Foreword

The U.S. non-rail vehicle (bus) manufacturing industry faces extreme challenges today. In the last decade, no fewer than ten manufacturers have either reorganized or gone out-of-business. Today, the financial condition of most bus manufacturers is tenuous at best. Presented as a stand-alone report to the Federal Transit Administration (FTA), the purpose of this publication is to provide an exploratory evaluation of the viability of the U.S. bus manufacturing industry to meet the demand for fixed-route transit buses. This study is available to all interested readers but includes information particularly salient to federal transportation officials, transit agency representatives, and bus manufacturing industry professionals.

The study includes a market overview analysis and results from surveys, questionnaires, and interviews with nine representative U.S. transit agencies and four U.S. bus manufacturers. The first two chapters of the report provides the background and overview of the current U.S. transit bus industry as well as trends that impact the bus market. The third chapter presents key findings and perspectives provided by study participants. The fourth chapter provides a summary and conclusions of the study.

Acknowledgements

This research would not have been possible without the support of the nine transit agencies and four bus manufacturers that graciously participated in this study. All of the transit agency executives and the bus company executives shared valuable perspectives, information, and experiences that were useful in analyzing the current state of the public transit bus market. The insights presented in this study will be useful for reviewing existing, and creating new, FTA policies and initiatives related to the transit bus market.

Disclaimer/Notice

The primary research — information provided by nine transit agencies and four bus manufacturers — is an essential element of this report. While the FTA deems the nine transit agencies as representative — small, medium-sized, and large agencies from various geographic regions in the U.S. — nevertheless, nine out of 5,804 public transportation agencies in the U.S. does not provide exhaustive information. Commentary provided by transit agency survey respondents has not been attributed to specific individuals or agencies in order to comply with the non-disclosure statement that was printed on the survey instrument.

The financial data and other company information, as well as the verbatim commentary, provided by the bus manufacturers are summarized, analyzed and presented in such a way that the protection of proprietary data is assured. While this report lists the participating companies, specific references to sources of information, data, or attributed comments have been avoided.

Executive Summary

Currently, only four manufacturers account for most of the transit bus production in the United States. Nevertheless, buses represent the largest single mode of public transportation. In order to investigate the viability of the U.S. transit bus manufacturing market, this study examined a variety of reference sources on the topic and conducted surveys and interviews with representative transit agencies and bus manufacturers.

A general consensus emerged from the study that the viability of the U.S. bus manufacturing industry is at risk. Increasingly, the ability of bus manufacturers to meet the demands of public bus transit has diminished. Research related to the needs of transit agencies, with respect to non-rail vehicles, demonstrated that a variety of factors influence the purchasing decisions of transit agencies, including fleet size, vehicle age, service needs, and financial capacity. Vehicle types and sizes that are critical for current and future operations of transit agencies reflect each agency's operating environments, including service area climate, population size, and community needs. In addition, new technology that addresses fuel economy and environmental requirements is also considered an important factor for driving purchasing decisions, particularly decisions made by large transit agencies. The inter-related issues of maintenance, technical training, implementation of new technology/alternative fuel sources, as well as budgetary constraints, pose challenges for transit agencies. The diversified needs and challenges of the transit agencies, in turn, have gravely impacted the bus manufacturers and their ability to meet the market demands.

Needless to say, the bus manufacturers have expressed serious concerns regarding the state of the industry. The fluctuation in demand and the general lack of volume in orders and purchases of transit buses threaten the bus manufacturing business. Various issues — such as procurement and contracting, warranties, the *Buy America* policy, funding, and demand for new technologies — have compounded the difficulties faced by bus manufacturers today. In addition, costs of doing business have become increasingly high, specifically materials and fuel prices and healthcare costs. Requirements such as the Altoona Bus Test, 12-year/500,000 mile service life, and the 2007 and 2010 emissions standards also pose major challenges for the bus manufacturers.

Research results suggest that the current crisis faced by the transit bus industry must be addressed immediately. Expanded examination of specific issues relating to public transit needs and trends will enhance FTA's ability to assess policies and develop new initiatives in order to respond to the increasing demands of the transit bus industry.

Introduction

Thirteen bus manufacturers produce roughly six thousand buses (non-rail vehicles) annually to meet the U.S. demand. During the past decade, not fewer than ten bus manufacturers serving the U.S. transit market have reorganized or gone out-of-business. Currently, only four manufacturers account for most of the transit bus production in the United States. Nevertheless, buses represent the largest single mode of public transportation. Buses, in the U.S. transit market, range from the traditional transit buses (35 – 40 ft.) to the larger articulated buses and include the 30-ft. or smaller buses. The Federal Transit Administration (FTA) partially funds the purchase of most of these vehicles through grants. Transit, suburban and intercity buses are used in local, feeder, express and limited stop service.

Objective and Methodology

The objective of the study is to provide an exploratory evaluation of the viability of the U.S. bus manufacturing industry to meet U.S. demand for fixed-route transit buses. The study focuses on market factors (i.e. types and sizes of buses, propulsion systems, new [or required] technologies); status or "health" of bus manufacturers to supply U.S. transit agency demand; and the impact of federal programs/legislation (i.e. *Buy America* policy and pooled procurement).

The strategic approach to the study included developing and documenting an understanding of the non-rail vehicle market from the perspectives of nine representative U.S. transit agencies and four major U.S. bus manufacturers. Both primary and secondary research was conducted for this study starting in May 2005 and concluding in November 2005.

Initially, secondary research was conducted from May 2005 through June 2005 to provide a market overview featuring data derived primarily from electronic and published sources of information, including industry journals and publications, conference presentations, Internet website information, brochures, press releases, and newspaper articles. The research focused on determining:

1. Key trends, vehicle segmentation, principal types and characteristics of buses, technologies, as well as bus service, that drive local transit agency decisions to purchase buses
2. Issues affecting U.S. bus manufacturers and major bus products being produced

Secondly, primary research was conducted from July 2005 through early November 2005 — a survey of nine representative U.S. transit agencies, and surveys of, and interviews with, four representative U.S. bus manufacturers.

1. Transit Agency Research — FTA sent a letter of introduction to the nine selected transit agencies asking for their participation in the study. On July 22, 2005, surveys

were transmitted electronically to the agencies' general managers and procurement executives. The survey instrument focused on the agencies' bus operations and procurements, covering topics related to bus fleet size and types, new purchases and deliveries, bus services and needs, new technologies, and procurement issues. The selected agencies represent all sizes of transit agencies/communities (small, middle-sized and large), as well as the various geographic areas of the United States. By August 22, 2005, all nine agencies had completed and returned the surveys. Responses that required further clarification or additional information were followed up by e-mail inquiries and/or by telephone. Tabulations and analysis of the results are presented in this report. The transit agencies that were surveyed included (in alphabetical order):

- Charlotte Area Transit System (CATS) — Charlotte, North Carolina
- Chittenden County Transportation Authority (CCTA) — Burlington, Vermont
- City of Jackson Transit System (JATRAN) — Jackson, Mississippi
- City of Phoenix Public Transit Department (ValleyMetro) — Phoenix, Arizona
- Indianapolis Public Transportation Corporation (IndyGo) — Indianapolis, Indiana
- King County Department of Transportation (King County Metro) — Seattle, Washington
- Miami-Dade Transit (MDT) — Miami, Florida
- MTA New York City Transit (NYCT) — New York, New York
- Santa Fe Trails/City of Santa Fe — Santa Fe, New Mexico

2. Bus Manufacturer Research — Primary research of the bus manufacturers consisted of two components. The first component was a survey that was distributed to the four FTA-selected bus manufacturers. The survey included assessment of trends, financial performance, production capacity, production utilization, and investment in innovative or new technologies. The second component consisted of face-to-face interviews with executives of the respective manufacturers, conducted between August 11 and November 9, 2005. The interviews included the bus manufacturers' perspectives on the impact of federal policy, specifically the *Buy America* provision and pooled procurements. In order to assure the protection of proprietary data, bus manufacturers received a Confidentiality Statement. Tabulation and analysis of the collected survey data and interview responses are included as integral aspects of this report; the representative manufacturers included (in alphabetical order):

   - DaimlerChrysler Commercial Buses N.A. (Orion) — Greensboro, North Carolina (Interview date: September 19, 2005)
   - Gillig Corporation — Hayward, California (Interview date: August 11, 2005)
   - New Flyer Industries, Inc. — Dallas, Texas (Interview date: September 28, 2005)
   - North American Bus Industries — Anniston, Alabama (Interview date: November 9, 2005)

Scope of Study

By providing an exploratory evaluation of the viability of the U.S. bus manufacturing industry to meet the demand for fixed-route transit buses, this study serves as a starting point for a more thorough review of current FTA policies that impact bus procurement and bus manufacturers, as well as for determining areas for further research. The primary and secondary research results are useful in gaining a general understanding of the current issues faced by transit agencies, with regard to buses and bus procurement, and bus manufacturers.

Needless to say, various political, economic, social and technological factors affect every mode of transportation in the U.S. While this study touches on some aspects of these factors, it is not an exhaustive analysis due to the realities of the scope and the budget. The scope of study focuses primarily on addressing key elements of the financial issues of bus manufacturing, procurement of buses, and federal policy, specifically on *Buy America* and pooled purchasing.

Organization of Content

The overall organization of the study is based on the market overview analysis and questionnaire and interview results. The first chapter of the report provides the background and overview of the current U.S. transit bus industry as well as trends that impact the bus market. The second chapter presents key findings and perspectives provided by study participants. The third chapter focuses on the competitive landscape affecting the bus manufacturing industry. The fourth chapter provides a summary and conclusions of the study.

The *Market Overview* chapter is divided into two parts that provide background and trends seen among transit agencies and bus manufacturers respectively. The first part presents a frame of reference with which to view bus transit in comparison to other modes of transit as well as highlighted trends in transit agencies' bus transit spending, including purchasing, operations, and maintenance. This section also reviews key trends in types of bus vehicles, fixed-route service types, fuel and propulsion systems, as well as technology. The second part provides a background with which to understand the changes and resultant instability encountered by the bus manufacturers. This section also reviews non-rail transit vehicle production over the last five years and provides an overview of transit vehicle production by vehicle type, vehicle production by fuel and propulsion system, and new technologies emerging in transit bus manufacturing.

The chapter entitled *Transit Agency Survey Results and Manufacturer Questionnaire and Interview Results* presents key findings and perspectives provided by the study participants. The chapter includes the transit agencies' responses to questions related to bus operations and procurement, including bus fleet size and type, new purchases and delivery, bus services and needs, new technology, and procurement issues. This chapter also includes valuable data and insights provided by the four bus manufacturers that participated in the study. Information includes the manufacturers' financial performance

data as well as perspectives of company executives. These research findings allow a close look at the current status of the transit manufacturing market and the challenges faced by the industry today.

The *Competitive Landscape for Transit Bus Manufacturers in the United States* chapter provides a theoretical analysis of the research and interview findings of the study. The chapter examines the dynamics between various competitive forces that influence the viability of the U.S. transit bus manufacturing industry. Various topics, including issues related to contracting, suppliers, competition from other transportation modes, and industry competition are discussed.

The *Summary and Conclusion* chapter presents a synopsis of principal observations derived from this study. This chapter summarizes key findings presented in the *Market Overview* and reviews highlighted similarities and differences in perspectives and experiences of the study participants (bus manufacturers and transit agencies). In addition, the chapter summarizes current and future demands and challenges with respect to the bus industry. The chapter concludes by recommending further study of issues that pose particular concerns for the transit bus industry today.

Non-Rail Vehicle Market Overview

A review of published and electronic sources suggests that U.S. non-rail vehicle (bus) manufacturers are facing significant challenges. These challenges threaten the manufacturers' ability to provide the types and quantities of buses that are required by U.S. public transit systems. The main objective of this chapter is to present an overview and background on the current status, trends, and issues associated with the transit bus market.

Background and Trends — Transit Agencies

Profile of Bus Transit

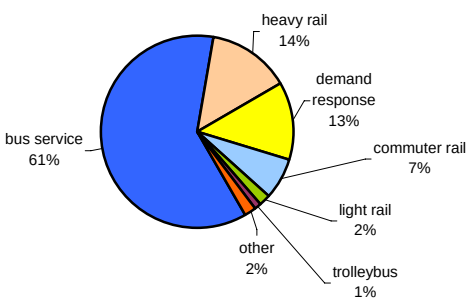
In the United States, there are 5,804 public transportation agencies.[1] These transit systems provide transportation for the public and support the U.S. economy by creating employment opportunities for officials, operators and other transit staff, as well as for myriad contractors, suppliers, manufacturers and others involved in supplying transit-related goods and services. Cities and towns across America are benefiting by the economic multiplier effect broadly described as transit-oriented development (TOD).

Currently, 1,982 transit agencies in the nation operate buses.[2] Although more agencies operate demand response vehicles (as seen in Figure 1) than buses, in terms of specific modes of public transportation employing and benefiting the largest number of Americans, bus transit leads all other modes. New York City Transit operates 4,483 buses, the largest bus fleet in North America.[3]

Figure 1: Public Transportation Mode	No. of Agencies Operating
Demand response	5,346
Bus	1,982
Vanpool	70
Ferryboat	46
Light rail	27
Commuter rail	21
Heavy Rail	14
Automated guideway transit	7
Trolleybus	4
Other (aerial tramway, inclined plane, monorail, cable car)	9
TOTAL* (Not the sum of modes because some agencies operate more than one mode.)	5,804*

Source: *Public Transportation Fact Book. 2005.*

Figure 2: Percentage of Employees per Vehicle Mode



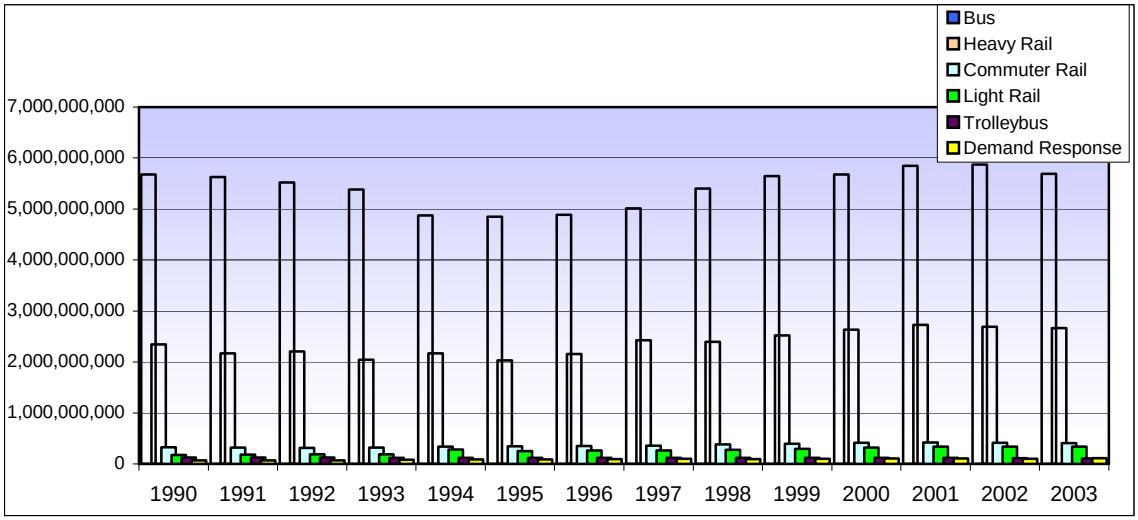
Source: *Public Transportation Fact Book. 2005.*

Recent statistics, published by APTA in 2005 show that approximately 214,000 of the nation's 351,000 public transportation employees are involved in some capacity of bus service.[4] Figure 2 depicts the percentage of employees per vehicle mode.

Since 1990, bus passengers have made approximately 4.8 to 5.8 billion unlinked trips annually. Other transportation modes have experienced more growth in terms

of numbers of annual unlinked passenger trips; nevertheless, total numbers of unlinked bus trips far exceed any other mode of public transit as depicted in Figure 3.[5]

Figure 3: Unlinked Passenger Trips by Mode



Source: *Public Transportation Fact Book. 2005.*

Bus Purchases and Operating Costs

According to the most recent available statistics in APTA's 2005 *Public Transportation Fact Book*, annual U.S. expenditures on transit bus purchases exceeded $1.77 billion in 2003, representing an increase of nearly $400 million (more than 30%) compared to 2002 expenditures of approximately $1.38 billion.

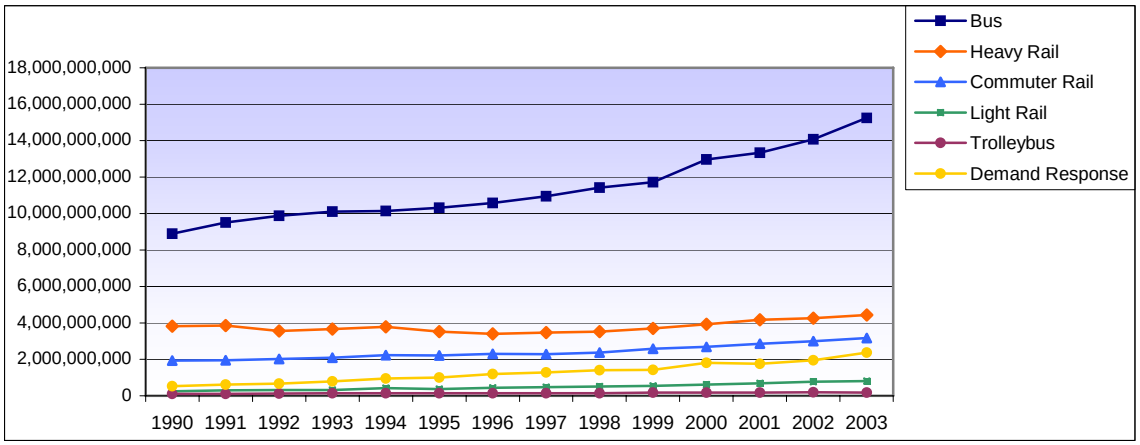
Although fleet purchases are costly, maintenance and vehicle operations costs are significantly greater than purchasing expenditures. The following chart, Figure 4, highlights transit agency bus purchase expenditures as well as vehicle maintenance and operations costs. Costs in all three areas rose over the five-year period (1999-2003); however, annual expenditures associated with vehicle operations increased the most from approximately $5.9 billion in 1999 to nearly $7.7 billion by 2003.

