DEVELOPING INPUT TO "BEST-VALUE" VEHICLE PROCUREMENT PRACTICE: AN ANALYSIS OF SUPPLIER EVALUATION AND SELECTION IN THE US PUBLIC TRANSPORTATION INDUSTRY

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ABSTRACT

Collectively, US public transportation systems operated 137,047 vehicles per peak period in 2008 (American Public Transportation Association 2010). Buses accounted for the largest segment among these vehicles, and the passenger van segment was second. Together, they accounted for 78% of the vehicles operated per peak period (American Public Transportation Association 2010).

Due to their pervasive use in the public transportation industry, buses and vans have been the focus in various academic research studies. However, very few studies have focused on vehicle procurement. Further, none have focused on the specific vehicle procurement function of supplier evaluation and selection.

The over-arching objective of this research is to gain a deeper understanding of the relative importance of vehicle supplier attributes in reference to the Federal Transit Administration's (FTA) "best-value" procurement initiative and the influence of these supplier attributes on the evaluation and selection of vehicle suppliers. The vehicles under study in this research are the various types of buses and vans used in the provision of public transportation services.

This research studies vehicle procurement decision-makers at public transportation agencies to determine which criteria, or supplier attributes, they perceive to be the most important when evaluating vehicle suppliers. Results indicate that the top five attributes were quality, reliability, after-sales support, warranties and claims, and integrity. The order of these top five attributes changed according to the type of supplier being evaluated, i.e., conventional fuel vehicle supplier versus alternative fuel vehicle supplier. The reason for this change was explained as being due to the increased engineering and technological expertise required of alternative fuel vehicle suppliers.

Utilizing the Analysis of Covariance (ANCOVA) method, the research showed that the variation in the perception of the importance of particular supplier attributes was not generally influenced by an agency's urban classification, its vehicle fleet size, its capital expenditure level, its decision-makers' education level, or their years of experience. However, FTA region was determined to have an influence on two attributes.

Utilizing a conditional logit discrete choice model, the research also found that in practice, as opposed to perception, price and not quality had the highest parameter estimate and was therefore the most important supplier attribute during evaluation. It was followed by quality, after-sales support, technical capability, and delivery.

Further, to garner a deeper understanding as to which inherent components of attributes render some attributes more important than others, participants in the research identified 41 attribute components and provided metrics by which to measure these components and, by extension, the attributes themselves.

This research contributes in four areas. These are government procurement initiatives, agency "best-value" procurement practice, vehicle supplier marketing, and academic research in supplier evaluation and selection in the public transportation industry where it is seminal work in this area.

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1. INTRODUCTION

1.1 Overview

As of 2008, U.S. public transportation systems operated 137,047 vehicles, in a typical peak period, out of a total available fleet of 169,436 for-service vehicles (American Public Transportation Association 2010). Of this total fleet, buses accounted for the largest segment with 66,506 available for peak service while paratransit vehicles accounted for the second largest segment with 65,799 vehicles (American Public Transportation Association 2010).Combined, buses and paratransit vehicles account for approximately 78%[1] of all vehicles providing public transportation service in the United States (American Public Transportation Association 2010). In the year 2008, of the 18,631 new vehicles delivered to the public transportation industry, 3,563 were buses and 12,457 were paratransit vehicles, accounting for approximately 86%[2] of all new vehicles purchased (American Public Transportation Association 2010).

Considering both the pervasive use of buses and vans within the public transportation industry and the proportion they generally comprise, as seen in 2008, of total new vehicle purchases, understanding the manner in which they are procured is of paramount importance.

Vehicle procurement in the US public transportation industry is characterized as being comprised of multi-agency input, multi-tiered regulatory compliance requirements, and multi-objective approaches. Multi-objective approaches arise due to the involvement of various participants in the procurement process. These various participants are individuals representing various organizations involved in the procurement process that each have unique objectives. Combinations of the aforementioned factors serve as input into a procurement process that is often deemed complex and replete with conflicting objectives.

The alignment of vehicle procurement objectives coupled with a deeper understanding of the public transportation vehicle procurement process are key in realizing the strategic goals of the industry. These strategic goals include improving cost and spend efficiency through utilizing the life-cycle cost analysis approach, facilitating environmental and energy sustainability, and maintaining a “state-of-good repair”.[3] Vehicles, and the way in which they are procured, are intrinsically related to the realization of the three aforementioned industry strategic goals.

There exist, however, impediments to the realization of the aforementioned public transportation industry strategic goals. This research isolates a potential impediment, a stage in the vehicle procurement process, and analyzes it to gain a deepened understanding and to serve as input to improved procurement practice.

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[1] Percentage calculated based on vehicle data provided by the APTA 2010 Public Transportation Fact Book

[2] Percentage calculated based on vehicle data provided by the APTA 2010 Public Transportation Fact Book

[3] These terms refer to concepts that are detailed further in (Booz Allen Hamilton 2007), (USDOT 2010), and (Federal Transportation Administration 2010)

1.2 Research Problem

Many of the public transportation providers in the United States that receive federal and state government funds are stipulated by law to comply with vehicle procurement regulations. These regulations communicate the federal and state governments' positions on vehicle procurement. However, given the multi-agency aspect of public procurement processes, these governmental positions on vehicle procurement are not the only positions that exist. Two other positions influence decision-making in vehicle procurement processes – that of the public transportation agency purchasing the vehicle and that of the vehicle supplier. The focus of this research is on the position of the public transportation agency purchasing the vehicle, more specifically, the positions of their procurement decision-makers (PDMs).

Governmental procurement-related efforts are concentrated on the development and implementation of procurement regulation. However, a lesser degree of attention to public transportation agency positions on procurement issues can lead to disconnects between government policy objectives and industry practice. Establishing procurement policy and regulations without adequate accommodation of the goals and objectives of public transportation agency procurement decision-makers, who actually conduct vehicle purchases, is akin to trying to tie shoelaces with one hand – the shoe rarely gets tied efficiently and optimally, if tied at all.

Four factors, or sub-problems, collectively constitute the aggregate research problem - a lack of information on and understanding of the way public transportation agency procurement decision-makers make decisions when purchasing vehicles. The four factors contributing to the aggregate problem are 1) the limited scholarly literature pertaining to public procurement, especially procurement in the public transportation industry, 2) federal government procurement initiatives and their interpretation, 3) state government procurement regulation, and its limiting effect, and 4) government environment and energy focused regulation that influences, or will influence, the types of vehicles procured by public transportation agencies.

The literature is replete with research on the strategies and practices regarding the procurement function in the private sector. However, the procurement and purchasing practices of public sector entities receive significantly less focus (Wang and Bunn, 2004; Schiele and McCue, 2006). As a result, a significant knowledge gap exists -there is relatively little information on the purchasing function, as practiced by public entities (Bryntse, 1996; Murray, 1999, 2001; Wang and Bunn, 2004). Acknowledging that the strategic goals of government are generally different from those of the private sector, their respective purchasing goals will also be different (Knott, 1993; Murray, 2001; Furneaux et al., 2008; Van Der Wal et al., 2008). While the strategic goals of private sector enterprises are generally driven by the incentive to maximize profit and shareholder value, the strategic goals of public sector entities are generally influenced by the need to practice and exhibit equity, democracy, public accountability, efficiency, competitiveness, balancing stakeholder interests, and managing the associated political processes and their influences (Van Der Wal et al., 2008). These differences in public and private organizational strategic goals often result in them having different procurement policies, foci, and objectives. More specifically, differences occur in their procurement and purchasing strategies, their operational strategies, and the supplier evaluation methods they employ (Murray, 1999, 2001; Wang and Bunn, 2004; Astrom and Brochner, 2007). Public procurement decisions are influenced by a complex network of individual actors and stakeholders who individually have no influence over the other's strategic objectives (Kickert, Klijn and Koppenjan, 1997).

The Federal government procurement regulations and initiatives that directly pertain to this research are those related to supplier evaluation. In practice, suppliers are evaluated and rated on specific criteria. Concerning the criteria used in the evaluation of suppliers during procurements, the FTA encourages, when permissable, public transportation agencies employing the “best-value” approach. In the “best-value” procurement approach grantees acquire a product or service they consider to possess more technical superiority than another product or service that is priced lower (Federal Transit Administration, 2001). The relevance of the “best-value” approach varies depending on the product being purchased. If an agency’s product or service requirements are clearly definable and the risks of unsuccessful performance are small, price plays a more dominant role in the decision-making process. However, when an agency’s product or service requirements are less definitive and performance risks are greater, price becomes less important and other criteria gain more relative importance in the supplier selection process (Federal Transit Administration, 2001).

While the FTA does not specify or dictate the use of any particular supplier evaluation criteria, it states that criteria may include, but are not limited to, technical design, technical approach, length of delivery schedules, quality of proposed personnel, past performance, and management plan (Federal Transit Administration, 2008). Additionally, while the FTA provided *Best Practice Procurement Manual (BPPM)* states that grantees may employ any rating method or combination of methods including color ratings, adjectival ratings, numerical weights, or ordinal rankings when evaluating and selecting suppliers, the FTA does not specify nor dictate the use of any particular method or analytical process to do so (Federal Transit Administration, 2008). Various public transportation agencies have adopted solely quantitative approaches to evaluating suppliers while, conversely, others have adopted solely adjective rating methods (Federal Transit Administration, 2001). As a result, problems and challenges surrounding the relative objectivity and/or subjectivity of the supplier evaluation methods utilized by public transportation agency procurement decision-makers exist (Federal Transit Administration, 2001).

It should be noted that in addition to the identified federal procurement initiative, additional regulatory requirements often guide public transportation agencies’ vehicle procurement processes. State government procurement regulations are generally more restrictive than Federal government requirements (Federal Transit Administration 2001). In instances where a public transportation agency’s vehicles are procured by the State, as is the case with many non-urban public transportation service providers, State procurement laws directly influence the type of procurement solicitation method used when procuring the vehicles. Many states’ procurment departments stipulate, or give preference to, the use of Inviatation for Bid (IFB) solicitations in the procurement of buses and vans. IFB solicitation methods dictate that purchasers select the supplier that offers the lowest price i.e. price is the most important evaluation criterion (Federal Transit Administration 2008). Conversely, Request for Proposal (RFP) solicitations permit the use of various other criteria, in addition to price, on which a supplier can be evaluated. Various public transportation agencies across the United States utilize RFPs, especially when they purchase their own vehicles and are not procuring utilizing State government funds.

Various environment and energy-focused policy objectives, regulations, and initiatives exist, and are being developed, by both federal and state governments. On the Federal level, there is legislation in the form of the Clean Air Act and any amendments to it; Federal transportation authorizations and their respective re-authorizations; and climate change-specific legislation. On the state level, there are various legislative initiatives that aim at reducing green house gas (GHG) emissions. These state initiatives include Senate Bills (SBs), House Bills (HBs), Assembly Bills (ABs), trading schemes, climate action plans, GHG reduction plans, and alternative fuel mandates.

In the process of developing a consolidated environmental policy position, the United States Department of Transportation (USDOT), in 2010, conducted a study *“Transportation's Role in Reducing U.S. Greenhouse Gas Emissions*.” The study evaluated potentially viable strategies to reduce transportation GHGs (Center for Climate Change and Environmental Forecasting, US DOT 2010). The study evaluated four groups of strategies and two cross-cutting strategies. Various of these strategies, cross-strategies, and their constituents communicate public transportation’s role in GHG reduction strategies. These include the public transportation industry introducting low-carbon fuels into vehicle fleets, increasing vehicle fuel economy, and facilitating reduced carbon-intensive travel activity. The first two of these GHG reduction strategies are directly related to the types of vehicle used, and thus procured, by public transportation agencies.

On the State government level, bills focused on climate and the environment include California's Assembly Bill (AB) 32 of 2006, California Senate Bill (SB) 375 of 2008 which establishes GHG reduction targets for California's eighteen metropolitan planning organizations (MPOs), and Washington state's House Bill (HB) 2815 of 2008, *"Climate Action and Green Jobs,"* which requires the state DOT to adopt vehicle miles travelled (VMT) reduction strategies and also requires any agency that operates on-road vehicles that emit in excess of 2,500 metric tons of GHGs to report it annually (Gallivan and Grant 2010). Public transportation agencies will play key roles in the realization of the aforementioned bills' emissions targets and have already begun to be involved in strategy and solution implementation (Gallivan and Grant 2010). Again, public transportation's role in state GHG reduction strategies is significantly contigent on the types of vehicles that agencies procure.

Additional anticipated policies, mandates, and legislative measures have been cited by public transportation agencies as stipulating new or increased environmental requirements (Gallivan and Grant 2010). These include New Jersey's Global Warming Response Act, Arizona's Executive Order 2006-13, Oregon's state goals for GHG reduction, and Florida's Executive Order 07-127 (Gallivan and Grant 2010).

These existing, and impending, environmentally related regulations influence, and stand to influence in the future, the types of vehicles public transportation agencies procure and utilize. Interestingly, as of 2009, approximately 30% of buses and 10% of paratransit vehicles were alternatively powered or fueled (American Public Transportation Association, 2010). The procurement of alternatively fueled and powered vehicles stands to increase as regulations dictate the utilization of more environmentally condusive vehicles and fuels in public transportation agency fleets.

More specifically, the four aforementioned factors combine to contribute to a problem that lead to the need for this research. Specific to the public transportation industry, while literature on vehicle engineering, optimal fleet-mix and fleet-size, economics, policy, and costing does exist (Booz Allen Hamilton 2007; Peterson and Molloy 2007; Peterson 2006; Peterson 2007; KFH Group 2000; Northeast Advanced Vehicle Consortium 2005; Hemily and King 2002; AECOM Consult 2007; Macek, et al. 2007), no existing academic literature analyzes the procurement process itself. Further, to date, no scholarly literature exists that specifically studies and analyzes the vehicle supplier evaluation process in the procurement of public transportation vehicles in the US.

Second, there are various issues related to the FTA's "best-value" procurement initiative that warrant investigation. Given the wide scope of both agency and service types existing in the public transportation industry, "best- value" procurements may assume different contextual meanings across varied scenarios. This can lead to the same supplier attribute, or criterion, being assigned a different importance level as situations or factors change. Does attribute importance vary according to the size of an agency's fleet or its geographic location? Does attribute importance vary according to the type of vehicle being procured? Does attribute importance vary according to individual characteristics of agencies' procurement decision-makers? To date, there exists no study on the FTA's "best-value" initiative, in practice or theory, which addresses the identification, categorization, or standardization of supplier attributes used as evaluation metrics in choosing vehicle suppliers and how these may differ, or be altered, based on various factors.

Third, in many instances state government regulations stipulate the use of IFB solicitations and thereby prohibit the use of any criteria other than price when evaluating vehicle suppliers. Therefore, most agencies that procure vehicles through a state agency or that utilize state funds in vehicle procurements employ "lowest-price" methods[4] to award vehicle supplier contracts. Two related problems arise from this practice. As alluded to previously, some state agency stipulated procurement practices are, at times, in direct conflict with, and prohibit, the practice of "best-value" vehicle procurement. This gives rise to two questions. Which supplier attributes do decision-makers at IFB restricted public transportation agencies believe are just as or more important than price when evaluating vehicle suppliers? How would vehicle suppliers be evaluated if such procurement decision-makers could practice "best-value" procurements through the use of RFPs in solicitations?

Fourth, as states develop and introduce various environment and energy focused policies and regulations, the lowest-cost method of procurement may not be the optimal procurement method when procuring alternatively fueled and powered vehicles. Which other supplier attributes, in addition to cost or price, are just as or more important when procuring alternatively powered or fueled vehicles? What are the differences in the relative ranking of supplier attributes when conventional diesel or gas versus alternatively powered vehicle procurements are compared? This research intends to address these questions.

1.3 Research Objectives

The objective of this research is to gain a deeper understanding of, and insight into, the relative importance of vehicle supplier attributes and their influence on the evaluation and selection of vehicle suppliers in the US public transportation industry. This is done with the intent of developing input to "best-value" vehicle procurement practice. Vehicles, in reference to this research, refer to buses and vans.

To accomplish the main objective of the research, eight sub-objectives will be pursued. These eight sub-objectives and their constituent tasks are described in the following section.

1.3.1 Research Sub-Objectives

1.3.1.1 Research Sub-Objective 1

This research sub-objective seeks to determine the vehicle fleet composition of public transportation agencies across the United States. Its intent is to identify the types of buses and vans being purchased by US public transportation agencies and the types of fuels being utilized by these buses and vans. Accomplishment of this sub-objective would provide a contextual precursor to subsequent vehicle supplier analysis.

1.3.1.2 Research Sub-Objective 2

This research sub-objective seeks to identify the suppliers that supply vehicles to public transportation agencies across the United States. Its intent is to identify the suppliers of vehicles and to determine if the market share of vehicle suppliers varies by 1) vehicle type 2) vehicle fuel type and 3) FTA region. Accomplishment of this sub-objective would provide a contextual precursor to subsequent vehicle supplier analysis. It can also be used in the development of inferences surrounding supplier choice variation based on research results.

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[4] For a more detailed description of the types of procurement methods authorized by federal and state governments see (Federal Transit Administration 2008) and (Federal Transit Administration 2001), and respective state procurement guidelines, most of which are provided by respective state DOTs.

1.3.1.3 Research Sub-Objective 3

This research sub-objective seeks to determine how public transportation agency procurement decision-makers rank and assign relative importance to various vehicle supplier attributes. Further, its intent is to determine if the relative importance of these supplier attributes vary based on whether a supplier is supplying a conventional fuel vehicle versus if they are supplying an alternatively fueled vehicle.

1.3.1.4 Research Sub-Objective 4

This research sub-objective seeks to test six hypotheses regarding the differences in the relative importance of specific vehicle supplier attributes when evaluating suppliers of conventional fuel vehicles versus when evaluating suppliers of alternative fuel vehicles. A hypothesis test is also developed regarding the differences in the relative importance of a specific vehicle supplier attribute between procurement decision-makers at urban public transportation agencies versus procurement decision-makers at non-urban public transportation agencies.

The research hypotheses are as follows:

1. $\mathbf{H_o}$: μ value of the importance of the supplier attribute Quality when evaluating suppliers of alternatively powered buses and vans is **less than, or equal to**, its importance when evaluating suppliers of diesel or gasoline buses and vans
   $\mathbf{H_a}$: μ value of the importance of the supplier attribute Quality when evaluating suppliers of alternatively powered buses and vans is **higher than** its importance when evaluating suppliers of diesel or gasoline buses and vans
2. $\mathbf{H_o}$: μ value of the importance of the supplier attribute Price when evaluating suppliers of alternatively powered buses and vans is **higher than, or equal to**, its importance when evaluating suppliers of diesel or gasoline buses and vans
   $\mathbf{H_a}$: μ value of the importance of the supplier attribute Price when evaluating suppliers of alternatively powered buses and vans is **lower than** its importance when evaluating suppliers of diesel or gasoline buses and vans
3. $\mathbf{H_o}$: μ value of the importance of the supplier attribute After-Sales-Support when evaluating suppliers of alternatively powered buses and vans is **less than, or equal to**, its importance when evaluating suppliers of diesel or gasoline buses and vans
   $\mathbf{H_a}$: μ value of the importance of the supplier attribute After-Sales-Support when evaluating suppliers of alternatively powered buses and vans is **higher than** its importance when evaluating suppliers of diesel or gasoline buses and vans
4. $\mathbf{H_o}$: μ value of the importance of the supplier attribute Warranties & Claims Policies when evaluating suppliers of alternatively powered buses and vans **is less than, or equal to**, its importance when evaluating suppliers of diesel or gasoline buses and vans
   $\mathbf{H_a}$: μ value of the importance of the supplier attribute Warranties & Claims Policies when evaluating suppliers of alternatively powered buses and vans is **higher than** its importance when evaluating suppliers of diesel or gasoline buses and vans
5. $\mathbf{H_o}$: μ value of the importance of the supplier attribute Technical Capability when evaluating suppliers of alternatively powered buses and vans **is less than, or equal to**, its importance when evaluating suppliers of diesel or gasoline buses and vans
   $\mathbf{H_a}$: μ value of the importance of the supplier attribute Technical Capability when evaluating suppliers of alternatively powered buses and vans is **higher than** its importance when evaluating suppliers of diesel or gasoline buses and vans
6. $\mathbf{H_o}$: μ value of the importance of the supplier attribute Price for non-urban (rural) transportation agencies is **less than, or equal to** its importance to urban area agencies when they evaluate bus and van suppliers

H_a: μ value of the importance of the supplier attribute Price is **higher** for non-urban (rural) transportation agencies than urban area agencies when they evaluate bus and van suppliers

The first five hypotheses hypothesize that the vehicle supplier attributes of quality, price, after-sales-support, warranty and claims policies, and technical capability are all perceived by procurement decision-makers to be more important when evaluating suppliers of alternative fuel vehicles as opposed to when evaluating suppliers of conventional fuel vehicles.

Quality's relative importance is hypothesized to be so because of the research's position that the complex engineering and mechanics involved in the development of alternatively powered vehicles result in a premium being placed on ensuring their pristine condition upon purchase, more so than for conventional diesel or gasoline vehicles.

Price's relative importance is hypothesized to be so because of the research's position that the increased technological utilization and composition of alternatively powered vehicles results in there being less of an emphasis being placed on negotiating their purchasing price than for conventional diesel or gasoline vehicles.

After-Sales-Support's relative importance is hypothesized to be so because of the research's position that the complex engineering, mechanics, and technology involved in both the operations and maintenance of alternative fuel vehicles result in a preference for vendor support after the point-of-sale, more so than for conventional diesel or gasoline vehicles.

Likewise, warranties and claims policies' relative importance is hypothesized to be so because of the research's position that the complex engineering, mechanics, and technology involved in both the operations and maintenance of alternative fuel vehicles result in a premium being placed on the ability of public transportation agencies to make claims on malfunctioning or underperforming vehicle components after the point-of-sale, more so than for conventional diesel or gasoline vehicles.

Technical Capability's relative importance is hypothesized to be so because of the research's position that the complex engineering, mechanics, and technology involved in the development and manufacturing of alternative fuel vehicles results in a preference for higher vendor technological competence, more so than for conventional diesel or gasoline vehicles.
Price's difference in relative importance between agencies operating in urbanized versus non-urbanized areas is hypothesized to be so because of the research's position that the generally higher capital budgets of urbanized public transportation agencies renders price a relatively less important or less constraining criterion as opposed to its importance to agencies in non-urbanized areas due to their generally lower capital budgets.

1.3.1.5 Research Sub-Objective 5

This research sub-objective seeks to determine if any significant correlation or relationships exist between the variation in the relative importance of vehicle supplier attributes and 1) the urban classification of a procurement decision-maker's agency 2) the FTA region of a procurement decision-maker's agency 3) the education level of a procurement decision-maker 4) the vehicle fleet size of a procurement decision-maker's agency 5) the capital expenditure of a procurement decision-maker's agency 6) the years of experience of a procurement decision-maker.

1.3.1.6 Research Sub-Objective 6

This sub-objective seeks to accomplish two tasks. These two tasks are 1) to determine the utility assigned to a specific vehicle supplier attribute when it is grouped together with other attributes and they collectively represent a vehicle supplier's offering or bid proposal 2) to determine the probability of a vehicle supplier, with a specific supplier attribute level combination mix, being chosen ahead of a competing supplier when bidding for a vehicle contract.

1.3.1.7 Research Sub-Objective 7

This sub-objective seeks to determine if the rank of specific vehicle supplier attributes as determined by their identified relative importance in sub-objective 3 i.e. their perceived importance, is the same as their rank as determined by their relative importance in sub-objective 6 i.e. their importance in practice.

1.3.1.8 Research Sub-Objective 8

After identifying the relative importance of several vehicle supplier attributes, this sub-objective seeks to identify both sub-attributes and practical metrics by which identified supplier attributes and sub-attributes can be measured. This sub-objective intends to utilize the provided metrics as input to public transportation agency supplier evaluation "best-practice."

The research will address the aforementioned sub-objectives utilizing descriptive statistical analysis, inferential statistical analysis, and discrete choice modeling. Further, for the discrete choice analysis method, a conditional logit model, was chosen. The conditional logit model facilitates the incorporation of utility theory in determining the importance of vehicle supplier attributes.

1.4 Research Contributions

This research contributes in the areas of US public transportation vehicle supplier proposal evaluation policy, public transportation agency vehicle supplier evaluation and selection practice, vehicle supplier proposal and bid competitive strategy, and to academic research related to procurement, supplier evaluation and selection, and public transportation.

This research contributes to vehicle supplier proposal evaluation policy in various ways. From the federal government level, this research can serve as a source of information on how vehicle suppliers are evaluated, or stand to be evaluated, in "best-value" vehicle procurement scenarios. Further, this research contributes to a deeper understanding of how the definition of "best-value" varies according to a public transportation agency's organizational characteristics, procurement decision-maker characteristics, and the type of vehicle being procured. This information will serve the federal government in developing product-, service-, or agency- specific policy insight and positions toward "best-value" vehicle supplier bid evaluation and supplier selection policy.

Of paramount importance on the federal level, the identification of vehicle supplier attribute preferences will facilitate the FTA in determining whether vehicle procurement in practice aligns with federal policy preferences and objectives. Interestingly, the FTA communicates that there is no single supplier evaluation tool, method, or model that it recommends, or dictates be used, when evaluating vehicle suppliers (Federal Transit Administration 2001). The output of this research can serve as a platform from which appropriate evaluation models that capture and measure supplier attributes precisely can be identified, developed, and customized.

From the state government level, this research can benefit vehicle supplier evaluation and selection practice in various ways. First, given that many state agencies practice "lowest-bid" procurements when purchasing vehicles by utilizing Invitation for Bid (IFB) procurement methods solely, output of this research can serve as a broad based primer to state regulators on the existence of a multiplicity of supplier attributes, other than price, on which it is important for suppliers to be evaluated. Further, the vehicle supplier attributes identified as important in the research can serve as input to public transportation agency vehicle supplier evaluation and selection policy reform, should state governments deem it fit to permit the use of Request for Proposal (RFP) procurement methods. The output of this research is also important on the state level of government when considering the fact that many states have, or are in the process of, enacting environment- and energy-focused legislation that may influence, or even stipulate, public transportation agencies' purchase of alternatively powered vehicles. If so, various other vehicle supplier attributes, in addition to price, should be included when evaluating suppliers. This research can serve as broad-based input into increasing the understanding as to which supplier attributes are deemed most important then.

The output of this research also provides beneficial input to both public transportation agencies and vehicle suppliers. In relation to public transportation agencies, organization buying literature communicates that there are various buying situations or "classes" that an organization may be involved in (Robinson, Faris and Wind 1967). One such situation is considered the "new task" scenario. Occurring less frequently, new task situations, like the purchase of alternative fuel vehicles, arise when an organization has not purchased a particular type of product or service before and, as a result, generally requires increased volumes of information, more product alternatives, and a wider supplier pool to choose from. For public transportation agencies that have never previously purchased alternatively powered vehicles but plan to do so in the future, the output of this research may serve as a tool in identifying important alternatively powered vehicle supplier attributes that can be utilized as evaluation metrics when deciding on suppliers.

Vehicle suppliers, it may be argued, stand to benefit most from the output of this research. This is due to two substantial benefits the study yields for vehicle suppliers. First, the output of the study will provide suppliers with a deeper understanding of how and why public transportation procurement decision-makers rank certain supplier attributes the way they do and how they evaluate suppliers based on these attributes. Second, possessing the aforementioned information, vehicle suppliers can allocate resources accordingly across their product development, sales, and bid proposal strategies according to procurement decision-makers' supplier attribute preferences.

The most significant contribution of this research comes in the form of its additions to scholarly bodies of knowledge. First, the study adds to the relatively limited body of knowledge on public procurement and specifically, supplier evaluation and selection in the public arena. Further, and of extreme value to the public transportation industry, this research represents the "seminal" work in a scholarly discourse on supplier evaluation and selection in the US public transportation industry.

1.5 Dissertation Organization

The organization of this dissertation is as follows. Section 2 presents a background on the US public transportation industry with specific focus on the vehicle market and vehicle suppliers for both conventionally and alternatively powered vehicles. Section 3 presents a literature review on supplier selection and supplier evaluation. Section 4 discusses the data sources, data collection procedures, model design, the procedure of data synthesis, and the methodological approach to achieving the objectives of this research. Section 5 presents the statistical and quantitative analyses utilized in analyzing the data related to the research objectives. Section 6 discusses the supplier evaluation and selection practice and policy implications based on the results of the data analyses. Section 7will summarize the important findings of the research study and suggest directions for future research and practice.

2. BACKGROUND

This section describes specific aspects of the US public transportation industry that pertain to this research. First, it provides a general description of the US public transportation industry's vehicle market and the vehicle supplier industry. Second, it provides a discourse on energy and environment issues related to public transportation and on the alternatively powered and fueled vehicle dynamics pertaining to the US public transportation industry.

2.1 Public Transportation Vehicle Market

Various types of buses and vans are utilized in the delivery of public transportation services. Based on its minimum service-life requirements, the FTA classifies buses and vans into five categories (Booz Allen Hamilton 2007). These categories are the heavy-duty large-bus category, the heavy-duty small-bus category, the medium-duty and purpose-built bus category, the light-duty mid-sized bus category, and the light-duty small bus, cutaway, and modified van category (Booz Allen Hamilton 2007).

2.1.1 Large Heavy-Duty Buses

Large heavy-duty buses have minimum service-life requirements of 12 years or 500,000 miles. They are commonly referred to as "12-year" buses in reference to their minimum service-life requirement of 12 years. Large heavy-duty buses have historically been "high-floor" vehicles. However, from the mid-90's they were also manufactured with "low-floors." They can be powered by a wide variety of propulsion systems including diesel, gas, CNG, electric, and hybrid technologies.

Most large heavy-duty buses are manufactured predominantly for use in the public transportation industry. Ninety-five percent of the large heavy-duty buses produced are done so for the public transportation industry (Booz Allen Hamilton 2007).They account for approximately seventy percent, or more, of the nation's public transportation bus fleet.[5] A significant proportion of the components used in the manufacturing of "12 year" buses are sourced from the heavy-truck market. Manufacturers of these buses include Gillig Corporation, Millennium Transportation, North American Bus Industries (NABI), New Flyer, Nova Bus, and Orion.

2.1.2. Small Heavy-Duty Buses

Accounting for approximately one percent of the nation's bus and van public transportation fleet, the minimum service-life requirements of vehicles in the small heavy-duty bus category are 10 years or 350,000 miles (Booz Allen Hamilton 2007). They are commonly referred to as "10-year" buses in reference to their minimum service-life requirement of 10 years. Many of the components that are used in the manufacture of these buses are sourced from the heavy-duty and medium-duty truck industry. The manufacturing process of "10 year" buses comprises the utilization of a stripped chassis made by a truck manufacturer like International, Freightliner, or GM, and then the addition of a body and additional components by a bus manufacturer like Blue Bird, Optima, and Thomas Built Buses. Some "10-year" bus manufacturers also manufacture vehicle chassis.

The market to which "10 year" buses belong is referred to as the "body-on-frame" market. In the "body-on-frame" market, small heavy-duty buses account for a very small proportion of production. Of the 600,000 "body-on-frame" vehicles manufactured yearly, only 200 to 300 are finished as "10 year" buses (Booz Allen Hamilton 2007). Other vehicles produced in the "body-on-frame" market include school

[5] Calculated based on the percentages given for the other bus and van classes in Booz Allen Hamilton (2007)

buses and motor homes. Manufacturers in the "body-on-frame" market include Blue Bird Corporation, Optima Bus, Supreme Corporation, and Thomas Built Buses.

2.1.3 Medium-Duty and Purpose-Built Buses

Medium-duty and purpose-built buses have minimum service-life requirements of 7 years or 200,000 miles. They are commonly referred to as "7-year" buses in reference to their minimum service-life requirement of 7 years. Medium-duty and purpose-built buses account for approximately two percent of the nation's bus and van public transportation fleet (Booz Allen Hamilton 2007). Utilizing parts from the trucking industry, their dual manufacturing process comprises the use of front-engine cab chassis, or stripped chassis, produced by a trucking manufacturer like International, Freightliner, or Workhorse, and then the addition of a body and components by a bus manufacturer like Champion, El Dorado National, or Goshen Coach. Of the 500,000 vehicles manufactured yearly for the medium-duty truck market, approximately 300 are finished as "7 year" buses (Booz Allen Hamilton 2007). Other vehicles produced by manufacturers in this market include airport and hotel courtesy vehicles, ambulances, moving vans, medium-sized trucks, and motor homes. Manufacturers include Cable Car Classics, Champion Bus, Eldorado National, Glaval Bus, Goshen Coach, Molly Corporation, Starcraft Automotive Corporation, Startrans, Supreme Corporation, and Trolley Enterprises.

2.1.4 Light-Duty Vehicles

Comprising of vehicular markets that overlap in many respects, light-duty vehicles, also known as "5-year" and "4-year" vehicles, comprise in excess of 20 percent of the nation's bus and van public transportation fleet. The minimum service-life requirements for these vehicles are 5 years or 150,000 miles and 4 years or 100,000 miles, respectively. Vehicles belonging to this category include modified minivans, full-size passenger vans, and buses built on cutaway van chassis. In providing public transportation service, many of the vehicles in this category are utilized in vanpooling, demand-response, and paratransit. Many light-duty vehicles are equipped with wheelchair lifts, ramps, and raised roofs, as is required by law,[6] through second stage modifications or initial manufacturer modifications.

Vehicles originally manufactured for the minivan market and then modified for the public transportation industry represent 3,000 of the 1.1 million minivans sold each year (Booz Allen Hamilton). Additionally, of the 370,000 cutaway chassis sold yearly, approximately 2,500 are modified for public transportation use. The manufacturers of light-duty vehicles can be divided into two groups: those selling vehicles and chassis directly and those modifying vehicles for public transportation use. Manufacturers who provide vehicles and chassis directly include Ford Motor Company, General Motors, and Daimler Chrysler which has since been split and the Chrysler division's majority owner is Fabbrica Italiana Automobili Torino (FIAT). Those manufacturers modifying vehicles for public transportation use include Braun Corporation, Champion Bus, Eldorado National, Girardin Corporation, Goshen Coach, Mid Bus, National Coach Corp, Starcraft Automotive Corporation, Supreme Corporation, Turtle Top, and Vision Point Mobility.

Table 2.1 displays information on the vehicles that belong to each of the FTA determined bus categories. The information includes lengths, weight, seating capacities, average costs, and minimum service-life year and mile requirements.

[6] The Americans with Disabilities Act (ADA) of 1990

Table 2.1 FTA Transportation Vehicle Categories

Bus Category	Vehicle Information				Minimum Service-Life Requirements (Attained First)	
	Length (ft)	Approx GVW (lbs)	Seating Capacity	Average Cost ($)	Years	Miles
Heavy-Duty Large Bus	35-48 60 (Articulated)	33,000-40,000	27-40	325,000-600,000	12	500,000
Heavy Duty Small Bus	30	26,000-33,000	26-35	200,000-325,000	10	350,000
Medium-Duty and Purpose-Built Bus	30	16,000-26,000	22-30	75,000-175,000	7	200,000
Light Duty Mid-Sized Bus	25-35	10,000-16,000	16-25	50,000-65,000	5	150,000
Light-Duty Small Bus, Cutaways, and Modified Van	16-28	6,000-14,000	10-22	30,000-40,000	4	100,000

Source: Booz Allen Hamilton (2007)

The FTA's most recent list, at the time of the conducting of this research, of public transportation bus and van manufacturers that are eligible to bid on contracts funded with FTA funds, for fiscal year 2010, is displayed in Table 2.2.

Pertaining to the acquisition of vehicles used in public transportation service, there are Federal laws and regulations that influence the way in which their procurement processes occur (Federal Transit Administration 2008). These requirements are in areas that include accessibility, transit vehicle manufacturer compliance with disadvantaged business enterprise (DBE) requirements, minimum service life, spare ratios, bus testing, in-state dealers, pre-award and post-delivery award review, Buy America, and air pollution and fuel economy, among others (Federal Transit Administration 2001).

Concerning accesibility, the major governing regulation is the Americans with Disabilities Act of 1990 (ADA). ADA stipulates that all vehicles used in the delivery of public transportation service be equipped to accomodate individuals with disabilities (49 CFR 38, 1998). These requirements result in vehicles being manufactured with low floors or being equipped with wheel chair lifts and ramps (Booz Allen Hamilton 2007).

The FTA requires that transit vehicle manufacturers (TVM's) provide certification that they have complied with the FTA's disadvantaged business enterprise requirements. These regulations are instituted to ensure non-discrimination and to create a level playing field in the award and administration of DOT funded contracts (49 CFR 26.1 2005).

The FTA enforces a minimum service-life policy that stipulates the minimum number of miles or years that vehicles purchased utilizing federal funds must be in service before being retired. Failure to adhere to the minimum service-life policy results in a financial penalty being levied against the non-compliant public transportation agency (Federal Transit Administration 2008).

The FTA also stipulates that a grant recipient, in forecasting anticipated vehicular needs, must not acquire an excessive amount of vehicles. This is enforced through the FTA's spare ratio requirements (Federal Transit Administration 2008).

When a new bus model, or an existing model that has been significantly altered, is to be purchased, the FTA requires the model be tested to determine if it meets FTA standards. The FTA's testing facility in Altoona, Pennsylvania, is the site at which bus model standards are tested (Federal Transit Administration 2008). Comprising seven components, the test assesses vehicles for maintainability, reliability, safety, performance, structural integrity, fuel economy, and noise levels.

The FTA also prohibits grant recipients limiting third-party bus procurements to in-state vehicle dealers. While the FTA respects state licensing requirements, it is prohibited by law from financially supporting bus procurements that source only from state licensed vehicle dealers (Federal Transit Administration 2008).

FTA stipulations require the conducting of pre-award and post-delivery audits when public transportation vehicles are to be purchased (Federal Transit Administration 2008). A pre-award audit is required of grantees prior to entering into a formal contract. It includes the grantee obtaining Buy America certification, the buyer's requirements certification, and, when applicable, a manufacturer's or vendor's Federal Motor Vehicle Safety Standards (FMVSS) certification. A pre-award audit may be conducted by a grantee, third party, or consultant.

A post-delivery audit is required prior to grantees receiving ownership titles to vehicles. Like a pre-award audit, it includes the grantee obtaining post-delivery Buy America certification, post-delivery buyer's requirements certification, and, when applicable, post-delivery manufacturer's or vendor's Federal Motor Vehicle Safety Standards (FMVSS) certification. A post-delivery audit may be conducted by a grantee, third party, or consultant.

Additionally, as part of a post-delivery audit, a resident vehicle inspector representing the recipient must be present throughout the vehicle manufacturing process to monitor manufacturing on site. At minimum, detailed records on all vehicle manufacturing activities and their alignment to contract specifications must be reported. Referred to as an in-plant inspection, the requirement does not apply to purchases of ten or fewer buses, to rural area service providers procuring twenty or fewer vehicles, or providers in urbanized areas of populations of 200,000 or fewer.

Table 2.2 Vehicle Manufacturers Eligible to Bid on FTA Funded Contracts FY'10

Manufacturer	Location
Accubuilt Inc.	Elkhart, Indiana
Alstom Transportation, Inc.	Hornell, New York
Ameritrans (TMC Group, Inc.)	Elkhart, Indiana
AnsaldoBreda SpA	Pistoia Italy
ARBOC Mobility, LLC	Middlebury, Indiana
Bombardier Inc.	Quebec, Canada
Braun Corporation	Winamac, Indiana
Brookville Equipment Corporation	Brookville, Pennsylvania
CAFUSA Inc.	Washington, DC
Champion Bus Inc/General Coach America, Inc.	Imlay City, Michigan
Coach & Equipment Manufacturing Corporation	Penn Yan, New York
Daimler Buses North America Inc	Mississauga, Ontario
Daimler Buses North Carolina LLC	Mississauga, Ontario
Design Line USA	Charlotte, North Carolina
Diamond Coach Corporation	Oswego, Kansas
Doppelmayr Cable Car America, Inc.	Cary, North Carolina
ElDorado National (California) (Kansas), Inc.	Riverside, California
Elkhart Coach	Elkhart, Indiana
Gillig Corporation, LLC	Haywood, California
Glaval Bus Division of Forest River, Inc.	Elkhart, Indiana
Goshen Coach, Inc.	Elkhart, Indiana
GulfTran, LLC	Nappanee, Indiana
Ilderton Conversion Company	High Point, North Carolina
Kawasaki Rail Car, Inc.	Yonkers, New York
Kinkisharyo International, L.L.C.	Palm Harbor, Florida
Leitner-Poma of America, Inc.	Grand Junction, Colorado
Midway Specialty Vehicles, LLC	Elkhart, Indiana
Mitsubishi Heavy Industries America, Inc.	New York, New York
Mobility Transportation Services	Canton, Michigan
Mobility Works	Arkron, Ohio
Molly Corporation	Wells, Maine
MotivePower, Inc. (A Webtec Company)	Boise, Idaho
Motor Coach Industries	Schaumburg, Illinois
Navistar, Inc	Melrose Park, Illinois
New England Wheels	Billerica, Massachusetts
New Flyer Industries Inc.	Winnipeg, Manitoba
North American Bus Industries, Inc.	Anniston, Alabama
Oregon Iron Works, Inc.	Clackamas, Oregon
Proterra LLC	Golden, Colorado
Siemens Industry Inc.	Sacramento, California
Starcraft Bus div. of Forest River, Inc.	Goshen, Indiana
Sumitomo Corporation of America	New York, New York
Supreme Corporation/Startrans Bus	Goshen, Indiana
Transportation Technology, Inc.	Yonkers, New York
Turtle Top	New Paris, Indiana
Vossloh Espana S.A.U.	Albuixech, Spain

Source: Federal Transit Administration(2009)

Buy America regulation stipulates that grantees that receive funds from the FTA ensure that when procuring vehicles at, or in excess of, $150,000, that each vehicle be comprised of more than sixty percent domestic parts and that the final assembly of the vehicle occur in the United States. More specifically, the cost of the vehicle's components that were produced in the United States must total more than sixty percent of the cost of all the vehicle's components. Buy America regulation is applicable to all, and any type, of vehicle procured utilizing federal funds, i.e., buses, vans, mini-vans, station wagons, or regular cars.

Pertaining to FTA requirements, vehicle purchasing contracts must include provisions that communicate a need to comply with EPA regulations like Control of Air Pollution from Mobile Sources (40 CFR Pt. 85), Control of Air Pollution from New and In-Use Motor Vehicles and New and In-Use Motor Vehicle Engines (40 CFR Pt. 86), and Fuel Economy of Motor Vehicles (40 CFR Pt. 600) (Federal Transit Administration 2008).

The following section discusses the environmental aspects of the US public transportation industry in more detail.

2.2 Transportation Vehicles and Alternative Fuels

Green public procurement (GPP) refers to the practice of governmental entities assigning high priority to environmental factors when making procurement and purchasing decisions. The intent of GPP practices is to facilitate reduction in the impact on human health, waste management, and the environment. In the US, the Environmental Protection Agency (EPA) has instituted its Environmentally Preferable Purchasing (EPP) initiative which has the objective of supporting environmentally preferable purchasing across the federal government. The need for environmentally preferable purchasing can be applied, and has been in varied measure, to the US public transportation industry.

The transportation sector produces various types of greenhouse gases (GHGs). Primary among these gases are carbon dioxide (CO_2), methane (CH_4), nitrogen oxide (NO), and hydrofluorocarbons (HFCs). Transportation, as a sector, accounts for five percent globally, and twenty-nine percent domestically in the US, of GHG emissions(Center for Climate Change and Environmental Forecasting, US DOT 2010). Further, carbon dioxide, as a product of fossil fuel combustion, accounts for 95 percent of transportation GHG emissions in the US (Center for Climate Change and Environmental Forecasting, US DOT 2010).

Various levels of government in the US, in recognition of the need to more closely regulate and manage GHG emissions from the transport sector, have implemented climate and environment related regulations, initiatives, and programs.

The FTA has collaborated with other organizations and has been integrally involved in the development of various public transportation industry-wide climate, energy, and environment focused studies, research, and plans. These include the Transit Cooperative Research Program's (TCRP) *Current Practices in Greenhouse Gas Emissions Savings from Transportation* study, the US DOT's *Transportation's Role in Reducing U.S. Greenhouse Gas Emissions* report, the *Moving Cooler* study, and the *Transportation Green Building Action Plan* (Federal Transit Administration 2010).

The FTA also manages various grant programs that directly support public transportation environment and environment related technology driven solutions and applications development. These programs include the Clean Fuels Grant Program (5308), the Bus and Bus Facilities (5309, 5318), the Transportation Cooperative Research Program (5313), the National Research & Technology Program (5314), and the Transportation Investments for Greenhouse Gas and Energy Reduction (TIGGER) program, among others. The Clean Fuels Grant Program (5308) has two objectives. Its first objective is to assist specific geographical areas in achieving and maintaining National Ambient Air Quality Standards for ozone and carbon monoxide. Its second objective is to support emerging clean fuel and advanced propulsion technologies for buses and vans and to support market development initiatives for such technologies. Funds received from the program may be used to purchase or lease clean fuel buses; to construct or lease clean fuel bus facilities or electrical recharging facilities and associated equipment; and to fund projects relating to clean fuel, biodiesel, hybrid electric, or zero emissions technology buses that exhibit emissions reduction capabilities that are equivalent or superior to existing clean fuel or hybrid electric technologies (Federal Transit Administration 2010).

Public transportation agencies have various options through which they can reduce GHG emissions. Key option areas include vehicle fuels and power sources, technology, and service operations (Gallivan and Grant 2010). Public transportation can play an integral role in facilitating meeting GHG reduction strategic goals by using alternative fuels, utilizing fleets consisting of alternatively powered vehicles, and by decreasing car trips through attaining higher ridership levels. Significant opportunities for GHG reductions exist for road-based transportation systems where approxiamately 80% of US transportation buses are powered by conventional diesel engines (Gallivan and Grant 2010). Alternative fuel and power sources that public transportation agencies may utilize in their vehicle fleets include compressed natural gas (CNG), liquefied natural gas (LNG), hybrid-diesel electric technology, gasoline-electric technology,fuel cell technology, biofuels, and various other power sources.

Compressed natural gas (CNG) and liquefied natural gas (LNG) combust more cleanly than diesel and gasoline. However, there are no documented GHG reduction benefits from CNG or LNG buses (Clark et al., 2007). This is due to the fact that total GHG emissions from a CNG or LNG bus are the same, on a per-mile basis, as that of a diesel bus. CNG has tended to be cost competitive with diesel; however, the infrastructure necessary to facilitate CNG usage requires more capital outlay (Clark et al., 2007). This infrastructure consists of high-pressure storage, compressors, and dispensors. However, given that infrastructure is established, the operating costs of CNG or LNG fleets can be less than that of other fuel propulsion systems. This is due to lower fuel and maintenance costs (Clark et al., 2007).

Powered by a combination of an internal combustion engine and an electric motor, hybrid-diesel electric and gasoline-electric vehicles are being considered more frequently by public transportation agencies. However, these buses cost significantly more than a conventional diesel or gasoline buses, e.g., approximately US $500,000 and $300,000 respectively (Clark et al., 2007). In addition to capital outlay, operating costs are increased, driven by the costs for battery maintenance and replacement. However, as battery technology develops, both capital outlay and operating costs should decrease, while performance and durability improve (Clark et al., 2007).

Fuel cells produce electricity through the conversion of chemicals. The most common process utilized by bus propulsion system developers is that of powering fuel cells with hydrogen. Though the basic technological aspects associated with hydrogen fuel cells are well understood, various technological, institutional, and cost factors hinder a more pervasive adoption of fuel cell technology by public transportation agencies. Due to these barriers, fuel cells are not yet commercially viable and most buses employing fuel cell technology are still significantly subsidized (IEA, 2002). However, it is worth noting that hydrogen fuel cells are forecasted by many to be the preferable bus propulsion system of the future (Clark et al., 2007).

Biofuels are being utilized more frequently by public transportation agencies. This increased use can be partially attributed to requirements of various municipalities that specific percentages of utilized diesel be derived from biomass sources (Biodiesel Magazine, 2008). There are various factors that can make the use of biodiesel either more or less compelling in practice. There is little difference in the capital or infrastructure costs required to operate a coventional diesel bus versus a bus utilizing biodiesel. This is because the only altered component is the fuel itself. However, fuel costs can be higher for buses utilizing B20, which comprises 20% biofuel and 80% diesel, and B20 has incrementally less stored energy compared to diesel fuel (Clark et al., 2007).

Other bus propulsion system technologies include propane systems which, though gaining popularity with some public transportation agencies, are more reluctantly adopted given that the supply of propane is limited (McCann, 2008). Another alternative fuel of interest is ethanol; however, it has not yet pervaded the US public transportation market.

The use of alternative fuels and power sources in public transportation vehicles has the potential to yield various benefits. These benefits, facilitated by reduced tailpipe emissions of air pollutants, include increased public health, reduced risk of soil and water contamination from diesel spills, and less noisy operations (US Department of Transportation 2006). An indirect benefit of adopting alternative fuels and power sources in public transportation fleets is increased energy security. This benefit accrues in the form of reduced reliance on imported petroleum, the reduction of risks associated with petroleum price volatility, and the mitigation of risks asscoiated with supply chain interruptions.

In conclusion, it has been determined that the public transportation vehicle market is fragmented in various ways. Two such ways are by vehicle category, determined by FTA defined life-and mileage-expectancy, and by vehicle fuel or power source. Additionally, the suppliers of vehicles represent a broad spectrum of manufacturers and dealers that cater to a wide scope of industries and customers. Accordingly, the choice of a vehicle and its supplier is an involving one. From amongst the available variety of vehicle suppliers, this research, as aforementioned, seeks to determine how these suppliers are evaluated and selected by public transportation agency procurement decision-makers. Based on this research objective, a comprehensive review of literature was conducted to investigate how suppliers are selected, what criteria are used when evaluating suppliers, and how these selection processes have been modeled. Findings are detailed in the following section.

3. LITERATURE REVIEW

This section details the findings of a review of literature that is focused on the main topic area of this research, supplier selection. Supplier selection is a key business and organizational function. Interest in it gained prominence in the 1960s with the seminal work of W.G. Dickson in 1966. Subsequently, various approaches and research methodologies have attempted to study supplier selection in various contexts, time periods, geographic locations, industries, and environments. The literature shows that various trends, principles, and models have been identified and developed in an attempt to better understand supplier selection and to capture and explain these purchasing trends, issues, and phenomena. These findings are detailed in this chapter.

The supplier evaluation and selection process may be defined as the process of finding the suppliers that are able to provide a prospective buyer with the right quality products or services, at the right price, in the right quantities, and at the right time (Mandal and Deshmukh 1994; Sarkis and Talluri 2002).

Generally considered a five-phase process, supplier selection comprises the realization of a need for a new supplier, the determination and formulation of the relevant evaluation criteria with which suppliers will be measured, the initial screening and development of a short-list of suppliers derived from a larger list, i.e., pre-qualification, the final selection of a supplier, and the continual evaluation and assessment of a selected supplier (de Boer and van der Wegen 2003).

The literature shows that several factors influence the supplier selection process. The first is the number of suppliers to be selected, which can be derived from the particular sourcing strategy employed by a firm. A firm may employ a single sourcing strategy where a single supplier is to be selected or may employ a multiple sourcing strategy through which numerous suppliers are selected. Further, sourcing strategies themselves differ based on various factors, including the minimum order quantity required, supplier capacity to fulfill orders, and the level of supplier competition required by the purchasing firm's policies.

Another factor that influences supplier selection is the type of product to be purchased. The type of product required will influence the criteria to be used in evaluating suppliers (Wilson 1994). In relation, Lehmann and O'Shaughnessy (1982) described four product types and the evaluation criteria most frequently used when procuring them. The results of their study are presented in Table 3.1.

Table 3.1 Importance of Selection Criteria Relative to Product Type

Product Type	Description	Important Criteria
Routine Order Products	Learning to use is easy and the functional capability of the product is not questioned	Reliable Delivery, Price
Procedural Problem Products	Learning to use is not easy (likely problems) but the functional capability of the product is not questioned	Service, Delivery
Performance Problem Products	The products ability to perform satisfactorily in the context of its environment of operation is questioned and doubted, especially from a technical perspective	Delivery, Service
Political Problem Products	Large capital outlays are required and decisions involve multiple decision-makers	Price, Reputation, and Product Reliability

Source: Lehmann and O'Shaughnessy (1982)

Table 3.1 communicates important information that can be used in substantiating the use of particular criteria in the evaluation of suppliers of particular types of products. For "Routine Order" products, because of familiarity with the product or service, delivery and price are important supplier criteria. "Procedural Problem" products or services, where there are challenges in learning how to use or utilize such products, require supplier service and delivery to be important criteria used when evaluating suppliers. "Performance Problem" products arise when the ability of a product to perform at expected standards, especially technically, in context of the environment in which it will be utilized, is questioned. As such, supplier delivery and service are deemed important supplier evaluation criteria. "Political Problem" products require that supplier price, reputation, and product reliability be important evaluation criteria given that, as products, they require relatively large capital outlays and the input of multiple decision-makers.

The type of manufacturing strategy utilized by a purchasing firm has also been found to influence supplier selection. The literature identifies three such manufacturing strategies. These manufacturing strategies are make-to-order (MTO), in which the purchasing firm's order is received prior to final assembly, make-from-stock (MFS), in which purchasing activities are executed based on anticipated customer orders, and make-to-stock (MTS), in which the final product is assembled in anticipation of customer orders (Cakravastia, Toha, and Nakamura 2002).

The location of a supplier is also an evaluation criterion used in supplier selection. Suppliers that are domestic, and if domestic in closer proximity, tend to be associated with purchasing processes that are less complicated than those associated with suppliers that are at farther distances or in another country.

The number of individuals or departments of a firm involved in the procurement decision-making process also influences supplier selection. The more individuals or departments involved, the more complicated the process and ability to arrive at a consensus becomes.

The literature identifies various factors that complicate the supplier selection process. These factors include the fact that supplier evaluation criteria may be qualitative, quantitative, or both, that there are often conflicts among and between evaluation criteria, that various alternatives may exist, and that there may be internal and external constraints imposed on the procurement process (de Boer, van der Wegen and Telgen 1998; Jayaraman, Srivastava and Benton 1999; Karpak, Kasuganti and Kumcu 1999; Karpak, Kumcu and Kasuganti 1999; Min 1994; Muralidharan, Anantharaman and Deshmukh 2001; Vokurka, Choobineh and Vadi 1996; Weber, Current and Desai 2000).

Supplier selection as a function generally requires the conducting of two tasks: which criteria should be used to evaluate suppliers and what method should be used to effectively compare suppliers. In tandem, research in supplier selection has been categorized into three general groups - the evaluation criteria used, the analytical methods utilized in developing decision support tools employed in addressing the selection problem, and the buyer-seller relationship (Sonmez 2006).

3.1 Supplier Selection Criteria

Works in the literature focused on the criteria used for evaluation in supplier selection have tended to approach the issue from one of three perspectives. The process of assigning the relative importance of, or weights to, evaluation criteria is the most commonly addressed issue. Another approach is to categorize evaluation criteria as being either critical, objective, or subjective (Houshyar and Lyth 1992). More recently, and interestingly, environmentally focused evaluation criteria have been incorporated into supplier selection studies. This trend can be attributed to the increased awareness and concern for the environment of organizational buyers (Humphreys, McIvor and Chan 2003; Humphreys, Wong and Chan 2003; Min and Galle, Green 1997; Noci 1997).

Research in the literature has examined the differences in the importance of evaluation criteria as a function of the buying decision-maker gender (Swift and Gruben 2000). Similarly, various studies have examined the influence of age, job experience, educational background, and race on supplier selection evaluation criteria level of importance (Aaronson, et al. 2004; Deng and Wortzel 1995; Hirakubo and Kublin 1998; Patton 1996).

Another factor that influences which evaluation criteria are utilized in selecting suppliers is an organization's size. Studies have shown that not only do larger organizations utilize a different set of evaluation criteria than those used by smaller organizations, but also that the formality of the process also varies in proportion to an organization's size (Pearson and Ellram 1995).

The work considered to be the seminal one in the area of supplier selection evaluation criteria was conducted by G.W. Dickson in 1966. The study was conducted using a survey that was distributed to approximately three hundred firms, the majority of which belonged to the manufacturing industry. The purchasing managers of sample firms were required to identify factors they deemed very important when selecting suppliers. Dickson's study provided 23 criteria that the purchasing managers ranked and did so in four unique, product-specific purchasing scenarios. Further, each of the study's respondents had to consider each of the four scenarios and rate the level of importance of each of the 23 provided criteria. The rating of criteria was done utilizing a scale of one to four, where four indicated extreme importance and zero indicated slight or no importance.

