THE IMPACT OF END-USER DECISION-MAKING IN THE SUPPLY OF PUBLIC

TRANSPORTATION

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Efficient public transportation provides economic and social opportunities that increase accessibility to markets and employment as well as providing investment benefits. Key challenges to the U.S. public transportation industry include developing modes and increasing the availability of public transportation in a manner that meets the needs of individual users in a cost effective manner. A problem facing public transportation officials is the need to understand the factors that influence consumer decision-making and consumer attitudes toward public transportation. Feedback regarding experiences as well as expectations from commuters provides information for developing and improving public transportation. Thus, decision-making factors of end-users are keys to improving supply, growth, and understanding utilization of public transportation. Public transportation officials seek to improve the public transportation experience for commuters by increasing modes and benefits of the systems. The decision-making factors of the end-users require identification and examination in order to provide a high quality and efficient experience for commuters. The research questions of interest in the current dissertation are: (1) What are the decision-making factors affecting commuters' attitudes toward public transportation? and (2) How do the end-user decision-making factors affect the supply of public transportation? The purpose of this research is to extend the current body of knowledge about decision-making factors by developing and testing a new theoretical model to measure the attitudes of public transportation end-users. This study has its theoretical foundation in the theory of planned behavior, theory of reasoned action, and rational choice theory. To understand how public transportation is affected by decision-making factors, it is necessary to analyze the relationships among the decision factors and

attitudes. The findings of this study contribute by building theory and having implications for practice. This study employs a mixed methodology of qualitative and quantitative research. More specifically, the development of a framework and testing of that framework via collection of data using a survey instrument, semi-structured interviews, and data scraping of customer comments underpin the methodology employed in this study. To this end, Essay 1 develops a conceptual framework of decision-making factors that affect the supply of public transportation based on the extant literature. The integrated framework developed is operationalized using a survey to test a model that depicts the framework within the context to which the study was situated. The results of the structural model using PLS provide insights for the development of public transportation. Essay 2 involves two phases in the methodology. First, the study develops a causal loop that depicts the operationalized conceptual framework from Essay 1. Second, discussion panels were conducted to confirm the system dynamic causal loop visualization that was developed to fit the model. Finally, Essay 3 examines the conceptual framework developed and tested in the prior essays by analyzing electronic word of mouth (eWOM) of online comments. The third essay examines eWOM of current public transportation users that is available online. This eWOM data was examined using text mining and the resulting quantitative output was compared to the operationalized theoretical framework from the prior works. The results also illustrate the functionality of text analytics for confirmatory model assessment.

ACKNOWLEDGMENTS

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CHAPTER 1

INTRODUCTION

Background

U.S. Public Transportation

Public transportation is a vital element to maintain economic development

(www.apta.com). A high quality, affordable, and ecofriendly public transportation infrastructure

improves the development of economies (www.transitfuture.org; Murray et al., 1998).   The

effects of public transportation go beyond the basic movement of people and goods, for public

transportation is essential in the operation, development, and efficiency of an economy (Eberts,

2000; Rodrigue, 2013; Cervero et al., 2002; Murray et al., 1998). Efficient and viable public

transportation provides economic and social opportunities that lead to additional accessibility to

markets, employment, and other investment benefits (Rodrigue, 2013; Bel & Albalate, 2010;

Sterns et al., 2003; Cervero et al., 2002; Murray et al., 1998). Unreliable, poorly managed, and

poorly maintained public transportation result in deficiencies in lifestyle and opportunity

(Rodrigue, 2013; Bel & Albalate, 2010; Cervero et al., 2002; Murray et al., 1998).

In the U.S., public transportation links the economy together to bring output,

employment, and income while also connecting producers and consumers at a regional level

(Rodrigue, 2013; Bel & Albalate, 2010; Cervero et al., 2002; Murray et al., 1998). Various

organizations document the benefits of public transportation, including the United States

government and the American Public Transportation Association (APTA) and show public

transportation stimulates economic growth, reduces dependency on foreign oil, and improves our

environment (www.apta.com; Banister et al., 2011). The APTA cites energy conservation and

environmental protection as benefits of using public transportation over other transporting

modes. Within these benefits are reducing greenhouse gas emissions, energy savings, and clean

technology (www.apta.com). The APTA also states that by utilizing public transportation, an

individual can save an average of $8,000 annually and shows that modes of public transportation

have increased in the United States since the original light rail available to commuters over 120

years ago (www.apta.com).

Public transportation affects the development of a region in various ways. The core goal

of transportation is the movement of goods and people to allow for interactions between

economic entities (Rodrigue, 2013; Bel & Albalate, 2010; Sterns et al., 2003; Cervero et al.,

2002; Murray et al., 1998). Operational and geographical aspects of public transportation

provide wider accessibility to markets, distribution, and consumption (Rodrigue, 2013; Bel &

Albalate, 2010; Sterns et al., 2003; Cervero et al., 2002 Murray et al., 1998). Improvements in

economies of scale, utilization levels, and productivity result from efficient and reliable

transportation modes (Rodrigue, 2013; Cervero et al., 2002). Mobility is a fundamental activity

of economic development (Cervero et al., 2002). The direct impacts of a viable public

transportation system are employment, larger markets and economies, and improved cost of

transportation and time to delivery (Rodrigue, 2013; Bel & Albalate, 2010; Cervero et al., 2002;

Murray et al., 1998).

Key challenges to the U.S. public transportation industry include developing modes and

availability of public transportation that meets the needs of the individual user, and that is

compatible with the economic vitality of its user communities in a cost effective manner.

Challenges related to the timing of development, placement, and mode of transportation

resources result due to differences in priorities between manufacturing and the service industries.

The service industry focuses on transportation that is efficient and logistically supportive while

manufacturing industries tend to focus on access to and improvement of ports, roads, and railways. As an economy shifts, its impact upon transportation development is evident prior to, during, and immediately after. As a result, public reliance on different modes of transportations varies with economic shifts. Transportation planning has a positive impact on the development of a region with promotion of markets and social expansion but also hinders growth by creating mobility gaps. Mobility gaps between different socio-economic groups become especially prevalent during changes in the economy (Rodrigue, 2013). These gaps may be a result of the transportation challenges that arise from the change in the cost of public transportation (Rodrigue, 2013; Bel & Albalate, 2010). Related costs, such as the prices of imports, oil and gas, welfare, and competitiveness, all influence the availability of transportation (Schmutzler, 2011; Rodrigue, 2013). The transportation industry must weigh all of these concerns as part of the logistical planning process.

Commuter Advantages

For end-users, there are many benefits of using public transportation. The availability of public transportation stimulates economic growth improving work accessibility for individuals (www.apta.com; Rodrigue, 2013; Bel & Albalate, 2010; Sterns et al., 2003; Cervero et al., 2002; Murray et al., 1998). Public transportation allows for carriage of workers to jobs and creates jobs through the transportation companies themselves. Blumenfeld-Lieberthal (2009) explained that transportation networks are strong indicators of economic activity between cities.

Extensive research shows the environmental benefits of public transportation. Awadallah and Fini (2013) showed that automotive transportation not only emits large amounts of greenhouse gas emissions, but these emissions steadily increase. The use of public

transportation by environmentally savvy commuters means one less person driving a car and thus, less gas emissions and more energy savings being conducted (www.apta.com; Banister et al., 2011; Schmutzler, 2011). Public transportation is approximately twice as energy efficient as cars and helps reduce dependency on foreign oil (Shapiro, 2002). APTA also notes that electricity, as opposed to imported oil, powers more than 40% of public transportation (www.apta.com), which reduces taxes on individuals through less demand. Additionally, use of public transportation results in less congestion on the roads. While this might not directly benefit the commuter, it does affect other travelers.

Less congestion also relates to the environmental benefits with lower gas emissions. Certain modes of public transportation are able to move at high speeds with few stops to reduce travel time and allow consumers to save time. By transporting larger numbers of people and goods with a larger capacity than personal vehicles, public transportation also cuts down on congestion. Combining time, congestion, and environmental benefits, APTA states that public transportation saves over 796 million hours in potential delays as well as 303 million gallons of fuel annually (www.apta.com).

Public transportation can enhance social activity and integrity (www.aboutcivil.org; Cervero et al., 2002; Murray et al., 1998). People are able to meet and talk to others while being transported to their location of choice. Using public transportation eliminates the need for a driver's license. Individuals unable to drive or uncomfortable driving in a specific area are provided the freedom to travel (Sterns et al., 2003; Cervero et al., 2002). In addition, public transportation is available and enhances that social integrity for individuals, independent of socio-economic status or other demographics (Sterns et al., 2003; Cervero et al., 2002).

Finally, public transportation is cost effective. Not only are fees usually lower than the

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cost of gasoline, making it more cost friendly to commuters, it saves on taxpayers as well.

Public transportation allows cities to save funding on infrastructure and maintenance by

requiring fewer roads, which in turn means less paving and maintenance (www.apta.com). The

amount of utilities required for public transportation, such as water, sewer, and electrical lines, is

also less with public transportation (www.apta.com; Schmutzler, 2011). Additionally, the

utilization of public transportation requires fewer parking garages (www.apta.com), which can

save a city approximately $15,000 per space per year (Litman, 2011). Through the savings in

time, congestion, imported oil, public transportation is saving $17 billion each year in taxpayer

money (www.apta.com).

Commuter Disadvantages

While many advantages of using public transportation on an individual level exist,

several disadvantages accompany this decision. Public transportation has a set schedule of travel

(www.aboutcivil.org). Although this can prove to be a large advantage by knowing that travel

time will be consistent each day, it can create complications if the choices available cause long

wait times or are not compatible with individual schedules. Another disadvantage for end-users

is the defined locations of public transportation. Again, this can be quite advantageous with

consistent embarkation and debarkation facilities but can cause problems due to distance or

accessibility for commuters (www.aboutcivil.org). These specific locations might also require

the use of additional means of transportation aside from walking. Many individuals may view

sharing space with others as disadvantageous as a result of the compact area available in public

transportation. Concerns held by individuals may include claustrophobia, aversion to being near

individuals who are sick, and overall discomfort. The set routes for public transportation could

prove to be burdensome for commuters due to the indirect routes and inconvenient stops for work or social activities.

Problem Statement

The problem facing public transportation officials is the understanding of the factors that influence commuter decision-making and that affect consumer attitude toward the use of public transportation. Public transportation officials are defined as those individuals involved in the management operations and strategic planning of public transportation, including the A train and corresponding bus system in the metropolitan area. Although some of the potential advantages and disadvantages of public transportation for commuters have been identified, a clear understanding of the factors that influence consumer selection of specific modes of public transportation have not been clearly identified in the literature to date. As the development of public transportation progresses, public transportation officials need to examine these decision-making factors of current commuters of public transportation to plan for and anticipate future needs (www.transitfuture.org; Ebert, 2000; Bel & Albalate, 2010; Sterns et al., 2003; Cervero et al., 2002). Public transportation officials must consider the balance of costs and benefits to the commuter. Feedback regarding experiences as well as expectations from commuters are critical pieces of information for expansion and development of public transportation. These inputs impact the attitude a commuter will have towards public transportation. Each input will also influence the progression of public transportation in an area to promote economic growth. Thus, decision-making factors of end-users become keys to the supply, future growth, and understanding of public transportation.

Research Question

Public transportation officials are seeking ways to improve the public transportation experience for commuters with the increase of available modes and added benefits (www.apta.com; Sterns et al., 2003). The decision-making factors of the end-users need to be identified and examined in order to provide a high quality and efficient experience for commuters. Therefore, the research questions become (1) What are the decision-making factors affecting commuters' attitudes toward public transportation? and (2) How do the end-user decision-making factors affect the supply of public transportation?

Purpose and Contribution

The purpose of this proposed study is to extend the current body of knowledge of decision-making factors through an empirically tested framework and to develop a new theoretical model to measure attitude of end-users who utilize public transportation. This study is based on a collective model of variables affecting attitude with a theoretical foundation in theory of planned behavior (TPB), theory of reasoned action (TRA), and rational choice theory. Utility theory is used as a proxy to measure attitude. To fully understand how public transportation is affected by decision-making factors, it is necessary to analyze the effects of various factors on attitude. This research contributes to theory, practice, and academia.

This study contributes to theory by offering a proposed theoretical model synthesized through the theories of TPB, TRA, and rational choice theory. Due to attitude being a balance of costs and benefits, it can be assessed that decision-making factors comprise these costs and benefits. Based on the theoretical foundation and proposed theoretical model, an empirically tested framework and causal loop analysis provide insight to practitioners in the public

transportation field. A better understanding of decision-making factors for officials to consider when developing and expanding public transportation is presented. Finally, this dissertation fills the gap in the literature by examining attitude and the factors influencing the balance of costs and benefits. The inconsistency in defining attitude and the factors that constitute it is evident when reviewing various theories. Misinterpretation of attitude and the factors feeding into it can hinder analysis and comparison techniques.

Research Design

This study employs a mixed methodology of qualitative and quantitative research through the analysis of data collection through survey instruments, semi-structured interviews, and latent semantic analysis of online customer comments. Essay 1 presents a conceptual framework of decision-making factors that affect the supply of public transportation based on an extensive literature review and theoretical foundation. This integrated framework is tested using a survey of working professional commuters currently seeking undergraduate and graduate degrees at a southwestern metropolitan university. End-users are an essential aspect to the need for public transportation. The needs and desires of these end-users must be taken into consideration for a successful service and ultimately, a competitive advantage. The feedback regarding the service of public transportation is essential in the future development of public transportation – where it will go, types of services provided, optimal service based on end-user needs and desires, etc.

Essay 2 is a two-step process of methodology. It will take the tested integrated conceptual model from Essay 1 and visualize it with a causal loop diagram. Causal loops provide a visual representation to public transportation officials in order to see the entire system – system creation, input, and equilibrium. This system shows the portion of the supply chain involving services and

the end-user. Causal loops visually highlight any deficiencies in the service of public transportation as well as where potential problems (bottlenecks, costs, etc.) occur. The second step of this essay is to use a discussion panel to validate the decision-making factors and interrelationships in the causal loop diagram.

The third and final essay validates the conceptual model by analyzing electronic word of mouth (eWOM). An analysis of online comments of current public transportations commuters will be obtained and analyzed through latent semantic analysis (LSA). The results will then be used to generate quantitative output to test and validate the proposed theoretical model. The results will also illustrate the functionality of text analytics for confirmatory model assessment.