Figure 4: National Cost Totals for Vehicles, Operations & Maintenance[6]

BUS	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
Purchased Transportation	$1,150,075,000	$1,270,794,000	$1,389,410,000	$1,383,734,000	$1,778,668,000
Vehicle Operations	$5,896,392,000	$6,586,878,300	$6,745,100,000	$7,115,582,000	$7,658,222,000
Vehicle Maintenance	$2,331,423,000	$2,591,066,900	$2,555,911,000	$2,695,856,000	$2,857,571,000

In order to meet public demand for bus service, transit agencies spend vast sums on operating costs. Nationwide, annual expenditures on bus operations exceed annual operations costs for other modes, and the costs of bus operations have been rising every year. In 2003, APTA reported that total annual operating expenses for buses exceeded $15 billion, representing, nearly 58% of the total operating expenses incurred within public transportation. This represents a significant increase from 1990 annual operating expenses of $8.9 billion in 2003.[7] (Although inflation naturally accounts for part of the increase; adjusted figures based on the Consumer Price Index[*] indicate that the 2003 equivalent of $8.9 billion in 1990 would be approximately $12.5 billion — several billion dollars less than the actual sum of the 2003 total operating expenses.[8]) Figure 5 graphs total operating expenses by vehicle mode based on APTA data.[♦]

Figure 5: Operating Expenses by Mode from 1990-2003



Source: *Public Transportation Fact Book*. 2005.

As measured by APTA, "total operating expenses" reflect many variables such as vehicle operations and maintenance, general administration, and purchased transportation.[9] Among the variables identified by APTA that impact bus operating expenses, the category of "salaries, wages and fringes" was most significant in 2003. Of the $15 billion spent in 2003, salaries, wages and fringes accounted for 83% of vehicle operating expenses for agencies that offer bus service – an increase by 60% since 1990. Purchased transportation was another significant expense - for agencies that substitute or supplement existing fleets - accounting for approximately 13% of operating expenses.

The impact of increased fuel prices is a significant change since 2003 (when the latest statistics were released by APTA). In 2003, APTA reported that fuel and lubricants accounted for approximately 6% of vehicle operating expenses. Although exact figures

[*] Using the Consumer Price Index, the 1990 figure $8,903,100,000 equates to $12,535,200,245.68 in 2003 dollars.

[♦] "Total operating expenses" are published annually in APTA's *Public Transportation Fact Book* and can be tabulated as the sum of one of two categories ("b" or "c"). Category "b" includes salaries and wages, fringe benefits, services, materials and supplies, utilities, casualty and liability, and purchased transportation. Category "c" includes purchased transportation, vehicle operations, vehicle maintenance, non-vehicle maintenance, and general administration.

are not yet available, fuel and lubricant prices undoubtedly have increased significantly between 2003 and the date of this report. For example, diesel fuel has increased from $1.50 per gallon during the week of January 20, 2003 to $2.48 during the same week of 2005. In fact, diesel fuel currently is $0.55 per gallon higher than this time last year.[10]

Bus Vehicle Types in Public Transit

The American Public Transportation Association provides the following definitions of bus vehicle types used by transit agencies across the U.S.[11] (The vehicle types exclude double decked buses, vans, and automobiles that were not included in this study.)

Articulated Buses
Typically, articulated buses are 54- to 60-ft.-long vehicles with two connected passenger compartments. The buses have long and continuous interiors, with the rear bodies connected to the main body of the buses by joint mechanisms.

Intercity Buses
Intercity buses have one door at the front of the vehicle, separate luggage compartments, high-backed seats and restroom facilities for high-speed and long-distance operations. 40- and 45-ft buses typically are used by the largest transit agencies for express and limited-stop services.

45-ft., 40-ft., 35-ft. and 30-ft. Transit Buses — 40-ft. transit buses are the most common size non-rail vehicle in the U.S. Transit buses make frequent stops and usually have doors at the front and middle of the vehicle, low-back seating, no luggage compartments, and no restroom facilities.

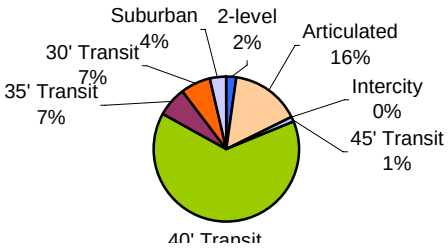
Suburban Buses
Like the intercity buses, suburban buses have one door at the front of the vehicle and high-backed seats. However, these buses do not usually have any luggage compartments or restroom facilities. Suburban buses typically are used for long-distance runs with limited stops.

Trolley Replica (Trolley)
Trolley replicas are transit vehicles with interiors and exteriors that are designed to resemble streetcars from the early Twentieth Century. Trolley replicas usually are shorter in length than other non-rail vehicles (22 to 32-ft.) and commonly are used for tourist-oriented circulator or shuttle services in historic districts.

Trolleybuses
Trolley buses are rubber-tired vehicles, operating on city streets, propelled by electric power through overhead lines.

Trends in Types of Bus Vehicles

Figure 6: Types of New Buses On Order in January 2005



Source: *Public Transportation Fact Book*. 2005.

There are a number of factors and variables related to vehicle operations, maintenance and purchasing. Bus vehicle type has a significant impact on concomitant costs. Naturally, transit agency systems and service types in the U.S. require variable bus vehicle types in terms of length, number of seats, and other distinguishing features such as "kneeling" capability and varying floor depths. Figure 6 highlights trends in terms of non-rail vehicle orders based on length.

The 40-ft. bus (ranging between 37'6" and 42'5") is the most prevalent bus size for U.S. transit agencies based on the number of buses built and number of orders per year. APTA's most recent data (depicted in Figure 6) underscores the high demand for 40-ft. buses in comparison to other sizes.

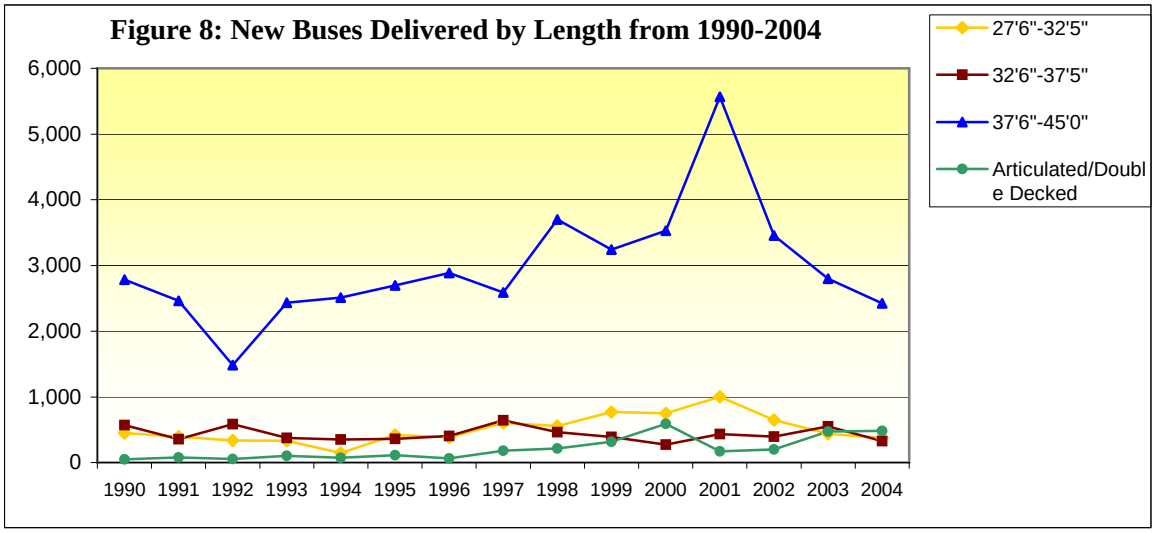
Despite the popularity of 40-ft. buses, the number of annual orders dropped significantly between January 2004 and January 2005 (as depicted in Figure 7). However, lower demand is not limited to this size category — the number of vehicles on order in 2005 decreased for most bus categories (with the exception of 30-ft. buses and small vehicles).

Figure 7: National Quantity-Ordered Figures for Different Vehicle Types[12]

Vehicle Type	Quantity on Order (January 2000)	Quantity on Order (January 2001)	Quantity on Order* (January 2002)	Quantity on Order (January 2004)	Quantity on Order (January 2005)
Articulated (55'-61')	795	305	803	857	368
Intercity (35'-45')	61	28	790	22	2
45' Transit (45')	202	145	170	108	25
40' Transit (37'6"-42'5")	6,103	6,045	3,490	2,143	1,510
35' Transit (32'6"-37'5")	222	307	424	197	157
30' Transit (27'6"-32'5")	553	511	240	114	161
Suburban (27'6-45')	13	10	25	225	84
Trolley replica (all lengths)	16	16	6	1	13
Small Vehicle (<27'6")	109	242	118	42	125

* Data from the 2005 and 2004 APTA *Fact Books* has statistics on bus orders from 2004 and 2005; however, data from the 2003-2001 books do not have data that corresponds to the same year. Bus order data in the 2003-2001 books reflects information from the prior year in each case.

Taking into account the number of annual bus orders, (as well as bus deliveries by vehicle type) is a means of measuring trends in bus procurement and product delivery. Generally, a certain amount of lag-time is expected between the time that a bus is ordered and the time of delivery. Transit agencies may order buses a year or two in advance of delivery; thus, it is important to examine bus orders as well as deliveries when evaluating fluctuations in fleet size. Although there was a sharp increase in deliveries of 40-ft. buses in 2002, subsequent years have seen a decline in deliveries as depicted in Figure 8.



Source: *Public Transportation Fact Book.* 2005.

As transit agencies seek to balance budget realities with vehicle needs, various challenges arise. Vehicle weight continues to be a challenge as ADA-compliant lifts and/or ramps for wheelchair passengers, alternative fuel systems and a growing variety of advanced electronic components have pushed the weight of some transit buses well past 30,000 pounds. In 1992, in an effort to encourage lightweight and innovative structures, the FTA developed the Advanced Technology Transit Bus (ATTB) program, aimed at bringing bus curb-weight below 20,000 pounds; however, no manufacturers attempted to build to the ATTB weight benchmark.[13]

In 1999, NABI debuted its "spiritual successor to the ATTB," the CompoBus, as the world's first and only heavy-duty (lighter weight) bus with an integrated structure fabricated from advanced composites. In 2003, the Los Angeles Metropolitan Transit Authority (MTA) deployed twenty of NABI's 40-ft., 22,222-pound CompoBuses costing about $310,000 per vehicle.[14] Additionally, MTA ordered 100 of NABI's 45-ft. 45C-LFW CompoBuses at a cost of $368,053 per vehicle.[15] Since deployment, MTA reported that, in less than two years, ridership on the CompoBuses increased 30%.[16] Phoenix's Valley Metro has purchased 56 45C-LFW CompoBuses with powertrains fueled by liquid natural gas, and Valley Metro ordered eight 45-ft. CompoBuses in 2004 for Tempe, Arizona.[17] In October 2002, Chicago's CTA approved an $8.6 million contract[18] for 25 diesel vehicles (NABI's first diesel CompoBuses), the first of which CTA deployed in January 2004.[19]

Despite the growing interest in the innovative design, the CompoBus program has faced numerous complications including unforeseen costs and delays. As an example, NABI sought and obtained a *Buy America* waiver that allowed initial production of its CompoBus in Hungary. Unexpected costs, unpredictable foreign currency exchange fluctuations, and problems related to supply chain problems were just some of challenges that were exacerbated further by controversy about the *Buy America* waiver. Ultimately, the FTA denied NABI's request for an extension of the waiver, the "final straw" that led the manufacturer to cease production upon completion of existing contracts. Subsequently, the company determined that cost increases per vehicle for production in the U.S. would be prohibitively expensive.[20]

As expected, cost is a major determinant in bus manufacturing and purchasing trends. As the history of NABI's CompoBus exemplifies, the cost-benefit considerations of producing innovative designs and technologies may not prove to be advantageous, particularly with respect to the American supply chain and the manufacturing industry. Viable innovations that could make vehicles more economical have the potential to increase the number of vehicle orders. However, as the number of orders continues to decline, vehicle costs for most types of buses are increasing. In the span of just one year, the average cost of certain vehicle types — articulated buses and 40-ft. buses — has increased by more than $30,000 as depicted in Figure 9 along with national cost figures from 1999 to 2005 for various vehicle types.[21]

Figure 9: National Cost Figures for Various Vehicle Types[22]

Vehicle Type	Average Cost of New Vehicle (1999-2000)	Average Cost of New Vehicle (2000-2001)	Average Cost of New Vehicle (2001-2002)	Average Cost of New Vehicle (2003-2004)	Average Cost of New Vehicle (2004-2005)
Articulated (55'-61')	$399,000	$413,000	$438,000	$503,000	$534,000
Intercity (35'-45')	$448,000	$415,000	$364,000	$410,000	$428,000
45' Transit (45')	$355,000	$391,000	$386,000	$336,000	N/A
40' Transit (37'6"-42'5")	$287,000	$288,000	$289,000	$303,000	$341,000
35' Transit (32'6"-37'5")	$257,000	$252,000	$274,000	$287,000	$276,000
30' Transit (27'6"-32'5")	$220,000	$222,000	$233,000	$259,000	$251,000
Suburban (27'6-45'**)**	$256,000	$293,000	$299,000	$295,000	$172,000
Trolley replica (all lengths)	$262,000	$266,000	$261,000	$277,000	$287,000
Small Vehicle (<27'6")	$165,000	$143,000	$135,000	$106,000	$78,000

Data from 2005 are from an APTA survey of 15% of bus/trolleybus transit agencies. Data from 1999-2004 are from APTA survey of 10% of non-rail transit agencies. Cost includes amount paid to manufacturer or agent.

Age of Buses

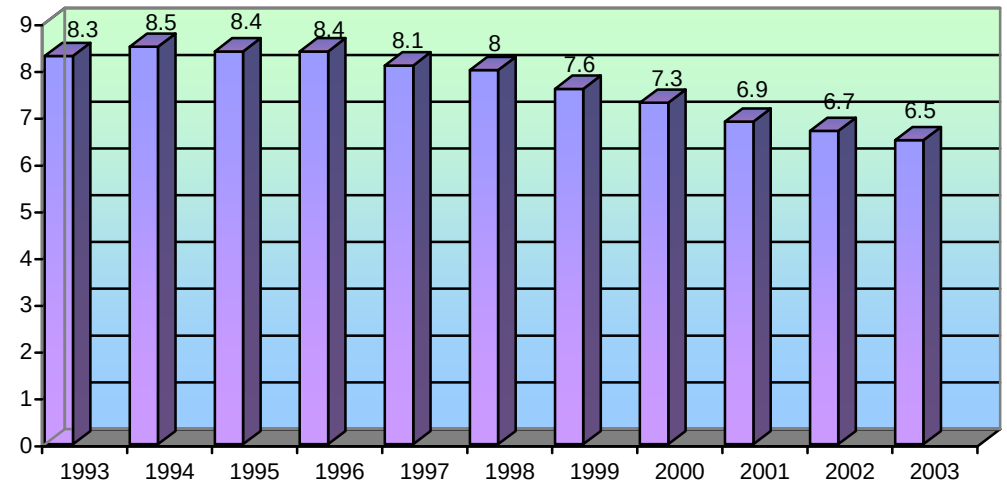
Transit agencies in Chicago and Los Angeles (two of the five largest in the U.S.) operate bus fleets with more than 2,000 vehicles, representing annual operating expenses ranging

from $600 million to more than $750 million. Comparatively, a much smaller community, such as Gainesville, Florida, for example, operates a fleet of 104 buses with annual operating expenses of approximately $10 million.[23] Differences of this magnitude, which are even more pronounced in the nation's smaller towns that operate a few dozen buses, illustrate the varying needs and requirements of transit agencies nationwide. However, all transit agencies are required to maintain fleets in a good state of repair and need to replace buses that have exceeded the industry standard retirement age of twelve years/500,000 miles. Retired buses in good condition provide revenue for some transit agencies through sales to other entities.

Transit bus manufacturers have expressed some concerns about the twelve-year/500,000-mile vehicle service life standard. According to one bus manufacturer participating in this study, bus engines and transmissions usually are at the end of the life cycle at seven or eight years. The manufacturer questioned the cost benefit of the twelve-year standard and commented that heavy investments in maintenance by the transit agencies typically start around the eight-year mark. One suggestion is to re-set the service life standard at eight years and install a re-manufactured engine or transmission to decrease the probability of breakdowns and costs of major repairs.

Replacement of buses is critical to reduce fleet emissions, improve vehicle availability, and to provide passenger amenities. Increasing ridership requires expansion of transit fleets in order to provide additional service to meet future demands. Monitoring bus age assists transit agencies in determining which buses should be replaced or refurbished. According to *National Transit Database* information obtained from eleven years of reports tracking 396 to 463 U.S. transit agencies, the average fleet age of buses has been decreasing steadily since 1994.[24] The need to replace old fleets is constant, and purchasing and lease options are means through which transit agencies strive to keep fleets in compliance with federal and state regulations. Despite concerns about aging fleets, NTD data documents a decline in the average bus fleet age nationwide, as depicted in Figure 10.

Figure 10: Average Bus Fleet Age (Years) 1992-2003



Source: *National Transit Database.* 2004.

Types of Bus Service

Prevalent Types of Fixed-Route Transit Bus Service

The most prevalent types of fixed-route transit bus service in the U.S. include local (all-stop), express, and limited-stop, as well as bus rapid transit (BRT). Figure 11 outlines each type of service and vehicle commonly used for bus operations:

Figure 11: Prevalent Types of Bus Service and Vehicle in the U.S.

Type of Service	Description[25]	Type of Vehicle[26]
Local (All-stop)	• Most common type of service in which vehicles may stop every 1 to 2 blocks • Includes circulator, feeder, neighborhood, trolley, or shuttle service, which operate in small geographical areas (e.g., office park circulators, historic district routes, transit mall shuttles, rail feeder routes, and university campus loops)	• 40-ft.-long, high-floor buses are the most common; 35- and 30-ft.-long buses also are common in small cities and on lightly-patronized routes • Articulated buses (54- to 60-ft.-long) operate in large metropolitan areas (e.g., Orange County Transportation Authority in California uses 60-ft. long articulated buses)
Express	• Long distance operations without stop, esp. in major metropolitan areas during peak commuting hours (e.g., park-and-ride-routes between suburban parking lots and the central business districts)	• 40 and 45-ft.-long buses with front doors only and high-backed seats for use in high-speed, long-distance operations (e.g., NYC Transit predominantly uses 45-ft. buses for express service)
Limited-stop	• Hybrid between local and express service • Stops are less frequent than local service	• Same type of vehicle used for express service
Bus Rapid Transit	• Express or limited-stop services laid over express, limited-stop, or local routes, extending beyond the limits of exclusive busways, bus lanes, tunnels, or expressways (rights-of-way) • Stations and facilities are integrated into the community to promote intermodal connectivity and enhance economic development • Equipped with high technology features — electronic boarding/fare collection, traffic signal priority, automatic vehicle location (AVL) systems, passenger information systems, and alternative propulsion systems	• High-capacity vehicle (40-ft. to 60-ft. articulated buses (e.g., Massachusetts Bay Transportation Authority in Boston uses 60-ft. articulated buses) • Vehicle designs to minimize boarding time, (e.g., low-floor, multi-door buses) • Alternative propulsion systems (e.g., Valley Metro in Phoenix uses LNG fueled, 45-ft. buses. King County Metro operates diesel-electric buses for transit through the Metro Bus Tunnel in downtown Seattle. Los Angeles County MTA includes traffic signal priority, AVL, and passenger information systems in buses for BRT.