The result of the study reconfirmed a previous observation of Dickson, that price was not consistently ranked as the most important criteria in supplier evaluation and selection. Likewise, the relative ranking of various evaluation criteria changed as the buying situation and products were altered. Warranties, production capacity, and technical capacity, while deemed of critical importance for specific purchases, were deemed insignificant for others. Dickson concluded that a vendor's ability to meet quality standards (quality), their ability to deliver the product on time (delivery), and their performance history were the most important criteria when evaluating potential suppliers (Dickson 1966). However, Dickson offered some generalizations concerning the dynamics of the evaluation criteria used in supplier selection. These generalizations state that the level of complexity associated with a product or service being considered for purchase is directly proportional to the amount of evaluation criteria involved in the supplier selection process. In relation, the level of complexity associated with a product or service being considered for purchase is indirectly proportional to the level of importance the criteria of price will have on supplier selection, i.e., the amount paid becomes less important relative to product quality. Conversely, the less complex a product or service, the more influence the criteria of price will have on eventual supplier selection. Consequently, Dickson concluded that the nature of the product or service being sought for purchase is a major determinant of the type and number of criteria used in evaluating a potential supplier. It then follows that there is no unique combination of evaluation criteria that represent the panacea for all supplier selection problems. Tables 3.2, 3.3, and 3.4 show results from Dickson's 1966 study.

Table 3.2 Aggregate Criteria Ratings

Number	Factor	Mean	Relative Importance
1	Quality	3.508	Extreme Importance
2	Delivery	3.417	Considerable Importance
3	Performance History	2.998	
4	Warranties & Claims Policies	2.849	
5	Production Facilities and Capacity	2.775	
6	Price	2.758	
7	Technical Capability	2.545	
8	Financial Position	2.514	
9	Procedural Compliance	2.488	Average Importance
10	Communication System	2.426	
11	Reputation and Position in Industry	2.412	
12	Desire for Business	2.256	
13	Management and Organization	2.216	Average Importance
14	Operating Controls	2.211	
15	Repair Service	2.187	
16	Attitude	2.120	
17	Impression	2.054	
18	Packaging Ability	2.009	
19	Labor Relations Record	2.003	
20	Geographical Location	1.872	
21	Amount of Past Business	1.597	
22	Training Aids	1.537	
23	Reciprocal Arrangements	0.610	Slight Importance

Source: Dickson (1966)

Table 3.3 Criteria Most Commonly Used in Supplier Selection

Criteria	Percentage of Firms Utilizing the Criteria
Quality	96.6
Price	93.9
Delivery	93.9
Service	81.8
Technical Capacity	63.6
Financial Strength	51.5
Geographical Location	42.4
Reputation	42.4
Reciprocal Arrangements	15.1
Other Factors	12.1

Source: Dickson (1966)

Table 3.4 Importance of Criteria According to Product Situation

Rank	Situation A Paint	Situation B Desks	Situation C Computers	Situation D Art Work
1	Quality	Price	Quality	Delivery
2	Warranties	Quality	Technical Capability	Production Capacity
3	Delivery	Delivery	Delivery	Quality
4	Performance History	Warranties	Production Capacity	Performance History
5	Price	Performance History	Performance History	Communication System

Source: Dickson (1966)

Over the past four decades comprehensive reviews and research on supplier evaluation and selection have been conducted. Similar to, adding to, and in instances enhancing the work of Dickson, many are frequently cited in the literature. Notable among them are Weber, Current, and Brown (1991) where 76 articles published between 1966 and 1990 were analyzed and classified in reference to Dickson's 23 selection criteria; and Zhang, Lei, Cao, and Ng (2003) where 49 articles published between 1992 and 2003 were analyzed and reviewed according to Webster et al. (1991).

A study conducted by Cheraghi et al.(2004) entitled "Critical Success Factors for Supplier Selection: An Update" analyzed the changes in the relative importance of criteria identified in research between the period of 1966 to 1990 versus that of criteria identified in research between the period of 1990 to 2001. The authors reviewed 113 articles in total and presented the findings. Eighty-six, or 76% of the articles, utilized more than one criterion. This further substantiates the commonly held position that the supplier selection problem is a multi-criteria decision-making problem. The study indicates that increased competition, globalization, and the rapid development of Internet technology have altered the purchasing landscape. As a result, not only has the relative importance of existing evaluation criteria changed, but new evaluation criteria have been identified that are taking precedence over some evaluation criteria formerly considered to be more important in the supplier selection process (Cheraghi, Dadashzadeh and Subramanian 2004). Tables 7 and 8 show some results from the study.

The results displayed in Tables 3.5 and 3.6 reveal some points of interest. Notably, repair service, communication system, procedural compliance, and supplier financial position all experienced significant increases in relative importance. This may be attributed to a change in the nature of the way products and services are purchased, increases in regulations, environmental awareness, and buyer supplier relationships. Conversely, once extremely important criteria, such as geographical location, production facilities and capacity, and warranties and claims policies, have experienced significant declines in relative importance.

Table3.5 Criteria Comparison: 1966 to 1990 and 1991 to 2001

Factor	1966-1990		1990-2001		Overall	
	Papers	%	Papers	%	Papers	%
Quality	40	54%	31	79%	71	63%
Delivery	45	61%	30	77%	75	66%
Performance History	7	9%	4	10%	11	10%
Warranties & Claims Policies	1	1%	0	0%	1	1%
Production Facilities and Capacity	25	34%	10	26%	35	31%
Price	55	74%	26	67%	81	72%
Technical Capability	19	26%	11	28%	30	27%
Financial Position	8	11%	7	18%	15	13%
Procedural Compliance	2	3%	2	5%	4	4%
Communication System	3	4%	4	10%	7	6%
Reputation and Position in Industry	9	12%	1	3%	10	9%
Desire for Business	2	3%	0	0%	2	2%
Management and Organization	10	14%	7	18%	17	15%
Operating Controls	5	7%	0	0%	5	4%
Repair Service	7	9%	11	28%	18	16%
Attitude	9	12%	5	13%	14	12%
Impression	4	5%	2	5%	6	5%
Packaging Ability	5	7%	0	0%	5	4%
Labor Relations Record	3	4%	1	3%	4	4%
Geographical Location	15	20%	2	5%	17	15%
Amount of Past Business	1	1%	0	0%	1	1%
Training Aids	3	4%	0	0%	3	3%
Reciprocal Arrangements	3	4%	2	5%	5	4%

Source: Cheraghi, Dadashzadeh and Subramanian (2004)

Again, these occurrences may be attributed to the nature of goods or services being purchased, the enabling of technology to “nullify” the effect of distance, and the advent of just-in-time supply chains. However, it must be noted, as supported by the literature, that the relative importance of these criteria may vary substantially by industry or company.

Table 3.7, based on the study conducted by Cheraghi et al. (2004), illustrates the changing relative importance of evaluation criteria over time. Interestingly, evaluation criteria that were not listed in Dickson’s 1966 study have been developed and have emerged as important evaluation criteria in subsequent years (Cheraghi, Dadashzadeh and Subramanian 2004).

Table 3.6 Change in Relative Importance of Criteria

Criteria	Change in Importance: 1966 to 1990 vs. 1990 to 2001 (%)
Repair Service	198%
Communication System	153%
Procedural Compliance	90%
Financial Position	66%
Quality	47%
Management and Organization	33%
Delivery	26%
Reciprocal Arrangements	26%
Technical Capability	10%
Performance History	8%
Attitude	5%
Impression	-5%
Price	-10%
Production Facilities and Capacity	-24%
Labor Relations Record	-37%
Geographical Location	-75%
Reputation and Position in Industry	-79%
Warranties & Claims Policies	-100%
Desire for Business	-100%
Operating Controls	-100%
Packaging Ability	-100%
Amount of Past Business	-100%

Source: Cheraghi, Dadashzadeh and Subramanian (2004)

The dynamics behind the changes in relative importance of supplier selection evaluation criteria, and the emergence of others, can be attributed to numerous socio-economic, business, and environmental trends, some of which have been discussed earlier. The authors also note that the emergence of the Internet has made both e-commerce and e-procurement capacity and capability very important additions to supplier selection criteria. A Purchasing Magazine survey observed that most industrial purchasing and supply professionals credit the Internet as a tool that can save sourcing time, efficiently locate new suppliers, reduce costs, improve communication, assist with tracking supplier performance, and facilitate the increased allocation of time to more value-added work (Cheraghi, Dadashzadeh and Subramanian 2004).

Since Dickson's seminal work in 1966 on vendor selection criteria and evaluation, significant political, economic, social, and technological developments have occurred. These have had an indelible impact on the way businesses operate and as a result the way the organizational purchasing function is carried out.

The relative importance of quality, delivery, price, and service has altered over time (Bharadwaj 2004; Lehmann and O'Shaughnessy 1974; Matthyssens and Faes 1985).

Though evaluation criteria like quality, delivery, price, and service are considered significant, a buying organization's level of control over them is dependent on organization factors, the buying situation, and the individuals making the buying decision (Bharadwaj 2004; Robinson, Faris and Wind 1967; F. Webster 1965).

After Dickson's 1966 work, a study conducted by Weber et al. (1991) reveals that between the years 1966 to 1991 significant focus was on Just-in-Time production and delivery systems and, as such, supplier selection criteria were heavily weighted with that objective in mind. After 1991, the concept of supply chain management emerged and has become the predominant approach, in most cases, on which purchasing function activities are predicated (Zhang, et al. 2003).

Table 3.7 Previous and Current Ranking of Supplier Selection Criteria

Current Rank	Previous Rank	Criteria
1	3	Quality
2	2	Delivery
3	1	Price
4	10	Repair Service
5	5	Technical Capability
6	4	Production Facilities and Capacity
7	9	Financial Position
8	7	Management and Organization
9	New	Reliability
10	New	Flexibility
11	8	Attitude
12	13	Communication System
13	10	Performance History
14	6	Geographical Location
15	New	Consistency
16	New	Long-Term Relationship
17	14	Procedural Compliance
18	12	Impression
19	13	Reciprocal Arrangements
20	New	Process Improvement
21	New	Product Development
22	New	Inventory Costs
23	New	JIT
24	New	Quality Standards
25	New	Integrity
26	New	Professionalism
27	New	Research
28	New	Cultural
29	8	Reputation and Position in Industry
30	13	Labor Relations Record
Passé	11	Operating Controls
Passé	11	Packaging Ability
Passé	13	Training Aids
Passé	14	Desire for Business
Passé	15	Amount of Past Business
Passé	15	Warranties & Claims Policies

Source: Cheraghi, Dadashzadeh and Subramanian (2004)

The increase in the significance of supplier financial position as a criterion over the past four decades can be attributed to the propensity of buyers to want to form deepened relationships, with their suppliers, which enhance supply chain efficiency, profitability, and cost management. The decline in the significance of geographical location as a criterion is rooted in the fact that economic globalization has resulted in global sourcing and, as a result, facilitated through improved global logistics, distance is not as much of an impediment as it was previously. The advent of the Internet, coupled with an increased desire for information sharing between buyers and suppliers, has led to the growth in significance of communication systems as a supplier selection criterion (Zhang, et al. 2003).

It is important to note that post Dickson's 1966 seminal work based on 23 criteria used in vendor selection, additional criteria have been identified and used in supplier selection analyses. Though their relative ranking between each other has changed intermittently over the years, price, quality, and delivery have consistently remained the three most important criteria utilized when evaluating potential suppliers. Specific to these three criteria, price has experienced the most changes. This can be due to the various ways in which it has been defined.

Whereas Dickson in his 1966 study defined price as the price offered by the vendor including discounts and freight charges, more recent studies have altered its definition. In some instances various cost derived criterion replaced that of price. It has been divided into fixed cost, design cost, supplier cost, inventory holding cost, fixed ordering cost, quality cost, technology cost, and after-sales service cost (Current and Weber 1994; Gupta and Krishnan 1999; Tempelmeier 2002; Bhutta and Huq 2002). Additionally, the total cost of ownership (TCO), a management philosophy that seeks to determine the cost of owning an asset through its entire life-cycle, has become a significant criterion in supplier selection (Bhutta and Huq 2002).

Dickson defined quality as a supplier's ability to consistently meet quality specifications (Dickson 1966). In papers subsequent to Dickson's, quality has included compliance to the ISO9001 system (Lee, Lee and Jeong 2003) and inspection, experimentation, and quality staff (Choy and Lee 2002).

Delivery, as defined by Dickson, is a supplier's ability to meet specific delivery schedules. Though this remains the most frequent definition, its meaning has evolved to include freight terms (Min 1994), lead time (Youssef, Zairi and Mohanty 1996), delivery capacity (Karpak, Kasuganti and Kumcu 1999), shipment quality (Choy and Lee 2002,2003), and cycle time and just-in-time delivery capability (Bevilacqua and Petroni 2002).

More recently developed supplier evaluation criteria include reliability, flexibility, consistency, long-term relationship, process improvement, product development, inventory costs, just-in-time, quality standards, integrity, professionalism, research, and cultural (Cheraghi, Dadashzadeh and Subramanian 2004). Further, Zhang, et al.(2003) describe additional definitions for three of the newly developed criteria: product design and development, flexibility, and relationship.

Product design and development, as a criterion, has been altered to include design capability (Pearson and Ellram 1995; Chan 2003), product development and improvement (Choy and Lee 2002,2003), and commitment to continuous improvement (Kannan and Tan 2003).

As a criterion, flexibility has included general flexibility (Masella and Rangone 2000), responsiveness to customer needs (Mummalaneni, Dubas and Chao 1996), response to changes and process flexibility (Ghodsypour and O'Brien 1998), flexibility in change order (Verma and Pullman 1998), flexibility of response to customers' requirements (Bevilacqua and Petroni 2002), quota flexibility (Kumar, Vrat and Shankar 2003), and the ability to respond to unexpected demand, i.e., reverse capacity (Kannan and Tan 2003).

In terms of relationship being utilized as a criterion, in a Mummalaneni, Dubas and Chao (1996) study, Chinese purchasing managers' preferences and trade-off practices in supplier selection and evalution were analyzed in terms of the level of quality of relationship they had with their respective suppliers. The role of past and current relationships with suppliers and their effect on supplier selection were also studied, especially the willingness to share information (Kannan and Tan 2003).

It should be noted that the increased awareness of environment and energy issues has resulted in the inclusion of environmental criteria in the supplier evaluation and selection process (Min and Galle 1997; Noci 1997; Humphreys, McIvor and Chan 2003; Humphreys, Wong and Chan 2003; Tuzkaya, et al. 2009).

Recognizing the fact that purchasing strategies often neglect environmental impacts, Min and Galle (1997) conducted an empirical study that sought to identify the environmental factors that had the potential to reshape supplier selection decisions. The study comprised a survey of members of the National Association of Purchasing Management (NAPM). A major finding of the study was that purchasing strategies seemed to be "reactive" in that they are only instituted when stipulated by regulation as opposed to being proactively integrated into long-term corporate policy.

Noci (1997), while highlighting the growing interests of many organizations in the area of integrating environmental factors into supplier relationships, admonishes that work had not yet existed in developing decision-support systems that could assist in selecting the best supplier from an environmental perspective. Noci proceeds to first design a conceptual approach to identifying metrics for evaluating supplier environmental performance and, second, to suggest techniques for conducting such evaluations.

In developing a knowledge-based system (KBS) that integrated environmental factors into the supplier selection process, Humphreys, McIvor, and Chan (2003) utilized both cased-based reasoning (CBR) and multi-attribute analysis (MAA). The study was developed based on an analysis of the environmental management practices of various companies as well as information sourced from an extensive literature review. Components of the framework presented in the study that were deemed important were computerized utilizing KBS techniques.

Humphreys, Wong, and Chan (2003) developed a decision-support tool that facilitates companies intergating environmental criteria into the supplier selection process.

In considering both the direct and indirect environmental issues in supplier selection, Tuzkaya, et al. (2009) utilize fuzzy-analytical and fuzzy-preference models by which suppliers' environmental performance can be quantified.

In addition to identifying and ranking supplier selection evaluation criteria, another category under which research addressing supplier selection problems and issues is classified is that of the decision methods and tools utilized in supplier selection evaluation.

3.2 Supplier Selection Evaluation Methods

Quantitative approaches to the supplier selection problem can belong to either of three categories. These categories are linear weighted models, mathematical programming models, and statistical and probabilistic approaches (Weber, Current, and Benton 1991). Additionally, other various types of methods are employed including hybrids and combinations of the aforemetioned methods (Ghodsypour and O'Brien 1998).

3.2.1 Linear-Weighted Models

Linear weighted models employ methods that facilitate the assignment of a weight to each criterion being considered in a supplier selection problem. These weights are, generally, subjectively determined and are used in determining a supplier's aggregate score. More specifically, a supplier's score in a given criteria category is multiplied by the weight assigned to that category, the products in all criteria categories are then totaled to arrived at a score for the supplier. One of the most commonly used linear weighted methods in the supplier selection problem is the Analytic Hierarchy Process (AHP). AHP is a "modern multi-criteria decision making method" which provides a framework to address multiple criteria problems (Saaty 1994).

The AHP, in general, facilitates the structuring of a problem to comprise an objective or goal, criteria, sub-criteria, and alternatives of choice. The weighting of criteria is determined through structured comparison and alternatives are then compared against the criteria for evaluation – which results in a score for each alternative.

Another linear weighted model that has been utilized for the supplier selection problem is the interpretive structural modeling technique (ISM). ISM identifies and summarizes relationships among factors and develops the structural model of the problem (Mandal and Deshmukh 1994). Utilizing another linear weighted method to determine the relative weights of criteria, Min (1994), used the multi-attribute utility approach to the international supplier selection problem. Fuzzy expert systems and combined scoring methods have also been used in studying the selection of suppliers (Kwong, Ip and Chan 2002).

Linear weighted modeling methods are not without limitations and shortcomings. Three of these limitations and shortcomings are commonly referred to in the literature. The first shortcoming is that models like the AHP and ISM are based on the subjectivity and opinion of decision-makers (Zhang, et al. 2003). Second, when additional criteria are introduced into such models, reclassification and modification are a necessity (Bevilacqua and Petroni 2002). Third, linear weighted models do not facilitate analysis in scenarios where multiple suppliers are required or desirous.

3.2.2 Mathematical Programming Models

Mathematical programming models are employed to facilitate optimization. Further, they are employed as a means of selecting suppliers while simultaneously needing to maximize or minimize an objective function that is subject to either buyer or supplier constraints. The objective function of these optimization models may be single criterion, where a classical optimization method is used, or multiple criteria, where goal programming or multi-objective programming is utilized (Lee, Lee and Jeong 2003).

One of the most comprehensive reviews of the supplier selection literature found that one of the most commonly utilized mathematical programming methods when modeling supplier selection is single-objective or multi-objective mixed integer programming (Zhang, et al. 2003). In a study that used multi-objective mixed integer programming, Weber and Current (1993) minimized the total purchase price, late deliveries, and rejected units. To minimize the costs associated with vendor selection with price breaks, Chaudry et al. (1993) utilized linear and mixed binary integer programming. Rosenthal et al. (1995) developed a buyer's purchasing strategy to minimize total cost using mixed integer linear programming. Their model was further developed by Sarkis and Semple (1999).

The reduction in complexity of a product family through product design was facilitated through integer programming – minimizing design, procurement, and a usage cost was the objective of a study by Gupta and Krishnan (1999). Taking into account total logistics costs, which comprised net price, storage, transportation, and ordering costs, a multiple sourcing problem was solved utilizing a mixed integer non-linear programming model. The model instituted constraints related to service, quality, and budget (Ghodsypour and O'Brien 1998). In a study that optimized, under dynamic demand conditions, the supplier selection and purchase order sizing for a sole item, a mixed integer linear model was formulated (Tempelmeier 2002). With price, delivery, and quality being the preferred criteria of the buyer, and the capacity of vendors being the constraint, Dahel (2003) developed a multi-objective mixed integer program to determine both the number of suppliers to select and the order quantities attributable to each from a multi-product and multi-supplier perspective.

Another mathematical programming method employed in solving supplier selection problems is data envelopment analysis (DEA). Where the existence of multiple variables for both input and output make comparison challenging, DEA assesses the comparative efficiencies of decision-making units. It is a non-parametric method that facilitates the measurement of efficiency in the absence of the form of the production function or variable weights. DEA defines a non-parametric frontier that is used as the reference point for efficiency measurements (Braglia and Petroni 2000). DEA has been applied in numerous instances to the supplier selection problem. See Weber, Current and Desai (1998), Braglia and Petroni (2000), and Liu, Ding and Lall (2000) for examples.

For a vendor selection problem comprising three objectives – minimize net costs, minimize net rejections, and minimize net late deliveries subject to numerous constraints. Due to the fact that some parameters were fuzzy in nature, a fuzzy mixed integer goal programming model was used (Kumar, Vrat and Shankar 2003).

As a method used in addressing supplier selection problems, mathematical programming models facilitate the use of numerous constraints and are more prone to represent, due to their dynamic nature, the current buyer environment. Additionally, mathematical programming models facilitate the analysis and selection of multiple suppliers. However, the literature notes two main issues with mathematical programming models – both impeding their practicality. First, mathematical programming models accommodate and use quantitative criteria only. Second, in many instances industry managers find the user-friendliness too complex to be practical (Zhang, et al. 2003).

3.2.3 Statistical Models

Zhang, et al.(2003) noted three studies in which statistical approaches were taken in analyzing and solving supplier selection problems. In studying the preferences and trade-offs considered by Chinese purchasing managers in supplier selection and evaluation, conjoint analysis was used (Mummalaneni, Dubas and Chao 1996). Discrete choice analysis was used to examine supplier choice by Verma and Pullman (1998). Tracey and Tan (2001) used factor analysis to analyze relationships among varied supplier selection evaluation criteria.

3.2.4 Other Models

Other methods that have been applied to the supplier selection problem include the activity based costing approach (ABC) (Roodhooft and Konings 1996), total cost of ownership (TCO) (Degraeve, Labro and Roodhooft 2000), and transaction cost theory (Qu and Brocklehurst 2003). Table 3.8 represents a compilation of the methods used in addressing the supplier selection problem throughout the literature.

In a research report that discusses the state of the art as it relates to the supplier selection problem, Benyoucef, Ding and Xie (2003) describe the various types of selection criteria, issues, and challenges concerning the selection of suppliers, and a description of the methods used in solving supplier selection problems. The authors divide the methods used in the supplier selection problem into three general categories: elimination methods, optimization methods, and probabilistic methods (Benyoucef, Ding and

Xie 2003). Benyoucef et *al.* (2003) discuss the various advantages and disadvantages associated with the various methods used in solving the supplier selection problem. Table 3.9 is adopted from the Benyoucef *et al.* (2003) study.

Additions to the body of knowledge in supplier selection have been consistent since its advent as an important component of the procurement business function. However, the focus of the research in this area has been relatively imbalanced. Most of the research in supplier selection has been focused on private enterprise and much less on public sector purchasing.

Further, while public sector purchasing and procurement has received some focus, to date, no literature exists that focuses specifically on the modeling of the vehicle supplier selection processes of publicly funded transportation agencies in the US. Therefore, building on the existing public procurement literature and simultaneously generating exploratory work in supplier selection in the US public transportation industry, this research intends to garner a deeper understanding of the way in which vehicle suppliers are evaluated by public transportation agency procurement decision-makers, to determine which supplier attributes are deemed most important relative to others, to determine whether these supplier attributes are deemed most important as a function of decision-maker or organizational factors, and to determine the probability, through discrete choice modeling, of a specific supplier being chosen as a function of its attribute level combinations. The intended audience of this research includes public transportation policy makers, public transportation agency personnel, vehicle suppliers, and researchers in the academic community.

Table 3.8 Quantitative Methods Used for Evaluation in the Supplier Selection Problem

Category	Method	Literature
Multi-Criteria Decision Making	Analytic Hierarchy Process	(Akarte, et al. 2001), (Barbarosoglu and Yazgac 1997), (Bhutta and Huq 2002), (Ghodsypour and O'Brien 1998), (Muralidharan, Anantharaman and Deshmukh 2001), (Nydick and Hill 1992), (Sarkis and Talluri 2002), (Tan and Tummala 2001), (Wang, Huang and Dismukes 2004), (Yahya and Kingsman 1999)
	Outranking Methods	(de Boer, van der Wegen and Telgen, 1998), (Dulmin and Mininno 2003)
	MAUT	(Fonseca, Uppal and Greene 2004), (Min 1994)
	Linear Weighted Point	(Muralidharan, Anantharaman and Deshmukh, 2002)
	Judgmental Modeling	(Da Silva, Davies and Naude 2002), (Naude and Lockett 1993)
	Interpretive Structural Modeling	(Mandal and Deshmukh 1994)
	Categorical Method	(Houshyar and Lyth 1992)
	Fuzzy Sets	(Wu 1990)
	Total Cost Based Approaches	(Atkinson 2004), (Bahli and Rivard 2003) (Berger and Zeng 2005) (Bhutta and Huq 2002) (deBoer, van Dijkhuizen and Telgen 2000) (Degraeve, Labro and Roodhooft 2000) (Degraeve, Labro and Roodhooft, 2004) (Degraeve and Roodhooft, 1998) (Degraeve and Roodhooft, 1999) (Degraeve and Roodhooft, 1999) (Degraeve, Roodhooft and van Doveren, 2005) (Peng and York 2001) (Qu and Brocklehurst 2003) (Roodhooft and Konings 1996) (Youssef, Zairi and Mohanty 1996) (Smytka and Clemens 1993)

Table 3.8 (Continued)

Category	Method	Literature
Mathematical Programming	Non-Linear Programming	(Ghodsypour and O'Brien, 2001)
	Mixed Integer Programming	(Cakravastia, Toha and Nakamura 2002) (Degraeve, Roodhooft and van Doveren, 2005) (Jayaraman, Srivastava and Benton 1999)
	Linear Programming	(Ghodsypour and O'Brien 1998) (Ghodsypour and O'Brien, 2001) (Yan and Wei 2002)
	Integer Programming	(Feng, Wang and Wang 2001) (Gupta and Krishnan 1999)
	Heuristics	(Akinc 1993) (Basnet and Leung 2005) (Ganeshan, Tyworth and Guo 1999) (Tempelmeier 2002)
	Goal Programming	(Dowlatshahi 2001) (Karpak, Kasuganti and Kumcu 1999) (Karpak, Kumcu and Kasuganti,1999) (Wang, Huang and Dismukes 2004)
	Data Envelopment Analysis	(Braglia and Petroni 2000) (Liu, Ding and Lall 2000) (Weber, 1996) (Weber, Current and Desai, 1998) (Weber, Current and Desai 2000)
	Structural Equation Modeling	(Lin, et al. 2005) (Tracey and Tan 2001)
Multivariate Statistical Analysis	Principal Component Analysis	(Petroni and Braglia 2000)
	Factor Analysis	(Krause, Pagell and Curkovic 2001) (Tracey and Tan 2001)
	Confidence Interval Approach	(Muralidharan, Anantharaman and Deshmukh 2001)
	Neural Networks	(Choy, Lee and Lo, 2002) (Choy, Lee and Lo, 2004)

Table 3.8 (Continued)

Category	Method	Literature
Artificial Intelligence & Expert Systems	Case-Based Reasoning	(Choy, Lee and Lau, et al. 2005) (Choy, Lee and Lo, 2002) (Choy, Lee and Lo, 2002) (Choy, Lee and Lo, 2003) (Choy, Lee and Lo, 2003) (Choy, Lee and Lo, 2004) (Choy, Lee and Lo, 2004) (Humphreys, McIvor and Chan 2003)
	Bayesian Belief Networks	(Kreng and Chang 2003)
	Group Decision Making	(Han and Ahn 2005) (Mandal and Deshmukh 1994) (Muralidharan, Anantharaman and Deshmukh 2001) (Muralidharan, Anantharaman and Deshmukh, 2002) (W. Patton 1997) (Patton, Puto and King, 1986) (Tan and Tummala 2001) (Yan and Wei 2002)
Others Methods	Multiple Methods	(Akinc 1993) (Bhutta and Huq 2002) (Degraeve, Roodhooft and van Doveren, 2005) (Ghodsypour and O'Brien 1998) (Muralidharan, Anantharaman and Deshmukh 2001) (Wang, Huang and Dismukes 2004) (Weber, Current and Desai, 1998) (Weber, Current and Desai 2000)

Table 3.9 Advantages and Disadvantages of Utilized Supplier Selection Methods

<table>
<tr><th colspan="3">Methods</th><th>Advantages</th><th>Disadvantages</th></tr>
<tr><td colspan="3">Elimination</td><td>Fast

User friendly

Considers subjective criteria</td><td>Final decision not made based on aggregate criteria score

Doesn’t accommodate constraints</td></tr>
<tr><td rowspan="4">Optimization</td><td rowspan="2">Not Subjects to Constraints</td><td>Multi-Criteria</td><td>User friendly

Considers both subjective and objective criteria</td><td>Relies on human judgment

Doesn’t accommodate constraints</td></tr>
<tr><td>Oriented Cost</td><td>Objective method</td><td>Does not consider subjective criteria</td></tr>
<tr><td rowspan="2">Subject to Constraints</td><td>Single-Objective</td><td>Facilitates an optimal solution

Accommodate multiple constraints</td><td>Does not consider subjective criteria

Complex in management use</td></tr>
<tr><td>Multi-Objective</td><td>Facilitates multiple optimal solutions

Accommodate multiple constraints</td><td>Complexity in considering subjective criteria

Complex in management use</td></tr>
<tr><td colspan="2">Probabilistic</td><td>Facilitates the analysis of the risk associated with supplier behavior</td><td colspan="2">Doesn’t facilitate an optimal solution

Complexity in interpreting results

Doesn’t accommodate constraints</td></tr>
</table>

Source: Benyoucef, Ding and Xie (2003)

4. METHODOLOGY

This chapter comprises five sections and outlines the methodology utilized in addressing each of the eight expressed research sub-objectives. The first section describes the approach utilized in the research design. The second section describes the population and sample used in the study. The third section describes the variables used, where necessary, in the respective research sub-objectives. The fourth section describes the data collection procedures utilized in the research. The final section, section five, describes the analytical techniques and models utilized in the research.

4.1 Research Design

To a significant extent, this research is exploratory in nature. Exploratory research arises due to the need to better understand a problem or issue for which limited information exists or which no prior studies have addressed. In this instance the exploratory nature of the study exists due to the fact that, up to the point of conducting the literature review, there was no existing record of literature analyzing the vehicle supplier selection process as exercised by procurement decision-makers at US public transportation agencies. An empirical study employing both statistical and econometric analysis was designed and utilized in addressing the research objectives.

4.2 Research Population and Sample

The following sections give descriptions of the population and sample studied in this research.

4.2.1 Research Study Population

The population that was observed in this research was that of the personnel of federally funded, not-for-profit agencies that provide public transportation service in the US. These individuals were directly responsible for, or had job responsibilities that entailed, making procurement and purchasing decisions regarding buses and vans. These individuals are referred to as procurement decision-makers throughout this research. The research population comprised managers and personnel in the procurement, purchasing, supply, and contracts departments of public transportation agencies. However, due to the nature of the US public transportation industry, individuals making purchasing decisions regarding buses and vans were also employed in the operations, engineering, planning, and finance departments of public transportation agencies. Further, in various instances, bus and van procurements are conducted by state agencies, most often State Departments of Transportation (DOTs). As a result, the research population also included procurement decision-makers from state DOTs.

4.2.2 Research Study Sample

Both single-staged and multi-staged sampling techniques were used as sampling methods in this research. Single-stage sampling was used to directly contact and sample procurement decision-makers from within the population and was facilitated by the use of the public transportation agency executive directory available on the Federal Transit Administration's (FTA) website and by state public transportation agency executive management directories available for public record.

Multi-stage sampling is used when groups or organizations within the population, called clusters, are initially sampled and subsequent sampling of individuals within these clusters occurs (Babbie 1990, Fink and Kosecoff 1985). Various groups and organizations within the US public transportation industry were contacted and asked to provide member contact information as a means to subsequent sampling. The groups and organizations that were contacted included the American Public Transportation Association's

Procurement and Materials Management Committee, the Community Transportation Association of America, and the National Transit Institute.

APTA's Procurement and Materials Management Committee, a key source of individuals in the sample, comprises public transportation procurement, purchasing, and supply professionals that are concerned with various aspects of public transportation procurement including procurement methods, life-cycle cost evaluations, terms and conditions, bond requirements, federal procurement requirements and, central to this study, the relationship between buyers and suppliers of transportation equipment, materials, and services. The committee is also involved in the development of industry-wide procurement standards.

The Community Transportation Association of America (CTAA) is an association comprised of organizations and individuals who are involved in the creation of mobility solutions in the US. A major component of CTAA's activities involves the provision of technical assistance to member organizations, predominantly small-urban and rural public transportation providers. Procurement, and specifically the procurement of vehicles, is included among the various facets of technical assistance provided by the CTAA.

The National Transit Institute (NTI) provides training, support, and clearinghouse services to the US public transportation industry. The individuals sampled through NTI were public transportation agency procurement decision-makers that participated in prior NTI procurement workshops.

Sampling from the members of the aforementioned organizations facilitated a sample from a wide scope and variety of procurement, purchasing, and supply professionals, one that was representative of the US public transportation industry. Further, this facilitated an adequate measure of stratification in the research sample. Stratification was required due to the fact that the US public transportation industry comprises agencies that operate in urbanized areas, 50,000 or more in population, and non-urbanized areas, less than 50,000 in population.[7] This factor results in agencies having unique characteristics that include fleet size, number of employees, service-area size, agency infrastructure, types of services provided, and capital funding levels. Therefore, sample stratification was necessary to capture as complete as possible a representative sample of the procurement decision-makers, and the agencies they represent, across the US public transportation industry.

The research sampling process was guided by two requirements. First, for an individual to have been included in the sample they had to be employed by a federally funded, not-for-profit organization that provided public transportation services. Second, all individuals sampled in the study were selected through random sampling.

[7] The FTA , in various of its grant programs, classify agencies as being in Urbanized or Non-Urbanized areas

4.3 Research Variables

In conducting this research, groups of variables were identified and used as either dependent or independent variables in statistical and discrete choice analyses.

A comprehensive list of 31 variables that could have been potentially used was developed by referring to existing literature on supplier evaluation and selection.[8] Various supplier attributes, or evaluation criteria, are consistently used as variables in supplier selection research and were identified in Dickson (1966), Cheraghi, Dadashzadeh and Subramanian (2004), and Zhang, Lei, Cao, and Ng (2003). The comprehensive list of 31 attributes was then reduced by a panel of public transportation industry experts to the 10 most relevant and important. The expert panel consisted of public transportation agency executives, retired procurement executives, senior management consultants, and public transportation specialists in academia. The 10 chosen attributes were used as dependent variables in the statistical analyses of the research and five of them were used as independent variables in the discrete choice analyses. Table 4.1 displays the comprehensive supplier attribute list that was ranked by the public transportation industry expert panel.[9] Table 4.2 displays the 10 supplier attributes deemed to be the most relevant and important by the public transportation industry expert panel.

To facilitate aspects of the quantitative analyses and statistical tests in the research, factors that were thought to have an influence on the perceived levels of importance of the 10 selected supplier attributes were identified and chosen to be independent variables.

[8] This list was adopted, with some attribute exclusion, from Cheraghi et al., (2004)
[9] Each attribute score is calculated as an average of summed scores for that attribute as scored by the experts

Table 4.1 Supplier Attribute List Ranked by Public Transportation Industry Experts

Vehicle Supplier Attributes	Rank	Score
Quality	1	9.57
Reliability	2	9.29
Integrity	3	9.00
Delivery	4	8.86
Performance History	5	8.86
Technical Capability	6	8.86
Price	7	8.29
After-Sales-Support	8	8.00
Professionalism	9	7.86
Procedural Compliance	10	7.57
Repair Service	11	7.57
Warranties and Claims Policies	12	7.43
Management and Organization	13	7.43
Financial Position	14	7.29
Production Facilities and Capacity	15	7.14
Environment Position/Compliance	16	7.00
Reputation and Position in Industry	17	7.00
Consistency	18	7.00
Inventory Costs	19	6.71
Training Aids	20	6.57
Flexibility	21	6.57
Attitude	22	6.43
Communication System	23	6.43
Amount of Pass Business	24	6.00
Impression	25	5.86
Product Development	26	5.71
Labor Relations Record	27	5.71
Desire for Business	28	5.43
Long-Term Relationship	29	5.43
Cultural	30	5.43
Geographic Location	31	4.43

Table 4.2 Dependent Variables Used in Research Analyses

Dependent Variable	Variable Name (Supplier Attributes)	Variable Definition
y_q	Quality	A supplier's ability to reduce variation in preferred vehicle standards of design and performance
y_d	Delivery	A supplier's ability to meet a preferred date of vehicle availability
y_p	Price	A supplier's offering price for a vehicle
y_{tc}	Technical Capability	A supplier's understanding and expertise concerning vehicle engineering, technology, design, and operation
y_r	Reliability	A supplier's dependability to meet order requirements
y_{ph}	Performance History	A supplier's previous track record in areas important to the buyer
y_{pc}	Procedural Compliance	A supplier's adherence to stipulated regulatory and buyer procedural requirements
y_{as}	After-Sales-Support	A supplier's provision of additional services after the sale of a vehicle e.g. technology support, data-management
y_{int}	Integrity	A supplier's adherence to ethical principles e.g. honesty
y_{wc}	Warranties & Claims Policies	A supplier's guarantee, without charge, that any vehicle or vehicle component not meeting predetermined performance standards will be replaced or repaired

The selected independent variables belonged to either of two factor categories: agency factors or procurement decision-maker factors. The agency factors included geographic region, as defined by the FTA's 10 geographic regions; agency urban classification, defined by whether the agency provided service in an urban area or a non-urban area; the number of vehicles in an agency's fleet, and the level of capital expenditure of an agency within in a given fiscal year. The procurement decision-maker factors included decision-maker years of experience in procurement and decision-maker level of education. Table 4.3 displays the independent variables used in several of the analyses employed in the research.

Table 4.3 Independent Variables Used in Research Analyses

Independent Variable	Variable Name (Supplier Attributes)
x_{agr}	Agency FTA Region
x_{ac}	Agency Classification e.g. Urban, Non-Urban
x_{af}	Agency Number of Vehicles in Fleet
x_{ars}	Agency Capital Expenditure Level
x_{iep}	Individual Years of Experience in Procurement/Purchasing
x_{ie}	Individual Level of Education

Five of the 10 expert panel identified supplier attributes were used as independent variables in determining which vehicle supplier attributes were most important in practice. These five supplier attributes were utilized as independent variables in a discrete choice experiment. The experiment is discussed in more detail in a subsequent section. The five attributes used as independent variables in the discrete choice experiment are displayed in Table 4.4.

Table 4.4 Independent Variables Used in Research Choice Analysis

Independent Variable	Variable Name (Supplier Attributes)
x_q	Quality
x_d	Delivery
x_p	Price
x_{tc}	Technical Capability
x_{as}	After-Sales-Support

The five discrete choice analysis independent variables were chosen for specific reasons. First, quality, delivery, and price have consistently been ranked as the three most important supplier attributes across all industries throughout the literature (Dickson 1966; Cheraghi, Dadashzadeh and Subramanian 2004; Zhang, Lei, Cao, and Ng 2003). Having also been ranked with relatively high scores by the public transportation industry expert panel,[10] the inclusion of quality, delivery, and price as independent variables was deemed important.

The other two selected independent variables, technical capability and after-sales-support, were selected for three reasons. First, they, as ranked by the public transportation expert panel, are specifically relevant and contextual to the public transportation industry due to buses and vans being high-priced pieces of capital equipment that have associated technical, operational, and maintenance implications. These implications made technical capability and after-sales-support important vehicle supplier evaluation attributes in the research. Second, the potential increase in the use of alternatively powered vehicles by public transportation agencies further substantiated their importance as supplier attributes and thus, independent variables. Third, from the perspective of public transportation agencies and their vehicle suppliers, they were deemed to be more measurable and tangible in facilitating feasible action-plans and initiatives based on the research's results.

4.4 Research Data Collection Procedures

The data used in achieving research sub-objectives one and two were extracted from the FTA's National Transit Database (NTD). The data utilized to achieve sub-objectives three to seven were collected through a survey instrument comprising three sections. The data utilized to achieve sub-objective eight were collected through phone interviews and conversations facilitated through email.

The rationale behind developing and using the survey instrument was threefold. First, with sufficient responses, the survey could have facilitated the generalization of research findings from the sample to the population (Babbie 1990). Second, the survey instrument faciltated a more efficient and economical data collection process in comparison to having had to conduct in-person and on-site interviews on a per agency basis. Third, the survey instrument generated data in a structured and consistent format which facilitated the subsequent use of statistical analysis techniques to identify any existing correlation or relationships between dependent and independent variables (Fowler 1988; Sudman and Bradburn 1986; Babbie 1990; Fink and Kosecoff 1985). Fourth, the survey instrument facilitated the development of a fractional factorial design based discrete choice experiment that resulted in a less resource-intensive research design.

[10] Quality, Delivery, and Price were all ranked highly by the panel of public transportation experts

The survey facilitated a cross-sectional research study and collected all the required data at one specific point in time – the time at which a procurement decision-maker responded to it.The data requirements included data on public transportation agencies, on procurement decision-makers, on the perceived importance of vehicle supplier attributes, and on procurement decision-makers' preferences for suppliers based on the attribute level combinations the suppliers possessed.

The survey collected the required data through either of three sections. The first section collected data on public transportation agency location, procurement decision-maker years of procurement experience, procurement decision-maker level of education, the procurement solicitation methods employed, and alternative fuel vehicle purchases.

The second section of the survey collected data on the perceived importance procurement decision-makers assign to each of the 10 supplier attributes using a numerical ranking scale. This was done for suppliers of conventional fuel vehicles and for suppliers of alternative fuel vehicles.

The third section of the survey collected choice data through a discrete choice experiment. Procurement decision-makers were asked to make choices between suppliers in defined choice sets. Each supplier was represented by a combination of attributes, each at either of two levels. See Appendix I to view the research survey instrument.

The survey instrument, coupled with the FTA's NTD database, facilitated the collection of all the data that was required to accomplish the research objective and sub-objectives. Table 4.5 displays the research objectives, variable categories, and corresponding data sources.

Table 4.5 Research Objectives, Variable Category, and Corresponding Data Source

Research Sub-Objective	Variables	Corresponding Data Source
Determine the types of buses and vans used in public transportation agency fleets and the types of fuels they utilize	No Variables Involved	FTA NTD Revenue Vehicle Inventory
Identify the suppliers of buses and vans to public transportation agency fleets	No Variables Involved	FTA NTD Revenue Vehicle Inventory
Determine the perceived importance of vehcile supplier attibutes for conventional vehicle suppliers and for alternative vehicle suppliers	Vehicle Supplier Attributes (Dependent)	Survey Section II
Determine the statistical differences, if any at all, in the perceived importance of vehicle supplier attibutes between both types of vehicle suppliers	Vehicle Supplier Attributes (Dependent)	Survey Section II
Determine what specific transportation agency and decision-maker characteristics and attributes influence the variances in the way the importance of vehicle supplier attributes are perceived for suppliers of both vehicle types	Agency Factors (Independent) Individual Factors (Independent)	Survey Section I Survey Section I
Determine the practiced importance of vehicle supplier attibutes when selecting and evaluating vehilce suppliers Develop a model that predicts the probability that a given type of supplier will be chosen based on its combination of attribute levels	Supplier Attribute Importance (Dependent) Supplier Attribute Level (Independent)	Survey Section III Survey Section III
Determine any differences in the perceived importance of supplier attributes and their importance in practice	Vehicle Supplier Attributes (Dependent)	Survey Section II Survey Section III
Identify sub-attributes, or constitutents, of seven of the 10 supplier attributes and metrics by which they can be measured	Vehicle Supplier Attributes (Dependent)	Telephone and Email Conversations

Various steps were taken prior to mass distribution of the survey to potential research participants. These steps included establishing survey clarity, survey validity, survey reliability, and conducting survey pre-testing (Mason and Bramble 1989; Carmines and Zeller 1979). The completed survey was then submitted for approval from the North Dakota State University (NDSU) Institutional Review Board (IRB). IRB approval is needed when human beings are the units of analysis and response sources in federally funded research at universities. The IRB protects the rights, safety, and welfare of all individuals participating in NDSU research projects (NDSU 2010). IRB approval was granted on December 23, 2010.

The survey was administered to procurement decision-makers electronically. The choice to use an electronic medium, the Internet, to administer the survey was based on three factors.

First, the use of such a medium reduced survey administration costs. Second, the use of an electronic medium facilitated faster survey turn-around times. Third, the distribution of a survey through an electronic medium removed some of the tasks associated with responding to a survey and, thus, facilitated increased survey “user-friendliness” and the survey response rate.

The proper and procedural administration of the survey facilitated achieving the research objective and sub-objectives. The survey can be viewed in Appendix I.

4.5 Research Data Analysis Procedures

Various types of analytical techniques and procedures were used in addressing the research sub-objectives. These procedures included descriptive statistical analysis, inferential statistical analysis, and econometric analysis. The following sections describe the procedures in more detail.

4.5.1 Statistical Analysis

Various types of statistical analyses were utilized in the research. In identifying the types of vehicles in agency fleets, the types of fuels the vehicles utilized, and the suppliers of the vehicles, i.e., research sub-objectives one and two, descriptive statistical analysis was used after data mining techniques were employed to extract the relevant data. In determining which vehicle supplier attributes were perceived to be most important, i.e., research sub-objective three, descriptive statistical analysis was used after a Likert-type scale in the survey instrument generated the relevant data.

A Likert scale is a psychometric scale widely used in survey research. It was developed by psychologist Rensis Likert when he proposed a summated scale for the assessment of survey respondents’ attitudes (Likert 1932). It is a bipolar scaling method used to measure either positive or negative response, or attitude, towards a statement or item. It is advised, and is considered a generally accepted rule, to use as wide a scale as possible (Dawes 2008).

A common disagreement in the analysis of data derived from Likert-type surveys is how to classify the derived data. The literature identifies three ways in which data derived from Likert-type scales are generally classified. These classifications are ordinal data, interval data, and nominal data. Much of the debate over how the data are classifed stems from the statistical analysis that each data classification type facilitates. Treated as ordinal data, Likert-type derived data are analyzed utilizing non-parametric statistical tests including chi-square tests, Mann-Whitney tests, Wilcoxon signed-rank tests, or Kruskal-Wallis tests.

Grounded in the belief that parametric statistical tests are more powerful than non-parametric statistical tests, various studies have classified Likert-type derived data as interval data. Classified as interval data, and assuming that conditions of normality are met, these data can be tested utilizing methods including t-tests and analysis-of-variance (ANOVA). Statisticians have analyzed Likert-type survey generated data utilizing t-tests and other parametric procedures (Sisson and Stocker 1989). Instances also describe parametric statistical tests applied to Likert-type derived data utilizing the Central Limit Theorem.

Detractors of using Likert-type derived data as interval data posit that the scale, given that it generally allows one of five responses along an unidentified scale, assumes that the distances between each response are equal. However, alternatives and hybrids of Likert-type scales utilizing continuous line or track bar scales that facilitate measurement have been developed (Allen and Seaman 2007). They further substantiate the treatment of Likert-type derived data as interval data.

The Likert-type derived data in this research was treated as interval data. This was due to the fact that the Likert-type scale utilized in the survey provided equidistance between rating points (See Survey Section II in Appendix I.)

The classification of the data as interval data facilitated the use of inferential statistical techniques in pursuing research sub-objectives four and five. In pursuing research sub-objective four hypotheses testing utilizing paired-sample t- tests for means and two-sample t-tests for means and variance were employed. In pursuing research sub-objective five both analysis of variance (ANOVA) and regression analysis were employed being combined in an analysis of covariance (ANCOVA) model.

4.5.2 Discrete Choice Analysis

In determining which vehicle supplier attributes were most important in practice, a discrete choice experiment that facilitated the eliciting of preferences in the absence of revealed preference data was utilized(Mangham, Hanson and McPake 2009). Discrete choice experiments facilitate the generation of hypothetical alternative choice scenarios. The hypothetical scenarios in discrete choice experiments comprise alternatives, in this case vehicle suppliers, represented by combinations of attributes each, at varied levels. The alternative scenarios simulate real-world cases. Choices made among alternatives facilitate two things. First, they derive the relative importance of attributes when making choices. Second, they identify whether preference for specific alternatives is influenced by their constituent attributes and the levels of those attributes.

The design of discrete choice experiments comprises various steps. These steps include characterizing the decision problem, establishing attributes, assigning attribute levels, developing a choice questionnaire, collecting the data, and analyzing the data. Each of these steps, as pertains to this research, will be addressed in the following sections.

4.5.2.1 Characterizing the Decision Problem

A major issue that resulted in conducting this research was a lack of information on how public transportation procurement decision-makers evaluate and choose vehicle suppliers. As a result, a discrete choice experiment was utlized for two reasons. The first reason was to determine which of the five vehicle supplier attributes included in the model were most important in practice. The second reason was to develop a model that had the ability to predict the probability that a given vehicle supplier would be chosen given that supplier’s combination of attributes at various levels.

4.5.2.2 Establishing Attributes

Five supplier attributes were utilized in the discrete choice experiment. These attributes were quality, delivery, price, technical capability, and after-sales-support. Reasons for the choice of these attributes were detailed in section 4.3.

4.5.2.3 Assigning Attribute Levels

Experts in applied statistics have developed fractional factorial design procedures that can be utilized in designing discrete choice experiments (Bishop, Fienberg and Holland 1975; Green and Tull 1978; Hahn and Shapiro 1966; Louviere 1988; Mc Clean and Anderson 1984)**.**

In fractional factorial design experiments, only a chosen fraction of the treatment combinations required for a full factorial experiment are selected to be run (National Institute of Standards and Technology, 2010). Occasionally, the cost and resources required to run a full factorial experiment neccesitate the use of a fractional design, e.g., ½ or ¼ of the full factorial experiment. These fractions represent a subset of the number of runs required to identify the most important effects in a full factorial experiment.

Important concepts associated with fractional factorial design experiments need to be noted. First, properly designed two-level fractional factorial designs possess the properties of being both balanced and orthogonal (National Institute of Standards and Technology, 2010). A balanced experiment is one in which all treatment combinations have the same number of observations. Orthogonality refers to the effects of any specific factor summing to zero across the effects of other factors (National Institute of Standards and Technology, 2010).

The concept of confounding, also referred to as aliasing, is also central to fractional factorial experimental design. Confounding refers to the phenomena in which some treatment effects or interactions of factors cannot be estimated independently of each other. This occurs as a result of fractional factorial experiments running combinations that are much smaller than those required in full factorial design experiments. Confounding results in the lost ability to estimate some effects and interactions among, and between, factors (National Institute of Standards and Technology, 2010).

The resolution of a fractional factorial design experiment identifies the degree to which the main effects of that experiment are confounded. A resolution of infinity, ∞, is assigned to fractional factorial designs that exhibit no confounding. It is a generally accepted rule that fractional factorial designs of resolutions three, four, and five are most effective. Resolutions below three are considered to possess too much confounding of main effects and those higher than five are said to be impractical because they allow the estimation of high-level interactions that rarely occur in practice (National Institute of Standards and Technology, 2010).

Fractional factorial designs are generally noted as,

$$l_R^{k-p}$$

Where l is the number of levels associated with each factor investigated in the study, k is the number of factors investigated in the study, p is the size of the fraction of the full factorial utilized and also represents the generators (the effects or interactions that are confounded), and R indicates the resolution of the design. The fractional factorial design utilized in this research was,

$$2_V^{5-1}$$

Where each of the five supplier attributes had two levels, the fraction used was ½, represented as -1,[11] and the resolution of the design was five.

The levels assigned to the five vehicle supplier attributes were +1 and -1, where +1 denotes the higher level of an attribute and -1 denotes the lower level of an attribute. Table 4.6 displays the vehicle supplier attribute level codes utilized in the research.

Table 4.6 Supplier Attribute Fractional Factorial Design Level Codes

Vehicle Supplier Attribute	**Fractional Factorial Design Level Code:** +1	**Fractional Factorial Design Level Code:** -1
Quality	Significantly exceeds minimum quality standards	Meets minimum quality standards
Delivery	Always on time	Sometimes late
Price	Higher than competitor's	Lower than competitor's
Technical Capability	Offers significantly more than competitor	Offers less than competitor
After-Sales-Support	Offers significantly more than competitor	Offers less than competitor

The resolution of a fractional factorial design experiment can be improved, e.g., from a resolution of two to a resolution of three. This can be accomplished by applying either of two methods: mirror-image foldover designs or alternative foldover designs (National Institute of Standards and Technology, 2010). A mirror-image foldover design was utilized in this research.

4.5.2.4 Developing a Choice Questionnaire

Minitab was used to generate a two-level, five-factor, ½ fraction, and resolution five fractional factorial experiment for this research. The Minitab output can be seen in Appendix II. Table 4.7 displays the derived experiment design and shows that thirty-two supplier profiles or "suppliers" were generated and that each supplier profile comprised each of the five attributes at either of the two levels, + or -.

Table 4.7 Supplier Choice Scenario with Assigned Levels

Supplier Attributes	**Supplier 1.**	**Supplier 2.**	
Quality	Meets minimum quality (-)	Significantly exceeds minimum quality (+)	
Delivery	Sometimes late (-)	Always on time (+)	
Price	Lower (-)	Higher (+)	
Technical Capability	Offers significantly more (+)	Offers less (-)	
After-Sales-Support	Offers significantly more (+)	Offers less (-)	
My Choice is……….	Supplier 1.	Supplier 2.	Neither

Mirror fold-over design was applied in this experiment. Mirror fold-over design occurs when the signs associated with factor levels, or level codes, are reversed. Table 4.8 displays the original profiles of suppliers 1 through 16 and their respective "fold-overs," represented by supplier profiles 17 through 32. In further developing the questionnaire for the experiment, Table 4.9 was developed. It is a modified

[11] A ½ is represented as the exponential $^{-1}$ using fraction to negative exponent conversion

version of Table 4.20 where each supplier profile or “supplier” was matched with its respective fold-over design profile. This facilitated the development of the supplier choice sets in the survey.

Table 4.8 Discrete Choice Experiment Fractional Factorial Design

Supplier #	Quality	Delivery	Price	Tech. Capability	After-Sales-Support
1	-1	-1	1	1	1
2	1	-1	-1	1	1
3	1	-1	1	-1	1
4	1	1	-1	1	-1
5	-1	1	-1	-1	-1
6	1	1	-1	-1	1
7	-1	1	-1	1	1
8	-1	1	1	1	-1
9	1	-1	1	1	-1
10	-1	1	1	-1	1
11	-1	-1	-1	1	-1
12	1	1	1	-1	-1
13	1	1	1	1	1
14	-1	-1	1	-1	-1
15	1	-1	-1	-1	-1
16	-1	-1	-1	-1	1
17	1	1	-1	-1	-1
18	-1	1	1	-1	-1
19	-1	1	-1	1	-1
20	-1	-1	1	-1	1
21	1	-1	1	1	1
22	-1	-1	1	1	-1
23	1	-1	1	-1	-1
24	1	-1	-1	-1	1
25	-1	1	-1	-1	1
26	1	-1	-1	1	-1
27	1	1	1	-1	1
28	-1	-1	-1	1	1
29	-1	-1	-1	-1	-1
30	1	1	-1	1	1
31	-1	1	1	1	1
32	1	1	1	1	-1

Table 4.9 displays the generated supplier profiles and their corresponding fold-overs. Procurement decision-makers had to choose from among a supplier profile, its fold-over design supplier profile, or neither, which was also a choice on the survey. See Table 4.7 for an example of a choice set that procurement-decision makers had to decide on in the experiment.