Organization of the Dissertation

This manuscript includes a description of an investigation of the decision-making processes utilized in relation to public transportation, beginning with a literature review of the decision making process of public transportation, followed by three essays and a summary discussion. The first essay presents factors that influence the decision to use public transportation in a metropolitan area. The second essay describes the influence of these decision-making factors on the supply of public transportation to end-users through causal loop visualization. A description of the use and analysis of electronic word of mouth (eWOM) is included in the third essay to identify public transportation decision-making factors followed with text analytics techniques to identify the frequency and strength of variables from end-user customer comments. Finally, the closing discussion includes several implications of these analyses and suggestions on where the future of public transportation will evolve.

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CHAPTER 2

LITERATURE REVIEW

Decision-Making Factors

Previous research shows multiple factors affect the decision making process for public transportation. Andreassen (1995) identified that individual customer preferences are mirrored in their expectations and perceptions in a service. Consumer choice consistency is the most stable when being used for routine activities, such as work and school (Vanier & Trippi, 1976). Litman (2013) revealed the positive impact on public health through public transportation. Health impacts improved through less pollution emissions, leading to a recommended focus on better planning. Al-Shakkah and Osman (2011) analyzed nine decision-making factors and showed two groups are formed. The primary group consists of time, cost, risk, benefits, and resources, whereas the secondary group contains financial impact, feasibility, intangibles, and ethics. These factors provide the underlying basis for commuter decision making. What a commuter considers when choosing a mode of public transportation is essential information for the supply of public transportation. Before analyzing the decision-making factors of commuters, a theoretical foundation is required to fully understand the connection of decision-making factors, attitude, and ultimately, behavior.

The theoretical foundation for this study is grounded in the theory of planned behavior, the theory of reasoned action, and rational choice theory. Each of these theories analyzes attitude and decision making from various points of view by shaping behavioral intentions and explaining the balance of cost and benefits. Strong connections between the theories are evident in the figures presented below.

TPB and TRA

The theory of reasoned action (TRA) provides a foundation to predict behavioral

intention through attitude and behavior consisting of the three general constructs: behavioral

intention, attitude, and subjective norm (Fishbein & Ajzen, 1975, 1980). The theory of planned

behavior (TPB) provides a link between beliefs and behavior (Ajzen, 1991). Ajzen (1985, 1991)

expanded TRA by implementing behavioral control as an additional indicator of intentions and

behavior. He stated that attitude, subjective norms, and perceived behavioral controls shape an

individual's behavioral intentions (Ajzen, 1991). TRA explains that a higher motivation or

intention will result if people have a positive attitude in regards to a behavior and others desire a

performance of such behavior (subjective norm) (Ajzen, 19985, 1991). Both, TRA and TPB

show a high correlation of attitudes, subjective norms, perceived behavioral controls, and

behavioral intentions (Sheppard, Hartwick, & Warshaw, 1988). Figure 1 is the results of

combining the factors of TRA and TPB and depicting the correlation among them.
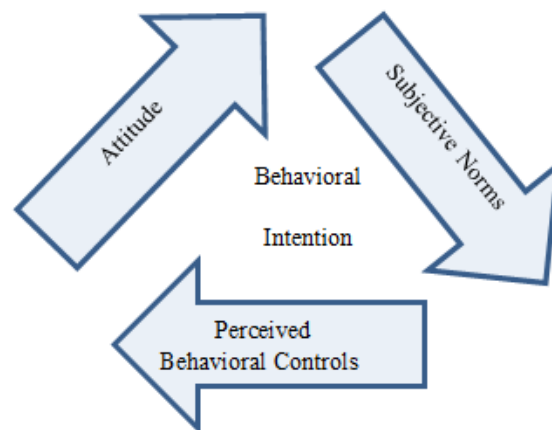
Figure 1. TRA and TPB model.

Rational Choice Theory

Rational choice theory is a framework for balancing costs against benefits to maximize a personal advantage (Friedman, 1953). Rationality has been defined as wanting more of a good or service rather than less and is a key aspect in economics regarding human decision-making (Friedman, 1953; Lohmann, 2008; Hedström & Stern, 2008). The desired rationality of wanting more of a good or service involves the additional desire of seeking cost effectiveness without compromising the overall value (Blume & Easley, 2008; Sen, 2008). Rational choice theory interprets this balancing of costs and benefits through a rational decision making process (Friedman, 1953) and is depicted in Figure 2. This decision making process is a rational action consisting of a pattern of choices (Friedman, 1953). These patterns can be seen in the selection of public transportation. Preferring to utilize public transportation over other modes is a rational behavior.
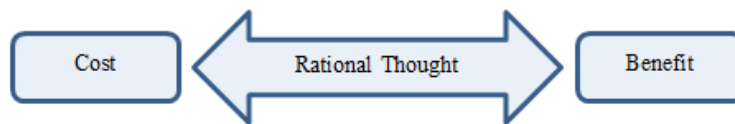
Figure 2. Rational choice theory model.

Proposed Theoretical Model

The above theories each analyze costs and benefits in relation to varying forms of attitude. TPB and TRA show the influence of a positive attitude resulting in higher motivation or intentions. As attitude shifts, motivation alters as well. Factors affecting attitude would therefore influence motivation. Those factors, defined as cost and benefits by rational choice theory, involve wanting a good or service or desiring a relationship. Costs and benefits are

balanced or compromise is given. The resulting balance defines the attitude presented in a decision-making situation.

Although attitude is analyzed from different angles, inference can be made that all are simply attitude. Cost and benefit influence attitude through both rational choice theory. Therefore, we can see these two factors affecting attitude simultaneously and at different proportions. By combining the above theories and focusing on one portion of the original triangle created by TPB and TRA, we can depict the focused section as seen in Figure 3.
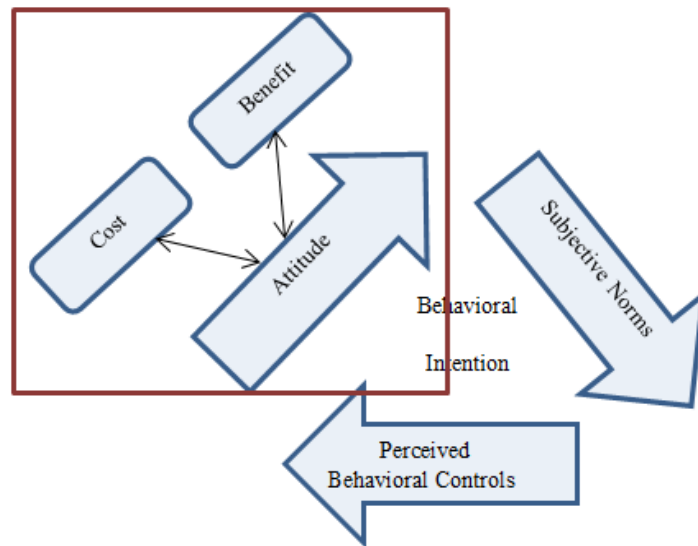
Figure 3. Proposed theoretical model.

Identification and Explanation of Research Gap

A problem with focusing on attitude in decision-making is that there is no consistent makeup of attitude. Attitude is debated on being formed by decision-making factors or forming decision-making factors. In the theories above, decision attitude is either not defined or is not consistently defined. Yager (1998) states that attitude for a decision is optimistic or pessimistic in nature. Aruguete and Nixon (2010) studied decision making is based on attitude and knowledge with knowledge ultimately affecting decision attitude. Casper, Benedict, and Perry

(1989) analyzed that attitude is an important avenue in understanding decision making and that the interpretation of the decision-making factors can influence attitude. In studies presenting the prisoner's dilemma or game theory, attitude in decision-making is not defined at all and is often just mentioned as the focus moves to outcomes (Congar & Maniquet, 2010). The lack of consistency in the definition or list of decision-making factors makes comparison among studies difficult.

The importance of decision-making factors and its impact on attitude is critical in the supply of goods and services (Magnan & Fawcett, 2008; Stank, Keller, & Daugherty, 2001; Felea & Albastroiu, 2012). In public transportation, there is a need of understanding the end-user's decision-making factors as well as how these factors affect the supply of public transportation. By understanding the decision making factors of the end-user, improvements in the supply chain can be made. These improvements can be pushed up the supply chain for further advances in providing these demanded services to commuters.

Utility Theory

Certain behavioral traits, such as attitude and satisfaction, cannot be measured directly. Economists have developed methods to measure these traits by analyzing at the usefulness of a good or service. Utility theory looks at the utility, or usefulness, which is the ability of the good or service to satisfy needs / wants (Marshall, 1920). Per Marshall (1920), the more often an individual purchases or consumes a good or service or is willing to pay more for that good or service, the more satisfied that individual is. Therefore, the higher the utility an end-user perceives a good or service to be, the more positive an attitude that end-user will have.

Using utility theory as the theoretical foundation for identifying and analyzing the

decision-making factors affecting the supply of public transportation contributes to public transportation in multiple ways. First, it empirically identifies the factors affecting decision making towards public transportation. It then tests an integrated framework connecting these factors to strategic goals and operations to increase the quality and experience of public transportation. Third, this research creates a visual analysis of decision-making factors through the analysis of causal loops. Fourth, a discussion panel provides feedback and appropriateness of the causal loop as well as confirm the decision-making factors of public transportation. Finally, this research empirically tests how these decision making factors affect the supply of public transportation through text mining. These results provide a broader understanding of the needs and desires of end-users as well as the importance into how to positively influence attitude and the impact of public transportation.

CHAPTER 3

ESSAY 1

Introduction

This research develops and analyzes factors affecting attitudes towards public transportation and the decision about transportation mode. Public transportation is slowly evolving from a secondary transportation mode to an alternative primary mode of transportation in metropolitan areas. The objective of this research is to develop and test an integrated theoretical framework by modeling the transportation decision process. The theoretical framework is developed based upon the existing literature and tested using partial least squares structural equation modeling (PLS-SEM). This framework extends various theories about the working class individual's transportation decision-making process. The results of this research have important implications for transportation-planning professionals because the constructs developed and tested within the framework extend the understanding of the influences on an individual commuter's decisions about the mode of transportation.

Scholars have previously examined the public transportation decision-making process. For instance, Keumi and Murakami (2012) studied the transportation options to access an international airport and described the multiple service levels that improve flight access. Analysis of travel decisions for schoolchildren in Nigeria revealed factors such as safety, security, and high cost of transportation influencing their individual decisions (Ipingbemi & Aiworo, 2013). Most studies concentrated on the public school systems from elementary to high school, emphasizing the cost, time, and safety for the commuters. Among these, safety and cost emerge as the major concerns for decision making for schoolchildren (Ipingbemi et al., 2013). For instance, crashes resulting from distracted driving remain a significant concern that prompt

adding safety measures (Westlake & Boyle, 2012). Intentions to switch from driving to utilizing public transportation is higher for car commuters than motorcycle commuters based on perceived ease of use and positive, or reinforcing, marketing (Chen & Chao, 2011). These prior studies suggest the need for further investigation into why individual commuters select one transportation mode over another. Modeling this transportation decision process will increase theoretical understanding about commuter decision making. This model also provides insight for designing transportation that has better appeal to individual commuters and, as a result, increases public transportation usage.

This research is framed within the context of a large Texas metropolitan university with an enrollment above 36,000 students. With more than 7,000 graduate students many of whom work full time and commute to take classes, this study has a variety of respondents that allow these findings to have relevance beyond just the university setting. The significant commuter traffic involved with a university of this size can have a direct impact on traffic flow and the public transportation demand on a regional scale. Additionally, the working graduate students seeking professional masters degrees represent mobile middle class workers who are a core public transportation target group. Texas has growing metropolitan areas and along with that growth is expanding the public transportation opportunities. The university in this study was recently connected to a major city via a new high-speed train system. However, the areas residents having a history of using automotive transportation across long distances so it is important to identify factors that influence attitudes toward public transportation. The above characteristics provide a perfect climate to study the future of public transportation in growing cities.

Analysis of the public transportation mode of the professionals in this metroplex reveals that there is no one predominate transportation option. This analysis examines working commuters who utilize the growing public transportation network within about a 50 mile radius. I aim to explore the decision about utilizing public transportation in this expanding urban environment and how attitudes such as intention to use, perceived security and restrictions, convenience, and knowledge affect the transportation decision.

Literature Review

Previous research shows multiple factors affect the transportation decision making process. Research suggests that factors, such as traffic, safety, and security, differ in priority among individuals depending on the commuter's starting point (DeBoer, 2005, Ettema et al., 2011, Pabayo et al., 1999). Attitudes on transportation mode determine schedule and multiple activities in the commuters' lives (Eom et al., 2009, Wilson et al., 2010). For example, travel distance influences travel mode to various destinations (DiGuiseppi et al., 1998). Assessing whether or not stress factors determine the mode of transportation remains a concern (Beck et al., 2013, Eom et al., 2009, Lucidi et al., 2013, Wilson et al., 2010, Xiao et al., 2013). Safety is an important factor in selecting a mode of transportation and is schedule dependent (Eom et al., 2009, Kamga et al., 2011, Kang et al., 2013, Matsika et al., 2013, Pabayo et al., 1999, Wilson et al., 2010). Information about specific modes of transportation influences the commuters decision about which mode of transportation to use (Rong-Change et al., 2013). Age, background, gender, and parent/household income influence the travel behaviors of commuters (DeBoer, 2005, Eom et al., 2009, Field, 1999, Pabayo, 1999, Wilson et al., 2010). Affordability of parking associated with public transportation along with the convenience associated with the

use of that specific mode of transportation is a concern to commuters (DiGuiseppi et al., 1998, Eom et al., 2009, Pabayo et al., 1999, Wu et al., 2013). However, increasing fuel prices continues to influence the selection of transportation and make public transportation modes more attractive (Maghelal, 2011).

Although each prior study is unique, all relate to the transportation logistics of professional commuters. By compiling topics and contextualizing the factors from these prior studies, we develop our survey instrument. The intent is to use this new integrated survey instrument to provide a contribution about the decision process that will allow for better understanding of the key factors of choosing a mode of transportation. Analysis of these factors will allow identification of the issues in this logistics application.

Research Methodology and Hypotheses

In this research, we conducted a survey of commuters at a large metropolitan university to determine the factors that influence attitudes towards public transportation and the role of those factors in the transportation decision process. Our study shows the transportation decision process is shaped by factors such as the perceived public transportation security, knowledge, price, and convenience as well as emotional and interpersonal factors. These factors are operationalized into latent constructs. We depict these constructs and hypothesized relationships in Figure 1 and discuss each in the following paragraphs.

Perceived Public Transportation Security

Safety continues to play a role in transportation decisions and is examined in the context of transportation to and from a metropolitan university. Four questions emphasize the degree to

which the commuter feels safe against security threats when using a specific mode of transportation (Table 1). To account for the preconceived perception of safety of individual modes of transportation, the two modes of public transportation, buses and trains, were included as separate reflective exogenous constructs that form the 2nd order formative exogenous perceived security of public transportation construct. Perceptions of security on a bus and a train lead to higher overall perceived public transportation security for a commuter. Building upon the development of these constructs, we posit the following hypotheses, which will assist in future preparations regarding transportation security for working professionals.

