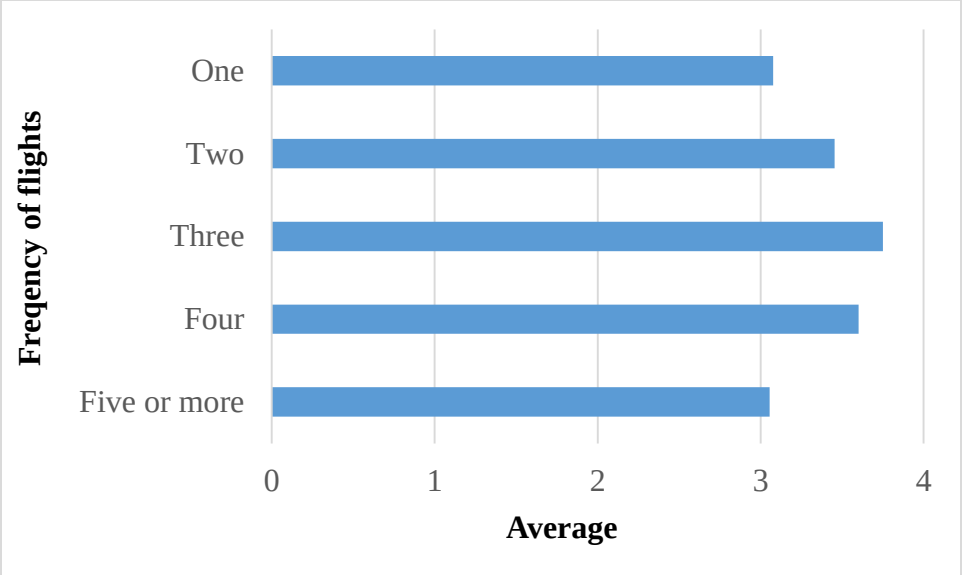

Figure 16: Comparison between Frequency of Visits and Responses

CHAPTER IV- DISCUSSION

This study was designed to determine the effectiveness of the current airport terminal sign system through the investigation of the three research questions: effectiveness of terminal signs at an international airport in the last year, how can the terminal signs be improved to make the navigation process simpler, and what other facilities can be brought into the airport terminal to aid the passengers in finding their way. After the data collection and analysis, it was determined that there was a significant relationship between the country of citizenship of the participants and their ability to identify the meaning of the signs. This relationship shows that citizens from developing countries such as Nigeria and India are finding it a bit difficult to understand the signs when compared to citizens of developed countries such as, in this case, the United States. Also, the relationship between the frequency of visits to the airport and the capability of identifying the meaning of the signs was established, but no significant difference was found between the groups. The reason may be due to a low sample size.

The participants, perceived effectiveness was positive, as most of them indicated that the sign system that is currently in place is very effective for allowing them to find their way inside an airport terminal. Therefore, the answer to the first research question "How effective are the signs at the international airport terminals experienced by travelers in the last year?" is yes, they are effective. The sub questions under first research questions, which queried regarding the difficulty level, misperceptions, and experiences that the participants had been through inside an airport terminal, also had a majority of positive responses from the participants. Hence, the answers to these questions was yes, the signs were not perceived to be confusing and yes, it was easy for

the participants to find the way to their destination gate. However, out of all the participants who mentioned that the signs seem to be effective and non-confusing, only one was able to identify the meaning of all the five signs presented during the survey correctly. This implies that participants have a wrong perspective about their understanding of the current sign standards and there is likely a need for these to be improved and made simpler for passengers to decipher. So, the answer to the sub question "Was it easy for the participants to decipher the signs?" is no.

The next research questions in this study are "How can terminal signs at an airport be further improved to make the navigation process simpler for the passengers?" and "What other facilities can be brought into the airport terminal to aid the passengers in finding their way to the destination gate?" Comments based responses from the participants were collected, analyzed, and grouped based upon their similarity to answer these two research questions.