Table 4.9 Discrete Choice Experiment Fractional Factorial Design Fold-Over Pairs

Supp #	Quality	Delivery	Price	Technical Capability	After-Sales-Support	Supp #	Quality	Delivery	Price	Technical Capability	After-Sales-Support
1	-1	-1	1	1	1	**17**	1	1	-1	-1	-1
2	1	-1	-1	1	1	**18**	-1	1	1	-1	-1
3	1	-1	1	-1	1	**19**	-1	1	-1	1	-1
4	1	1	-1	1	-1	**20**	-1	-1	1	-1	1
5	-1	1	-1	-1	-1	**21**	1	-1	1	1	1
6	1	1	-1	-1	1	**22**	-1	-1	1	1	-1
7	-1	1	-1	1	1	**23**	1	-1	1	-1	-1
8	-1	1	1	1	-1	**24**	1	-1	-1	-1	1
9	1	-1	1	1	-1	**25**	-1	1	-1	-1	1
10	-1	1	1	-1	1	**26**	1	-1	-1	1	-1
11	-1	-1	-1	1	-1	**27**	1	1	1	-1	1
12	1	1	1	-1	-1	**28**	-1	-1	-1	1	1
13	1	1	1	1	1	**29**	-1	-1	-1	-1	-1
14	-1	-1	1	-1	-1	**30**	1	1	-1	1	1
15	1	-1	-1	-1	-1	**31**	-1	1	1	1	1
16	-1	-1	-1	-1	1	**32**	1	1	1	1	-1

The inclusion of the option "neither" ensured that the vehicle supplier choice set was exhaustive; a requirement in discrete choice analysis. Further, the option of neither in discrete choice experiments can be defined as meaning either of two things. First, it can mean that the decision-maker is not pleased with the alternatives presented and prefers a different choice characterizing different components or attributes. Second, it can mean that the decision-maker desires the same components or attributes represented in the choice set but at different level combinations. In this research, the second definition of neither was assumed, i.e., the decision-maker preferred a supplier with the same attributes at different level combinations.

4.5.2.5 Collecting of Data

The data for this discrete choice experiment was collected through a survey instrument administered electronically to public transportation procurement decision-makers throughout the US. Details of this process were discussed in section 4.4.

4.5.2.6. Analyzing the Data

As aforementioned, discrete choice modeling was used to accomplish two tasks. The first was to determine the assigned importance to each of the five supplier attributes included in the model. The second was to use the assigned importance of the attributes to develop a model with the ability to predict a supplier's chance of being chosen.

An exhaustive search of the literature revealed only two papers that addressed the supplier selection problem utilizing discrete choice analysis, Van der Rhee, Verma and Plaschka in 2009 and, Verma and Pullman in 1998. Neither of these papers addressed the supplier selection issue from a public entity perspective or, more specifically, a public transportation vehicle supplier selection perspective. However, the discrete choice model methodology employed in this research was that used in Verma and Pullman in 1998.

Discrete choice scenarios arise when the item or alternative being decided upon is a discrete, non-continuous entity, and the decision maker has to choose from amongst a set of alternatives that meet stipulated criteria. The stipulated criteria are that the number of alternatives in the set must be finite, that the alternatives are mutually exclusive, and that the set of alternatives is exhaustive (Ben-Akiva and Lerman 1985; Train 1986).

Discrete choice models faciliate the determination of the utility to a decision-maker of making a specific choice among a set of finite alternatives, assuming that the alternative that provides the most utility is chosen. The models' objective is to develop the random utility function of a specific choice. The model theory notes however that the utility of a specific choice may not be known with certainty and accounts for this uncertainty in the model by including a random error term. This random error term is sometimes referred to as disturbance. This characteristic, the random utility function containing random error, results in utility estimation being a probabilistic problem. As such, the random utility function for any choice consists of both a deterministic component and a stochastic component. Therefore the random utility function of an individual *i* for choice *j* is

$$U_{ij} = V_{ij} + \varepsilon_{ij}$$

where

V_{ij} is a utility function that is assumed to be linear in the explanatory variables in the model and is the deterministic component of the utility function. The term ε_{ij} represents the random error or disturbance in the model and accounts for any level of utility that wasn't observed in V_{ij}.

It is variance in the assumptions of the distribution of ε_{ij} that has given rise to the development and utilization of different types of discrete choice models (Ben-Akiva and Lerman 1985; Train 1986).

The discrete choice model that was utilized in this research study is the conditional logit model (CLM).In 1973, Daniel Mc Fadden developed the conditional logit model to model the expected utilities derived by a decision-maker based on the characteristics or attributes of the alternatives in the choice set. It utilizes the determined effects of choice attributes to calculate choice probabilities. Another important characteristic of the conditional logit model is that the stochastic random error ε_{ij} is assumed to be a type I extreme-value (IEV) distribution or a Gumbel distribution.

The conditional logit model utilizes the derived utility functions to develop the probability of choice. As such, in determining the probability of a vehicle supplier being selected from amongst a group of alternative suppliers based on its combination of attribute-levels, the conditional logit model calculates,

$$P_{ij} = \frac{exp(x_{ij}\,\beta)}{\sum_{j=1}^{J} exp(x_{ij}\,\beta)}$$

where

P_{ij} is the probablility of procurement decision-maker *i* selecting vehicle supplier *j* from the choice set of vehicle suppliers *J*.

x_{ij} in the equation represents a vector of the systematic utility of vehicle supplier attributes specific to the *j*th supplier alternative as detrmined by procurement decision-maker *i*. β represents a vector of coefficients, or parameter estimates, to be estimated.

β parameters are most often determined utlizing the maximum likelhihood estimation procedure. The maximum likelihood procedure derives an estimator that indicates the values at which the β parameters, based on the input of the procurment decision-maker sample, would have occurred. The the log-likelihood function of the conditional logit model is noted as,

$$L = \sum_{i=1}^{N} \sum_{j \in C_i} d_{ij} \ln P_{ij}$$

where

$$d_{ij} = \begin{cases} 1 \text{ if individual } i \text{ chooses supplier alternative } j \\ 0 \text{ if individual i chooses otherwise} \end{cases}$$

And N represents the set of procurement decision-makers in the sample and C_i represents each procurement decision-maker's choice set which consists of j suppliers.

The conditional logit model can then be utilized to predict the probability that a previously unavailable vehicle supplier will be chosen. This is facilitated through the knowledge of β and the vector x_{ij}, supplier specific attribute level combinations. SAS®9.2 was used to estimate the conditional logit model.

Additionally, the values of the β parameters for supplier attributes derived from the conditional logit model were compared to the mean values derived from the Likert-type attribute rankings. This facilitated the determination of any differences between the relative importance of vehicle supplier attributes in perception versus in practice.

5. RESULTS AND ANALYSIS

This chapter comprises ten sections and details the results generated from the various analytical methods utilized in addressing the research's objectives.

The first section describes the sample that was collected and on which analyses for this research were based. The second section comprises an analysis of the vehicle fleets of public transportation agencies whose procurement personnel participated in the research. The third section comprises an analysis of the research sample vehicle fleet's suppliers. The fourth section involves an analysis of research participants', i.e., procurement decision-makers', perceived importance of chosen vehicle supplier attributes. Focusing on the differences in the level of importance of vehicle supplier attributes between conventional fuel vehicles and alternative fuel vehicles, section five utilizes statistical techniques to test several hypotheses. Section six consists of analyses to determine the relationship between the variation of supplier attributes' level of importance relative to both public transportation agency and procurement decision-maker factors. The seventh section comprises the use of a conditional logit model to estimate the utility functions of vehicle suppliers with varied attribute level mixes and to develop probabilities of choice for these vehicle suppliers. The eighth section consists of an analysis of the difference in importance of supplier attributes when derived by Likert-type scaling, i.e., perception, versus when derived by a discrete choice model, i.e., in practice. The ninth section identifies sub-attributes of the main attributes used in the research and various metrics by which suppliers can be evaluated in each of the attribute areas. The tenth section discusses the modeling and analytical limits of the research.

5.1 Research Sample Description and Statistics of Data

The FTA's National Transit Database (NTD) and its website listing of public transportation service providers was utilized in determining the research population. The sampling frame was determined and the survey instrument was administered electronically and randomly delivered to 1000 public transportation agencies across the United States. The survey collection period lasted from January 10th, 2011, to March 24th, 2011. Of the 1000 agencies contacted, 327 procurement decision makers responded. These 327 procurement decision-makers represented 278 public transportation agencies across the United States. This gives a survey response rate of approximately 28%. The sample size of 278 agencies facilitated statistical inference at a 95% confidence level and with a confidence interval of five. This was important when inferential statistical methods were utilized in addressing certain of the research objectives.

Given the research's objectives, the survey instrument was designed to collect data on various aspects of both public transportation agencies and their procurement decision-makers. Further, the need to collect data across these varied aspects resulted in the high level of importance in collecting a sample most representative of the population under observation. The various analytical methods employed in the research required data of varied natures. These types of data included data related to a public transportation agency's service area population size, the FTA region in which it operates, the education level of the procurement decision-maker participating in the research, his or her years of procurement related experience, public transportation agency revenue vehicle fleet size, public transportation agency capital expenditure, the public transportation agency utilized procurement method, and public transportation agency alternative fuel vehicle purchasing. The following sections discuss the data collected in each of these areas.

5.1.1 Participant Agency Service Area Urban Classification

The research sample consisted of 226, or 69.1%, procurement decision-makers whose agencies operated within service areas classified as being urban. Agencies operating within service areas classified as being non-urban were represented by 101, or 30.9%, of the procurement decision-makers participating in the research study.

5.1.2 Participant FTA Region

The research sample consisted of procurement decision-makers employed at public transportation agencies across the United States. Each of these public transportation agencies belonged to one of 10 FTA regions. The 10 FTA regions collectively comprise the 50 states, Washington D.C., Puerto Rico, the US Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands. Table 5.1 displays each of the FTA regions and its constituent state, district, or commonwealth.

With respect to the FTA regions represented in the research sample, the regions with the higher representations were Region 4 and Region 5 at 19.6 % and 18.3% respectively. The FTA regions with the lowest representation were Region 1 and Region 8 at 6.4% and 4.3% respectively. Table 5.2 displays the representation of each FTA region in the research sample.

Table 5.1 Federal Transit Administration Regions

FTA Region	States, District, or Commonwealth
Region 1	Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut
Region 2	New York and New Jersey
Region 3	Delaware, Maryland, Pennsylvania, Virginia, and West Virginia and the District of Columbia
Region 4	Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, The Commonwealth of Puerto Rico, and the United States Virgin Islands
Region 5	Illinois, Ohio, Minnesota, Wisconsin, Indiana, and Michigan
Region 6	Texas, Oklahoma, Arkansas, Louisiana, and New Mexico
Region 7	Missouri, Iowa, Nebraska, and Kansas
Region 8	Colorado, Utah, Montana, Wyoming, South Dakota, and North Dakota
Region 9	Arizona, California, Hawaii and Nevada, Guam, American Samoa, and the Northern Mariana Islands
Region 10	Washington, Oregon, Idaho, and Alaska

Table 5.2 FTA Region Representation in the Research Sample

FTA Region	Number of Respondents	% of Research Sample
Region 1	21	6.4%
Region 2	26	8.0%
Region 3	33	10.1%
Region 4	64	19.6%
Region 5	60	18.3%
Region 6	31	9.5%
Region 7	27	8.3%
Region 8	14	4.3%
Region 9	26	8.0%
Region 10	25	7.6%

Though not used as a variable in the research, the number of research participants from each state and the District of Columbia was observed. There were no research participants from the state of Hawaii, Guam, American Samoa, the Northern Mariana Islands, the Commonwealth of Puerto Rico, and the United States Virgin Islands.

The states with highest representation were Florida, Texas, and California at 7.7%, 7%, and 6.4% respectively. The states with the lowest representation were Alaska, Louisiana, Maine, Rhode Island, and the District of Columbia, each at 0.3%. Table 5.3 displays both the number of respondents, and their research sample percentage, from a specific state or district.

Table 5.3 Research Participants by State or District

State	Number of Respondents	Percentage
Alaska	1	0.3%
Alabama	5	1.5%
Arkansas	3	0.9%
Arizona	4	1.2%
California	21	6.4%
Colorado	2	0.6%
Connecticut	9	2.8%
District of Columbia	1	0.3%
Florida	25	7.7%
Georgia	3	0.9%
Iowa	14	4.3%
Illinois	13	4.0%
Indiana	5	1.5%
Kansas	9	2.8%
Kentucky	4	1.2%
Louisiana	1	0.3%
Massachusetts	7	2.1%
Maryland	9	2.8%
Maine	1	0.3%
Michigan	9	2.8%
Minnesota	11	3.4%
Missouri	4	1.2%
Mississippi	2	0.6%
Montana	3	0.9%
New Hampshire	2	0.6%
New Jersey	10	3.1%
New Mexico	2	0.6%
Nevada	1	0.3%
New York	16	4.9%
North Carolina	15	4.6%
North Dakota	5	1.5%
Ohio	15	4.6%
Oklahoma	2	0.6%
Oregon	9	2.8%
Pennsylvania	11	3.4%
Rhode Island	1	0.3%
South Carolina	2	0.6%
South Dakota	2	0.6%
Tennessee	8	2.5%
Texas	23	7.0%
Utah	2	0.6%
Virginia	10	3.1%
Washington	15	4.6%
Wisconsin	7	2.1%
West Virginia	2	0.6%

5.1.3 Procurement Decision-Maker Education Level

Research participants, i.e., procurement decision-makers, were categorized based on their highest attained level of education. The categories were high school diploma, bachelor's degree, graduate or professional degree, and other. The "Other" category was developed to include professional certifications, additional courses, and industry or association certifications.

The category with the highest representation was bachelor's degree at 48.6%. It was followed by graduate and professional degree at 30.6%, high school diploma at 13.5%, other at 7.3%. The number of research participants in each of the aforementioned categories was 159, 100, 44, and 24 respectively.

5.1.4 Procurement Decision-Maker Years of Experience

The data used to determine research participants' years of procurement related experience was generated from the research survey instrument. Research participants were categorized based on their years of experience in procurement or a related job function or capacity. The categories were 0 to 9 years, 10 to 20 years, and 21 years and over.

The category with the highest representation was 21 years and over at 41.6%. It was followed by 10 to 20 years at 33% and 0 to 9 years at 25.1%. The number of research participants in each of the aforementioned categories was 136, 108, and 82 respectively.

The least amount of experience recorded was "just over a month" while the most was 49 years. The mean for years of experience was 18.30 years with a standard deviation of 11.12 and a median of 18 years. When skewness was observed, it was 0.26, indicating that the data collected for years of experience characterized an approximately symmetric distribution.

5.1.5 Procurement Decision-Maker Agency Revenue Vehicle Fleet Size

The 327 research participants represented 278 public transportation agencies for which revenue vehicle fleet sizes were determined. The data were derived from the NTD's 2009 Revenue Vehicle Fleet Inventory, 2009 being the most recent year for which data are available.

In categorizing research participants based on their respective agencies' vehicle fleet sizes, the FTA's NTD fleet classification system was used. The NTD categorizes vehicle fleets into seven classes. These classes are (1) under 25 (2) 25 to 49 (3) 50 to 99 (4)100 to 249 (5)250 to 499 (6)500 to 999 and (7) over 1000. In relation to the research sample, the fleet category with the largest representation was under 25 at 20.5%. The category with the lowest representation was 500 to 999 at 5.8%.

The smallest recorded fleet consisted of two vehicles while the largest consisted of 6354 vehicles. The mean fleet size was 361, with a standard deviation of 755. However, it is worth noting that the median fleet size was 73 vehicles. The skewness of the sample vehicle fleet data was 3.9, indicating that the fleet size data characterized a positively skewed distribution and observations were significantly bunched in the lower fleet size categories. Table 5.4 displays the number of respondents whose public transportation agencies were represented within specific revenue vehicle fleet size categories.

Table 5.4 Procurement Decision-Maker Agency Revenue Vehicle Fleet Size

Agency Vehicle Fleet Size Category	Number of Respondents	% of Research Sample
Under 25	67	20.5%
25 to 49	50	15.3%
50 to 99	46	14.1%
100 to 249	40	12.2%
250 to 499	38	11.6%
500 to 999	19	5.8%
Over 1000	29	8.9%

5.1.6 Procurement Decision-Maker Agency Capital Expenditure Level

Of the 327 research participants, agency capital expenditure level data were available for 310. The data were derived from the NTD's 2009 Agency Capital Expenditure database, 2009 being the most recent year for which data were available. The particular database category of capital expenditures that was analyzed was the rolling stock expenditure data set.

In categorizing research participants based on their respective agencies' capital expenditure level, five classes were established. These classes were (1) $0 to $999,999.99 (2) $1,000,000 to $9,999,999.99 (3) $10,000,000 to $19,999,999.99 (4) $20,000,000 to $99,999,999.99 and (5) $100,000,000 and over.

In relation to the research sample, the capital expenditure level category with the largest representation was $0 to $999,999.99 at 51.4%. The categories with the lowest representation were $20,000,000 to $99,999,999.99 and $100,000,000 and over, both at 5.5%.

The smallest capital expenditure level recorded was $0 while the largest was $1,412,875,366. The mean capital expenditure level was $19,883,611.98 with a standard deviation of 92509718.21. However, it is important to note that the median capital expenditure level was $691,119.

The skewness for the capital expenditure level data was 11.6, indicating that the data characterized a positively skewed distribution and observations were significantly bunched in the lower capital expenditure level categories. Table 5.5 displays the number of respondents whose public transportation agencies were represented within the capital expenditure level categories.

Table 5.5 Procurement Decision-Maker Agency Capital Expenditure Level

Agency Capital Expenditure Level Category	Number of Respondents	Percentage
$0 to $999,999,99	168	51.4%
$1,000,000 to $9,999,999.99	83	25.4%
$10,000,000 to $19,999,999.99	23	7.0%
$20,000,000 to $99,999,999.99	18	5.5%
$100,000,000 and over	18	5.5%

Table 5.6 displays the summary statistics for the procurement decision-maker years of experience, the agency revenue vehicle fleet size, and the agency capital expenditure level data sets. The statistics were computed using SAS®9.2 software. Software output for the summary statistics can be seen in Appendix III.

Table 5.6 Statistics for Fleet Size, Capital Budget Size, and Years of Experience

Data Set	Mean	Standard Deviation	N	Minimum	Maximum	Median	Skewness
Vehicles in Fleet	361.05	755.05	289	2.00	6,354	73.00	3.92
Capital Expenditure Level	19,883,611.98	92,509,718.21	310	0.00	1,412,875,366.00	691,119.00	11.66
Years of Experience	18.30	11.12	327	0.10	49.00	18.00	0.26

5.1.7 Public Transportation Agency Procurement Regulation and Policy

Procurement decision-makers were asked to identify the procurement method, if any, which is stipulated by agency or state regulations. The choices were (1) Must choose the lowest bidder i.e. IFBs (2) Allowed to utilize “Best-Value” procurements, i.e., RFPs, and (3) Other. In the category of other, public transportation agencies were involved in join-procurements, piggy-back procurements, and procurement consortiums. Each of these may have a stipulated procurement method. In instances where the procurement agreement is administered and managed by a public transportation agency, RFPs are most often utilized. In instances where the procurement agreement is administered and managed by a state agency, an IFB is most often utilized. In some instances both methods are allowed and are utilized at various points in the procurement process.

Of the 327 research participants, 211, or 64.5%, indicated that their agency was allowed to utilize “best-value” methods or RFPs in vehicle procurements. Fifty-five, or 16.8%, of procurement decision-makers indicated that their agency’s vehicles are procured through IFBs or awarded to the bidder offering the lowest vehicle price. Sixty-one participants, 18.7%, indicated that their agency was allowed to use either IFBs or RFPs or was involved in join-procurement agreements, “piggy-back” procurements, or procurement consortiums.

5.1.8 Public Transportation Agency Alternative Fuel Vehicle Purchasing

Research participants were asked to identify whether their agency had purchased any alternative fuel vehicles in the past five years and whether it intended to do so over the next five years. Within the past five years, 172, or 52.6%, of participants indicated that their agency had. When asked about their agency’s intent on purchasing alternative fueled vehicles over the next five years, 211, or 64.5%, of participants indicated their agencies planned to do so. This represents, with respect to the research sample, an increase in purchasing from 52.6% to 64.5%, an 11.9% increase over a 10-year period. This provides some insight into the potential shift, in varied measures, from conventionally fueled vehicles to alternatively fueled ones.

5.2 Research Sample Revenue Vehicle Fleet

This section utilizes data from the FTA’s NTD 2009 Revenue Vehicle Inventory database, 2009 being the year for which the most recent data were available, to identify specific characteristics of the revenue vehicle fleets of research participants’ agencies. Updated annually, the FTA’s NTD Revenue Vehicle Inventory database provides varied types of information on an agency’s revenue vehicle fleet.

The data extracted from the data base included public transportation agencies’ database ID number, public transportation agencies’ FTA region, total revenue fleet numbers, revenue fleet vehicle types, vehicle manufacturers/suppliers, and vehicle fuel types. Data mining and extraction techniques were used to generate output for 1) the vehicle types in the research sample fleet, 2) the fuel types utilized by vehicles in the research sample fleet, 3) the alternative fuel types utilized by vehicles in the research sample fleet, 4) the fuel types utilized by specific vehicle types in the research sample fleet and, 5) the fuel types utilized within specific FTA regions based on the research sample fleet. The following sections discuss the results of the research sample fleet analysis.

5.2.1 Research Sample Fleet Vehicle Types

The research sample fleet comprised 60,005 revenue vehicles and represented 278 public transportation agencies. The aggregate sample fleet consisted of 8 types of vehicles. These vehicle types were articulated buses, buses, double-decker buses, over-the-road buses, school buses, taxicab vans, trolley buses, and vans. The vehicle types with the larger representation within the sample fleet were buses and vans at 68.2% and 24.9% respectively. Table 5.7 displays the vehicle types in the research sample fleet.

Table 5.7 Research Sample Fleet Vehicle Types

Vehicle Type	Number in Research Sample	Percentage
Bus	40,938	68.2%
Van	14,968	24.9%
Articulated Bus	3,135	5.2%
Taxicab Van	539	0.9%
Trolley Bus	254	0.4%
Other	101	0.2%
Over-the-Road Bus	63	0.1%
School Bus	6	0.01%
Double-Decker Bus	1	0.002%

5.2.2 Research Sample Fleet Fuel Types

Within the aggregate sample fleet 13 types of fuels were utilized in the vehicles. These fuels were biodiesel, bunker fuel, compressed natural gas (CNG), diesel, dual fuel, electric battery, gasoline, grain additive, hybrid diesel, hybrid gasoline, liquefied natural gas (LNG), liquefied natural petroleum (LNP), and methanol. The vehicle fuel type with the largest representation in the sample fleet was diesel at 58.6%. Diesel was followed by gasoline at 18.9%. The fuel types with relatively significant representation in the sample fleet were biodiesel and compressed natural gas (CNG) at 6.7% and 6.5% respectively. It is also worth noting that hybrid diesel and liquefied natural petroleum (LNP) accounted for 2% and 1.4% respectively. Table 5.8 displays the fuel types in the research sample fleet.

Table 5.8 Research Sample Fleet Fuel Types

Vehicle Fuel Type	Number in Research Sample	Percentage
Diesel	35,136	58.6%
Gasoline	11,340	18.9%
Biodiesel	3,999	6.7%
Compressed Natural Gas (CNG)	3,904	6.5%
Dual	3,271	5.5%
Hybrid Diesel	1,180	2.0%
Liquefied Natural Gas (LNG)	814	1.4%
Electric Battery	271	0.5%
Liquefied Petroleum Gas (LPG)	52	0.1%
Hybrid Gasoline	19	0.03%
Bunker Fuel	8	0.01%
Other	4	0.01%
Methanol	4	0.01%
Grain Additive	3	0.01%

5.2.3 Research Sample Fleet Alternative Fuel Types

Conventional fuels, i.e., diesel and gasoline, were isolated, and only the alternative fuel types utilized by alternative fuel vehicles in the sample fleet were analyzed. The number of vehicles in the sample fleet that utilized alternative fuels was 13,325, or 22.5%. Eleven alternative fuels were utilized. These alternative fuels were biodiesel, bunker fuel, compressed natural gas (CNG), dual fuel, electric battery, grain additive, hybrid diesel, hybrid gasoline, liquefied natural gas (LNG), liquefied natural petroleum (LNP), and methanol. The alternative fuel type with the largest utilization among alternative fuel vehicles in the sample fleet was biodiesel at 29.6%. Biodiesel was followed by compressed natural gas (CNG) and dual fuel at 28.9% and 24.2% respectively. The alternative fuel types with relatively significant representation in the sample fleet were hybrid diesel, liquefied natural petroleum (LNP), and electric battery which accounted for 8.7%, 6%, and 2% respectively. Table 5.9 displays the alternative fuel types in the research sample fleet.

Table 5.9 Research Sample Fleet Alternative Fuel Types

Vehicle Alternative Fuel Type	Number in Research Sample	Percentage
Biodiesel	3,999	29.6%
Compressed Natural Gas (CNG)	3,904	28.9%
Dual	3,271	24.2%
Hybrid Diesel	1,180	8.7%
Liquefied Natural Gas (LNG)	814	6.0%
Electric Battery	271	2.0%
Liquefied Petroleum Gas (LPG)	52	0.4%
Hybrid Gasoline	19	0.1%
Bunker Fuel	8	0.1%
Methanol	4	0.03%
Grain Additive	3	0.02%

5.2.4 Research Sample Fleet Fuel Type by Vehicle Type

The types of fuels utilized by vehicle type were observed for the research sample fleet. Articulated buses primarily utilized diesel with 77.8% of 3,135 using this fuel. Hybrid diesel followed accounting for 10.3% while biodiesel, compressed natural gas (CNG), and dual fuel accounted for 5.8%, 3.3%, and 2.9% respectively.

Of 40,938 buses, 67.9% utilized diesel. Compressed natural gas (CNG) had the second highest utilization rate at 9.1%. It was followed by biodiesel and dual fuel at 8.2% and 7.5% respectively. It is worth noting that gasoline, hybrid diesel, and liquefied natural gas (LNG) accounted for utilization rates among buses of 2.9%, 2.1%, and 2% respectively.

The one double-decker bus in the research sample fleet utilized diesel. Over-the-road buses, however, numbered at 63, utilized both diesel and biodiesel at rates of 69.8% and 30.2% respectively. School buses in the sample also utilized only two fuel types. The six school buses in the sample fleet utilized gasoline and diesel at rates of 83.3% and 16.7% respectively. The 254 trolley buses in the research sample all utilized electric battery.

Of the vehicles that belonged to the taxicab van class, 93% of 539 utilized gasoline while 6.9% utilized diesel. The 14,968 vans in the sample fleet utilized a total of seven fuels. Gasoline had the highest utilization rate at 64.1% and was followed by diesel at 31.8%. Biodiesel accounted for a 2.8% utilization rate while compressed natural gas, dual fuel, grain additive, and liquefied petroleum gas (LPG) each accounted for less than 1%. Table 5.10 displays the research sample fleet's fuel type by vehicle type information.

Table 5.10 Research Sample Fleet Fuel Type by Vehicle Type

Fuel Type	Vehicle Type							
	Articulated Bus	**Bus**	**Double Decker Bus**	**Over the Road Bus**	**School Bus**	**Taxicab Van**	**Trolley Bus**	**Van**
Biodiesel	5.8%	8.2%		30.2%				2.8%
Bunker Fuel		0.02%						
CNG	3.3%	9.1%						0.45%
Diesel	77.8%	67.9%	100%	69.8%	16.7%	6.9%		31.8%
Dual	2.9%	7.5%						0.7%
Electric Battery		0.04%					100%	
Gasoline		2.9%			83.3%	93.1%		64.1%
Grain Additive								0.02%
Hybrid Diesel	10.3%	2.1%						
Hybrid Gasoline		0.04%				0.19%		
LNG		2%						
LPG		0.1%						0.047%
Methanol		0.01%						

5.2.5 Research Sample Fleet Fuel Type by FTA Region

The types of fuels utilized in each FTA region were observed for the research sample fleet. In FTA Region 1 five fuel types were utilized. Of the 2,859 vehicles in the sample from FTA Region 1, diesel was utilized most at a rate of 50.5%. It was followed by gasoline at 19.9%, biodiesel at 15.6%, and compressed natural gas at 13.8%. Less than 1% of vehicles in the sample from FTA Region 1 utilized hybrid diesel.

The vehicles from FTA Region 2 utilized seven fuels. Of the 11,528 vehicles representing the region, diesel was utilized most at a rate of 75.2%. It was followed by dual fuel at 13.7%, compressed natural gas at 6%, and gasoline at 3.3%. For each of the fuel types biodiesel, bunker fuel, and hybrid diesel, less than 1% of the vehicles utilized them.

The vehicles from FTA Region 3 also utilized seven fuels. Of the 8,171 vehicles representing the region, diesel was utilized most at a rate of 69.4%. It was followed by gasoline at 19.4%, compressed natural gas at 6%, and hybrid diesel at 3.8%. The fuel types biodiesel, dual fuel, and hybrid gasoline each accounted for 1% or less utilization rates in the region.

In FTA Region 4 eight fuel types were utilized. Of the 6,257 vehicles representing the region, diesel was utilized most at a rate of 62.2%. It was followed by gasoline at 27.2%, biodiesel at 5.6%, and dual fuel at 3.1%. The fuel types compressed natural gas (CNG), electric battery, hybrid diesel, and hybrid gasoline each accounted for 1% or less utilization rates in the region.

The vehicles from FTA Region 5 utilized eight fuels. Of the 9,295 vehicles representing the region, diesel was utilized most at a rate of 60.9%. It was followed by biodiesel at 17.3%, dual fuel at 11.8%, gasoline at 5.2%, hybrid diesel at 2.9%, and compressed natural gas (CNG) at 1.2%. Electric battery and methanol both accounted for less than 1% utilization in the region.

In FTA Region 6 seven fuel types were utilized. Of the 6,429 vehicles representing the region, diesel was utilized most at a rate of 58.2%. It was followed by gasoline at 24.4%, compressed natural gas (CNG) at 8%, hybrid diesel at 5%, and liquefied natural gas (LNG) at 3%. The fuel types biodiesel and liquefied petroleum gas (LPG) each accounted for utilization rates of less than 1% in the region.

In FTA Region 7, from a fleet of 1,022 vehicles, diesel was utilized most at a rate of 68.5%. It was followed by biodiesel at 15.8%, gasoline at 11.9%, and compressed natural gas (CNG) at 3.5%. Hybrid diesel accounted for less than 1% utilization in the region.

In FTA Region 8, from a fleet of 1,514 vehicles, diesel was marginally most utilized at a rate of 51%. It was closely followed by gasoline at 49.4%. Hybrid diesel accounted for less than 1% utilization in the region.

Vehicles in FTA Region 9 had the most diverse fuel type utilization among the regions represented in the research. Nine fuel types were utilized. Among 5,999 vehicles, diesel was utilized most at a rate of 32.6%. It was followed by compressed natural gas (CNG) at 26.5%, gasoline at 26.3%, liquefied natural gas (LNG) at 10.3%, and biodiesel at 3.1%. The fuel types electric battery, hybrid diesel, hybrid gasoline, and liquefied petroleum gas (LPG) each accounted for utilization rates of less than 1% in the region.

In FTA Region 10 seven fuel types were utilized. Of the 6,897 vehicles, diesel was marginally most utilized at a rate of 38.3%. It was closely followed by gasoline at 38%, biodiesel at 15.3%, dual fuel at 4.6%, electric battery at 2.3%, and hybrid diesel at 1.2%. Less than 1% of vehicles from the region utilized compressed natural gas (CNG). Table 5.11 displays the research sample fleet's fuel type by FTA region.

Table 5.11 Research Sample Fleet Fuel Type by FTA Region

Fuel Type	FTA Region									
	1	2	3	4	5	6	7	8	9	10
Biodiesel	15.6%	0.9%	0.5%	5.6%	17.3%	0.9%	15.8%		3.1%	15.3%
Bunker Fuel		0.1%								
CNG	13.8%	6%	6%	0.9%	1.2%	8%	3.5%		26.5%	0.3%
Diesel	50.5%	75.2%	69.4%	62.2%	60.9%	58.2%	68.5%	51%	32.6%	38.3%
Dual		13.7%	1%	3.1%	11.8%					4.6%
Electric Battery				0.3%	0.6%				0.07%	2.3%
Gasoline	19.9%	3.3%	19.4%	27.2%	5.2%	24.4%	11.9%	49.4%	26.3%	38%
Grain Additive							0.3%			
Hybrid Diesel	0.1%	0.9%	3.8%	0.7%	2.9%	5%		0.2%	0.7%	1.2%
Hybrid Gasoline			0.012%	0.03%					0.3%	
LNG						3%			10.3%	
LPG						0.6%			0.2%	
Methanol					0.04%					

5.3 Research Sample Fleet Suppliers

This section utilizes data from the FTA's NTD 2009 Revenue Vehicle Inventory database, 2009 being the year for which the most recent data were available, to identify the suppliers of vehicles to the research sample fleet. The data extracted from the data base included public transportation agencies' database ID number, public transportation agencies' FTA region, total fleet numbers, vehicle types, manufacturers or suppliers, and fuel types. Data mining and extraction techniques were used to generate output for (1) a vehicle supplier's "sample market share" by vehicle type (2) a vehicle supplier's "sample market share" by fuel type and (3) a vehicle supplier's "sample market share" by FTA region. "Sample market share", in context of this research, refers to a supplier's share of vehicles in a particular category or class observed in the research. The following sections discuss the results of the research sample fleet supplier analysis.

The 60,005 vehicles in the research sample fleet were supplied by 64 vehicle suppliers. Vehicle suppliers in the public transportation industry are primarily the manufacturers of the vehicles. This is so due mostly to the fact that buses and, to a lesser extent vans, are highly customized and are most often procured directly from the manufacturers. This fact leads to most bus and van manufacturers being the direct suppliers of vehicles to public transportation authorities. In some instances the direct suppliers of vehicles to public transportation agencies may not be the original manufacturers of the vehicles. This is particularly so in the case of medium and smaller buses and vans. The frame and chassis of these smaller vehicles are purchased from original manufacturers, and the body and additional customized components are subsequently built and added by another manufacturer. Vehicles that are produced in this manner are referred to as belonging to the "body on frame" market. Both these types of manufacturers are identified in the FTA's NTD 2009 Revenue Vehicle Inventory database and are collectively referred to as suppliers in the context of this research.

With respect to the research sample fleet, three suppliers accounted for significant "sample market share". New Flyer Industries had the highest representation within the sample fleet supplying 17.6% of the fleet's vehicles. New Flyer Industries was followed by Gillig Corporation and Ford Motor Company, each supplying 15.1% and 11.5% of the research sample fleet's vehicles respectively.

Accounting for relatively substantial representation within the sample fleet, NOVA Bus Corporation, North American Bus Industries, Chevrolet Motor Division, Motor Coach Industries International, El Dorado National, Coach and Equipment Manufacturing Company, Bus Industries of America, Orion Bus Industries Limited, Flexible Corporation, Neoplan USA Corporation, Chrysler Corporation – Dodge Division, Goshen Coach, and Champion Motorcoach Inc. each supplied between 1% and 7.4% of the sample fleet's vehicles.

All other bus and van suppliers each supplied less than 1% of the sample fleet's vehicles. Table 5.12 displays the "sample market share" of suppliers to the research sample fleet.

Table 5.12 Supplier "Sample Market Share"

Supplier	Number of Vehicles in Sample Fleet	Percentage
New Flyer Industries	10,534	17.6%
Gillig Corporation	9,029	15.1%
Ford Motor Company	6,887	11.5%
NOVA Bus Corporation	4,454	7.4%
North American Bus Industries	3,997	6.7%
Chevrolet Motor Division – General Motors	3,039	5.1%
No Supplier Listed	2,794	4.7%
Motor Coach Industries International	2,459	4.1%
El Dorado National	2,376	4.0%
Coach and Equipment Manufacturing Company	2,040	3.4%
Bus Industries of America	2,023	3.4%
Orion Bus Industries Ltd.	1,694	2.8%
Flexible Corporation	1,336	2.2%
Neoplan - USA Corporation	1,189	2.0%
Dodge Division - Chrysler Corporation	1,012	1.7%
Goshen Coach	768	1.3%
Champion Motor Coach Inc.	613	1.0%
Startrans (Supreme Corporation)	536	0.9%
Blue Bird Corporation	383	0.6%
Chance Bus Inc.	352	0.6%
Transportation Manufacturing Company	350	0.6%
Braun	320	0.5%
General Motors Corporation	307	0.5%
Thomas Built Buses	231	0.4%
Starcraft	173	0.3%
World Trans Inc. (Mobile-Tech Corp.)	140	0.2%
Glaval Bus	132	0.2%
Van Hool N.V.	91	0.2%
International	87	0.1%
Turtle Top	74	0.1%
Breda Transportation Inc.	59	0.1%
AAI/Skoda	57	0.1%
Oshkosh Truck Corporation	54	0.1%
Canadian Vickers Ltd.	51	0.1%
Mid Bus Inc.	49	0.1%
Collins Bus Corporation	45	0.1%
Shepard Brothers Inc.	41	0.1%
Cable Car Concepts Inc.	29	0.1%
Spartan Motors Inc.	27	0.04%

Table 5.12 (continued)

Tourstar	27	0.04%
Wide One Corporation	24	0.04%
Freightliner Corporation	20	0.03%
Diamond Coach Corporation	15	0.02%
Nissho Iwai American Corporation	11	0.02%
Plymouth Division - Chrysler Corporation	11	0.02%
Eagle Bus Manufacturing	10	0.02%
Overland Custom Coach Inc.	10	0.02%
Prevost Car Inc.	8	0.01%
Trolley Enterprises Inc.	6	0.01%
American MAN Corporation	5	0.01%
Specialty Vehicle Manufacturing Corporation	4	0.01%
Allen Ashley Inc.	2	0.003%
AM General Corporation	2	0.003%
Dutcher Corporation	2	0.003%
Federal Coach	2	0.003%
Rico Industries	2	0.003%
Sabre Bus and Coach Corporation	2	0.003%
Status Specialty Vehicles	2	0.003%
Transcoach	2	0.003%
Asea Brown Boveri Ltd.	1	0.002%
Boyertown Auto Body Works	1	0.002%
Kansas Coach Manufacturing	1	0.002%
Metrotrans Corporation	1	0.002%
National Mobility Corporation	1	0.002%
Wheeled Coach Industries Inc.	1	0.002%

In addition to determining the general research sample fleet supplier “sample market share”, supplier “sample market share” by FTA region, by fuel type, and by vehicle type was determined. The following sections provide the results for these analyses.

5.3.1 Supplier “Sample Market Share” by Vehicle Type

The number of vehicles each supplier was responsible for supplying within each vehicle type category in the sample fleet was determined.

For the articulated buses, 3,135 in number, suppliers with significant share were New Flyer Industries at 67.7%, Neoplan USA Corporation at 19.1% and North America Bus Industries Inc. at 12.7%. Each of the other suppliers’ “sample market share” for articulated buses accounted for less than 1%. Table 5.13 displays the “sample market share” of suppliers of articulated buses to the research sample fleet.

Table 5.13 Supplier "Sample Market Share" for Articulated Buses

Articulated Buses		
Supplier	**Number in Sample Fleet**	**Percentage**
New Flyer Industries	2123	67.7%
Neoplan - USA Corporation	599	19.1%
North American Bus Industries Inc.	397	12.7%
American MAN Corporation	14	0.4%
Chance Bus Inc.	2	0.1%

The vehicle type category of buses accounted for the most vehicles within the research sample fleet numbering 40,938, or 68.2%. For these buses, two suppliers had significant "sample market share." These were Gillig Corporation at 21.8% and New Flyer Industries at 20.5%. Significant "sample market share" was also observed for North American Bus Industries Inc., Motor Coach Industries International, Bus Industries of America, Orion Bus Industries Ltd., and EL Dorado National with rates of 10.9%, 8.8%, 5.9%, 4.9%, 4.1%, and 4% respectively. Flexible Corporation, Ford Motor Company, Neoplan USA Corporation, Goshen Coach, and Coach and Equipment Manufacturing Company each accounted for between 1% and 3.3% of the "sample market share" for buses. Each of the other suppliers' "sample market share" for buses accounted for less than 1%. Table 5.14 displays the "sample market share" of suppliers of buses to the research sample fleet.

Table 5.14 Supplier "Sample Market Share" for Buses

Buses		
Supplier	**Number in Sample Fleet**	**Percentage**
Gillig Corporation	8925	21.8%
New Flyer Industries	8372	20.5%
NOVA Bus Corporation	4454	10.9%
North American Bus Industries Inc.	3591	8.8%
Motor Coach Industries International	2430	5.9%
Bus Industries of America	2023	4.9%
Orion Bus Industries Ltd.	1694	4.1%
El Dorado National	1647	4%
Flexible Corporation	1336	3.3%
Ford Motor Company	954	2.3%
No Supplier Listed	1245	3%
Neoplan - USA Corporation	590	1.4%
Goshen Coach	464	1.1%
Coach and Equipment Manufacturing Company	393	1%
Champion Motor Coach Inc.	355	0.9%
Chance Bus Inc.	350	0.9%
Blue Bird Corporation	344	0.8%
Transportation Manufacturing Company	339	0.8%

Table 5.14 (continued)

Startrans (Supreme Corporation)	246	0.6%
Thomas Built Buses	221	0.5%
Starcraft	139	0.3%
Chevrolet Motor Division-General Motors	124	0.3%
Glaval Bus	108	0.3%
General Motors Corporation	93	0.2%
Van Hool N.V.	91	0.2%
International	83	0.2%
Turtle Top	74	0.2%
Oshkosh Truck Corporation	54	0.1%
Mid Bus Inc.	49	0.1%
Collins Bus Corporation	42	0.1%
Spartan Motors Inc.	20	0.05%
Freightliner Corporation	19	0.05%
Eagle Bus Manufacturing	10	0.02%
Overland Custom Coach Inc.	10	0.02%
Diamond Coach Corporation	9	0.02%
Shepard Brothers Inc.	6	0.01%
Trolley Enterprises Inc.	6	0.01%
Cable Car Concepts Inc.	4	0.01%
Specialty Vehicle Manufacturing Corporation	4	0.01%
World Trans Inc. (also Mobile-Tech Corporation)	4	0.01%
Allen Ashley Inc.	2	0.005%
AM General Corporation	2	0.005%
Prevost Car Inc.	2	0.005%
Rico Industries	2	0.005%
Sabre Bus and Coach Corporation	2	0.005%
Status Specialty Vehicles	2	0.005%
Transcoach	2	0.005%
Asea Brown Boveri Ltd.	1	0.002%
Boyertown Auto Body Works	1	0.002%

The 63 over-the-road buses in the research sample fleet were supplied by two suppliers. Motor Coach Industries International had 46% of the "sample market share" while Prevost car accounted for 9.5%. For 44.4% of the over-the-road buses in the sample, suppliers weren't identified. Table 5.15 displays the "sample market share" of the suppliers of the over-the-road buses in the research sample fleet.

Table 5.15 Supplier "Sample Market Share" for Over-the-Road Buses

Over-the-Road Buses		
Supplier	**Number in Sample Fleet**	**Percentage**
Motor Coach Industries International	29	46%
No Supplier Listed	28	44.4%
Prevost Car Inc.	6	9.5%

The 254 trolley buses in the research sample fleet were supplied by four suppliers. Gillig Corporation had 39.4% of the "sample market share" while Breda Transportation Inc. and AAI/Skoda accounted for 23.2% and 22.4% respectively. New Flyer Industries had 15%. Table 5.16 displays the "sample market share" of the suppliers of the trolley buses in the research sample fleet.

Table 5.16 Supplier "Sample Market Share" for Trolley Buses

Trolley Bus		
Supplier	**Number in Sample Fleet**	**Percentage**
Gillig Corporation	100	39.4%
Breda Transportation Inc.	59	23.2%
AAI/Skoda	57	22.4%
New Flyer Industries	38	15%

Vans accounted for the second largest vehicle category in the research sample fleet, with 14,968 vehicles, or 24.9%. Ford Motor Company had the most significant "sample market share" at 39.6%. Chevrolet and Coach and Equipment Manufacturing Company followed at 19% and 11% respectively. Table 5.17 displays the "sample market share" of the suppliers of the vans within the research sample fleet.

Table 5.17 Supplier "Sample Market Share" for Vans

Van		
Supplier	**Number in Sample Fleet**	**Percentage**
Ford Motor Company	5,932	39.6%
Chevrolet Motor Division-General Motors	2,851	19%
Coach and Equipment Manufacturing Company	1,647	11%
Dodge Division - Chrysler Corporation	1,012	6.8%
El Dorado National	729	4.9%
Braun	320	2.1%
Goshen Coach	304	2%
Startrans (Supreme Corporation)	290	1.9%
Champion Motor Coach Inc.	258	1.7%
General Motors Corporation	214	1.4%
World Trans Inc. (also Mobile-Tech Corporation)	136	0.9%
Canadian Vickers Ltd.	76	0.5%
Shepard Brothers Inc.	35	0.2%
Starcraft	34	0.2%
Tourstar	27	0.2%
Glaval Bus	24	0.2%
Wide One Corporation	24	0.2%
Nissho Iwai American Corporation	11	0.1%
Plymouth Division - Chrysler Corporation	11	0.1%
Transportation Manufacturing Company	11	0.1%
Thomas Built Buses	10	0.1%
Blue Bird Corporation	9	0.1%
Spartan Motors Inc.	7	0.05%
Diamond Coach Corporation	6	0.04%
International	4	0.03%
Collins Bus Corporation	3	0.02%
Dutcher Corporation	2	0.01%
Federal Coach	2	0.01%
Freightliner Corporation	1	0.01%
Kansas Coach Manufacturing	1	0.01%
Metrotrans Corporation	1	0.01%
National Mobility Corporation	1	0.01%
Wheeled Coach Industries Inc.	1	0.01%

It was more challenging to identify the suppliers of some vehicle types in the research sample fleet. This was due to either a low vehicle count within a specific vehicle category or to the fact that no suppliers were listed for specific vehicle types. There was one double-decker bus in the sample fleet, and it was supplied by New Flyer Industries. For the school bus category, while six school buses were in the sample fleet, only one was identified as being supplied by Ford Motor Company. No suppliers were identified for the other five school buses. While 539 taxicab vans were in the research sample fleet, no suppliers were identified for any of them.

5.3.2 Supplier "Sample Market Share" by Fuel Type

The number of vehicles each supplier supplied for each fuel type represented in the research sample fleet was determined.

In the research fleet sample 3,999 vehicles utilized biodiesel. Of these, Gillig Corporation supplied 41%. Gillig Corporation was followed by New Flyer Industries at 27.3%. El Dorado National had a mentionable "sample market share" of 9%. Motor Coach Industries International, Flexible Corporation, Startrans, Nova Bus Corporation, Goshen Coach, Chevrolet, and Glaval Bus each had between 1.4% and 3.4% of the "sample market share" for biodiesel. Each of the other suppliers' "sample market share" accounted for less than 1%. Table 518 displays the "sample market share" of suppliers of biodiesel vehicles to the research sample fleet.

Table 5.18 Supplier "Sample Market Share" for Biodiesel Vehicles

Biodiesel Vehicles		
Supplier	**Number in Sample Fleet**	**Percentage**
Gillig Corporation	1,639	41%
New Flyer Industries	1,090	27.3%
El Dorado National	358	9%
Motor Coach Industries International	134	3.4%
Flexible Corporation	130	3.3%
Startrans (Supreme Corporation)	128	3.2%
NOVA Bus Corporation	77	1.9%
Goshen Coach	74	1.9%
Chevrolet Motor Division-General Motors	56	1.4%
Glaval Bus	56	1.4%
Ford Motor Company	33	0.8%
Blue Bird Corporation	23	0.6%
Bus Industries of America	23	0.6%
Champion Motor Coach Inc.	23	0.6%
International	22	0.6%
Chance Bus Inc.	19	0.5%
General Motors Corporation	18	0.5%
Van Hool N.V.	16	0.4%
Spartan Motors Inc.	14	0.4%
Transportation Manufacturing Company	12	0.3%
No Supplier Listed	11	0.3%
Thomas Built Buses	9	0.2%
Orion Bus Industries Ltd.	8	0.2%
Diamond Coach Corporation	7	0.2%
Freightliner Corporation	7	0.2%
Coach and Equipment Manufacturing Company	3	0.1%
World Trans Inc.	3	0.1%
Sabre Bus and Coach Corporation	2	0.1%
Trolley Enterprises Inc.	2	0.1%
Overland Custom Coach Inc.	1	0.03%
Turtle Top	1	0.03%

For the compressed natural gas (CNG) vehicles, 3,904 in number, the supplier with the most significant share of vehicles was New Flyer Industries at 41%. New Flyer Industries was followed by Orion Bus Industries Ltd. at 18.2% and North America Bus Industries Inc. at 16.8%. Supplying a relatively significant proportion was Bus Industries of America at 7.8%. Neoplan USA Corporation, El Dorado National, Motor Coach Industries International, Nova Bus Corporation, Thomas Built Buses, Goshen Coach, and Ford Motor Company each supplied between 1% and 3.1% of the vehicles in the research sample fleet that utilized compressed natural gas (CNG). Each of the other suppliers' "sample market share" accounted for less than 1%. Table 5.19 displays the "sample market share" of suppliers of compressed natural gas (CNG) vehicles to the research sample fleet.

Table 5.19 Supplier "Sample Market Share" for CNG Vehicles

Compressed Natural Gas (CNG) Vehicles		
Supplier	**Number in Sample Fleet**	**Percentage**
New Flyer Industries	1,599	41%
Orion Bus Industries Ltd.	709	18.2%
North American Bus Industries Inc.	656	16.8%
Bus Industries of America	306	7.8%
Neoplan - USA Corporation	120	3.1%
El Dorado National	111	2.8%
Motor Coach Industries International	73	1.9%
NOVA Bus Corporation	49	1.3%
Thomas Built Buses	46	1.2%
Goshen Coach	40	1%
Ford Motor Company	38	1%
Chance Manufacturing Company	35	0.9%
Transportation Manufacturing Company	25	0.6%
No Supplier Listed	34	0.9%
Blue Bird Corporation	15	0.4%
Flexible Corporation	14	0.4%
Starcraft	13	0.3%
Dodge Division - Chrysler Corporation	8	0.2%
Champion Motor Coach Inc.	5	0.1%
Oshkosh Truck Corporation	4	0.1%
Gillig Corporation	2	0.1%
Glaval Bus	1	0.03%
Startrans (Supreme Corporation)	1	0.03%

The vehicles utilizing diesel were the largest vehicle segment in the research sample fleet, numbering 35,136 and accounting for 58.6%. For these vehicles, three suppliers had significant "sample market share". These suppliers were New Flyer Industries at 19.2%, Gillig Corporation at 17.7%, and NOVA Bus Corporation at 11.5%. Relatively significant "sample market share" was experienced by North American Bus Industries Inc., Ford Motor Company, Motor Coach Industries International, and Coach and Equipment Manufacturing Company at 7.4%, 7.2%, 6.1%, and 4.3% respectively. El Dorado National, Flexible Corporation, Neoplan USA Corporation, and Orion Bus Industries Ltd. each supplied between 2.6% and 3.4% of the vehicles utilizing diesel in the research sample fleet. Table 5.20 displays the "sample market share" of suppliers of diesel vehicles to the research sample fleet.

Table 5.20 Supplier "Sample Market Share" for Diesel Vehicles

Diesel Vehicles		
Supplier	**Number in Sample Fleet**	**Percentage**
New Flyer Industries	6,742	19.2%
Gillig Corporation	6,233	17.7%
NOVA Bus Corporation	4,039	11.5%
North American Bus Industries Inc.	2,592	7.4%
Ford Motor Company	2,521	7.2%
Motor Coach Industries International	2,132	6.1%
Coach and Equipment Manufacturing Company	1,515	4.3%
El Dorado National	1,193	3.4%
Flexible Corporation	1,175	3.3%
No Supplier Listed	1,309	3.7%
Neoplan - USA Corporation	1,044	3.%
Orion Bus Industries Ltd.	916	2.6%
Bus Industries of America	460	1.3%
Champion Motor Coach Inc.	414	1.2%
Goshen Coach	392	1.1%
Startrans (Supreme Corporation)	354	1%
Blue Bird Corporation	335	1%
Chevrolet Motor Division-General Motors	314	0.9%
Chance Bus Inc.	282	0.8%
Transportation Manufacturing Company	229	0.7%
General Motors of Canada Ltd.	170	0.5%
Thomas Built Buses	139	0.4%
World Trans Inc. (Mobile-Tech Corp.)	137	0.4%
Turtle Top	69	0.2%
International	65	0.2%
Starcraft	60	0.2%
Mid Bus Inc.	49	0.1%
Oshkosh Truck Corporation	50	0.1%
Glaval Bus	41	0.1%
Cable Car Concepts Inc.	27	0.1%
Wide One Corporation	24	0.1%
Freightliner Corporation	13	0.04%
Van Hool N.V.	15	0.04%
Collins Bus Corporation	12	0.03%
Spartan Motors Inc.	11	0.03%
Overland Custom Coach Inc.	7	0.02%
Prevost Car Inc.	8	0.02%
Shepard Brothers Inc.	6	0.02%
Allen Ashley Inc.	2	0.01%
AM General Corporation	2	0.01%
American MAN Corporation	5	0.01%
Diamond Coach Corporation	5	0.01%
Dodge Division - Chrysler Corporation	3	0.01%
Dutcher Corporation	2	0.01%
Eagle Bus Manufacturing	4	0.01%

Table 5.20 (continued)		
Plymouth Division - Chrysler Corporation	4	0.01%
Rico Industries	2	0.01%
Specialty Vehicle Manufacturing Corporation	4	0.01%
Status Specialty Vehicles	2	0.01%
Trolley Enterprises Inc.	4	0.01%
Boyertown Auto Body Works	1	0.003%
Braun	1	0.003%
Metrotrans Corporation	1	0.003%

For the dual fuel vehicles in the research sample, 3,271 in number, the supplier with the most significant "sample market share" was Bus Industries of America at 37.7%. Bus Industries of America was followed by Gillig Corporation at 28% and New Flyer Industries at 10.3%. Goshen Coach, Ford Motor Company, El Dorado National, NOVA Bus Corporation, Coach Equipment and Manufacturing Company, Transportation Manufacturing Company, North American Bus Industries Inc., and Thomas Built Buses each supplied between 1.1% and 3.8% of the dual fuel vehicles in the research sample fleet. Each of the other suppliers' "sample market share" accounted for less than 1%. Table 5.21 displays the "sample market share" of the suppliers of the dual fuel vehicles to the research sample fleet.

The 271 electric battery and propulsion vehicles in the research sample fleet were supplied by four suppliers. Gillig Corporation supplied 36.9% of the vehicles. Breda Transportation Inc. followed at 21.8%, then AAI/Skoda at 21% and New Flyer Industries at 14%. Table 5.22 displays the "sample market share" of the suppliers of the electric battery and propulsion vehicles in the research sample fleet.

Table 5.21 Supplier "Sample Market Share" for Dual Fuel Vehicles

Dual Fuel Vehicles		
Supplier	**Number in Sample Fleet**	**Percentage**
Bus Industries of America	1234	37.7%
Gillig Corporation	915	28.0%
New Flyer Industries	336	10.3%
Goshen Coach	125	3.8%
Ford Motor Company	116	3.6%
El Dorado National	112	3.4%
NOVA Bus Corporation	108	3.3%
Coach and Equipment Manufacturing Company	77	2.4%
Transportation Manufacturing Company	73	2.2%
North American Bus Industries Inc.	45	1.4%
Thomas Built Buses	37	1.1%
Motor Coach Industries International	18	0.6%
Flexible Corporation	17	0.5%
No Supplier Listed	23	0.7%
Chance Bus Inc.	11	0.3%
Blue Bird Corporation	10	0.3%
Startrans (Supreme Corporation)	10	0.3%
Cable Car Concepts Inc.	2	0.1%
Overland Custom Coach Inc.	2	0.1%

Table 5.22 Supplier "Sample Market Share" for Electric Battery and Propulsion Vehicles

Electric Battery and Propulsion Vehicles		
Supplier	**Number in Sample Fleet**	**Percentage**
Gillig Corporation	100	36.9%
Breda Transportation Inc.	59	21.8%
AAI/Skoda	57	21%
New Flyer Industries	38	14%
No Supplier Listed	17	6.3%

Vehicles utilizing gasoline accounted for the second-largest number of vehicles in the research sample fleet at 11,340, or 18.9%. For vehicles utilizing gasoline, two suppliers had significant "sample market share." Ford Motor Company was first at 36.8%, and Chevrolet Motor Division was second at 23.5%. Significant "sample market share" for gasoline vehicles was experienced by Dodge and El Dorado National at 8.8% and 5% respectively. Coach and Equipment Manufacturing Company, Braun, Champion Motor Coach Inc., Goshen Coach, and General Motors Corporation each supplied between 1% and 3.9% of the vehicles utilizing gasoline in the research sample fleet. Each of the other suppliers' "sample market share" accounted for less than 1% of the vehicles utilizing gasoline in the research sample fleet. Table 5.23 displays the "sample market share" of the suppliers of the vehicles utilizing gasoline in the research sample fleet.