> H1: The degree to which a commuter perceives the security of public transportation positively influences attitude towards public transportation.

> H2: Perceived security of public transportation is a formative construct consisting of the underlying components Bus and Train Security.

Knowledge

Four questions examine the degree to which a consumer is informed about transportation choices (Table 1). This construct explores an area that was not adequately researched in prior studies. Knowledge about the various modes of transportation provides insight on how and why decisions are made towards public transportation. The following hypotheses examine this construct within the context of the integrated model:

> H3: The degree to which the commuter perceives knowledge of public transportation positively influences attitude toward public transportation.

Price

Related to the construct of price are four questions regarding the extent to which the commuter believes pricing constraints affect the decision to use a specific transportation mode

(Table 1). Restrictions regarding price and affordability are essential factors when determining which mode of transportation is utilized. "I cannot afford a bus ticket" and "I cannot afford to park on campus" are example questions that identify the emotional factors and constraints faced when choosing a transportation mode. This leads to the hypothesis:

> H4: The degree to which a commuter perceives price positively influences attitude towards public transportation.

Transportation Convenience

The thirteen questions that relate to the factor of convenience examine the extent to which a consumer believes that using a specific mode of transportation when commuting to a metropolitan university is comfortable and easy (Table 1). Transportation convenience was related to the constructs of time, personal convenience, and public transportation schedule. Convenience of transportation schedules and individual time and convenience provide a view of some of the functional factors that lead to our next hypotheses:

> H5: The degree to which a commuter perceives convenience positively influences attitude towards public transportation.

> H6: Convenience of public transportation is a formative construct consisting of the underlying components time, personal convenience and public transportation schedule.

Attitude towards Public Transportation

Six questions were developed as part of this research regarding the degree to which a consumer's attitude will affect their decision to use a specific mode of transportation (Table 1). This construct analyzes how behaviors and attitudes affect the decision making process associated with transportation mode. Examples of these questions are "Driving to campus gives me a sense of freedom," "Taking the bus provides a sense of happiness," "Taking the train

decreases my stress level." Each question focuses on the individual and its impact on the

transportation decision-making process.
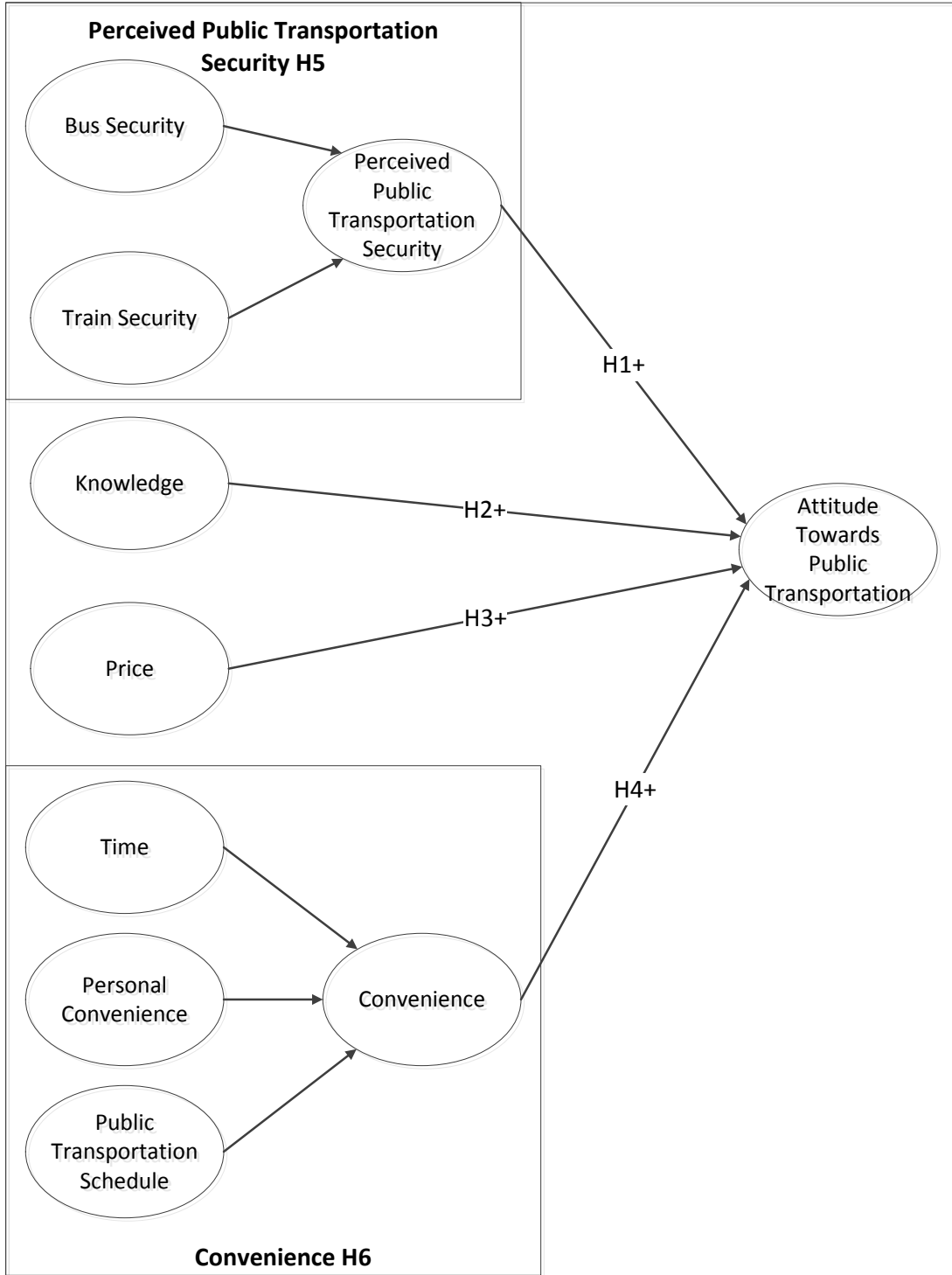
Figure 4. Theoretical model.

Table 1

Construct and Literature Review

Attitudes Towards Public Transportation	6 questions	Contextualized from Beck et al., 2012, Eom et al., 2009, Field, 2013, Lucidi et al., 2013
Perceived Public Transportation Security	4 questions	Contextualized from Eom et al., 2009, Pabayo, 1999, Wilson et al., 2010
Price	4 questions	Contextualized from Eom et al., 2009, Wilson et al., 2010
Convenience	13 questions	Contextualized from DiGuissepi et al., 1998, Eom et al., 2009, Wilson et al., 2010
Knowledge	4 questions	Contextualized from Eom et al., 2009, Lucidi et al., 2013, Wilson et al., 2010

Sample and Data Collection

Undergraduate and graduate commuters at a metropolitan university in the southwestern United States where public transportation and ample parking is available to commuters were given the survey. The site we chose for conducting our survey is an ideal one for this study due to recently opened "A" train that now connects the university and to a nearby (35 miles) major city. Moving professional commuters to this option is critical to the growth in this area. This study is important in establishing how new transportation modes might be received in a metropolitan area where public transportation continues to grow along with the local population and businesses.

Respondents in our survey used a variety of different transportation modes. The commuters were notified of the purpose of the study at the beginning of the survey via the Internal Review Board approved consent notice. An a priori power analysis using Gpower3.1 (Faul et al., 2007) was performed to determine a minimum necessary sample size which was 107

observations for a medium effect size of 0.15 with an alpha error probability of 0.05 and corresponding power of 0.95 with four predicting endogenous constructs. Data was collected over a two-week period and provided 495 responses. Of those responses, 32 were discarded for incomplete or invalid responses, allowing for a useable sample of 463 responses. The sample size greatly exceeds the sufficient analytical power minimum determined through the a priori power analysis (Cohen, 1988). A comparison of early and late responses identified no significant differences and suggested that the data did not suffer from a non-response bias. (Armstrong & Overton, 1977).

Analyses and Results

Analytical Approach

The developmental nature of the study and the inclusion of both reflective and formative constructs within the specified model supports the use of Partial Least Squares Structural Equation Modeling (PLS-SEM) (Hair, Hult, Ringle, & Sarstedt, 2014; Law & Wong, 1999; Wold, 1985). Analysis was conducted using the SmartPLS 2.0 M3 (C M Ringle, Wende, & Will, 2005) with the path weighting scheme to estimate the initial structural model relationships. PLS-SEM generates coefficients for the individual model paths to measure the directionality and magnitude of the relationships between latent constructs. Evaluation of a model within PLS-SEM is a two-step sequential approach that requires the initial assessment of the measurement model, which provides information regarding the reliability and validity of latent constructs. Confirmation of reliability and validity via the measurement model is followed by an evaluation of the structural model (Christian M Ringle, Sinkovics, & Henseler, 2009).

Measurement Model

With a cursory examination of the descriptive statistics and an established a priori model,

we analyzed the dataset using PLS-SEM (see Table 2). Internal consistency reliability was

assessed using the reflective latent indicator variables in the outer model.   Reliability was

supported through the indicators exceeding the minimum acceptable threshold of 0.7 for

Cronbach's alpha (Cronbach, 1951; Nunnally & Bernstein, 1994). Additionally, excluding the

exogenous reflective construct of Time (0.72) the composite reliability (Werts, Linn, & Jöreskog,

1974) exceeds the preferred 0.8 threshold (Nunnally & Bernstein, 1994).

Table 2

Verification of the Measurement Model

	Attitude	Bus Security	Knowledge	PT Sched	Personal Convenience	Price	Time	Train Security	Convenience	PT Security
Composite Reliability	0.916	0.875	0.828	0.807	0.846	0.865	0.724	0.932	*	*
Cronbach's Alpha	0.934	0.941	0.885	0.912	0.890	0.936	0.878	0.967	*	*
AVE	0.704	0.889	0.658	0.838	0.619	0.879	0.783	0.936	*	*
Attitude-1	0.805	0.222	0.229	-0.202	0.144	0.258	0.240	0.204	0.351	0.241
Attitude-2	0.852	0.260	0.236	-0.187	0.177	0.242	0.254	0.165	0.369	0.230
Attitude-3	0.800	0.267	0.245	-0.094	0.185	0.190	0.205	0.180	0.288	0.244
Attitude-4	0.867	0.146	0.203	-0.140	0.099	0.200	0.181	0.289	0.255	0.264
Attitude-5	0.863	0.195	0.194	-0.110	0.095	0.178	0.157	0.330	0.219	0.314
Attitude-6	0.842	0.187	0.183	-0.130	0.076	0.166	0.153	0.327	0.218	0.308
Bus Security-1	0.261	0.942	0.261	0.015	0.132	-0.001	0.261	0.488	0.676	0.221
Bus Security-2	0.223	0.944	0.183	0.015	0.120	0.080	0.230	0.529	0.565	0.231
Knowledge-1	0.171	0.290	0.803	0.017	0.165	-0.039	0.230	0.086	0.227	0.762
Knowledge-2	0.184	0.063	0.811	0.067	-0.020	0.031	0.136	0.187	0.202	0.777
Knowledge-3	0.242	0.308	0.825	0.007	0.139	-0.059	0.240	0.072	0.095	0.902
Knowledge-4	0.226	0.095	0.806	-0.014	-0.007	0.098	0.107	0.250	0.124	0.891
PT Sched-1	-0.164	0.010	0.056	0.920	0.187	-0.043	-0.069	0.063	-0.482	0.047
PT Sched-2	-0.156	0.019	0.052	0.911	0.249	-0.015	-0.093	0.045	-0.456	0.040
Personal Convienece-1	0.096	0.094	0.039	0.221	0.770	0.116	-0.030	0.054	0.213	0.093
Personal Convienece-2	0.112	0.062	0.012	0.104	0.821	0.156	0.047	-0.052	0.182	0.057
Personal Convienece-3	0.109	0.104	0.022	0.137	0.847	0.200	0.068	-0.010	0.283	0.080
Personal Convienece-4	0.140	0.184	0.160	0.277	0.788	0.231	0.074	0.052	0.418	-0.008
Personal Convienece-5	0.171	0.092	0.114	0.239	0.701	0.280	0.087	0.136	0.425	0.039
Price-1	0.261	0.056	-0.015	-0.027	0.250	0.955	0.087	0.102	0.334	0.119
Price-2	0.198	0.019	-0.034	-0.035	0.213	0.920	0.063	0.075	0.327	0.134
Time-1	0.233	0.328	0.235	-0.074	0.129	0.065	0.906	0.108	0.225	0.189
Time-2	0.189	0.114	0.146	-0.082	-0.026	0.081	0.862	0.262	0.037	0.158
Train Security-1	0.288	0.530	0.179	0.085	0.033	0.063	0.199	0.968	0.224	0.189
Train Security-2	0.276	0.514	0.177	0.029	0.037	0.123	0.189	0.967	0.003	0.216
								* This value is not reported for formative constructs		

Convergent validity of the item indicators were verified with the outer loadings of indicators greater than the accepted threshold for 0.7 (Hair et al., 2014). At the individual reflective construct level, convergent validity was confirmed through the average variance extracted (AVE) values of the reflective latent constructs exceeds the establish criteria of 0.5 (Fornell & Larcker, 1981). Discriminant validity was supported through the analysis of the indicator cross loadings. Additionally, the indicators were consistent with the Fornell-Larker criterion (Fornell & Larcker, 1981) providing that the square root of the AVE values of the reflective constructs should be higher than the highest correlation of the latent constructs (Table 3).