In most cities, ridership relates to size of population, and ridership, also, impacts the types of bus service that transit agencies provide to the community. A review of published literature and information posted on transit agencies' websites suggests that

transit agencies located in areas with relatively large populations provide express, limited-stop, or BRT service in addition to local (all-stop) service. Transit agencies that serve relatively small communities may provide only local services. Because BRT replaces some existing service, bus system/routes must be restructured prior to BRT implementation.[27]

Federal and state policies and priorities impact the bus services that transit agencies provide. Authorized by the *Intermodal Surface Transportation Efficiency Act* (ISTEA) *of 1991* and the *Transportation Equity Act for the 21st Century* (TEA-21) *of 1998*, more than $14 billion in federal funding became available through the Congestion Mitigation and Air Quality Improvement (CMAQ) program during the period from 1992 to 2003. CMAQ, a decentralized program, funded local transportation projects designed to help reduce transportation-related emissions.[28]

According to a study conducted by the Transportation Research Board in 2002, approximately 44% of the CMAQ funding from 1992 to 1999 was directed to transit projects, of which 7.2% was expended on service expansion across the nation. By region, the New England region (Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut) expended the largest portion (16.5%) of the grant for transit service expansion, followed by the Western Pacific region (California, Nevada, and Arizona — 13.3%) and the Mid-Atlantic region (Pennsylvania, Delaware, Washington, D.C., Maryland, Virginia, and West Virginia — 11.4%).[29]

Although the degree of state involvement in the program differed by state, the CMAQ program allowed states to administer the funds and determine the spending priorities.[30] Through an initiative directed by Vermont Governor Douglas, the Chittenden County Transportation Authority (CCTA) received a grant to add two express routes in 2003, which connected the neighboring counties with the central business district in Burlington, Vermont during peak commuting hours.[31] Similarly, in New Hampshire, Concord Area Transit (CAT) received a grant to establish a local route in 2005 that connects the New Hampshire Technical Institute (a community college) with the downtown business district.[32]

Some U.S. cities face budget challenges related to bus transit. In Indianapolis, where traffic congestion is ranked 27th worst among the nation's 85 largest cities, Indianapolis Public Transportation Corporation (IndyGo) faces challenges to improve service under budget constraints.[33] After cutting ten underutilized routes (e.g. express and local service) in 2004, IndyGo proposed an "ambitious"[34] service improvement plan in March 2005, which provides more frequent local service, longer service hours, and operations of express service over the next fifteen years.[35] However, the cost estimate announced a few months later sparked controversy — some critics argued that costs outweighed the potential benefits of service expansion. Currently, IndyGo is under severe scrutiny by lawmakers, taxpayers, and the local media.[36]

Trends in Types of Bus Service

Bus Rapid Transit (BRT)

New types of service associated with changes in regional transportation or land use policies, area development, lifestyle, and availability of new technology continue to evolve. Based on successful examples in the U.S. and abroad, an increasing number of U.S. transit agencies have been providing or extending bus rapid transit (BRT) service since the early 1990s.[37]

According to a report published by the Federal Transit Administration (FTA) in 2004, significant increases in transit ridership have occurred in all corridors where BRT has been implemented; these increases can be attributed primarily to BRT passengers.[38] Case studies of 26 BRT implementations in the U.S. and overseas conducted by the Transportation Research Board in 2003 found that lower development costs and greater flexibility, as compared with rail transit, were the primary reasons for selecting BRT.[39]

In recent years, BRT has gained increased popularity among transit agency decision-makers due to the availability of federal funding through *New Start* and other programs related to transit improvement and capital investment.[40] Some transit agency officials look to BRT as an alternative to light rail or as an interim solution for rail. Associated with high technology, modern vehicle design, and close community links, advocates note that BRT helps to improve the image of bus service and enhances local economic development.[41]

Figure 12 highlights representative major corridors in the U.S. where new (or extended) BRT service was opened in 2005 or is scheduled to open in the next two years:[42]

Figure 12: Major BRT Corridors Scheduled to Open in the Next Two Years

BRT Corridor	Operating Transit Agencies
Silver Line, Phase II (extension project)	Massachusetts Bay Transit Authority (MBTA) — Boston, Massachusetts
New Britain-Hartford Busways	Connecticut Transit (CTTRANSIT) — Hartford, Connecticut
Euclid Corridor Silver Line	Greater Cleveland Regional Transit Authority (RTA) — Cleveland, Ohio
Metro Area Express	Kansas City Area Transportation Authority — Missouri, Kansas
Emerald Express Corridor	Lane Transit District (LTD) — Eugene, Oregon
Metro Orange Line	Los Angeles County Metropolitan Transit Authority (MTA) — Los Angeles, California

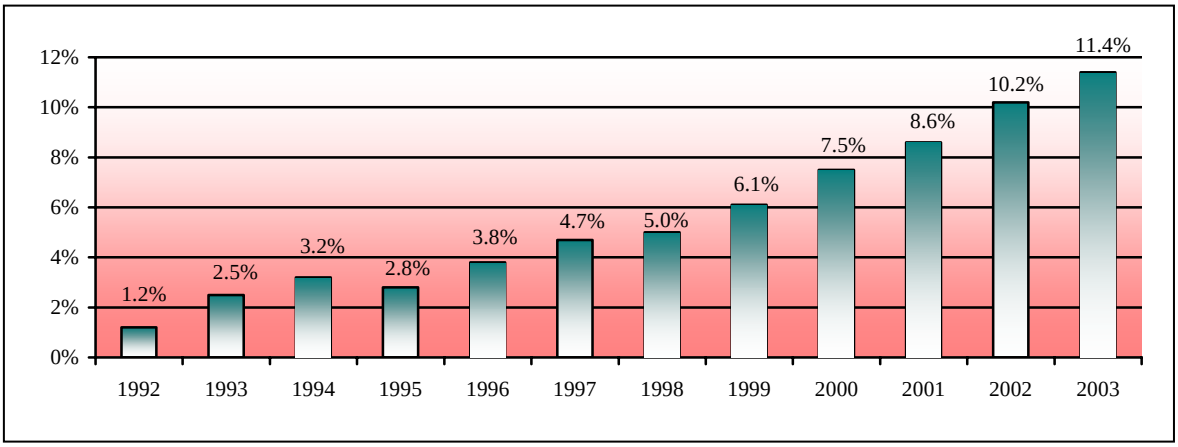
Although BRT service in many U.S. cities is still in the initial stages of operation, this emerging and growing trend across the nation is already impacting vehicle type and design and capturing the interest of many transit agencies.[43] For example, Valley Metro in Phoenix, Arizona, which started BRT service in 2003, operates liquefied natural gas (LNG)-fueled, 45-ft. buses, specially designed for BRT.

Other transit agencies, including Tempe Transit in Arizona, Los Angeles County Metropolitan Transportation Authority, and Chicago Transit Authority purchased the same type of 45-ft. vehicle for BRT or express route operations.[44]

Vehicle Fuel and Propulsion Systems

Diesel fuel has long been the most common type of fuel for transit buses. However, stringent emissions regulations and rising concerns about the public health risks of diesel exhaust in recent years have caused transit agencies to consider alternative sources of fuel for transit buses. By definition, alternative fuels exclude diesel and gasoline. According to the *National Transit Database* (NTD), alternative fuels include compressed natural gas (CNG), electric, battery, ethanol, methanol, liquefied petroleum gas (LPG), liquefied natural gas (LNG), kerosene, bio-diesel, grain substitute and other fuel services. As depicted in Figure 13, the percentage of bus fleets nationwide using alternative fuels rose from 1.2% in 1992 to 11.4% in 2003.[45]

Figure 13: Percentage of Nationwide Bus Fleet Using Alternative Fuels: 1992–2003



Source: *National Transit Database*. 2003

Surveys conducted by APTA of about 300 U.S. transit agencies (representing roughly 70% of the national totals of buses and 100% of trolleybuses) show similar increases in alternative fuel usage over the past decade. Figure 14 depicts patterns of fuel usage in 2005 compared to 1995. The bus transit industry has seen notable increases in the usage of alternative fuels over the past decade, in particular compressed natural gas (CNG), which increased in usage from 1.3% in 1995 to 11.1% in 2005. In 1992, Santa Fe Trails was one of the pioneering transit agencies to use CNG as a fuel source.[46] CNG continues to be more popular than liquefied natural gas (LNG). Currently, the City of Phoenix Public Transit Department (Valley Metro) has the nation's largest LNG fleet, operating 295 LNG-fueled buses.[47] However, the use of new power sources like bio-diesel, hydrogen, jet fuel and propane blends is minimal, representing only 0.3% of the total power sources, according to the cited research data.

Figure 14: Comparison of the Usage of Bus Power Source (1995 vs. 2005)

Bus Power Source	1995		2005	
	Number of Vehicles	Percentage	Number of Vehicles	Percentage
Compressed Natural Gas (CNG) & Blends	678	1.3%	6,744	11.1%
Diesel	50,158	96.1%	51,391	84.9%
Electric & Other	37	0.07%	631	1.0%
Ethanol & Blends	82	0.2%	0	0.0%
Gasoline	243	0.5%	276	0.5%
Liquefied Natural Gas (LNG) & Blends	357	0.7%	1,003	1.7%
Methanol	399	0.8%	0	0.0%
Propane	31	0.06%	292	0.5%
Other*	202	0.4%	189	0.3%
Total	**52,187**	**100.0%**	**60,526**	**100.0%**

Source: APTA, *Public Transportation Factbook, 2005*. (APTA surveys of about 300 transit agencies including about 70% of all buses)
* Other includes bio/soy fuel, biodiesel, hydrogen, jet fuel, and propane blends.

As Figure 14 indicates, diesel continues to dominate the bus fuel market, accounting for almost 85% of the power sources for the 60,526 buses documented in 2005. Annual U.S. diesel consumption by buses and trolleybuses amounted to approximately 536 million gallons in 2003 compared to approximately 114 million gallons of non-diesel fuel.[48]

Accordingly, data on transit agencies' purchasing trends shows an overwhelming preference for diesel-powered buses. (Please see Figure 15.) In 2004, 65.8% of the newly-built fleets ran on diesel, and 74.8% of the orders placed as of January 2005 specified diesel. Compressed natural gas (CNG), the second most popular power source, accounted for 16.8% of buses newly-built in 2004 and 16.5% of buses on order. Dual-powered systems (i.e., hybrids such as diesel-electric and gas-electric) represent the third most popular power option accounting for 13.4% of the newly-built buses in 2004; however, new orders for hybrids declined in 2005.[49]

Figure 15: New Bus and Trolleybus Market by Power Source, 2004-2009

Power Source	Built in 2004		On Order as of January 2005		Potential Orders (Tentative)*	
	Number of Vehicles	Percentage	Number of Vehicles	Percentage	Number of Vehicles	Percentage
Diesel	2,110	65.8%	1,841	74.8%	4,628	53.3%
CNG	540	16.8%	405	16.5%	1,389	16.0%
Dual-power	430	13.4%	131	5.3%	528	6.1%
LNG	52	1.6%	33	1.3%	69	0.8%
Electric catenary	28	0.9%	0	0.0%	0	0.0%
Gasoline	23	0.7%	17	0.7%	49	0.6%
Propane	4	0.1%	0	0.0%	18	0.2%
Other	22	0.7%	33	1.3%	51	0.6%
Undecided	N/A	N/A	N/A	N/A	1,948	22.4%
Total	3,209	100.0%	2,460	100.0%	8,680	100.0%

Source: *Public Transportation Fact Book.* 2005. (APTA survey represents about 70% of buses and 100% of trolleybuses in the U.S.)
*Potential orders are projected and may not actually occur.

A review of various industry and government publications revealed that many transit agencies are considering using cleaner fuels based on the following commonly cited reasons:

- Federal emissions and air quality regulations — Stringent compliance standards required by the U.S. Environmental Protection Agency (EPA) motivate transit agencies to procure buses with lower levels of emissions.[50] In 2001, EPA established new emissions standards to take effect from model year 2007 in an effort to reduce nitrogen oxide (NOx) emissions by 95% and particulate matter (PM) by 80% from current levels.[51] The regulation also requires diesel fuel refiners to produce ultra low-sulfur diesel (ULSD) with a sulfur content of 15 parts per million (ppm) by June 2006, thereby widening the "clean diesel" market.[52] The phase-in schedule requires 100% compliance by 2010. Also, many urban areas have been designated as "non-attainment"[1] areas by the EPA. Some transit agencies have implemented aggressive clean fuel programs in order to reduce pollution. For example, since 2003, Knoxville Area Transit has incorporated alternative fuels for 88% of its transit fleet as a result of an agency-wide effort.[53]

- State air quality regulations — Most notably, California's transit agencies – large and small – have been actively procuring clean fuel buses to comply with state environmental regulations. In 2000, California Air Resources Board (CARB) of the California Environmental Protection Agency adopted the *Urban Transit Bus Fleet Rule* requiring the state's transit agencies to choose between the alternative fuel path and the diesel path for complying with the state's stringent nitrogen oxide (NOx) and particulate matter (PM) emissions standards.[54] Since 2002, California transit agencies choosing the diesel approach have been required to use ULSD. The rule also stipulated that at least 15% of new bus purchases by California transit agencies (with fleet sizes of more than 200) must be Zero Emission Buses (ZEBs).[55]

- Public relations — Environmentally-friendly vehicles raise positive public opinion and community support for cleaner fuels. Many transit agencies using alternative fuels report positive public response and see the benefit of promoting clean buses in order to increase ridership and revenue.[56]

- Local Economy — In addition to decreasing dependency on foreign oil, interest in alternative fuels has been raised to support local farming communities. Specifically, bio-diesel is expected to boost local soybean farming — soybeans are used in the manufacturing of an ingredient in one form of bio-diesel. The Bi-State Development Agency of St. Louis, Missouri was the first transit agency to conduct an extensive bio-diesel research and demonstration project, and the agency appears to have been satisfied with the results.[57] Recently, County Ride of Queen Anne County, Maryland

[1] EPA defines a "non-attainment" area as "any area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient air quality standard for the pollutant." (EPA Internet Website. 2005.)

received $60,000 in federal and state grants to purchase B20 (blend of 20% bio-diesel and 80% conventional diesel) for use in 188 vehicles, including school buses.[58]

During the past few years, transit agencies across the U.S. – small, mid-sized, and large – have purchased new buses with power sources ranging from clean diesel to hybrids to natural gas. Representative examples of notable procurement decisions and activities from 2003 to 2005 related to "clean fuel" buses include:

- **Chicago Transit Authority** — 245 40-ft. clean diesel transit buses and 20 40-ft. diesel-electric hybrid buses[59]
- **King County Metro** — 213 60-ft. articulated diesel-electric hybrid buses[60]
- **Los Angeles MTA** — 200 60-ft., low-floor CNG articulated buses (first of this type to be used in the U.S.) and up to five 60-ft. articulated hybrid buses[61]
- **MTA New York City Transit** — 325 diesel-electric hybrid buses[62]
- **San Diego Metropolitan Transit System** — 47 40-ft., low-floor CNG buses[63]
- **Six transit agencies in California** — 76 gasoline-electric hybrid buses to transit agencies in Long Beach, Orange, Norwalk, Gardena, Montebello and Fresno[64]
- **Southeastern Pennsylvania Transportation Authority (SEPTA)** — 20 low-floor diesel-electric hybrid buses[65]
- **SunLine Transit Agency** — nation's first hydrogen-electric hybrid bus[66] and 40-ft. hydrogen-fueled hybrid electric fuel cell bus (in partnership with AC Transit)[67]
- **Washington Metropolitan Area Transit Authority** — 250 40-ft., low-floor CNG buses for delivery between August 2005 and March 2006;[68] 100 diesel-electric hybrid buses and 117 clean diesel buses for delivery from 2006 to 2008[69]

Some commonly cited reasons for the slow pace of acceptance and application of alternative fuel systems in transit buses include:

- <u>High costs</u> — Although federal and state grants typically cover much of the cost, the procurement of buses with alternative fuel and propulsion systems, nonetheless, can be cost-prohibitive, especially for small transit agencies. According to APTA, a hybrid bus typically costs more than $500,000. Even for retrofits, engine upgrades for CNG cost about $30,000 per bus.[70] In addition, CNG entails additional infrastructure costs (approximately $1.7 million for a single fueling station in 1999 dollars).[71] CNG maintenance, repair, and operating costs may be higher over the long term compared to diesel, depending on fuel prices and the transit agencies' maintenance and operations practices.[72] The first 40-ft. hydrogen fuel cell vehicle produced for Santa Clara Valley Transit Authority in California cost more than $1.6 million.[73]

- <u>Funding uncertainties</u> — Several federal agencies, including the DOE, EPA, and FTA provide grants to local transit agencies for bus procurement. Funding cuts for clean buses are apparent in the most recent transportation legislation, *SAFETEA-LU*. In addition, programs designed specifically to promote clean bus technology typically have been under funded. For example, funds received through the Congestion Mitigation and Air Quality Improvement Program, established in 1991 through

ISTEA legislation and reauthorized by TEA-21, represent only about 5% of the state-apportioned transportation funds.[74]

- Reliability issues — Because of the relative infancy of the alternative fuel and propulsion systems market in the U.S., transit agencies may still encounter problems related to maintenance and performance, as well as limitations in both topography and range.[75] The hydrogen fuel cell is the latest alternative fuel technology currently under evaluation by several transit agencies. Through the California Fuel Cell Partnership, three transit agencies in California (AC Transit, SunLine Transit, and Santa Clara VTA) currently are demonstrating (in revenue service) a total of seven 40-ft. fuel cell buses. However, viable commercialization of the technology is still in the future — at least fifteen years, according to industry sources.[76] In May 2005, DOE announced its plan to spend $64 million on R&D projects aimed at commercializing hydrogen fuel cell vehicles and refueling stations by 2020.[77]

In response to difficulties faced by transit agencies, the California Air Resources Board (CARB) voted in October 2005 to relax the 2007 emissions standards for buses from 0.2 grams of nitrogen oxide (NOx) per brake horse power-hour (bhp-hr) to 1.2 grams of NOx per bhp-hr. The stringent 0.2-grams standard would have required some transit agencies to defer buying diesel buses at least until 2010 because the more expensive hybrid vehicles are the only commercially available technology to meet the upcoming 2007 CARB standards. CARB voted to relax the standards citing prohibitive costs for transit agencies. The new 2007 CARB standards complements the federal standard and allows transit agencies to purchase diesel buses certified at 1.2 grams of NOx per bhp-hr.[78]

Environmental Technology Trends

As in the case of many innovations, environmental technology in the U.S. bus market is driven by federal policy. Transit application of alternative fuels began primarily as a response to federal laws, including the *Alternative Motor Fuels Act of 1988*, the *Clean Air Act Amendments of 1990*, and the *Energy Policy Act of 1992*, which aimed to address air quality problems and to reduce dependence on foreign petroleum.[79] Technology to enhance fuel efficiency and reduce emissions has been developed over the years to include various alternative fuels as well as cleaner diesel. With EPA's most recent nitrogen oxide emissions standards set to take effect in 2007, and made more stringent in 2010, efforts have been made to enhance emissions control technologies, including after-treatment devices, such as filters and catalytic converters, as well as exhaust gas recirculation equipment.[80]

With regard to fuels and propulsion systems, the past couple of years have seen some emphasis diverted away from natural gas fuels, particularly CNG.[81] For example, diesel fuel improvements are being driven, in part, by EPA's rule requiring the use of ultra-low sulfur diesel (ULSD) by 2006. ULSD contains 95% less sulfur than conventional diesel and requires no major alterations to transit operations or infrastructure.[82] According to *MassTransit*, an industry publication, clean diesel has resulted in better emissions levels in some cases than CNG.[83] In addition, increased viability of the hybrid propulsion system is steering more transit agency interest toward hybrid buses.