For hybrid diesel vehicles, 1,180 in number, the supplier that supplied the most vehicles was New Flyer Industries at 61.1%, followed by Gillig Corporation at 11.3%. North American Bus Industries Inc., Motor Coach Industries International, Orion Bus Industries Ltd., and Van Hool N.V. supplied 9.6%, 8.6%, 5.2%, and 3.6% of hybrid diesel vehicles respectively. Each of the other suppliers' "sample market share" accounted for less than 1% of the vehicles utilizing hybrid diesel in the research sample fleet. Table 5.24 displays the “sample market share” of suppliers of hybrid diesel vehicles in the research sample fleet.

Vehicles utilizing Liquefied Natural Gas (LNG) numbered 814 in the research sample fleet. North American Bus Industries Inc. supplied 73% of these vehicles while NOVA Bus Corporation supplied 22%. El Dorado National and New Flyer Industries supplied 3% and 2% of the liquefied natural gas (LNG) vehicles respectively. Table 5.25 displays the “sample market share” of suppliers of vehicles utilizing liquefied natural gas (LNG) in the research sample fleet.

Table 5.23 Supplier “Sample Market Share” for Gasoline Vehicles

Gasoline Vehicles	Number in Sample Fleet	Percentage
Ford Motor Company	4,173	36.8%
Chevrolet Motor Division-General Motors	2,668	23.5%
No Supplier Listed	1,385	12.2%
Dodge Division - Chrysler Corporation	1,001	8.8%
El Dorado National	566	5%
Coach and Equipment Manufacturing Company	445	3.9%
Braun	319	2.8%
Champion Motor Coach Inc.	158	1.4%
Goshen Coach	126	1.1%
General Motors Corporation	109	1%
Starcraft	100	0.9%
Canadian Vickers Ltd.	51	0.5%
Startrans (Supreme Corporation)	41	0.4%
Shepard Brothers Inc.	35	0.3%
Glaval Bus	34	0.3%
Collins Bus Corporation	33	0.3%
Tourstar	27	0.2%
Van Hool N.V.	16	0.1%
Nissho Iwai American Corporation	11	0.1%
Transportation Manufacturing Company	11	0.1%
Plymouth Division - Chrysler Corporation	7	0.1%
Eagle Bus Manufacturing	6	0.1%
Turtle Top	4	0.04%
Diamond Coach Corporation	3	0.03%
New Flyer Industries	3	0.03%
Federal Coach	2	0.02%
Spartan Motors Inc.	2	0.02%
Asea Brown Boveri Ltd.	1	0.01%
Kansas Coach Manufacturing	1	0.01%
National Mobility Corporation	1	0.01%
Wheeled Coach Industries Inc.	1	0.01%

Table 5.24 Supplier "Sample Market Share" for Hybrid Diesel Vehicles

Hybrid Diesel Vehicles		
Supplier	**Number in Sample Fleet**	**Percentage**
New Flyer Industries	721	61.1%
Gillig Corporation	133	11.3%
North American Bus Industries Inc.	113	9.6%
Motor Coach Industries International	102	8.6%
Orion Bus Industries Ltd.	61	5.2%
Van Hool N.V.	43	3.6%
El Dorado Bus	5	0.4%
Transcoach	2	0.2%

Table 5.25 Supplier "Sample Market Share" for LNG Vehicles

Liquefied Natural Gas (LNG) Vehicles		
Supplier	**Number in Sample Fleet**	**Percentage**
North American Bus Industries Inc.	591	73%
NOVA Bus Corporation	181	22%
El Dorado National	28	3%
New Flyer Industries	14	2%

There were 52 vehicles utilizing liquefied petroleum gas (LPG) in the research sample fleet. Six suppliers provided them. Champion Motor Coach Inc. supplied 26.9%, followed by General Motors Corporation at 19.2%, Chance Bus Inc. at 9.6%, Ford Motor Company at 7.7%, and El Dorado National and Goshen Coach, both at 5.8%. Table 5.26 displays the "sample market share" of suppliers of vehicles utilizing liquefied natural petroleum (LPG) in the research sample fleet.

Various types of fuels were utilized less by vehicles in the research sample fleet. Eight vehicles utilized bunker fuel, and they were all supplied by Goshen Coach. Three vehicles utilized grain additive.

Table 5.26 Supplier "Sample Market Share" for LPG Vehicles

Liquefied Petroleum Gas (LPG) Vehicles		
Supplier	**Number in Sample Fleet**	**Percentage**
No Supplier Listed	14	26.9%
Champion Motor Coach Inc.	13	25%
General Motors Corporation	10	19.2%
Chance Bus Inc.	5	9.6%
Ford Motor Company	4	7.7%
El Dorado National	3	5.8%
Goshen Coach	3	5.8%

Two of these vehicles were supplied by Ford Motor Company while one was supplied by Chevrolet. New Flyer Industries and Startrans were the two suppliers of the sample fleet's 19 hybrid gasoline vehicles at supply rates of 84.2% and 10.5% respectively. No supplier was listed for one of the hybrid gasoline vehicles.

5.3.3 Supplier "Sample Market Share" by FTA Region

The top five vehicle suppliers in each FTA region were identified. For FTA Region 1 New Flyer Industries supplied 21.4% of the 2,860 vehicles in the sample operating in that region. New Flyer Industries was followed by Ford Motor Company at 18.2%, NOVA Bus Corporation at 14.2%, North American Bus Industries Inc. at 10.5% and Neoplan USA Corporation at 8.3%.

For FTA Region 2, 11,528 vehicles in the sample operated there. NOVA Bus Corporation supplied 17.7% of those vehicles while Bus Industries of America supplied 16.9%. Motor Coach Industries International, Coach and Equipment Manufacturing Company, and New Flyer Industries supplied 14.2%, 11.6%, and 11.6% of the region's vehicles in the research sample fleet.

The top five vehicle suppliers for FTA Region 3's 8,209 vehicles were New Flyer Industries at 18.9%, Gillig Corporation at 13.6%, Ford Motor Company at 11.2%, Orion Bus Industries Ltd. at 10.1%, and Coach and Equipment Manufacturing Company and North American Bus Industries Inc., both at 8.5%.

Of the research sample fleet's 6,257 Region 4 vehicles, Gillig Corporation supplied 25.8%. Gillig Corporation was followed by Ford Motor Company at 16.1%, North American Bus Industries Inc. at 14.1%, Nova Bus Corporation at 6%, and both Chevrolet and Dodge at 3.1%.

In FTA Region 5, New Flyer Industries supplied 29.2% of the region's vehicles represented in the research sample fleet, and Gillig Corporation supplied 22.9%, followed by Nova Bus Corporation at 9.4%, North American Bus Industries Inc. at 6%, and El Dorado National at 5.7%. There were 9,295 vehicles from FTA Region 5.

In FTA Region 6 there were 6,427 vehicles. New Flyer Industries supplied 24% of the sample while Ford Motor Company supplied 15.6%, followed by NOVA Bus Corporation at 9.6%, North American Bus Industries Inc. at 6.9%, and Gillig Corporation at 5.5%.

In Region 7, of 1,022 vehicles, Gillig Corporation supplied 55.2% of the vehicles, followed by Chevrolet at 13.1%, Ford Motor Company at 9.7%, New Flyer Industries at 4.6%, and Orion Bus Industries Ltd. at 3.8%.

In FTA Region 8, Ford Motor Company supplied 42.7% of the vehicles while Gillig Corporation supplied 29.4%, followed by Chevrolet at 13.1%, Motor Coach Industries International at 4.3% and Chance Bus Inc. at 3.2%. There were 1,511 vehicles from FTA Region 8.

In Region 9, of 5,999 vehicles, New Flyer Industries supplied 25%, followed by Gillig Corporation at 17.5%, North American Bus Industries Inc. at 14.1%, El Dorado National at 12.9%, and Ford Motor Company at 10.4%.

In FTA Region 10 there were 6,897 vehicles. Chevrolet supplied 26.5% while New Flyer Industries supplied 22%, followed by Gillig Corporation at 20.1%, Ford Motor Company at 10.6%, and El Dorado National at 6%.

Table 5.27 displays the top five vehicle suppliers by FTA Region. The full list of suppliers for each FTA region can be seen in Appendix IV.

Table 5.27 Top 5 Suppliers by FTA Region

Supplier Rank	FTA Region				
	1 (2,860)	**2 (11,528)**	**3 (8,209)**	**4 (6,257)**	**5 (9,295)**
1	New Flyer 21.4%	NOVA Bus 17.7%	New Flyer 18.9%	Gillig 25.8%	New Flyer 29.2%
2	Ford Motor 18.2%	Bus Industries of America 16.9%	Gillig 13.6%	Ford Motor 16.1%	Gillig 22.9%
3	NOVA Bus 14.2%	Motor Coach 14.2%	Ford Motor 11.2%	NAB I Inc. 14.1%	NOVA Bus 9.4%
4	NABI Inc. 10.5%	Coach and Equipment 11.6%	Orion Bus 10.1%	NOVA Bus 6%	NABI Inc. 6%
5	Neoplan 8.3%	New Flyer 8.4%	Coach and Equipment/ NABI Inc. 8.5%	Chevrolet/ Dodge 3.1%	El Dorado 5.7%
1	New Flyer 24%	Gillig 55.2%	Ford Motor 42.7%	New Flyer 25%	Chevrolet 26.5%
2	Ford Motor 15.6%	Chevrolet 13.1%	Gillig 29.4%	Gillig 17.5%	New Flyer 22%
3	NOVA Bus 9.6%	Ford Motor 9.7%	Chevrolet 13.1%	NABI Inc. 14.1%	Gillig 20.1%
4	NABI Inc. 6.9%	New Flyer 4.6%	Motor Coach 4.3%	El Dorado 12.9%	Ford Motor 10.6%
5	Gillig 5.5%	Orion Bus 3.8%	Chance Bus 3.2%	Ford Motor 10.4%	El Dorado 6%

5.3.4 Supplier Attribute Perceived Importance

The importance of 10 vehicle supplier attributes as perceived by the 327 procurement decision-makers participating in the research was determined. The vehicle supplier attributes that were ranked and compared were after-sales support, delivery, integrity, performance history, price, procedural compliance, quality, reliability, technical capability, and warranties and claims. Each supplier attribute was scored on a 10-point Likert-type scale. The importance of each of the 10 supplier attributes was observed when procurement decision-makers evaluated both conventional vehicle suppliers and for alternative fuel vehicle suppliers. This was done to facilitate a comparison of how supplier's attributes are ranked between suppliers of these two types of vehicles.

The supplier attributes' ranks with respect to conventional fuel vehicles were observed. Reliability had the highest mean score at 9.11. It was followed by quality at 9.10, integrity at 8.65, warranties and claims at 8.64, after-sales support at 8.49, performance history at 8.63, procedural compliance at 8.14, price at 8.01, technical capability at 7.89, and delivery at 7.18. Table 5.28 displays the ranking of the supplier attributes for conventional fuel vehicle suppliers and their descriptive statistics. The statistics were computed using SAS®9.2 software. The software output for the summary statistics can be seen in Appendix V.

Table 5.28 Conventional Fuel Vehicle Supplier Attribute Ranking

Conventional Fuel Vehicle Supplier Attribute	Rank	Mean	Median	Variance	Standard Deviation
Reliability	1	9.11	9	1.25	1.19
Quality	2	9.10	9	1.48	1.27
Integrity	3	8.65	9	2.20	1.48
Warranties and Claims	4	8.64	9	2.16	1.47
After-Sales Support	5	8.49	9	2.71	1.65
Performance History	6	8.36	9	2.26	1.50
Procedural Compliance	7	8.14	8	3.26	1.80
Price	8	8.01	8	4.67	2.16
Technical Capability	9	7.89	8	3.25	1.80
Delivery	10	7.18	7	3.58	1.89

The variances and standard deviations for the vehicle supplier attributes for conventional fuel vehicles indicate that there are some attributes for which perceived importance is relatively more consistently important than others. Both the variances and standard deviations for the conventional fuel vehicle supplier attributes generally increased as the rank of importance of the attribute decreased. For example, reliability had the smallest variance and standard deviation at 1.25 and 1.19 respectively. This communicated that there was more consistency in assigning its perceived importance among research participants. Interestingly, reliability was ranked the most important vehicle supplier attribute when conventional fuel vehicle suppliers were evaluated.

Conversely, price had the largest variance and standard deviation, 4.67 and 2.16 respectively. This indicated that price's perceived importance had relatively less consistency in the perception of research participants. Interestingly, while not ranked as being least important, price was ranked eighth out of the ten conventional fuel vehicle supplier attributes that were ranked.

When observing the supplier attributes' importance with respect to alternative fuel vehicle suppliers, quality had the highest mean score at 9.36. It was followed by reliability at 9.14, after-sales support at 9.02, warranties and claims at 8.75, integrity at 8.68, technical capability at 8.61, performance history at 8.50, procedural compliance at 8.16, price at 7.49, and delivery at 7.14. Table 5.29 displays the ranking of the supplier attributes for alternative fuel vehicle suppliers and their descriptive statistics. The statistics were computed using SAS®9.2 software. Software output for the summary statistics can be seen in Appendix V.

As with the conventional fuel vehicle suppliers, the variances and standard deviations for the vehicle supplier attributes for alternative fuel vehicles indicate that there are some attributes for which perceived importance is relatively more consistently important than others.

Table 5.29 Alternative Fuel Vehicle Supplier Attribute Ranking

Alternative Fuel Vehicle Supplier Attribute	Rank	Mean	Median	Variance	Standard Deviation
Quality	1	9.36	10	1.30	1.14
Reliability	2	9.14	9	1.51	1.23
After-Sales Support	3	9.02	10	2.15	1.47
Warranties and Claims	4	8.75	9	2.20	1.48
Integrity	5	8.68	9	2.32	1.52
Technical Capability	6	8.61	9	2.75	1.66
Performance History	7	8.50	9	2.40	1.55
Procedural Compliance	8	8.16	8	3.43	1.85
Price	9	7.49	8	7.15	2.67
Delivery	10	7.14	7	3.88	1.97

Both the variances and standard deviations for the alternative fuel vehicle supplier attributes generally increased as the rank of importance of the attribute decreased. For example, quality had the smallest variance and standard deviation at 1.30 and 1.14 respectively. This communicated that there was more consistency in assigning its perceived importance among research participants. Interestingly, quality was ranked the most important vehicle supplier attribute when evaluating alternative fuel vehicle suppliers. Price had the largest variance and standard deviation values, 7.15 and 2.67 respectively. These indicated that price's perceived importance had relatively less consistency in the perception of research participants. Interestingly, while not ranked as being least important, price was ranked ninth out of the ten alternative fuel vehicle supplier attributes that were ranked.

The relative importance and rankings of the vehicle supplier attributes for both the conventional fuel vehicle suppliers and the alternative fuel vehicle suppliers were observed for any existing differences. Quality and reliability were the two most important vehicle supplier attributes for both types of vehicles. For conventional fuel vehicle suppliers, reliability was ranked first while quality was ranked first for alternative fuel vehicle suppliers. After-sales support, while being the third most important attribute for alternative fuel vehicle suppliers, was the fifth most important supplier attribute for conventional fuel vehicle suppliers, being preceded by integrity and warranties and claims respectively.

Technical capability was the sixth most important supplier attribute for alternative fuel vehicles. However, it was ranked ninth with respect to the most important conventional fuel vehicle supplier attributes. Performance history, procedural compliance, and price were deemed more important.

It is important to note the lesser relative importance of price for both types of vehicle suppliers. It was ranked eighth and ninth most important when suppliers of both vehicle types were evaluated. Of note, for the suppliers of both types of vehicles, the attribute of delivery was perceived to be the least important. Table 5.30 displays the comparison of the relative importance of vehicle supplier attributes.

Table 5.30 Comparison of Supplier Attribute Importance Rankings

Rank	Conventional Fuel Vehicle Supplier Attribute	Alternative Fuel Vehicle Supplier Attribute
1	Reliability	Quality
2	Quality	Reliability
3	Integrity	After-Sales Support
4	Warranties and Claims	Warranties and Claims
5	After-Sales Support	Integrity
6	Performance History	Technical Capability
7	Procedural Compliance	Performance History
8	Price	Procedural Compliance
9	Technical Capability	Price
10	Delivery	Delivery

5.3.5 Supplier Attribute Perceived Importance Hypothesis Testing

Six hypotheses were tested to determine whether or not there was sufficient evidence to assert that the perceived importance of specific vehicle supplier attributes varied according to specific factors. More specifically, the research hypothesized that there were differences in the relative importance of specific vehicle supplier attributes depending on whether or not they were being utilized in evaluating a conventional fuel vehicle supplier versus an alternative fuel vehicle supplier, or whether the procurement decision-maker conducting the supplier evaluation was employed at a public transportation agency that operated in an urban service area versus a non-urban service area. The tests were carried out using SAS®9.2 software. Software output for the summary statistics can be seen in Appendix VI.

The first hypothesis test, a two sample paired t-test for means, tested whether or not there was sufficient sample evidence to support the hypothesis that the vehicle supplier attribute quality is more important when evaluating suppliers of alternative fuel vehicles (Quality_a) than it is when evaluating suppliers of conventional fuel vehicles (Quality_c) i.e.

$$\mathbf{H_o}: \mu\,\text{Quality}_c \geq \mu\,\text{Quality}_a$$
$$\mathbf{H_a}: \mu\,\text{Quality}_c < \mu\,\text{Quality}_a$$

The test results, based on SAS®9.2 output, were

Hypothesis Test

Null hypothesis: Mean of (Quality c – Quality a) => 0
Alternative: Mean of (Quality c – Quality a) < 0

t Statistic	Df	Prob > t
-3.692	326	0.0001

The results showed that given the relatively high t statistic of -3.692 and the low p-value of 0.0001, the null hypothesis can be rejected at a 95% confidence level and it can be stated that sufficient sample evidence exists to conclude that the vehicle supplier attribute quality is more important when evaluating suppliers of alternative fuel vehicles than it is when evaluating suppliers of conventional fuel vehicles.

The second hypothesis test, a two sample paired t-test for means, tested whether or not there was sufficient sample evidence to support the hypothesis that the vehicle supplier attribute price is more important when evaluating suppliers of conventional fuel vehicles ($Price_c$) than it is when evaluating suppliers of alternative fuel vehicles ($Price_a$) i.e.

$$\mathbf{H_o}: \mu\ Price_c \leq \mu\ Price_a$$
$$\mathbf{H_a}: \mu\ Price_c > \mu\ Price_a$$

The test results, based on SAS®9.2 output, were

Hypothesis Test

Null hypothesis: Mean of (Price c – Price a) <= 0
Alternative: Mean of (Price c – Price a) > 0

t Statistic	Df	Prob > t
3.670	326	0.0001

The results showed that, given the relatively high t statistic of 3.670 and the low p-value of 0.0001, the null hypothesis can be rejected at a 95% confidence level, and it can be stated that sufficient sample evidence exists to conclude that the vehicle supplier attribute price is more important when evaluating suppliers of conventional fuel vehicles than it is when evaluating suppliers of alternative fuel vehicles.

The third hypothesis test, a two sample paired t-test for means, tested whether or not there was sufficient sample evidence to support the hypothesis that the vehicle supplier attribute after-sales support is more important when evaluating suppliers of alternative fuel vehicles (After-Sales $Support_a$) than it is when evaluating suppliers of conventional fuel vehicles (After-Sales $Support_c$) i.e.

$$\mathbf{H_o}: \mu\ \text{After-Sales } Support_c \geq \mu\ \text{After-Sales } Support_a$$
$$\mathbf{H_a}: \mu\ \text{After-Sales } Support_c < \mu\ \text{After-Sales } Support_a$$

The test results, based on SAS®9.2 output, were

Hypothesis Test

Null hypothesis: Mean of (After-Sales Support c – After-Sales Support a) => 0
Alternative: Mean of (After-Sales Support c – After-Sales Support a) < 0

t Statistic	Df	Prob > t
-7.090	326	0.0001

The results showed that, given the relatively high t statistic of -7.090 and the low p-value of 0.0001, the null hypothesis can be rejected at a 95% confidence level, and it can be stated that sufficient sample evidence exists to conclude that the vehicle supplier attribute after-sales support is more important when evaluating suppliers of alternative fuel vehicles than it is when evaluating suppliers of conventional fuel vehicles.

The fourth hypothesis test, a two sample paired t-test for means, tested whether or not there was sufficient sample evidence to support the hypothesis that the vehicle supplier attribute technical capability is more important when evaluating suppliers of alternative fuel vehicles (Technical Capability $_a$) than it is when evaluating suppliers of conventional fuel vehicles (Technical Capability $_c$), i.e.,

$$\mathbf{H_o}: \mu \text{ Technical Capability}_c \geq \mu \text{ Technical Capability}_a$$
$$\mathbf{H_a}: \mu \text{ Technical Capability}_c < \mu \text{ Technical Capability}_a$$

The test results, based on SAS®9.2 output, were

Hypothesis Test

Null hypothesis: Mean of (Technical Capability c – Technical Capability a) => 0
Alternative: Mean of (Technical Capability c – Technical Capability a) < 0

t Statistic	Df	Prob > t
-8.293	326	0.0001

The results showed that, given the relatively high t statistic of -8.293 and the low p-value of 0.0001, the null hypothesis can be rejected at a 95% confidence level, and it can be stated that sufficient sample evidence exists to conclude that the vehicle supplier attribute technical capability is more important when evaluating suppliers of alternative fuel vehicles than it is when evaluating suppliers of conventional fuel vehicles.

The fifth hypothesis test, a two sample paired t-test for means, tested whether or not there was sufficient sample evidence to support the hypothesis that the vehicle supplier attribute warranties and claims is more important when evaluating suppliers of alternative fuel vehicles (Warranties and Claims $_a$) than it is when evaluating suppliers of conventional fuel vehicles (Warranties and Claims $_c$) i.e.

$$\mathbf{H_o}: \mu \text{ Warranties and Claims}_c \geq \mu \text{ Warranties and Claims}_a$$
$$\mathbf{H_a}: \mu \text{ Warranties and Claims}_c < \mu \text{ Warranties and Claims}_a$$

The test results, based on SAS®9.2 output, were

Hypothesis Test

Null hypothesis: Mean of (Warranties and Claims c – Warranties and Claims a) => 0
Alternative: Mean of (Warranties and Claims c – Warranties and Claims a) < 0

t Statistic	Df	Prob > t
-1.637	326	0.0513

The results showed that given the relatively low t statistic of -1.637 and the high p-value of 0.0513, there is not sufficient sample evidence to reject the null hypothesis at a 95% confidence level and conclude that the vehicle supplier attribute warranties and claims is more important when evaluating suppliers of alternative fuel vehicles than it is when evaluating suppliers of conventional fuel vehicles.

The sixth hypothesis test, a two sample t-test for means, tested whether or not there was sufficient sample evidence to support the hypothesis that the vehicle supplier attribute price is more important when procurement decision-makers employed at public transportation agencies that operate in non-urban service areas are evaluating suppliers of conventional fuel vehicles (Price $_{nu}$) than the importance of price in supplier evaluations by those procurement decision-makers employed at a public transportation agencies that operate in urban service areas ($Price_u$).

$$H_o: \mu\, Price_u \geq \mu\, Price_{nu}$$
$$H_a: \mu\, Price_u < \mu\, Price_{nu}$$

To test the hypothesis for means, a hypothesis test for variance of the means was required first to determine if the variances between the two groups of procurement decision-makers were equal or not. The test results for both these hypothesis tests, based on SAS®9.2 output, were

Group	N	Mean	Std. Dev.	Std. Error
Price U	226	7.880531	2.2468	0.1495
Price NU	101	8.306931	1.9377	0.1928

Hypothesis Test: Variance

Null hypothesis: Variance 1 / Variance 2 = 1
Alternative: Variance 1 / Variance 2 ≥ 1

- Degrees of Freedom -

F	Numer.	Denom.	Pr > F
1.34	225	100	0.0927

Hypothesis Test: Means

Null hypothesis: Mean 1 - Mean 2 => 0
Alternative: Mean 1 - Mean 2 < 0

If Variances Are	t statistic	Df	Pr > t
Equal	-1.652	325	0.0497
Not Equal	-1.748	220.83	0.0409

The results for the test for variance showed that the variances between the groups' means were different. The results for the test of means showed that, given the t-statistic when variances are not equal of -1.652 and the p-value of 0.0409, the null hypothesis can be rejected at a 95% confidence level, and it can be stated that sufficient sample evidence exists to conclude that the vehicle supplier attribute price is more important to procurement decision-makers employed at public transportation agencies that operate in non-urban service areas when evaluating suppliers of conventional fuel vehicles than it is to their counterparts at a public transportation agencies that operate in urban service areas. However, it must be noted that the relatively low t-statistic, coupled with the relatively high p-value, renders the strength of this statistical conclusion as needing more sample evidence to further substantiate the conclusion. This could probably be achieved by comparing the groups when they have more equal sample sizes.

5.3.6. Influences on Perceived Importance of Supplier Attributes

The variances in the scores assigned to each vehicle supplier attribute by research participants were observed to determine whether or not they could have been influenced by either, or a combination of, public transportation agency or procurement decision-maker characteristics. More specifically, the variance in the scores assigned to each vehicle supplier attribute for both conventional and alternative fuel vehicle suppliers was observed to determine whether it was correlated to either the urban classification of a public transportation agency, the FTA region in which a public transportation agency operated, the number of vehicles in an agency's fleet, the capital expenditure of an agency, an agency's procurement decision-maker's level of education, and an agency's procurement decision-maker's years of relevant procurement related experience.

The approach generally used in determining correlation or relationships consists of two steps. In the first step an analysis of variance is conducted to test for significant variance within and between groups for which values of the observed variable or dependent variable are recorded. If variance is determined to be significant, the second step involves developing a linear regression model to determine how much the variation in the dependent variable can be explained by variations in the independent variables.

In this research, the least squares method is used to determine whether any relationships exist between any of the vehicle supplier attributes' variations in scores and any of the variations in public transportation agency or procurement decision-maker characteristics.

The six independent variables utilized in the analysis consisted of three categorical or design variables and three continuous or regressor variables. The three categorical or design variables comprised of the urban classification of a public transportation agency, the FTA region in which a public transportation agency operated, and an agency's procurement decision-maker's level of education. The three continuous or regressor variables comprised the number of vehicles in an agency's fleet, the capital expenditure of an agency, and an agency's procurement decision-maker's years of relevant procurement related experience.

Given the combination of both categorical and continuous independent variables, an analysis of covariance (ANCOVA) method was utilized to test for significance in relationships with the dependent supplier attribute variable scores.

The analysis of covariance (ANCOVA) method combines both analysis of variance (ANOVA) and regression analysis by introducing continuous variables, or covariates, into conventional ANOVA experiments (Rutherford 2001). In ANCOVA, the covariates, or continuous independent variables, are introduced into the model to facilitate determining the effects of the categorical independent variables on the dependent variables with more accuracy (Rutherford 2001).

The GLM (Generalized Linear Model) procedure in SAS®9.2 was used to conduct the ANCOVA tests. Each supplier attribute for each of the two general vehicle fuel types was tested. This resulted in 20 ANCOVA tests being conducted.

The F statistic and p-values for each of the 20 tested vehicle supplier attributes were observed for significance. The R-Square value for each test was also observed to determine the level of variation in the score of the specific vehicle supplier attribute being tested that could have been attributed to the effect of any or a combination of the independent variables.

Eighteen of the 20 vehicle supplier attributes that were tested had p-values that ranged from 0.0823 to 0.5442, according to a significance level of 5% or $\alpha = 0.05$. This communicated that for 18 of the 20 vehicle supplier attributes tested, none of the independent variables could explain the variations in their respective supplier attribute scores with significance.

The corresponding *F* test statistic values for the 20 tests ranged from 0.93 to 1.91 (two of these were in tests that were significant and are discussed in a subsequent section). Additionally, the highest R-Square value of all the tests was 0.129477, indicating that the level of variation in supplier attribute scores was not significantly explained by any of the six independent variables, though for two of the attributes their p-values resulted in their being significant. These two attributes, the integrity of conventional fuel vehicle suppliers and the warranties and claims offered by alternative fuel vehicle suppliers, are discussed in a subsequent section.

Tables 5.31 to 5.50 display the results of the ANCOVA tests for each vehicle supplier attribute. The SAS®9.2 coding and output for each test is in Appendix VII.

Table 5.31 ANCOVA Results for After-Sales Support (Alternative Fuel Vehicle)

After-sales support (Alternative Fuel Vehicle)					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	17	38.6945366	2.2761492	1.16	0.3020
Error	218	428.7758023	1.9668615		
Corrected Total	235	467.4703390			
	R-Square	**Coefficient of Variation**	**Root MSE**	**After-sales support $_a$ Mean**	
	0.082774	15.44460	1.402448	9.080508	

Table 5.32 ANCOVA Results for After-Sales Support (Conventional Fuel Vehicle)

After-sales support (Conventional Fuel Vehicle)					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	17	59.6056303	3.5062135	1.34	0.1676
Error	218	568.7842002	2.6091018		
Corrected Total	235	628.3898305			
	R-Square	**Coefficient of Variation**	**Root MSE**	**After-sales support $_c$ Mean**	
	0.094855	18.89019	1.615271	8.550847	

Table 5.33 ANCOVA Results for Delivery (Alternative Fuel Vehicle)

Delivery (Alternative Fuel Vehicle)					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	17	61.4426231	3.6142719	1.00	0.4587
Error	218	787.3836481	3.6118516		
Corrected Total	235	848.8262712			
	R-Square	**Coefficient of Variation**	**Root MSE**	**Delivery$_a$ Mean**	
	0.072385	26.36772	1.900487	7.207627	

Table 5.34 ANCOVA Results for Delivery (Conventional Fuel Vehicle)

Delivery (Conventional Fuel Vehicle)					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	17	53.4456112	3.1438595	0.93	0.5442
Error	218	740.1984566	3.3954058		
Corrected Total	235	793.6440678			
	R-Square	**Coefficient of Variation**	**Root MSE**	**$Delivery_c$ Mean**	
	0.067342	25.49053	1.842663	7.228814	

Table 5.35 ANCOVA Results for Integrity (Alternative Fuel Vehicle)

Integrity (Alternative Fuel Vehicle)					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	17	40.7952241	2.3997191	1.14	0.3148
Error	218	457.7471488	2.0997576		
Corrected Total	235	498.5423729			
	R-Square	**Coefficient of Variation**	**Root MSE**	**$Integrity_a$ Mean**	
	0.081829	16.50467	1.449054	8.779661	

Table 5.36 ANCOVA Results for Integrity (Conventional Fuel Vehicle)

Integrity (Conventional Fuel Vehicle)					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	17	58.4377332	3.4375137	1.68	0.0483
Error	217	444.3026924	2.0474778		
Corrected Total	234	502.7404255			
	R-Square	**Coefficient of Variation**	**Root MSE**	**$Integrity_c$ Mean**	
	0.116238	16.43508	1.430901	8.706383	

Table 5.37 ANCOVA Results for Performance History (Alternative Fuel Vehicle)

Performance History (Alternative Fuel Vehicle)					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	17	50.4491287	2.9675958	1.45	0.1167
Error	218	446.9873119	2.0504005		
Corrected Total	235	497.4364407			
	R-Square	**Coefficient of Variation**	**Root MSE**	**Performance $History_a$ Mean**	
	0.101418	16.60607	1.431922	8.622881	

Table 5.38 ANCOVA Results for Performance History (Conventional Fuel Vehicle)

Performance History (Conventional Fuel Vehicle)					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	17	41.0776100	2.4163300	1.06	0.3979
Error	218	498.2274748	2.2854471		
Corrected Total	235	539.3050847			
	R-Square	**Coefficient of Variation**	**Root MSE**	**Performance $History_c$ Mean**	
	0.076168	17.96463	1.511770	8.415254	

Table 5.39 ANCOVA Results for Price (Alternative Fuel Vehicle)

Price (Alternative Fuel Vehicle)					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	17	173.724089	10.219064	1.54	0.0823
Error	218	1444.852183	6.627762		
Corrected Total	235	1618.576271			
	R-Square	**Coefficient of Variation**	**Root MSE**	**$Price_a$ Mean**	
	0.107331	34.52095	2.574444	7.457627	

Table 5.40 ANCOVA Results for Price (Conventional Fuel Vehicle)

Price (Conventional Fuel Vehicle)					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	17	103.388527	6.081678	1.30	0.1966
Error	218	1023.098761	4.693114		
Corrected Total	235	1126.487288			
	R-Square	**Coefficient of Variation**	**Root MSE**	**$Price_c$ Mean**	
	0.091780	27.23819	2.166360	7.953390	

Table 5.41 ANCOVA Results for Procedural Compliance (Alternative Fuel Vehicle)

Procedural Compliance (Alternative Fuel Vehicle)					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	17	62.8722079	3.6983652	1.20	0.2646
Error	218	670.8735548	3.0774016		
Corrected Total	235	733.7457627			
	R-Square	**Coefficient of Variation**	**Root MSE**	**Procedural Compliance_a Mean**	
	0.085687	21.27459	1.754252	8.245763	

Table 5.42 ANCOVA Results for Procedural Compliance (Conventional Fuel Vehicle)

Procedural Compliance (Conventional Fuel Vehicle)					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	17	71.5340236	4.2078837	1.42	0.1308
Error	218	648.1058069	2.9729624		
Corrected Total	235	719.6398305			
	R-Square	**Coefficient of Variation**	**Root MSE**	**Procedural Compliance_c Mean**	
	235	719.6398305	1.724228	8.199153	

Table 5.43 ANCOVA Results for Quality (Alternative Fuel Vehicle)

Quality (Alternative Fuel Vehicle)					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	17	16.7393997	0.9846706	0.95	0.5206
Error	218	226.8877189	1.0407694		
Corrected Total	235	243.6271186			
	R-Square	**Coefficient of Variation**	**Root MSE**	**Quality_a Mean**	
	0.068709	10.82566	1.020181	9.423729	

Table 5.44 ANCOVA Results for Quality (Conventional Fuel Vehicle)

Quality (Conventional Fuel Vehicle)					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	17	22.0618235	1.2977543	0.93	0.5350
Error	218	302.9720748	1.3897802		
Corrected Total	235	325.0338983			
	R-Square	**Coefficient of Variation**	**Root MSE**	**Quality_c Mean**	
	0.067875	12.82110	1.178889	9.194915	

Table 5.45 ANCOVA Results for Reliability (Alternative Fuel Vehicle)

Reliability (Alternative Fuel Vehicle)					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	17	29.3686046	1.7275650	1.29	0.2036
Error	218	293.0508869	1.3442701		
Corrected Total	235	322.4194915			
	R-Square	**Coefficient of Variation**	**Root MSE**	**$Reliability_a$ Mean**	
	0.091088	12.61525	1.159427	9.190678	

Table 5.46 ANCOVA Results for Reliability (Conventional Fuel Vehicle)

Reliability (Conventional Fuel Vehicle)					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	17	31.3180975	1.8422410	1.31	0.1900
Error	218	307.4403771	1.4102770		
Corrected Total	235	338.7584746			
	R-Square	**Coefficient of Variation**	**Root MSE**	**$Reliability_c$ Mean**	
	0.092450	13.05366	1.187551	9.097458	

Table 5.47 ANCOVA Results for Technical Capability (Alternative Fuel Vehicle)

Technical Capability (Alternative Fuel Vehicle)					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	17	36.3018267	2.1354016	0.94	0.5287
Error	218	495.6769869	2.2737476		
Corrected Total	235	531.9788136			
	R-Square	**Coefficient of Variation**	**Root MSE**	**Technical $Capability_a$ Mean**	
	0.068239	17.30011	1.507895	8.716102	

Table 5.48 ANCOVA Results for Technical Capability (Conventional Fuel Vehicle)

Technical Capability (Conventional Fuel Vehicle)					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	17	61.9701722	3.6453042	1.11	0.3485
Error	218	718.0764380	3.2939286		
Corrected Total	235	780.0466102			
	R-Square	**Coefficient of Variation**	**Root MSE**	**Technical $Capability_c$ Mean**	
	0.079444	22.86816	1.814918	7.936441	

Table 5.49 ANCOVA Results for Warranties and Claims (Alternative Fuel Vehicle)

Warranties and Claims (Alternative Fuel Vehicle)					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	17	67.2686273	3.9569781	1.91	0.0186
Error	218	452.2737456	2.0746502		
Corrected Total	235	519.5423729			
	R-Square	**Coefficient of Variation**	**Root MSE**	**Warranties and Claims$_a$ Mean**	
	0.129477	16.51730	1.440365	8.720339	

Table 5.50 ANCOVA Results for Warranties and Claims (Conventional Fuel Vehicle)

Warranties and Claims (Conventional Fuel Vehicle)					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	17	56.5106568	3.3241563	1.47	0.1094
Error	218	494.6206991	2.2689023		
Corrected Total	235	551.1313559			
	R-Square	**Coefficient of Variation**	**Root MSE**	**Warranties and Claims$_c$ Mean**	
	0.102536	17.53744	1.506288	8.588983	

Table 5.36 and Table 5.39 display results showing that two of the 20 vehicle attribute tests were significant. These tests included results for evaluating suppliers of conventional fuel vehicles on integrity (F = 1.68, p-value = 0.0483) and when evaluating suppliers of alternative fuel vehicles on warranties and claims (F = 1.91, p-value = 0.0186). These tests had R-Square values of 0.116238 and 0.129477 respectively. Because of the relative significance of these tests, the effects of the independent variables on the variation in each of these supplier attribute's scores were tested.

The effects on both of the supplier attributes' scores were tested by observing the sum of squares (*SS*) for each of the six independent variables and their corresponding *F*-values and p-values. Two SS types are generated using the PROC GLM in SAS®9.2, the Type I SS and Type III SS. Type I SS measures the difference between the arithmetic means of the dependent variable for each of the categorical variables and disregards the effects of the covariates or continuous variables. Type III SS measures the difference between the least square (LS) means, adjusted for the effects of the covariates in the model (Rutherford 2001). The Type III SS was utilized in testing for effects in this research because 1) it adjusted for the effects of covariates and 2) it is the preferred method when testing unbalanced data samples because it tests a function of the underlying parameters that is not relative to the number of observations per categorical variable level (Rutherford 2001).

In observing the Type III SS tests for evaluating suppliers of conventional fuel vehicles on integrity and evaluating suppliers of alternative fuel vehicles on warranties and claims, the FTA region in which a procurement decision-maker's agency operated had a significant effect in the variance of the score for both. For evaluating suppliers of conventional fuel vehicles on integrity the test result for FTA was F-Value = 2.07 and p-value = 0.0335. For evaluating suppliers of alternative fuel vehicles on warranties and claims the test result for FTA was F-Value = 2.93 and p-value = 0.0027, the most significant of the two tests. Each of the other five independent variables, urban class, education level, number of vehicles, capital expenditure, and years of experience had no significant effect on either integrity of conventional vehicle suppliers or warranties and claims offered by alternative fuel vehicle suppliers. Table 5.51 displays the results for the Type III SS tests for integrity of conventional vehicle suppliers and the warranties and claims offered by alternative fuel vehicle suppliers. The SAS®9.2 output can be viewed in Appendix VII.

In addition to the Type III SS effects tests, the least squares mean (LS Mean) for each of the FTA regions were observed for both integrity of conventional vehicle suppliers and the warranties and claims offered by alternative fuel vehicle suppliers. These means reflect adjustments for the covariates' effects on the variance in each supplier attribute's scores.

Table 5.51 Type III SS Effects Tests for Warranties and Claims and Integrity

Warranties and Claims (Alternative Fuel Vehicle)					
Source	**DF**	**Type III SS**	**Mean Square**	**F Value**	**P-Value**
Urban Class	1	0.02285426	0.02285426	0.01	0.9165
FTA	9	54.63213892	6.07023766	2.93	0.0027
Education	4	9.47789165	2.36947291	1.14	0.3376
Vehicles	1	0.00432198	0.00432198	0.00	0.9636
Capital	1	0.28319722	0.28319722	0.14	0.7121
Years	1	0.17270060	0.17270060	0.08	0.7732
Integrity (Conventional Fuel Vehicle)					
Source	**DF**	**Type III SS**	**Mean Square**	**F Value**	**P-Value**
Urban Class	1	0.05872039	0.05872039	0.03	0.8657
FTA	9	38.12548862	4.23616540	2.07	0.0335
Education	4	8.17834423	2.04458606	1.00	0.4092
Vehicles	1	0.12057474	0.12057474	0.06	0.8085
Capital	1	0.29266936	0.29266936	0.14	0.7057
Years	1	2.61522377	2.61522377	1.28	0.2597

For warranties and claims offered by alternative fuel vehicle suppliers, the highest LS mean was in FTA Region 3 at 9.40, and the lowest, 7.37, was in FTA region 8. Table 5.52 displays the LS means for each FTA region as it pertains to warranties and claims offered by alternative fuel vehicle suppliers. The effect of FTA region as a categorical variable may be a result of policy and regulation by regional FTA offices, similar state or local statutes, culture and trends, the type of vehicles utilized, and the types of public transportation services synonymous with certain states and regions.

For the integrity of conventional fuel vehicle suppliers test, the highest LS mean was in FTA Region 3 at 9.14 and the lowest, 7.62 in FTA region 2. Table 5.53 displays the LS means for each FTA region as it pertains to integrity of conventional fuel vehicle suppliers.

Table 5.52 LS Means for Warranties and Claims by FTA Region

Warranties and Claims (Alternative Fuel Vehicle)			
FTA	**LS Mean**	**Standard Error**	**P- Value**
1	8.76128129	0.41668055	<.0001
2	8.00155624	0.42845675	<.0001
3	9.40392559	0.32464555	<.0001
4	9.15168900	0.26024787	<.0001
5	8.88900516	0.28071984	<.0001
6	8.37743394	0.32933703	<.0001
7	8.32444571	0.35427376	<.0001
8	7.37341612	0.43840884	<.0001
9	8.97681674	0.37075085	<.0001
10	8.83554522	0.35064946	<.0001

Table 5.53 LS Means for Integrity by FTA Region

Integrity (Conventional Fuel Vehicle)			
FTA	**LS Mean**	**Standard Error**	**P- Value**
1	8.46687005	0.41394497	<.0001
2	7.61600291	0.42562145	<.0001
3	9.14480064	0.32251622	<.0001
4	9.03727862	0.25858243	<.0001
5	8.83149890	0.27893431	<.0001
6	8.90936373	0.33288021	<.0001
7	8.00414638	0.35197678	<.0001
8	8.53498063	0.43553623	<.0001
9	8.75621889	0.36858634	<.000
10	8.99044174	0.34834784	<.0001

With the exception of the warranties and claims offered by alternative vehicle suppliers and the integrity of conventional fuel vehicles, it was determined that the variations in the scores given to supplier attributes could not be significantly explained, at a 5% significance level (α=0.05), by variations in the urban classification of a public transportation agency, the FTA region in which a public transportation agency operates, the number of vehicles in an agency's fleet, the capital expenditure of an agency, an agency's procurement decision-maker's level of education, and an agency's procurement decision-maker's years of relevant procurement related experience.

For both the integrity of conventional vehicle suppliers and the warranties and claims offered by alternative fuel vehicle suppliers, further investigation may be required to more substantively determine what specific FTA regional factors account for the variances in the way procurement decision-makers scored these attributes.

5.3.7 Supplier Choice Analysis

The results of the conditional logit analysis were observed to determine two phenomena. The first was the "level of importance" or part-worth utility assigned to each of the five supplier attributes in the model. This was accomplished by observing their β parameter estimate values. The second was to utilize the β parameters estimate values to develop random utility functions for each of the suppliers in the choice sets and to subsequently use these utility functions to predict the probability of a particular vehicle supplier being chosen when competing in bids for vehicle contracts.

A conditional logit model was developed using SAS® 9.2. In observing the results of the model, various factors substantiate the statistical significance of the model. First, the log likelihood at -4169 is higher in value than the log likelihood null at -5748. As a result, the log likelihood ratio was estimated to be 3158.7.[12] This indicated the statistical significance of the model.

Both the Akaike Information Index (AIC) and the Schwarz Criterion were greater than 0 at 8347 and 8380 respectively. Their respective values indicate that the empirical data, on which the conditional logit model's estimation was based, fitted well.

The SAS® 9.2. MDC (Multinomial Discrete Choice) procedure generates nine goodness-of-fit measures for the conditional logit model. Seven of the nine measures are pseudo R^2 measures. The seven pseudo R^2 measures are the Aldrich-Nelson, the Craig-Uhler 1, the Craig-Uhler 2, the Estrella, the Adjusted Estrella, the McFadden's LRI (Likelihood Ratio Index), and the Veall-Zimmerman. The pseudo R^2 measures test the null hypothesis that, besides the intercept, all coefficients in the model are equal to 0. The model coefficients measure the explained variation of the model's dependent variable on a scale of 0 to 1. The higher the values, i.e., the closer to 1, the more the variables with their respective coefficients explain variation in the model's dependent variable. All of the pseudo R^2 measures for the conditional logit model used in the research showed that the model's coefficients were greater than 0 and their values had influence on the variation in the dependent variable "Decision." Table 5.54 and Table 5.55 display the model output for the dependent variable and the goodness-of-fit measures for the conditional logit model. The comprehensive SAS®9.2 coding and output can be seen in Appendix VIII.

The five vehicle supplier attributes used in the model were all statistically significant. Quality, delivery, price, technical capability, and after-sales support each had the same p-value of <0.001, making them all statistically significant at $\alpha = 0.05$. The β parameter estimates or part-worth utility values for each of the five vehicle supplier attributes communicated their relative "importance" to vehicle procurement decision-makers when evaluating and selecting suppliers.

Table 5.54 Conditional Logit Estimates Dependent Variable Information

Conditional Logit Estimates	
Dependent Variable: Decision	
Number of Observations	5232
Number of Cases	15696
Log Likelihood	-4169
Log Likelihood Null (LogL(0))	-5748
Maximum Absolute Gradient	5.51145E-9
Number of Iterations	5
Optimization Method	Newton-Raphson
AIC	8347
Schwarz Criterion	8380

[12] To further substantiate the statistical significance of the conditional logit model, the Proc PHREG procedure was used to run another conditional logit model that estimates based on a χ^2 distribution. The log likelihood ratio was 2547.2672 with 5 degrees of freedom and a p-value of <0.001. This established the model's statistical significance at a confidence level of 5% i.e. $\alpha = 0.05$. The SAS®9.2 ouput can be viewed in Appendix IX.

Table 5.55 Conditional Logit Estimates Goodness-of-Fit Measures

Conditional Logit Estimates		
Goodness-of-Fit Measures		
Measure	**Value**	**Formula**
Likelihood Ratio (R)	3158.7	2 * (LogL - LogL0)
Upper Bound of R (U)	11496	- 2 * LogL0
Aldrich-Nelson	0.3765	R / (R+N)
Cragg-Uhler 1	0.4532	1 - exp(-R/N)
Cragg-Uhler 2	0.5099	(1-exp(-R/N)) / (1-exp(-U/N))
Estrella	0.5063	1 - (1-R/U)^(U/N)
Adjusted Estrella	0.505	1 - ((LogL-K)/LogL0)^(-2/N*LogL0)
McFadden's LRI	0.2748	R / U
Veall-Zimmermann	0.5478	(R * (U+N)) / (U * (R+N))

Price was most important and had the highest part-worth utility of -0.7246. It should be noted that, though the sign for the price estimate was negative, its absolute value was the highest, making it the most significant. The negative sign serves as an indication of an inversely proportional relationship between price and supplier utility. Price was followed by quality at 0.6818, after-sales support at 0.6780, technical capability at 0.4411, and delivery at 0.2433. Table 5.56 displays the model output for parameter estimates or part-worth utilities for the conditional logit model.

Table 5.56 Conditional Logit Parameter Estimates

Conditional Logit Estimates					
Parameter Estimates					
Parameter	**DF**	**Estimate**	**Standard Error**	**t Value**	**Approx Pr > |t|**
Quality	1	0.6818	0.0230	29.63	<.0001
Delivery	1	0.2433	0.0216	11.28	<.0001
Price	1	-0.7246	0.0232	-31.26	<.0001
Technical Capability	1	0.4411	0.0221	19.92	<.0001
After-Sales Support	1	0.6780	0.0230	29.49	<.0001

Another aspect of the research involved determining the non-linear effects of the vehicle supplier attributes on eventual supplier decisions. This was facilitated by developing a conditional logit model that incorporated two-way interactions between the five supplier attributes used as independent variables. Determining two-way interactions between the attributes was feasible due to the fact that the discrete choice experiment developed for the research was generated using a fractional factorial design, which utilized supplier profiles that were orthogonal in nature (Bishop, Fienberg and Holland 1975; Green and Tull 1978; Hahn and Shapiro 1966; Louviere 1988; Mc Clean and Anderson 1984; National Institute of Standards and Technology 2010). When all two-way interactions were identified, the conditional logit model comprised 15 independent variables, i.e., the 5 original vehicle supplier attributes and 10 variables that represented two-way interactions between them.

In observations of the results of the conditional logit model with two-way attribute interactions, the log likelihood, at -4130, was higher in value than the log likelihood null at -5748. As a result, the log likelihood ratio was estimated to be 3236.7.[13] This indicated the statistical significance of the model. Both the Akaike Information Index (AIC) and the Schwarz Criterion were greater than 0 at 8289 and 8387 respectively. All of the psudeo R^2 measures for the two-way interaction conditional logit model showed that the model's coefficients were greater than 0 and that their values had influence on the variation in the dependent variable "Decision." Further, the seven psudeo R^2 measures for the two-way interaction conditional logit model were marginally higher than their counterparts in the first model. This indicated that the two-way interaction conditional logit model had a relatively better fit of the empirical data. Table 5.57 and Table 5.58 display the model output for the dependent variable and the goodness-of-fit measures for the two-way interaction conditional logit model. The comprehensive SAS®9.2 coding and output can be seen in Appendix VIII.

Table 5.57 Two-Way Interaction Conditional Logit Model Information

Two-Way Interaction Conditional Logit Estimates	
Dependent Variable: Decision	
Number of Observations	5232
Number of Cases	15696
Log Likelihood	-4130
Log Likelihood Null (LogL(0))	-5748
Maximum Absolute Gradient	8.593E-9
Number of Iterations	5
Optimization Method	Newton-Raphson
AIC	8289
Schwarz Criterion	8387

Table 5.58 Two-Way Conditional Logit Model Goodness-of-Fit Measures

Two-Way Interaction Conditional Logit Estimates		
Goodness-of-Fit Measures		
Measure	**Value**	**Formula**
Likelihood Ratio (R)	3236.9	2 * (LogL - LogL0)
Upper Bound of R (U)	11496	- 2 * LogL0
Aldrich-Nelson	0.3822	R / (R+N)
Cragg-Uhler 1	0.4613	1 - exp(-R/N)
Cragg-Uhler 2	0.519	(1-exp(-R/N)) / (1-exp(-U/N))
Estrella	0.5164	1 - (1-R/U)^(U/N)
Adjusted Estrella	0.5126	1 - ((LogL-K)/LogL0)^(-2/N*LogL0)
McFadden's LRI	0.2816	R / U
Veall-Zimmermann	0.5562	(R * (U+N)) / (U * (R+N))

In observations of the parameter estimates or coefficients of the 15 vehicle supplier attributes or attribute interactions, 10 were statistically significant. In addition to quality, delivery, price, technical capability, and after-sales support, the model resulted in the identification of five other statistically significant two-way attribute interactions. These significant two-way attribute interactions were quality*delivery, quality*price, quality*after-sales support, price*technical capability, and price*after-sales support.

[13] To further substantiate the statistical significance of the conditional logit model, the Proc PHREG procedure was used to run another conditional logit model that estimates based on a χ^2 distribution. The log likelihood ratio was 3140.3014 with 15 degrees of freedom and a p-value of <0.001. This established the model's statistical significance at a confidence level of 5% i.e. α = 0.05. The SAS®9.2 ouput can be viewed in Appendix IX.

The β parameter estimates or part-worth utility values for each of the 10 significant vehicle supplier attributes and two-way attribute interactions communicated their relative "importance" to vehicle procurement decision-makers when evaluating and selecting vehicle suppliers. Again, price was most important and had the highest part-worth utility of -0.7831 and a p-value of <0.001. Price was followed by quality at 0.7174 with a p-value of <0.001, after-sales support at 0.7120 with a p-value of <0.001, technical capability at 0.4561 with a p-value of <0.001, and delivery at 0.2673 with a p-value of <0.001. It is interesting to note that the rank of the attributes, as determined by the parameter estimates, remained the same as in the first conditional logit model.

Of the five other statistically significant two-way attribute interactions, the two most significant were quality*price at 0.1920 with a p-value of <0.001 and price*after-sales support at 0.2246 with a p-value of <0.001. Quality*delivery had a parameter estimate of -0.0915 with a p-value of 0.0102, quality*after-sales support had a parameter estimate of -0.0872 with a p-value of 0.0158, and price*technical capability had a parameter estimate of 0.1084 and a p-value of 0.0027. The latter three two-way attribute interactions, while statistically significant at $\alpha = 0.05$, have parameter estimates that signify their relatively lesser effect on the supplier choice process.

The two two-way attribute interactions that did have more relative impact on the supplier choice process, quality*price and price*after-sales support, consisted of the individual vehicle supplier attributes that had the highest part-worth utilities. This further substantiates the importance of these three attributes in evaluating and choosing vehicle suppliers. Table 5.59 displays the model output for parameter estimates or part-worth utilities for the two-way interaction conditional logit model.

The β parameter estimate values for each of the supplier attributes in the conditional logit model in Table 5.56 were used to develop random utility functions which were subsequently used to predict the probability of a particular vehicle supplier being chosen when competing in bids for vehicle contracts.

Table 5.59 Two-Way Interaction Conditional Logit Parameter Estimates

Two-Way Interaction Conditional Logit Estimates					
Parameter Estimates					
Parameter	**DF**	**Estimate**	**Standard Error**	**t Value**	**Approx Pr > |t|**
Quality	1	0.7174	0.0242	29.60	<.0001
Delivery	1	0.2673	0.0233	11.49	<.0001
Price	1	-0.7831	0.0245	-31.92	<.0001
Technical Capability	1	0.4561	0.0237	19.23	<.0001
After-Sales Support	1	0.7120	0.0242	29.37	<.0001
Quality*Delivery	1	-0.0915	0.0356	-2.57	0.0102
Quality*Price	1	0.1920	0.0367	5.23	<.0001
Quality*Technical Capability	1	-0.0689	0.0359	-1.92	0.0549
Quality*After-Sales Support	1	-0.0872	0.0362	-2.41	0.0158
Delivery*Price	1	0.0623	0.0357	1.74	0.0814
Delivery*Technical Capability	1	-0.0396	0.0348	-1.14	0.2548
Delivery*After-Sales Support	1	-0.0679	0.0357	-1.90	0.0569
Price*Technical Capability	1	0.1084	0.0361	3.00	0.0027
Price*After-Sales Support	1	0.2246	0.0369	6.08	<.0001
Technical Capability*After-Sales Support	1	0.0155	0.0356	0.44	0.6632

Calculating the choice probabilities for each of the suppliers included in the discrete choice experiment's choice sets was facilitated by utilizing the equation

$$P_{ij} = \frac{exp(x_{ij}\,\beta)}{\sum_{j=1}^{J} exp(x_{ij}\,\beta)}$$

where

P_{ij} is the probability of procurement decision-maker *i* selecting vehicle supplier *j* from the choice set of vehicle suppliers *J*.

x_{ij} in the equation represents a vector of the systematic utility of vehicle supplier attributes specific to the *j*th supplier alternative as determined by procurement decision-maker *i*. β represents a vector of coefficients, or the parameter estimates for each of the supplier attributes, as calculated by the conditional logit model.

The application of the choice probabilities manifests itself in two ways. First, the determination of the probability of being chosen can be subsequently used to determine which of two suppliers competing for a vehicle contract is more likely to be awarded the contract based on their attribute level combinations. In observations of the choice probabilities, three scenarios tended to occur when suppliers competed with each other in the "discrete choice experiment bids." The first type of scenario occurred when the level of the attributes a supplier offered resulted in an extremely high choice probability. An example of this can be seen in Table 5.61 where in choice set 14 supplier 28's choice probability was approximately 100% because it offered the positive level of all the attributes. Note that for price the positive level was lower price. Similar scenarios existed in choice sets 4 and 6 where only one of the offered attributes of the winning supplier was on a negative level.