Recommendations

This study found that participants were likely having a wrong perspective about how effective the current sign system is. But, they did tend to find their way to their destination gate by following the English translations of the signs. However, this is not going to be the case at all airports around the world. Different languages are spoken in different countries, and not all airports would mandatorily have English translations for the signs. It seems likely that the participants in this study would have been confused without the English translations at some of the international airports they visited. So, it would be better to develop standard non-language signs that are easy to interpret. This information can be widely circulated in the form of books or web based applications, or

printed behind the boarding pass tickets with definitions for each symbol in different languages widely spoken by the traffic passing through a particular airport terminal.

There could also be more wayfinding facilities brought into the airport terminal, such as an automated way teller machine with a simple and appealing user interface. The terminal would have had to be built in a way to minimize confusion and complex designs. Also, new terminal designs can be used to naturally enhance the way finding ability of the passengers; it is better to follow simple, standard, pier-type, or linear terminal configurations during the design phase.

The challenge of processing the passengers belonging to a variety of cultures is a difficult task, but this study has identified some key issues related to signs and wayfinding inside the airport terminal. The suggestions developed through this study, if implemented, would be helpful in reducing the stress level of passengers, reducing the overcrowding of airports, and potentially saving a substantial amount of time for airport staff and passengers.

Limitations of Research

It is important to note that although some significant relationships were found, it does not provide strong evidence of cause and effect. This study is not concluding that the current sign system and wayfinding facilities in the international airports are bad, but rather concludes that it might be improved and made simpler for the air travelers around the world to interpret in less time.

The population used in the study does not represent a large cross-section of demographics, particularly when it comes to age. Age can play a major role in wayfinding inside the airport terminal; for example, adults under 50 would be likely

familiar with the latest technologies, and might use their smart phone or iPad or other facilities inside the airport terminal to determine their destination gate. Even though they may not be familiar with the new technologies integrated into an airport terminal, they can likely manage to play with it and find their destination gate. But, it may not be the same case with adults over 50, as they sometimes require help from someone else to get familiarized with new technologies.

The education level of the participants who took part in this study was also not consistent with the general population, as 42 students had a master's degree, 27 students had an undergraduate degree, and 3 students had a doctorate degree. So, the results would not have been the same if the same study had been conducted with the general public.

Recommendations for Future Research

This study has opened up the potential for an array of future studies to further investigate the topic matter. This study considered the country of citizenship and education level of the participants; a future study should be conducted by examining different elements, such as age, gender, and how many languages are known. This may yield different perspectives about the wayfinding process for different demographic groups.

The data collected in this study was through an online survey; collecting data by conducting in person interviews with the passengers at the airport would yield more genuine responses. The timeline of this study was so short, it was impractical to obtain permission from the airport managers to conduct interviews at the airport. It would be important to choose an appropriate place to conduct interviews with the passengers, because most of the time passengers would be in a hurry to reach their gate before the

scheduled departure time, and even if they happened to take the survey the true responses from them might be comparatively low. Conducting interviews at the gate an hour or two before the scheduled departure time would be a better idea, as passengers who have arrived early would be willing to share their wayfinding experience at that particular airport.

In addition, a future study on terminal signage, if at all possible, should be conducted as an experimental study in a workstation by utilizing graphic and simulation modeling technologies to effectively represent a three-dimensional environment of the airport. These technologies would allow the researcher to test different concepts or logics under various scenarios and determine participants' responses, which can lead to a holistic understanding of how the public will experience the facilities. New symbols and signs that might be developed in the future can also be tested by experimental methods before integrating these into airport terminals. Conducting experiments with proposed signs will give an opportunity for the terminal designer to test their effectiveness before implementation, to be sure passengers can decipher their meaning correctly.

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APPENDICES

APPENDIX A

IRB Approval

IRB
INSTITUTIONAL REVIEW BOARD
Office of Research Compliance,
010A Sam Ingram Building,
2269 Middle Tennessee Blvd
Murfreesboro, TN 37129

MIDDLE TENNESSEE STATE UNIVERSITY

EXEMPT APPROVAL NOTICE

Click here to enter a date.