Table 3

Determination of Discriminant Validity

	Attitude	Bus Security	Knowledge	PT Sched	Personal Convienece	Price	Time	Train Security
Attitude	0.839							
Bus Security	0.257	0.943						
Knowledge	0.258	0.235	0.811					
PT Sched	-0.175	0.016	0.059	0.915				
Personal Convienece	0.158	0.133	0.082	0.237	0.787			
Price	0.249	0.042	-0.025	-0.032	0.249	0.938		
Time	0.241	0.260	0.219	-0.088	0.066	0.081	0.885	
Train Security	0.291	0.540	0.184	0.059	0.036	0.096	0.200	0.968

For the formative constructs, perceived public transportation security and convenience, the traditional methods for the verification of convergent validity and reliability are not applicable (Bollen, 1989). Convergent validity was assessed through redundancy analysis with formative latent constructs perceived public transportation security and convenience. Convergent validity was confirmed as a result of the constructs exceeding the minimum path coefficient threshold of 0.9 (Chin, 1998). Due to the nature of formative second-order constructs

(Jarvis, MacKenzie, & Podsakoff, 2003), some level of correlation between individual items associated with each individual latent variable construct is expected. Though correlations between individual items associated within their parent reflective construct are present, the potential for multicollinearity needs to be addressed for the individual items also acting as formative indicators. Levels of multicollinearity among the constructs were deemed acceptable due to the variance inflation factors (VIF) falling below the established threshold of 5. VIFs were obtained by regressing each formative indicator against the latent variable score for the exogenous construct attitude towards public transportation. Additionally the inter-item correlations remained below 0.9 across the individual reflective indicators and below 0.2 between the latent variable score for the exogenous construct attitude towards public transportation and the individual formative indicators (Hair, Ringle, & Sarstedt, 2011), demonstrating acceptable levels of multicollinearity. Verification of convergent validity and reliability of the formative constructs for perceived public transportation security and convenience are shown via the data in Tables 4 and 5, respectfully.

Table 4

Verification of Convergent Validity and Reliability of the Formative Construct Security

Correlations	Bus Security-1	Bus Security-2	Train Security-1	Train Security-2	Attitude LVS	VIF
Bus Security-1	1.00	0.78	0.50	0.44	0.01	2.78
Bus Security-2	0.78	1.00	0.50	0.53	-0.02	2.90
Train Security-1	0.50	0.50	1.00	0.87	0.01	4.62
Train Security-2	0.44	0.53	0.87	1.00	0.02	4.61
Attitude LVS	0.01	-0.02	0.01	0.02	1.00	

Table 5

Verification of Convergent Validity and Reliability of the Formative Construct Convenience

Correlations	Time-1	Time-2	PT Sched-1	PT Sched-2	Personal Convienece-1	Personal Convienece-2	Personal Convienece-3	Personal Convienece-4	Personal Convienece-5	Attitude LVS	VIF
Time-1	1.00	0.57	-0.07	-0.06	0.02	0.10	0.14	0.15	0.08	0.01	1.614
Time-2	0.57	1.00	-0.05	-0.11	-0.09	-0.03	-0.04	-0.03	0.08	0.03	1.586
PT Sched-1	-0.07	-0.05	1.00	0.68	0.18	0.07	0.08	0.21	0.25	-0.01	1.967
PT Sched-2	-0.06	-0.11	0.68	1.00	0.23	0.12	0.18	0.30	0.19	0.02	2.024
Personal Convienece-1	0.02	-0.09	0.18	0.23	1.00	0.61	0.61	0.51	0.37	-0.02	1.954
Personal Convienece-2	0.10	-0.03	0.07	0.12	0.61	1.00	0.72	0.43	0.37	0.02	2.308
Personal Convienece-3	0.14	-0.04	0.08	0.18	0.61	0.72	1.00	0.52	0.39	0.07	2.483
Personal Convienece-4	0.15	-0.03	0.21	0.30	0.51	0.43	0.52	1.00	0.72	0.01	2.799
Personal Convienece-5	0.08	0.08	0.25	0.19	0.37	0.37	0.39	0.72	1.00	0.01	2.307
Attitude LVS	0.01	0.03	-0.01	0.02	-0.02	0.02	0.07	0.01	0.01	1.00	

Structural Model

After the confirmation of the reliability and validity of the outer model, analysis of the individual path coefficients from the inner model was conducted. Estimated bootstrap standard error was generated to calculate the Student's t test with the recommended 5,000 bootstrap samples (Hair et al., 2014) to test for path significance. The results are shown in Figure 2. Hypotheses 1, 2, 3, and 4 are supported through the analysis of the significance of the relationship and directionality of the sign of each path coefficient within the structural model at the 0.01 level.
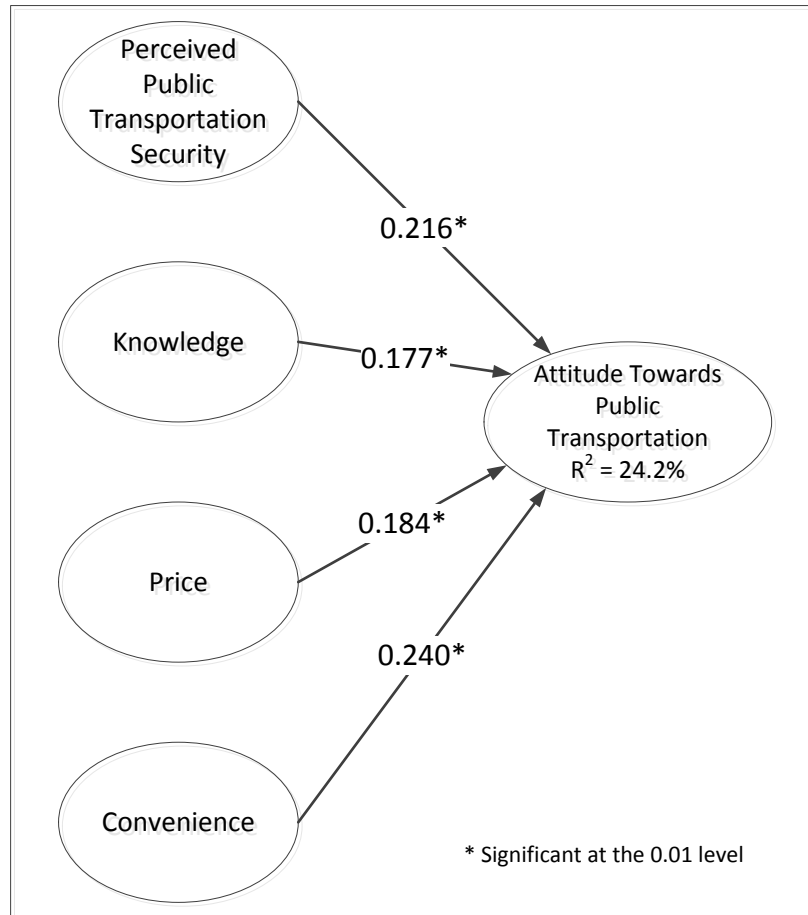
Figure 5. Structural model.

The conformation of the individual higher-order constructs is required to verify the theoretical model. Convergent validity was established through redundancy analysis of the individual latent formative constructs. Analysis of the collinearity diagnostics show acceptable levels of inter-item correlation among the first-order indicators. Verification of the significance of the indicator weights of the individual first-order reflective latent constructs that comprise the higher-order formative construct confirms the presence of each underlying latent factor. These statistical tests in conjunction with the theoretical interpretation of the constructs perceived public transportation security and convenience support the contention that both constructs are formative higher-order constructs and therefore Hypotheses 5 and 6 are supported.

Discussion and Implication

The objective of this study was to analyze the factors affecting attitude towards public transportation and create an integrated theoretical framework about the transportation decision process. This analysis suggests that transportation security, knowledge, price, and convenience affect the attitude towards public transportation and the subsequent decision on mode of transportation. This study expands on prior research by developing a transportation decision-making model within the context of a large growing metropolitan area which is expanding the public transportation options.

A large metropolitan university with over 36,000 students and 7,000 graduate students many of whom work full time in Texas was utilized in this study. This environment allowed developing and analyzing how various factors shape attitudes toward public transportation. Using PLS to analyze the relationships, we concluded that the individual's perception of security, knowledge, price, and convenience positively influence attitude toward public transportation.

This research contributes to the transportation literature by developing and testing a framework that includes newly contextualized factors that allow better understanding attitudes about public transportation. Prior research focuses on the mode of transportation decisions for young students who are often in grade school. Building upon this research, we investigated the rationales that influence an individual's attitude towards public transportation and developed a framework that drive the implementation of different types of quality, convenience, and safety factors. The result of this study offer a deeper understanding of factors utilized in the decision making process and the subsequent effect of these factors on selecting the mode of transportation.

This research not only examines influential factors but also develops and tests these factors within a new integrated theoretical framework. This framework explains the individual's evaluation criteria, which is used to determine the motives that drive everyday choice of transportation. The empirical analysis reveals that perceived security affects an individual's attitude of public transportation. Specifically, bus and train security help form the overall perceived security notions in public transportation. The effects of security on attitude show that when organizations consider factors of security in public transportation, they might benchmark against other established public transportation systems. Such benchmarking allows for establishing a strategic plan to promote positive attitudes towards public transportation.

Knowledge about a transportation system and transportation price are positively related to attitude toward using public transportation. The understanding of these two factors provides further detail on how to create a quality public transportation system. While one can argue that individuals will choose lower price and higher knowledge on any form of transportation, our theoretical framework provides conceptual insight into the necessity for adjusting these factors to encourage a higher quality service that improves attitudes. Significant insight is gained by recognizing that different factors differentially influence attitudes toward public transportation. Management practices treating these independently are likely less effective than viewing factors within an integrated process such as the model developed in this research.

Prior research focuses on the implications of convenience on attitude towards public transportation but does not examine the effects of the antecedents of convenience. However, the framework resulting from this research shows that time, personal convenience, and public transportation schedule significantly increase our comprehension of how factors affect attitudes toward public transportation and, in turn, influence transportation authorities to improve the

quality and experience for commuters. Evaluating the effectiveness of these factors further promotes organizational practices to enhance convenience. Therefore, more insight is gained by recognizing that different factors have a positive impact on attitude towards public transportation. The results show that addressing commuter convenience factors makes the decision to use public transportation more likely.

This exploratory research studies attitudes toward transportation modes of commuters. By extracting topics, contexts, and constructs from multiple sources and developing an integrated survey instrument, we are able to make an important research contribution about the decision process for choosing a mode of transportation. By having done so, this work provides a better understanding of the key factors in the urban transportation decision process.

Limitations and Future Direction

One limitation of this study is that while we examined transportation to a metropolitan university, the sample was limited to a single university. However, that university is extremely large with over 7,000 graduate students with a large portion of those being commuters. Also, due to the need to explore how a variety of factors interrelate, the number of factors analyzed were restricted to provide a model that was anchored in existing theory. Future work should consider additional constructs and more complex relationships.

Also, while the university utilized for this study is in a metropolitan area where public transportation is provided, the available transportation system at this time is not as extensive as the public transportation provided in large older cities, such as Boston, Chicago, and New York. Analyzing metropolitan universities in a variety of cities with various modes of public transportation is a valuable area for future research.

This study provides an important first step in developing and testing factors that predict attitude towards public transportation. While this study had an exploratory component about the factors included, future examination of these factors in other environments as well as along with other factors is a worthy endeavor. A comparison of attitudes towards public transportation in various areas would help identify trends and regional differences in attitudes toward using public transportation.

Conclusion

Improving the quality of public transportation alternatives and attitudes toward those alternatives is an important step toward improving utilization. To aid the effort to improve public transportation utilization, this study examines factors such as security, knowledge, price, and convenience and builds an integrated decision making model. The findings from this study contribute to research on transportation in four ways. First, it empirically analyzes that these four factors, security, knowledge, price, and convenience, play important role in attitudes toward public transportation. Second, the posited and tested framework connects these factors to strategic goals and ultimately, quality management practices that will allow enhancing the experience and attitude of commuters. Third, this research confirms the driving factors that affect the service performance of public transportation. Finally, the framework shows how these factors integrate with quality practices and operational performance of a growing public transportation system in a well-developed metropolitan area. The results of this study provide a broader understanding of performance benefits and provide insight into how to positively influencing people's attitudes toward public transit.

CHAPTER 4

ESSAY 2

Introduction

Utilizing causal loop diagrams to visualize how decision-making factors affect attitude toward public transportation shows the impact these factors have on the supply and demand of public transportation as well as the local population. In addition, the causal loop visualization allows examining how each factor is interconnected. The structure provided by the causal diagram is invaluable for verifying consistency with theory and allows revising either theory or the diagram when such change is deemed appropriate. In order to provide proper supply of public transportation, public transportation officials must have the knowledge of the commuter's decision-making factors and the effect each has on the attitude towards public transportation. A visual aspect of the effects of decision-making factors on attitude towards public transportation is a useful tool to analyze the supply and demand of public transportation and how local population is affected.

This research visualizes a theoretical framework of decision-making factors for selecting a mode of public transportation with visual model mapping. General systems theory (GST) provides the theoretical basis for the utilization of a causal loop diagram to provide a systematic view of the decision-making factors. GST is a theoretical foundation of explaining some observable phenomena through investigations of a whole unit, or system, rather than reducing observations to elementary units which are then investigated separately (von Bertalanffy, 1969). According to von Bertalanffy (1969), reducing complex problems into isolated units leads to the risk of the researcher losing the perspective of a system as a whole. This includes not only the individual parts of a system but also the interactions between these parts. When complex

systems, such as organizations, are broken into individual events, comprehension of the entire system loses meaning, especially of the relationship or interactions being conducted. However, analyzing a system as a whole and not as localized events provides a picture of the relationships between the various elements in the system. Thus, GST is the science of wholeness (von Bertalanffy, 1969). Boulding (1956) suggests that when using GST, researchers select a specific phenomenon and build a relevant theoretical approach to analyze the situation. The theoretical approach chosen for this study is to investigate the impact of decision-making factors on the supply and demand of public transportation. This process, while dynamic in nature, can only see consequences after a period of time has passed. This makes it difficult to exercise corrective actions quickly, but by implementing a visual diagram, the lag time can be reduced.

An introduction to a causal loop diagram visually depicting the relationship among the decision-making factors used in selecting a mode of public transportation and its effects on the supply of that transportation is based on a survey analysis and by drawing from and integrating prior literature. By simultaneously considering the decision-making factors and the supply and demand and economic development of public transportation, this research advances the understanding of decision-making factors of public transportation commuters in a metropolitan area. Furthermore, this research creates a visual representation of these relationships and interdependencies among these decision-making factors and the supply of public transportation.

This paper is organized in the following manner. First, an extensive literature review regarding general systems theory and decision-making factors affecting the supply of public transportation as well as causal loop diagram studies is conducted. Next, we describe the methodology of developing causal loop diagrams in the area of public transportation supply and then develop causal loop diagram representing the system of the interrelationships of decision-

making factors on the supply of public transportation. Future research and limitations to this study are discussed, followed by the conclusion of the research conducted.

Literature Review

Causal Loop Diagrams

A review of relevant research suggests that causal loop diagrams capture the dynamics of systems while providing a visual representation of the conceptual structure of variables and influence among those variables (Carvalho, H. et al., 2001; Fukunaga, Y. et al., 2007; Sterman, J., 2000; Venkatewaran, J. et al., 2007). Loo (2003) emphasizes the roles of project management skills and interpersonal skills, such as decision-making factors, as influencing factors to project outcomes as well as the importance of feedback for both corrective and reinforcing actions.