The second type of scenario occurred when the attribute level mix of suppliers "competing" in a choice set resulted in one's choice probability being substantially higher than the other's; however, there were more positive and negative level attribute mixes in the winning supplier's offerings. An example of this can be seen in Table 5.61 where, in choice set 9, supplier 18's choice probability was approximately 74%, though it offered the negative level of both quality and technical capability. These types of scenarios tended to substantiate the importance of certain attributes relative to others. The importance of the attributes was communicated through their conditional logit model generated parameter estimates. Similar scenarios existed in choice sets 1, 5, 10, 11, and 12 where more than one of the offered attributes of the winning supplier was on a negative level.

The third type of scenario occurred when the attribute level mix of two "competing" suppliers resulted in choice probabilities that made one marginally win over the other. These scenarios tended to derive winners based on the subjectivity of the procurement decision-makers because of the high level of attribute level mixture for each of the suppliers in these scenarios. An example of this can be seen in Table 81 where in choice set 15, though winning supplier 29's choice probability was 52%, it was closely followed by the 48% choice probability of losing supplier 30. Similar scenarios existed in choice sets 3 and 16.These types of scenarios may be the ones that are of most interest to vehicle suppliers as they are the most competitive scenarios and may most closely simulate "real world" scenarios.

The second application of the choice probabilities of suppliers involved developing tables like Table 5.61, where the attribute level mix of suppliers and their respective choice probabilities are identified. This information can serve as input to suppliers' product development, sales, and bid proposal strategies. For example, for any supplier in Table 5.61, changes in resource allocations among the five supplier attributes to influence their resulting level can change the probability of being chosen when competing for vehicle contracts.

Table 5.60 displays the choice probability calculations based on the results of the conditional logit model. Table 5.61 displays the supplier attribute level mixes and the resulting choice probabilities for each of the 32 suppliers in the 16 supplier choice sets of the discrete choice experiment.

Table 5.60 Supplier Choice Probability Calculations

Choice Probabilities Calculation Table									
Choice Set	Vehicle Supplier Attribute (Part-Worth Utility β) and Attribute Levels								
	Quality (0.6818)	Delivery (0.2433)	Price (-0.7246)	Technical Capability (0.4411)	After-Sales Support (0.678)	Utility $x_{ij}\beta$	$exp(x_{ij}\beta)$	$\sum_{j=1}^{J} exp(x_{ij}\beta)$	P_{ij}
1	-1	-1	1	1	1	-0.5306	0.58825191	2.288203886	0.257
1	1	1	-1	-1	-1	0.5306	1.69995197	2.288203886	0.743
1	0	0	0	0	0	0	0	0	0
2	1	-1	-1	1	1	2.2822	9.79821278	9.900272212	0.990
2	-1	1	1	-1	-1	-2.2822	0.10205943	9.900272212	0.010
2	0	0	0	0	0	0			
3	1	-1	1	-1	1	-0.0492	0.95199071	2.002421128	0.475
3	-1	1	-1	1	-1	0.0492	1.05043042	2.002421128	0.525
3	0	0	0	0	0	0	0	0	0
4	1	1	-1	1	-1	1.4128	4.10744015	4.350900788	0.944
4	-1	-1	1	-1	1	-1.4128	0.24346064	4.350900788	0.056
4	0	0	0	0	0	0	0	0	0
5	-1	1	-1	-1	-1	-0.833	0.4347431	2.734952125	0.159
5	1	-1	1	1	1	0.833	2.30020903	2.734952125	0.841
5	0	0	0	0	0	0	0	0	0
6	1	1	-1	-1	1	1.8866	6.59690104	6.748487371	0.978
6	-1	-1	1	1	-1	-1.8866	0.15158633	6.748487371	0.022
6	0	0	0	0	0	0	0	0	0
7	-1	1	-1	1	1	1.4052	4.07634193	4.321659916	0.943
7	1	-1	1	-1	-1	-1.4052	0.24531799	4.321659916	0.057
7	0	0	0	0	0	0	0	0	0
8	-1	1	1	1	-1	-1.4	0.24659696	4.301796931	0.057
8	1	-1	-1	-1	1	1.4	4.05519997	4.301796931	0.943
8	0	0	0	0	0	0	0	0	0
9	1	-1	1	1	-1	-0.523	0.59273966	2.279820968	0.260
9	-1	1	-1	-1	1	0.523	1.68708131	2.279820968	0.740
9	0	0	0	0	0	0	0	0	0
10	-1	1	1	-1	1	-0.9262	0.39605587	2.920952186	0.136
10	1	-1	-1	1	-1	0.9262	2.52489632	2.920952186	0.864
10	0	0	0	0	0	0	0	0	0
11	-1	-1	-1	1	-1	-0.4374	0.64571309	2.194388518	0.294
11	1	1	1	-1	1	0.4374	1.54867542	2.194388518	0.706
11	0	0	0	0	0	0	0	0	0
12	1	1	1	-1	-1	-0.9186	0.39907736	2.9048572	0.137
12	-1	-1	-1	1	1	0.9186	2.50577984	2.9048572	0.863
12	0	0	0	0	0	0	0	0	0
13	1	1	1	1	1	1.3196	3.74192431	4.009166486	0.933
13	-1	-1	-1	-1	-1	-1.3196	0.26724218	4.009166486	0.067
13	0	0	0	0	0	0	0	0	0
14	-1	-1	1	-1	-1	-2.7688	0.06273724	16.00223238	0.004
14	1	1	-1	1	1	2.7688	15.9394951	16.00223238	0.996
14	0	0	0	0	0	0	0	0	0
15	1	-1	-1	-1	-1	0.044	1.04498235	2.001936312	0.522
15	-1	1	1	1	1	-0.044	0.95695396	2.001936312	0.478
15	0	0	0	0	0	0	0	0	0
16	-1	-1	-1	-1	1	0.0364	1.03707059	2.001325106	0.518
16	1	1	1	1	-1	-0.0364	0.96425451	2.001325106	0.482
16	0	0	0	0	0	0	0	0	0

Table 5.61 Probability of Choice and Supplier Attribute Level Combinations

Set	Supplier	Quality	Delivery	Price	Technical Capability	After-Sales Support	Probability
1	Supplier 1	-	-	+	+	+	0.257
1	Supplier 2	+	+	-	-	-	0.743
2	Supplier 3	+	-	-	+	+	0.990
2	Supplier 4	-	+	+	-	-	0.010
3	Supplier 5	+	-	+	-	+	0.475
3	Supplier 6	-	+	-	+	-	0.525
4	Supplier 7	+	+	-	+	-	0.944
4	Supplier 8	-	-	+	-	+	0.056
5	Supplier 9	-	+	-	-	-	0.159
5	Supplier 10	+	-	+	+	+	0.841
6	Supplier 11	+	+	-	-	+	0.978
6	Supplier 12	-	-	+	+	-	0.022
7	Supplier 13	-	+	-	+	+	0.943
7	Supplier 14	+	-	+	-	-	0.057
8	Supplier 15	-	+	+	+	-	0.057
8	Supplier 16	+	-	-	-	+	0.943
9	Supplier 17	+	-	+	+	-	0.260
9	Supplier 18	-	+	-	-	+	0.740
10	Supplier 19	-	+	+	-	+	0.136
10	Supplier 20	+	-	-	+	-	0.864
11	Supplier 21	-	-	-	+	-	0.294
11	Supplier 22	+	+	+	-	+	0.706
12	Supplier 23	+	+	+	-	-	0.137
12	Supplier 24	-	-	-	+	+	0.863
13	Supplier 25	+	+	+	+	+	0.933
13	Supplier 26	-	-	-	-	-	0.067
14	Supplier 27	-	-	+	-	-	0.004
14	Supplier 28	+	+	-	+	+	0.996
15	Supplier 29	+	-	-	-	-	0.522
15	Supplier 30	-	+	+	+	+	0.478
16	Supplier 31	-	-	-	-	+	0.518
16	Supplier 32	+	+	+	+	-	0.482

5.3.8 Supplier Attribute Importance Comparison

This aspect of the research involved comparing the level of importance of the five supplier attributes as assigned by Likert-type scaling derived means with the level of importance of the five supplier attributes as assigned by the conditional logit model parameter estimates. Observations were made for differences between the two.

There were two major observations in conducting the comparison. Price, while ranking third in perception, ranked first in practice. This substantiates the importance of price in evaluating suppliers in actuality, a phenomenon that may be brought on by both regulation and by agency budgetary constraints. Second, results of the comparison show that in both perception and practice, after-sales support was extremely important to procurement decision-makers when evaluating vehicle suppliers. Of the five attributes chosen for the comparison, after-sales support ranked second in perception[14] and third in practice.

Table 5.62 displays the rankings of each of the supplier attributes quality, price, after-sales support, technical capability, and delivery as derived by Likert-type scaling and by parameter estimates from the conditional logit model. It facilitates the comparison of how important the attributes are perceived to be versus the level of importance they are assigned in practice.

Table 5.62 Supplier Attribute Ranking Comparison

Rank	Perceived Supplier Attribute Importance	Mean Value	Practiced Supplier Attribute Importance	Parameter Estimate Value β
1	Quality	9.10	Price	-0.7246
2	After-Sales Support	8.49	Quality	0.6818
3	Price	8.01	After-Sales Support	0.6780
4	Technical Capability	7.89	Technical Capability	0.4411
5	Delivery	7.18	Delivery	0.2433

5.3.9 Supplier Attributes: Sub-Attributes and Metrics

In an attempt to further understand the derived means and parameter estimates for certain supplier attributes included in the research, a sub-group of procurement decision-makers from among the sample was chosen and asked to provide further information on 1) sub-attributes of the main attributes and 2) metrics that can be used to measure suppliers in each of the identified attribute areas.

Of the 10 supplier attributes used in the Likert-type scaling survey, which included the five attributes used in the conditional logit model, seven were included in this aspect of the research. The seven attributes that were used included quality, reliability, delivery, technical capability, after-sales support, warranties and claims, and performance history. The attributes price, procedural compliance, and integrity were not included in this aspect of the research for various reasons. Price was not included because, in the context of this research, it refers only to the retail price of a bus or van. Procedural compliance was not included because the procedure employed by suppliers may be so varied that it may have proven challenging to

[14] The rankings of the perceived importance of supplier attributes in Table 5.32 were adjusted after the other five supplier attributes in Table 5.28 were removed to facilitate direct comparison with the "practiced" importance of supplier attributes. For example, because reliability, integrity, and warranties and claims were removed from the table, quality moved to number one and after sales support to number two. It is important to note, however, that, despite this adjustment, the rankings of the "perceived" importance of attributes in Table 5.32 are accurate because their assigned mean scores would have resulted in their maintaining the rank they have in Table 5.32.

achieve some form of standardization to report in the research. Likewise, integrity was not included, due to the wide range of subjectivity that may apply to its measurement.

In observations of the identified sub-attributes and attribute metrics, it was determined that all seven of the attributes had sub-attributes. These sub-attributes facilitated the generation of more specific information that can be used by public transportation procurement decision-makers when developing specifications for vehicle suppliers. Further, the identification of metrics by which to evaluate suppliers in each of the attribute areas facilitated the development of more definitive evaluation criteria.

It is interesting to note that some of the identified sub-attributes were identical for both after-sales support and warranties and claims. However, it should be noted that other identified sub-attributes within these attribute areas substantiated the attributes' differences. It is important to note that for this reason only specific attributes were included in the conditional logit model discussed in a previous section. Table 5.63 displays the attributes and their procurement decision-maker identified sub-attributes while Table 5.64 displays the attributes and their procurement decision-maker identified measurements and metrics.

Table 5.63 Supplier Attributes and Identified Sub-Attributes

Attribute	Sub-Attributes
Quality	Safety Features, Material Quality, Finish and Fit of Parts, Vehicle Design, Innovation and Improvement in Design, Operational Reliability, Vehicle Aesthetics, Wheel Chair Equipped Ready
Reliability	Warranty Work Done On-Site Within 5 Days of Call, Warranty Period Exclude Vehicle Down-Time Due to Warranty Problems, Allowance to Claim Fleet Defect Clearly Defined, Supplier Adherence to Specifications, Service Life, Prior Experience with Vehicle Type
Delivery	Vehicle Acceptance Time, Warranty Start Time, Manufacturing Capacity, Liquidated Damages Assessment
Technical Capability	Federal Standard Compliance, Liability for Design, Staff Certifications, Staff Experience, Efficient Tooling on Production Line, Latest Technology Utilization
After-Sales Support	Local Service Representative, Response Time, Breakage Percentage (Shipping and Handling), Parts Fulfillment, Call Center, Availability of Training, Parts Supply
Warranties and Claims	Clarity of Warranty and Claims Policy, Defected Parts Handling and Shipping, Designated Warranty and Claims Staff, Claims Processing Time
Performance History	Average Miles in Service, Percentage of Vehicles in Service Beyond 12 Years, Years in Business, Demand for Vehicle, Vehicle Operation in Mixed Climate and Topography

Table 5.64 Supplier Attributes and Identified Measurements and Metrics

Attribute	Measurements and Metrics
Quality	Frame failure within 12,10,7, or 5 years; Electrolysis within 6 years; permits buyer visit to manufacturing plant, number of vehicle defects to be corrected, customer references, evaluation of quality assurance plan, evaluation of manufacturing process and management plan, variance from vehicle to vehicle, production work rejection rate, caliber of inspection staff
Reliability	Number of road calls per 1000 mile for original equipment manufacturer (OEM) supplied components, miles between road calls, mean timle between failures, number of recalls, roll out rate for past vehicles purchased,
Delivery	Deliveries within 12 months of order, number of change orders, number of back orders, lead time to delivery
Technical Capability	Number of bus type built before, roll cage certification by qualified independent testing company, number of professional engineers on staff, ability to correct defects on first attempt, ability to upgrade vehicle without the need for major modifications, approved equals and deviations to technical specifications, ability to implement customizations into base vehicle design
After-Sales Support	Performance record in spare parts delivery, the breadth and scope of provided training, location of local service representative, time frame over which support is offered, number of visits from supplier field representative, cost of training, cost of parts
Warranties and Claims	Response time to claims, overnight shipping of parts, list of unsolved claims, location and number of claims staff
Performance History	Number of complaints filed against supplier, number of fleet defects in the last 15 years

5.3.10 Modeling and Analysis Limits

Though the models utilized in this research yielded both statistically significant and value-adding results, three points are worth noting to add perspective to the interpretation of their output.

First, this study was cross-sectional in nature, and the position can be taken that a study that was longitudinal in nature would have more accurately captured supplier choice behavior, attribute importance perception, and variations in them. However, given the exploratory nature of this research, this point may not be as applicable.

Second, the vehicle supplier evaluation process is very complex, and decision-makers may include more criteria than the five used in the conditional logit model in this research. This was done, however, for two specific reasons. The first was that the five attributes used in the discrete choice model were deemed most appropriate by a public transportation expert panel, and they were also the attributes for which a supplier can make tangible changes if research results dictated so. The second reason that only five supplier attributes were used was that the time to complete the survey would have significantly increased due to larger choice sets in the discrete choice experiment. This may have resulted in a lower survey response rate. That being said, however, had time permitted; a model incorporating more supplier attributes may have yielded results of a varied nature.

The third limit to the research's analytics was the fact that the data used for vehicle fleet sizes and for capital expenditures were for fiscal year 2009 and not fiscal year 2011. Arguments can be made then that the ANCOVA results may not reflect the most recent influences of both vehicle fleet size and capital expenditure on how procurement decision-makers perceive the importance of specific supplier attributes. While this may be a point worth noting, two others are as well. First, it was assumed that if any significant relationship existed between these two variables and the perceived importance of attributes, data from a recent previous fiscal year would still show significant correlation. Second, in the case of fleet size, it can be argued that the change in the size of a public transportation agency's vehicle fleet on a yearly basis is not significant enough, at least in most cases, to negatively affect the observation of a strong correlation between it and the way a procurement decision-maker perceives the importance of an attribute.

While not a limiting factor, a point worth noting with regard to interpreting the research's results centers on vehicle ownership. While over 99% of the vehicles in the research sample were wholly owned by their respective public transportation agencies, other vehicles in the industry may be leased. Therefore, it must be noted that if leased vehicles comprised the majority of the sample fleet, the relative importance of supplier attributes included in the analysis may have been different.

6. DISCUSSION

This section consists of two discussions. The first is a discussion on the research's results and its facilitation of a deeper understanding of many of the dynamics surrounding vehicle supplier evaluation and selection in the US public transportation industry. The second surrounds the contributions of the research to both the industry and academic arenas.

The first discussion comprises a discourse on observations, thoughts, and issues surrounding various aspects of the research sample, survey responses, and the results from the analyses. The observations, thoughts, and issues include urban public transportation agency versus non-urban public transportation agency representation in the research, FTA region representation, procurement-decision maker education, procurement decision-maker experience and its influence on the research, public transportation agency vehicle fleet numbers and capital expenditures, the procurement policy and regulatory framework under which public transportation agencies operate, alternative fuel vehicle past and planned purchases, the fleet characteristics of public transportation agencies, vehicle supplier markets and competition, the relative importance of supplier attributes, influences on the importance of supplier attributes, and the composition of and dynamics associated with specific vehicle supplier attributes.

Observing the representation of public transportation agencies in the research sample, 226 operated in urban areas while 101 operated in non-urban areas. It is important to note, however, that included among the 101 non-urban area agencies were 11 State Department of Transportation Public Transportation Offices. With respect to the purpose of this research, this was important given the fact that many non-urban agencies' vehicles are procured by state DOTs, and it is the procurement decision-makers at these state departments that evaluate and make decisions about suppliers. As such, the responses of these 11 state DOT procurement decision-makers represented all of the public transportation agencies whom they purchase vehicles for.

It was also beneficial that all 10 FTA regions were substantially represented, with 64 agencies coming from the most represented region to 14 agencies coming from the least represented one.

It was interesting to note that the education level with most representation among public transportation agency procurement decision-makers was a bachelor's degree, with 48.6% of research participants having attained this level of education. This may be as a result of there not being any specific necessity for graduate-level education and more emphasis being placed on practical procurement related experience. However, it is important to note that 30.6% of respondents had attained graduate or professional degrees. This speaks to two points. First, given that most of the research participants were senior-level management, many of them would have acquired graduate and professional education as a means for promotion and career advancement. Another reason for this may be the more recent emergence of logistics, and procurement as a function within it, as a specialist field. This has led to the pursuit of graduate and law degrees with specializations in these areas. Research participants noted they had attained graduate-level education in management, logistics, or contract law.

An observation of note was the fact that only three out of 327 respondents indicated they had attained either the Certified Purchasing Manager (CPM),the Certified Professional in Supply Management (CPSM), or the Certified Public Purchasing Officer (CPPO) certificate, highly respected credentials among procurement and purchasing professionals nationwide and internationally.

The average number of years of experience of a procurement professional participating in the research was 18.3 years. Further, 41.6% of respondents had 21 or more years of experience. This boded well for the research's purpose, as responses to the survey were based on familiarity with procurement practice and vehicle supplier evaluation and selection issues.

While the range in the vehicle fleet sizes of the 278 represented agencies was large, the majority of fleets numbered 100 or fewer vehicles. Even more interesting was the fact that, while the largest recorded capital expenditure was $1,412,875,366, approximately 77% of agencies spent less than $10M in rolling stock with 51% spending less than $1M. These figures shed light on the wide scope of public transportation agency types in the US. They also highlight the fact that the majority of agencies operate on the lower ends of vehicle fleet size and capital expenditure category ranges observed in the research sample.

Pertaining to the procurement policy and regulatory framework through which agencies conducted purchasing operations, it was interesting to note that 64.5% of respondents indicated that they were permitted to evaluate vehicle suppliers based on "best-value" by utilizing RFPs. Those that were restricted to evaluating based on vehicle price only, utilizing IFBs, were 16.8%. Further, 18% of respondents indicated that their agency took part in joint procurements or procurement consortiums, arrangements in which either RFPs or IFBs are utilized according to stipulations the lead buyer has to follow. This is a favorable finding as it communicates the importance being placed by appropriate decision-makers on efficiently and effectively spending capital funds by considering more than just the price that suppliers offer.

Another favorable finding was that 52.6% of 327 respondents indicated that their agency had purchased an alternative vehicle in the past five years. Even more favorable was the fact that 64.5% of respondents indicated that their agency intended to do so over the next five years, a research sample increase of 11.9%. This has implications for both the types of vehicles that will be purchased over the next five years and the suppliers that they may most likely be purchased from. There would most likely be an increase in demand for alternative fuel vehicles over the next five years, and, according to the type of alternative fuel in high demand, general or specialty suppliers may see increased sales or at least the potential for such. However, it is important to note that the majority of vehicles in the research sample fleet utilized diesel or gasoline. This signified that the number of alternative fuel vehicles that were purchased were minimal relative to the respective agency fleet sizes. This may not change unless regulations dictate the use of alternative fuel vehicles, which are more costly.

The total number of vehicles represented in the research sample fleet was 60,005. There were eight vehicle types represented in the research sample fleet. These were articulated buses, buses, double-decker buses, over-the-road buses, school buses, taxicab vans, trolley buses, and vans. However, of these vehicle types, traditional buses (28 foot to 60 foot) and vans accounted for the majority of vehicles in the sample at 68.2% and 24.9% respectively. These are the major types of vehicles purchased by public transportation agencies because they are utilized in the most prevalent public transportation service types – fixed-route service and paratransit or demand response service. Vans are also substantially, if not solely, utilized in the provision of van pool services, a service type being more frequently offered by public transportation agencies. This would have implications for vehicle suppliers that specialize in the provision of these two vehicle types and, for those that do not. For those suppliers that do specialize in either or both of these vehicle types, emphasis could be placed on developing product differentiation and supplier competitive advantages around core and strategic competencies. For those suppliers that do not specialize in traditional buses or vans, two points are worth noting. First, consideration must be given to whether or not entry into these vehicle-type markets would be feasible and potentially profitable. Second, a competitive strategy may be for a supplier to specialize in any of the other vehicle types and develop a niche market.

Potential supplier implications may also exist when the fuel types utilized by vehicles in the research sample fleet are considered. Vehicles utilizing diesel accounted for 58.6% while those utilizing gasoline accounted for 18.9%. These two fuel types represented conventional fuel in the research study, and therefore, only 22.5% of vehicles within the research sample fleet were considered to have utilized alternative fuel. This is synonymous with vehicle fuel utilization rates in the public transportation industry at large (American Public Transportation Association 2010). Further, seven of the eight vehicle types represented in the research sample fleet utilized diesel. Among these seven vehicle types diesel was the highest utilized fuel for four – articulated buses, buses, double-decker buses, and over-the-road buses. Gasoline was the highest utilized fuel for three vehicle types – school buses, taxicab vans, and vans. Trolley buses utilized electric power sources only.

Of the alternative fuels utilized by vehicles in the research sample fleet, biodiesel and compressed natural gas (CNG) had the highest utilization rates. Biodiesel and compressed natural gas (CNG) accounted for 29.6% and 28.9% respectively while dual fuel vehicles accounted for 24.2% of the vehicles that utilized alternative fuels.

There may be various supplier implications based on these fuel utilization findings. First, the majority of vehicles in the sample utilized diesel or gasoline. As such, suppliers of these vehicle types serve a larger market, and opportunities for sales may more profusely abound. Conversely but not negatively, suppliers of alternative fuel vehicles, while serving smaller markets, can specialize and develop niches. Based on the research sample fleet, particular supplier niche opportunities may lie in the provision of biodiesel and compressed natural gas (CNG) vehicle markets.

When vehicle fuel utilization by FTA region was observed, some points with vehicle supplier implications were worth noting. First, diesel was the highest utilized fuel by vehicles across all FTA regions. However, the rate of utilization varied from 75.2% in Region 2 to 32.6% in Region 9. Region 9 had the highest utilization of compressed natural gas (CNG) at 26.5%, which may have been attributed to the fact that California is in FTA Region 9 and has higher vehicle emission standards and regulations. It was also interesting to note that relatively high biodiesel use was observed for Regions 1, 5, 7, and 10. Inferences can be made concerning this, and it may be stated that these occurrences can be attributed to regulatory requirements in Region 1, culture in Region 10 and the availability of the natural resources that facilitate using biodiesel at a reduced cost in Regions 5 and 7, though these are just hypothetical assertions and are not supported by documented proof or data. These findings and assertions, if significant, can also have implications for vehicle suppliers. Based on the type of vehicles a supplier offers, there may be implications for its geographical market strategy. It may also drive supplier decisions regarding the types of vehicles to supply relative to the variations in environment regulations across geographic regions.

In total, 64 suppliers supplied the vehicles in the research sample fleet. This indicated that there was a significant number of supplier options available to public transportation procurement decision-makers. This implied two things. First, with a larger number of available suppliers there would be a need to identify the attributes on which suppliers are evaluated and chosen. Second, with a larger number of available suppliers, competition between them is probably more intense and service offerings plenteous. However, not all suppliers competed in the same vehicle type or vehicle fuel type markets.

The three suppliers that supplied the largest number of vehicles to the research sample fleet were New Flyer Industries at 17.6%, Gillig Corporation at 15.1%, and Ford Motor Company at 11.5%. Both New Flyer Industries and Gillig Corporation were the major suppliers of buses while Ford Motor Company was the major supplier of vans.

Including the aforementioned suppliers, other specific suppliers experienced significant "sample market share" in specific vehicle type and vehicle fuel type categories. Table 6.1 displays suppliers with significant "sample market share" in the research sample fleet by vehicle type or vehicle fuel type. Their respective position in each of the categories is provided in parentheses.

Table 6.1 Supplier "Sample Market Share" Across Vehicle Types and Fuel Types

Gillig Corporation	**New Flyer Industries**	**Ford Motor Company**
Buses (1)	Articulated Buses (1)	Vans (1)
Trolley Buses (1)	Compressed Natural Gas (CNG) Vehicles (1)	Gasoline Vehicles (1)
Biodiesel Vehicles (1)	Diesel Vehicles(1)	Liquefied Petroleum Gas (LPG) Vehicles (4)
Electric Propulsion Vehicles (1)	Hybrid Diesel Vehicles (1)	Diesel Vehicles(5)
Hybrid Diesel Vehicles (2)	Hybrid Gasoline Vehicles (1)	Dual Fuel Vehicles (5)
Diesel Vehicles(2)	Biodiesel Vehicles (2)	Buses (10)
Dual Fuel Vehicles (2)	Buses (2)	Biodiesel Vehicles (11)
	Dual Fuel Vehicles (3)	Compressed Natural Gas (CNG) Vehicles (11)
	Electric Propulsion Vehicles (4)	
	Liquefied Natural Gas (LNG) Vehicles (4)	
	Trolley Buses (4)	
North American Bus Industries (NABI)	**Motor Coach Industries International**	**NOVA Bus Corporation**
Liquefied Natural Gas (LNG) Vehicles (1)	Over-the-Road Buses (1)	Liquefied Natural Gas (LNG) Vehicles (2)
Articulated Buses (3)	Diesel Vehicles(4)	Buses (3)
Compressed Natural Gas (CNG) Vehicles (3)	Biodiesel Vehicles (4)	Diesel Vehicles(3)
Hybrid Diesel Vehicles (3)	Buses (5)	Biodiesel Vehicles (7)
Buses (4)	Diesel Vehicles(6)	Dual Fuel Vehicles (7)
Diesel Vehicles(4)	Compressed Natural Gas (CNG) Vehicles (7)	Compressed Natural Gas (CNG) Vehicles (8)
Dual Fuel Vehicles (10)	Dual Fuel Vehicles (12)	

Table 6.1 (continued)

Coach Equipment & Manufacturing	**El Dorado National**
Vans (3)	Biodiesel Vehicles (3)
Gasoline Vehicles (6)	Liquefied Natural Gas (LNG) Vehicles (3)
Diesel Vehicles(7)	Vans (5)
Dual Fuel Vehicles (8)	Gasoline Vehicles (5)
Buses (13)	Dual Fuel Vehicles (6)
	Compressed Natural Gas (CNG) Vehicles (6)
	Hybrid Diesel Vehicles (7)
	Diesel Vehicles(8)
	Buses (8)

Further observation revealed that in addition to suppliers that had significant "sample market share" across various vehicle types and fuel types, some suppliers had significant "sample market share" in specific vehicle types or with vehicles that utilized specific fuel types. This may indicate that these particular suppliers concentrated and competed in specific vehicle niches.

Regarding vehicles types, Neoplan had significant "sample market share" for articulated buses, Prevost Car Inc. did for over-the-road buses, Breda Transportation Inc. and AAI/Skoda did for trolley buses, as did Chevrolet and Dodge for vans.

Regarding fuel types, Orion Bus Ltd. had significant "sample market share" for compressed natural gas (CNG) vehicles, Bus Industries of America and Goshen Coach did for dual fuel vehicles, Goshen Coach also did for bunker fuel vehicles, Breda Transportation Inc. and AAI/Skoda did for electric powered vehicles, Chevrolet and Dodge did for gasoline vehicles, Van Hool NV and Orion Bus Ltd. did for hybrid diesel vehicles, Champion Motor Coach Inc., General Motors Corporation, and Chance Bus did for liquefied petroleum gas (LPG) vehicles, and Startrans did for hybrid gasoline vehicles.

Based on the results of this research, the type of vehicle to be purchased can therefore lead to a supplier evaluation and selection process that comprises numerous suppliers to one that consists of just a few. Irregardless of the number of suppliers involved in the evaluation process, the attributes on which they are evaluated were observed to be of central importance.

The supplier attributes that were perceived to be most important when public transportation agency procurement decision-makers evaluate vehicle suppliers were identified in this research. The supplier attributes of after-sales support, delivery, integrity, performance history, price, procedural compliance, quality, reliability, technical capability, and warranties and claims were observed for their perceived importance when evaluating suppliers of both conventional fuel and alternative fuel vehicles.

The attributes of quality and reliability held the top two spots in both instances. However, their respective rankings switched between positions one and two. The attribute quality comprised sub-attributes that included vehicle material quality, vehicle aesthetics, and vehicle design. In contrast, the attribute reliability comprised sub-attributes that included prior experience with vehicle type, allowance to claim fleet defect clearly defined, and response to vehicle problems within five days of a call. When evaluating suppliers of alternative fuel vehicles, procurement decision-makers perceived vehicle feature-centric supplier attributes more important. This may be as a result of procurement decision-makers' having less experience with these types of vehicles. When evaluating suppliers of conventional fuel vehicles, procurement decision-makers perceived service and experience-centric supplier attributes as more important. This may be a result of procurement decision-makers' having more experience with conventional fuel vehicles and a resulting need for there to be a supplier that can aptly respond to issues that experience indicates will occur.

Another attribute that was ranked differently when evaluating suppliers of both types of vehicles was supplier integrity. Again, this difference in ranking, third when evaluating conventional fuel vehicle suppliers and fifth when evaluating alternative fuel vehicle suppliers, when inquired about, was attributed to the fact that procurement decision-makers have had more experience procuring conventional fuel vehicles and can hold suppliers responsible in more areas than they can when procuring alternative fuel vehicles.

Technical capability was another attribute that was ranked differently when evaluating the two types of vehicle suppliers. While it ranked ninth when evaluating suppliers of conventional fuel vehicles, it ranked sixth when evaluating suppliers of alternative fuel vehicles. The reason for this difference in ranking became apparent when technical capability's identified sub-attributes were observed. Sub-attributes of the attribute technical capability included liability for design, staff certifications, staff experience, and utilization of the latest technologies. Given both procurement decision-makers' relative lack of experience with procuring alternative fuel vehicles, and, the increased engineering and technological characteristics of these vehicles, the technical capability of a supplier providing them becomes more important.

The attributes performance history, procedural compliance, price, and delivery were perceived to be less important when both types of suppliers were evaluated. They all ranked in the bottom half of the 10 evaluated attributes in both instances. The reasons for this may vary according to the attribute. Performance history, though in theory expressed as being important, was perceived as being less important because gaining information on a supplier's past performance is very time consuming and often infeasible. This is the case, as communicated by several procurement decision-makers, because agencies that have contracted with suppliers that have performed poorly are reluctant to admit doing so and, as a consequence, the performance history of suppliers becomes less apparent. Another reason that performance history ranked not only low, but even lower, when evaluating suppliers of alternative fuel vehicles was that due to the relatively less widespread procurement and use of such vehicles, information on their suppliers' performance histories does not often exist.

Procedural compliance's relative lack of importance stems from the fact that, as conveyed by procurement decision-makers, the focus is on receiving a good quality vehicle with ample support thereafter; thus the procedural process by which the vehicle is produced and delivered is of much less importance. It is important to note here that this attribute does not extend to regulatory compliance, which in the US public transportation industry, at least for vehicles that are purchased using government funds, must be met and therefore need not be included among evaluation criteria.

A similar situation occurred with the supplier attribute delivery. As explained by research participants, much more emphasis is placed on vehicle quality and the associated support services than on how the vehicle is delivered. It must be noted, however, that under certain scenarios the importance of the attribute delivery can take preeminence over others. Procurement decision-makers indicated that if a replacement vehicle was suddenly required, the vehicle's delivery date and in-transit issues would be of more importance. However, given that in most instances the capital planning process and forecasted need for buses are established long in advance of the actual date the buses are needed, the supplier attribute of delivery was not deemed as important as others.

The importance of the attribute price, in perception, was lower than many of the other supplier attributes. Price ranked eighth in importance when evaluating suppliers of conventional fuel vehicles and even lower, at ninth, when evaluating suppliers of alternative fuel vehicles. Price's relatively low ranking in both instances was communicated by research participants as being necessary due to the many risks involved in just purchasing a vehicle because it cost less. Price's lower ranking when evaluating suppliers of alternative fuel vehicles was explained as being a result of there being more concern with the quality, support, and technical issues related to purchasing such a vehicle as opposed to purchasing a conventional fuel vehicle.

The results displaying the ranking of attributes also revealed the consistency in importance of various attributes. Two such attributes were warranties and claims and after-sales support. Both maintained positions in the top five attributes when rankings were observed for evaluating both types of suppliers. Warranties and claims was ranked fourth when evaluating both types of suppliers. After-sales support was ranked fifth when evaluating suppliers of conventional fuel vehicles and third when evaluating suppliers of alternative fuel vehicles.

The consistency in the importance of warranties and claims was understood when its identified sub-attributes were observed. Its sub-attributes included defected parts handling and shipping, claims processing time, and designated warranties and claims staff. The nature of these sub-attributes dictated that they may be of equal importance irrespective of whether or not a vehicle supplier was supplying a conventional fuel vehicle or an alternative fuel vehicle.

When the sub-attributes of after-sales support were observed, the change in its relative importance according to the type of supplier being evaluated was further understood. The identified sub-attributes for after-sales support included parts fulfillment, call center availability, and the availability of training. Each of these sub-attributes was explained as being more important when procuring, and thereafter operating and maintaining, an alternative fuel vehicle. This results in suppliers of alternative fuel vehicles being held to higher standards when being evaluated on the after-sales support they would provide.

Some similarities in the identified sub-attributes for warranties and claims and after-sales support existed. These similarities focused on response time. The definition of response time, however, differs between these two attributes. Whereas for warranties and claims response time may refer to the time it takes a supplier to respond to a claim, for after-sales support it may more likely refer to the response time to a technical question or expressed training need. It is worth noting that the other identified sub-attributes for each of the attributes serve to make a clear distinction between them.

Hypothesis testing was used to statistically substantiate the difference in the perceived importance levels of specific supplier attributes when the vehicle type or aspects of decision-maker change. Using paired sample t-tests, the supplier attributes quality, technical capability, and after-sales support were observed as being statistically more important, at $\alpha = 0.05$, when evaluating alternative fuel vehicle suppliers as opposed to suppliers of conventional fuel vehicles. The results for after-sales support and technical capability were highly significant with t-statistic values of -7.090 and -8.293 respectively. The equal importance of warranties and claims when evaluating both supplier types was further substantiated through the tests. The higher importance of price when evaluating suppliers of conventional fuel vehicles was also substantiated.

Hypothesis testing also revealed that price was more important to procurement decision-makers at agencies in non-urban areas than to their counterparts at agencies in urban areas. This probably arose due primarily to the fact that many urban agencies generally have larger capital budgets and programs, and vehicle price therefore becomes less of a factor, relative to others, when evaluating suppliers.

The fact that statistical testing showed that an agency's urban classification, its vehicle fleet size, its capital expenditure level, its decision-makers' education level, or their years of experience had no influence on supplier attributes' scoring and ranking was enlightening. However, it was interesting to see, along with its relatively lower level of significance, that the FTA region in which a public transportation agency operates influenced the manner in which its procurement decision-makers evaluate suppliers of conventional fuel vehicles on their integrity and how they evaluate suppliers of alternative fuel vehicles on their warranties and claims offerings. Further investigation of the model results did reveal statistically significant differences in the way these attributes were ranked between regions, but no substantial reasons for this have been identified. It was believed that this may be a result of the service types offered in regions, the vehicle types used in providing these services, the procurement agreements utilized based on regulations, or regional cultural trends. It was determined that further investigation, beyond the scope of this research, was needed to arrive at a substantial explanation for this result. This result did, however, give further substantiation to an assumption of the research, which was that the evaluation and choice of a vehicle supplier had less to do with characteristics of the individual doing the evaluation and more to do with characteristics of the supplier, represented by attribute level combinations.

This assumption was substantiated when results for the conditional logit models used in the research were observed. The explanation of supplier choice as a function of the supplier attribute level combinations and the utility of individual attributes yielded more statistically significant results than those that tested for attribute importance as a function of decision-makers' characteristics. This was an important finding.

Another important finding was that the output of the conditional logit model revealed that among the five supplier attributes in the model, price was the most important in practice. This result was different from the results of earlier analyses on the perceived importance of price, in which it ranked much lower. It was interesting to note that both quality and after-sales support maintained their relatively high rankings in practice. Furthermore, when supplier attributes were paired and introduced into the conditional logit model, the attribute pairs with the most significant impact on supplier decisions were price with quality and price with after-sales support. Combinations of quality, price, and after-sales support were the most significant interaction variables in the conditional logit model. The results of the two conditional logit models revealed that, though procurement decision-makers at public transportation agencies acknowledge, appreciate, and understand the importance of quality, after-sales support, and various other supplier attributes, in actual situations they make supplier decisions with most importance given to price. This revealed importance of price in practice bears indirect implications in other government policy related initiatives. These implications surround the fact that price's importance in supplier evaluation may indirectly erode efforts to achieve policy objectives aimed at increasing the use of life-cycle costing techniques in fleet management and improving the state-of-good-repair of vehicles. This, along with the results revealing after-sales support's consistent high importance, was a key finding of the study.

In the analysis of the results for several of the research's sub-objectives, the main objective of the research was achieved. The objective was to gain a deeper understanding of supplier evaluation and selection in the US public transportation industry and to use the research's results as potential input to "best-value" vehicle procurement practice with specific focus on the supplier evaluation phase.

The results of the research contributed to four areas: government procurement activities, public transportation agency supplier evaluation and selection practice, vehicle supplier strategy, and academic research.

This research contributed to government procurement activities on two levels – the federal level and the state level. From the federal government level, the results of this research can add value in two areas. The first of these two areas relates to the FTA's published information on "best-value" procurement. While the FTA's *Best Practice Procurement Manual (BPPM)* provides a definition for "best-value" procurement, two areas can be added. The FTA does not specify or dictate the use of any specific criteria, but it does list six criteria that can potentially be used in evaluating supplier proposals. In this research, the procurement decision-maker identified an additional 41 attributes. They provide further detail on the types of criteria that can be used and contributes to the existing body of knowledge by identifying potential “best-value” evaluation criteria. Additionally, the FTA does not specify nor dictate the use of any particular analytical processes when evaluating and choosing suppliers. The discrete choice model utilized in this research provided a method by which the importance of supplier attributes used in the supplier evaluation process can be determined. Also, the 41 identified sub-attributes and their measurements provide input into developing a deeper understanding as to the types of criteria used and help in identifying the best analytical and quantitative methods that may be used to effectively evaluate and compare vehicle suppliers.

The second area in which the results of this research can add value to federal procurement initiatives is by the FTA utilizing the results to test if the general attribute preferences of public transportation agency procurement decision-makers align with and serve in the best interest of its policy objectives. An example can be alluded to in the policy objective of maintaining a state of good repair. Maintaining a state of good repair, in the context of vehicles, refers to a public transportation agency’s purchasing, maintaining, rehabilitating, and managing buses and vans in a manner that maximizes the output from them as assets while minimizing the cost of operating them throughout their life cycles. If, as the research reveals, the most important attribute when evaluating a supplier in actuality is the price they offer, then that procurement practice does not align with federal government state-of-good-repair policy objectives. The attributes of quality, after-sales support, and warranties and claims may be more important supplier attributes if state-of-good-repair is a priority.

From the state government perspective, the results of this research can add value in two specific areas. First were the results substantiating the importance of other supplier attributes in addition to that of price. Second, the results provided a detailed list of potential evaluation criteria that contributed significantly. Such application of these results is specific to state agencies that procure vehicles on behalf of public transportation agencies or that stipulate the use of IFBs and low-bid methods to those agencies that use state funds to procure vehicles. While budgetary constraints do often necessitate these stipulations, the use of price as the sole criterion for making a supplier decision may be more costly to state agencies in the long run. Should state agencies embark on procurement method reform initiatives, the results of research can serve as input to developing “best-value” supplier evaluation guidelines and in identifying potential supplier evaluation criteria.

Another area in which the results of this research can add value to state government procurement initiatives is in minimizing any ramifications to vehicle supplier evaluation and selection practice and effectiveness as a result of environmental, energy use, and climate change related regulations. On the state government level, bills focused on climate and the environment include California’s Assembly Bill (AB) 32 of 2006, California Senate Bill (SB) 375 of 2008, which establishes GHG reduction targets for California’s eighteen metropolitan planning organizations (MPOs), and Washington State’s House Bill (HB) 2815 of 2008, *“Climate Action and Green Jobs,”* which requires the state DOT to adopt vehicle miles travelled (VMT) reduction strategies and also requires any agency that operates on-road vehicles that emit in excess of 2,500 metric tons of GHGs to report the tonnage annually (Gallivan and Grant 2010). Additional anticipated policies, mandates, and legislative measures have been cited by public transportation agencies as stipulating new or increased environmental requirements. These include New Jersey’s Global Warming Response Act, Arizona’s Executive Order 2006-13, Oregon’s state goals for GHG reduction, and Florida’s Executive Order 07-127 (Gallivan and Grant 2010). As observed in the research results, procurement decision-makers, through experience, have indicated that the importance of criteria change when evaluating suppliers of alternative fuel vehicles. The increased engineering and technological complexity of alternative fuel vehciles necessitate the use of supplier evaluation methods that permit the use of other important criteria as opposed to solely price. This research identifies the evaluation criteria or supplier attributes deemed most important when evaluating alternative vehicle suppliers. This can assist state governments in integrating important changes in supplier evalaution practice as laws require the increased use of alternative fuel vehicles.

A significant contribution of this research is that it provides input to improving public transportation agency supplier evaluation and selection practice. Here, this research contributes in three ways. First, the supplier analysis that was conducted can assist agencies in identifying potential suppliers in their region, of a specific vehicle type, or within a specific fuel type.

Second, for agencies that desire to develop ideas for weighting supplier evaluation criteria, the identified attribute mean values and parameter estimates can provide input to techniques for relatively weighting attributes. This can improve the effectivenesss of "best-value" procurements by allocating relative focus on specific attributes and criteria. This is extremely beneficial to newly established public transportation agencies or lesser-experienced procurement departments or managers.

The third area in which the research's results contribute to public transportation agency supplier evaluation and selection "best-practice" is by agencies' personnel being able to use the supplier choice probability tables to determine which supplier their peers identified should win in a bid. This can be done by comparing an actual supplier's attribute level combination to the supplier profile it most closely matches in the choice probability table.

The research's results can also be of benefit to vehicle suppliers in at least three areas. First, both the vehicle fleet and supplier analyses can contribute to the market research and business development efforts of suppliers. Suppliers can determine not only which types of vehicles and fuel types are purchased in which particular FTA regions but also to determine who their major competitors are in these categories. Second, the results detail to suppliers which criteria they are being judged on and the importance assigned to each of these criteria. This information could be used as suppliers develop sales strategies and seek to improve proposal competitiveness. The third benefit can be realized in suppliers utilizing the choice probability tables to determine how their offerings in each attribute area may affect their perfomance when bidding. For example, a supplier may determine, after observing the probability choice tables, that its current proposal comprises an attribute level combination that has a probability to win of .26 and may subsequently redistribute resources among attribute areas and induce a probability to win of .93.

A major contribution of this research, if not the most significant, is its addition to the scholarly body of knowledge in various areas. In addition to adding to the supplier evaluation and selction literature since Dickson's seminal work in 1966, this research contributes in the area of supplier evaluation from a public entity perspective, an area much less focused on in the literature (Wang and Bunn, 2004; Schiele and McCue, 2006; Bryntse, 1996; and Murray, 1999, 2001). The results of this research reveal that though purchasing managers in the US public transportation sector understand the necessity and importance of utilizing multicriteria in supplier evaluation processes, the coupling of budgetary constraints and procurement regulation often dictate awarding contracts to the lowest bidding supplier. The works of Dickson in 1996, Weber *et al*. in 1991, and Cheraghi *et al*. in 2004, among others, identify specific supplier attributes that may be used in the evaluation of suppliers in specific industries or for specific products. This research contributes to this aspect of the literature by identifying 41 supplier evaluation attributes, applicable to the public transportation industry, and specifically applicable in the purchasing of vehicles. Another area of focus in the supplier evaluation and selection literature has been the application of quantitative methods in both measuring attributes and in modeling the supplier evaluation and selection process itself. The work of Zhang *et al*. in 2003 and Benyoucef, Ding and Xie in 2003 document the application of various analytical methods to supplier evaluation and selection problems. This research contributes to this body of knowledge by applying ANCOVA and discrete choice modeling to the study of the vehicle supplier selection process in the public transportation industry. As a result, the most significant contribution to the body of knowlegde that this research facilitates is it being the seminal work in the evaluation and selection of suppliers in the US public transportation industry.

The following section provides a summary of the research and identifies future research opportunities as a result of it.

7. SUMMARY AND CONCLUSION

The overarching objective of this research was to gain a deeper understanding of which supplier attributes are most important when procurement decision-makers in the US public transportation industry evaluate and select vehicle suppliers. The intent was for this information to be leveraged and used as input into developing the practice of "best-value" procurement, a procurement method by which multiple supplier attributes are evaluated as opposed to just the supplier's price. The research sought to develop this input by pursuing the tasks required by eight research sub-objectives.

The eight research sub-objectives were 1) to analyze the research sample to determine the types of vehicles that are being purchased by public transportation agencies and to suggest any potential implications to supplier evaluation and selection practice, 2) to analyze the research sample to identify the suppliers of vehicles to the research sample fleet and to suggest any potential implications to supplier evaluation and selection practice, 3) to determine the perceived importance of specific supplier attributes and their relative importance when evaluating suppliers of both conventional fuel and alternative fuel vehicles, 4) to determine whether specific supplier attributes are statistically more important when evaluating suppliers of alternative fuel vehicles versus when evaluating suppliers of conventional fuel vehicles and for procurement decision-makers in non-urban areas versus their counterparts in urban areas, 5) to determine whether certain procurement decision-maker characteristics influence the perceived importance they assign to specific vehicle supplier attributes, 6) to determine the importance assigned to specific vehicle supplier attributes in practice and to use these assigned importance values to predict how procurement decision-makers would choose suppliers, 7) to determine if there are any differences in assigned importance values to attributes in perception versus practice, and 8) to gain a deeper understanding of the constituents of specific vehicle supplier attributes and to identify metrics by which they can be measured.

Sub-objectives one and two were accomplished utilizing data mining and extracting techniques on the 2009 Revenue Fleet Inventory Data Base of the FTA's National Transit Database.

There were eight vehicle types in the 60,005 vehicle research sample fleet. The largest represented vehicle type was traditional 28-foot to 60-foot buses, while the second largest was vans. Together, they accounted for 93.1% of the vehicles in the sample fleet. This may be due to the fact that both these types of vehicles are utilized in the two predominant types of public transportation services offered by US public transportation agencies – fixed-route service with buses and paratransit or demand-response services with vans. Another interesting finding was that, in spite of the fact that 13 fuel types were utilized by vehicles in the sample fleet, 77.5% of the vehicles utilized diesel or gasoline, the conventional fuels. Only 22.5% of vehicles utilized any form of alternative fuel. Biodiesel and compressed natural gas (CNG) were the most utilized alternative fuel types.

Potential supplier evaluation implications of these findings were identified as the need for suppliers to develop value-added services and product differentiation strategies to successfully compete in the already very competitive markets of these two vehicle and fuel types. Another potential supplier selection implication of these findings was the potential for suppliers to become highly specialized in the production of any of the other five vehicle types or 11 fuel types and create a niche by serving in a smaller yet less competitive market, e.g., to focus on the supply of trolley buses or buses that utilize liquefied petroleum gas (LPG).

Analysis of the 64 suppliers of the vehicles in the research sample fleet revealed that there were suppliers that had significant "sample market share" across numerous vehicle types and fuel types. These suppliers included New Flyer Industries, Gillig Corporation, Ford Motor Company, North American Bus

Industries, Motor Coach Industries International, NOVA Bus Corporation, Coach Equipment & Manufacturing, and El Dorado National. Conversely, while they did not have significant "sample market share" across numerous vehicle types and fuel types, some suppliers did have significant "sample market share" in specific vehicle types or fuel types. "Specialty" suppliers included Neoplan USA Corporation for articulated buses, Prevost Car Inc. for over-the-road buses, Breda Transportation Inc. and AAI/Skoda for trolley buses, and Chevrolet and Dodge for passenger vans. With respect to vehicles utilizing specific types of fuels, "specialty" suppliers were Orion Bus Ltd. for compressed natural gas (CNG) vehicles, Bus Industries of America and Goshen Coach for dual fuel vehicles. Goshen Coach also supplied all the bunker fuel vehicles in the sample fleet. Breda Transportation Inc. and AAI/Skoda had significant share in supplying electric powered vehicles, as did Startrans for hybrid gasoline vehicles.

These findings had potential implications to supplier evaluation and selection practice by identifying which vehicle types and fuel types specific suppliers specialized in. This leads to the possibility of public transportation agencies using this information to develop supplier short-lists, a prerequisite of the supplier evaluation process.

The research also identified the vehicle supplier attributes that procurement decision-makers perceived to be most important when evaluating both suppliers of conventional fuel vehicles and alternative fuel vehicles. For suppliers of both types, the five supplier attributes perceived to be most important were quality, reliability, after-sales support, warranties and claims, and integrity. However, results did show that the level of perceived importance for each of these top five attributes changed according to which type of supplier was being evaluated. The ranking of attributes when suppliers of conventional fuel vehicles were evaluated was 1) reliability (9.11), 2) quality (9.10), 3) integrity (8.65), 4) warranties and claims (8.64), and 5) after-sales support (8.49). However, when suppliers of alternative fuel vehicles were evaluated, the order of the perceived importance of these attributes changed to 1) quality (9.36), 2) reliability (9.14), 3) after-sales support (9.02), 4) warranties and claims (8.75), and 5) integrity (8.68). The major reason for the change in rank of the attributes' perceived importance was primarily attributed to the increased engineering and technological composition of alternative fuel vehicles and the resulting alterations in requirements on their suppliers.

The differences in the perceived importance of supplier attributes when suppliers of the different vehicle types were evaluated were statistically substantiated. Paired-sample t-tests and two-sample t-tests were used and it was concluded that quality, after-sales support, and technical capability were relatively more important when evaluating suppliers of alternative fuel vehicles versus when evaluating those that supply conventional fuel vehicles. It was also concluded that price is more important when evaluating those that supply conventional fuel vehicles versus those of alternative fuel vehicles. Another test led to the conclusion that price is a more important supplier attribute for procurement decision-makers in non-urban areas than it is to those in urban areas.

Analysis of Covariance (ANCOVA) tests conducted in the research revealed that an agency's urban classification, its vehicle fleet size, its capital expenditure level, its decision-makers' education level, or their years of experience had no statistically significant influence on the perceived importance a procurement decision-maker assigns to a specific supplier attribute. However, two tests were significant and revealed that the FTA region to which a public transportation agency's procurement decision-maker belongs influences the manner in which they evaluate suppliers of conventional fuel vehicles on their integrity and how they evaluate suppliers of alternative fuel vehicles on the warranties and claims they offer.

The research results suggested that supplier attribute combinations, and not procurement decision-maker characteristics, can explain the variation in supplier choice and attribute importance with more accuracy and statistical significance. A discrete choice experiment was used to determine the importance of specific supplier attributes in practice. To estimate the parameter values, or part-worth utilities, of specific supplier attributes, a conditional logit model was used. It identified the relative importance of specific supplier attributes in practice. Results showed that price, with a parameter estimate of -0.7246, was the most important supplier attribute. It was followed by quality with a parameter estimate of 0.6818, after-sales support with a parameter estimate of 0.6780, technical capability with a parameter estimate of 0.4411, and delivery with a parameter estimate of 0.2433. These parameter estimates were used to develop the choice probabilities of suppliers with varied attribute level combinations. The choice probabilities identified the probability of a supplier being chosen instead of a supplier with its "mirror" or opposite attribute level combination.

A very substantive research deliverable was the identification of 41 supplier attribute constituents, or sub-attributes, which can be used in evaluating vehicle suppliers. These sub-attributes were identified by a sub-set of the research's 327 participants. They represent the constituents of the attributes quality, price, delivery, technical capability, after-sales support, performance history, warranties and claims, and reliability. Metrics by which each of the 41 sub-attributes could be measured were identified by research participants.

As discussed in detail in the previous chapter, the results of this research add value in the areas of government procurement policy and initiatives, public transportation agency "best-value" procurement practice, vehicle supplier marketing and sales strategy, and in academic research, where it represents the first work of its type focusing on vehicle supplier evaluation and selection in the US public transportation industry.

As aforementioned, this research represents the first scholastic "foray" into the dynamics of vehicle supplier evaluation and selection in the public transportation industry. As such, it is exploratory in nature and utilizes models and quantitative techniques to facilitate exploratory analyses. The research process and information garnered from the results have shed light on various areas of the vehicle supplier evaluation and selection process that require more focus. It was determined that the vehicle supplier evaluation and selection process is complex and that such complexities vary on a per agency basis. Accurately capturing the entirety of complexities and their associated dynamics in one study or model is extremely challenging, if not impossible. This study, however, facilitates a deepened understanding of vehicle supplier attribute importance and its role in the supplier evaluation and selection process. It provides various facets of output that can serve as input to more tactical and definitive supplier evaluation operations.

7.1 Future Research Needs

Through the process of conducting this research and analyzing its results, a number of research needs pertaining to vehicle supplier evaluation and selection in the US public transportation industry were identified. These research needs focus on other aspects of the supplier evaluation process, yielding a deeper understanding of evaluation criteria dynamics, the identification and increased use of analytical methods that can be employed to solve per agency supplier evaluation and selection problems, the development of additional supplier product markets based on the importance of specific attributes, and a deeper understanding of supplier evaluation and selection for other important public transportation related products.

An area in need of further research involves an analysis of the vehicle specification function as practiced by public transportation agency procurement decision-makers. Such research can investigate how vehicle specifications could, and should, change, as environmental, energy use, and climate change regulations become enforced. These regulations would require the purchase of alternative fuel vehicles. This research would focus on the function in the vehicle procurement process that precedes actual supplier evaluation and selection. Its results can contribute to the development of vehicle specification practices that lead to more effective supplier "filtration" and make the vehicle procurement process more efficient.

Another area of research is to expand on the sub-attributes identified in this study by using empirical methods and quantitative models to appropriately weight the 41 criteria. Similarly, a need exists for management science based research that, on a per public transportation agency basis, applies quantitative tools that can effectively measure multiple evaluation criteria and provide input to the development of vehicle procurement decision support tools.

Further investigation into the vehicle after-sales support function in the public transportation industry is required. Research dedicated to a fuller understanding of its dynamics, the identification of untapped market segments for suppliers, and the identification of the ever-evolving needs of public transportation agencies as vehicle technology and engineering develop will add significant value to both supplier and public transportation agency practice.

In a broader sense than just its application to vehicles, the evaluation and selection of technology vendors in the public transportation industry warrants further research. As experienced with vehicles, technology is becoming more utilized and embedded in the day-to-day functions and operations in many other areas in the public transportation industry. As a result of this, public transportation agencies have increased their purchase of management information systems, enterprise resource planning systems, call center technologies, advanced traveler information systems, fleet management systems, and electronic payment and revenue systems, among other technology based solutions. A deeper understanding of how procurement decision-makers evaluate and select the suppliers of these products is not only beneficial but necessary.

The supplier evaluation and selection process in the public transportation industry is an area that offers many opportunities for both theoretical and applied research. Such initiatives can significantly contribute to improved procurement practice, induce agency cost-savings, and most importantly, facilitate providing public transportation services with the right vehicle, at the right cost, at the right times, and in the right places.