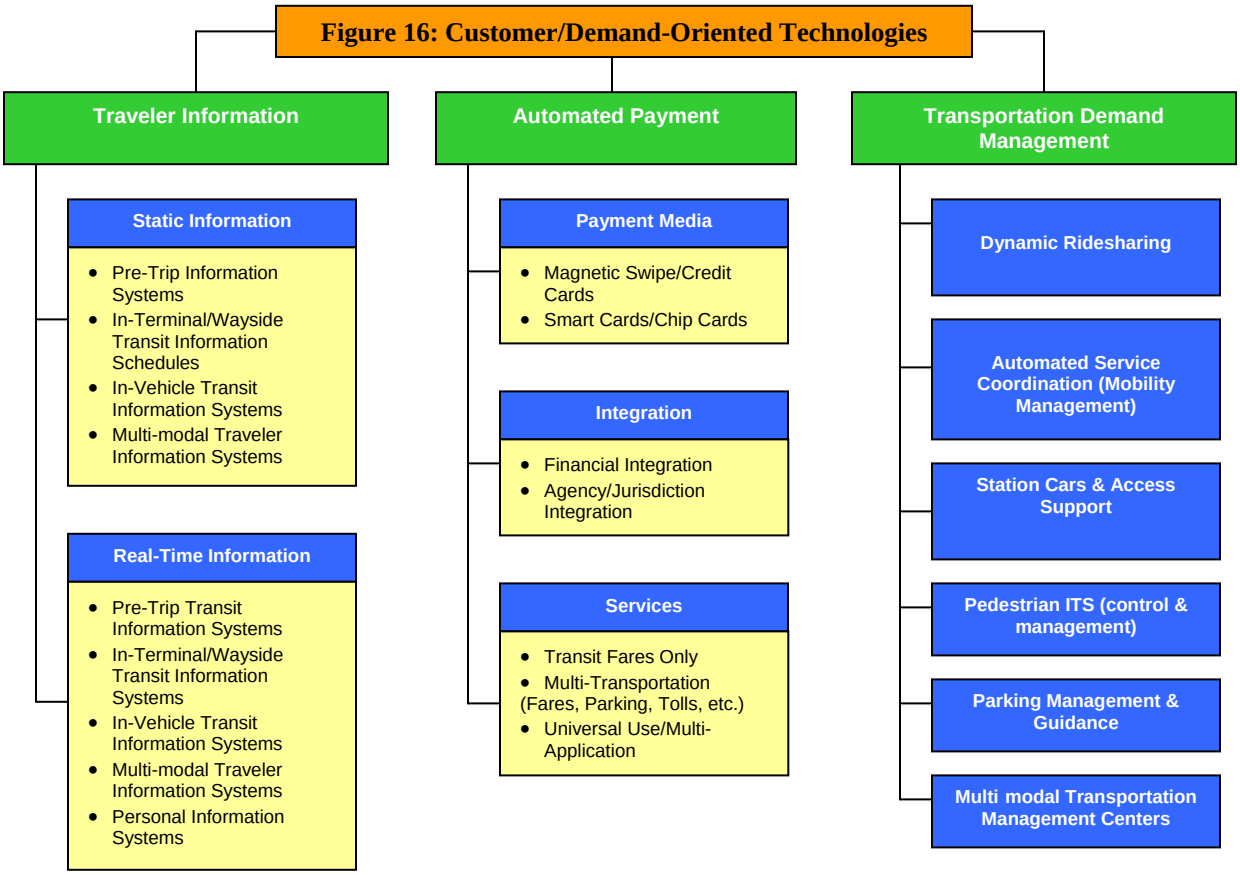
As a result, the combined disadvantages of high maintenance and operations costs, coupled with market forces, gradually may be moving interest away from CNG, as demonstrated by the slight decrease in the percentage of potential CNG orders depicted in Figure 15. In 2004, Washington Metropolitan Area Transit Authority (WMATA) made a decision to purchase 117 clean diesel buses instead of the originally proposed CNG buses, citing prohibitive costs for upgrading CNG fueling facilities. In September 2005, WMATA announced that fifty diesel-electric buses will be put into service by the end of the year and that the agency plans to purchase an additional fifty.[84] Similarly, MTA New York City Transit has made a decision to procure 100 diesel-electric hybrid buses (with an option for an additional 400 buses) augmenting its inventory of 325 hybrid buses, instead of purchasing 120 CNG buses.[85]

In spite of notable local exceptions, national statistics show that CNG grew dramatically in the past decade to become the most popular alternative fuel choice in the U.S. today. While the hydrogen fuel cell propulsion system is ideal in that it produces no harmful emissions, the technology is still in the testing and demonstration stage and remains cost prohibitive for many transit agencies. In the interim, hybrid technology is expected to grow significantly.[86] In anticipation of the growing market, the Transit Cooperative Research Program, a research component of the Transportation Research Board, launched an independent research study in 2004 to provide analysis and technical evaluation of hybrid buses and to serve as a source of contemporary information for transit agencies. Research results will be published in 2007.

Transit Bus Technology Trends

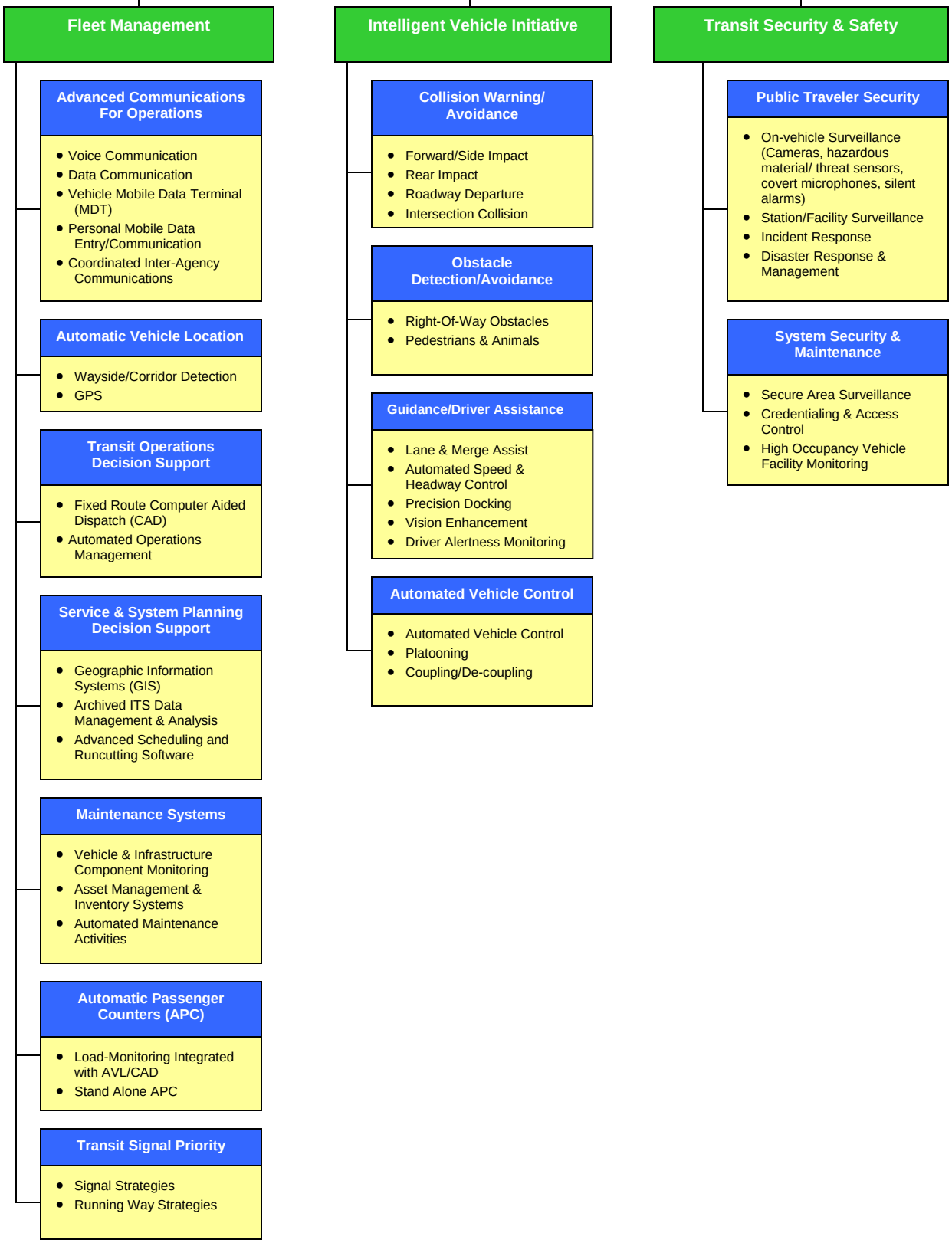
Innovative technologies enhance the convenience, efficiency, accessibility and safety of public transportation. As discussed, advancements and innovations related to bus design, service types and fuel and propulsion systems have faced challenges, as well as achieving success. Similarly, Intelligent Transportation Systems (ITS) have presented various challenges as well as advancements. The Federal Transit Administration's Advanced Public Transportation Program (APTS) is a key component of the Department of Transportation's initiative to advance ITS throughout the U.S. transportation infrastructure; APTS has encouraged the development of various ITS technologies that have been applied successfully by the bus industry.

About five years ago, in order to have a consistent definition and breakdown, APTA and the Intelligent Transportation Society of America (ITSA) ITS Transit Stakeholders Group for the ITS Transit Impacts Matrix, developed an ITS Transit typology to identify various transit technologies. In fall 2003, the ITS Transit team revised the typology to incorporate recent advancements.[87] Bus transit technologies were classified into two major categories — customer/demand-oriented technology and operations-oriented technology. The following charts, Figures 16 and 17, depict the major transit technologies as defined by the ITS Transit team.



Source: U.S. Department of Transportation ITS Internet Website

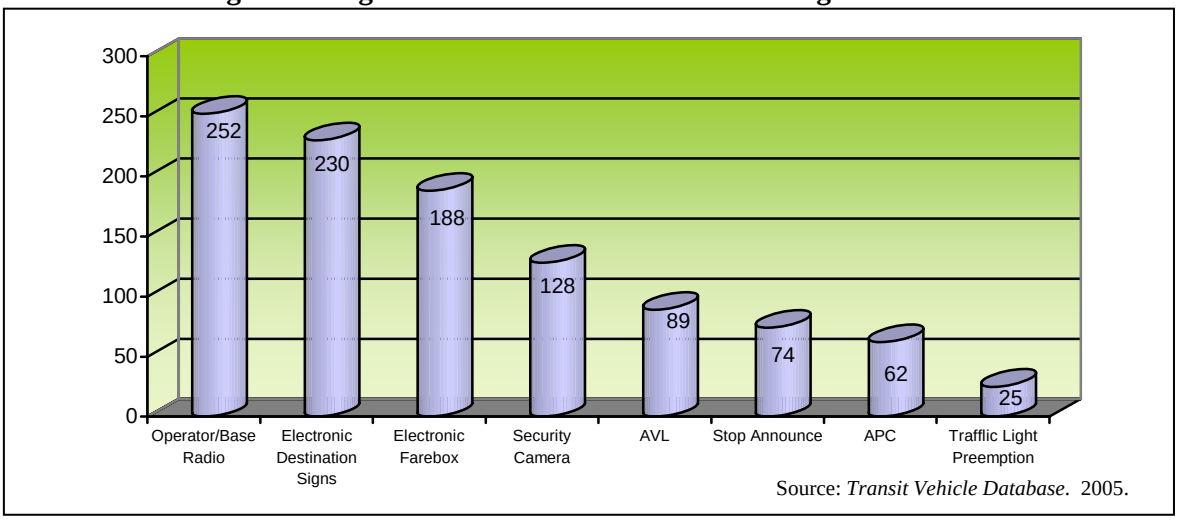
Figure 17: Operations-Oriented Technology



Source: U.S. Department of Transportation ITS Internet Website

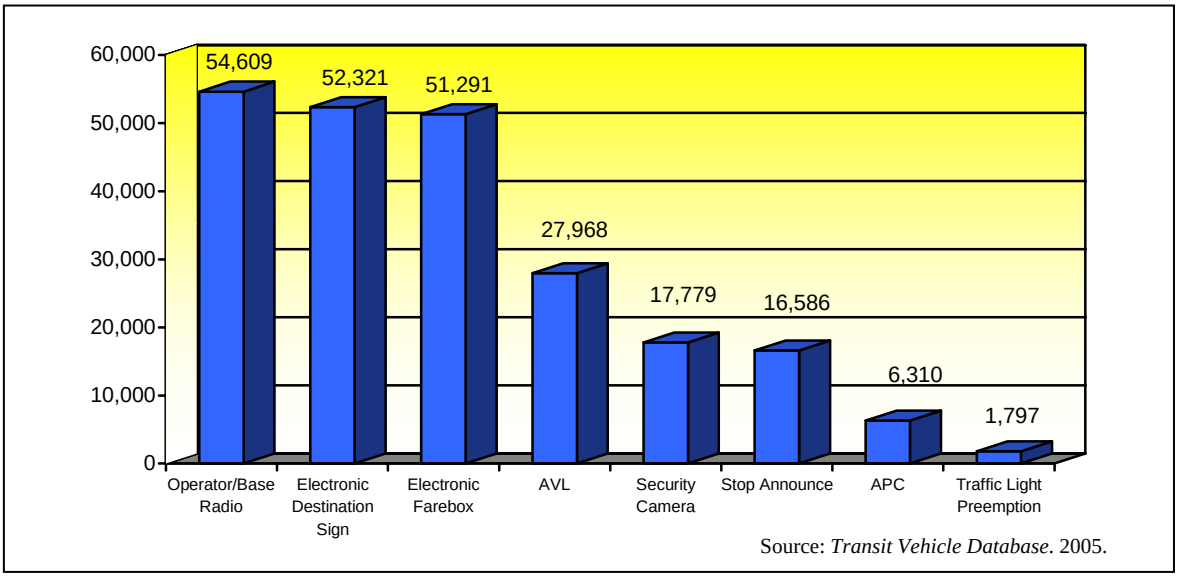
During the February 2004 meeting of the ITS Public Transportation Forum Advisory Group, ITS initiatives focused on multimodal coordination, transaction systems, traveler information, and automated transit services emerged as priorities.[88] Related technology, including bus rapid transit, intelligent vehicle, transit signal priority, automated fare payment, automatic passenger counters, and real time traveler information systems have been deployed at varying levels. According to the 2004 data from the 2005 Transit Vehicle Database, operator/base radio, electronic destination signs, and electronic fare boxes are prevalent technologies. These customer/demand-oriented technologies have been installed on thousands of buses in most of the 260 agencies that were surveyed.[89] These technologies often complement operations-oriented technology, notably Automatic Vehicle Location (AVL) equipment is installed increasingly alongside other technologies. (Please see Figures 18 and 19.)

Figure 18: Agencies with Prevalent ITS Technologies in 2004



Source: *Transit Vehicle Database*. 2005.

Figure 19: Buses with Prevalent ITS Technologies in 2004



Source: *Transit Vehicle Database*. 2005.

Also, as security issues remain at the forefront of transit industry concerns, vehicle tracking devices, security cameras, and other measures are becoming more commonplace in the nation's largest transit systems. Figure 18 indicates that 128 transit agencies of the surveyed 260 had installed security cameras on buses.

The charts that follow (Figures 20 and 21) review operations-oriented technology and customer/demand-oriented technology highlighting the two prevalent technologies documented in the *2005 Transit Vehicle Database*.