Prior research emphasizes customer satisfaction, or attitude, on business to business perspectives (Lam et al. 2004; Bolton 1998; Oliver 1999). Fornell (1992) and Oliver (1999) show that the effect of a positive attitude or more satisfaction on customer loyalty has been investigated as a management technique for business to business, but neither researched the effect of attitudes on overall supply and demand. Research also illustrates that individuals will remain loyal to a service organization if they feel they are receiving a higher value from the service provided (Lam et al. 2004; Bitner and Hubbert 1994; Bolton and Drew 1991).

Ale et al. (2006) developed a causal model for comparing safety measures in the aviation industry. Their study measured safety alternatives in order to find probabilities and causes of adverse incidents in the aviation industry. Mohaghegh and Mosleh (2009) explored issues regarding measurements of organizational safety risk through causal modeling, focusing on the effects of organizational factors and relationship implications.

Goh et al. (2012) used the concept of systems dynamics to analyze accident prevention at a major drilling and mining contractor in Australia by creating a causal loop model. Their results show that extensive individual knowledge influenced the impact of decisions made and thus, showed the dynamic influencing effectiveness of individual knowledge.

Love et al. (2008) used planned schedule, cost, and quality parameters to develop a systemic causal model provide insights about the architectural and engineering decision-making and work practices influencing design-error-induced rework. This work leads to greater profitability and improved performance for organizations based on schedule, cost, and quality.

General Systems Theory Perspective

Investigating the interrelationships of decision-making factors on the supply of public transportation provides an appropriate platform for a systems thinking perspective due to its primary conceptualization being in line with GST. Systems thinking is a philosophical approach for seeing concepts and relationships as a whole rather than individually. Interrelationships are key when using this viewpoint. Using GST also provides a framework in which patterns of change in processes are observed versus a static snapshot (Senge, 1994).

Systems thinking is a complex view of the world, for it assumes that it is not possible to view things in isolation from others, but that everything is more or less connected to everything else (Sterman, 2000). Systems thinking and GST are interested in the performance of a system as a whole. However, even if each individual piece of a system performs well or within each individual standards, the entire system may not perform at an acceptable level in regards to the system (Ackoff, 1971). Systems thinking is essential with the increasing complexity of organizations and allows for more application of impacts when analyzed at such a level.

Methodology and Model Description

Using causal loop diagrams to visualize factors involved in an organization through general systems theory (von Bertalanffy, 1969; Katz & Kahn, 1978), the causal loop diagram is simplified to visualize only the factors represented. It is noted that additional factors come into play when expanding the overall system. The organizational performance may be directly affected by the external environment influences, such as the decision-making factors of the commuters, regulations on where to locate public transportation, or government policies that must be addressed throughout any process relating to public transportation. On the other hand, the external environment is directly impacted by the products and services produced by the organization, specifically the supply of public transportation. The additional boxes throughout the model represent the individual components and relationships that make up the system as presented by general systems theory.

The boxes provided in this causal loop model have been designated as the most important factors in our study by providing a visual representation to public transportation officials in order to see the entire system – system creation, inputs, and equilibrium – as well as the correlation of cause and effect relationships. These choices were not made in isolation. Based on a survey conducted at a large southwestern metropolitan of self-identified working professionals currently seeking an undergraduate or graduate degree, key factors were determined and used to augment the modal choices of potential public transportation users. A proposed theoretical framework was developed based on extant literature and tested using the results from the survey through Partial Least Square Structural Equation Modeling (PLS-SEM). Factors, including security, knowledge, price, and convenience, were essential factors for commuters in the decision-making process of choosing a mode of public transportation and were then used to build an integrated

decision-making model. These factors provide key variables at an individual level for the entire system. Based on literature, additional factors, including supply and demand of public transportation as well as local population, are key factors at a system level that are essential to the causal loop diagram to depict the supply of public transportation.

The correlation of cause and effect relationships is prevalent in system analysis. The use of causal loop diagrams provides a method in which to visually identify and analyze these relationships and performances of the participating variables (Fukunaga, Y. et al., 2007). Relationships are identified using a system of arrows and directional signs (plus and minus signs). Positive relationships are specified by plus signs and represent both variables move in the same directions (as one increases, the other increases). Relationships with a negative link will move in opposite directions (as one increases, the other decreases). In this analysis, causal loop diagrams are developed as a conceptual tool to describe the system of decision-making factors affecting the supply of public transportation. Developed based on extant literature and a previously conducted study from which a theoretical framework was developed and tested, the causal loops were initially drafted. The diagrams and paths were then reviewed by a discussion panel of several current public transportation commuters in the metropolitan area.

The objective of this study is to visualize the decision-making factors affecting attitude towards public transportation based on an integrated theoretical framework about the public transportation decision-making process. The sample group used to test the theoretical framework included working professionals seeking an undergraduate or graduate degree at a metropolitan university. Based on PLS analysis, four individual factors, security, knowledge, price, and convenience, affect attitude towards public transportation and the subsequent decision-making process related to choice of mode of transportation, as can be seen in Figure 1.
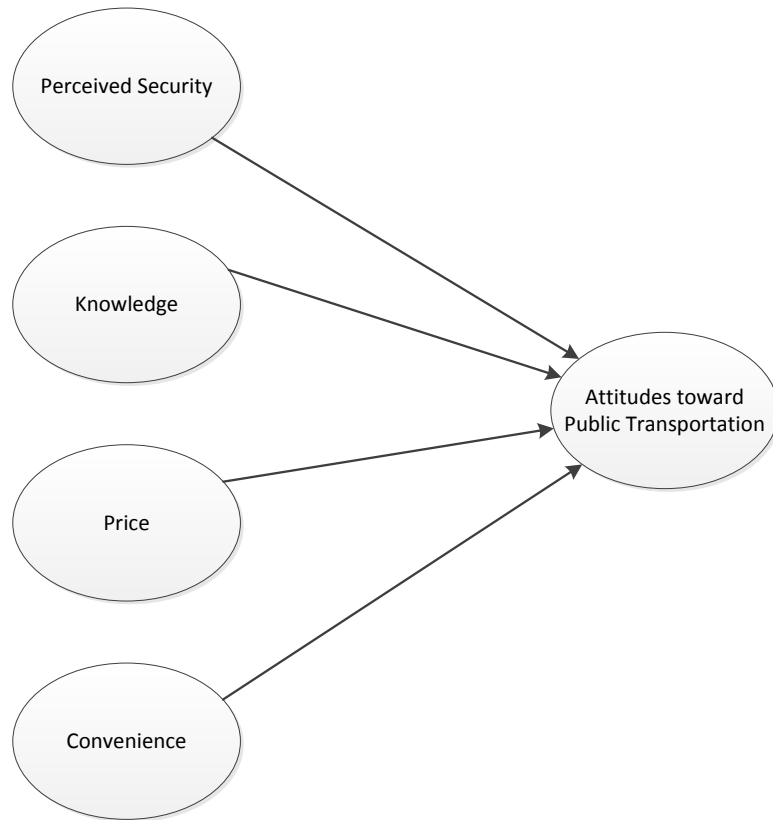
Figure 6. Causal loop 1: Factors affecting attitudes toward public transportation.

Figure 1 visualizes the individual's evaluation criteria used in determining the
motivations that influence everyday decisions about public transportation. The empirical
analysis revealed that perceived security affects an individual's attitude toward public
transportation. Security effects on attitude towards public transportation illustrate the need for
organizers to fully consider security and possible benchmark security measures against other
established public transportation systems in order to further promote positive attitudes toward the
security of public transportation.

Knowledge of both the transportation system and the transportation price are positively
related to attitude toward using public transportation. Knowledge and price are both an essential
component in providing a quality public transportation system, and by understanding these two
components, each can be adjusted to improve the service at hand. Looking at knowledge and

price as an integrated model, as in the causal loop diagram, emphasizes the systematic influence of these two factors on attitude towards public transportation.

Convenience, which included time, personal convenience, and public transportation schedule in the original PLS analyzed theoretical framework, increases the attitude toward public transportation. Understanding the impact of this factor can influence transportation authorities to improve the quality and experience for commuters and promote organizational practices to enhance convenience.

Additional insight is gained by recognizing that different factors have a positive impact on attitude towards public transportation as depicted in Figure 1. The causal loop diagram shows that by addressing each individual factor will make the decision to use public transportation more likely.
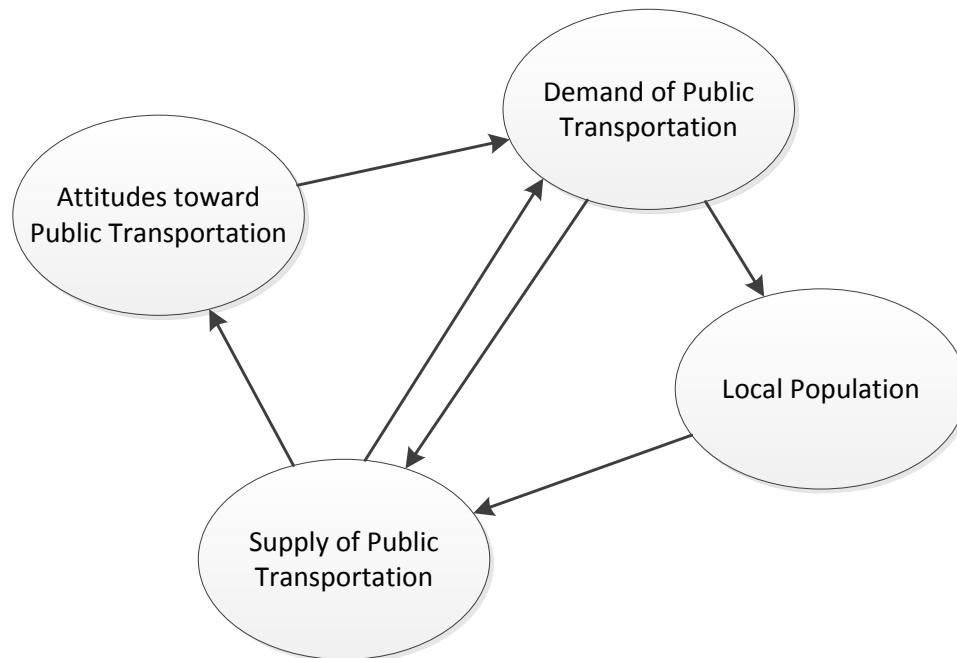

Figure 7. Causal loop 2: Interrelationship between attitudes, supply, demand, and local population.

Customers' attitude in the supply and demand of quality service is an essential component for businesses. Organizations are better able to strategically place themselves in the

marketplace by focusing on improvements in performance, core competencies, and strategic

positioning (Prybutok and Qin 2008; Conger et al. 2013; Singh et al. 2012). Gilbert et al. (2004)

and Aaker and Jacobson (1994) show that higher economic returns are an additional benefit for

organization that integrate supply and demand with expected service required by customers to

boost their attitude toward that service. Thus, public transportation officials must continuously

seek ways to supply quality public transportation in order to increase the demand for its services

(Prybutok et al. 2008; Gregory et al. 1997; Pun and Ho 2001). Public transportation officials

also must provide supreme service in public transportation, for it is imperative for gaining and

sustaining a competitive advantage (Lee et al.2004).

Figure 2 extends the causal loop diagram. Attitudes toward public transportation is

further interrelated to demand and supply of public transportation, as well as local population.

This visualization interconnects the additional factors and influences of attitudes toward public

transportation in a systematic view that can be used by public transportation officials to provide

additional quality and service to commuters.

Improving attitudes toward public transportation can result in happy and dedicated

customers who have the power to expand the commuter group of public transportation. It is

essential to note that poor service will lead to dissatisfied customers who have the option of

looking elsewhere for their transportation needs (Gilbert et al. 2004). Organizations need to

focus on understanding the importance of these decision-making factors and the interaction it has

not only with attitudes towards public transportation but also supply and demand of the services

(Prybutok et al., 2008).

Positive attitude towards public transportation increases the demand, or desire, for public

transportation as well. With a more positive attitude or sense of satisfaction, an increase of

desire for that good or service occurs (Bolton, 1998). Customer service and satisfaction based on the quality of the demand of a service are continuously important factors (Boakye et al. 2012; Bellou and Andronikidis 2008). The interest or demand of service quality by a customer is based on the premise that the customer possesses a positive attitude or perception toward an organization's service quality and therefore is likely to remain a customer of that organization (Schneider et al., 1998).

Figure 2 integrates the connection of local population with supply and demand of public transportation and has been contextualized through preview studies (Elf, M. et al., 2007, Lane, D.C. et al., 2000, Pavlova, M. et al., 2012). While Figure 2 does not specify the individual factors affecting attitude towards public transportation, it is an essential piece to the logistical process of why services would be rendered by the population.

A partial equilibrium, as explained by Jain (2006) of looking at the market of goods and services by keeping prices constant, is created through the increase of demand causing an increase in supply of public transportation. Keeping this aspect quite simplistic, analysis on the partial equilibrium simplifies assumptions and allows for efficiency and comparative statics. As demand increases for public transportation due to more positive attitudes, public transportation officials will increase the supply of public transportation in order to satisfy their clientele. As a satisfactory supply of public transportation is provided, demand will increase as additional individuals seek that satisfaction.

Providing solid service quality is a critical component for service industries (Cronin et al. 1992; Ofir and Simonson 2001). The ability of public transportation officials to understand and capitalize on the decision-making factors of commuters can directly impact the organization's strategic plans in hopes of improving the supply of the service (Jain et al. 2004; Prybutok and

Qin 2009; Singh et al. 2012). Organizations that are able to supply exceptional service to its

customers have shown to have a more established and satisfied base (Aaker et al., 1994; Gilbert

and Veloutsou, 2006). Using the causal loop visualization as a tool, service providers are better

able to understand, acknowledge, and pursue the factors influencing decision-making in order to

meet and exceed the expectations and requirements of consumers utilizing public transportation

(Paulrajan and Rajkumar 2011).