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APPENDIX I. RESEARCH SURVEY

Vehicle Supplier Evaluation and Selection Study

INTRODUCTION

Dear Public Transportation Professional,

This letter pertains to graduate study research being conducted by Marc A. Scott at the North Dakota State University (NDSU). The research study focuses on vehicle procurement at US public transportation agencies and is being conducted through the Upper Great Plains Transportation Institute at NDSU. The objective of the research study is to gain a deeper understanding as to which supplier evaluation criteria are most important to you when selecting public transportation vehicle suppliers. The research requires the input of public transportation professionals. Being such a professional, your input will be collected through the attached survey. All aspects of your input to the research are confidential and all responses will be observed solely by the researcher and no other individual or party.

It would be greatly appreciated if you respond to the following questions by **March 24th 2011.** It should take **approximately 10 minutes** to complete the questions. Please save the survey, respond to the questions, and upon completing the survey send it as an attachment to marc.scott@ndsu.edu} (**preferably**) or fax it to (701) 231 1945 (whichever best facilitates your response to the survey).

Your participation in this study is voluntary. You reserve the exclusive right to choose to respond to the questions or not, and to also discontinue your participation at anytime without any penalty or loss of benefits to which you are otherwise entitled. Your decision to participate or not to participate in no way, in the present or the future, affects your relations with NDSU.

If you have any questions regarding your rights as a research subject, or if you have any concerns or complaints about the research, you may contact the NDSU Institutional Review Board (IRB) Office at (701) 231 8908. If you have questions specific to this research project, please contact Marc A. Scott at (701) 429 0737.

Thanks in advance for your invaluable contribution to this research. It is most appreciated.

Yours Sincerely,

Marc A. Scott

SECTION 1 – Transit Professional and Transit Agency Information

Please respond to each question by:
- Checking the appropriate box
- Writing your response in the provided space: **Just Click on Space (It Becomes Highlighted) and Begin Writing**

Please answer the following:

1. What is your organization's or agency's name?

2. In which state does your organization or agency operate?

3. How many years of experience do you have in the public transportation industry?

4. What is the highest level of education you have attained:
   a. High School Diploma ☐
   b. Undergraduate Degree e.g. BS or BA ☐
   c. Graduate Degree e.g. MS, MA, MBA, PhD ☐
   d. Professional Degree e.g. MD or JD ☐
   e. Other ☐ Comment-

5. Vehicle procurement law in the state in which your agency operates allows you to:
   a. Award vehicle supplier contracts based on the criteria of lowest-price proposals **only** ☐
   b. Award vehicle supplier contracts based on "best-value"[15]proposals (other criteria involved) ☐
   c. Other ☐ Comment-

6. Has your organization or agency purchased any alternative fuel/powered vehicles in the **past 5 years**:
   a. Yes ☐
   b. No ☐
   Comment-

7. Will your organization or agency purchase any alternative fuel/powered vehicles in the **next 5 years**:
   a. Yes ☐
   b. No ☐
   Comment-

SECTION 2 – Vehicle Supplier Attribute Importance (Your Opinion)

The following table asks you to rank the importance of vehicle supplier attributes on a scale from 1 to 10 (With 1 being not important at all and 10 being extremely important).

You are asked to rank each vehicle supplier attribute's importance when evaluating for conventional gasoline/diesel vehicles **versus** alternatively fueled/powered vehicles. This allows comparison between the two types of vehicles. In the context of this research **you are not restricted by any form of regulation, please rate the level of importance of supplier attributes as you believe them to be.**

Please mark the box ☒ that corresponds to the score you give each vehicle supplier attribute for both conventional fuel and alternative fuel vehicles.

Example:

Supplier Attributes	Level of Importance (Rating)																			
	Conventional Fuel Vehicle Supplier (Gas/Diesel										*Alternative Fuel/Power Vehicle Supplier*									
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
Quality	☐	☐	☐	☐	☐	☐	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒
Delivery	☐	☐	☐	☐	☒	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐

[15] "Best-Value", based on the Federal Transit Administration's (FTA) definition refers to when an agency evaluates a supplier proposal by giving importance to other supplier evaluation criteria than just product price i.e. price is not the only evaluation criteria on which the award decision is based.

Please complete the following:

Supplier Attributes	Level of Importance (Rating)																			
	Conventional Fuel Vehicle Supplier (Gas/Diesel)										*Alternative Fuel/Power Vehicle Supplier*									
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
Quality	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Delivery	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Price	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Technical Capabili	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Reliability	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Performance Histo	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Procedural Compli	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
After-Sales-Suppo	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Integrity	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Warranties & Clain	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

SECTION 3 – Vehicle Supplier Selection

Below are "Vehicle Supplier Choice Scenarios". In each scenario you are required to choose the vehicle supplier with the attribute combinations you prefer. Your choice will be based on what each vehicle supplier has to offer in each of the 5 supplier attribute areas – *Quality*, *Delivery*, *Price*, *Technical Capability*, and *After-Sales-Support*.

Each scenario consists of three choices – two vehicle suppliers and a neither option. **Only choose "neither" if you absolutely do not prefer any of the other vehicle suppliers** (Choosing an actual supplier allows more accurate analysis).

Place a mark ☒ in the check box provided at bottom of the column that represents your vehicle supplier choice

- **Vehicle Supplier Choice Scenario 1**

Supplier Attributes	Supplier 1.	Supplier 2.	
Quality	Meets minimum quality	Significantly exceeds minimum quality	
Delivery	Sometimes late	Always on time	
Price	Higher	Lower	
Technical Capability	Offers significantly more	Offers less	
After-Sales-Support	Offers significantly more	Offers less	
My Choice is……….	**Supplier 1.** ☐	**Supplier 2.** ☐	Neither ☐

Comment

- **Vehicle Supplier Choice Scenario 2**

Supplier Attributes	Supplier 3.	Supplier 4.	
Quality	Significantly exceeds minimum quality	Meets minimum quality	
Delivery	Sometimes late	Always on time	
Price	Lower	Higher	
Technical Capability	Offers significantly more	Offers less	
After-Sales-Support	Offers significantly more	Offers less	
My Choice is……….	**Supplier 3.** ☐	**Supplier 4.** ☐	Neither ☐

Comment

- **Vehicle Supplier Choice Scenario 3**

Supplier Attributes	Supplier 5.	Supplier 6.	
Quality	Significantly exceeds minimum quality	Meets minimum quality	
Delivery	Sometimes late	Always on time	
Price	Higher	Lower	
Technical Capability	Offers less	Offers significantly more	
After-Sales-Support	Offers significantly more	Offers less	
My Choice is……….	**Supplier 5.** ☐	**Supplier 6.** ☐	Neither☐

Comment

- **Vehicle Supplier Choice Scenario 4**

Supplier Attributes	Supplier 7.	Supplier 8.	
Quality	Significantly exceeds minimum quality	Meets minimum quality	
Delivery	Always on time	Sometimes late	
Price	Lower	Higher	
Technical Capability	Offers significantly more	Offers less	
After-Sales-Support	Offers less	Offers significantly more	
My Choice is……….	**Supplier 7.** ☐	**Supplier 8.** ☐	Neither ☐

Comment

- **Vehicle Supplier Choice Scenario 5**

Supplier Attributes	Supplier 9.	Supplier 10.	
Quality	Meets minimum quality	Significantly exceeds minimum quality	
Delivery	Always on time	Sometimes late	
Price	Lower	Higher	
Technical Capability	Offers less	Offers significantly more	
After-Sales-Support	Offers less	Offers significantly more	
My Choice is……….	**Supplier 9.** ☐	**Supplier 10.** ☐	Neither ☐

Comment

• Vehicle Supplier Choice Scenario 6

Supplier Attributes	Supplier 11.	Supplier 12.	
Quality	Significantly exceeds minimum quality	Meets minimum quality	
Delivery	Always on time	Sometimes late	
Price	Lower	Higher	
Technical Capability	Offers less	Offers significantly more	
After-Sales-Support	Offers significantly more	Offers less	
My Choice is……….	**Supplier 11.** ☐	**Supplier 12.** ☐	Neither ☐

Comment

• Vehicle Supplier Choice Scenario 7

Supplier Attributes	Supplier 13.	Supplier 14.	
Quality	Meets minimum quality	Significantly exceeds minimum quality	
Delivery	Always on time	Sometimes late	
Price	Lower	Higher	
Technical Capability	Offers significantly more	Offers less	
After-Sales-Support	Offers significantly more	Offers less	
My Choice is……….	**Supplier 13.** ☐	**Supplier 14.** ☐	Neither ☐

Comment

• Vehicle Supplier Choice Scenario 8

Supplier Attributes	Supplier 15.	Supplier 16.	
Quality	Meets minimum quality	Significantly exceeds minimum quality	
Delivery	Always on time	Sometimes late	
Price	Higher	Lower	
Technical Capability	Offers significantly more	Offers less	
After-Sales-Support	Offers less	Offers significantly more	
My Choice is……….	**Supplier 15.** ☐	**Supplier 16.** ☐	Neither ☐

Comment

- **Vehicle Supplier Choice Scenario 9**

Supplier Attributes	Supplier 17.	Supplier 18.	
Quality	Significantly exceeds minimum quality	Meets minimum quality	
Delivery	Sometimes late	Always on time	
Price	Higher	Lower	
Technical Capability	Offers significantly more	Offers less	
After-Sales-Support	Offers less	Offers significantly more	
My Choice is……….	**Supplier 17.** ☐	**Supplier 18.** ☐	Neither ☐

Comment

- **Vehicle Supplier Choice Scenario 10**

Supplier Attributes	Supplier 19.	Supplier 20.	
Quality	Meets minimum quality	Significantly exceeds minimum quality	
Delivery	Always on time	Sometimes late	
Price	Higher	Lower	
Technical Capability	Offers less	Offers significantly more	
After-Sales-Support	Offers significantly more	Offers less	
My Choice is……….	**Supplier 19.** ☐	**Supplier 20.** ☐	Neither ☐

Comment

- **Vehicle Supplier Choice Scenario 11**

Supplier Attributes	Supplier 21.	Supplier 22.	
Quality	Meets minimum quality	Significantly exceeds minimum quality	
Delivery	Sometimes late	Always on time	
Price	Lower	Higher	
Technical Capability	Offers significantly more	Offers less	
After-Sales-Support	Offers less	Offers significantly more	
My Choice is……….	**Supplier 21.** ☐	**Supplier 22.** ☐	Neither ☐

Comment

• Vehicle Supplier Choice Scenario 12

Supplier Attributes	Supplier 23.	Supplier 24.	
Quality	Significantly exceeds minimum quality	Meets minimum quality	
Delivery	Always on time	Sometimes late	
Price	Higher	Lower	
Technical Capability	Offers less	Offers significantly more	
After-Sales-Support	Offers less	Offers significantly more	
My Choice is……….	**Supplier 23.** ☐	**Supplier 24.** ☐	Neither ☐

Comment

• Vehicle Supplier Choice Scenario 13

Supplier Attributes	Supplier 25.	Supplier 26.	
Quality	Significantly exceeds minimum quality	Meets minimum quality	
Delivery	Always on time	Sometimes late	
Price	Higher	Lower	
Technical Capability	Offers significantly more	Offers less	
After-Sales-Support	Offers significantly more	Offers less	
My Choice is……….	**Supplier 25.** ☐	**Supplier 26.** ☐	Neither ☐

Comment

• Vehicle Supplier Choice Scenario 14

Supplier Attributes	Supplier 27.	Supplier 28.	
Quality	Meets minimum quality	Significantly exceeds minimum quality	
Delivery	Sometimes late	Always on time	
Price	Higher	Lower	
Technical Capability	Offers less	Offers significantly more	
After-Sales-Support	Offers less	Offers significantly more	
My Choice is……….	**Supplier 27.** ☐	**Supplier 28.** ☐	Neither ☐

Comment

• Vehicle Supplier Choice Scenario 15

Supplier Attributes	Supplier 29.	Supplier 30.	
Quality	Significantly exceeds minimum quality	Meets minimum quality	
Delivery	Sometimes late	Always on time	
Price	Lower	Higher	
Technical Capability	Offers less	Offers significantly more	
After-Sales-Support	Offers less	Offers significantly more	
My Choice is……….	**Supplier 29.** ☐	**Supplier 30.** ☐	Neither ☐

Comment

• Vehicle Supplier Choice Scenario 16

Supplier Attributes	Supplier 31.	Supplier 32.	
Quality	Meets minimum quality	Significantly exceeds minimum quality	
Delivery	Sometimes late	Always on time	
Price	Lower	Higher	
Technical Capability	Offers less	Offers significantly more	
After-Sales-Support	Offers significantly more	Offers less	
My Choice is……….	**Supplier 31.** ☐	**Supplier 32.** ☐	Neither ☐

Comment

APPENDIX II. FRACTIONAL FACTORIAL DESIGN

Minitab Fractional Factorial Design Output Utilized in Supplier Choice Discrete Choice Experiment

12/6/2010 4:25:22 PM

```
Welcome to Minitab, press F1 for help.
```

Fractional Factorial Design

```
Factors:   5   Base Design:         5, 16   Resolution:    V
Runs:     16   Replicates:              1   Fraction:    1/2
Blocks:    1   Center pts (total):      0


Design Generators: E = ABCD


Alias Structure

I + ABCDE

A + BCDE
B + ACDE
C + ABDE
D + ABCE
E + ABCD
AB + CDE
AC + BDE
AD + BCE
AE + BCD
BC + ADE
BD + ACE
BE + ACD
CD + ABE
CE + ABD
DE + ABC
```

StdOrder	RunOrder	CenterPt	Blocks	A	B	C	D	E
13	1	1	1	-1	-1	1	1	1
10	2	1	1	1	-1	-1	1	1
6	3	1	1	1	-1	1	-1	1
12	4	1	1	1	1	-1	1	-1
3	5	1	1	-1	1	-1	-1	-1
4	6	1	1	1	1	-1	-1	1
11	7	1	1	-1	1	-1	1	1
15	8	1	1	-1	1	1	1	-1
14	9	1	1	1	-1	1	1	-1
7	10	1	1	-1	1	1	-1	1
9	11	1	1	-1	-1	-1	1	-1
8	12	1	1	1	1	1	-1	-1
16	13	1	1	1	1	1	1	1
5	14	1	1	-1	-1	1	-1	-1
2	15	1	1	1	-1	-1	-1	-1
1	16	1	1	-1	-1	-1	-1	1

APPENDIX III. SUMMARY STATISTICS FOR SAS®9.2 OUTPUT

09:59 Tuesday, May 10, 2011 2

The MEANS Procedure

Variable	Mean	Std Dev	N	Minimum	Maximum	Median
Vehicles_in_Fleet	361.05	755.05	289	2.00	6354.00	73.00
Capital_Funds	19883611.98	92509718.21	310	0.00	1412875366.0	691119.00
Years_of_Experience	18.30	11.12	327	0.10	49.00	18.00

Variable	Range	Skewness	Kurtosis
Vehicles_in_Fleet	6352.00	3.92	19.32
Capital_Funds	1412875366.0	11.66	168.01
Years_of_Experience	48.90	0.26	-0.95

APPENDIX IV. SAMPLE VEHICLE SUPPLIERS BY FTA REGION

Table A-IV.1 FTA Region 1 Suppliers

Region 1		
Supplier	**Vehicles in Regional Fleet**	**Percentage of Regional Fleet**
New Flyer of America	**612**	**21.4%**
Ford Motor Company	**521**	**18.2%**
NOVA Bus Corporation	**405**	**14.2%**
North American Bus Industries Inc.	**299**	**10.5%**
Neoplan - USA Corporation	**237**	**8.3%**
Dodge Division - Chrysler Corporation	**156**	**5.5%**
ElDorado National	**107**	**3.7%**
Gillig Corporation	**98**	**3.4%**
No Supplier Listed	**93**	**3.3%**
Turtle Top	**69**	**2.4%**
Orion Bus Industries Ltd.	**63**	**2.2%**
Transportation Manufacturing Company	**45**	**1.6%**
Braun	**43**	**1.5%**
Motor Coach Industries International	**30**	**1.1%**
Chance Manufacturing Company	**19**	**0.7%**
Startrans (Supreme Corporation)	**18**	**0.6%**
Eagle Bus Manufacturing	**10**	**0.4%**
Blue Bird Corporation	**9**	**0.3%**
Prevost Car Inc.	**8**	**0.3%**
Starcraft	**6**	**0.2%**
Thomas Built Buses	**4**	**0.1%**
Goshen Coach	**3**	**0.1%**
General Motors Corporation	**2**	**0.1%**
Diamond Coach Corporation	**1**	**0.03%**
International	**1**	**0.03%**
Van Hool N.V.	**1**	**0.03%**

Table A-IV.2 Table 1. FTA Region 2 Suppliers

Region 2		
Supplier	**Vehicles in Regional Fleet**	**Percentage of Regional Fleet**
NOVA Bus Corporation	**2037**	**17.7%**
Bus Industries of America	**1952**	**16.9%**
Motor Coach Industries International	**1641**	**14.2%**
Coach and Equipment Manufacturing Company	**1342**	**11.6%**
New Flyer of America	**972**	**8.4%**
Ford Motor Company	**954**	**8.3%**
No Suppliers Listed	**661**	**5.7%**
Flexible Corporation	**415**	**3.6%**
North American Bus Industries Inc.	**279**	**2.4%**
Gillig Corporation	**272**	**2.4%**
Orion Bus Industries Ltd.	**268**	**2.3%**
Neoplan - USA Corporation	**173**	**1.5%**
Chevrolet Motor Division	**147**	**1.3%**
World Trans Inc. (also Mobile-Tech Corporation)	**136**	**1.2%**
Goshen Coach	**67**	**0.6%**
Dodge Division - Chrysler Corporation	**52**	**0.5%**
Blue Bird Corporation	**51**	**0.4%**
El Dorado National	**50**	**0.4%**
Starcraft	**15**	**0.1%**
Transportation Manufacturing Company	**14**	**0.1%**
Champion Motor Coach Inc.	**13**	**0.1%**
General Motors Corporation	**4**	**0.03%**
Startrans (Supreme Corporation)	**3**	**0.03%**
Thomas Built Buses	**3**	**0.03%**
Cable Car Concepts Inc.	**2**	**0.02%**
Overland Custom Coach Inc.	**2**	**0.02%**
Chance Bus Inc.	**1**	**0.01%**
Freightliner Corporation	**1**	**0.01%**
Glaval Bus	**1**	**0.01%**

Table A-IV.3 FTA Region 3 Suppliers

Region 3		
Supplier	**Vehicles in Regional Fleet**	**Percentage of Regional Fleet**
Flyer Industries Ltd	**1553**	**18.9%**
Gillig Corporation	**1117**	**13.6%**
Ford Motor Company	**923**	**11.2%**
Orion Bus Industries Ltd.	**829**	**10.1%**
Coach and Equipment Manufacturing Company	**698**	**8.5%**
North American Bus Industries Inc.	**694**	**8.5%**
Neoplan - USA Corporation	**524**	**6.4%**
Flexible Corporation	**356**	**4.3%**
No Suppliers Listed	**289**	**3.5%**
Braun	**184**	**2.2%**
Motor Coach Industries International	**175**	**2.1%**
El Dorado National	**148**	**1.8%**
NOVA Bus Corporation	**122**	**1.5%**
Chevrolet Motor Division-General Motors	**117**	**1.4%**
General Motors Corporation	**69**	**0.8%**
Chance Bus Inc.	**59**	**0.7%**
Startrans (Supreme Corporation)	**55**	**0.7%**
Mid Bus Inc.	**49**	**0.6%**
Champion Motor Coach Inc.	**48**	**0.6%**
Van Hool N.V.	**43**	**0.5%**
Starcraft	**35**	**0.4%**
Dodge Division - Chrysler Corporation	**30**	**0.4%**
Transportation Manufacturing Company	**23**	**0.3%**
Goshen Coach	**20**	**0.2%**
Thomas Built Buses	**13**	**0.2%**
International	**10**	**0.1%**
Freightliner Corporation	**7**	**0.1%**
Spartan Motors Inc.	**7**	**0.1%**
Shepard Brothers Inc.	**6**	**0.1%**
Blue Bird Corporation	**4**	**0.1%**
Glaval Bus	**1**	**0.01%**
World Trans Inc. (also Mobile-Tech Corporation)	**1**	**0.01%**

Table A-IV.4 FTA Region 4 Suppliers

Region 4		
Supplier	**Vehicles in Regional Fleet**	**Percentage of Regional Fleet**
Gillig Corporation	**1614**	**25.8%**
Ford Motor Company	**1009**	**16.1%**
North American Bus Industries Inc.	**882**	**14.1%**
No Suppliers Listed	**788**	**12.6%**
NOVA Bus Corporation	**377**	**6.0%**
Chevrolet Motor Division-General Motors	**192**	**3.1%**
Dodge Division - Chrysler Corporation	**192**	**3.1%**
Blue Bird Corporation	**176**	**2.8%**
Goshen Coach	**155**	**2.5%**
Startrans (Supreme Corporation)	**114**	**1.8%**
Thomas Built Buses	**89**	**1.4%**
Champion Motor Coach Inc.	**77**	**1.2%**
Chance Manufacturing Company	**77**	**1.2%**
Orion Bus Industries Ltd.	**69**	**1.1%**
Flexible Corporation	**66**	**1.1%**
General Motors of Canada Ltd.	**66**	**1.1%**
New Flyer Industries	**61**	**1.0%**
Canadian Vickers Ltd.	**51**	**0.8%**
Motor Coach Industries International	**36**	**0.6%**
Cable Car Concepts Inc.	**27**	**0.4%**
International	**25**	**0.4%**
Transportation Manufacturing Company	**24**	**0.4%**
Neoplan - USA Corporation	**22**	**0.4%**
Bus Industries of America	**14**	**0.2%**
Freightliner Corporation	**11**	**0.2%**
Braun	**9**	**0.1%**
Oshkosh Truck Corporation	**5**	**0.1%**
Spartan Motors Inc.	**5**	**0.1%**
Glaval Bus	**4**	**0.1%**
Specialty Vehicle Manufacturing Corporation	**4**	**0.1%**
Trolley Enterprises Inc.	**4**	**0.1%**
Collins Bus Corporation	**3**	**0.1%**
Diamond Coach Corporation	**2**	**0.03%**
Dutcher Corporation	**2**	**0.03%**
Status Specialty Vehicles	**2**	**0.03%**
Transcoach	**2**	**0.03%**
Boyertown Auto Body Works	**1**	**0.02%**

Table A-IV.5 FTA Region 5 Suppliers

Region 5		
Supplier	**Vehicles in Regional Fleet**	**Percentage of Regional Fleet**
New Flyer Industries	**2710**	**29.2%**
Gillig Corporation	**2130**	**22.9%**
NOVA Bus Corporation	**869**	**9.4%**
North American Bus Industries Inc.	**553**	**6.0%**
El Dorado National	**533**	**5.7%**
No Suppliers Listed	**432**	**4.7%**
Ford Motor Company	**377**	**4.1%**
Flexible Corporation	**320**	**3.4%**
Goshen Coach	**184**	**2.0%**
Motor Coach Industries International	**156**	**1.7%**
Transportation Manufacturing Company	**124**	**1.3%**
Startrans (Supreme Corporation)	**114**	**1.2%**
Champion Motor Coach Inc.	**86**	**0.9%**
Blue Bird Corporation	**81**	**0.9%**
Braun	**76**	**0.8%**
Glaval Bus	**74**	**0.8%**
AAI/Skoda	**57**	**0.6%**
General Motors Corporation	**50**	**0.5%**
Thomas Built Buses	**47**	**0.5%**
Dodge Division - Chrysler Corporation	**45**	**0.5%**
Oshkosh Truck Corporation	**45**	**0.5%**
Chevrolet Motor Division-General Motors	**39**	**0.4%**
Orion Bus Industries Ltd.	**32**	**0.3%**
Van Hool N.V.	**32**	**0.3%**
Starcraft	**28**	**0.3%**
International	**27**	**0.3%**
Chance Manufacturing Company	**25**	**0.3%**
Bus Industries of America	**17**	**0.2%**
Spartan Motors Inc.	**14**	**0.2%**
Turtle Top	**5**	**0.1%**
Collins Bus Corporation	**4**	**0.04%**
Overland Custom Coach Inc.	**3**	**0.03%**
Federal Coach	**2**	**0.02%**
Trolley Enterprises Inc.	**2**	**0.02%**
Diamond Coach Corporation	**1**	**0.01%**
National Mobility Corporation	**1**	**0.01%**

Table A-IV.6 FTA Region 6 Suppliers

Region 6		
Supplier	**Vehicles in Regional Fleet**	**Percentage of Regional Fleet**
New Flyer Industries	**1545**	**24.0%**
Ford Motor Company	**1001**	**15.6%**
NOVA Bus Corporation	**614**	**9.6%**
North American Bus Industries Inc.	**444**	**6.9%**
Gillig Corporation	**356**	**5.5%**
El Dorado National	**333**	**5.2%**
Champion Motor Coach Inc.	**321**	**5.0%**
Dodge Division - Chrysler Corporation	**289**	**4.5%**
Motor Coach Industries International	**284**	**4.4%**
Goshen Coach	**243**	**3.8%**
Neoplan - USA Corporation	**197**	**3.1%**
Chevrolet Motor Division	**185**	**2.9%**
No Suppliers Listed	**153**	**2.4%**
Orion Bus Industries Ltd.	**111**	**1.7%**
Chance Manufacturing Company	**101**	**1.6%**
Transportation Manufacturing Company	**100**	**1.6%**
Thomas Built Buses	**53**	**0.8%**
Flexible Corporation	**23**	**0.4%**
Glaval Bus	**23**	**0.4%**
Blue Bird Corporation	**13**	**0.2%**
Nissho Iwai American Corporation	**11**	**0.2%**
Starcraft	**10**	**0.2%**
Van Hool N.V.	**5**	**0.1%**
Startrans (Supreme Corporation)	**3**	**0.1%**
Allen Ashley Inc.	**2**	**0.03%**
Braun	**2**	**0.03%**
General Motors Corporation	**2**	**0.03%**
International	**2**	**0.03%**
Bus Industries of America	**1**	**0.02%**
Kansas Coach Manufacturing	**1**	**0.02%**
Metrotrans Corporation	**1**	**0.02%**

Table A-IV.7 FTA Region 7 Suppliers

Region 7		
Supplier	**Vehicles in Regional Fleet**	**Percentage of Regional Fleet**
Gillig Corporation	**564**	**55.2%**
Chevrolet Motor Division-General Motors	**134**	**13.1%**
Ford Motor Company	**99**	**9.7%**
New Flyer of America	**47**	**4.6%**
Orion Bus Industries Ltd.	**39**	**3.8%**
Neoplan - USA Corporation	**36**	**3.5%**
Startrans (Supreme Corporation)	**25**	**2.5%**
Dodge Division - Chrysler Corporation	**17**	**1.7%**
Chance Manufacturing Company	**16**	**1.6%**
El Dorado National	**16**	**1.6%**
Diamond Coach Corporation	**7**	**0.7%**
Overland Custom Coach Inc.	**5**	**0.5%**
Thomas Built Buses	**5**	**0.5%**
Transportation Manufacturing Company	**4**	**0.4%**
Blue Bird Corporation	**2**	**0.2%**
No Suppliers Listed	**2**	**0.2%**
Sabre Bus and Coach Corporation	**2**	**0.2%**
General Motors Corporation	**1**	**0.1%**
Spartan Motors Inc.	**1**	**0.1%**

Table A-IV.8 FTA Region 8 Suppliers

Region 8		
Supplier	**Vehicles in Regional Fleet**	**Percentage of Regional Fleet**
Ford Motor Company	**646**	**42.7%**
Gillig Corporation	**445**	**29.4%**
Chevrolet Motor Division	**199**	**13.1%**
Motor Coach Industries International	**65**	**4.3%**
Chance Bus Inc.	**49**	**3.2%**
No Supplier Listed	**37**	**2.5%**
New Flyer of America	**19**	**1.3%**
Goshen Coach	**10**	**0.7%**
NOVA Bus Corporation	**10**	**0.7%**
Van Hool N.V.	**10**	**0.7%**
Bus Industries of America	**5**	**0.3%**
ElDorado Bus	**4**	**0.3%**
Transportation Manufacturing Company	**4**	**0.3%**
Dodge Division - Chrysler Corporation	**2**	**0.1%**
El Dorado National	**2**	**0.1%**
General Motors Corporation	**2**	**0.1%**
Asea Brown Boveri Ltd.	**1**	**0.1%**
Blue Bird Corporation	**1**	**0.1%**

Table A-IV.9 FTA Region 9 Suppliers

Region 9		
Supplier	**Vehicles in Regional Fleet**	**Percentage of Regional Fleet**
New Flyer Industries	**1500**	**25.0%**
Gillig Corporation	**1049**	**17.5%**
North American Bus Industries Inc.	**846**	**14.1%**
El Dorado National	**771**	**12.9%**
Ford Motor Company	**625**	**10.4%**
Orion Bus Industries Ltd.	**283**	**4.7%**
No Supplier Listed	**240**	**4.0%**
Chevrolet Motor Division-General Motors	**199**	**3.3%**
Startrans (Supreme Corporation)	**105**	**1.8%**
Starcraft	**79**	**1.3%**
Dodge Division - Chrysler Corporation	**70**	**1.2%**
Motor Coach Industries International	**50**	**0.8%**
Blue Bird Corporation	**40**	**0.7%**
Flexible Corporation	**25**	**0.4%**
Glaval Bus	**22**	**0.4%**
NOVA Bus Corporation	**20**	**0.3%**
General Motors Corporation	**13**	**0.2%**
Thomas Built Buses	**12**	**0.2%**
Champion Motor Coach Inc.	**9**	**0.2%**
Transportation Manufacturing Company	**9**	**0.2%**
Collins Bus Corporation	**8**	**0.1%**
Goshen Coach	**7**	**0.1%**
Braun	**5**	**0.1%**
Chance Manufacturing Company	**5**	**0.1%**
Oshkosh Truck Corporation	**4**	**0.1%**
AM General Corporation	**2**	**0.03%**
International	**1**	**0.02%**

Table A-IV.10 FTA Region 10 Suppliers

Region 10		
Supplier	**Vehicles in Regional Fleet**	**Percentage of Regional Fleet**
Chevrolet Motor Division	**1827**	**26.5%**
New Flyer Industries	**1515**	**22.0%**
Gillig Corporation	**1384**	**20.1%**
Ford Motor Company	**732**	**10.6%**
El Dorado National	**412**	**6.0%**
Dodge Division - Chrysler Corporation	**159**	**2.3%**
Flexible Corporation	**131**	**1.9%**
No Suppliers Listed	**103**	**1.5%**
Startrans (Supreme Corporation)	**99**	**1.4%**
General Motors Corporation	**98**	**1.4%**
Goshen Coach	**79**	**1.2%**
Breda Transportation Inc.	**59**	**0.9%**
Champion Motor Coach Inc.	**59**	**0.9%**
Shepard Brothers Inc.	**35**	**0.5%**
Bus Industries of America	**34**	**0.5%**
Collins Bus Corporation	**30**	**0.4%**
Tourstar	**27**	**0.4%**
Wide One Corporation	**24**	**0.4%**
Motor Coach Industries International	**23**	**0.3%**
International	**21**	**0.3%**
Plymouth Division - Chrysler Corporation	**11**	**0.2%**
Glaval Bus	**7**	**0.1%**
American MAN Corporation	**5**	**0.1%**
Thomas Built Buses	**5**	**0.1%**
Coons Manufacturing Inc.	**4**	**0.1%**
Blue Bird Corporation	**3**	**0.04%**
Transportation Manufacturing Company	**3**	**0.04%**
World Trans Inc. (also Mobile-Tech Corporation)	**3**	**0.04%**
Rico Industries	**2**	**0.03%**
Braun	**1**	**0.01%**
Freightliner Corporation	**1**	**0.01%**
Wheeled Coach Industries Inc.	**1**	**0.01%**

APPENDIX V. DESCRIPTIVE ANALYSIS SAS®9.2 OUTPUT

14:28 Sunday, May 8, 2011 3

The MEANS Procedure

Variable	Mean	Std Dev	Std Error	Variance	N	Minimum
Quality__	9.10	1.22	0.07	1.48	327	1.00
Quality_a_	9.36	1.14	0.06	1.30	327	1.00
Delivery__	7.18	1.89	0.10	3.58	327	1.00
Delivery_a_	7.14	1.97	0.11	3.88	327	1.00
Price__	8.01	2.16	0.12	4.67	327	1.00
Price_a_	7.49	2.67	0.15	7.15	327	1.00
Technical_Capability__	7.89	1.80	0.10	3.25	327	1.00
Technical_Capability_a_	8.61	1.66	0.09	2.75	327	1.00
Reliability__	9.11	1.12	0.06	1.25	327	1.00
Reliability_a_	9.14	1.23	0.07	1.51	327	1.00
Performance_History__	8.36	1.50	0.08	2.26	327	1.00
Performance_History_a_	8.50	1.55	0.09	2.40	327	1.00
Procedural_Compliance__	8.14	1.80	0.10	3.26	327	1.00
Procedural_Compliance_a_	8.16	1.85	0.10	3.43	327	1.00
After_Sales_Support_	8.49	1.65	0.09	2.71	327	1.00
After_Sales_Support_a_	9.02	1.47	0.08	2.15	327	1.00
Integrity_	8.65	1.48	0.08	2.20	325	1.00
Integrity_a_	8.68	1.52	0.08	2.32	327	1.00
Warrt_Claims_	8.64	1.47	0.08	2.16	327	1.00
Warrt_Claims_a_	8.75	1.48	0.08	2.20	327	1.00

Variable	Maximum	Median	Range	Coeff of Variation	Skewness
Quality__	10.00	9.00	9.00	13.36	-2.44
Quality_a_	10.00	10.00	9.00	12.20	-3.40
Delivery__	10.00	7.00	9.00	26.37	-0.62
Delivery_a_	10.00	7.00	9.00	27.57	-0.71
Price__	10.00	8.00	9.00	26.99	-1.67
Price_a_	10.00	8.00	9.00	35.71	-1.23
Technical_Capability__	10.00	8.00	9.00	22.84	-1.27
Technical_Capability_a_	10.00	9.00	9.00	19.27	-1.83
Reliability__	10.00	9.00	9.00	12.28	-2.45
Reliability_a_	10.00	9.00	9.00	13.43	-2.73
Performance_History__	10.00	9.00	9.00	17.99	-1.28
Performance_History_a_	10.00	9.00	9.00	18.22	-1.49
Procedural_Compliance__	10.00	8.00	9.00	22.17	-1.19
Procedural_Compliance_a_	10.00	8.00	9.00	22.72	-1.32
After_Sales_Support_	10.00	9.00	9.00	19.39	-1.61
After_Sales_Support_a_	10.00	10.00	9.00	16.26	-2.45
Integrity_	10.00	9.00	9.00	17.14	-1.45
Integrity_a_	10.00	9.00	9.00	17.56	-1.71
Warrt_Claims_	10.00	9.00	9.00	17.02	-1.93
Warrt_Claims_a_	10.00	9.00	9.00	16.96	-1.91

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The MEANS Procedure

Variable	Kurtosis	t Value	Pr > |t|
Quality__	9.87	135.33	<.0001
Quality_a_	17.22	148.18	<.0001
Delivery__	0.22	68.58	<.0001
Delivery_a_	0.34	65.59	<.0001
Price__	2.59	67.01	<.0001
Price_a_	0.54	50.64	<.0001

Technical_Capability__	1.89	79.18	<.0001
Technical_Capability_a_	4.40	93.86	<.0001
Reliability__	11.47	147.25	<.0001
Reliability_a_	11.46	134.67	<.0001
Performance_History__	2.59	100.53	<.0001
Performance_History_a_	2.96	99.24	<.0001
Procedural_Compliance__	1.59	81.58	<.0001
Procedural_Compliance_a_	1.95	79.60	<.0001
After_Sales_Support_	3.38	93.24	<.0001
After_Sales_Support_a_	8.05	111.22	<.0001
Integrity_	2.68	105.18	<.0001
Integrity_a_	3.86	102.97	<.0001
Warrt_Claims_	6.14	106.26	<.0001
Warrt_Claims_a_	4.99	106.65	<.0001

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APPENDIX VI. HYPOTHESIS TESTING SAS®9.2 OUTPUT

1 09:36 Saturday, April 30, 2011

Two Sample Paired t-test for the Means of Quality__ and Quality_a_

Sample Statistics

Group	N	Mean	Std. Dev.	Std. Error
Quality__	327	9.103976	1.2165	0.0673
Quality_a_	327	9.357798	1.142	0.0632

Hypothesis Test

Null hypothesis: Mean of (Quality__ - Quality_a_) => 0
Alternative: Mean of (Quality__ - Quality_a_) < 0

t Statistic	Df	Prob > t
-3.692	326	0.0001

2
09:36 Saturday, April 30, 2011

Two Sample Paired t-test for the Means of Price_and Price_a_

Sample Statistics

Group	N	Mean	Std. Dev.	Std. Error
Price__	327	8.012232	2.1621	0.1196
Price_a_	327	7.486239	2.6733	0.1478

Hypothesis Test

Null hypothesis: Mean of (Price__ - Price_a_) <= 0
Alternative: Mean of (Price__ - Price_a_) > 0

t Statistic	Df	Prob > t
3.670	326	0.0001

3
09:36 Saturday, April 30, 2011

Two Sample Paired t-test for the Means of After_Sales_Support_and After_Sales_Support_a_

Sample Statistics

Group	N	Mean	Std. Dev.	Std. Error
After_Sales_Support_	327	8.489297	1.6464	0.091
After_Sales_Support_a_	327	9.024465	1.4672	0.0811

Hypothesis Test

Null hypothesis: Mean of (After_Sales_Support_ - After_Sales_Support_a_) => 0
Alternative: Mean of (After_Sales_Support_ - After_Sales_Support_a_) < 0

t Statistic	Df	Prob > t
-7.090	326	<.0001

4

09:36 Saturday, April 30, 2011

Two Sample Paired t-test for the Means of Technical_Capability_and Technical_Capability_a

Sample Statistics

Group	N	Mean	Std. Dev.	Std. Error
Technical_Capability__	327	7.892966	1.8026	0.0997
Technical_Capability_a_	327	8.605505	1.658	0.0917

Hypothesis Test

Null hypothesis: Mean of (Technical_Capability__ - Technical_Capability_a_) => 0
Alternative: Mean of (Technical_Capability__ - Technical_Capability_a_) < 0

t Statistic	Df	Prob > t
-8.293	326	<.0001

5

09:36 Saturday, April 30, 2011

Two Sample Paired t-test for the Means of Warrt_Claims and Warrt_Claims_a_

Sample Statistics

Group	N	Mean	Std. Dev.	Std. Error
Warrt_Claims_	327	8.639144	1.471	0.0813
Warrt_Claims_a_	327	8.749235	1.4835	0.082

Hypothesis Test

Null hypothesis: Mean of (Warrt_Claims_ - Warrt_Claims_a_) => 0
Alternative: Mean of (Warrt_Claims_ - Warrt_Claims_a_) < 0

t Statistic	Df	Prob > t
-1.637	326	0.0513

6

11:55 Saturday, April 30, 2011

Two Sample t-test for the Means of Price__U_ and Price__NU_

Sample Statistics

Group	N	Mean	Std. Dev.	Std. Error
Price__U_	226	7.880531	2.2468	0.1495
Price__NU_	101	8.306931	1.9377	0.1928

Hypothesis Test

Null hypothesis: Mean 1 - Mean 2 => 0
Alternative: Mean 1 - Mean 2 < 0

If Variances Are	t statistic	Df	Pr > t
Equal	-1.652	325	0.0497
Not Equal	-1.748	220.83	0.0409

Two Sample Test for Variances of Price__U_ and Price__NU_

Sample Statistics

Group	N	Mean	Std. Dev.	Variance
Price__U_	226	7.880531	2.2468	5.047886
Price__NU_	101	8.306931	1.9377	3.754851

Hypothesis Test

Null hypothesis: Variance 1 / Variance 2 = 1
Alternative: Variance 1 / Variance 2 ^= 1

	- Degrees of Freedom -		
F	Numer.	Denom.	Pr > F
1.34	225	100	0.0927

APPENDIX VII. ANCOVA SAS®9.2 OUTPUT

The SAS System 13:27 Monday, May 2, 2011 1

The GLM Procedure

Class Level Information

Class	Levels	Values
UrbanClass	2	1 2
FTA	10	1 2 3 4 5 6 7 8 9 10
Education	5	1 2 3 4 5

Number of Observations Read 236
Number of Observations Used 236

Dependent Variable: AfterSalesSupportA AfterSalesSupportA

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	17	38.6945366	2.2761492	1.16	0.3020
Error	218	428.7758023	1.9668615		
Corrected Total	235	467.4703390			

R-Square	Coeff Var	Root MSE	AfterSalesSupportA Mean
0.082774	15.44460	1.402448	9.080508

Source	DF	Type I SS	Mean Square	F Value	Pr > F
UrbanClass	1	2.04388737	2.04388737	1.04	0.3091
FTA	9	23.13111334	2.57012370	1.31	0.2346
Education	4	11.68569028	2.92142257	1.49	0.2076
Vehicles	1	1.05242216	1.05242216	0.54	0.4653
Capital	1	0.74999536	0.74999536	0.38	0.5375
Years	1	0.03142813	0.03142813	0.02	0.8995

Source	DF	Type III SS	Mean Square	F Value	Pr > F
UrbanClass	1	1.61814546	1.61814546	0.82	0.3654
FTA	9	22.48473502	2.49830389	1.27	0.2544
Education	4	11.76380467	2.94095117	1.50	0.2046
Vehicles	1	1.71911839	1.71911839	0.87	0.3509
Capital	1	0.72580296	0.72580296	0.37	0.5442
Years	1	0.03142813	0.03142813	0.02	0.8995

Least Squares Means

Urban Class	AfterSales SupportA LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1=LSMean2 t Value	Pr > |t|
1	8.81775381	0.17113143	<.0001	-0.91	0.3654
2	9.05857621	0.25153620	<.0001		

FTA	AfterSales SupportA LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	8.85581499	0.40571183	<.0001	1
2	7.89510766	0.41717803	<.0001	2
3	9.24943032	0.31609957	<.0001	3
4	9.20724224	0.25339710	<.0001	4
5	9.09990389	0.27333016	<.0001	5
6	8.92083767	0.32066755	<.0001	6
7	8.79271966	0.34494784	<.0001	7

8	9.25949589	0.42686815	<.0001	8
9	9.22115010	0.36099118	<.0001	9
10	8.87994768	0.34141895	<.0001	10

Least Squares Means for Effect FTA
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: AfterSalesSupportA

i/j	1	2	3	4	5	6	7	8	9	10
1		1.781946	-0.86252	-0.83385	-0.56092	-0.1369	0.124379	-0.72896	-0.74451	-0.04948
		0.0761	0.3893	0.4053	0.5754	0.8912	0.9011	0.4668	0.4574	0.9606
2	-1.78195		-2.82552	-2.91082	-2.65947	-2.07747	-1.69417	-2.35584	-2.60509	-2.00143
	0.0761		0.0052	0.0040	0.0084	0.0389	0.0917	0.0194	0.0098	0.0466
3	0.862519	2.825522		0.121893	0.411967	0.807394	1.028866	-0.02018	0.066241	0.876266
	0.3893	0.0052		0.9031	0.6808	0.4203	0.3047	0.9839	0.9472	0.3819
4	0.833848	2.91082	-0.12189		0.339087	0.785511	1.047509	-0.11379	-0.03613	0.864369
	0.4053	0.0040	0.9031		0.7349	0.4330	0.2960	0.9095	0.9712	0.3883
5	0.56092	2.659474	-0.41197	-0.33909		0.474556	0.732067	-0.33356	-0.30685	0.562688
	0.5754	0.0084	0.6808	0.7349		0.6356	0.4649	0.7390	0.7593	0.5742
6	0.136896	2.077472	-0.80739	-0.78551	-0.47456		0.284706	-0.6665	-0.68322	0.094345
	0.8912	0.0389	0.4203	0.4330	0.6356		0.7761	0.5058	0.4952	0.9249
7	-0.12438	1.694166	-1.02887	-1.04751	-0.73207	-0.28471		-0.90396	-0.90556	-0.18467
	0.9011	0.0917	0.3047	0.2960	0.4649	0.7761		0.3670	0.3662	0.8537
8	0.728958	2.355837	0.020179	0.113793	0.333557	0.666498	0.903961		0.072551	0.723614
	0.4668	0.0194	0.9839	0.9095	0.7390	0.5058	0.3670		0.9422	0.4701
9	0.744505	2.605093	-0.06624	0.03613	0.306848	0.683216	0.905559	-0.07255		0.756117
	0.4574	0.0098	0.9472	0.9712	0.7593	0.4952	0.3662	0.9422		0.4504
10	0.049483	2.001429	-0.87627	-0.86437	-0.56269	-0.09434	0.184668	-0.72361	-0.75612	
	0.9606	0.0466	0.3819	0.3883	0.5742	0.9249	0.8537	0.4701	0.4504	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Education	AfterSales SupportA LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	9.49931690	0.26124948	<.0001	1
2	9.07939326	0.15621079	<.0001	2
3	9.00874549	0.20552574	<.0001	3
4	8.08139580	0.58319217	<.0001	4
5	9.02197359	0.35696528	<.0001	5

Least Squares Means for Effect Education
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: AfterSalesSupportA

i/j	1	2	3	4	5
1		1.446443	1.578981	2.254372	1.107994
		0.1495	0.1158	0.0252	0.2691
2	-1.44644		0.304178	1.670667	0.152214
	0.1495		0.7613	0.0962	0.8792
3	-1.57898	-0.30418		1.527046	-0.03326
	0.1158	0.7613		0.1282	0.9735
4	-2.25437	-1.67067	-1.52705		-1.39634
	0.0252	0.0962	0.1282		0.1640
5	-1.10799	-0.15221	0.033263	1.39634	
	0.2691	0.8792	0.9735	0.1640	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

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The GLM Procedure

Class Level Information

Class	Levels	Values
UrbanClass	2	1 2
FTA	10	1 2 3 4 5 6 7 8 9 10
Education	5	1 2 3 4 5

Number of Observations Read 236
Number of Observations Used 236

Dependent Variable: AfterSalesSupportC AfterSalesSupportC

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	17	59.6056303	3.5062135	1.34	0.1676
Error	218	568.7842002	2.6091018		
Corrected Total	235	628.3898305			

R-Square	Coeff Var	Root MSE	AfterSalesSupportC Mean
0.094855	18.89019	1.615271	8.550847

Source	DF	Type I SS	Mean Square	F Value	Pr > F
UrbanClass	1	1.08617459	1.08617459	0.42	0.5195
FTA	9	50.20502592	5.57833621	2.14	0.0276
Education	4	2.76198620	0.69049655	0.26	0.9004
Vehicles	1	0.29748202	0.29748202	0.11	0.7359
Capital	1	0.19112269	0.19112269	0.07	0.7869
Years	1	5.06383884	5.06383884	1.94	0.1650

Source	DF	Type III SS	Mean Square	F Value	Pr > F
UrbanClass	1	0.17479273	0.17479273	0.07	0.7960
FTA	9	43.17325052	4.79702784	1.84	0.0628
Education	4	3.10737036	0.77684259	0.30	0.8792
Vehicles	1	0.02665626	0.02665626	0.01	0.9196
Capital	1	0.34738631	0.34738631	0.13	0.7155
Years	1	5.06383884	5.06383884	1.94	0.1650

Least Squares Means

Urban Class	AfterSales SupportC LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1=LSMean2 t Value	Pr > |t|
1	8.44082463	0.19710081	<.0001	0.26	0.7960
2	8.36167484	0.28970709	<.0001		

FTA	AfterSales SupportC LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	8.36973695	0.46727904	<.0001	1
2	6.94964951	0.48048525	<.0001	2
3	8.86525907	0.36406802	<.0001	3
4	8.87423453	0.29185038	<.0001	4
5	8.50567211	0.31480831	<.0001	5
6	8.53943981	0.36932919	<.0001	6
7	8.22038128	0.39729405	<.0001	7
8	8.39932542	0.49164585	<.0001	8
9	8.72262754	0.41577199	<.0001	9
10	8.56617116	0.39322964	<.0001	10

Least Squares Means for Effect FTA
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: AfterSalesSupportC

i/j	1	2	3	4	5	6	7	8	9	10
1		2.286967	-0.94276	-1.03933	-0.27122	-0.31021	0.25563	-0.04639	-0.62439	-0.34971
		0.0232	0.3468	0.2998	0.7865	0.7567	0.7985	0.9630	0.5330	0.7269
2	-2.28697		-3.46996	-3.70694	-2.98222	-2.79565	-2.08239	-2.1733	-3.0242	-2.85231
	0.0232		0.0006	0.0003	0.0032	0.0056	0.0385	0.0308	0.0028	0.0048
3	0.94276	3.469964		-0.02252	0.860182	0.695098	1.261353	0.811023	0.29007	0.61586
	0.3468	0.0006		0.9821	0.3906	0.4877	0.2085	0.4182	0.7720	0.5386
4	1.039326	3.706939	0.022516		1.010901	0.797246	1.434601	0.897944	0.341951	0.706386
	0.2998	0.0003	0.9821		0.3132	0.4262	0.1528	0.3702	0.7327	0.4807
5	0.271223	2.982218	-0.86018	-1.0109		-0.0777	0.590311	0.192986	-0.47672	-0.13438
	0.7865	0.0032	0.3906	0.3132		0.9381	0.5556	0.8471	0.6340	0.8932
6	0.310211	2.795653	-0.6951	-0.79725	0.077699		0.6156	0.23942	-0.36185	-0.05355
	0.7567	0.0056	0.4877	0.4262	0.9381		0.5388	0.8110	0.7178	0.9573
7	-0.25563	2.082392	-1.26135	-1.4346	-0.59031	-0.6156		-0.30088	-0.92171	-0.63561
	0.7985	0.0385	0.2085	0.1528	0.5556	0.5388		0.7638	0.3577	0.5257
8	0.04639	2.173299	-0.81102	-0.89794	-0.19299	-0.23942	0.300884		-0.5311	-0.27618
	0.9630	0.0308	0.4182	0.3702	0.8471	0.8110	0.7638		0.5959	0.7827
9	0.624393	3.0242	-0.29007	-0.34195	0.476724	0.361845	0.921711	0.531101		0.301031
	0.5330	0.0028	0.7720	0.7327	0.6340	0.7178	0.3577	0.5959		0.7637
10	0.349713	2.852315	-0.61586	-0.70639	0.134376	0.053551	0.635609	0.276183	-0.30103	
	0.7269	0.0048	0.5386	0.4807	0.8932	0.9573	0.5257	0.7827	0.7637	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Education	AfterSales SupportC LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	8.53582569	0.30089437	<.0001	1
2	8.45411530	0.17991595	<.0001	2
3	8.27896675	0.23671450	<.0001	3
4	8.09443142	0.67169221	<.0001	4
5	8.64290953	0.41113515	<.0001	5

Least Squares Means for Effect Education
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: AfterSalesSupportC

i/j	1	2	3	4	5
1		0.244371	0.717812	0.609315	-0.21581
		0.8072	0.4736	0.5430	0.8293
2	-0.24437		0.654753	0.522785	-0.43453
	0.8072		0.5133	0.6017	0.6643
3	-0.71781	-0.65475		0.263833	-0.79458

	0.4736	0.5133		0.7922	0.4277
4	-0.60931	-0.52278	-0.26383		-0.70696
	0.5430	0.6017	0.7922		0.4803
5	0.21581	0.434534	0.794582	0.706964	
	0.8293	0.6643	0.4277	0.4803	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

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The GLM Procedure

Class Level Information

Class	Levels	Values
UrbanClass	2	1 2
FTA	10	1 2 3 4 5 6 7 8 9 10
Education	5	1 2 3 4 5

Number of Observations Read	236
Number of Observations Used	236

Dependent Variable: DeliveryA DeliveryA

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	17	61.4426231	3.6142719	1.00	0.4587
Error	218	787.3836481	3.6118516		
Corrected Total	235	848.8262712			

R-Square	Coeff Var	Root MSE	DeliveryA Mean
0.072385	26.36772	1.900487	7.207627

Source	DF	Type I SS	Mean Square	F Value	Pr > F
UrbanClass	1	6.80971205	6.80971205	1.89	0.1711
FTA	9	27.37728536	3.04192060	0.84	0.5780
Education	4	13.24297867	3.31074467	0.92	0.4550
Vehicles	1	7.89521040	7.89521040	2.19	0.1407
Capital	1	0.90675970	0.90675970	0.25	0.6168
Years	1	5.21067692	5.21067692	1.44	0.2310

Source	DF	Type III SS	Mean Square	F Value	Pr > F
UrbanClass	1	0.78965394	0.78965394	0.22	0.6406
FTA	9	31.32923678	3.48102631	0.96	0.4710
Education	4	15.46805568	3.86701392	1.07	0.3719
Vehicles	1	8.24542581	8.24542581	2.28	0.1323
Capital	1	1.22206090	1.22206090	0.34	0.5614
Years	1	5.21067692	5.21067692	1.44	0.2310

Least Squares Means

Urban Class	DeliveryA LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1=LSMean2 t Value	Pr > |t|
1	7.17615283	0.23190379	<.0001	0.47	0.6406
2	7.00792165	0.34086198	<.0001		

FTA	DeliveryA LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	7.21458410	0.54978861	<.0001	1
2	6.66547622	0.56532670	<.0001	2
3	7.23316380	0.42835315	<.0001	3
4	7.39798533	0.34338372	<.0001	4
5	6.90966951	0.37039543	<.0001	5
6	7.49726849	0.43454331	<.0001	6
7	6.27509843	0.46744605	<.0001	7
8	7.01767829	0.57845797	<.0001	8
9	7.72676539	0.48918672	<.0001	9
10	6.98268284	0.46266397	<.0001	10

Least Squares Means for Effect FTA
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: DeliveryA

i/j	1	2	3	4	5	6	7	8	9	10
1		0.751594	-0.03004	-0.32113	0.517074	-0.43919	1.366661	0.262388	-0.77023	0.350896
		0.4531	0.9761	0.7484	0.6056	0.6610	0.1731	0.7933	0.4420	0.7260
2	-0.75159		-0.87399	-1.19915	-0.39778	-1.24319	0.543719	-0.44877	-1.53859	-0.47571
	0.4531		0.3831	0.2318	0.6912	0.2151	0.5872	0.6540	0.1254	0.6348
3	0.030044	0.873993		-0.35142	0.657709	-0.47888	1.592704	0.318792	-0.85319	0.438368
	0.9761	0.3831		0.7256	0.5114	0.6325	0.1127	0.7502	0.3945	0.6616
4	0.321126	1.199146	0.351418		1.138359	-0.20094	2.093955	0.611158	-0.63028	0.80937
	0.7484	0.2318	0.7256		0.2562	0.8409	0.0374	0.5417	0.5292	0.4192
5	-0.51707	0.397775	-0.65771	-1.13836		-1.14915	1.115974	-0.16659	-1.52598	-0.13783
	0.6056	0.6912	0.5114	0.2562		0.2518	0.2657	0.8678	0.1285	0.8905
6	0.439189	1.243194	0.478879	0.200942	1.14915		2.004198	0.696513	-0.38529	0.876156
	0.6610	0.2151	0.6325	0.8409	0.2518		0.0463	0.4868	0.7004	0.3819
7	-1.36666	-0.54372	-1.5927	-2.09396	-1.11597	-2.0042		-1.06122	-2.26426	-1.10544
	0.1731	0.5872	0.1127	0.0374	0.2657	0.0463		0.2898	0.0245	0.2702
8	-0.26239	0.448767	-0.31879	-0.61116	0.166587	-0.69651	1.061221		-0.99003	0.049235
	0.7933	0.6540	0.7502	0.5417	0.8678	0.4868	0.2898		0.3233	0.9608
9	0.770233	1.538585	0.853187	0.630276	1.525983	0.385286	2.264256	0.99003		1.216802
	0.4420	0.1254	0.3945	0.5292	0.1285	0.7004	0.0245	0.3233		0.2250
10	-0.3509	0.475706	-0.43837	-0.80937	0.137834	-0.87616	1.105443	-0.04923	-1.2168	
	0.7260	0.6348	0.6616	0.4192	0.8905	0.3819	0.2702	0.9608	0.2250	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Education	DeliveryA LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	7.73739896	0.35402464	<.0001	1
2	6.98481188	0.21168452	<.0001	2
3	7.14938407	0.27851224	<.0001	3
4	6.67124014	0.79029593	<.0001	4
5	6.91735114	0.48373113	<.0001	5