Figure 20: Highlighted Operations-Oriented ITS Technology

Operations Oriented Technology	Incorporated Technology	Features
Automatic Vehicle Location (AVL) Among 260 agencies surveyed in 2004, 89 agencies had installed AVL systems on their fleet vehicles. In total, 27,968 vehicles are equipped with some form of AVL.[90] GPS-based AVL is often complements other ITS components, including the Automated Stop Announcement, Automatic Passenger Counters, Communications systems (radio, text messaging, etc.), Computer Aided Dispatch and Electronic Departure and/or Destination Signs.[91]	• Signpost/odometer technologies are older and were the most common form of vehicle tracking until the mid-1990s.[92] • Newer systems employ Global Positioning System (GPS) which is increasingly affordable and available; GPS-AVL is one of the fastest-growing GPS applications and is used by numerous agencies throughout the U.S.[93] • Other older forms of vehicle tracking include radio navigation/location and dead reckoning	⇒ Real-time monitoring ⇒ Control centers process raw data or data processed on-board vehicles for vehicle position and tracking ⇒ Transit agencies can integrate AVL data with other information (e.g., demographic data) to evaluate passenger activity and schedule adherence ⇒ Increasingly installed, GPS AVL software performs conventional geographic information system (GIS) functions (such as zoom, pan, identify and queries) and displays bus locations on a computer terminal using GIS software. Advanced vehicle tracking packages also support networked and Web-based functions.[94]
Automatic Passenger Counters (APC) Among 260 agencies surveyed in 2004, 62 agencies had installed APC systems on their fleet vehicles; however, the percentage of vehicles with APC systems varies widely from agency to agency. In total, 6,310 vehicles have APC systems installed.[95] Los Angeles County Metropolitan Transportation Authority (MTA) has the largest number, a total of 1,998, of APC-equipped vehicles representing over half the bus fleet.	• Infrared sensors[96] • Treadle mats	⇒ First deployed in the 1970s[97] ⇒ Delayed type applications such as scheduling and planning ⇒ Complements recent technologies, most commonly AVL ⇒ Real-time applications costly and require equipping entire vehicle fleets ⇒ Tendency to equip a select number of vehicles and rotate APC-equipped buses throughout the system to obtain passenger information from various routes

Figure 21: Highlighted Customer/Demand-Oriented ITS Technology

Customer/Demand Oriented Technology	Incorporated Technology	Features
Automated Payment Electronic fare box technology is widely available and is standard equipment for most large and medium-sized urban transit systems.[98] Among 260 agencies surveyed in 2004, 188 agencies had installed electronic fare boxes. In total, 51,291 vehicles were equipped.[99] Electronic fare boxes can be configured to integrate newer ITS technology — magnetic cards, smart cards, and other electronic fare media and related integration capabilities.[100]	• Electronic fare media include: o Magnetic Swipe/Credit Cards o Smart Cards/Chip Cards ▪ Contact ▪ Contactless ▪ Hybrid/Combi-card • Contactless cards have Radio Frequency (RF) interface.[101] • Regional fare systems incorporate RIS-based software interface for interoperability.[102]	⇒ Contactless smart cards are increasingly popular among transit agencies.[103] ⇒ "Open systems" enable different financial service providers (i.e. credit cards, debit cards, etc.) to be integrated into the transportation fare payment system. ⇒ Some smart cards allow usage in multi-transportation services (i.e., fares, parking, tolls, etc.)[104] ⇒ Multiple/regional agency fare system is increasing, as in the case of San Francisco.[105]
Electronic Destination Signs Among 260 agencies surveyed in 2004, 230 agencies had installed electronic destination signs. In total, 52,321 vehicles were equipped.[106] In compliance with ADA regulations, electronic destination signs have become a commonplace technology on transit buses.	• Traditional roller-curtain[107] print sign • Electro-magnetic flip dot/split-flap signs • Hybrid signs • Light-Emitting Diode (LED) signs	⇒ Route names and destinations on the fronts and sides (and sometimes rear) of buses[108] ⇒ Can be integrated with an AVL system ⇒ Buses can be retrofitted with electronic signs

Although not included in the *2005 Transit Vehicle Database*, the Intelligent Vehicle Initiative (IVI) is a growing operations-oriented ITS technology. Originally authorized in 1998 by *TEA-21*, IVI — part of the DOT's ITS program — is intended to reduce vehicle crashes and promote safety through various driver assistance technologies. IVI involves technology development in collision warning/avoidance, obstacle detection/ avoidance, guidance/driver assistance, and automated vehicle control. Unlike other forms of transit ITS, such as AVL or APC, which have been employed for decades in various forms many of the IVI technologies are still developmental or in the early stages of implementation. For example, although precision docking has been implemented successfully by several transit agencies in Europe and Japan, it is still in the testing and demonstration phase in the U.S.[109] Some communities, however, are considering optical and mechanical technologies for precision docking and vehicle guidance applications. In August 2003, Caltrans successfully demonstrated the hands-free docking system that enabled buses to dock within one inch of the curb.[110] Currently, data on the benefits and costs of deployment in the U.S. are insufficient for transit agency planning purposes.[111]

Another developing operations-oriented technology — predictive monitoring — is being tested in a pilot program geared towards facilitating vehicle maintenance. By assisting component monitoring and asset management systems, predictive monitoring technology

can save both time and money in fleet management. In January 2005, Metro St. Louis partnered with Accenture to develop this pioneering system to improve and mitigate fleet vehicle maintenance by using sensors and statistical analysis to forecast bus equipment failures before they occur. The pilot project captures data from Quake Global data collection boxes, which are installed on the buses that then transmit the data via satellite to Accenture's lab where asset health monitoring software by SmartSignal analyzes the sensor data.[112]

As transit technologies continue to evolve and benefit passengers, operators and transit agencies, pilot projects and demonstration programs enable agencies to find out how new developments would operate within the context of the nation's varying demographic and transit needs. Certain technologies may be beneficial for all sizes of agencies; however, capital costs can be prohibitive for various equipment and software programs, particularly for very comprehensive systems that incorporate numerous technologies such as GPS, computer-assisted dispatch, mobile data terminals, silent alarms and other advanced features. For such comprehensive systems, larger transit agencies generally fare better than smaller agencies because the cost of major infrastructure is distributed over a larger number of vehicles; thus, the per-bus cost of large fleets can be significantly lower than for those agencies operating smaller fleets.[113]

Background and Trends — Bus Manufacturers

Background

As technological advancements and regulatory requirements continue to influence transit needs, the bus manufacturing industry faces the challenge of keeping pace with rapidly changing demands. Twenty-five years ago, the federal government's *Baseline for Advanced Design Buses* (also known as the "White Book") outlined industry bus trends specifically mandating a single fuel type (diesel) as well as a single standard floor height. At that time, articulated buses were rarely used by U.S. transit agencies.[114]

By the early 1990s, a few transit agencies were purchasing low-floor buses, most of which were built by New Flyer in the late 1980s and based upon designs by its parent company — Dutch bus builder Den Oudsten. Founded in 1981, Neoplan USA Corp. had also begun to offer low-floor buses, after having licensed the design from Neoplan AG of Germany. Roughly 50 percent of the U.S. transit bus fleets in the early 90s were wheelchair accessible, primarily equipped with powered lifts. However, because of the introduction of low-floor transit buses some agencies had begun to phase out the older lift technology buses associated with ADA-compliant high-floor buses. Furthermore, alternative fuel and propulsion systems and multiplexed electrical systems were being introduced also. While producing significant benefits for transit agencies, these advancements fundamentally changed design and manufacturing.[115]

By 2000, many manufacturers were offering low-floor buses, and alternative fuels were becoming commonplace with nearly 10% of the active transit bus fleet in the U.S. being powered by non-traditional sources in 2001. As the EPA prepares to impose more stringent engine emissions standards in 2007 and again in 2010, manufacturers are aware that these changes not only will affect the design of diesel engines, but also will require modifications of engine cooling systems as well as after-treatment technologies.

The rapid pace of change has been challenging for the bus manufacturing industry. Over the last decade, at least ten transit bus manufacturers have closed their doors, or reorganized, including a number of prominent manufacturers among which are:

- Flxible Corporation
- Transportation Manufacturing Company
- General Motors Corporation
- Ikarus USA (Union City Body Company)
- NOVA Bus of America
- Bus Industries of America

When the cited manufacturers were operational, collectively they built thousands of vehicles — many of which remain in service today. Prior to closing operations, all of these manufacturers had reorganized at least once.

For many years, it has been commonplace in the bus manufacturing industry for companies to form mergers and acquire other companies, along with bus designs. In 1987, Transportation Manufacturing Company (TMC), a division of Greyhound Corporation,* bought the production rights for the RTS bus from General Motors Corporation (GMC). TMC shifted production of the RTS from GMC's Pontiac, Michigan facility to its facility in Roswell, New Mexico. TMC produced the RTS until 1994 when NOVA Bus bought the production rights.

At the time NOVA Bus was created, it was owned by the La Fortune family, FTQ, and Bombardier. In 1998, NOVA Bus was sold to Volvo/Henlys. NOVA Bus currently is a division of Prevost Car Inc., a division of Volvo.

The emergence of low-floor designs negatively impacted various manufacturers, including NOVA Bus of America. After several failed attempts to design a low-floor transit bus for the U.S. market, Volvo closed its NOVA Bus of America plant in Roswell, New Mexico in 2002. Today, NOVA Bus of Ste. Eustache, Canada produces a single product, the Nova LFS, a 40-ft. low-floor urban transit bus.

While some builders changed hands and were able to continue vehicle production, other builders such as Flxible Corporation ceased operations — with customer vehicles still on

* Greyhound Corporation changed its name to Dial Corporation in 1990. In 1993, Dial divested itself of all bus production and established Motor Coach Industries International (MCII) that included both MCI and TMC.

the production line. When it closed its doors in 1996, Flxible was in a production run for the Maryland Transit Administration. Prior to going out of business in 1996, Edward Kravitz, President and CEO of Flxible participated in the 1995 FTA-sponsored Bus Industry Summit that focused on the health of the U.S. bus industry. In the context of his presentation, Kravitz identified several issues that, in his opinion, negatively impacted the market. Most notable were his comments regarding industry demand and capacity observing that:

> "*In the early 1980s we had a Secretary of Transportation who announced that this country needed 10,000 new buses every year. But he didn't announce that they were not going to fund 10,000 new buses every year. As a result, we had a significant amount of foreign competition come into the industry. We ended up with industry capacity which we have today, of over 6,000 units for an industry that only buys from 1,500 to 4,000 buses…*"[116]

Kravitz commented further that:

> *"Many large companies have left the industry because they lost significant sums of money. The public record of some of these companies has revealed losses in the neighborhood of $100 to $200 million. This is after being in the business for only four or five years. The reason new people come in is because everybody always thinks he's smarter than the next guy…"* [117]

Participants in the 1995 Bus Industry Summit identified six challenges facing the industry.[118] At the time of the Bus Industry Summit in 2000, similar issues were addressed. Figure 22 depicts the issues that were addressed five years apart, and the exploratory research suggests that many of these same issues continue to exert pressure on U.S. bus manufacturers.[119]

Figure 22: Bus Industry Summit Issues

1995 Bus Industry Summit	2000 Bus Industry Summit
• Funding uncertainties • Fluctuations in market demand • Unmet research and development needs • Compliance with Federal policies and regulations • Complexities of the procurement process • Approaches to guarantee bus performance, including the use of warrantees and bonding	• Poor communication among industry stakeholders • Technology deployment • FTA policies and regulations • Vehicle procurement and standard procurement guidelines • Vehicle quality • Manufacturing capacity utilization • Human resource issues (e.g., recruiting, training, etc.)

2000 Bus Industry Summit Issues

Poor communication – Identifies as on of the most salient issues, industry representatives expressed the need for more interaction and cooperation among industry members. Two important points regarding communication were noted *Proceedings of Bus Summit 2000: Ensuring a Healthy U.S. Bus Industry*:[120]

- Better information collection and dissemination would benefit all sectors of the industry.

- Increased use of the Internet, perhaps through a centralized database or portal, could facilitate exchange of procurement information, specifications, planned delivery dates, and other critical information.

Technology deployment – Issues related to technological advancements were another topic of concern for those who attended the 2000 Summit. Technologies such as ITS, composite materials, alternative fuels, and GPS, exert extraordinary pressure on all members of the transit bus industry. Recommendations included: [121]

- Research and development costs should be shared more effectively shared among the manufacturers, FTA and transit agencies.
- Technological innovations should be more thoroughly reviewed to ensure feasibility and compatibility before incorporating them into federal assisted procurements.
- The industry should consider reducing the number and variety of technological innovations and focus only on those innovations with the greatest promise of success.
- In the context of new technology procurements, transit agencies should avoid specifying every component. It would be more cost effective for the bus manufacturers to select components.

FTA policies and regulations – Numerous comments were made regarding the need for action by the FTA. Several critical points that were addressed included:[122]

- The FTA's 12 year/500,000 mile design criteria might need to be reassessed.
- In order to better manage piggybacked procurements, FTA should consider developing a uniform bus guideline.
- The costs and benefits of *Buy America* need to be reassessed.
- The FTA should consider improving the quality and procedures of the Altoona bus test.

Vehicle procurement – A number of recommendations regarding vehicle procurement were made including:[123]

- Piggybacked procurements could be better facilitated, particularly for smaller agencies, by consolidating quantities and limiting the differences between the vehicles.
- The procurement process would be improved if communications and the exchange of information were more open. Proprietary information may create an inequitable situation for the bus manufactures.
- The process associated both with bids and Requests for Proposals (RFPs) should be streamlined. Two suggestions were made in particular – 1) the bus manufacturers should submit essential information only, such as qualifications and capacity, and 2) on the bid or RFP due date, manufacturers should submit pricing only.

- Options and option pricing should be made less complicated and risky.
- Multiple-year contract procedures need to be improved.

Standard Bus Procurement Guidelines (SBPG) – The SBPG was developed and released in 1997. Despite the efforts of many to develop an acceptable standard, many attendees to the 2000 Summit voice concern that the SBPG was being underutilized. Specifically, they noted the following:

- The SBPG needs to be updated, particularly with regard to technology.
- Transit agencies are not following the SBPG.
- A "third party" outside of FTA, APTA, transit agencies, and manufacturers should update the SBPG.
- The bus industry should start adopting performance standards.
- The bus manufacturers should have more lead time to develop components and subcomponents.

Vehicle quality – Two specific concerns about vehicle quality were voiced during the 2000 Summit:[124]

- Increased reliability may help to reduce operating costs.
- Bus quality and reliability could be improved through better standards and construction processes.

Manufacturing capacity – The utilization of manufacturing capacity was a concern articulated at the 2000 Summit. Attendees recommended using existing capacity more effectively and stabilizing the demand for buses.[125]

Human resources – Participants in the 2000 Summit also discussed vocal about shortfalls in human resources, most notably, the following needs were identified:[126]

- Provide additional training to drivers and update operator manuals to reflect current technology, vehicle components and their operation.
- Hire and train qualified transit agency employees. (Attendees asserted that some agencies were understaffed and that an industry-wide effort to recruit skilled transit employees would benefit the entire industry.)

Regrettably, most of the issues and concerns discussed at the 2000 Bus Industry Summit prevail today. Ongoing and current issues are presented in more detail on pages 57-67 and pages 71-77.

Vehicle Production

In 2004, twenty-one bus manufacturers built public transit vehicles; however, vehicle production continued to decline for the third year in a row. According to APTA's 2005 Transit Vehicle Database, a total of 3,178 buses were built in 2004.[127] This figure represents a 14.29% decline from 2003. As Figures 23 and 24 demonstrate, bus production has been declining steadily from a high production level of approximately 6,200 vehicles in 2001 to the current level. In 2004, the following five bus builders produced 2,770 vehicles or approximately 87% of transit bus production:

- Gillig Corporation
- New Flyer of America
- North American Bus Industries (NABI)
- Orion Bus Industries
- Neoplan USA Corporation

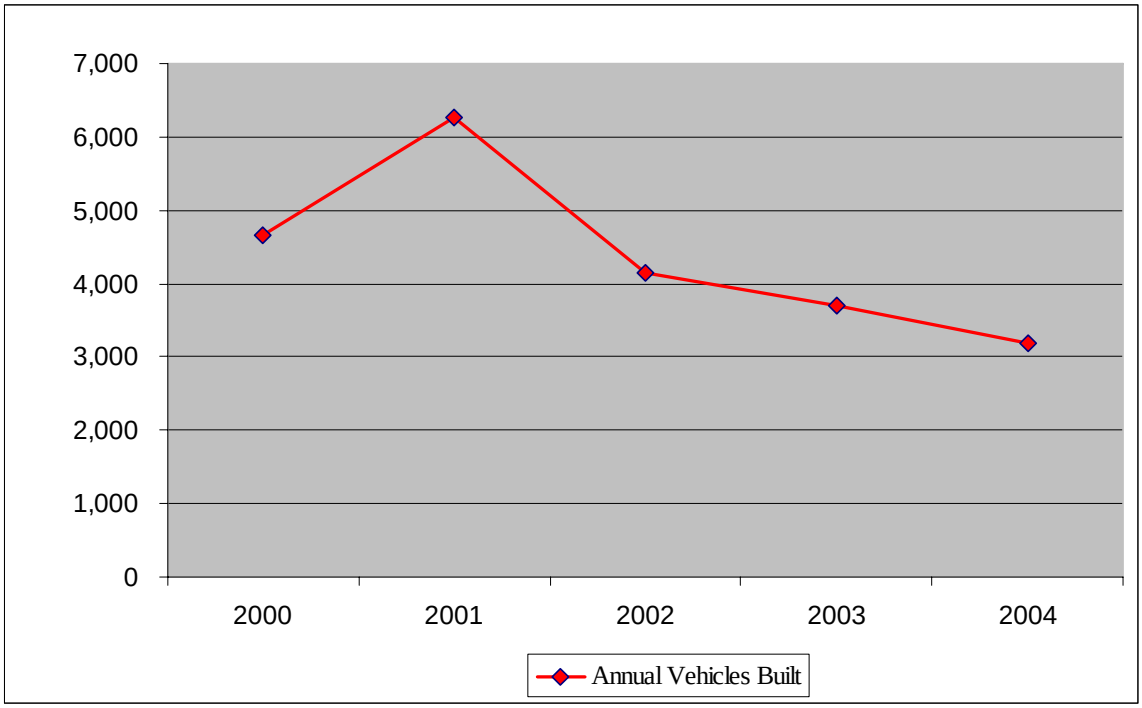
Figure 23: Bus Production Numbers*

Manufacturer	2000	2001	2002	2003	2004
BlueBird	28	114	50	19	42
Champion	27	115	45	4	34
Chance Bus	93	113	0	0	0
El Dorado-National	120	202	65	30	30
Gillig Corp.	980	1,076	1,013	908	778
Motor Coach Industries	187	911	731	421	100
Neoplan USA	142	231	253	222	98
New Flyer	1,104	1,548	629	819	1,062
North American Bus Industries	474	1,061	393	644	508
Nova Bus	587	583	378	3	0
Optima Bus	0	0	73	75	50
Orion	784	123	334	207	324
Thomas Built	25	41	12	41	4
Thomas/Dennis	10	5	40	23	0
Van Hool	0	0	2	118	0
Others	93	146	125	174	148
Total:	**4,654**	**6,269**	**4,143**	**3,708**	**3,178**
		34.70%	-33.91%	-10.50%	-14.29%

Source: *2000-2005 Transit Vehicle Database*

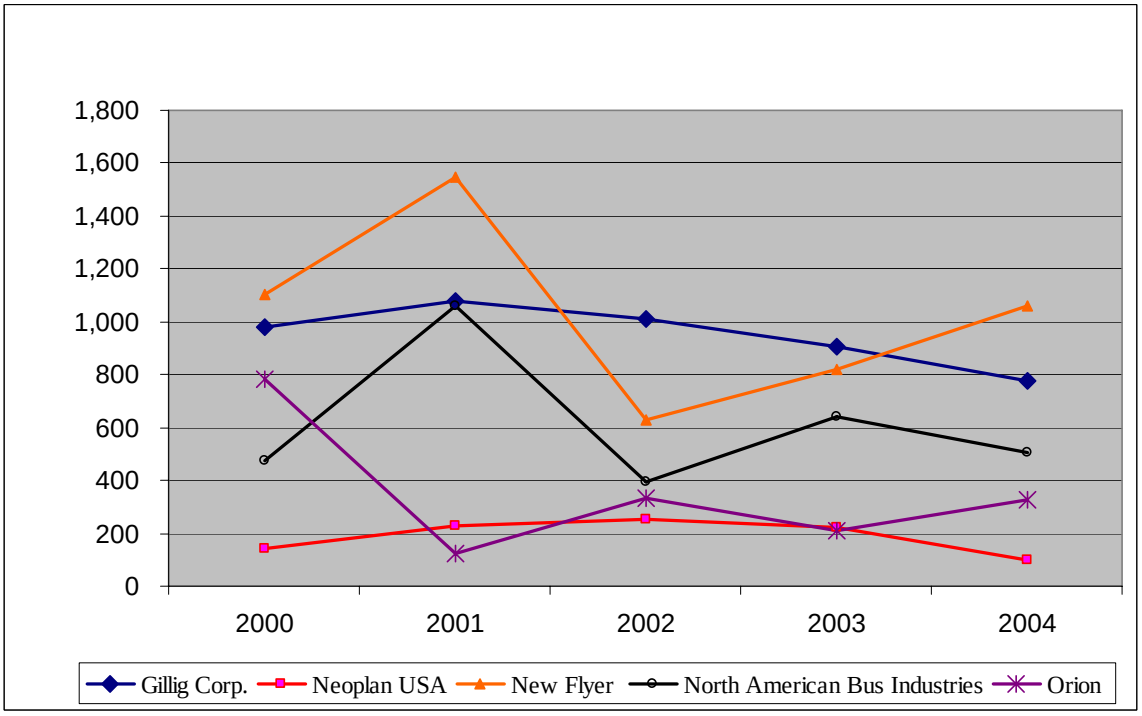
* Figure 23 represents vehicle production related only to public transportation. The quantities shown in the chart on this page reflect production for private sector customers.