Investigator(s): Vairavan Ganesh & Wendy Beckman
Department: Aersospace
Investigator(s) Email: vq2t@mtmail.mtsu.edu
Protocol Title: "Terminal Signage "
Protocol ID: 16-1161

Dear Investigator(s),

The MTSU Institutional Review Board, or a representative of the IRB, has reviewed the research proposal identified above and this study has been designated to be EXEMPT.. The exemption is pursuant to 45 CFR 46.101(b) **(2) Educational Tests, Surveys, Interviews, or Observations**

The following changes to this protocol must be reported prior to implementation:

- Addition of new subject population or exclusion of currently approved demographics
- Addition/removal of investigators
- Addition of new procedures
- Other changes that may make this study to be no longer be considered exempt

The following changes do not have to be reported:

- Editorial/administrative revisions to the consent of other study documents
- Changes to the number of subjects from the original proposal

All research materials must be retained by the PI or the faculty advisor (if the PI is a student) for at least three (3) years after study completion. Subsequently, the researcher may destroy the data in a manner that maintains confidentiality and anonymity. IRB reserves the right to modify, change or cancel the terms of this letter without prior notice. Be advised that IRB also reserves the right to inspect or audit your records if needed.

Sincerely,

Institutional Review Board
Middle Tennessee State University

NOTE: All necessary forms can be obtained from www.mtsu.edu/irb.

APPENDIX B

Informed Consent Statement

You are being asked to take part in a research study, which evaluates the effectiveness of the terminal signs at international airports. The purpose of this study is to determine how well the terminal signs supports airline passengers in reaching their destination before their scheduled departure time, and how signs can be improved to make the way finding process simpler. Taking part in this study is completely voluntary. You may skip any questions that you do not want to answer. If you decide to take part, you are free to withdraw at any time. If you agree to be part of the research study, you will complete an online survey. The survey includes questions inquiring about your educational level, country of citizenship, and your experience at an airport terminal. The online survey will take about 10 minutes to complete. If you should have any questions about this research study please feel free to contact Vairavan Ganesh at vg2t@mtmail.mtsu.edu, my Faculty Advisor Dr. Wendy Sue Beckman at wendy.beckman@mtsu.edu, or the MTSU office of compliance at 615-494-8918.

APPENDIX C

The Email that Was Sent to Graduate Students

Hello,

I'm Vairavan Ganesh, a master's degree student in the MTSU Aerospace Department. I am conducting my thesis research on airport terminal signs. The goal of my research is to determine the effectiveness of the terminal signs inside an airport and the role it plays in aiding the airline passengers to reach their destination gate inside the airport before the scheduled departure time. The research will consist of a short 19-question survey that should not take more than 10 minutes to complete. If you have traveled internationally, please consider participating in this survey.
The survey is completely anonymous and no identifying information will be collected in order to minimize the risk of participation. If you would like to participate, please click on the link below to go to the survey.

https://www.surveymonkey.com/r/CWQBTXL

Many thanks!
Vairavan Ganesh

APPENDIX D

Online Survey Questions

1. Do you agree to take part in this survey?
    - Yes
    - No
2. Highest educational level
    - High school
    - Graduate
    - Undergraduate
    - Doctorate
3. Country of citizenship
4. Have you ever traveled internationally?
    - Yes
    - No
5. Please name the International Airport which you most recently traveled to, and please base your answers to the following questions on that experience.
6. How recently did you visit this airport?
7. How many times have you visited the airport overall?
    - One
    - Four
    - Two
    - Five or more
    - Three
8. How early did you get to the airport? (Indicate in hours before the scheduled departure time)
    - One
    - Four
    - Two
    - Five or more
    - Three

9. How effective were the terminal signs at the airport in determining the way to your destination?

- Very effective
- Effective
- Neutral
- Not effective
- Very ineffective

10. How many times did you end up being confused or lost at the airport terminal?

- Very frequently
- Frequently
- Occasionally
- Rarely
- Never

11. How quickly did you reach the destination gate before the scheduled departure time with the aid of terminal signs at the airport terminal?

- Well in advance
- Just before
- On-time
- Last minute
- Behind schedule

12. Please mention how difficult it was to determine the way to the destination gate with the help of the terminal signs at the airport?