Least Squares Means for Effect Education
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: DeliveryA

i/j	1	2	3	4	5

1		1.912977	1.396641	1.250885	1.404648
		0.0571	0.1639	0.2123	0.1615
2	-1.91298		-0.52289	0.387364	0.131967
	0.0571		0.6016	0.6989	0.8951
3	-1.39664	0.522887		0.581018	0.430562
	0.1639	0.6016		0.5618	0.6672
4	-1.25089	-0.38736	-0.58102		-0.26962
	0.2123	0.6989	0.5618		0.7877
5	-1.40465	-0.13197	-0.43056	0.269618	
	0.1615	0.8951	0.6672	0.7877	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

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The GLM Procedure

Class Level Information

Class	Levels	Values
UrbanClass	2	1 2
FTA	10	1 2 3 4 5 6 7 8 9 10
Education	5	1 2 3 4 5

Number of Observations Read 236
Number of Observations Used 236

Dependent Variable: DeliveryC DeliveryC

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	17	53.4456112	3.1438595	0.93	0.5442
Error	218	740.1984566	3.3954058		
Corrected Total	235	793.6440678			

R-Square Coeff Var Root MSE DeliveryC Mean

0.067342	25.49053	1.842663	7.228814

Source	DF	Type I SS	Mean Square	F Value	Pr > F
UrbanClass	1	6.05008930	6.05008930	1.78	0.1833
FTA	9	31.23839973	3.47093330	1.02	0.4231
Education	4	10.17580210	2.54395053	0.75	0.5595
Vehicles	1	4.64933034	4.64933034	1.37	0.2432
Capital	1	0.13265353	0.13265353	0.04	0.8435
Years	1	1.19933620	1.19933620	0.35	0.5529

Source	DF	Type III SS	Mean Square	F Value	Pr > F
UrbanClass	1	1.74594646	1.74594646	0.51	0.4741
FTA	9	33.49949728	3.72216636	1.10	0.3667
Education	4	10.60278668	2.65069667	0.78	0.5388
Vehicles	1	3.51731904	3.51731904	1.04	0.3099
Capital	1	0.19179540	0.19179540	0.06	0.8124
Years	1	1.19933620	1.19933620	0.35	0.5529

Least Squares Means

Urban Class	DeliveryC LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1=LSMean2 t Value	Pr > |t|
1	7.19414305	0.22484785	<.0001	0.72	0.4741
2	6.94399130	0.33049086	<.0001		

FTA	DeliveryC LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	6.99060012	0.53306065	<.0001	1
2	6.45240412	0.54812598	<.0001	2
3	6.93633814	0.41532001	<.0001	3
4	7.33806876	0.33293587	<.0001	4
5	7.05673617	0.35912572	<.0001	5
6	7.82203339	0.42132183	<.0001	6
7	6.48769796	0.45322346	<.0001	7
8	6.97711334	0.56085772	<.0001	8
9	7.66035311	0.47430265	<.0001	9
10	6.96932665	0.44858689	<.0001	10

Least Squares Means for Effect FTA
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: DeliveryC

i/j	1	2	3	4	5	6	7	8	9	10
1		0.759775	0.090497	-0.62749	-0.11567	-1.33228	0.754524	0.018536	-1.0388	0.0332
		0.4482	0.9280	0.5310	0.9080	0.1842	0.4513	0.9852	0.3000	0.9735
2	-0.75977		-0.76843	-1.49537	-1.01531	-2.11128	-0.0507	-0.68955	-1.80616	-0.79954
	0.4482		0.4431	0.1363	0.3111	0.0359	0.9596	0.4912	0.0723	0.4248
3	-0.0905	0.768429		-0.88341	-0.25247	-1.65635	0.769232	-0.06222	-1.29073	-0.05955
	0.9280	0.4431		0.3780	0.8009	0.0991	0.4426	0.9504	0.1982	0.9526
4	0.627492	1.495365	0.883415		0.676422	-1.01025	1.635531	0.598263	-0.63721	0.741181
	0.5310	0.1363	0.3780		0.4995	0.3135	0.1034	0.5503	0.5247	0.4594
5	0.115673	1.01531	0.252467	-0.67642		-1.54364	1.032129	0.12666	-1.16267	0.170189
	0.9080	0.3111	0.8009	0.4995		0.1241	0.3032	0.8993	0.2462	0.8650
6	1.33228	2.111282	1.656354	1.010246	1.543636		2.2568	1.265592	0.279952	1.497416
	0.1842	0.0359	0.0991	0.3135	0.1241		0.0250	0.2070	0.7798	0.1357
7	-0.75452	0.0507	-0.76923	-1.63553	-1.03213	-2.2568		-0.72137	-1.88646	-0.77605
	0.4513	0.9596	0.4426	0.1034	0.3032	0.0250		0.4715	0.0606	0.4386
8	-0.01854	0.689552	0.062216	-0.59826	-0.12666	-1.26559	0.721372		-0.98388	0.011299
	0.9852	0.4912	0.9504	0.5503	0.8993	0.2070	0.4715		0.3263	0.9910
9	1.038801	1.806157	1.290727	0.637211	1.162672	-0.27995	1.886461	0.983878		1.165501
	0.3000	0.0723	0.1982	0.5247	0.2462	0.7798	0.0606	0.3263		0.2451
10	-0.0332	0.799542	0.059545	-0.74118	-0.17019	-1.49742	0.77605	-0.0113	-1.1655	
	0.9735	0.4248	0.9526	0.4594	0.8650	0.1357	0.4386	0.9910	0.2451	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Education	DeliveryC LSMEAN	Standard Error	Pr > |t|	LSMEAN Number

1	7.60533335	0.34325303	<.0001	1
2	7.09938391	0.20524377	<.0001	2
3	6.95241880	0.27003818	<.0001	3
4	6.81787765	0.76625026	<.0001	4
5	6.87032217	0.46901305	<.0001	5

Least Squares Means for Effect Education
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: DeliveryC

i/j	1	2	3	4	5
1		1.326414	1.599455	0.952886	1.298499
		0.1861	0.1112	0.3417	0.1955
2	-1.32641		0.481598	0.358665	0.462154
	0.1861		0.6306	0.7202	0.6444
3	-1.59946	-0.4816		0.168618	0.15712
	0.1112	0.6306		0.8663	0.8753
4	-0.95289	-0.35867	-0.16862		-0.05926
	0.3417	0.7202	0.8663		0.9528
5	-1.2985	-0.46215	-0.15712	0.059257	
	0.1955	0.6444	0.8753	0.9528	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

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The GLM Procedure

Class Level Information

Class	Levels	Values
UrbanClass	2	1 2
FTA	10	1 2 3 4 5 6 7 8 9 10

Education	5	1 2 3 4 5

Number of Observations Read	236
Number of Observations Used	236

Dependent Variable: IntegrityA IntegrityA

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	17	40.7952241	2.3997191	1.14	0.3148
Error	218	457.7471488	2.0997576		
Corrected Total	235	498.5423729			

R-Square	Coeff Var	Root MSE	IntegrityA Mean
0.081829	16.50467	1.449054	8.779661

Source	DF	Type I SS	Mean Square	F Value	Pr > F
UrbanClass	1	2.04774923	2.04774923	0.98	0.3245
FTA	9	31.46798584	3.49644287	1.67	0.0988
Education	4	3.72124143	0.93031036	0.44	0.7774
Vehicles	1	0.05598245	0.05598245	0.03	0.8704
Capital	1	3.15625838	3.15625838	1.50	0.2215
Years	1	0.34600677	0.34600677	0.16	0.6852

Source	DF	Type III SS	Mean Square	F Value	Pr > F
UrbanClass	1	0.00087056	0.00087056	0.00	0.9838
FTA	9	29.14516011	3.23835112	1.54	0.1345
Education	4	3.16668954	0.79167238	0.38	0.8249
Vehicles	1	1.86045938	1.86045938	0.89	0.3476
Capital	1	3.00123545	3.00123545	1.43	0.2332
Years	1	0.34600677	0.34600677	0.16	0.6852

Least Squares Means

Urban Class	IntegrityA LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1=LSMean2 t Value	Pr > |t|
1	8.71730248	0.17681841	<.0001	-0.02	0.9838
2	8.72288832	0.25989516	<.0001		

FTA	IntegrityA LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	8.59863372	0.41919429	<.0001	1
2	8.17309314	0.43104154	<.0001	2
3	9.33577019	0.32660407	<.0001	3
4	9.13714235	0.26181789	<.0001	4
5	8.82687068	0.28241337	<.0001	5
6	8.47868427	0.33132385	<.0001	6
7	8.16265405	0.35641102	<.0001	7
8	8.54504841	0.44105367	<.0001	8
9	8.97471675	0.37298751	<.0001	9
10	8.96834043	0.35276485	<.0001	10

Least Squares Means for Effect FTA

t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: IntegrityA

i/j	1	2	3	4	5	6	7	8	9	10
1		0.763918	-1.56332	-1.23665	-0.50762	0.244415	0.831797	0.093651	-0.74176	-0.73369
		0.4457	0.1194	0.2175	0.6122	0.8071	0.4064	0.9255	0.4590	0.4639
2	-0.76392		-2.34767	-2.06985	-1.39674	-0.59903	0.019069	-0.62158	-1.52419	-1.56415
	0.4457		0.0198	0.0396	0.1639	0.5498	0.9848	0.5349	0.1289	0.1192
3	1.563317	2.347675		0.555432	1.356998	2.038236	2.557768	1.534242	0.818502	0.84337
	0.1194	0.0198		0.5792	0.1762	0.0427	0.0112	0.1264	0.4140	0.3999
4	1.236648	2.069848	-0.55543		0.948639	1.747845	2.383353	1.24793	0.408376	0.43146
	0.2175	0.0396	0.5792		0.3439	0.0819	0.0180	0.2134	0.6834	0.6666

5	0.507623	1.396736	-1.357	-0.94864		0.893075	1.532018	0.570082	-0.36213	-0.35027
	0.6122	0.1639	0.1762	0.3439		0.3728	0.1270	0.5692	0.7176	0.7265
6	-0.24441	0.599025	-2.03824	-1.74785	-0.89307		0.679701	-0.12641	-1.09219	-1.09344
	0.8071	0.5498	0.0427	0.0819	0.3728		0.4974	0.8995	0.2760	0.2754
7	-0.8318	-0.01907	-2.55777	-2.38335	-1.53202	-0.6797		-0.71673	-1.66122	-1.65084
	0.4064	0.9848	0.0112	0.0180	0.1270	0.4974		0.4743	0.0981	0.1002
8	-0.09365	0.621585	-1.53424	-1.24793	-0.57008	0.126408	0.716728		-0.7868	-0.78106
	0.9255	0.5349	0.1264	0.2134	0.5692	0.8995	0.4743		0.4323	0.4356
9	0.741758	1.524188	-0.8185	-0.40838	0.362132	1.092188	1.661225	0.786797		0.013676
	0.4590	0.1289	0.4140	0.6834	0.7176	0.2760	0.0981	0.4323		0.9891
10	0.733691	1.564152	-0.84337	-0.43146	0.350266	1.093441	1.650838	0.781057	-0.01368	
	0.4639	0.1192	0.3999	0.6666	0.7265	0.2754	0.1002	0.4356	0.9891	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Education	IntegrityA LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	8.65919161	0.26993122	<.0001	1
2	8.67939541	0.16140193	<.0001	2
3	8.63936140	0.21235570	<.0001	3
4	8.51470987	0.60257259	<.0001	4
5	9.10781870	0.36882782	<.0001	5

Least Squares Means for Effect Education
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: IntegrityA

i/j	1	2	3	4	5
1		-0.06735	0.061774	0.222325	-1.00785
		0.9464	0.9508	0.8243	0.3146
2	0.067354		0.166825	0.26682	-1.09918
	0.9464		0.8677	0.7899	0.2729
3	-0.06177	-0.16682		0.198659	-1.14008
	0.9508	0.8677		0.8427	0.2555
4	-0.22233	-0.26682	-0.19866		-0.85218
	0.8243	0.7899	0.8427		0.3950
5	1.007846	1.09918	1.140083	0.852183	
	0.3146	0.2729	0.2555	0.3950	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

The GLM Procedure

Class Level Information

Class	Levels	Values
UrbanClass	2	1 2
FTA	10	1 2 3 4 5 6 7 8 9 10
Education	5	1 2 3 4 5

Number of Observations Read 236
Number of Observations Used 235

Dependent Variable: IntegrityC IntegrityC

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	17	58.4377332	3.4375137	1.68	0.0483
Error	217	444.3026924	2.0474778		
Corrected Total	234	502.7404255			

R-Square	Coeff Var	Root MSE	IntegrityC Mean
0.116238	16.43508	1.430901	8.706383

Source	DF	Type I SS	Mean Square	F Value	Pr > F
UrbanClass	1	2.20637148	2.20637148	1.08	0.3004
FTA	9	45.73965433	5.08218381	2.48	0.0102
Education	4	7.44513461	1.86128365	0.91	0.4595
Vehicles	1	0.00575292	0.00575292	0.00	0.9578
Capital	1	0.42559605	0.42559605	0.21	0.6489
Years	1	2.61522377	2.61522377	1.28	0.2597

Source	DF	Type III SS	Mean Square	F Value	Pr > F
UrbanClass	1	0.05872039	0.05872039	0.03	0.8657
FTA	9	38.12548862	4.23616540	2.07	0.0335
Education	4	8.17834423	2.04458606	1.00	0.4092
Vehicles	1	0.12057474	0.12057474	0.06	0.8085
Capital	1	0.29266936	0.29266936	0.14	0.7057
Years	1	2.61522377	2.61522377	1.28	0.2597

Least Squares Means

Urban Class	IntegrityC LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1=LSMean2 t Value	H0:LSMean1=LSMean2 Pr > |t|
1	8.65209900	0.17464554	<.0001	0.17	0.8657
2	8.60622150	0.25660451	<.0001		

FTA	IntegrityC LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	8.46687005	0.41394497	<.0001	1
2	7.61600291	0.42562145	<.0001	2
3	9.14480064	0.32251622	<.0001	3
4	9.03727862	0.25858243	<.0001	4
5	8.83149890	0.27893431	<.0001	5
6	8.90936373	0.33288021	<.0001	6
7	8.00414638	0.35197678	<.0001	7
8	8.53498063	0.43553623	<.0001	8
9	8.75621889	0.36858634	<.0001	9
10	8.99044174	0.34834784	<.0001	10

Least Squares Means for Effect FTA
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: IntegrityC

i/j	1	2	3	4	5	6	7	8	9	10
1		1.546817	-1.45599	-1.32652	-0.82124	-0.90497	0.894021	-0.12055	-0.57782	-1.05222
		0.1234	0.1468	0.1861	0.4124	0.3665	0.3723	0.9042	0.5640	0.2939
2	-1.54682		-3.12608	-3.09021	-2.62974	-2.54485	-0.71801	-1.55517	-2.19524	-2.73761
	0.1234		0.0020	0.0023	0.0092	0.0116	0.4735	0.1214	0.0292	0.0067
3	1.455993	3.126077		0.304483	0.846005	0.560148	2.518542	1.198235	0.891855	0.358798
	0.1468	0.0020		0.7611	0.3985	0.5760	0.0125	0.2321	0.3735	0.7201
4	1.326522	3.090206	-0.30448		0.637116	0.33872	2.558837	1.07209	0.715383	0.121234
	0.1861	0.0023	0.7611		0.5247	0.7351	0.0112	0.2849	0.4751	0.9036
5	0.821244	2.629738	-0.846	-0.63712		-0.19918	1.932453	0.607385	0.1867	-0.39851
	0.4124	0.0092	0.3985	0.5247		0.8423	0.0546	0.5442	0.8521	0.6906
6	0.904971	2.544853	-0.56015	-0.33872	0.199178		1.95218	0.71692	0.336804	-0.18142
	0.3665	0.0116	0.5760	0.7351	0.8423		0.0522	0.4742	0.7366	0.8562
7	-0.89402	0.718014	-2.51854	-2.55884	-1.93245	-1.95218		-1.00757	-1.55768	-2.04654
	0.3723	0.4735	0.0125	0.0112	0.0546	0.0522		0.3148	0.1208	0.0419
8	0.120546	1.555167	-1.19824	-1.07209	-0.60739	-0.71692	1.007566		-0.41016	-0.85107
	0.9042	0.1214	0.2321	0.2849	0.5442	0.4742	0.3148		0.6821	0.3957
9	0.577816	2.19524	-0.89186	-0.71538	-0.1867	-0.3368	1.557683	0.41016		-0.5086
	0.5640	0.0292	0.3735	0.4751	0.8521	0.7366	0.1208	0.6821		0.6116
10	1.052221	2.737611	-0.3588	-0.12123	0.398507	0.181417	2.04654	0.851071	0.508599	
	0.2939	0.0067	0.7201	0.9036	0.6906	0.8562	0.0419	0.3957	0.6116	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Education	IntegrityC LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	8.42086291	0.26663434	<.0001	1
2	8.69434053	0.15933135	<.0001	2
3	8.35469335	0.21070934	<.0001	3
4	8.64219157	0.59506791	<.0001	4
5	9.03371288	0.36416649	<.0001	5

Least Squares Means for Effect Education
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: IntegrityC

i/j	1	2	3	4	5
1		-0.92292	0.208014	-0.3449	-1.39414
		0.3571	0.8354	0.7305	0.1647
2	0.922917		1.42903	0.085553	-0.88173
	0.3571		0.1544	0.9319	0.3789
3	-0.20801	-1.42903		-0.46355	-1.67121
	0.8354	0.1544		0.6434	0.0961
4	0.344896	-0.08555	0.46355		-0.56965
	0.7305	0.9319	0.6434		0.5695
5	1.394139	0.881728	1.671209	0.569654	

0.1647	0.3789	0.0961	0.5695

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

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The GLM Procedure

Class Level Information

Class	Levels	Values
UrbanClass	2	1 2
FTA	10	1 2 3 4 5 6 7 8 9 10
Education	5	1 2 3 4 5

Number of Observations Read 236
Number of Observations Used 236

Dependent Variable: PerformanceHistoryA PerformanceHistoryA

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	17	50.4491287	2.9675958	1.45	0.1167
Error	218	446.9873119	2.0504005		
Corrected Total	235	497.4364407			

R-Square	Coeff Var	Root MSE	PerformanceHistoryA Mean
0.101418	16.60607	1.431922	8.622881

Source	DF	Type I SS	Mean Square	F Value	Pr > F
UrbanClass	1	0.11665573	0.11665573	0.06	0.8117
FTA	9	37.67919255	4.18657695	2.04	0.0361
Education	4	4.80948461	1.20237115	0.59	0.6728
Vehicles	1	6.45245701	6.45245701	3.15	0.0775
Capital	1	0.65999524	0.65999524	0.32	0.5711
Years	1	0.73134360	0.73134360	0.36	0.5510

Source	DF	Type III SS	Mean Square	F Value	Pr > F
UrbanClass	1	1.35015866	1.35015866	0.66	0.4180
FTA	9	34.18128406	3.79792045	1.85	0.0605
Education	4	6.20668371	1.55167093	0.76	0.5545
Vehicles	1	5.10153118	5.10153118	2.49	0.1162
Capital	1	0.56592726	0.56592726	0.28	0.5999
Years	1	0.73134360	0.73134360	0.36	0.5510

Least Squares Means

Urban Class	Performance HistoryA LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1=LSMean2 t Value	Pr > |t|
1	8.65392063	0.17472790	<.0001	0.81	0.4180
2	8.43394200	0.25682244	<.0001		

FTA	Performance HistoryA LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	8.83484751	0.41423819	<.0001	1
2	8.35225870	0.42594537	<.0001	2
3	9.02473852	0.32274265	<.0001	3
4	8.96279602	0.25872244	<.0001	4
5	8.63445929	0.27907441	<.0001	5
6	7.99171044	0.32740663	<.0001	6
7	8.77299185	0.35219720	<.0001	7
8	7.53858632	0.43583912	<.0001	8
9	8.70698939	0.36857770	<.0001	9
10	8.61993513	0.34859414	<.0001	10

Least Squares Means for Effect FTA
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: PerformanceHistoryA

i/j	1	2	3	4	5	6	7	8	9	10
1		0.876694	-0.40754	-0.29734	0.451017	1.738573	0.119425	2.292579	0.255195	0.431601
		0.3816	0.6840	0.7665	0.6524	0.0835	0.9050	0.0228	0.7988	0.6665
2	-0.87669		-1.37412	-1.32653	-0.61011	0.715209	-0.77775	1.376019	-0.68255	-0.53279
	0.3816		0.1708	0.1861	0.5424	0.4752	0.4376	0.1702	0.4956	0.5947
3	0.407539	1.374116		0.175285	1.053144	2.486036	0.555455	2.91809	0.72895	0.940272
	0.6840	0.1708		0.8610	0.2934	0.0137	0.5792	0.0039	0.4668	0.3481
4	0.29734	1.326529	-0.17529		1.015882	2.60854	0.469767	3.037657	0.650852	0.886841
	0.7665	0.1861	0.8610		0.3108	0.0097	0.6390	0.0027	0.5158	0.3761
5	-0.45102	0.610109	-1.05314	-1.01588		1.668332	-0.32335	2.243299	-0.17978	0.036391
	0.6524	0.5424	0.2934	0.3108		0.0967	0.7467	0.0259	0.8575	0.9710
6	-1.73857	-0.71521	-2.48604	-2.60854	-1.66833		-1.70044	0.873417	-1.59378	-1.41966
	0.0835	0.4752	0.0137	0.0097	0.0967		0.0905	0.3834	0.1124	0.1571
7	-0.11943	0.777753	-0.55546	-0.46977	0.323349	1.700443		2.341349	0.136636	0.317363
	0.9050	0.4376	0.5792	0.6390	0.7467	0.0905		0.0201	0.8914	0.7513
8	-2.29258	-1.37602	-2.91809	-3.03766	-2.2433	-0.87342	-2.34135		-2.16515	-2.01917
	0.0228	0.1702	0.0039	0.0027	0.0259	0.3834	0.0201		0.0315	0.0447
9	-0.2552	0.682546	-0.72895	-0.65085	0.17978	1.593778	-0.13664	2.165146		0.188945
	0.7988	0.4956	0.4668	0.5158	0.8575	0.1124	0.8914	0.0315		0.8503
10	-0.4316	0.532785	-0.94027	-0.88684	-0.03639	1.41966	-0.31736	2.019173	-0.18894	
	0.6665	0.5947	0.3481	0.3761	0.9710	0.1571	0.7513	0.0447	0.8503	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Education	Performance HistoryA LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	8.70630299	0.26673984	<.0001	1
2	8.48147477	0.15949369	<.0001	2
3	8.24389789	0.20984503	<.0001	3
4	8.51107516	0.59544842	<.0001	4
5	8.77690579	0.36446719	<.0001	5

Least Squares Means for Effect Education
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: PerformanceHistoryA

i/j	1	2	3	4	5
1		0.758489	1.457689	0.304006	-0.16051
		0.4490	0.1464	0.7614	0.8726
2	-0.75849		1.001846	-0.04853	-0.76704
	0.4490		0.3175	0.9613	0.4439
3	-1.45769	-1.00185		-0.4309	-1.3127
	0.1464	0.3175		0.6670	0.1907
4	-0.30401	0.048532	0.430899		-0.38652

	0.7614	0.9613	0.6670	0.6995
5	0.160508	0.767038	1.312699	0.386517
	0.8726	0.4439	0.1907	0.6995

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

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The GLM Procedure

Class Level Information

Class	Levels	Values
UrbanClass	2	1 2
FTA	10	1 2 3 4 5 6 7 8 9 10
Education	5	1 2 3 4 5

Number of Observations Read	236
Number of Observations Used	236

Dependent Variable: PerformanceHistoryC PerformanceHistoryC

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	17	41.0776100	2.4163300	1.06	0.3979
Error	218	498.2274748	2.2854471		
Corrected Total	235	539.3050847			

R-Square	Coeff Var	Root MSE	PerformanceHistoryC Mean
0.076168	17.96463	1.511770	8.415254

Source	DF	Type I SS	Mean Square	F Value	Pr > F
UrbanClass	1	0.07884819	0.07884819	0.03	0.8528
FTA	9	22.79265412	2.53251712	1.11	0.3581
Education	4	10.61134809	2.65283702	1.16	0.3291
Vehicles	1	3.91129759	3.91129759	1.71	0.1922
Capital	1	2.07303296	2.07303296	0.91	0.3420
Years	1	1.61042904	1.61042904	0.70	0.4021

Source	DF	Type III SS	Mean Square	F Value	Pr > F
UrbanClass	1	2.16783790	2.16783790	0.95	0.3312
FTA	9	16.47576269	1.83064030	0.80	0.6157

Education	4	10.37512143	2.59378036	1.13	0.3409
Vehicles	1	5.14610395	5.14610395	2.25	0.1349
Capital	1	1.82262645	1.82262645	0.80	0.3728
Years	1	1.61042904	1.61042904	0.70	0.4021

Least Squares Means

Urban Class	Performance HistoryC LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1=LSMean2 t Value	Pr > |t|
1	8.47062527	0.18447117	<.0001	0.97	0.3312
2	8.19188386	0.27114350	<.0001		

FTA	Performance HistoryC LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	8.12604646	0.43733716	<.0001	1
2	7.81084335	0.44969715	<.0001	2
3	8.68057728	0.34073960	<.0001	3
4	8.68242395	0.27314945	<.0001	4
5	8.43576450	0.29463631	<.0001	5
6	8.10321895	0.34566365	<.0001	6
7	8.43033790	0.37183660	<.0001	7
8	7.95673626	0.46014261	<.0001	8
9	8.60589367	0.38913052	<.0001	9
10	8.48070331	0.36803263	<.0001	10

Least Squares Means for Effect FTA
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: PerformanceHistoryC

i/j	1	2	3	4	5	6	7	8	9	10
1		0.54237	-1.12726	-1.22468	-0.66027	0.044585	-0.55647	0.283628	-0.90715	-0.67463
		0.5881	0.2609	0.2220	0.5098	0.9645	0.5785	0.7770	0.3653	0.5006
2	-0.54237		-1.68331	-1.79368	-1.2797	-0.54934	-1.08469	-0.23369	-1.44898	-1.26287
	0.5881		0.0937	0.0742	0.2020	0.5833	0.2793	0.8154	0.1488	0.2080
3	1.127259	1.683311		-0.00495	0.62572	1.316056	0.522968	1.346208	0.162283	0.439743
	0.2609	0.0937		0.9961	0.5322	0.1895	0.6015	0.1796	0.8712	0.6606
4	1.224678	1.793684	0.00495		0.722862	1.47369	0.590962	1.466049	0.184433	0.494211
	0.2220	0.0742	0.9961		0.4705	0.1420	0.5552	0.1441	0.8538	0.6217
5	0.660269	1.279701	-0.62572	-0.72286		0.817572	0.011997	0.928799	-0.39942	-0.10665
	0.5098	0.2020	0.5322	0.4705		0.4145	0.9904	0.3540	0.6900	0.9152
6	-0.04458	0.549344	-1.31606	-1.47369	-0.81757		-0.67436	0.267439	-1.0609	-0.80798
	0.9645	0.5833	0.1895	0.1420	0.4145		0.5008	0.7894	0.2899	0.4200
7	0.556467	1.084691	-0.52297	-0.59096	-0.012	0.674363		0.850855	-0.34423	-0.09892
	0.5785	0.2793	0.6015	0.5552	0.9904	0.5008		0.3958	0.7310	0.9213
8	-0.28363	0.233691	-1.34621	-1.46605	-0.9288	-0.26744	-0.85085		-1.13941	-0.92671
	0.7770	0.8154	0.1796	0.1441	0.3540	0.7894	0.3958		0.2558	0.3551
9	0.907153	1.448978	-0.16228	-0.18443	0.399425	1.060897	0.344233	1.139405		0.257365
	0.3653	0.1488	0.8712	0.8538	0.6900	0.2899	0.7310	0.2558		0.7971
10	0.674626	1.262874	-0.43974	-0.49421	0.106648	0.807982	0.098917	0.926713	-0.25736	
	0.5006	0.2080	0.6606	0.6217	0.9152	0.4200	0.9213	0.3551	0.7971	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Education	Performance HistoryC LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	8.18785061	0.28161393	<.0001	1
2	8.40556374	0.16838746	<.0001	2
3	7.92447814	0.22154652	<.0001	3
4	8.67429566	0.62865212	<.0001	4
5	8.46408466	0.38479080	<.0001	5

Least Squares Means for Effect Education
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: PerformanceHistoryC

i/j	1	2	3	4	5
1		-0.69569	0.786405	-0.71748	-0.59482
		0.4874	0.4325	0.4738	0.5526
2	0.695692		1.921556	-0.41733	-0.14391
	0.4874		0.0560	0.6768	0.8857

3	-0.78641	-1.92156		-1.14542	-1.25876
	0.4325	0.0560		0.2533	0.2095
4	0.717478	0.417331	1.145422		0.289503
	0.4738	0.6768	0.2533		0.7725
5	0.594819	0.143915	1.258759	-0.2895	
	0.5526	0.8857	0.2095	0.7725	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

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The GLM Procedure

Class Level Information

Class	Levels	Values
UrbanClass	2	1 2
FTA	10	1 2 3 4 5 6 7 8 9 10
Education	5	1 2 3 4 5

Number of Observations Read	236
Number of Observations Used	236

Dependent Variable: PriceA PriceA

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	17	173.724089	10.219064	1.54	0.0823
Error	218	1444.852183	6.627762		
Corrected Total	235	1618.576271			

R-Square	Coeff Var	Root MSE	PriceA Mean
0.107331	34.52095	2.574444	7.457627

Source	DF	Type I SS	Mean Square	F Value	Pr > F
UrbanClass	1	1.5762712	1.5762712	0.24	0.6263
FTA	9	109.2536050	12.1392894	1.83	0.0639
Education	4	42.9446444	10.7361611	1.62	0.1703
Vehicles	1	19.7905574	19.7905574	2.99	0.0854
Capital	1	0.0605104	0.0605104	0.01	0.9240
Years	1	0.0985002	0.0985002	0.01	0.9031

Source	DF	Type III SS	Mean Square	F Value	Pr > F
UrbanClass	1	0.4821374	0.4821374	0.07	0.7876
FTA	9	105.2209384	11.6912154	1.76	0.0765
Education	4	50.8541872	12.7135468	1.92	0.1084
Vehicles	1	10.9493665	10.9493665	1.65	0.2000

Capital	1	0.0711764	0.0711764	0.01	0.9176
Years	1	0.0985002	0.0985002	0.01	0.9031

Least Squares Means

Urban Class	PriceA LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1=LSMean2 t Value	Pr > |t|
1	7.63092323	0.31414226	<.0001	0.27	0.7876
2	7.49946933	0.46173955	<.0001		

FTA	PriceA LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	6.82473066	0.74475641	<.0001	1
2	7.58544734	0.76580467	<.0001	2
3	8.11617687	0.58025712	<.0001	3
4	7.77103087	0.46515555	<.0001	4
5	7.60281355	0.50174625	<.0001	5
6	7.43049458	0.58864246	<.0001	6
7	8.02190747	0.63321327	<.0001	7
8	5.45457001	0.78359260	<.0001	8
9	8.04631157	0.66266368	<.0001	9
10	8.79847986	0.62673535	<.0001	10

Least Squares Means for Effect FTA
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: PriceA

i/j	1	2	3	4	5	6	7	8	9	10
1		-0.76865	-1.54162	-1.22316	-0.97405	-0.69476	-1.28561	1.347842	-1.35613	-2.2047
		0.4429	0.1246	0.2226	0.3311	0.4879	0.1999	0.1791	0.1765	0.0285
2	0.768652		-0.60319	-0.22427	-0.02088	0.170964	-0.44876	2.00433	-0.49322	-1.34292
	0.4429		0.5470	0.8228	0.9834	0.8644	0.6540	0.0463	0.6224	0.1807
3	1.541618	0.603189		0.543244	0.770501	0.917813	0.115689	2.9068	0.089148	-0.8815
	0.1246	0.5470		0.5875	0.4418	0.3597	0.9080	0.0040	0.9290	0.3790
4	1.223161	0.224274	-0.54324		0.289488	0.508791	-0.34536	2.748057	-0.38957	-1.47817
	0.2226	0.8228	0.5875		0.7725	0.6114	0.7302	0.0065	0.6972	0.1408
5	0.974052	0.020883	-0.7705	-0.28949		0.248777	-0.54408	2.445943	-0.61143	-1.66627
	0.3311	0.9834	0.4418	0.7725		0.8038	0.5869	0.0152	0.5415	0.0971
6	0.694759	-0.17096	-0.91781	-0.50879	-0.24878		-0.71595	2.118414	-0.7632	-1.71944
	0.4879	0.8644	0.3597	0.6114	0.8038		0.4748	0.0353	0.4462	0.0870
7	1.285613	0.448761	-0.11569	0.345361	0.544085	0.715947		2.70849	-0.0281	-0.89562
	0.1999	0.6540	0.9080	0.7302	0.5869	0.4748		0.0073	0.9776	0.3714
8	-1.34784	-2.00433	-2.9068	-2.74806	-2.44594	-2.11841	-2.70849		-2.6713	-3.47295
	0.1791	0.0463	0.0040	0.0065	0.0152	0.0353	0.0073		0.0081	0.0006
9	1.356132	0.493222	-0.08915	0.389567	0.611435	0.763203	0.0281	2.671296		-0.90802
	0.1765	0.6224	0.9290	0.6972	0.5415	0.4462	0.9776	0.0081		0.3649
10	2.204698	1.342921	0.8815	1.478169	1.666268	1.719438	0.895615	3.472946	0.90802	
	0.0285	0.1807	0.3790	0.1408	0.0971	0.0870	0.3714	0.0006	0.3649	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Education	PriceA LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	6.82989843	0.47957000	<.0001	1
2	7.07871350	0.28675277	<.0001	2
3	7.45338398	0.37727915	<.0001	3
4	7.65244872	1.07055321	<.0001	4
5	8.81153676	0.65527342	<.0001	5

Least Squares Means for Effect Education
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: PriceA

i/j	1	2	3	4	5
1		-0.46689	-1.09321	-0.71243	-2.50573
		0.6410	0.2755	0.4770	0.0130
2	0.466886		-0.87878	-0.52321	-2.50237
	0.6410		0.3805	0.6014	0.0131
3	1.093212	0.878784		-0.17857	-1.86044
	0.2755	0.3805		0.8584	0.0642
4	0.712426	0.523209	0.178569		-0.93738

	0.4770	0.6014	0.8584	0.3496
5	2.50573	2.502367	1.860442	0.937381
	0.0130	0.0131	0.0642	0.3496

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

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The GLM Procedure

Class Level Information

Class	Levels	Values
UrbanClass	2	1 2
FTA	10	1 2 3 4 5 6 7 8 9 10
Education	5	1 2 3 4 5

Number of Observations Read	236
Number of Observations Used	236

Dependent Variable: PriceC PriceC

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	17	103.388527	6.081678	1.30	0.1966
Error	218	1023.098761	4.693114		
Corrected Total	235	1126.487288			

R-Square	Coeff Var	Root MSE	PriceC Mean
0.091780	27.23819	2.166360	7.953390

Source	DF	Type I SS	Mean Square	F Value	Pr > F
UrbanClass	1	16.28234190	16.28234190	3.47	0.0639
FTA	9	69.37324349	7.70813817	1.64	0.1047
Education	4	15.36157338	3.84039335	0.82	0.5147
Vehicles	1	1.64536790	1.64536790	0.35	0.5544
Capital	1	0.71072926	0.71072926	0.15	0.6975
Years	1	0.01527093	0.01527093	0.00	0.9546

Source	DF	Type III SS	Mean Square	F Value	Pr > F
UrbanClass	1	7.71197910	7.71197910	1.64	0.2012

FTA	9	69.93725481	7.77080609	1.66	0.1012
Education	4	16.99260903	4.24815226	0.91	0.4617
Vehicles	1	2.26552489	2.26552489	0.48	0.4879
Capital	1	0.72165981	0.72165981	0.15	0.6953
Years	1	0.01527093	0.01527093	0.00	0.9546

Least Squares Means

Urban Class	PriceC LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1=LSMean2 t Value	Pr > |t|
1	7.84316130	0.26434642	<.0001	-1.28	0.2012
2	8.36890129	0.38854753	<.0001		

FTA	PriceC LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	8.02022357	0.62670234	<.0001	1
2	8.57627599	0.64441417	<.0001	2
3	8.72433281	0.48827844	<.0001	3
4	8.54791806	0.39142204	<.0001	4
5	8.30111898	0.42221261	<.0001	5
6	7.41685624	0.49533459	<.0001	6
7	8.67577783	0.53284031	<.0001	7
8	6.51736461	0.65938246	<.0001	8
9	7.87422495	0.55762244	<.0001	9
10	8.40621987	0.52738924	<.0001	10

Least Squares Means for Effect FTA
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: PriceC

i/j	1	2	3	4	5	6	7	8	9	10
1		-0.66769	-0.99883	-0.81057	-0.41788	0.822366	-0.83659	1.756866	0.192611	-0.51238
		0.5050	0.3190	0.4185	0.6764	0.4118	0.4037	0.0803	0.8474	0.6089
2	0.667691		-0.19997	0.040726	0.393205	1.520194	-0.12158	2.301448	0.892875	0.223729
	0.5050		0.8417	0.9676	0.6946	0.1299	0.9033	0.0223	0.3729	0.8232
3	0.998834	0.199968		0.329974	0.754851	2.079783	0.070812	2.864311	1.289069	0.488404
	0.3190	0.8417		0.7417	0.4512	0.0387	0.9436	0.0046	0.1987	0.6258
4	0.810569	-0.04073	-0.32997		0.504727	2.008238	-0.20917	2.862649	1.132978	0.24226
	0.4185	0.9676	0.7417		0.6143	0.0459	0.8345	0.0046	0.2585	0.8088
5	0.417882	-0.39321	-0.75485	-0.50473		1.51709	-0.57802	2.413519	0.699409	-0.17406
	0.6764	0.6946	0.4512	0.6143		0.1307	0.5638	0.0166	0.4850	0.8620
6	-0.82237	-1.52019	-2.07978	-2.00824	-1.51709		-1.8111	1.146016	-0.67361	-1.47779
	0.4118	0.1299	0.0387	0.0459	0.1307		0.0715	0.2530	0.5013	0.1409
7	0.836592	0.121578	-0.07081	0.20917	0.578022	1.811098		2.706025	1.096794	0.369441
	0.4037	0.9033	0.9436	0.8345	0.5638	0.0715		0.0073	0.2739	0.7122
8	-1.75687	-2.30145	-2.86431	-2.86265	-2.41352	-1.14602	-2.70602		-1.66195	-2.33128
	0.0803	0.0223	0.0046	0.0046	0.0166	0.2530	0.0073		0.0980	0.0207
9	-0.19261	-0.89288	-1.28907	-1.13298	-0.69941	0.673609	-1.09679	1.661952		-0.7632
	0.8474	0.3729	0.1987	0.2585	0.4850	0.5013	0.2739	0.0980		0.4462
10	0.512381	-0.22373	-0.4884	-0.24226	0.174058	1.477794	-0.36944	2.331284	0.763204	
	0.6089	0.8232	0.6258	0.8088	0.8620	0.1409	0.7122	0.0207	0.4462	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Education	PriceC LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	8.23106762	0.40355160	<.0001	1
2	8.03730960	0.24129853	<.0001	2
3	7.60886463	0.31747525	<.0001	3
4	8.01782883	0.90085590	<.0001	4
5	8.63508578	0.55140363	<.0001	5

Least Squares Means for Effect Education
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: PriceC

i/j	1	2	3	4	5
1		0.432063	1.296472	0.219481	-0.6071
		0.6661	0.1962	0.8265	0.5444
2	-0.43206		1.19421	0.021112	-1.02586
	0.6661		0.2337	0.9832	0.3061
3	-1.29647	-1.19421		-0.43596	-1.67056

	0.1962	0.2337		0.6633	0.0962
4	-0.21948	-0.02111	0.435964		-0.59322
	0.8265	0.9832	0.6633		0.5536
5	0.607105	1.02586	1.670557	0.593224	
	0.5444	0.3061	0.0962	0.5536	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

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The GLM Procedure

Class Level Information

Class	Levels	Values
UrbanClass	2	1 2
FTA	10	1 2 3 4 5 6 7 8 9 10
Education	5	1 2 3 4 5

Number of Observations Read	236
Number of Observations Used	236

Dependent Variable: ProceduralComplianceA ProceduralComplianceA

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	17	62.8722079	3.6983652	1.20	0.2646
Error	218	670.8735548	3.0774016		
Corrected Total	235	733.7457627			

R-Square	Coeff Var	Root MSE	ProceduralComplianceA Mean
0.085687	21.27459	1.754252	8.245763

Source	DF	Type I SS	Mean Square	F Value	Pr > F
UrbanClass	1	0.70963368	0.70963368	0.23	0.6316
FTA	9	33.06434198	3.67381578	1.19	0.3001
Education	4	15.09297079	3.77324270	1.23	0.3007
Vehicles	1	1.01166643	1.01166643	0.33	0.5670
Capital	1	0.72237585	0.72237585	0.23	0.6285
Years	1	12.27121915	12.27121915	3.99	0.0471

Source	DF	Type III SS	Mean Square	F Value	Pr > F
UrbanClass	1	1.34073603	1.34073603	0.44	0.5099
FTA	9	38.51875015	4.27986113	1.39	0.1935
Education	4	16.63410734	4.15852683	1.35	0.2520
Vehicles	1	2.78104310	2.78104310	0.90	0.3428
Capital	1	1.18046630	1.18046630	0.38	0.5363
Years	1	12.27121915	12.27121915	3.99	0.0471

Least Squares Means

Urban Class	Procedural ComplianceA LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1=LSMean2 t Value	Pr > |t|
1	8.17271317	0.21405974	<.0001	0.66	0.5099
2	7.95350349	0.31463404	<.0001		

FTA	Procedural ComplianceA LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	8.13240894	0.50748461	<.0001	1
2	7.51147236	0.52182711	<.0001	2
3	8.60438577	0.39539312	<.0001	3
4	8.72209079	0.31696174	<.0001	4
5	8.12233988	0.34189501	<.0001	5
6	7.90776601	0.40110697	<.0001	6
7	8.27024722	0.43147797	<.0001	7
8	7.15492381	0.53394798	<.0001	8
9	8.21416074	0.45154579	<.0001	9
10	7.99128778	0.42706386	<.0001	10

Least Squares Means for Effect FTA
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: ProceduralComplianceA

i/j	1	2	3	4	5	6	7	8	9	10
1		0.920758	-0.82682	-1.11857	0.018499	0.378107	-0.21723	1.411137	-0.13319	0.231335
		0.3582	0.4092	0.2646	0.9853	0.7057	0.8282	0.1596	0.8942	0.8173
2	-0.92076		-1.82288	-2.14703	-1.07801	-0.64167	-1.14492	0.492176	-1.10363	-0.77955
	0.3582		0.0697	0.0329	0.2822	0.5218	0.2535	0.6231	0.2710	0.4365
3	0.826823	1.822876		-0.27188	1.061764	1.368416	0.601782	2.323108	0.730728	1.162429
	0.4092	0.0697		0.7860	0.2895	0.1726	0.5479	0.0211	0.4657	0.2463
4	1.118572	2.147035	0.271881		1.514684	1.785521	0.912835	2.728396	1.054877	1.542963
	0.2646	0.0329	0.7860		0.1313	0.0756	0.3623	0.0069	0.2926	0.1243
5	-0.0185	1.078013	-1.06176	-1.51468		0.454617	-0.2818	1.616469	-0.18578	0.268022
	0.9853	0.2822	0.2895	0.1313		0.6498	0.7784	0.1074	0.8528	0.7889
6	-0.37811	0.641673	-1.36842	-1.78552	-0.45462		-0.64397	1.184502	-0.55726	-0.15406
	0.7057	0.5218	0.1726	0.0756	0.6498		0.5203	0.2375	0.5779	0.8777
7	0.217227	1.14492	-0.60178	-0.91284	0.281797	0.643972		1.726778	0.094774	0.472141
	0.8282	0.2535	0.5479	0.3623	0.7784	0.5203		0.0856	0.9246	0.6373
8	-1.41114	-0.49218	-2.32311	-2.7284	-1.61647	-1.1845	-1.72678		-1.60219	-1.27477
	0.1596	0.6231	0.0211	0.0069	0.1074	0.2375	0.0856		0.1106	0.2037
9	0.133189	1.10363	-0.73073	-1.05488	0.185777	0.557264	-0.09477	1.602193		0.394847
	0.8942	0.2710	0.4657	0.2926	0.8528	0.5779	0.9246	0.1106		0.6933
10	-0.23133	0.779549	-1.16243	-1.54296	-0.26802	0.154062	-0.47214	1.274765	-0.39485	
	0.8173	0.4365	0.2463	0.1243	0.7889	0.8777	0.6373	0.2037	0.6933	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Education	Procedural ComplianceA LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	8.57093199	0.32678389	<.0001	1
2	7.87584558	0.19539626	<.0001	2
3	8.06477293	0.25708186	<.0001	3
4	7.36614724	0.72948587	<.0001	4
5	8.43784390	0.44650999	<.0001	5

Least Squares Means for Effect Education
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: ProceduralComplianceA

i/j	1	2	3	4	5
1		1.9141	1.302436	1.531362	0.246968
		0.0569	0.1941	0.1271	0.8052
2	-1.9141		-0.65031	0.682132	-1.19103
	0.0569		0.5162	0.4959	0.2349
3	-1.30244	0.650308		0.919704	-0.74998
	0.1941	0.5162		0.3587	0.4541
4	-1.53136	-0.68213	-0.9197		-1.27193
	0.1271	0.4959	0.3587		0.2048
5	-0.24697	1.191031	0.749981	1.271929	
	0.8052	0.2349	0.4541	0.2048	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

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The GLM Procedure

Class Level Information

Class	Levels	Values
UrbanClass	2	1 2
FTA	10	1 2 3 4 5 6 7 8 9 10
Education	5	1 2 3 4 5

Number of Observations Read 236
Number of Observations Used 236

Dependent Variable: ProceduralComplianceC ProceduralComplianceC

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	17	71.5340236	4.2078837	1.42	0.1308
Error	218	648.1058069	2.9729624		
Corrected Total	235	719.6398305			

R-Square	Coeff Var	Root MSE	ProceduralComplianceC Mean
0.099403	21.02934	1.724228	8.199153

Source	DF	Type I SS	Mean Square	F Value	Pr > F
UrbanClass	1	0.02327137	0.02327137	0.01	0.9296
FTA	9	47.84479518	5.31608835	1.79	0.0718
Education	4	10.03296539	2.50824135	0.84	0.4988

Vehicles	1	0.99996541	0.99996541	0.34	0.5625
Capital	1	0.28515261	0.28515261	0.10	0.7571
Years	1	12.34787361	12.34787361	4.15	0.0428

Source	DF	Type III SS	Mean Square	F Value	Pr > F
UrbanClass	1	0.76543122	0.76543122	0.26	0.6124
FTA	9	49.14878953	5.46097661	1.84	0.0631
Education	4	8.59853549	2.14963387	0.72	0.5770
Vehicles	1	2.07543845	2.07543845	0.70	0.4043
Capital	1	0.59604534	0.59604534	0.20	0.6548
Years	1	12.34787361	12.34787361	4.15	0.0428

Least Squares Means

Urban Class	Procedural ComplianceC LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1=LSMean2 t Value	Pr > |t|
1	8.11616256	0.21039606	<.0001	0.51	0.6124
2	7.95053173	0.30924901	<.0001		

FTA	Procedural ComplianceC LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	8.16270777	0.49879891	<.0001	1
2	7.10687718	0.51289593	<.0001	2
3	8.56013659	0.38862589	<.0001	3
4	8.70652045	0.31153687	<.0001	4
5	8.03066013	0.33604341	<.0001	5
6	8.18707694	0.39424195	<.0001	6
7	8.29997723	0.42409314	<.0001	7
8	6.98447436	0.52480936	<.0001	8
9	8.21195591	0.44381749	<.0001	9
10	8.08308485	0.41975458	<.0001	10

Least Squares Means for Effect FTA
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: ProceduralComplianceC

i/j	1	2	3	4	5	6	7	8	9	10
1		1.592905	-0.70835	-1.04952	0.246817	-0.04173	-0.2201	1.730564	-0.08163	0.132796
		0.1126	0.4795	0.2951	0.8053	0.9668	0.8260	0.0849	0.9350	0.8945
2	-1.59291		-2.46611	-2.88637	-1.65861	-1.7795	-1.83162	0.171906	-1.76584	-1.61365
	0.1126		0.0144	0.0043	0.0986	0.0766	0.0684	0.8637	0.0788	0.1081
3	0.708351	2.466107		-0.34401	1.186544	0.745587	0.476705	2.569349	0.66335	0.920236
	0.4795	0.0144		0.7312	0.2367	0.4567	0.6340	0.0109	0.5078	0.3585
4	1.049525	2.886372	0.344012		1.736623	1.158785	0.835619	3.050242	1.045005	1.339196
	0.2951	0.0043	0.7312		0.0839	0.2478	0.4043	0.0026	0.2972	0.1819
5	-0.24682	1.65861	-1.18654	-1.73662		-0.33717	-0.52204	1.778526	-0.37319	-0.10908
	0.8053	0.0986	0.2367	0.0839		0.7363	0.6022	0.0767	0.7094	0.9132
6	0.041731	1.779501	-0.74559	-1.15879	0.33717		-0.20407	1.925092	-0.04604	0.195162
	0.9668	0.0766	0.4567	0.2478	0.7363		0.8385	0.0555	0.9633	0.8454
7	0.220097	1.831624	-0.4767	-0.83562	0.522045	0.204068		2.072167	0.151327	0.373484
	0.8260	0.0684	0.6340	0.4043	0.6022	0.8385		0.0394	0.8799	0.7092
8	-1.73056	-0.17191	-2.56935	-3.05024	-1.77853	-1.92509	-2.07217		-1.88901	-1.70363
	0.0849	0.8637	0.0109	0.0026	0.0767	0.0555	0.0394		0.0602	0.0899
9	0.081632	1.76584	-0.66335	-1.045	0.373194	0.046037	-0.15133	1.889009		0.232287
	0.9350	0.0788	0.5078	0.2972	0.7094	0.9633	0.8799	0.0602		0.8165
10	-0.1328	1.613649	-0.92024	-1.3392	0.109084	-0.19516	-0.37348	1.703633	-0.23229	
	0.8945	0.1081	0.3585	0.1819	0.9132	0.8454	0.7092	0.0899	0.8165	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Education	Procedural ComplianceC LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	8.30010823	0.32119091	<.0001	1
2	7.94918608	0.19205201	<.0001	2
3	7.88445603	0.25268185	<.0001	3
4	7.55780013	0.71700058	<.0001	4
5	8.47518523	0.43886788	<.0001	5

Least Squares Means for Effect Education
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: ProceduralComplianceC

i/j	1	2	3	4	5
1		0.983182	1.08817	0.959953	-0.33054
		0.3266	0.2777	0.3381	0.7413
2	-0.98318		0.226687	0.532915	-1.13415

	0.3266		0.8209	0.5946	0.2580
3	-1.08817	-0.22669		0.437513	-1.20822
	0.2777	0.8209		0.6622	0.2283
4	-0.95995	-0.53291	-0.43751		-1.10775
	0.3381	0.5946	0.6622		0.2692
5	0.330543	1.13415	1.208216	1.107746	
	0.7413	0.2580	0.2283	0.2692	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

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The GLM Procedure

Class Level Information

Class	Levels	Values
UrbanClass	2	1 2
FTA	10	1 2 3 4 5 6 7 8 9 10
Education	5	1 2 3 4 5

Number of Observations Read 236
Number of Observations Used 236

Dependent Variable: QualityA QualityA

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	17	16.7393997	0.9846706	0.95	0.5206
Error	218	226.8877189	1.0407694		
Corrected Total	235	243.6271186			

R-Square	Coeff Var	Root MSE	QualityA Mean
0.068709	10.82566	1.020181	9.423729

Source	DF	Type I SS	Mean Square	F Value	Pr > F
UrbanClass	1	0.25765628	0.25765628	0.25	0.6193
FTA	9	8.80758274	0.97862030	0.94	0.4910
Education	4	6.90631477	1.72657869	1.66	0.1606
Vehicles	1	0.12211113	0.12211113	0.12	0.7323
Capital	1	0.40373414	0.40373414	0.39	0.5340
Years	1	0.24200065	0.24200065	0.23	0.6301

Source	DF	Type III SS	Mean Square	F Value	Pr > F
UrbanClass	1	0.26544751	0.26544751	0.26	0.6141
FTA	9	8.52157265	0.94684141	0.91	0.5175
Education	4	6.99337652	1.74834413	1.68	0.1557

Vehicles	1	0.06658787	0.06658787	0.06	0.8006
Capital	1	0.44545509	0.44545509	0.43	0.5137
Years	1	0.24200065	0.24200065	0.23	0.6301

Least Squares Means

Urban Class	QualityA LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1=LSMean2 t Value	Pr > |t|
1	9.42625307	0.12448590	<.0001	0.51	0.6141
2	9.32871427	0.18297462	<.0001		

FTA	QualityA LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	9.08821523	0.29512638	<.0001	1
2	9.63585283	0.30346723	<.0001	2
3	9.42901825	0.22993986	<.0001	3
4	9.55501565	0.18432829	<.0001	4
5	9.26835602	0.19882817	<.0001	5
6	9.08706034	0.23326274	<.0001	6
7	9.18885363	0.25092492	<.0001	7
8	9.69379698	0.31051609	<.0001	8
9	9.53621328	0.26259530	<.0001	9
10	9.29245447	0.24835790	<.0001	10

Least Squares Means for Effect FTA
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: QualityA

i/j	1	2	3	4	5	6	7	8	9	10
1		-1.39639	-1.02662	-1.52262	-0.56908	0.003343	-0.27272	-1.5033	-1.25505	-0.57571
		0.1640	0.3057	0.1293	0.5699	0.9973	0.7853	0.1342	0.2108	0.5654
2	1.396389		0.593211	0.246523	1.115181	1.527988	1.159802	-0.13754	0.269096	0.959362
	0.1640		0.5537	0.8055	0.2660	0.1280	0.2474	0.8907	0.7881	0.3384
3	1.026621	-0.59321		-0.50045	0.608511	1.155074	0.743766	-0.72973	-0.34517	0.445233
	0.3057	0.5537		0.6173	0.5435	0.2493	0.4578	0.4663	0.7303	0.6566
4	1.522622	-0.24652	0.500449		1.244895	1.764357	1.272015	-0.41547	0.067147	0.953236
	0.1293	0.8055	0.6173		0.2145	0.0791	0.2047	0.6782	0.9465	0.3415
5	0.569082	-1.11518	-0.60851	-1.24489		0.660497	0.26046	-1.22239	-0.9319	-0.08475
	0.5699	0.2660	0.5435	0.2145		0.5096	0.7948	0.2229	0.3524	0.9325
6	-0.00334	-1.52799	-1.15507	-1.76436	-0.6605		-0.31097	-1.64152	-1.40472	-0.65148
	0.9973	0.1280	0.2493	0.0791	0.5096		0.7561	0.1021	0.1615	0.5154
7	0.272723	-1.1598	-0.74377	-1.27202	-0.26046	0.310968		-1.34429	-1.00931	-0.30152
	0.7853	0.2474	0.4578	0.2047	0.7948	0.7561		0.1803	0.3139	0.7633
8	1.503303	0.137539	0.729727	0.415468	1.222386	1.641523	1.34429		0.409872	1.051877
	0.1342	0.8907	0.4663	0.6782	0.2229	0.1021	0.1803		0.6823	0.2940
9	1.255053	-0.2691	0.345168	-0.06715	0.931897	1.404717	1.009312	-0.40987		0.742586
	0.2108	0.7881	0.7303	0.9465	0.3524	0.1615	0.3139	0.6823		0.4585
10	0.575708	-0.95936	-0.44523	-0.95324	0.084748	0.651477	0.301515	-1.05188	-0.74259	
	0.5654	0.3384	0.6566	0.3415	0.9325	0.5154	0.7633	0.2940	0.4585	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Education	QualityA LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	9.69735678	0.19004034	<.0001	1
2	9.41214079	0.11363220	<.0001	2
3	9.20407969	0.14950530	<.0001	3
4	8.95308153	0.42423065	<.0001	4
5	9.62075954	0.25966675	<.0001	5