Figure 24: Transit Bus Production (2000-2004)



Source: *2000-2005 Transit Vehicle Database*

Figure 25: Vehicles Built by Manufacturer



Source: *2000-2005 Transit Vehicle Database*

As Figure 25 depicts, in 2004 New Flyer of America built the largest number of vehicles — a total of 1,062 buses, representing approximately 33% of the total number of buses produced that year. Gillig Corporation was second in terms of production in 2004, followed by NABI, Orion, and Neoplan.

Of these five builders, only two builders — New Flyer and Orion — experienced production increases of 29.67% and 56.52% respectively in 2004. The remaining three experienced production declines ranging from 14% (Gillig) to 56% (Neoplan).

Vehicle Types

40-ft. Transit Bus

Among the types of non-rail transit vehicles produced in the U.S., the 40-ft. transit bus represents the single largest production volume of Gillig, NABI, Orion, Neoplan, and New Flyer. Between 2000 and 2004, these manufacturers built more than 11,300 40-ft. transit buses, which accounts for approximately 72% of the total production during the same period.

Production Numbers

40' Transit Bus

Manufacturer	2000	2001	2002	2003	2004
Gillig	567	764	646	670	473
New Flyer	726	1,402	460	521	684
NABI	355	1,044	368	438	362
Neoplan	0	0	110	100	98
Orion	713	99	308	115	291
Totals:	2,361	3,309	1,892	1,844	1,908

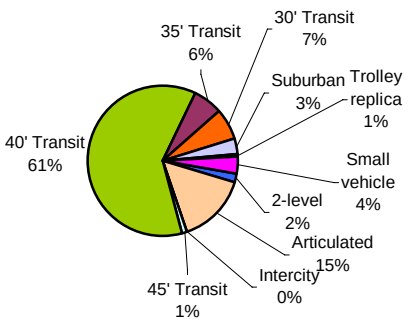
Percentages

40' Transit Bus

Manufacturer	2000	2001	2002	2003	2004
Gillig	24.02%	23.09%	34.14%	36.33%	24.79%
New Flyer	30.75%	42.37%	24.31%	28.25%	35.85%
NABI	15.04%	31.55%	19.45%	23.75%	18.97%
Neoplan	0.00%	0.00%	5.81%	5.42%	5.14%
Orion	30.20%	2.99%	16.28%	6.24%	15.25%

Source: *2000 - 2005 Transit Vehicle Database.*

Figure 26: New Buses Built in 2004



Source: *Public Transportation Fact Book*. 2005.

According to the *Transit Vehicle Database*, the five major bus manufacturers cited in the preceding chart built approximately 1,900 40-ft. transit buses in 2004. As Figure 26 illustrates, 40-ft. transit buses accounted for more than 60% of the total non-rail transit vehicle production during 2004.

New Flyer produced 684 40-ft. vehicles in 2004 — accounting for approximately 36% of the total 40-ft. transit bus production that year. Production of the 40-ft. transit bus by New Flyer reached its highest level in 2004 since the company's peak production of this vehicle in 2001.

60-ft. Articulated Transit Bus

The 60-ft. articulated bus accounted for 15% of the total non-rail transit vehicle production of 2004. Only three of the largest builders — New Flyer, NABI, and Neoplan — offer 60-ft. articulated buses.

Production Numbers

60' Articulated Bus

Manufacturer	2000	2001	2002	2003	2004
Gillig	0	0	0	0	0
New Flyer	330	45	53	228	323
NABI	119	0	25	84	146
Neoplan	142	106	106	72	0
Orion	0	0	0	0	0
Totals:	591	151	184	384	469

Percentages

60' Articulated Bus

Manufacturer	2000	2001	2002	2003	2004
Gillig	0.00%	0.00%	0.00%	0.00%	0.00%
New Flyer	55.84%	29.80%	28.80%	59.38%	68.87%
NABI	20.14%	0.00%	13.59%	21.88%	31.13%
Neoplan	24.03%	70.20%	57.61%	18.75%	0.00%
Orion	0.00%	0.00%	0.00%	0.00%	0.00%

Source: *2000 - 2005 Transit Vehicle Database.*

New Flyer currently leads the industry in production of articulated buses, producing 323 in 2004. New Flyer's production of articulated buses reached the firm's high point that year, representing nearly 69% of the total production of the articulated vehicles.

35-ft. Transit Bus

The major builders' production of the 35-ft. transit bus is significantly less than that of the 40-ft. transit bus. The 35-ft. transit bus vehicle type accounted for approximately 6% of total industry production in 2004.

Between 2000 and 2004, the five major builders produced a total of 1,278 35-ft. vehicles. This represents approximately 8% of all non-rail transit vehicles produced by these builders during that time period.

Production Numbers

35' Transit Bus

Manufacturer	2000	2001	2002	2003	2004
Gillig	128	226	240	183	134
New Flyer	31	54	59	64	25
NABI	0	0	0	29	0
Neoplan	0	0	0	0	0
Orion	14	4	0	54	33
Totals:	173	284	299	330	192

Percentages

35' Transit Bus

Manufacturer	2000	2001	2002	2003	2004
Gillig	73.99%	79.58%	80.27%	55.45%	69.79%
New Flyer	17.92%	19.01%	19.73%	19.39%	13.02%
NABI	0.00%	0.00%	0.00%	8.79%	0.00%
Neoplan	0.00%	0.00%	0.00%	0.00%	0.00%
Orion	8.09%	1.41%	0.00%	16.36%	17.19%

Source: *2000 - 2005 Transit Vehicle Database.*

Gillig Corporation produced the largest number of 35-ft. transit buses, manufacturing 911 between 2000 and 2004. Neoplan is the only builder among the top five manufacturers that does not produce 35-ft. transit buses.

30-ft. Transit Bus

The 30-ft. transit bus is offered by three of the major builders — Gillig, New Flyer, and NABI. Fewer than 800 30-ft. non-rail transit vehicles were manufactured by the major builders between 2000 and 2004. A number of other manufacturers, including Blue Bird Corporation, El Dorado-National, Mid Bus, and Optima Bus Corporation are capable of providing this vehicle type.

Production Numbers

30' Transit Bus

Manufacturer	2000	2001	2002	2003	2004
Gillig	285	74	88	18	78
New Flyer	17	47	57	6	30
NABI	0	0	0	70	0
Neoplan	0	0	0	0	0
Orion	0	0	1	2	0
Totals:	302	121	146	96	108

Percentages

30' Transit Bus

Manufacturer	2000	2001	2002	2003	2004
Gillig	94.37%	61.16%	60.27%	18.75%	72.22%
New Flyer	5.63%	38.84%	39.04%	6.25%	27.78%
NABI	0.00%	0.00%	0.00%	72.92%	0.00%
Neoplan	0.00%	0.00%	0.00%	0.00%	0.00%
Orion	0.00%	0.00%	0.68%	2.08%	0.00%

Source: *2000 - 2005 Transit Vehicle Database.*

Vehicle Fuel and Propulsion Systems

Transit bus manufacturers offer a variety of fuel and propulsion systems for their vehicles. Systems range from basic diesel to state-of-the-art hydrogen fuel cells. The most common power systems provided include:

- Diesel
- Compressed Natural Gas (CNG)
- Diesel and Electric Battery (DB)
- Liquefied Natural Gas (LNG)

Diesel

Diesel power remains the most common power system supplied by the five major builders. Between 2000 and 2004, the five major manufacturers built more than 11,500 diesel-powered transit buses. Gillig Corporation manufactured more than 4,700 diesel vehicles during that period, which represents the largest diesel vehicle production among the top five builders.

Together, the major manufacturers built 7,200 diesel-powered 40-ft. transit buses. This number accounted for approximately 63% of all diesel vehicles produced by the five major transit bus manufacturing companies between 2000 and 2004. These five bus builders also produced more than 1,500 diesel-powered 60-ft. articulated buses. Between 2000 and 2004, a total of 1,750 30-ft. and 35-ft. transit buses were manufactured by U.S. builders.

Diesel Fuel

Production Numbers

Manufacturer	2000	2001	2002	2003	2004
Gillig	980	1,056	1,013	904	748
New Flyer	767	978	398	798	591
NABI	198	196	338	488	255
Neoplan	142	231	241	178	98
Orion	618	117	30	83	57
Totals:	2,705	2,578	2,020	2,451	1,749

Percentages

Manufacturer	2000	2001	2002	2003	2004
Gillig	36.23%	40.96%	50.15%	36.88%	42.77%
New Flyer	28.35%	37.94%	19.70%	32.56%	33.79%
NABI	7.32%	7.60%	16.73%	19.91%	14.58%
Neoplan	5.25%	8.96%	11.93%	7.26%	5.60%
Orion	22.85%	4.54%	1.49%	3.39%	3.26%

Source: *2000 - 2005 Transit Vehicle Database.*

Compressed Natural Gas (CNG)

Between 2000 and 2004, three major bus manufacturers (New Flyer, NABI, and Orion) produced 3,350 CNG-powered transit buses. During this same period, NABI built more than 1,300 CNG vehicles; representing the largest production of CNG-powered transit buses during that period. More than 3,000 40-ft. transit buses were produced by these builders between 2000 and 2004. As a result, this vehicle accounted for approximately 91% of the CNG powered buses produced during that period of time.

CNG

Production Numbers

Manufacturer	2000	2001	2002	2003	2004
Gillig	0	0	0	0	0
New Flyer	337	570	216	16	127
NABI	215	655	51	133	253
Neoplan	0	0	12	44	0
Orion	141	4	304	124	148
Totals:	693	1,229	583	317	528

Percentages

Manufacturer	2000	2001	2002	2003	2004
Gillig	0.00%	0.00%	0.00%	0.00%	0.00%
New Flyer	48.63%	46.38%	37.05%	5.05%	24.05%
NABI	31.02%	53.30%	8.75%	41.96%	47.92%
Neoplan	0.00%	0.00%	2.06%	13.88%	0.00%
Orion	20.35%	0.33%	52.14%	39.12%	28.03%

Source: *2000 - 2005 Transit Vehicle Database.*

Diesel and Electric Battery (DB)

Transit buses powered by a combination of diesel and electric battery power first entered the market in 2000. Three major bus manufacturers — New Flyer, Orion, and Gillig — have built hybrid technology-powered vehicles. Between 2000 and 2004, New Flyer built the largest number of DB hybrid vehicles.

DB

Production Numbers

Manufacturer	2000	2001	2002	2003	2004
Gillig	0	0	0	4	27
New Flyer	0	0	15	5	292
NABI	0	0	0	0	0
Neoplan	0	0	0	0	0
Orion	5	2	0	0	119
Totals:	5	2	15	9	438

Percentages

Manufacturer	2000	2001	2002	2003	2004
Gillig	0.00%	0.00%	0.00%	44.44%	6.16%
New Flyer	0.00%	0.00%	100.00%	55.56%	66.67%
NABI	0.00%	0.00%	0.00%	0.00%	0.00%
Neoplan	0.00%	0.00%	0.00%	0.00%	0.00%
Orion	100.00%	100.00%	0.00%	0.00%	27.17%

Source: *2000 - 2005 Transit Vehicle Database.*

Liquefied Natural Gas (LNG)

Liquefied Natural Gas (LNG), though less popular than CNG, is provided as a power system by two of the major builders — NABI and New Flyer. Both NABI and New Flyer have built 40-ft. and 60-ft. buses powered by LNG.

Production Numbers

LNG

Manufacturer	2000	2001	2002	2003	2004
Gillig	0	0	0	0	0
New Flyer	0	0	0	0	52
NABI	61	210	4	23	0
Neoplan	0	0	0	0	0
Orion	0	0	0	0	0
Totals:	61	210	4	23	52

Percentages

Manufacturer	2000	2001	2002	2003	2004
Gillig	0.00%	0.00%	0.00%	0.00%	0.00%
New Flyer	0.00%	0.00%	0.00%	0.00%	100.00%
NABI	100.00%	100.00%	100.00%	100.00%	0.00%
Neoplan	0.00%	0.00%	0.00%	0.00%	0.00%
Orion	0.00%	0.00%	0.00%	0.00%	0.00%

Source: *2000 - 2005 Transit Vehicle Database.*

Other Fuel and Propulsion Systems

Major transit manufacturers supplied two other power systems between 2000 and 2004 – – a hybrid system powered by CNG and electric battery (CB) and a system powered by hydrogen fuel cell. Gillig Corporation was the only manufacturer to provide these power systems.

Transit Bus Technology Trends

The development of new technologies in the bus manufacturing industry is driven by the requirements of transit agencies and the federal government. Thus, the technologies highlighted here reflect federal policy and agency demands. Typically, these technologies are "bolt-on" components procured from components suppliers by the bus manufacturers. The five major transit bus manufacturers offer the following representative options:

- Automated Payment Systems
- Voice/Stop Annunciation Systems
- Vehicle Locator Systems (VLS)
- Vehicle Status Reporting Systems
- Automatic Passenger Counter Systems (APC)
- Video Surveillance Systems
- Fire Suppression Systems
- Collision Warning/ Avoidance Systems

The onset of new technologies, without question, has impacted the public transportation industry as follows:[128]

1. Initial capital costs of new buses have increased.
2. Operations and maintenance requirements and costs have gone up.
3. The complexity of design and manufacturing has threatened to disrupt the industry's supply chain.

Highlighted Procurement Issues

Procurement continues to be among the most complex and challenging issues for the U.S. transit industry. Issues associated with procurement range from bonding to standardization. In recent years, representatives of the transit industry, including APTA, FTA, NTI, and other stakeholders, have expressed a strong need to examine procurement practices.[129] The following section reviews two highlighted issues related to bus transit procurement and key issues associated with these programs — pooled procurement and the *Buy America* policy.

Buy America Policy

Originally passed by the U.S. Congress in 1978 as part of the *Surface Transportation Assistance Act*, the legislation authorizing FTA's *Buy America* policy reflects an attempt by Congress to protect the U.S. labor force and heavy industry from foreign competition. The original legislation, which specified a *preference* for products produced, mined, or manufactured in the U.S., subsequently has undergone several major amendments, including the *Surface Transportation Assistance Act of 1982* which required that all steel and manufactured products used in FTA-funded projects be produced in the U.S.[130] The 1982 amendment also included provisions for waivers to the *Buy America* policy, two of which specifically addressed the procurement of buses and other rolling stock in certain circumstances. These two factors that could result in a waiver being granted with regard to the *Buy America* policy for procurement of buses include situations in which: 1) the cost of components produced in the U.S. is more than 50% of the cost of all components of the vehicles or equipment, and 2) the inclusion of domestic material would increase the cost of the overall project contract by more than 10%.

Ultimately, the percentages relative to waivers were increased from 50% to 60% and from 10% to 25% respectively — the thresholds used today, with the exception of purchases under $100,000. Subsequent to the amendments that were passed in the 1980s, additional revisions were included in the transportation legislation of the 1990s (the *Intermodal Surface Transportation Efficiency Act* [ISTEA] *of 1991* and the *Transportation Equity Act for the 21st Century* [TEA-21] *of 1998*), most notably in ISTEA legislation, the addition of iron and iron products to the steel and manufactured products that were already covered in the policy.[131] In addition to the waiver requirements, current law also stipulates that final assembly of the vehicle be completed in the United States.[132] There are no statutory exceptions to *Buy America*, and all waivers are made on a case-by-case basis, unless codified as a general waiver.[133]

Although the policy has been enforced for a long time, the nuances and complexity of *Buy America* have often been misunderstood by transit agencies, and it appears that *Buy America* may create challenges and confusion in the transit industry that result in costly and/or delayed procurements.[134] In addition, the legislative history of *Buy America* lends itself to confusion with other federal laws and trade agreements, such as the *1933 Buy American Act* and the *North American Free Trade Agreement* (NAFTA).[135]

The *Buy America* policy is "…one of the most politically sensitive" requirements associated with federal funding for transit procurements.[136] The issue of whether the policy is out-of-date in light of increasing globalization of manufacturing, or still applicable to today's transit procurement environment, continues to be debated. Nevertheless, the policy is a key factor in transit procurements, and U.S. transit agencies as well as bus manufacturers are required to comply with the complex requirements of the policy in order to avoid being impacted negatively by the rule.

Opinions and assessments of the *Buy America* policy vary among the transit agencies and bus manufacturers that participated in this study. Most of the surveyed transit agencies indicated that the *Buy America* policy has not affected procurement practices and that they fully support the policy, while the bus manufacturers' responses were more divided. Some of the issues mentioned by those that oppose *Buy America* include:

- Potential increase in price of U.S. buses and inefficient use of resources
- Contradictory procurement requirements by transit agencies that specify foreign-made components
- Restrictions in procuring (or supplying) new technology and equipment
- Lack of effectiveness of waivers and protests

These issues are presented in more detail on pages 53, 62, 65-66 and 93 of this report.

Pooled Procurement

Pooled purchasing, often described as an effort to standardize specifications and contracting, is emerging as a topic of interest (or concern) for transit agencies and bus manufacturers. In 2004, Congress directed FTA to establish a pilot program, the Cooperative Procurement Pilot Program (CPPP), for the shared procurement of major capital equipment purchased by U.S. transit agencies.[137] The purpose of the program is to develop innovative procurement practices that provide significant benefits to the public transit industry including, but not limited to, cost savings, efficiency in the procurement process, and aggregating equipment requirements with other transit agencies. In November 2004, FTA selected three projects among the proposals submitted for the program.[138] The participants will receive a 90% share of federal grants to purchase major capital equipment, compared to the 80% cost share under standard funding provisions.[139]

CPPP Projects and Program Participants

- **30-ft, 35-ft, and 40-ft diesel-powered buses** — Consortium led by STV with nine transit agency participants (Capital District Transportation Authority, Corpus Christi Regional Transportation Authority, GRTC Transit System, Greater Portland Transit District, Pinellas Suncoast Transit Authority, Southwest Ohio Regional Transit Authority, Springs Transit, Toledo Area Regional Transit Authority, and Worcester Regional Transit Authority)
- **Diesel-powered cutaways** — Texas Department of Transportation
- **CNG-powered buses** — Regional Transportation Commission of Southern Nevada with four transit agencies (Orange County Transit, City of Phoenix Public Transit Department, Spokane Transit Authority, and Southern Nevada Transit Coalition)

Although not specifically related to bus purchases, the innovative procurement approach has been tested also by transit agencies at the state level for procuring ITS-related products. In 2004, the Iowa Rural Transit ITS Consortium (IRTIC), led by the Iowa Department of Transportation, combined efforts of fourteen of the sixteen regional transit agencies in Iowa to purchase ITS computing devices to upgrade communications systems and routing/scheduling processes.[140] As the only statewide ITS purchase and deployment consortium in the U.S., the shared procurement approach allowed smaller transit agencies to acquire ITS technology. Without this collaborative approach, each of the participating agencies could not have afforded to procure the technology independently.