- Very difficult
- Difficult
- Neutral
- Easy
- Very easy

13. Overall, how satisfied or dissatisfied were you with the terminal signs at the airport?

- Very satisfied
- Somewhat satisfied
- Neutral
- Somewhat
- Dissatisfied
- Very dissatisfied

14. What does this airport terminal sign mean? 

- Customs
- Immigration
- Security Check

15. What does this airport terminal sign mean? 

- Moving walkway
- Crosswalk
- Sidewalk

16. What does this airport terminal sign mean? 

- Meeter/Greeter
- Ticket purchase
- Immigration

17. What does this airport terminal sign mean? 

- Lost and found
- Shop umbrellas and gloves
- Symbol for rainy day

18. What does this airport terminal sign mean? 

- Information desk
- Hotel information
- Flight information

19. In a short phrase, please mention how can the terminal signs be improved or modified to make the way finding process simpler?

APPENDIX E

List of International Airports Mentioned by the Participants

- Dominican Republic
- Atlanta
- PUNTA CANA
- London Heathrow Airport
- CUN
- Newark airport
- Okinawa
- Newark airport
- Atlanta
- PORT HARCOURT
- Chūbu Centrair International Airport
- Nashville International Airport
- GUA
- Dusseldorf
- CUN - Cancun, Mexico
- Dallas/Ft Worth
- Nashville
- Toussaint L'Ouverture International Airport
- Rome, Athens
- Jorge Chaves international airport
- London Heathrow
- Ben Gurion International Airport
- Newark Liberty International Airport
- Atlanta
- Jamaica, Montego Bay
- Nashville (BNA)
- Kempegowda International Airport

- Charles De Gualle
- Nashville BNA
- Charles de Gaulle
- London Heathrow International Airport
- MIA
- Nashville International Airport
- Frankfurt International Airport
- Abuja
- Amsterdam
- Miami International Airport
- Toronto International (YYZ)
- Heathrow
- Frankfort
- Philadelphia
- GVA
- JFK, O'R Thambo,
- Nnamdi Azikiwe,
- Murtala International Airport
- Gold Coast, Australia
- Miami International Airport
- Nashville International Airport
- San Jose, Costa Rica
- London Heathrow
- BNA
- Dubai

APPENDIX F

Original Comments of the Participants

- Include short descriptions in English.
- perhaps with words rather than the signs
- WORDS
- don't recall many of these, had to guess...if guess wasn't right, they need clarifying
- Provide a sign key detailing what all the symbols mean.
- A key or symbol explanation on tickets
- Use symbols, signs and words
- Add words haha.
- universal symbols
- Motion symbols, color images, universal sign shapes
- I had no idea what these signs meant, but I think that typical signage to get to gates is easy
- Not sure since I've guessed at the meanings
- Additional symbols on the paperwork to distinguish them from other paperwork.

- Creating new signs as I have seen some here, the signs must be so clear that a child at age of 12 can also understand and can follow the airport locations without any confusion.nice research all the best.
- Larger and more frequent
- Well some of these signs I have never seen before. So I think to improve them would be to add one word or short phrase?
- Include text
- No idea, I mainly pay attention to written signs not symboled
- Smartphone app similar to map apps. GPS your location, put in you destination terminal and route.
- Specific the final destination and layover locations
- The only time I've been lost is finding my vehicle in the Parking areas; ha-ha. I don't think there is a whole lot to improve going IN to the airport. getting out, or between gates: I've run into problems there.
- Color coding
- perhaps a pamphlet or phone app that decodes symbols in appropriate language
- terminal sign should be bold and clear.

- More signs and better directionality (arrows, etc)
- Provide approximate DISTANCE to each (or set of) gates - e.g. 200 yards (5 minutes walking) to Gate C15 Perhaps publish a legend of each symbol and have it available for viewing at several locations within the airport.
- No comments
- I am not sure.
- More detailed symbols.
- Question 15 & 18 were guesses, because the images didn't load. I think that the signs could be improves with a key or a little lable next to each one so that travelers know what they mean.
- Improved visibility
- Signs should be electronic.
- Clarity and helpful staff
- By using some rainbow-like color combinations, meaning different colors can be maintained from a terminal nor the other.
- Include an English translation of the sign
- Words!
- It would be great if there were a legend in the back of your passport.
- Yes

- Write what they mean next to

  the signs
- The only problem I've really had in the airport was accidentally exiting the secure passenger boarding area and having to go back through security. Except at LAX, which is the armpit of the world! No signs there mean anything because the place is under construction!
- Not sure
- I think they are fine