Least Squares Means for Effect Education
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: QualityA

i/j	1	2	3	4	5
1		1.350562	2.182606	1.626735	0.244416
		0.1782	0.0301	0.1052	0.8071
2	-1.35056		1.231487	1.056425	-0.76025
	0.1782		0.2195	0.2919	0.4479
3	-2.18261	-1.23149		0.568184	-1.44038
	0.0301	0.2195		0.5705	0.1512

4	-1.62674	-1.05643	-0.56818		-1.36261
	0.1052	0.2919	0.5705		0.1744
5	-0.24442	0.76025	1.440377	1.362615	
	0.8071	0.4479	0.1512	0.1744	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

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The GLM Procedure

Class Level Information

Class	Levels	Values
UrbanClass	2	1 2
FTA	10	1 2 3 4 5 6 7 8 9 10
Education	5	1 2 3 4 5

Number of Observations Read 236
Number of Observations Used 236

Dependent Variable: QualityC QualityC

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	17	22.0618235	1.2977543	0.93	0.5350
Error	218	302.9720748	1.3897802		
Corrected Total	235	325.0338983			

R-Square	Coeff Var	Root MSE	QualityC Mean
0.067875	12.82110	1.178889	9.194915

Source	DF	Type I SS	Mean Square	F Value	Pr > F
UrbanClass	1	1.52250046	1.52250046	1.10	0.2964
FTA	9	7.01859574	0.77984397	0.56	0.8280
Education	4	11.35136891	2.83784223	2.04	0.0896
Vehicles	1	0.46427454	0.46427454	0.33	0.5639
Capital	1	0.06634539	0.06634539	0.05	0.8273
Years	1	1.63873846	1.63873846	1.18	0.2787

Source	DF	Type III SS	Mean Square	F Value	Pr > F

UrbanClass	1	2.68896182	2.68896182	1.93	0.1657
FTA	9	8.09749764	0.89972196	0.65	0.7557
Education	4	9.24551172	2.31137793	1.66	0.1596
Vehicles	1	0.18084536	0.18084536	0.13	0.7187
Capital	1	0.02883463	0.02883463	0.02	0.8856
Years	1	1.63873846	1.63873846	1.18	0.2787

Least Squares Means

Urban Class	QualityC LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1=LSMean2 t Value	Pr > |t|
1	9.25518200	0.14385202	<.0001	1.39	0.1657
2	8.94474005	0.21143977	<.0001		

FTA	QualityC LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	8.77007975	0.34103884	<.0001	1
2	8.63339132	0.35067726	<.0001	2
3	9.11828265	0.26571133	<.0001	3
4	9.22582019	0.21300402	<.0001	4
5	9.13520496	0.22975963	<.0001	5
6	9.29140025	0.26955114	<.0001	6
7	9.07165350	0.28996100	<.0001	7
8	9.14614470	0.35882270	<.0001	8
9	9.45851984	0.30344694	<.0001	9
10	9.14911312	0.28699464	<.0001	10

Least Squares Means for Effect FTA
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: QualityC

i/j	1	2	3	4	5	6	7	8	9	10
1		0.301612	-0.9077	-1.28642	-0.99818	-1.30571	-0.70722	-0.80787	-1.669	-0.92458
		0.7632	0.3650	0.1997	0.3193	0.1930	0.4802	0.4200	0.0966	0.3562
2	-0.30161		-1.20347	-1.56346	-1.31777	-1.58543	-0.98405	-1.05325	-1.92842	-1.24682
	0.7632		0.2301	0.1194	0.1890	0.1143	0.3262	0.2934	0.0551	0.2138
3	0.907702	1.203469		-0.36963	-0.05546	-0.50604	0.124965	-0.06645	-0.94807	-0.08698
	0.3650	0.2301		0.7120	0.9558	0.6133	0.9007	0.9471	0.3441	0.9308
4	1.28642	1.563461	0.369626		0.340543	-0.21397	0.463462	0.206412	-0.71914	0.240996
	0.1997	0.1194	0.7120		0.7338	0.8308	0.6435	0.8367	0.4728	0.8098
5	0.998179	1.317766	0.055465	-0.34054		-0.49244	0.180174	-0.0272	-0.97341	-0.04233
	0.3193	0.1890	0.9558	0.7338		0.6229	0.8572	0.9783	0.3314	0.9663
6	1.305707	1.585432	0.506038	0.213973	0.492443		0.580929	0.340082	-0.4523	0.390554
	0.1930	0.1143	0.6133	0.8308	0.6229		0.5619	0.7341	0.6515	0.6965
7	0.707222	0.984045	-0.12497	-0.46346	-0.18017	-0.58093		-0.17162	-0.97277	-0.19509
	0.4802	0.3262	0.9007	0.6435	0.8572	0.5619		0.8639	0.3317	0.8455
8	0.807869	1.053246	0.06645	-0.20641	0.027201	-0.34008	0.171617		-0.7031	-0.00673
	0.4200	0.2934	0.9471	0.8367	0.9783	0.7341	0.8639		0.4827	0.9946
9	1.669	1.928418	0.948072	0.719139	0.973407	0.4523	0.972773	0.7031		0.815681
	0.0966	0.0551	0.3441	0.4728	0.3314	0.6515	0.3317	0.4827		0.4156
10	0.924581	1.24682	0.086983	-0.241	0.042327	-0.39055	0.195086	0.006733	-0.81568	
	0.3562	0.2138	0.9308	0.8098	0.9663	0.6965	0.8455	0.9946	0.4156	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Education	QualityC LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	9.05156038	0.21960468	<.0001	1
2	9.20424060	0.13130982	<.0001	2
3	8.75686142	0.17276366	<.0001	3
4	9.07504216	0.49022770	<.0001	4
5	9.41210058	0.30006279	<.0001	5

Least Squares Means for Effect Education
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: QualityC

i/j	1	2	3	4	5
1		-0.62564	1.12841	-0.04441	-0.99558
		0.5322	0.2604	0.9646	0.3206
2	0.625645		2.291496	0.257295	-0.65551
	0.5322		0.0229	0.7972	0.5128
3	-1.12841	-2.2915		-0.6233	-1.9601
	0.2604	0.0229		0.5337	0.0513
4	0.044414	-0.2573	0.623299		-0.59527
	0.9646	0.7972	0.5337		0.5523
5	0.995575	0.655508	1.960097	0.595272	
	0.3206	0.5128	0.0513	0.5523	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

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The GLM Procedure

Class Level Information

Class	Levels	Values
UrbanClass	2	1 2
FTA	10	1 2 3 4 5 6 7 8 9 10
Education	5	1 2 3 4 5

Number of Observations Read 236
Number of Observations Used 236

Dependent Variable: ReliabilityA ReliabilityA

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	17	29.3686046	1.7275650	1.29	0.2036
Error	218	293.0508869	1.3442701		
Corrected Total	235	322.4194915			

R-Square	Coeff Var	Root MSE	ReliabilityA Mean
0.091088	12.61525	1.159427	9.190678

Source	DF	Type I SS	Mean Square	F Value	Pr > F
UrbanClass	1	0.50615819	0.50615819	0.38	0.5401

FTA	9	24.43175468	2.71463941	2.02	0.0384
Education	4	1.09163058	0.27290765	0.20	0.9365
Vehicles	1	1.72519605	1.72519605	1.28	0.2585
Capital	1	0.95693272	0.95693272	0.71	0.3998
Years	1	0.65693241	0.65693241	0.49	0.4853

Source	DF	Type III SS	Mean Square	F Value	Pr > F
UrbanClass	1	0.05854731	0.05854731	0.04	0.8349
FTA	9	20.14262525	2.23806947	1.66	0.0989
Education	4	0.94049729	0.23512432	0.17	0.9511
Vehicles	1	0.01902620	0.01902620	0.01	0.9054
Capital	1	1.06327159	1.06327159	0.79	0.3748
Years	1	0.65693241	0.65693241	0.49	0.4853

Least Squares Means

Urban Class	ReliabilityA LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1=LSMean2 t Value	Pr > |t|
1	9.09097637	0.14147711	<.0001	-0.21	0.8349
2	9.13678439	0.20794902	<.0001		

FTA	ReliabilityA LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	9.32003664	0.33540850	<.0001	1
2	8.48706173	0.34488779	<.0001	2
3	9.57703689	0.26132460	<.0001	3
4	9.39793813	0.20948745	<.0001	4
5	9.28607968	0.22596644	<.0001	5
6	8.70475420	0.26510102	<.0001	6
7	9.18398926	0.28517393	<.0001	7
8	8.76759124	0.35289876	<.0001	8
9	9.17441315	0.29843722	<.0001	9
10	9.23990291	0.28225653	<.0001	10

Least Squares Means for Effect FTA
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: ReliabilityA

i/j	1	2	3	4	5	6	7	8	9	10
1		1.86887	-0.6812	-0.22358	0.09439	1.566915	0.324401	1.206694	0.358964	0.198753
		0.0630	0.4965	0.8233	0.9249	0.1186	0.7459	0.2289	0.7200	0.8426
2	-1.86887		-2.75066	-2.44422	-2.13345	-0.53332	-1.5911	-0.58591	-1.63338	-1.85064
	0.0630		0.0064	0.0153	0.0340	0.5944	0.1130	0.5585	0.1038	0.0656
3	0.681199	2.750659		0.625929	0.969656	2.592559	1.071042	1.962904	1.140746	0.967137
	0.4965	0.0064		0.5320	0.3333	0.0102	0.2853	0.0509	0.2552	0.3345
4	0.223584	2.444219	-0.62593		0.427434	2.299665	0.653978	1.66043	0.702381	0.504845
	0.8233	0.0153	0.5320		0.6695	0.0224	0.5138	0.0983	0.4832	0.6142
5	-0.09439	2.133449	-0.96966	-0.42743		1.863531	0.294293	1.310817	0.341839	0.142889
	0.9249	0.0340	0.3333	0.6695		0.0637	0.7688	0.1913	0.7328	0.8865
6	-1.56691	0.533321	-2.59256	-2.29967	-1.86353		-1.28819	-0.14959	-1.29244	-1.49355
	0.1186	0.5944	0.0102	0.0224	0.0637		0.1990	0.8812	0.1976	0.1367
7	-0.3244	1.591104	-1.07104	-0.65398	-0.29429	1.288188		0.975423	0.024483	-0.14319
	0.7459	0.1130	0.2853	0.5138	0.7688	0.1990		0.3304	0.9805	0.8863
8	-1.20669	0.585908	-1.9629	-1.66043	-1.31082	0.149588	-0.97542		-0.93105	-1.08921
	0.2289	0.5585	0.0509	0.0983	0.1913	0.8812	0.3304		0.3529	0.2773
9	-0.35896	1.633384	-1.14075	-0.70238	-0.34184	1.292442	-0.02448	0.931054		-0.17555
	0.7200	0.1038	0.2552	0.4832	0.7328	0.1976	0.9805	0.3529		0.8608
10	-0.19875	1.850638	-0.96714	-0.50484	-0.14289	1.49355	0.143185	1.089212	0.175547	
	0.8426	0.0656	0.3345	0.6142	0.8865	0.1367	0.8863	0.2773	0.8608	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Education	ReliabilityA LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	9.12909891	0.21597914	<.0001	1
2	9.14292620	0.12914198	<.0001	2
3	9.08699736	0.16991144	<.0001	3
4	8.90174220	0.48213434	<.0001	4
5	9.30863724	0.29510894	<.0001	5

Least Squares Means for Effect Education
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: ReliabilityA

i/j	1	2	3	4	5
1		-0.05761	0.163914	0.437245	-0.50409
		0.9541	0.8700	0.6624	0.6147
2	0.057612		0.291279	0.488374	-0.53136
	0.9541		0.7711	0.6258	0.5957
3	-0.16391	-0.29128		0.368997	-0.67415
	0.8700	0.7711		0.7125	0.5009
4	-0.43725	-0.48837	-0.369		-0.73067
	0.6624	0.6258	0.7125		0.4658
5	0.504089	0.531359	0.674148	0.730672	
	0.6147	0.5957	0.5009	0.4658	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

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The GLM Procedure

Class Level Information

Class	Levels	Values
UrbanClass	2	1 2
FTA	10	1 2 3 4 5 6 7 8 9 10
Education	5	1 2 3 4 5

Number of Observations Read 236
Number of Observations Used 236

Dependent Variable: ReliabilityC ReliabilityC

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	17	31.3180975	1.8422410	1.31	0.1900
Error	218	307.4403771	1.4102770		
Corrected Total	235	338.7584746			

R-Square	Coeff Var	Root MSE	ReliabilityC Mean
0.092450	13.05366	1.187551	9.097458

Source	DF	Type I SS	Mean Square	F Value	Pr > F
UrbanClass	1	0.00041006	0.00041006	0.00	0.9864
FTA	9	24.56161447	2.72906827	1.94	0.0484
Education	4	4.62246360	1.15561590	0.82	0.5140
Vehicles	1	0.66498712	0.66498712	0.47	0.4930
Capital	1	0.78381090	0.78381090	0.56	0.4568
Years	1	0.68481136	0.68481136	0.49	0.4866

Source	DF	Type III SS	Mean Square	F Value	Pr > F
UrbanClass	1	0.14567037	0.14567037	0.10	0.7482
FTA	9	18.01211226	2.00134581	1.42	0.1811
Education	4	3.66297353	0.91574338	0.65	0.6279
Vehicles	1	0.02107903	0.02107903	0.01	0.9028
Capital	1	0.88289847	0.88289847	0.63	0.4297
Years	1	0.68481136	0.68481136	0.49	0.4866

Least Squares Means

Urban Class	ReliabilityC LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1=LSMean2 t Value	Pr > |t|
1	9.05262426	0.14490892	<.0001	0.32	0.7482
2	8.98036830	0.21299324	<.0001		

FTA	ReliabilityC LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	9.06542280	0.34354449	<.0001	1
2	8.09482021	0.35325373	<.0001	2
3	9.34521637	0.26766354	<.0001	3
4	9.25058023	0.21456899	<.0001	4
5	9.19383238	0.23144770	<.0001	5
6	8.93754506	0.27153157	<.0001	6
7	8.91631049	0.29209138	<.0001	7
8	8.95692123	0.36145902	<.0001	8
9	9.15973619	0.30567640	<.0001	9
10	9.24457780	0.28910323	<.0001	10

Least Squares Means for Effect FTA
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: ReliabilityC

i/j	1	2	3	4	5	6	7	8	9	10
1		2.12608	-0.72405	-0.51883	-0.34849	0.317949	0.347134	0.231385	-0.22698	-0.43383
		0.0346	0.4698	0.6044	0.7278	0.7508	0.7288	0.8172	0.8207	0.6648
2	-2.12608		-3.08077	-3.02788	-2.86496	-2.01568	-1.83107	-1.75792	-2.47068	-2.75941
	0.0346		0.0023	0.0028	0.0046	0.0451	0.0685	0.0802	0.0143	0.0063
3	0.724051	3.080767		0.322909	0.492561	1.182967	1.141076	0.919315	0.513072	0.281865
	0.4698	0.0023		0.7471	0.6228	0.2381	0.2551	0.3589	0.6084	0.7783
4	0.518832	3.027885	-0.32291		0.21171	1.013912	0.997565	0.755223	0.278698	0.018721
	0.6044	0.0028	0.7471		0.8325	0.3117	0.3196	0.4509	0.7807	0.9851
5	0.348486	2.864965	-0.49256	-0.21171		0.802113	0.781059	0.584763	0.101905	-0.15331
	0.7278	0.0046	0.6228	0.8325		0.4234	0.4356	0.5593	0.9189	0.8783
6	-0.31795	2.015684	-1.18297	-1.01391	-0.80211		0.055727	-0.04503	-0.59696	-0.83661
	0.7508	0.0451	0.2381	0.3117	0.4234		0.9556	0.9641	0.5512	0.4037
7	-0.34713	1.831068	-1.14108	-0.99756	-0.78106	-0.05573		-0.09288	-0.60763	-0.82073
	0.7288	0.0685	0.2551	0.3196	0.4356	0.9556		0.9261	0.5441	0.4127
8	-0.23138	1.757924	-0.91932	-0.75522	-0.58476	0.045034	0.092879		-0.45317	-0.64766
	0.8172	0.0802	0.3589	0.4509	0.5593	0.9641	0.9261		0.6509	0.5179
9	0.226978	2.470676	-0.51307	-0.2787	-0.1019	0.596962	0.607628	0.45317		-0.22203
	0.8207	0.0143	0.6084	0.7807	0.9189	0.5512	0.5441	0.6509		0.8245
10	0.433828	2.759405	-0.28186	-0.01872	0.153307	0.836606	0.820726	0.647663	0.222034	
	0.6648	0.0063	0.7783	0.9851	0.8783	0.4037	0.4127	0.5179	0.8245	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

ReliabilityC Standard LSMEAN

Education	LSMEAN	Error	Pr > |t|	Number
1	8.91833124	0.22121815	<.0001	1
2	9.10560051	0.13227457	<.0001	2
3	8.82884309	0.17403297	<.0001	3
4	9.01741781	0.49382947	<.0001	4
5	9.21228873	0.30226739	<.0001	5

Least Squares Means for Effect Education
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: ReliabilityC

i/j	1	2	3	4	5
1		-0.76178	0.340153	-0.18605	-0.8058
		0.4470	0.7341	0.8526	0.4212
2	0.761785		1.407224	0.174333	-0.334
	0.4470		0.1608	0.8618	0.7387
3	-0.34015	-1.40722		-0.36671	-1.13868
	0.7341	0.1608		0.7142	0.2561
4	0.186047	-0.17433	0.366713		-0.34165
	0.8526	0.8618	0.7142		0.7329
5	0.805797	0.333998	1.138682	0.341647	
	0.4212	0.7387	0.2561	0.7329	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

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The GLM Procedure

Class Level Information

Class	Levels	Values
UrbanClass	2	1 2
FTA	10	1 2 3 4 5 6 7 8 9 10
Education	5	1 2 3 4 5

Number of Observations Read	236
Number of Observations Used	236

Dependent Variable: **TechnicalCapabilityA TechnicalCapabilityA**

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	17	36.3018267	2.1354016	0.94	0.5287

Error	218	495.6769869	2.2737476
Corrected Total	235	531.9788136	

R-Square	Coeff Var	Root MSE	TechnicalCapabilityA Mean
0.068239	17.30011	1.507895	8.716102

Source	DF	Type I SS	Mean Square	F Value	Pr > F
UrbanClass	1	3.53644797	3.53644797	1.56	0.2137
FTA	9	4.76036845	0.52892983	0.23	0.9895
Education	4	15.99487389	3.99871847	1.76	0.1383
Vehicles	1	10.59883717	10.59883717	4.66	0.0319
Capital	1	1.24980243	1.24980243	0.55	0.4593
Years	1	0.16149678	0.16149678	0.07	0.7901

Source	DF	Type III SS	Mean Square	F Value	Pr > F
UrbanClass	1	1.07064173	1.07064173	0.47	0.4933
FTA	9	8.07903961	0.89767107	0.39	0.9368
Education	4	17.30987954	4.32746989	1.90	0.1110
Vehicles	1	9.12794333	9.12794333	4.01	0.0463
Capital	1	1.18371274	1.18371274	0.52	0.4714
Years	1	0.16149678	0.16149678	0.07	0.7901

Least Squares Means

Urban Class	Technical CapabilityA LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1=LSMean2 t Value	Pr > |t|
1	8.55574387	0.18399839	<.0001	0.69	0.4933
2	8.35985481	0.27044860	<.0001		

FTA	Technical CapabilityA LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	8.87355883	0.43621633	<.0001	1
2	7.97314326	0.44854465	<.0001	2
3	8.44435792	0.33986633	<.0001	3
4	8.59896132	0.27244941	<.0001	4
5	8.47996327	0.29388120	<.0001	5
6	8.32319879	0.34477777	<.0001	6
7	8.51483084	0.37088364	<.0001	7
8	8.36115178	0.45896333	<.0001	8
9	8.69156840	0.38813324	<.0001	9
10	8.31725905	0.36708942	<.0001	10

Least Squares Means for Effect FTA
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: TechnicalCapabilityA

i/j	1	2	3	4	5	6	7	8	9	10
1		1.553325	0.874728	0.605987	0.841238	1.07768	0.657703	0.860588	0.344938	1.060909
		0.1218	0.3827	0.5452	0.4011	0.2824	0.5114	0.3904	0.7305	0.2899
2	-1.55332		-0.91435	-1.29122	-1.04052	-0.65941	-0.95089	-0.62311	-1.31269	-0.65042
	0.1218		0.3615	0.1980	0.2992	0.5103	0.3427	0.5339	0.1907	0.5161
3	-0.87473	0.914347		-0.41545	-0.09124	0.276885	-0.14766	0.155145	-0.53855	0.280349
	0.3827	0.3615		0.6782	0.9274	0.7821	0.8827	0.8769	0.5907	0.7795
4	-0.60599	1.291222	0.415454		0.349633	0.703434	0.197733	0.481662	-0.22375	0.691937
	0.5452	0.1980	0.6782		0.7270	0.4825	0.8434	0.6305	0.8232	0.4897
5	-0.84124	1.040523	0.091238	-0.34963		0.3864	-0.07728	0.230958	-0.49808	0.38712
	0.4011	0.2992	0.9274	0.7270		0.6996	0.9385	0.8176	0.6189	0.6990
6	-1.07768	0.659409	-0.27689	-0.70343	-0.3864		-0.39607	-0.06947	-0.77944	0.012746
	0.2824	0.5103	0.7821	0.4825	0.6996		0.6924	0.9447	0.4366	0.9898
7	-0.6577	0.950894	0.147658	-0.19773	0.077284	0.396069		0.276803	-0.34744	0.389024
	0.5114	0.3427	0.8827	0.8434	0.9385	0.6924		0.7822	0.7286	0.6976
8	-0.86059	0.623109	-0.15515	-0.48166	-0.23096	0.06947	-0.2768		-0.58144	0.07783
	0.3904	0.5339	0.8769	0.6305	0.8176	0.9447	0.7822		0.5615	0.9380
9	-0.34494	1.312693	0.538553	0.22375	0.498077	0.779443	0.347441	0.581439		0.771478
	0.7305	0.1907	0.5907	0.8232	0.6189	0.4366	0.7286	0.5615		0.4413
10	-1.06091	0.650422	-0.28035	-0.69194	-0.38712	-0.01275	-0.38902	-0.07783	-0.77148	
	0.2899	0.5161	0.7795	0.4897	0.6990	0.9898	0.6976	0.9380	0.4413	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Education	Technical CapabilityA LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	9.14597365	0.28089220	<.0001	1
2	8.69446390	0.16795591	<.0001	2
3	8.48181280	0.22097873	<.0001	3
4	7.70637523	0.62704098	<.0001	4
5	8.26037113	0.38380464	<.0001	5

Least Squares Means for Effect Education
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: TechnicalCapabilityA

i/j	1	2	3	4	5
1		1.446485	1.988217	2.12878	1.911882
		0.1495	0.0480	0.0344	0.0572
2	-1.44648		0.851555	1.53841	1.070266

	0.1495		0.3954	0.1254	0.2857
3	-1.98822	-0.85156		1.187603	0.517892
	0.0480	0.3954		0.2363	0.6051
4	-2.12878	-1.53841	-1.1876		-0.76492
	0.0344	0.1254	0.2363		0.4451
5	-1.91188	-1.07027	-0.51789	0.764925	
	0.0572	0.2857	0.6051	0.4451	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

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The GLM Procedure

Class Level Information

Class	Levels	Values
UrbanClass	2	1 2
FTA	10	1 2 3 4 5 6 7 8 9 10
Education	5	1 2 3 4 5

Number of Observations Read	236
Number of Observations Used	236

Dependent Variable: **TechnicalCapabilityC TechnicalCapabilityC**

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	17	61.9701722	3.6453042	1.11	0.3485
Error	218	718.0764380	3.2939286		
Corrected Total	235	780.0466102			

R-Square	Coeff Var	Root MSE	TechnicalCapabilityC Mean
0.079444	22.86816	1.814918	7.936441

Source	DF	Type I SS	Mean Square	F Value	Pr > F
UrbanClass	1	22.56854565	22.56854565	6.85	0.0095
FTA	9	25.63468216	2.84829802	0.86	0.5576
Education	4	7.53291615	1.88322904	0.57	0.6834
Vehicles	1	6.02156106	6.02156106	1.83	0.1778
Capital	1	0.04156142	0.04156142	0.01	0.9107
Years	1	0.17090574	0.17090574	0.05	0.8200

Source	DF	Type III SS	Mean Square	F Value	Pr > F
UrbanClass	1	12.08191426	12.08191426	3.67	0.0568
FTA	9	27.34581622	3.03842402	0.92	0.5064
Education	4	6.15552138	1.53888034	0.47	0.7598

Vehicles	1	3.60441647	3.60441647	1.09	0.2967
Capital	1	0.05361258	0.05361258	0.02	0.8986
Years	1	0.17090574	0.17090574	0.05	0.8200

Least Squares Means

Urban Class	Technical CapabilityC LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1=LSMean2 t Value	Pr > |t|
1	8.01729469	0.22146240	<.0001	1.92	0.0568
2	7.35924913	0.32551477	<.0001		

FTA	Technical CapabilityC LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	8.24934842	0.52503454	<.0001	1
2	7.00632377	0.53987304	<.0001	2
3	7.75770951	0.40906668	<.0001	3
4	8.13257267	0.32792297	<.0001	4
5	7.66794401	0.35371849	<.0001	5
6	7.85704834	0.41497813	<.0001	6
7	7.63096241	0.44639943	<.0001	7
8	6.87610952	0.55241308	<.0001	8
9	7.91752646	0.46716124	<.0001	9
10	7.78717402	0.44183267	<.0001	10

Least Squares Means for Effect FTA
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: TechnicalCapabilityC

i/j	1	2	3	4	5	6	7	8	9	10
1		1.781612	0.832478	0.214108	1.032431	0.638227	0.941972	1.916197	0.52253	0.7323
		0.0762	0.4061	0.8307	0.3030	0.5240	0.3472	0.0566	0.6018	0.4648
2	-1.78161		-1.21135	-1.93064	-1.12855	-1.33144	-0.91102	0.173738	-1.38328	-1.22623
	0.0762		0.2271	0.0548	0.2603	0.1844	0.3633	0.8622	0.1680	0.2214
3	-0.83248	1.211349		-0.83693	0.19111	-0.18862	0.220641	1.365744	-0.28927	-0.054
	0.4061	0.2271		0.4035	0.8486	0.8506	0.8256	0.1734	0.7727	0.9570
4	-0.21411	1.930639	0.836934		1.134207	0.583932	0.979503	2.11435	0.431683	0.704873
	0.8307	0.0548	0.4035		0.2580	0.5599	0.3284	0.0356	0.6664	0.4816
5	-1.03243	1.12855	-0.19111	-1.13421		-0.38726	0.068103	1.278862	-0.48809	-0.23569
	0.3030	0.2603	0.8486	0.2580		0.6989	0.9458	0.2023	0.6260	0.8139
6	-0.63823	1.331438	0.188615	-0.58393	0.387262		0.388231	1.491794	-0.10632	0.12458
	0.5240	0.1844	0.8506	0.5599	0.6989		0.6982	0.1372	0.9154	0.9010
7	-0.94197	0.911016	-0.22064	-0.9795	-0.0681	-0.38823		1.129621	-0.46805	-0.25555
	0.3472	0.3633	0.8256	0.3284	0.9458	0.6982		0.2599	0.6402	0.7985
8	-1.9162	-0.17374	-1.36574	-2.11435	-1.27886	-1.49179	-1.12962		-1.52258	-1.34221
	0.0566	0.8622	0.1734	0.0356	0.2023	0.1372	0.2599		0.1293	0.1809
9	-0.52253	1.383282	0.289267	-0.43168	0.488089	0.10632	0.468045	1.522584		0.223216
	0.6018	0.1680	0.7727	0.6664	0.6260	0.9154	0.6402	0.1293		0.8236
10	-0.7323	1.22623	0.053997	-0.70487	0.235693	-0.12458	0.255552	1.342206	-0.22322	
	0.4648	0.2214	0.9570	0.4816	0.8139	0.9010	0.7985	0.1809	0.8236	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Education	Technical CapabilityC LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	7.87044388	0.33808479	<.0001	1
2	7.74205858	0.20215349	<.0001	2
3	7.39959900	0.26597231	<.0001	3
4	7.67118376	0.75471310	<.0001	4
5	7.75807434	0.46195129	<.0001	5

Least Squares Means for Effect Education
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: TechnicalCapabilityC

i/j	1	2	3	4	5
1		0.341724	1.171069	0.244807	0.201551

		0.7329	0.2428	0.8068	0.8405
2	-0.34172		1.13938	0.091682	-0.03281
	0.7329		0.2558	0.9270	0.9739
3	-1.17107	-1.13938		-0.34558	-0.69655
	0.2428	0.2558		0.7300	0.4868
4	-0.24481	-0.09168	0.345576		-0.09968
	0.8068	0.9270	0.7300		0.9207
5	-0.20155	0.032807	0.696551	0.099678	
	0.8405	0.9739	0.4868	0.9207	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

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The GLM Procedure

Class Level Information

Class	Levels	Values
UrbanClass	2	1 2
FTA	10	1 2 3 4 5 6 7 8 9 10
Education	5	1 2 3 4 5

Number of Observations Read 236
Number of Observations Used 236

Dependent Variable: **WarrtClaimsA WarrtClaimsA**

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	17	67.2686273	3.9569781	1.91	0.0186
Error	218	452.2737456	2.0746502		
Corrected Total	235	519.5423729			

R-Square	Coeff Var	Root MSE	WarrtClaimsA Mean
0.129477	16.51730	1.440365	8.720339

Source	DF	Type I SS	Mean Square	F Value	Pr > F
UrbanClass	1	2.06323310	2.06323310	0.99	0.3198
FTA	9	53.98329848	5.99814428	2.89	0.0030
Education	4	10.36917985	2.59229496	1.25	0.2910
Vehicles	1	0.36463523	0.36463523	0.18	0.6755
Capital	1	0.31558002	0.31558002	0.15	0.6969
Years	1	0.17270060	0.17270060	0.08	0.7732

Source	DF	Type III SS	Mean Square	F Value	Pr > F
UrbanClass	1	0.02285426	0.02285426	0.01	0.9165
FTA	9	54.63213892	6.07023766	2.93	0.0027
Education	4	9.47789165	2.36947291	1.14	0.3376
Vehicles	1	0.00432198	0.00432198	0.00	0.9636
Capital	1	0.28319722	0.28319722	0.14	0.7121
Years	1	0.17270060	0.17270060	0.08	0.7732

Least Squares Means

Urban Class	WarrtClaimsA LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1=LSMean2 t Value	Pr > |t|
1	8.59520144	0.17575810	<.0001	-0.10	0.9165
2	8.62382157	0.25833667	<.0001		

FTA	WarrtClaimsA LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	8.76128129	0.41668055	<.0001	1
2	8.00155624	0.42845675	<.0001	2
3	9.40392559	0.32464555	<.0001	3
4	9.15168900	0.26024787	<.0001	4
5	8.88900516	0.28071984	<.0001	5
6	8.37743394	0.32933703	<.0001	6
7	8.32444571	0.35427376	<.0001	7
8	7.37341612	0.43840884	<.0001	8
9	8.97681674	0.37075085	<.0001	9
10	8.83554522	0.35064946	<.0001	10

Least Squares Means for Effect FTA
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: WarrtClaimsA

i/j	1	2	3	4	5	6	7	8	9	10
1		1.372064	-1.37114	-0.90195	-0.28578	0.786865	0.838457	2.440203	-0.42767	-0.14827
		0.1715	0.1717	0.3681	0.7753	0.4322	0.4027	0.0155	0.6693	0.8823
2	-1.37206		-2.84874	-2.48427	-1.90739	-0.74125	-0.59338	1.056035	-1.86552	-1.65025
	0.1715		0.0048	0.0137	0.0578	0.4593	0.5535	0.2921	0.0635	0.1003
3	1.371141	2.848744		0.709596	1.381337	2.455826	2.36781	3.963577	0.97409	1.312488
	0.1717	0.0048		0.4787	0.1686	0.0148	0.0188	0.0001	0.3311	0.1907
4	0.901953	2.484273	-0.7096		0.807987	2.067621	2.035435	3.770597	0.442322	0.812942
	0.3681	0.0137	0.4787		0.4200	0.0399	0.0430	0.0002	0.6587	0.4171
5	0.285785	1.907392	-1.38134	-0.80799		1.320062	1.310014	3.08429	-0.21638	0.13316
	0.7753	0.0578	0.1686	0.4200		0.1882	0.1916	0.0023	0.8289	0.8942
6	-0.78686	0.741247	-2.45583	-2.06762	-1.32006		0.114652	1.923946	-1.32771	-1.02917
	0.4322	0.4593	0.0148	0.0399	0.1882		0.9088	0.0557	0.1857	0.3045
7	-0.83846	0.593384	-2.36781	-2.03543	-1.31001	-0.11465		1.793285	-1.3426	-1.05355
	0.4027	0.5535	0.0188	0.0430	0.1916	0.9088		0.0743	0.1808	0.2933
8	-2.4402	-1.05603	-3.96358	-3.7706	-3.08429	-1.92395	-1.79328		-2.95382	-2.71419
	0.0155	0.2921	0.0001	0.0002	0.0023	0.0557	0.0743		0.0035	0.0072
9	0.427671	1.865524	-0.97409	-0.44232	0.216382	1.327711	1.342597	2.953815		0.304822
	0.6693	0.0635	0.3311	0.6587	0.8289	0.1857	0.1808	0.0035		0.7608
10	0.148268	1.650248	-1.31249	-0.81294	-0.13316	1.02917	1.053552	2.71419	-0.30482	
	0.8823	0.1003	0.1907	0.4171	0.8942	0.3045	0.2933	0.0072	0.7608	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Education	WarrtClaimsA LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	9.02190427	0.26831255	<.0001	1
2	8.42140378	0.16043407	<.0001	2
3	8.68006887	0.21108228	<.0001	3
4	8.51527077	0.59895920	<.0001	4
5	8.40890982	0.36661610	<.0001	5

Least Squares Means for Effect Education
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: WarrtClaimsA

i/j	1	2	3	4	5
1		2.013997	1.071288	0.7843	1.385407
		0.0452	0.2852	0.4337	0.1673
2	-2.014		-1.08438	-0.153	0.032248
	0.0452		0.2794	0.8785	0.9743
3	-1.07129	1.08438		0.264226	0.6639
	0.2852	0.2794		0.7919	0.5075
4	-0.7843	0.152999	-0.26423		0.153742
	0.4337	0.8785	0.7919		0.8780
5	-1.38541	-0.03225	-0.6639	-0.15374	
	0.1673	0.9743	0.5075	0.8780	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

The SAS System 16:22 Monday, May 2, 2011 1

The GLM Procedure

Class Level Information

Class	Levels	Values
UrbanClass	2	1 2
FTA	10	1 2 3 4 5 6 7 8 9 10
Education	5	1 2 3 4 5

Number of Observations Read	236
Number of Observations Used	236

Dependent Variable: **WarrtClaimsC WarrtClaimsC**

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	17	56.5106568	3.3241563	1.47	0.1094
Error	218	494.6206991	2.2689023		
Corrected Total	235	551.1313559			

R-Square	Coeff Var	Root MSE	WarrtClaimsC Mean
0.102536	17.53744	1.506288	8.588983

Source	DF	Type I SS	Mean Square	F Value	Pr > F
UrbanClass	1	1.05544195	1.05544195	0.47	0.4959
FTA	9	48.84487123	5.42720791	2.39	0.0133
Education	4	5.47658630	1.36914658	0.60	0.6606
Vehicles	1	0.92036017	0.92036017	0.41	0.5249
Capital	1	0.00067488	0.00067488	0.00	0.9863
Years	1	0.21272230	0.21272230	0.09	0.7597

Source	DF	Type III SS	Mean Square	F Value	Pr > F
UrbanClass	1	0.00091687	0.00091687	0.00	0.9840
FTA	9	43.50942443	4.83438049	2.13	0.0281
Education	4	5.26301850	1.31575463	0.58	0.6775
Vehicles	1	0.48772080	0.48772080	0.21	0.6434
Capital	1	0.00003012	0.00003012	0.00	0.9971
Years	1	0.21272230	0.21272230	0.09	0.7597

Least Squares Means

Urban Class	WarrtClaimsC LSMEAN	Standard Error	H0:LSMEAN=0 Pr > |t|	H0:LSMean1=LSMean2 t Value	Pr > |t|
1	8.57882920	0.18380224	<.0001	-0.02	0.9840
2	8.58456165	0.27016029	<.0001		

FTA	WarrtClaimsC LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	8.60598261	0.43575129	<.0001	1
2	7.60905283	0.44806647	<.0001	2
3	9.15847072	0.33950401	<.0001	3
4	9.15941450	0.27215896	<.0001	4
5	8.82328844	0.29356790	<.0001	5
6	8.68182738	0.34441021	<.0001	6
7	7.92866152	0.37048825	<.0001	7
8	8.27384402	0.45847405	<.0001	8
9	8.85111159	0.38771946	<.0001	9
10	8.72530063	0.36669807	<.0001	10

Least Squares Means for Effect FTA
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: WarrtClaimsC

i/j	1	2	3	4	5	6	7	8	9	10
1		1.721659	-1.12719	-1.22263	-0.46495	-0.14867	1.243146	0.558422	-0.4651	-0.22779
		0.0865	0.2609	0.2228	0.6424	0.8819	0.2151	0.5771	0.6423	0.8200
2	-1.72166		-3.00971	-3.2022	-2.49554	-2.02297	-0.56165	-1.06874	-2.27189	-2.1121
	0.0865		0.0029	0.0016	0.0133	0.0443	0.5749	0.2864	0.0241	0.0358
3	1.127194	3.009706		-0.00254	0.859815	1.090436	2.579494	1.651227	0.670303	0.956487
	0.2609	0.0029		0.9980	0.3908	0.2767	0.0106	0.1001	0.5034	0.3399
4	1.222628	3.202204	0.002539		0.988639	1.219563	2.895738	1.795558	0.745692	1.067439
	0.2228	0.0016	0.9980		0.3239	0.2239	0.0042	0.0739	0.4567	0.2870
5	0.464947	2.495537	-0.85982	-0.98864		0.349052	1.985056	1.069208	-0.06556	0.23339
	0.6424	0.0133	0.3908	0.3239		0.7274	0.0484	0.2862	0.9478	0.8157
6	0.148673	2.02297	-1.09044	-1.21956	-0.34905		1.55832	0.747582	-0.35858	-0.09339
	0.8819	0.0443	0.2767	0.2239	0.7274		0.1206	0.4555	0.7203	0.9257
7	-1.24315	0.561649	-2.57949	-2.89574	-1.98506	-1.55832		-0.6224	-1.81534	-1.57028
	0.2151	0.5749	0.0106	0.0042	0.0484	0.1206		0.5343	0.0708	0.1178
8	-0.55842	1.068739	-1.65123	-1.79556	-1.06921	-0.74758	0.622399		-1.01691	-0.80137
	0.5771	0.2864	0.1001	0.0739	0.2862	0.4555	0.5343		0.3103	0.4238
9	0.465104	2.271888	-0.6703	-0.74569	0.06556	0.358575	1.815342	1.016911		0.259582
	0.6423	0.0241	0.5034	0.4567	0.9478	0.7203	0.0708	0.3103		0.7954
10	0.227792	2.112098	-0.95649	-1.06744	-0.23339	0.093391	1.570278	0.801374	-0.25958	
	0.8200	0.0358	0.3399	0.2870	0.8157	0.9257	0.1178	0.4238	0.7954	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Education	WarrtClaimsC LSMEAN	Standard Error	Pr > |t|	LSMEAN Number
1	8.78718625	0.28059275	<.0001	1
2	8.34449115	0.16777685	<.0001	2
3	8.44590949	0.22074315	<.0001	3
4	8.75332114	0.62637251	<.0001	4
5	8.57756910	0.38339548	<.0001	5

Least Squares Means for Effect Education
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: WarrtClaimsC

i/j	1	2	3	4	5
1		1.419759	1.022729	0.050131	0.453015
		0.1571	0.3076	0.9601	0.6510
2	-1.41976		-0.40656	-0.63721	-0.57527
	0.1571		0.6847	0.5247	0.5657
3	-1.02273	0.40656		-0.47131	-0.30824
	0.3076	0.6847		0.6379	0.7582
4	-0.05013	0.637209	0.471311		0.242927
	0.9601	0.5247	0.6379		0.8083
5	-0.45301	0.575272	0.308245	-0.24293	
	0.6510	0.5657	0.7582	0.8083	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

APPENDIX VIII. PROC MDC SAS®9.2 CODING AND OUTPUT

Coding for Conditional Logit Model

```
proc mdc data=VEHICLE;
model decision = Quality Delivery Price TechCap AftSS /
type=clogit
nchoice=3;
id PDM;
run;
```

SAS Output for Conditional Logit Model

The SAS System 13:54 Saturday, April 30, 2011 1

The MDC Procedure

Conditional Logit Estimates

Algorithm converged.

Dependent Variable	Decision
Number of Observations	5232
Number of Cases	15696
Log Likelihood	-4169
Log Likelihood Null (LogL(0))	-5748
Maximum Absolute Gradient	5.51145E-9
Number of Iterations	5
Optimization Method	Newton-Raphson
AIC	8347
Schwarz Criterion	8380

Discrete Response Profile

Index	CHOICE	Frequency	Percent
0	1	2162	41.32
1	2	2334	44.61
2	3	736	14.07

Goodness-of-Fit Measures

Measure	Value	Formula
Likelihood Ratio (R)	3158.7	2 * (LogL - LogL0)
Upper Bound of R (U)	11496	- 2 * LogL0
Aldrich-Nelson	0.3765	R / (R+N)
Cragg-Uhler 1	0.4532	1 - exp(-R/N)
Cragg-Uhler 2	0.5099	(1-exp(-R/N)) / (1-exp(-U/N))
Estrella	0.5063	1 - (1-R/U)^(U/N)
Adjusted Estrella	0.505	1 - ((LogL-K)/LogL0)^(-2/N*LogL0)
McFadden's LRI	0.2748	R / U
Veall-Zimmermann	0.5478	(R * (U+N)) / (U * (R+N))

N = # of observations, K = # of regressors

Parameter Estimates

Parameter	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Quality	1	0.6818	0.0230	29.63	<.0001
Delivery	1	0.2433	0.0216	11.28	<.0001
Price	1	-0.7246	0.0232	-31.26	<.0001
TechCap	1	0.4411	0.0221	19.92	<.0001
AftSS	1	0.6780	0.0230	29.49	<.0001

Coding for Two-Way Interaction Conditional Logit Model

```
proc mdc data=VEHICLEINT;
```

```
model decision = Quality Delivery Price TechCap AftSS QD QP QT QA DP DT DA PT PA TA /
type=clogit
nchoice=3;
id PDM;
run;
```

SAS Output for Two-Way Interaction Conditional Logit Model

The SAS System
15:30 Wednesday, May 18, 2011 1

The MDC Procedure

Conditional Logit Estimates

Algorithm converged.

Model Fit Summary

Dependent Variable	Decision
Number of Observations	5232
Number of Cases	15696
Log Likelihood	-4130
Log Likelihood Null (LogL(0))	-5748
Maximum Absolute Gradient	8.593E-9
Number of Iterations	5
Optimization Method	Newton-Raphson
AIC	8289
Schwarz Criterion	8387

Discrete Response Profile

Index	CHOICE	Frequency	Percent
0	1	2162	41.32
1	2	2334	44.61
2	3	736	14.07

Goodness-of-Fit Measures

Measure	Value	Formula
Likelihood Ratio (R)	3236.9	2 * (LogL - LogL0)
Upper Bound of R (U)	11496	- 2 * LogL0
Aldrich-Nelson	0.3822	R / (R+N)
Cragg-Uhler 1	0.4613	1 - exp(-R/N)
Cragg-Uhler 2	0.519	(1-exp(-R/N)) / (1-exp(-U/N))
Estrella	0.5164	1 - (1-R/U)^(U/N)
Adjusted Estrella	0.5126	1 - ((LogL-K)/LogL0)^(-2/N*LogL0)
McFadden's LRI	0.2816	R / U
Veall-Zimmermann	0.5562	(R * (U+N)) / (U * (R+N))

N = # of observations, K = # of regressors

The SAS System 15:30 Wednesday, May 18, 2011 2

The MDC Procedure

Conditional Logit Estimates

Parameter Estimates

Parameter	DF	Estimate	Standard Error	t Value	Approx Pr > |t|
Quality	1	0.7174	0.0242	29.60	<.0001
Delivery	1	0.2673	0.0233	11.49	<.0001

Price	1	-0.7831	0.0245	-31.92	<.0001
TechCap	1	0.4561	0.0237	19.23	<.0001
AftSS	1	0.7120	0.0242	29.37	<.0001
QD	1	-0.0915	0.0356	-2.57	0.0102
QP	1	0.1920	0.0367	5.23	<.0001
QT	1	-0.0689	0.0359	-1.92	0.0549
QA	1	-0.0872	0.0362	-2.41	0.0158
DP	1	0.0623	0.0357	1.74	0.0814
DT	1	-0.0396	0.0348	-1.14	0.2548
DA	1	-0.0679	0.0357	-1.90	0.0569
PT	1	0.1084	0.0361	3.00	0.0027
PA	1	0.2246	0.0369	6.08	<.0001
TA	1	0.0155	0.0356	0.44	0.6632

APPENDIX IX. PROC PHREG SAS®9.2 CODING AND OUTPUT

Coding for Conditional Logit Model

```
proc phreg data=VEHICLE outest=betas;
strata PDM;
model decision*decision(2) = Quality Delivery Price TechCap AftSS;
run;
```

SAS Output for Conditional Logit Model

The SAS System 20:37 Monday, May 23, 2011 1

The PHREG Procedure

Model Information

Data Set	WORK.VEHICLE
Dependent Variable	Decision Decision
Censoring Variable	Decision Decision
Censoring Value(s)	2
Ties Handling	BRESLOW

Number of Observations Read	15696
Number of Observations Used	15696

Summary of the Number of Event and Censored Values

Stratum	PDM	Total	Event	Censored	Percent Censored
1	1	48	16	32	66.67
2	2	48	16	32	66.67
3	3	48	16	32	66.67
4	4	48	16	32	66.67
5	5	48	16	32	66.67
6	6	48	16	32	66.67
7	7	48	16	32	66.67
8	8	48	16	32	66.67
9	9	48	16	32	66.67
10	10	48	16	32	66.67
11	11	48	16	32	66.67
12	12	48	16	32	66.67
13	13	48	16	32	66.67
14	14	48	16	32	66.67
15	15	48	16	32	66.67
16	16	48	16	32	66.67
17	17	48	16	32	66.67
18	18	48	16	32	66.67
19	19	48	16	32	66.67
20	20	48	16	32	66.67
21	21	48	16	32	66.67
22	22	48	16	32	66.67
23	23	48	16	32	66.67
24	24	48	16	32	66.67
25	25	48	16	32	66.67
26	26	48	16	32	66.67
27	27	48	16	32	66.67
28	28	48	16	32	66.67
29	29	48	16	32	66.67
30	30	48	16	32	66.67
31	31	48	16	32	66.67
32	32	48	16	32	66.67
33	33	48	16	32	66.67
34	34	48	16	32	66.67
35	35	48	16	32	66.67
36	36	48	16	32	66.67
37	37	48	16	32	66.67
38	38	48	16	32	66.67
39	39	48	16	32	66.67
40	40	48	16	32	66.67
41	41	48	16	32	66.67
42	42	48	16	32	66.67
43	43	48	16	32	66.67
44	44	48	16	32	66.67
45	45	48	16	32	66.67
46	46	48	16	32	66.67

47	47	48	16	32	66.67
48	48	48	16	32	66.67
49	49	48	16	32	66.67
50	50	48	16	32	66.67
51	51	48	16	32	66.67
52	52	48	16	32	66.67
53	53	48	16	32	66.67
54	54	48	16	32	66.67
55	55	48	16	32	66.67
56	56	48	16	32	66.67
57	57	48	16	32	66.67
58	58	48	16	32	66.67
59	59	48	16	32	66.67
60	60	48	16	32	66.67
61	61	48	16	32	66.67
62	62	48	16	32	66.67
63	63	48	16	32	66.67
64	64	48	16	32	66.67
65	65	48	16	32	66.67
66	66	48	16	32	66.67
67	67	48	16	32	66.67
68	68	48	16	32	66.67
69	69	48	16	32	66.67
70	70	48	16	32	66.67
71	71	48	16	32	66.67
72	72	48	16	32	66.67
73	73	48	16	32	66.67
74	74	48	16	32	66.67
75	75	48	16	32	66.67
76	76	48	16	32	66.67
77	77	48	16	32	66.67
78	78	48	16	32	66.67
79	79	48	16	32	66.67
80	80	48	16	32	66.67
81	81	48	16	32	66.67

82	82	48	16	32	66.67
83	83	48	16	32	66.67
84	84	48	16	32	66.67
85	85	48	16	32	66.67
86	86	48	16	32	66.67
87	87	48	16	32	66.67
88	88	48	16	32	66.67
89	89	48	16	32	66.67
90	90	48	16	32	66.67
91	91	48	16	32	66.67
92	92	48	16	32	66.67
93	93	48	16	32	66.67
94	94	48	16	32	66.67
95	95	48	16	32	66.67
96	96	48	16	32	66.67
97	97	48	16	32	66.67
98	98	48	16	32	66.67
99	99	48	16	32	66.67
100	100	48	16	32	66.67
101	101	48	16	32	66.67
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321	321	48	16	32	66.67
322	322	48	16	32	66.67
323	323	48	16	32	66.67
324	324	48	16	32	66.67
325	325	48	16	32	66.67
326	326	48	16	32	66.67
327	327	48	16	32	66.67
Total		15696	5232	10464	66.67

Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Without Covariates	With Covariates
-2 LOG L	40500.505	37953.238
AIC	40500.505	37963.238
SBC	40500.505	37996.051

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	2547.2672	5	<.0001
Score	2607.3149	5	<.0001
Wald	2652.2805	5	<.0001

Analysis of Maximum Likelihood Estimates

Parameter Standard Hazard

Parameter	DF	Estimate	Error	Chi-Square	Pr > ChiSq	Ratio	Label
Quality	1	0.43586	0.01727	637.1610	<.0001	1.546	Quality
Delivery	1	0.14067	0.01624	75.0691	<.0001	1.151	Delivery
Price	1	-0.47201	0.01746	730.9423	<.0001	0.624	Price
TechCap	1	0.26185	0.01654	250.6972	<.0001	1.299	TechCap
AftSS	1	0.43275	0.01725	629.2341	<.0001	1.541	AftSS

Coding for Two-Way Interaction Conditional Logit Model

```
proc phreg data=VEHICLE outest=betas;
strata PDM;
model decision*decision(2) = Quality Delivery Price TechCap AftSS QD QP QT QA DP DT DA PT PA TA;
run;
```

SAS Output for Two-Way Interaction Conditional Logit Model

The SAS System 10:36 Tuesday, May 24, 2011 1

The PHREG Procedure

Model Information

Data Set	WORK.VEHICLE	
Dependent Variable	Decision	Decision
Censoring Variable	Decision	Decision
Censoring Value(s)	2	
Ties Handling	BRESLOW	
Number of Observations Read	15696	
Number of Observations Used	15696	

Summary of the Number of Event and Censored Values

Stratum	PDM	Total	Event	Censored	Percent Censored
1	1	48	16	32	66.67
2	2	48	16	32	66.67
3	3	48	16	32	66.67
4	4	48	16	32	66.67
5	5	48	16	32	66.67
6	6	48	16	32	66.67
7	7	48	16	32	66.67
8	8	48	16	32	66.67
9	9	48	16	32	66.67
10	10	48	16	32	66.67
11	11	48	16	32	66.67
12	12	48	16	32	66.67
13	13	48	16	32	66.67
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231	231	48	16	32	66.67
232	232	48	16	32	66.67
233	233	48	16	32	66.67
234	234	48	16	32	66.67
235	235	48	16	32	66.67
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237	237	48	16	32	66.67
238	238	48	16	32	66.67
239	239	48	16	32	66.67
240	240	48	16	32	66.67
241	241	48	16	32	66.67
242	242	48	16	32	66.67
243	243	48	16	32	66.67
244	244	48	16	32	66.67
245	245	48	16	32	66.67
246	246	48	16	32	66.67
247	247	48	16	32	66.67
248	248	48	16	32	66.67
249	249	48	16	32	66.67
250	250	48	16	32	66.67
251	251	48	16	32	66.67
252	252	48	16	32	66.67
253	253	48	16	32	66.67
254	254	48	16	32	66.67
255	255	48	16	32	66.67
256	256	48	16	32	66.67
257	257	48	16	32	66.67
258	258	48	16	32	66.67
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263	263	48	16	32	66.67
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267	267	48	16	32	66.67
268	268	48	16	32	66.67
269	269	48	16	32	66.67
270	270	48	16	32	66.67
271	271	48	16	32	66.67
272	272	48	16	32	66.67
273	273	48	16	32	66.67
274	274	48	16	32	66.67
275	275	48	16	32	66.67
276	276	48	16	32	66.67
277	277	48	16	32	66.67
278	278	48	16	32	66.67
279	279	48	16	32	66.67
280	280	48	16	32	66.67
281	281	48	16	32	66.67
282	282	48	16	32	66.67
283	283	48	16	32	66.67

284	284	48	16	32	66.67
285	285	48	16	32	66.67
286	286	48	16	32	66.67
287	287	48	16	32	66.67
288	288	48	16	32	66.67
289	289	48	16	32	66.67
290	290	48	16	32	66.67
291	291	48	16	32	66.67
292	292	48	16	32	66.67
293	293	48	16	32	66.67
294	294	48	16	32	66.67
295	295	48	16	32	66.67
296	296	48	16	32	66.67
297	297	48	16	32	66.67
298	298	48	16	32	66.67
299	299	48	16	32	66.67
300	300	48	16	32	66.67
301	301	48	16	32	66.67
302	302	48	16	32	66.67
303	303	48	16	32	66.67
304	304	48	16	32	66.67
305	305	48	16	32	66.67
306	306	48	16	32	66.67
307	307	48	16	32	66.67
308	308	48	16	32	66.67
309	309	48	16	32	66.67
310	310	48	16	32	66.67
311	311	48	16	32	66.67
312	312	48	16	32	66.67
313	313	48	16	32	66.67
314	314	48	16	32	66.67
315	315	48	16	32	66.67
316	316	48	16	32	66.67
317	317	48	16	32	66.67
318	318	48	16	32	66.67
319	319	48	16	32	66.67
320	320	48	16	32	66.67
321	321	48	16	32	66.67
322	322	48	16	32	66.67
323	323	48	16	32	66.67
324	324	48	16	32	66.67
325	325	48	16	32	66.67
326	326	48	16	32	66.67
327	327	48	16	32	66.67
	Total	15696	5232	10464	66.67

Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Without Covariates	With Covariates
-2 LOG L	40500.505	37360.204
AIC	40500.505	37390.204
SBC	40500.505	37488.642

Testing Global Null Hypothesis: BETA=0

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	3140.3014	15	<.0001
Score	2628.0986	15	<.0001
Wald	2317.5518	15	<.0001

Analysis of Maximum Likelihood Estimates

Parameter	DF	Parameter Estimate	Standard Error	Chi-Square	Pr > ChiSq	Hazard Ratio	Label
Quality	1	0.68535	0.02332	864.0539	<.0001	1.984	Quality
Delivery	1	0.24878	0.02231	124.3657	<.0001	1.282	Delivery
Price	1	-0.75053	0.02361	1010.8988	<.0001	0.472	Price
TechCap	1	0.42415	0.02257	353.1572	<.0001	1.528	TechCap
AftSS	1	0.68067	0.02335	849.5317	<.0001	1.975	AftSS
QD	1	-0.08978	0.01780	25.4363	<.0001	0.914	QD

QP	1	0.27005	0.02055	172.7425	<.0001	1.310	QP
QT	1	-0.14049	0.01836	58.5246	<.0001	0.869	QT
QA	1	-0.22310	0.01980	127.0199	<.0001	0.800	QA
DP	1	0.08804	0.01815	23.5207	<.0001	1.092	DP
DT	1	-0.05111	0.01658	9.5018	0.0021	0.950	DT
DA	1	-0.08321	0.01776	21.9503	<.0001	0.920	DA
PT	1	0.15711	0.01877	70.0870	<.0001	1.170	PT
PA	1	0.28048	0.02065	184.5757	<.0001	1.324	PA
TA	1	-0.11741	0.01826	41.3434	<.0001	0.889	TA