The general consensus among transit agencies and bus manufacturers that participated in this study is that pooled procurement may be helpful for smaller transit agencies. Some issues voiced by the industry about this procurement method include:

- Ability of a single specification to satisfy the requirements of all participating transit agencies
- Program control and mass customization
- Lack of clear definition from the FTA regarding the pilot program

These issues are discussed in more detail on pages 53, 66-67 and 92-93 of this report.

Transit Agency Survey Results and Manufacturer Questionnaire & Interview Results

The Federal Transit Administration (FTA) conducted primary research through interviews and surveys of representatives of the nation's leading bus manufacturers and nine transit agencies in order to investigate the viability of the non-rail vehicle (bus) market in the United States. Survey and interview results confirmed the preliminary findings (outlined in the *Market Overview* chapter) that bus manufacturers currently are facing significant market challenges. These challenges threaten the manufacturers' ability to provide the types and quantities of buses that are required by U.S. public transit systems. This chapter presents key findings from surveys distributed to the nine representative transit agencies and four bus manufacturers, as well as in-depth interviews conducted with the respective bus manufacturer representatives.

Transit Agency Survey: Summary Analysis

The perspective of U.S. transit agencies with varying fleet sizes and characteristics, as well as demographic differences, is an important component of FTA's Non-rail Vehicle Market Viability Study. During the summer of 2005, the FTA surveyed nine transit agencies that were pre-selected as a representative sample group to provide information relative to buses and bus procurement practices.

From among twenty transit agencies suggested initially, FTA selected three large, three medium-sized, and three small transit agencies operating in various geographic locations of the U.S. to be included in the study. The transit agencies cited in the list that follows were selected to reflect diverse characteristics including population size, number of vehicles available for maximum service, number of annual unlinked trips, and geographic location:

Figure 27: Nine Transit Agencies Listed in Order of Annual Unlinked Trips

Transit Agency	City and State	Geographic Region	Urbanized Area Population[141]	Bus Fleet Size as of July 2005[142]	Annual Unlinked Trips (bus)[143]
MTA New York City Transit (NYCT)	New York, New York	Northeast	17,799,861	4,494	911,622,748
King County Dept. of Transportation (KC Metro)		West	2,712,205	1,407	70,380,463
	Miami, Florida	Southeast	4,919,036	916	64,546,632
City of Phoenix Public Transit Department (ValleyMetro)	Phoenix, Arizona	Southwest	2,907,049	449	40,635,507
Charlotte Area Transit System (CATS)	Charlotte, North Carolina	Southeast	758,927	326	18,389,837

Indianapolis Public Transportation Corporation (IndyGo)	Indianapolis, Indiana	Central	1,218,919	131	11,015,152
Chittenden County Transportation Authority (CCTA)	Burlington, Vermont	Northeast	105,365	52	1,654,693
City of Jackson Transit System (JATRAN)	Jackson, Mississippi	South	292,637	40	782,635
Santa Fe Trails - City of Santa Fe (SFT)	Santa Fe, New Mexico	Southwest	80,337	25	577,682

The survey instrument focused on the nine agencies' bus operations and procurements, including:

- Bus fleet size & type
- New purchases & delivery
- Bus services & needs
- New technology
- Procurement issues

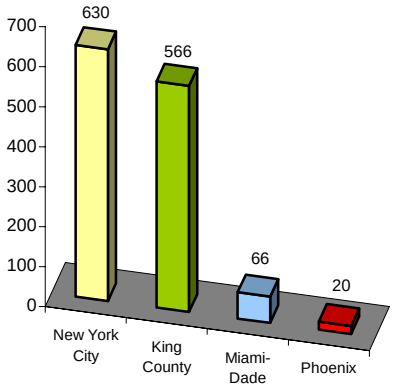
The following analysis summarizes key survey responses submitted by the nine transit agencies that participated in the survey.

Fleet Size & Type

In terms of vehicle size, transit agencies experience varying needs based upon the nature of the service area. For example, Santa Fe Trails in Santa Fe, New Mexico currently runs a small fleet of only twenty-five 30-ft. transit buses, while other transit agencies in similar-sized cities such as Burlington, Vermont have a more diverse fleet that includes 40-ft., 35-ft., and 30-ft. transit buses as well as seven small vehicles.

Articulated Buses — Articulated vehicles, while increasingly standard in large and even mid-sized cities, generally are not procured by smaller agencies including those smaller agencies participating in the survey. Among those surveyed, four transit agencies operate a total of 1,282 articulated vehicles as of August 2005.

Figure 28: Surveyed Agencies Operating Articulated Vehicles



As of August 2005, of the 1,407 vehicles operated by King County (of which 1,306 are owned), roughly 40% of the vehicles are articulated buses. Since 1978 when King County Metro first purchased 151 articulated buses, the agency has continued to increase its articulated fleet size and has built appropriate garage facilities.[144] According to a King County Metro representative, two articulated buses can transport as many passengers as three 40-ft. buses. The transit

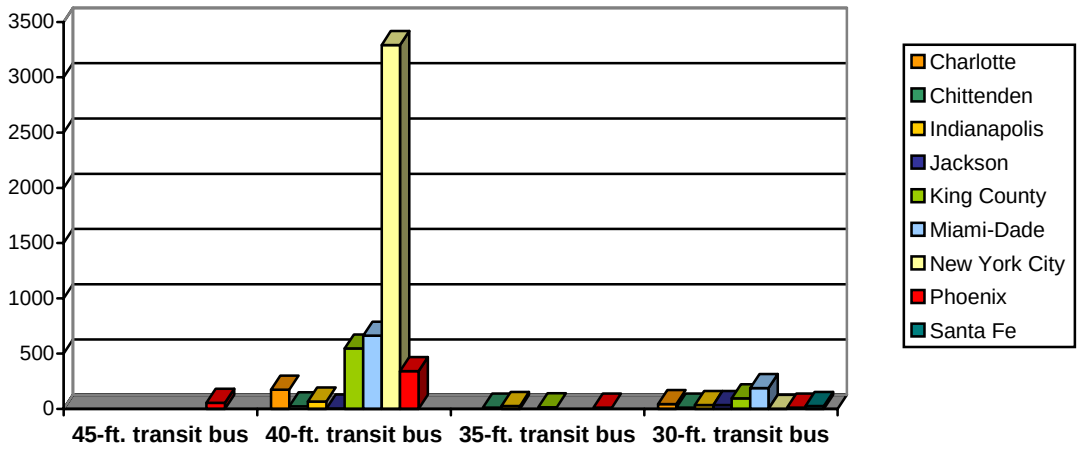
agency representative commented further that the benefits of large seating capacities for peak-hour ridership, coupled with the agency's history of large procurements, have led to its high percentage of articulated buses. By 2012, the agency plans to increase its inventory so that 50% of its fleet will be articulated vehicles.[145]

Although MTA New York operates the largest number of articulated vehicles, its 630 articulated buses represent only 14% of NYCT's fleet of 4,494 vehicles. Articulated buses represent 7.2% of the Miami-Dade fleet and 4.5% of the Phoenix fleet.

Intercity Buses — Among various bus types, intercity buses are not commonly used by public transit agencies; however, in New York City's large and diverse transit system, 571 intercity buses represent 12.7% of the fleet of 4,494 buses.

45-ft., 40-ft., 35-ft. and 30-ft. Transit Buses — 40-ft. transit buses are the most common size non-rail vehicle in the U.S. The next larger size, the 45-ft. transit bus, is less frequently procured by U.S. transit agencies. Among the nine surveyed agencies, only the City of Phoenix Public Transit Department operates 45-ft. buses with a fleet of 56 (or 12.5%) out of a total number of 449 buses.

Figure 29: 45-ft, 40-ft, 35-ft & 30-ft Transit Buses



Of the agencies surveyed, all but the smallest — Santa Fe Trails — operate 40-ft. transit buses. Santa Fe's fleet consists only of 30-ft. transit buses. Other smaller agencies also rely heavily upon 30-ft. transit buses. Among the agencies surveyed, 40-ft. and 30-ft. vehicles were the most prevalent buses in the fleets. The chart that follows shows the percentage of 40-ft. and 30-ft. buses among the total number of non-rail vehicles per participating agency.

Figure 30: Percentage of 40-ft. and 30-ft. Buses per Total Non-rail Vehicles

Transit Agency	Total 40' & 30' Fleet Size	40' Buses (no. of vehicles)	40' Buses (% of total fleet)	30' Buses (no. of vehicles)	30' Buses (% of total fleet)
MTA New York City Transit	4,494	3,293	73.3%	—	––
King County Dept. of Transportation	1,407	547	38.9%	95	6.7%
Miami-Dade Transit	916	662	72.3%	188	20.5%
City of Phoenix Public Transit Department	449	341	75.9%	12	2.7%
Charlotte Area Transit System	326	173	53.0%	42	12.8%
Indianapolis Public Transportation Corp.	131	67	51.0%	34	25.9%
Chittenden County Transportation Authority	52	22	42.0%	11	21.2%
City of Jackson Transit System	40	3	7.5%	34	85.0%
Santa Fe Trails – City of Santa Fe	25	—	—	25	100.0%

Only four agencies of the nine surveyed operate 35-ft. vehicles. In Chittenden County and Indianapolis, 35-ft. vehicles represent approximately 20% of the total fleets while in King County and Phoenix, less than 3% of the fleets are comprised of 35-ft. buses.

Suburban, Trolley Replica, and Small Vehicles — Suburban, trolley replicas and small vehicles represent smaller market segments in the U.S. non-rail vehicle market. According to those agencies surveyed, only Charlotte operates suburban vehicles. Four transit systems among the agencies surveyed — Chittenden County, Indianapolis; King County; and Phoenix — own and operate small vehicles. Both Charlotte and Jackson — towns attempting to reflect community ties to the past — operate trolley replicas with vintage exteriors, as well as interiors, designed to resemble trolleys from the early 1900s.

Trolleybuses — Only four transit agencies in the U.S. operate trolleybuses (vehicles propelled by a motor using an overhead system of wires). These agencies are in Boston, Massachusetts; Dayton, Ohio; San Francisco, California; and Seattle, Washington. The King County Department of Transportation in Seattle operates 149 trolleybuses — 10% of Seattle's fleet.

New Purchases & Delivery

2005 Purchasing Decisions

Six of the nine agencies surveyed had purchased, or developed purchase plans for, new vehicles in 2005. Among the nine agencies surveyed, none had purchased 45-ft. transit buses, 35-ft. transit buses, suburban vehicles, trolley replicas, small vehicles, or trolleybuses in 2005 (reflecting the timeframe of the survey period).

Primary reasons for selecting certain vehicle types relate to a number of factors, including the necessity to replace aging vehicles, service expansion and unique features of new vehicles. Charlotte, Miami-Dade, and Phoenix were among the agencies listing service expansion as a catalyst for procurement. Vehicle replacement was a primary factor in 2005 vehicle procurement for Phoenix, New York City and Chittenden County. MTA

New York City Transit also noted that fuel economy in hybrid-electric buses was a factor in purchasing. Sometimes physical attributes of newer vehicles play a role in vehicle procurement. Indianapolis observed that vehicle size, unique styling as well as driver amenities contributed to purchasing decisions.

Among the agencies that did not procure vehicles in 2005 (Jackson, King County and Santa Fe), primary reasons for not purchasing new vehicles included 2005 budget allowances, 2004 procurements as well as future procurement plans. Jackson and Santa Fe both noted that vehicle procurement is upcoming, with Jackson anticipating vehicle purchases in FY 2006 and Santa Fe expecting an RFP for new vehicles in November 2005. King County's fleet plan, which included substantial vehicle procurements in 2004, did not require vehicle procurement in 2005.

Articulated buses — Because of the greater length and complexity, articulated buses typically cost about $200,000 more than the more common 40-ft. transit bus. Also, various upgrades and amenities influence costs. For example, in 2005, Phoenix purchased fifteen articulated buses at a cost of $518,000 per vehicle, thirty-five 40-ft. buses at $400,000 per vehicle and seven 30-ft. transit buses at $330,000 per vehicle. Representative of the range of vehicle costs, Phoenix purchased 30-ft. vehicles at a cost $75,000 greater than Charlotte's 30-ft. vehicles (which cost the Charlotte Area Transit System $255,000 each).

45-ft. and 40-ft. Transit Buses — With a purchase decision of 100 hybrid 40-ft. transit buses (with option for an additional 400) as of August 2005, New York City Transit ordered the greatest number of buses in 2005 among the nine agencies surveyed. (By October, New York had ordered 216 hybrid buses for delivery to begin in 2006.) Miami-Dade followed with a total of 92 bus procurements and Phoenix with a total of 57 fleet vehicle purchases. Cost data for New York remains undetermined; however, Miami-Dade listed costs totaling $29.4 million for the procurement of intercity buses and 40-ft. transit buses. The average price per 40-ft. vehicle was approximately $300,000 in Miami.

2005 Vehicle Deliveries

Among transit vehicles delivered in 2005, none of the agencies surveyed took delivery of articulated, 35-ft., suburban, trolley replica, small vehicle, or trolleybus vehicles. Of the nine agencies surveyed, 2005 vehicle deliveries included:

Figure 31: 2005 Vehicle Deliveries

Vehicles Type Delivered	Transit Agency	No. of Vehicles	Year Ordered
Intercity bus	Miami-Dade	8 (45-ft.)	2005
40-ft. Transit bus	Charlotte	2	2004
	Miami-Dade	84	2004 (70); 2005 (14)
	New York City	206	2000
30-ft. Transit bus	Charlotte	4	2004
	Santa Fe	7	2006

As indicated in the preceding chart, most of the vehicles delivered in 2005 represent orders placed in 2004 or 2005. An exception is New York, which placed its order for 206 40-ft. hybrid electric transit buses in 2000. Another exception is Santa Fe, which noted that seven 30-ft. vehicles will be ordered in February 2006 (and therefore not delivered in 2005).

Fleet Vehicle Retirement

On an annual basis, hundreds of buses may be retired across the nation. Among the nine agencies surveyed, three agencies retired a total of more than 150 buses primarily because the buses had reached, or exceeded, the vehicle's useful life span. In 2005, there were no vehicles retired in Chittenden County, Indianapolis, Jackson, Miami-Dade, Phoenix, or Santa Fe. Buses that were retired in King County and New York City had reached an average age of more than fifteen years.

Bus Services & Needs

Fixed-Route Transit Bus Services

In most cities, ridership correlates to population size, which impacts the number of bus routes and types of bus service that transit agencies provide to communities. The survey respondents provided information about the respective agencies' current fixed-route transit bus services and those being planned over the next five to seven years. A review of the survey responses confirms that transit agencies located in areas with relatively large populations provide greater numbers of local routes and various types of service, including local, express, limited-stop, and/or bus rapid transit (BRT). Transit agencies that serve relatively small communities provide fewer numbers of local routes and one or two types of bus service.

Regarding new bus service, all of the surveyed agencies, except for one, indicated plans to expand bus service by increasing the number of routes and/or providing new types of service. Four transit agencies located in large cities (or a county) plan to increase the number of routes for all four types of service.

Critical Vehicle Types

Vehicle types and sizes that are critical for current and future operations of transit agencies reflect each agency's operating environments, including service area climate, population size, and community needs.

- Four transit agencies that serve large numbers of riders need high-capacity vehicles (e.g. 60-ft. articulated buses) as well as a variety of sizes of vehicles ranging from 30-ft. to 45-ft. buses.
- Three transit agencies that serve less populated areas, or that provide only local service, prefer smaller vehicles (e.g. 25- to 30-ft. buses) for reasons related to fuel economy and plans for increased services.
- Transit agencies located in northern states need to consider durability of vehicles that operate well in road conditions with high frequency of salting. One agency observed, "…We would like a 25' bus with a stainless steel undercarriage. We

operate in a northern climate with lots of road salt, and smaller, medium- or light-duty buses don't age well in our environment."

- Two agencies located in the western states intend to purchase buses with alternative fuels (e.g. LNG or CNG). One transit agency commented on the local policy that requires the agency to maintain a fleet in which LNG fuels at least 70% of the buses. Thus, the agency intends to purchase 40-ft. LNG buses.
- One agency observed that low-floor buses have become a standard in the region and indicated that the agency will replace all high-floor buses with low-floor ones in the next few years.

Bus-Related Challenges

The nine transit agencies surveyed predict that they will face significant challenges over the next five to seven years, including:
(Parentheses indicate the number of agencies citing the particular concern.)

- Implementation of new technology (4)
- Maintenance of vehicles (4)
- Training of technicians (3)
- Budgetary issues associated with higher operating costs (3)
- Handling alternative fuel (2)
- Compliance with federal and local regulations (1)

The issues of maintenance, technical training, and implementation of new technology/alternative fuel sources are inter-related for some of the transit agencies surveyed. Three agencies addressed challenges of implementing new technologies associated with vehicle maintenance and training to handle new technologies. One respondent indicated that management of maintenance programs and operation cycles for the agency's diverse bus fleet poses the most difficult challenge, as well as integrating new technological features on buses and increased use of alternative fuels/propulsion systems. Three agencies that provide smaller-scale bus service (i.e. only one or two types of bus service) addressed budgetary issues associated with increased operating costs due to higher fuel costs and parts inventories.

New Technology

"Must Have" Technology

Innovative technologies enhance the convenience, efficiency, accessibility and safety of public transportation. New transit bus technologies can be categorized into customer/demand-oriented technology and operations-oriented technology types. Survey respondents highlighted the following technology types as "must haves" in the next five to seven years (if cost were not an issue.):

Figure 32: "Must Have" Bus Technology

Customer/Demand-Oriented	Operations-Oriented
	▪ Automatic Vehicle Location (AVL) (6 agencies – 67%) ▪ Safety and security devices (5 agencies – 56%)

	▪ Automatic Passenger Counters (APC) (5 agencies – 56%) ▪ Obstacle detection device (3 agencies – 33%) ▪ Maintenance systems (3 agencies – 33%) ▪ Radio and data communication systems (2 agencies – 22%)

Survey responses demonstrated that new and innovative technologies are desired by all surveyed transit agencies, regardless of agency size. Automatic Vehicle Location (AVL) was the most frequently cited "must have" technology, followed by technology related to safety and security. Safety and security devices that were mentioned by the survey respondents included on-vehicle video and audio surveillance systems, passenger screening devices, and passenger safety devices such as wheelchair restraints and seat belts. Automatic Passenger Counters (APC) and automated payment systems were cited next, with five agencies expressing interest in the technology.