With an increase in supply, information regarding the decision-making factors should

increase as well. As part of the strategic operations of public transportation, public

transportation officials should be sharing this information with the commuters to boost

confidence in the public transportation services as well as increase attitudes toward public
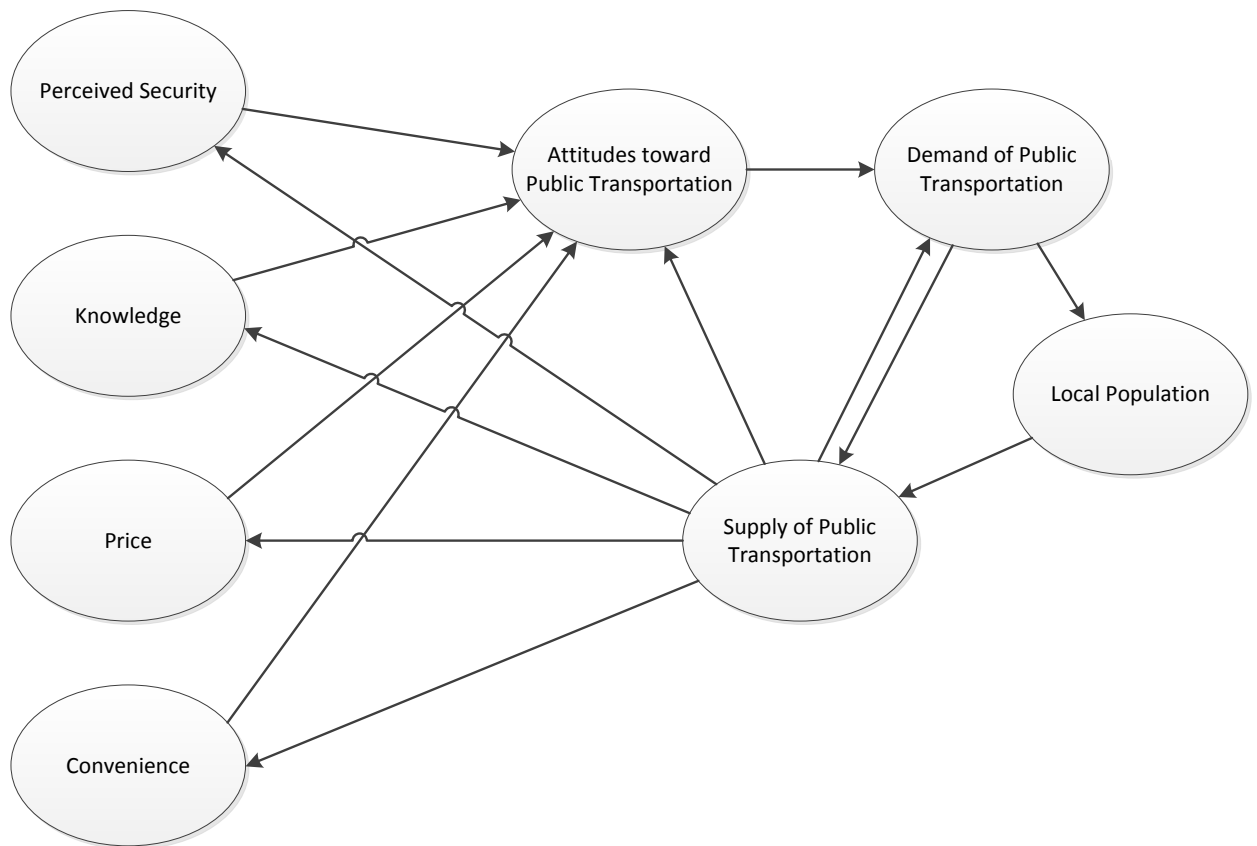
transportation.

Figure 8. Causal loop 3: Integrated loop.

The resulting causal loop (Figure 3) depicts the integration of the previous two causal loops to provide a visualization tool showing how decision-making factors affect attitude toward public transportation as well as the supply and demand of public transportation and local population. This causal loop diagram provides better insight on how each factor is interconnected in the supply of public transportation. Understanding the interrelationships in this structure further verifies the need to analyze relationships with a systematic viewpoint while also providing the ability to modify the causal loop as needed to fit each individual organization's needs.

Although the causal loop model is complex, it needs to be clarified that this is still an oversimplification of the entire system involved in supplying public transportation to an area based on decision-making factors. However, the attempt to simplify this system provides a two-dimensional model depicting and describing a complex phenomenon that can be utilized by public transportation officials to aid the efforts in improving public transportation utilization.

<center>Discussion Panels</center>

To confirm that the causal loop diagram covered the decision-making factors and interrelationships comprehensively and that it was appropriate for the population from which we drew our sample and in a metropolitan area with a relatively young public transportation system, we took the following steps. First, we invited six researchers who currently use the public transportation system on a weekly basis and possess considerable experience in systems analysis research to review the causal loop diagram. Second, we examined each relationship to determine if modification needed to be assessed. Next, we made adjustments as needed based on the discussion panel feedback and the initial survey results. This process included in-depth

discussions between the research team and faculty and student professionals to make these changes.

Future Research and Limitations

General systems theory puts forward that looking at all the individual components of a phenomenon as whole provides a systemic view and allows for better interpretation of relationships and impacts of various factors. With the induction of this theory by von Bertalanffy (1969), additional researchers have thought to advance this theory. In this study, we develop a causal loop diagram depicting the effects of decision-making factors on the supply of public transportation through the integration of literature and a survey of public transportation users at a metropolitan university. Therefore, one limitation of this study is that while the sample was limited to students at a single university, the participating commuters are self-identified working professionals seeking undergraduate or graduate degrees. Also, creating a causal loop diagram forces the need to restrict the number of factors presented to be interrelated that were both based on existing literature and survey results. Future work should be considered to explore potential factors that impact the supply of public transportation based on decision-making factors.

Another limitation to this study is that while the original survey was conducted in a metropolitan area where public transportation is available, the current public transportation system in this area is not as extensive as the public transportation provided in larger or older cities, such as Boston, Chicago, and New York. Varying degrees of relationship impacts could be an issue when looking at the overall system of how decision-making factors affect the supply of public transportation. Thus, implementing additional modes of public transportation with

multiple levels of complexity individual public transportation systems as well as a variety of cities are valuable areas for future research.

  The causal loop diagram provided in this study provides an imperative first step in designing a visual representation of the interrelationships of the decision-making factors affecting the supply of public transportation. While this study had an exploratory component about the factors included, further research of these factors and relationships involved in the supply of public transportation is a commendable endeavor, such as analyzing the effect of demand on attitude towards public transportation. The discussion panel served as validators of the decision-making factors of public transportation, but a discussion panel to identify trends and regional differences in attitudes toward using public transportation would be beneficial to the supply of public transportation.

<div align="center">Conclusion</div>

  Utilizing causal loop diagrams to visualize the interrelationships of decision-making factors affecting the attitude towards public transportation and supply and demand of public transportation services is an important step toward improving utilization. To assist in the effort to improve public transportation supply, this study provides a causal loop diagram as a visualization tool depicting the interrelationships of the decision-making factors affecting the attitude towards public transportation, including security, knowledge, price, and convenience, the supply and demand of public transportation, and the local population.

  The resulting causal loop diagram from this study contributes to research on public transportation in three explicit ways. First, this research visualizes that these multiple factors play important roles in attitudes toward public transportation and interact with supply and

demand of public transportation. Second, the causal loop structure is consistent with general

systems theory and allows for adaptations of the diagram as appropriately needed. Finally, the

discussion panel provides further agreement that the causal loop diagram is valid and worthwhile

for organizations to consider when implementing quality management changes regarding the

supply of public transportation as well as to enhance the service experience affecting commuter

attitudes.   The results of this causal loop diagram provide a broad visual understanding of

performance benefits and provide insight into how changes in the general system of public

transportation can positively influence people's attitudes toward public transit.

CHAPTER 5

ESSAY 3

Introduction

Word-of-mouth (WOM), or communicating information verbally, is considered a highly

influential factor in experiencing a new service or trying a new product (Jalilvand et al., 2011;

Duhan et al., 1997; Bone, 1995). Pakdil and Aydin (2007) state that individuals use experiences

as a basis of judgment in choosing future utilizations of transportation. This shows that the

decision-making factors of choosing a mode of public transportation is emphasized by the

previous experiences of its riders. The attitudes toward public transportation is based on both

past experiences as well as future expectations. The level of quality received will alter these

attitudes and ultimately impact the supply of public transportation. The word-of-mouth passed

along is influential in the image of utilizing public transportation. Individuals with positive

experiences will share satisfactory experiences with other people, which could lead to increases

in use of public transportation. Poor quality in public transportation services would then lead to

negative reviews about public transportation, leading to needed corrective action by the public

transportation officials. An analysis of online comments from various websites regarding public

transportation, via latent semantic analysis (LSA), shows the presence of customers' electronic

word-of-mouth (eWOM) topics on attitudes toward public transportation prevalent with the

extant literature. The pattern of word classification approximates the meaning of a word on the

average effect of the online comments in which it occurs. The results of this analysis provide

good operations management strategies in the supply of public transportation.

The use of WOM has shown to be a valuable influence in opinions and evaluations of

goods and services, one in which people trust for a source of valid information (Bickart and

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Schindler, 2001; Graham and Havlena, 2007). More traditional forms of communication, such as face-to-face communication, continues to be studied in regards to influencing decision-making (Arndt, 1967; Dichter, 1966; Engel, Kegerreis, and Blackwell, 1969; Katz and Lazarsfeld, 1955). Additional research is being conducted implementing the increasing use of technology, such as the Internet, as a platform for WOM and its impact through the passing of experiences, comments, information, and opinions (Gruen, Osmonbekov, and Czaplewski, 2006; Hennig-Thurau, Gwinner, Walsh, and Gremler, 2004; Park and Lee, 2009).

This research validates the conceptual model developed through extensive literature review and survey results of working professional public transportation commuters from a previous study by analyzing electronic word of mouth (eWOM) on attitudes toward public transportation. Obtaining comments from online websites, such as www.yelp.com, an analysis of eWOM of current public transportation users will be obtained and analyzed through latent semantic analysis (LSA) and cluster analysis. These results are then used to further develop the performance-based logistics (PBL) theory by providing empirical data in the move toward post-production support and feedback in performance throughout the supply chain. Therefore, the research question expected with this essay is: Does eWOM confirm the presence of public transportation decision-making factors, as established in prior literature and survey results?

This paper is organized in the following manner. First, an extensive literature review regarding utility theory, word-of-mouth, and electronic word-of-mouth is conducted. Next, we describe the methodology of LSA of online customer comments in the area of public transportation supply and then run LSA to establish common factors that represent the underlying decision-making factors on attitudes toward public transportation. Future research and limitations to this study are discussed, followed by the conclusion of the research conducted.

Literature Review

Word of Mouth: WOM

Word-of-mouth is the process by which consumers verbally share news, information, and opinions regarding a product or service to others (Jalilvand et al., 2011; Henning-Thurau et al., 2004). Using WOM allows consumers to directly express their feelings and experiences to others (Heriyati et al., 2011). Whether a marketer, retailer, or service provider, such as public transportation, listening to WOM, and thus, the spreading of information, is a valuable tool, one which should be listened to carefully. Word-of-mouth can positively influence decision-making factors, especially with the purchasing of a product or service (Heriyati et al., 2011). Heriyati et al. (2011) also noted that when receiving WOM, there was no significant influence regarding decision-making factors based on gender, indicating that WOM is significant for all people.

Williams and Buttle (2011) emphasized the strong influence of word-of-mouth on effectiveness in an organization. Their research showed that WOM had a positive impact on the decision-making process of consumers when considering new products or services. It also emphasized the influence WOM has on the decision to re-try goods or services, which also influences customer loyalty (Williams et al., 2011). Williams and Buttle (2011) continued to note that negative experiences expressed through WOM had a strong influence in producing negative outcomes for goods and services. The influence of WOM is an important issue for academics and organizations as WOM's use continues to grow, especially with the spreading of information and opinions. The impact from WOM on other individuals will have an effect on perceptions made and ultimately sales produced by an organization.

Electronic Word of Mouth: eWOM

Internet has become a major component in not only the business world, but in each individual's life (Boakye et al., 2014; Green, 2002). With the introduction of smartphones, tablets, and other various mobile computing device, communication and technology is easily accessible. Using these mobile devices has shifted the way people communicate and obtain information from a traditional verbal expression to an Internet interface (Walls, 2013; Olla & Patel, 2002; Sahagian, 2013). Communication through Internet networks is becoming more dominant. Thus, sharing information, experiences, and opinions about goods and services is also more dominant on an online platform. More individuals are posting comments or reviews about goods and services on various websites, such as social media, blogs, and company websites, to share their experiences. In return, people searching for feedback or possible influence regarding these goods and services are searching these online opinions. This electronic review is an essential and influential component in decision-making factors affecting goods and services, such as the use of public transportation.

Electronic word-of-mouth (eWOM) is communication through an electronic form, such as the Internet, by which individuals can share information, experiences, and opinions (Hennig-Thurau, 2004; Gupta et al., 2010). Gupta and Harris (2010) state that eWOM was created as a result of the introduction of the Internet. With the rise of Internet use as a communication platform and research tool, eWOM is increasing at an astonishing rate (Sahagian, 2013). The Internet introduced communication platforms, such as blogs, email, social media, chat rooms, consumer review websites, and many more (Sahagian, 2013). With the influence of the Internet affecting the modern world, eWOM is becoming more of an influencing factor when making decisions. The use of eWOM by consumers is used to express both positive and negative

reviews and comments about goods and services (Hennig-Thurau, 2005), and this information is becoming more influential in what experiences consumers are hoping to find.

Decision-Making Factors

Previous research shows multiple factors affect the decision making process for public transportation. Individual customer preferences are mirrored in their expectations and perceptions in a service (Andreassen, 1995). Vanier & Trippi (1976) state that consumer choice consistency is the most stable when being used for routine activities, such as work and school. Health concerns, specifically through less pollution emissions and the resulting emphasis of better public transportation planning has also been studied (Litman, 2013). Al-Shakkah and Osman (2011) have analyzed nine decision-making factors, forming two main groups providing the underlying basis for commuter decision-making. The primary group consists of time, cost, risk, benefits, and resources, whereas the secondary group contains financial impact, feasibility, intangibles, and ethics. Recognizing and understanding what a commuter considers when choosing a mode of public transportation is essential information for the supply of public transportation. Prior to analyzing the decision-making factors of commuters, our initial study developed and tested a theoretical foundation to fully understand the connection of decision-making factors, attitude, and ultimately, behavior. Using the theoretical foundation for this study of the theory of planned behavior, the theory of reasoned action, and rational choice theory, we are able to analyze attitude and the decision-making process from various points of view by shaping behavioral intentions and explaining the balance of cost and benefits.

Methodology and Model Description

Conceptual Model Sample and Data Collection

The sample for the conceptual model were self-identified working professionals currently using public transportation and residing in a large metropolitan area in the southwestern United States. Each are also currently seeking an undergraduate or graduate degree. The recently opened "A" train was selected as the geographical location for our research due to it connecting the outlying commuter belt to the nearby urban core, spanning a distance of 30 miles.

Participants of the survey were informed of the purpose of the study through the Internal Review Board approved consent notice prior to accessing the survey instrument. Data was collected over a two-week period which resulted in 495 responses. Of those, 32 were discarded for being incomplete or having invalid responses. The final useable sample consisted of 463 responses, which greatly exceeded the sufficient analytical power minimum determined through the a priori power analysis (Cohen, 1988). Using www.yelp.com as the data source, an analysis of the eWOM of current public transportation user was conducted. Yelp is local business review and social networking website that allows individuals to submit a review on products and services. LSA was used to generate quantitative output to test and validate the proposed theoretical model (Figure 9).

The objective of the original study was to create an integrated theoretical framework about the decision-making factors of public transportation by analyzing the factors affecting attitude towards public transportation. The resulting PLS analysis suggested that transportation security, knowledge, price, and convenience affect the attitude towards public transportation as well as the final decision on choosing a mode of transportation. By building upon prior research we were able to develop and test a framework that includes newly contextualized factors that

allow better understanding attitudes about public transportation. Resulting from this study is a deeper understanding of factors utilized in the decision-making process and the consequent effect of these decision-making factors on selecting the mode of public transportation.
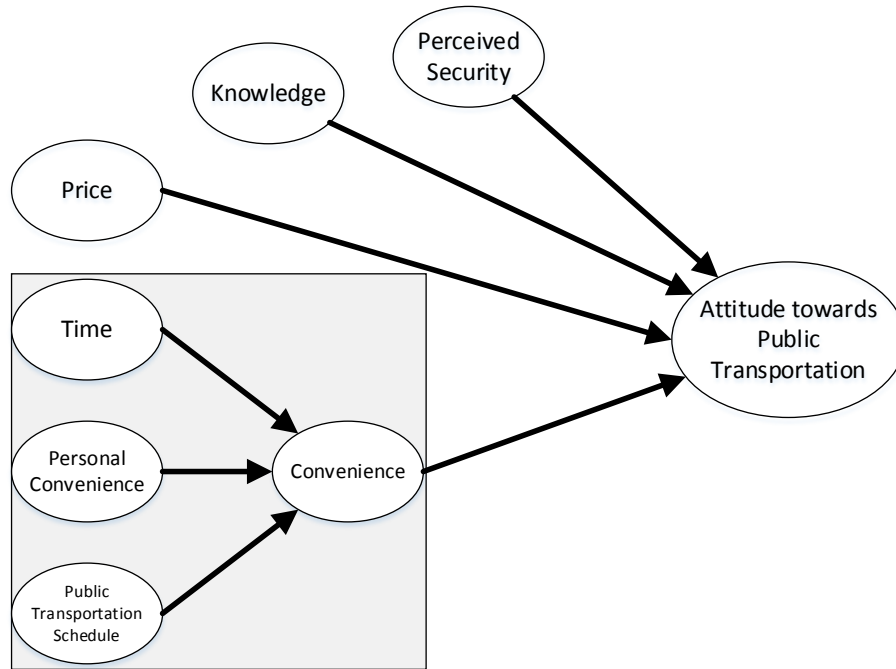

Figure 9. Theoretical framework.

This research examines the influential factors as well as develops and tests these factors within a new integrated theoretical framework, which further explains the individual's evaluation criteria. This framework, along with empirical analysis, allows for us to determine the motives that drive everyday choice of transportation. It shows that perceived security affects an individual's attitude of public transportation. This information reveals the need for public transportation officials to benchmark safety factors against other established public transportation systems in order to establish a strategic plan to promote positive attitudes towards public transportation. Knowledge and price information about a transportation system are shown to be positively related to attitude toward using public transportation. Comprehending these two factors provides additional information on how to implement further quality into the public

transportation system for commuters. The ability to adjust these factors to encourage higher

quality can improve attitudes toward public transportation, one which management practices

need to incorporate into their strategy while also treating both knowledge and price

independently. Convenience, which includes time, personal convenience, and public

transportation schedule, significantly influences attitudes toward public transportation and also

impacts the need for transportation authorities to improve the quality and experience for

commuters. Evaluating the effectiveness of each of these factors further promotes organizational

practices to enhance quality and positively impact attitude towards public transportation, thus,

resulting in public transportation officials addressing commuter decision-making factors in order

to promote the use of public transportation more likely.

Latent Semantic Analysis

Latent semantic analysis (LSA) was selected as the appropriate statistical method for this

study in order to estimate the linear combinations of the meaning of words and concepts

(Kulkarni, Apte, & Evangelopoulos, 2014). LSA is a technique in natural language processing

that extracts concepts from a matrix of terms to produce a pattern of word usage (Kulkarni et al.,

2014; Deerwater et al., 1990). Relationships between documents and the words they contain are

analyzed with the production of a set of related concepts or terms. Words with similar meaning

will occur in similar meaning documents. These words are compiled in a term frequency matrix,

which contains word counts per customer comment.

The mathematical technique of singular value decomposition (SVD) reduces the matrix

into singular values or vectors to show a decomposition of the original text relationships into

independent components (Deerwester et al., 1990). Taking the cosine of the angle between two

vectors produce values to determine the similarity between words. Very similar words have a value close to one while dissimilar words result in values close to zero. Topic clustering results when you are expecting distinct groups being clustered into readily identifiable separate non-overlapping entities. LSA is similar to factor analysis where cross-loadings and thus overlapping occurs.

The steps in using LSA include compiling a term frequency matrix form passages with coherent meanings and using singular value decomposition (SVD) to decompose the matrix in a way to allow for each coherent passage to be presented as a vector. Similarities between words, passages, or both are then computed. The resulting LSA analysis approximates the meaning of the effect of a word on the meaning of passages and vice versa. The similarity of the effects the words have on the passage is the correct interpretation of the derived relation between individual words, not the frequency of words in a passage. LSA allows for a word vector to represent a mixture of senses in comparison to contextual usage and not disambiguity in passage meaning formation.

Data Description

Data was collected from the online source www.yelp.com. The data sources collected were a generalized selection of mass transit providers in large metropolitan areas with a variety of new and established public transportation alternatives. Selection of area was based on a comparable level of public transportation available to allow for consistency of alternatives available across the online comments. Comments listed under public transportation, mass transit, or public transit were collected from www.yelp.com.

Comments were pulled from the website to create a document library to be analyzed through SAS Text Miner 13.1. The resulting data consisted of 913 self-reported customer comments from 6 major mass transit authorities across the United Stated, including Fort Worth, TX, Dallas, TX, Saint Louis, MO, Atlanta, GA, and Phoenix, AZ. The corpus length for the customer comments ranged from 57 to 2015 characters.

Analysis

To analyze the online customer comments, text mining was conducted to identify underlying themes or concepts contained in large amounts of data sets or documentations. Two main phases occur through the use of texting mining – exploration of textual data (descriptive mining) and discovery of information for further improvement (predictive mining) (SAS Institute Inc., 2012). Descriptive mining allows for the exploration of themes or concepts that are included in a large data set (SAS Institute Inc., 2012). This phase of text mining provides detailed information about terms or phrases and clusters them into meaningful groups for further interpretation and better understanding of the textual content (SAS Institute Inc., 2012). Predictive mining categorizes the textual documents for decision making implications (SAS Institute Inc., 2012). This information helps identify customers' willingness to experience their service in public transportation again, allowing for additional strategic planning development for public transportation officials.

In this study, SAS Enterprise Miner 13.1 was used to segregate text topics and text clusters through a series of steps. Initially, the data file containing the self-reported online customer comments as well as observation identification numbers and locations was imported into SAS Enterprise Miner 13.1 from an Excel spreadsheet using the Text Import node (SAS

Institute Inc., 2012). This data file was then converted from ASCII text format into a SAS table

and SAS data file. This SAS data set is used as the input for the Text Parsing node which

decomposes the data file into a quantitative representation required for text mining purposes

(SAS Institute Inc., 2012).

Each term in each comment contained in the data file was identified for its attributes

(numeric, alpha numeric or characters) and associated part of speech. Terms with corresponding

synonyms were aggregated and non-essential descriptors (i.e. parts of speech, including Aux,

Conj, Det, Interj, Part, Prep, and Proper Noun) and Numeric and Punctuation Attributes were

excluded. Any of these terms with the parts of speech that were selected in the Ignore Parts of

Speech dialog box during the Text Parsing step are ignored. This ensures that the document

analysis will ignore words considered to be low-content, such as prepositions and determiners

(SAS Institute Inc., 2012). The resulting terms in each observation were then parsed through the

Text Parsing node (shortened to its base root), resulting in 2352 unique "terms".

Transformation, or dimension reduction, occurred using the Text Filter node. This node

allows for the reduction of parsed terms to be analyzed by additionally filtering extraneous

information (SAS Institute Inc., 2012), such as removing location word groupings (downtown

area, mid-town, Dallas metro, Phoenix, etc.) and specific transportation modes descriptor to

provide nonspecific textual responses. The Text Filter node takes the quantitate representation

from the Text Parsing node and transforms it into an informative format to permit documentation

analysis (SAS Institute Inc., 2012), allowing for only the most valuable and pertinent information

to be considered when running the document analysis.

The resulting remaining term list was then run through LSA with a maximum of thirty

multi-term correlated topics. This document analysis performs classification or concept linking

of the text to the document collection through both the Text Topic node and the Text Cluster node (SAS Institute Inc., 2012).

Text Topic

The Text Topic node allows for an exploration of the data set by associating the document terms in topics (SAS Institute Inc., 2012). The purpose of the Text Topic node is to produce a combination of words that describe a main idea of interest that can be analyzed. This qualitative grouping technique is used to group the text topics into corresponding dimensions that were found in the a priori model to verify the existence of these decision-making factors. The Text Topics table (Table 1) specifies the single-term topics along with the topics that were specified when running the Text Topics node. Each group of text topics are color coded with the original theoretical framework of the decision-making model (Figure 2) to show the consistency and validation of the framework through the use of eWOM.

As seen in Table 1 and visually in Figure 2, no specifically identifiable convenience terms were mentioned. This is due to convenience being a formative construct with three primary parts – time, personal convenience, and schedule.

Table 6

Text Topics

| Topic	Number of Terms	# Docs
+airport,clean,+efficient,downtown,+safe	26	116
+people,+feel,+safe,especially,+pretty	28	120
+light rail,+rail,+light,valley,+game	12	129
transportation,+public,public transportation,+city,huge	5	88
+transit,mass,mass transit,+experience,+system	13	73
+trolley,+driver,+stop,+stop,+map	20	86
money,+save,+people,+gas,+car	26	108
+system,+honor,+check,+honor system,+find	35	86
+pass,+day,+day pass,+price,+week	13	88
+ticket,+machine,+buy,+fare,+ticket	22	77
+few,+time,+clean,+train,ridden	31	120
+time,+drive,+live,+few,work	40	137
+train,+wait,metro,+minute,back	47	116
on time,+run,+easy,+train,+always	33	103
+bike,+car,+sit,+train,+hour	34	77
+tre,+hour,+check,+union,+year	33	85
+bus,+leave,on time,+driver,+run	32	98
+west,+station,+end,station,+stop	40	94
+event,+park,downtown,+schedule,traffic	38	104
rail,light,valley,downtown,+point	15	39
+park,+station,+lot,+park lot,+area	30	104
rail,+system,+city,+live,+light rail system	30	122
+thing,+nice,valley,+expand,+move	34	97
+airport,+expand,+want,+connect,+car	39	122
+bus,+plan,+route,+trip,+time	20	110
+line,rail,+red,+green,+car	21	79
+area,metro,+service,+back,metro	31	111
+ride,+want,+fun,+town,+train	30	129
+ride,+first,+time,+love,+stop	31	127
+star,+car,+game,+four,+leave	42	105
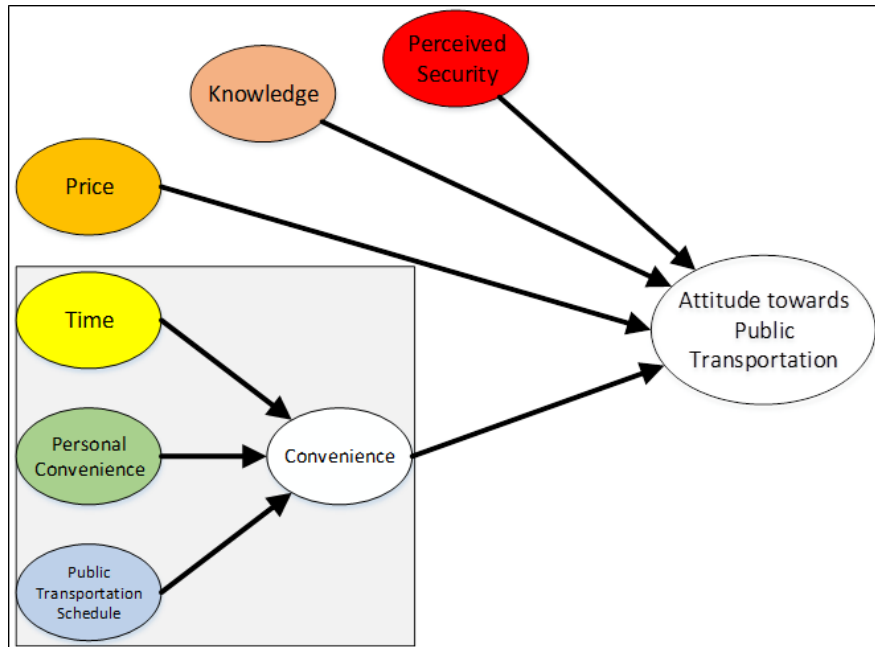
Figure 10. Theoretical framework coded with text topics.

Text Cluster

Upon realization that additional factors may be present, additional clustering analysis was conducted using the Text Cluster node. This node takes documents from the data set and clusters them into unconnected sets of documents (SAS Institute Inc., 2012). The Text Cluster node also reports on the descriptive terms contained in each of the clusters created (SAS Institute Inc., 2012). A tree hierarchy is created with a k-means clustering Expectation-Maximization algorithm with High SVD resolution, which transforms the original term frequency matrix into a dense representation of text clusters (SAS Institute Inc., 2012). A maximum of 10 descriptive terms and thirty clustered topics to highlight potential additional groupings were used when running the Text Cluster node. The resulting clustering (shown in the Cluster table in Table 2) provided 18 clusters centered on five unique topics, including four a priori established constructs – security, knowledge, convenience, and price - and a new topic, parking. Included in the Cluster table is an ID or cluster number, the descriptive terms that define each cluster, and the statistics (frequency and percentage) for each cluster.

Table 7

Text Clusters

Cluster	Cluster Description	Freq	%
1		69	8%
2	clean work +plan +schedule +train +expand	71	8%
3	+know +nice +feel especially +yes +move	35	4%
4	+driver +good +event +live +stop +feel	33	4%
5	+gas +save money +park +work +drive	37	4%
6	+time +read +few +last +find +always	56	6%
7	+few +station +clean +minute +home +drive	85	9%
8	people +car +price +feel +expand park	63	7%
9	+city 'public transportation' +finally +big +area +expand	72	8%
10	+west +end +home +move +little park	30	3%
11	+pay +ride especially +convenient +park +ticket	36	4%
12	+buy +pass +ticket +want +fare +pay	69	8%
13	+hour +weekend +happen +service +long +wait	37	4%
14	+line rail +area +west +light +move	51	6%
15	+love +stop +long +ride metro work	65	7%
16	+run +friend +schedule +place +wait metro	35	4%
17	+easy +look +convenient +price +town clean	33	4%
18	+game +night +light +last +happen +friend	36	4%

Frequency can be determined in the Cluster table to compare which cluster has the highest frequency. The Distance between Clusters figure (Figure 3) allows for a visual comparison of the clusters in terms of distance.
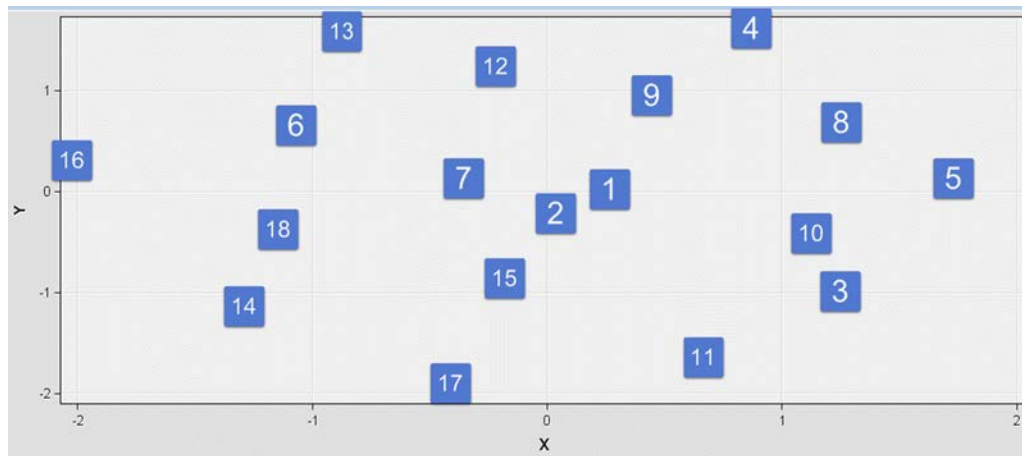

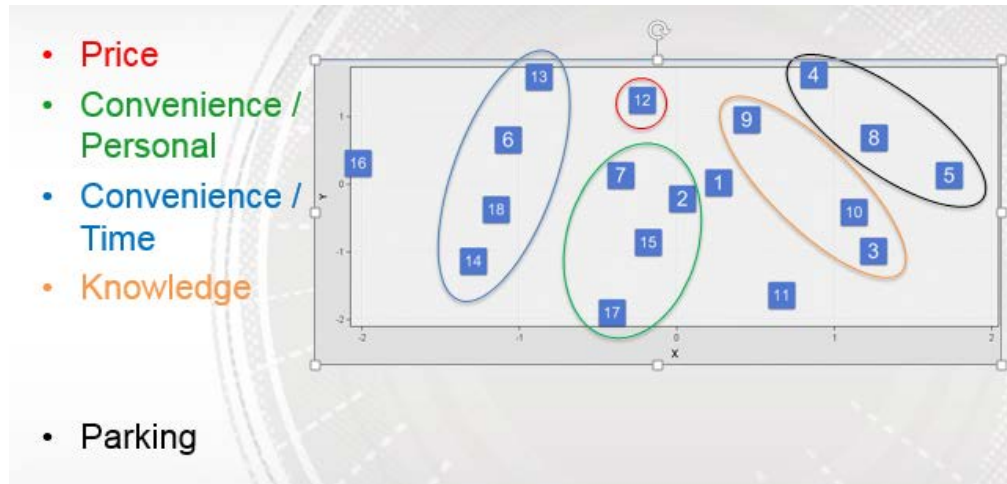*Figure 11.* Distance between Clusters.

Figure 12. Distance between clusters identified.

Discussion and Implication

The objective of this study was to validate the conceptual theoretical framework model of the decision-making process developed through extensive literature review and survey results of working professional public transportation commuters by analyzing eWOM. Using LSA as a validation method to analyze online customer comments, identification of underlying themes or concepts contained in the data sets was conducted. This analysis supports that transportation security, knowledge, price, and convenience affect the attitude towards public transportation and ultimately, the decision-making process on selecting mode of transportation. This study expands on prior research by validating a theoretical transportation decision-making model with empirical data from online comments.

This research contributes to the transportation literature by implementing latent semantic analysis to validate a theoretical decision-making framework to allow for better understanding of commuter attitudes toward public transportation. The use of electronic word–of-mouth is increasing with the expansion of Internet technology in our everyday lives. The results of this

study offer a deeper understanding and knowledge base of the decision-making factors utilized in determining mode of public transportation as well as the influence of online commuter comments on the service provided.

The text topic groupings verify the decision-making factors that were found based on extensive literature review and a survey study of working professional commuters. This validation of the decision-making factors provides an additional source of information for public transportation officials to examine when implementing strategic plans. These results also suggest that the knowledge obtained from a survey analysis using PLS-SEM are comparable to the results retrieved from online customer comments when running LSA. This research advocates the need to examine eWOM as a contender in pertinent information and opinion in the decision-making process of public transportation.

Text clustering provided 18 cluster groupings on five topics. Of those were the four a priori factors – security, knowledge, price, and convenience - from the theoretical decision-making framework. These results show the consistency of the online comments with the decision-making factors of public transportation. Again, this suggests the need for public transportation officials to consider online comments as an additional source of valid information when influencing attitudes toward public transportation.

Both the text topics and text cluster groupings illustrates the functionality of text analytics for confirmatory model assessment. This research has shown through empirical data collected from online customer comments that latent semantic analysis provides validation of a theoretical framework based on a survey-results and that was previous tested by PLS-SEM. Significant insight is gained by recognizing and understanding the importance of the decision-making factors that influence attitudes toward public transportation. Management and operations

practices should continue to view these factors as an integrated process and integrate the use of eWOM as an additional source of information as shown in this research.

Through the text clustering was a fifth unique topic – parking. Comparing eWOM and the survey-driven results suggested that there is future work in the exploration of the influence of parking to the decision making of using public transportation. Using this qualitative grouping technique, new dimensions can be identified that were not previously provided in the a priori model and currently un-utilized in the research. Public transportation officials can use this information and these techniques when deciding additional factors to consider as well as management operations that can be adjusted in the future.

Limitations and Future Research

One limitation to this study is the difficulty of LSA to interpret resulting dimensions. Although LSA can lead to results that can be further justified on a mathematical levels, meaning in the natural language could be prohibited. This occurs when words have multiple meanings depending on context and thus, are difficult to distinguish through LSA. The impact of sentiment and discrete emotions is a similar limitation to this study. The difficulty of LSA to interpret and properly cluster or group these types of terms is an issue that needs to be considered when running LSA and analyzing the results.

Another limitation is the limited corpus library leading to a confined data set. Due to the need to explore eWOM comments based on similar metropolitan areas with comparable public transportation systems, the number of comments analyzed were regulated. Future research should be extended to include additional geographic regions and a greater diversity in mass transit density and complexity.

Additionally, this research is limited due to stemmed terms leading to a lack of a language and cultural diversity. How language is formed and differentiates in areas and cultures can prove to be challenging in determining meaning of words. The term "coke" is common in some areas and implies the same meaning as "soda," "pop,", and "cola." To implement these different terms with the same meanings when using LSA is an obstacle that needs to be analyzed in future research.

Using www.yelp.com as the data source is also a limitation to this study. Due to individuals being able to freely submit reviews for products and services on Yelp, reviews can either be extreme or written as an entertainment factor. Issues have risen in the past regarding other businesses writing negative comments regarding a product or service in order to persuade people. However, Yelp has implemented a filtering process in order to display the comments from the most trustworthy and established sources. By allowing others to view these reviews, individuals can either rate the reviews or write additional comments in support of or against what was originally written. Using comments from additional websites regarding public transportation would be an important extension of this study for future research.

Conclusion

Improving public transportation and attitudes toward public transportation is essential in improving public transportations for commuters. Electronic word-of-mouth is becoming an important source for information on experiences and opinions and has been shown to be influential in evaluating services. This study conducts a latent semantic analysis of online comments from regarding public transportation. It shows the importance of eWOM topics on

attitudes toward public transportation and thus, the need to refer to these types of results in order to provide good operations management strategies in the supply of public transportation.

The LSA results validate the theoretical decision-making framework, which has shown the decision-making factors to include security, knowledge, price, and convenience. Through the use of Text Topics and Text Clustering, the findings from this study contribute to research on public transportation and eWOM in four explicit ways. First, through empirical data collected with eWOM comments, this research validates that the four decision-making factors of commuters, including security, knowledge, price, and convenience, are important concepts in attitudes toward public transportation. Second, the Text Topics results specified the single-term results which were then color coded with the theoretical decision-making framework. This consistency of results validates the proposed and tested framework and allows for a connection of the four primary factors to strategic goals. Enhancement of the experience and determination of the attitudes toward public transportation of commuters are better able to be predicted and improved upon with this analysis. Third, this research confirms the four a priori driving factors that affect the attitude toward public transportation through the clustering of topics. A new topic of parking resulted from eWOM and allows for an additional factor that public transportation officials should consider in strategic planning. Finally, the LSA analysis shows that eWOM plays an essential part in the validation of the theoretical framework. These online comments play an influential part in the quality practices and operational performance of public transportation, especially in a well-developed metropolitan area. The results from this research provide additional understanding of performance benefits based on online commuter comments, which also provides awareness into how to positively inspire people's attitudes toward public transportation.

CHAPTER 6

CONCLUSION

Summary

Essay 1

The decision-making factors of public transportation from a commuter perspective is essential in strategic development of public transportation and in the management practices to improve the acceptance and utilization of mass transit systems. This essay analyzed the factors affecting attitude towards public transportation by exploring the public transportation decision-making process of working professionals using a survey methodology. The objectives of this research were to develop and test a theoretical model of the transportation decision-making process of public transportation in a metropolitan area and to determine key factors that supplement the modal decision choices of potential public transportation users. This study provides a contribution to literature by developing and testing an integrated theoretical framework for modeling an individual's public transportation decision-making process. Using four independent variables, including perceived public transportation security, knowledge, price, and convenience, the proposed theoretical framework is based upon extant literature review and tested using partial least squares structural equation modeling (PLS-SEM). Based on the theory of reasoned action and the theory of planned behavior, while using utility theory as a proxy measure, the decision-making factors are developed and refined using confirmatory factor analysis.

Essay 2

Causal loop diagrams visualize how decision-making factors affect attitude toward public

transportation and show the impact these decision-making factors have on the supply and demand of public transportation as well as the local population. A visualization of the effects of decision-making factors on attitude towards public transportation provides a valuable tool to public transportation officials to analyze the supply and demand of public transportation and how local population is affected. Using general systems theory (GST) as the theoretical basis for the utilization of a causal loop diagram, a systematic view of the decision-making factors is provided. This study provides a causal loop diagram of the relationships and interdependencies among these decision-making factors and the supply of public transportation. This visualization tool affords better comprehension on how factors are interconnected in the supply of public transportation. The need to analyze relationships with a systematic viewpoint allows for understanding of the interrelationships in this structure and provides a visual template with the ability to modify the causal loop as needed to fit each individual organization's needs.

Essay 3

A latent semantic analysis (LSA) of online comments from www.yelp.com regarding public transportation presents the occurrence of customers' electronic word-of-mouth (eWOM) topics on attitudes toward public transportation customary in literature. Word classification provides an approximate meaning of a word within the online comments in which it occurs. This study validates the theoretical model developed through extant literature review and a survey of working professionals currently utilizing public transportation by analyzing electronic word of mouth (eWOM). This research uses latent semantic analysis of online comments regarding public transportation. Electronic word-of-mouth regarding attitudes toward public transportation is an important topic and provides strong reference in order to implement improved operations

management strategies in the supply of public transportation. The results from the latent sematic

analysis validate the theoretical framework and provides an illustration of how text analytics is

used as a confirmatory model assessment.

Table 8

Essay Summary

Essays	Results
1	Developed and tested theoretical framework based on survey data and analysis through PLS-SEM
2	Causal loop visualization of interrelationships of decision-making factors affecting attitude towards public transportation
3	Validates the theoretical decision-making framework through LSA of eWOM of commuters

Implications

Essay 1

This study provides a broader understanding of the influences on the current individual

commuter's public transportation decision-making process. Using PLS-SEM, the analysis

suggests that four individual factors, including security, knowledge, price, and convenience,

affect attitude towards public transportation and the decision-making process. The theoretical

framework developed in this study explains the individual's evaluation criteria used when

determining motives that drive everyday decisions about public transportation. This exploratory

study examines attitudes toward public transportation by commuters. By extracting constructs

from various sources, developing a theoretical framework and integrated survey instrument, an

important contribution was made regarding the decision-making process for choosing a mode of

public transportation. A better understanding of the key factors in the public transportation decision-making process is provided.

Essay 2

This research visualizes the multiple decision-making factors and shows the importance of attitude towards public transportation with supply and demand of public transportation. The causal loop diagram provides a consistent explanation with general systems theory and creates an adaptable model. The discussion panel validates the model, providing a worthwhile diagram for organizations to implement when management and strategic operation changes are considered in regards to public transportation and the experiences affecting commuter attitude. A visual representation of performance benefits is established and provides insights into how changes can be made to positively influence commuter's attitudes toward public transportation.

Essay 3

Electronic word-of mouth becomes an increasingly important source of information and influential in evaluating services. Through empirical data collected from eWOM comments, this study uses latent semantic analysis to validate the theoretical decision-making factors as significant concepts in affecting attitude towards public transportation. Text Topics results show a strong consistency of results of the four primary decision-making factors to strategic goals. Clustering results confirm that the four decision-making factors, including security, knowledge, price, and convenience affect attitude towards public transportation. Using eWOM through a latent semantic analysis is essential in the validation process of the theoretical framework and shows that online comments are influential in quality practices and operational performances of

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public transportation services. These results provide additional understanding to the decision-making process of commuters when choosing public transportation.

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