Alternative Power Source

In the context of new technologies, the surveyed agencies provided information on fuel types and propulsion systems. Five out of nine agencies indicated that ultra-low sulfur diesel (i.e. "clean" diesel) is being used for all, or some, of the agencies' transit bus fleets. Among the transit agencies that do not use "clean" diesel, Santa Fe Trails uses alternative fuel for 100% of its fleet. Seven of the nine agencies (78%) currently use, or plan to use in the next five to seven years, power sources other than diesel and/or gasoline. The two agencies that do not currently use, or plan to use, alternative power sources cited costs and lack of local government initiative as reasons for not introducing alternative fuels.

Fuel efficiency, response to public demand, and public relations were the main drivers for transit agencies to procure buses with alternative fuel/propulsion systems. Other motivators included goals to reduce emissions, long-term cost savings, and compliance with state/local mandates for alternative fuel usage. One agency noted that alternative fuel buses would help the agency "reach toward the leading edge in industry." Four agencies indicated that the goals have been fully met, while two agencies noted that goals remain largely unmet. Another indicated that the agency has not yet put alternative fuel buses into service.

Diesel-electric hybrid is the most commonly used alternative power source among the survey respondents. Five mid- to large-sized agencies currently operate, or plan to operate, diesel-electric hybrid buses. The number of hybrid vehicles owned by each agency varies from as few as two in Charlotte to more than 1,000 in New York City. Miami-Dade Transit reported its plans to procure approximately 400 diesel-electric hybrid and hydrogen fuel-cell, as well as 1,000 biodiesel, buses in the next five to seven years. Although the Chittenden County Transportation Authority currently does not own "clean" diesel/alternative fuel buses, an agency representative commented that "…we see our future in the hybrid technologies with ultra low sulfur diesel and diesel particulate filters." Biodiesel was the next most cited alternative power source, with three agencies currently using, or planning to use, the fuel type. Transit agencies that currently own

alternative fuel buses indicated various amounts of capital costs and maintenance & operations costs, depending on the number of vehicles owned and operated.

Procurement Issues

Participating transit agencies were surveyed for input on pooled procurement, *Buy America* and challenges that the agencies face today with regard to the procurement of buses. Opinions expressed by the agencies were, in general, similar in many respects, regardless of geographic location or agency size.

Pooled Procurement

Seven of the nine agencies expressed optimism regarding pooled procurement. Two of the respondents currently are participating in a pooled procurement program. Three agencies indicated that pooled procurement would benefit small transit properties. Predominant reasons for supporting the approach included reducing cost and saving time. One agency commented that pooled procurement "…is an excellent idea, especially for compliance with *Buy America* requirements. This would also benefit small agencies that do not have sufficient staff and/or technical expertise in bus procurements."

Although most of the surveyed agencies indicated enthusiasm for pooled procurement, the responses also included qualifiers such as the availability of options. One agency commented that pooled procurement "…is a good concept, provided there is the flexibility for agencies seeking extra 'bells and whistles'…" Another agency expressed optimism but also indicated concerns about "…the ability to satisfy the requirements of all interested agencies with a single specification." Two other agencies indicated that a pooled procurement approach would not address the agencies' diverse needs, specification requirements, and funding availability adequately.

***Buy America* Policy**

Most of the transit agency survey respondents observed that the *Buy America* policy has not affected their procurement practices. Comments varied with regard to the impact of *Buy America*. The policy is not applicable for some agencies that make small purchases (i.e. below the *Buy America* threshold) or for those agencies that do not use federal funding for bus procurement. Some agencies indicated that they fully comply with, and support, the policy. One agency representative reported the agency's "…full support of the *Buy America* program whether our rolling stock purchases are federally funded or not."

A different opinion was expressed by one survey respondent, who commented, "…the *Buy America* policy severely restricts agencies' ability to procure new technology and equipment. As new technologies are developed outside of the United States, special consideration should be given to exclude them from *Buy America* until companies in the United States are producing them. This should be a priority for items that are safety-related, [and that] help the environment, as related to pollution [mitigation] and fuel usage reduction."

Current Challenges

In response to the question about the significant challenges that transit agencies currently face with regard to bus procurement, four respondents expressed some kind of concern about the U.S. bus manufacturing industry. One respondent expressed concern about the "financial health of the industry and the potential for reductions in the number of manufacturers that can meet [the] *Buy America*" requirement. Two other agencies reported that the limited number of U.S. manufacturers poses a challenge.

Another agency commented on high maintenance and operations costs due to current warranty standards and the impression that "…while vehicle manufacturers are trying to keep costs down, the post-delivery and long-term maintenance and operations costs are not of apparent concern to the manufacturers." Other challenges reported that related to procurement included funding issues, cost and lead times, quality control and quality assurance, as well as limited staff and expertise to prepare adequate specifications and RFPs.

Findings Based on Questionnaires and Interviews with Four U.S. Transit Bus Manufacturers

The transit bus industry is one of the least profitable industries in the United States. As the CEO of one of the four U.S. transit bus manufacturers mentioned jocularly during an interview in the research phase of this study: "[If] you want to … make a small fortune in the transit bus industry — start with a large one." As described earlier in the *Market Overview*, at least ten transit bus manufacturers that previously served the U.S. market have gone out of business during the last decade. The latest example, Neoplan, was once considered among the top five U.S. transit bus builders — the firm stopped selling buses in September 2005. Today, only four major transit bus manufacturers remain in the U.S. market, including:

- Gillig Corporation
- New Flyer of America Inc.
- North American Bus Industries (NABI)
- Orion Bus Industries, a division of DaimlerChrysler Commercial Buses, N.A.

In an effort to provide a better understanding of the challenges faced by the transit bus industry, two analytical tools were developed:

- A financial performance questionnaire, which was sent to the four major U.S. transit bus manufacturers in early August
- A comprehensive, face-to-face interview with company executives

The following analysis highlights key results of the questionnaire and interview findings based on information provided by the four major U.S. bus manufacturers that participated in the study.

Financial Performance Questionnaire: Summarized Results

Financial Performance

Annual Sales Volumes — The annual sales volumes of the top four U.S. transit bus manufacturers have fluctuated significantly since 2000. Average industry sales ranged from a low of approximately $270 million in 2000 to a high of $376 million in 2004. The median industry volume over the same period ranged from a low of approximately $230 million in 2000 to a high of $331 million in 2004.

Annual Sales Volume by Vehicle Type ($) — As noted in the *Market Overview*, the 40-ft. transit bus has dominated market sales since 2000. During the six-year period (which includes 2005 estimates), the top four bus manufacturers have sold approximately $3.5 billion worth of 40-ft. transit buses. Sales volume associated with the 60-ft. articulated bus is second, with estimated sales of approximately $900 million (over the six-year period, 2000–2005). Despite the lower unit volume associated with the 60-ft. articulated bus, the average price exceeds that of the 40-ft. bus, thereby raising the dollar sales volume of the 60-ft. articulated bus.

Annual Sales Volume by Market Sector — Three of the four largest bus manufacturers conduct 100% of past and current business with public transit agencies. Total sales volume associated with public transit agencies amounted to approximately $5.3 billion from 2000 through 2005 (including 2005 estimates). Only one of the participating transit bus manufacturers diversifies its distribution. This company conducts 80% of its business with public transit agencies and the remaining 20% with private sector customers.

Average Number of Days Sales Outstanding (DSO) per year — This measurement examines the average number of days it take a company to receive payments on its accounts receivable. A higher number indicates trouble with collections. A lower number indicates that a company's credit policies are working correctly. The four largest transit bus manufacturers only provided complete data for 2003-2005 (including 2005 estimates). Based on that data, the average DSO from 2003-2005 ranged from 49 days to 51.37 days. The median DSO for the same period ranged from 46.5 days to 51.5 days. The highest average and median DSO occurred during 2004.

Annual Capital Expenditures ($) — Because one of the four bus manufacturers supplied data only from 2003-2005 (with estimates for 2005), data was analyzed for the same period of time for all four manufacturers. The amount varied greatly from year to year and from company to company. Average capital expenditures ranged from a low in 2003 of approximately $1.6 million to an estimated high in 2005 of just over $2.2 million. Median capital expenditures for the same period ranged from a low of $1 million in 2004 to an estimated high of $1.9 million in 2005.

Average Days of Working Capital per Year — This measurement examines the number of days required to convert working capital (current asset – current liabilities)

into revenue. A lower number is preferred because it indicates that less working capital is required to generate the same level of sales. Only two manufacturers responded to this question. One builder indicated that it averaged nine days of working capital, while the other indicated an average of sixty days. Clearly, the first company has been generating sales with less working capital.

Average Long-Term Debt to Working Capital — This measurement indicates the level to which a company is relying on long-term debt to fund its operations. None of the four participating transit bus manufacturers chose to answer this question. It is, however, public knowledge that at least two, among the four, manufacturers recently have taken on new and significant debt obligations.

Average Return on Net Assets Employed (RONAE) — This measurement indicates profit as a percentage of net operating assets and measures the strength of a company's ability to manage and allocate resources. Only one of the four largest transit bus manufacturers has consistently achieved a positive RONAE from 2000-2005 (with an estimate for 2005). Two of the other three experienced negative RONAE in different years from 2000-2005 (estimated). Multiple negative RONAE indicates just how difficult it has been for bus manufacturers to generate a profit over the last six years.

Production Capacity

Number of Production Facilities — Three of the top four bus manufacturers operate two or more facilities. Of these, two operate facilities in the United States and Canada. One company operates two plants located in one town, and the other company operates one facility.

Location of Production Facilities — Production facilities of the four largest bus manufacturers are sited in the following locations:

- Hayward, California
- Anniston, Alabama
- Oriskany, New York
- Mississauga, Ontario, Canada
- Winnipeg, Manitoba, Canada
- Crookston, Minnesota
- St. Cloud, Minnesota

Number of Production Lines — The four largest transit bus manufacturers generally operated at least two production lines per facility. Production lines are decreased to one line when the volume decreases. Several companies have the ability to add production lines should demand increase significantly.

Annual Production Volume (units) — As discussed in the *Market Overview*, annual bus production from the four largest transit bus manufacturers varied significantly during the period from 2000 to 2005. Total bus production figures for this period were:

Figure 33: Annual Production Volume

Year	Number of Units
2000	3,812
2001	5,118
2002	4,016
2003	4,396
2004	5,092
2005	4,103

Production Materials and Components

Average Number of Raw Materials and Components Suppliers — The top four transit bus manufacturers work with an average of 587 different raw materials and components suppliers. The largest number of suppliers to any one of the four builders is 1,253, and the smallest number of suppliers used by any one of the surveyed manufacturers is 288.

Average Raw Materials & Components Cost as a Percentage of Cost of Goods Sold (COGS) — A total COGS consists of three elements — materials/components, labor, and overhead. The measurement reviewed in this section estimates the materials and components portion of the COGS. Two of the four bus manufacturers were unable to provide historical data dating back to 2000. Therefore, the analysis measures results from 2003-2005 (with estimates for 2005). During that period, materials and components accounted for an average of 78.63% of the total COGS. The median during the same period was 76.25% of COGS. The highest cost of materials encountered by any of the four bus manufacturers was 90% in 2004. Based upon percentage of costs, materials and components constitute a significant portion of non-rail transit vehicle costs.

Labor

Union versus Non-Union — All but one of the top four transit bus manufacturers operates one or more unionized facilities.

Number of Full-Time Manufacturing Employees — The top four transit bus builders employ a total of nearly 3,000 manufacturing workers.

Full-Time Production Employees per Facility — The following table lists the number of full-time employees per manufacturing facility.

Figure 34: Full-Time Employees per Manufacturing Facility

Builder/Facility	Total Employees	Direct Employees	Indirect Employees
A	600	540	60
B/1	658	489	169
B/2	216	166	50
B/3	358	280	78
C/1	374	283	91
C/2	288	216	72
D	388	245	143
Totals:	**2,882**	**2,219**	**663**

Direct Labor[♦] Cost as a Percentage of COGS — This measures the amount of direct labor included in the COGS. Of the total number of full-time employees listed in the chart on this page, 77% are direct labor employees — included in the labor portion of COGS, and 23% are indirect labor employees generally included in the overhead portion of COGS. The distribution of direct labor versus indirect labor varies by manufacturer. The highest percentage of direct labor (among the four representative bus manufacturers participating in the study) was 90%, while 63.14% was the lowest percentage among the four manufacturers.

Indirect Labor as a Percentage of COGS — This measurement examines the percentage of indirect labor (e.g., forklift operators, maintenance, etc.) included in the COGS — the lower the percentage of indirect labor, the more efficient the operation.

Since none of the manufacturers provided historical data prior to 2003, this analysis is based on 2003-2005 (with estimates for 2005). The average percentage of indirect labor reported by the four manufacturers during this period was 2.39%, and the median for the same period was 2%. The highest average indirect labor rate is expected in 2005 at 2.38%. The lowest average rate of indirect labor occurred in 2004 at 2.08%. During the 2003-2005 period, the highest indirect labor rate of any one of the four manufacturers was 5.2%, and the lowest rate of any one of the four manufacturers was 0.5%

Number of Technical Employees — The transit bus industry requires significant engineering capacity. For most of the four largest transit bus manufacturers, the engineering department represents the single largest salaried department. The average number of technical support staff for the top four manufacturers is 92; the median is 51. The highest number of technical support staff employed by one manufacturer is 241, and the lowest is 25.

Annual Healthcare Costs ($) — Increases in annual healthcare costs have caused a substantial financial impact on all four companies. During the period 2000-2005 (with estimates for 2005), the four bus manufacturers averaged $3.57 million in healthcare costs. The median among the four during the same period was $3.75 million. The highest

[♦] Manufacturing direct labor includes fabrication, assembly, inspection, and test for constructing the end product. Engineering direct labor consists of engineering labors such as reliability, quality assurance, test, design, etc., that are readily identified with the end product. (Source: U.S. Department of Labor.)

amount paid by a single manufacturer (among the four) was $6.65 million in 2000. The average 2005 healthcare cost of the four transit bus builders was estimated at approximately $3.64 million.

Sales, General and Administrative (SG&A)

Sales, General and Administrative — SG&A is defined as costs not generally associated with production, such as office wages, advertising, travel, and bad debt. Costs generally are measured as a percentage of revenue. The top four bus manufacturers incurred SG&A expenses averaging 6.42% from 2000-2005 (with estimates for 2005). The median level of expense for the same period was 4.5%. The single highest percentage of SG&A expenses incurred by one of the four bus manufacturers occurred in 2000 — 19.4% of the company's revenue. That same year, by contrast, one of the four manufacturers had low SG&A expenses — reflecting only 2.6% of its revenue.

Annual SG&A Headcount — This measurement examines the number of non-production employees required to generate revenue. Generally, this figure includes sales, marketing, customer service, and administrative or clerical personnel. On average, during the period 2000-2005 (with estimates for 2005), the top four transit bus manufacturers employed 128 full-time SG&A personnel. The median number for the four bus manufacturers during the same period was slightly higher, totaling 135 employees. The single largest number of SG&A personnel employed by one of the four transit bus manufacturers totaled 225 in 2000. The lowest number of SG&A personnel employed by one of the four bus manufacturers was 25 in 2001.

Tradeshows — The top four bus manufacturers attend between one to twelve tradeshows and/or conferences per year. One company among the four, however, attends more than 150 tradeshows, meetings, and conferences per year.

Annual Legal Fees — Legal fees can be incurred for a variety of reasons, ranging from contract negotiations to customer issues. Between 2003 and 2005 (with estimates for 2005), the total legal fees incurred by the four transit bus builders amounted to $2.95 million. The average amount of legal fees incurred by the four transit bus builders during that same period was $246,200, and the median totaled $100,198. The highest single total legal fees spent by one of the four transit bus manufacturers exceeded $1.3 million in 2004. The lowest legal cost incurred by one of the four bus manufacturers was $50,000 in 2003.

Warranty Issues

Percentage of Legal Fees Spent on Customer Issues —The top four transit bus manufacturers were asked to separate customer-related legal expenses from total legal expenses. These expenses ranged from contract review to litigation costs. (Again, two manufacturers did not supply historical data prior to 2003.) Between 2003 and 2005 (with estimates for 2005), customer-related legal expenses averaged 17.43% of the companies'

overall legal expenses. The median percentage of customer-related legal expenses for the four companies during that period was 9.64%.

Annual Number of Warranty Issues — This factor measures the number of warranty claims made by transit agency clients to the top four bus manufacturers. During the period of 2000-2005 (with estimates for 2005), the top four bus manufacturers reported a total of 265,131 claims. The largest number of claims, more than 72,000, has occurred (to date) in 2005. The average number of claims encountered by the four bus manufacturers during the previous five-year period was 11,047 and the median number of claims over the previous five-year period was 10,818.

Annual Number of Component (Suppliers) Warranty Claims — This measures the number of warranty claims attributable to a product or sub-assembly part manufactured or purchased from a vendor. The analysis reflects data provided by three of the four transit bus manufacturers. (One bus manufacturer chose not to provide data.) The following table lists the total number of claims reported by three of the transit bus manufacturers, the total number of component parts claims, and the percentage of component parts claims relative to the total.

Figure 35: Annual Number of Component Warranty Claims

Year	Total Warranty Claims	Total Component Parts Claims	% of Component Parts Claims
2000	29,900	5,131	17.16%
2001	44,075	5,802	13.16%
2002	40,619	4,216	10.38%
2003	31,822	4,448	13.98%
2004	46,464	6,320	13.60%
2005	72,251	12,223	16.92%
Total:	**265,131**	**38,140**	**14.39%**

Average Warranty Claim (s) per Year ($) — This measurement assesses the costs incurred by the four transit bus manufacturers on an average warranty claim. For the period of 2000-2005 (with estimates for 2005), the average warranty claim amounted to approximately $245. The median value of a claim (experienced by the four transit bus builders) during the same period amounted to slightly more than $200. The highest average warranty claim experienced by one of the four manufacturers in one year (during 2000–2005) was approximately $568. The lowest average warranty claim experienced by one among the four in one year (during 2000-2005) was $90.

Analysis of Interviews with Four Transit Bus Manufacturers

The second component of the transit bus manufacturer research consisted of face-to-face interviews with executives of the four largest U.S. transit bus manufacturers. Each interview covered a variety of topics and lasted from two to six hours depending on the number of attendees and the depth of the dialogue. In addition to the formulated

questions that were reviewed and approved by the FTA project team, each interview contained a number of "probes" designed to delve further into a specific topic of question. The following summary provides an analysis of the findings.

Industry Challenges

Supply and Demand

One of the executives observed that transit bus manufacturing is fundamentally a "bad" (unprofitable) business. Three of the four bus manufacturers echoed that observation, as well, indicating that generating a profit in the transit bus industry is extremely difficult. According to one executive, the transit bus manufacturing industry "…has no room for error."

The lack of volume in the transit bus market compounds the profitability problem for manufacturers in that not enough 35-ft. to 60-ft. heavy-duty transit buses are being ordered and purchased. Three of the top four manufacturers cited the lack of volume as a major challenge. Moreover, the manufacturers expressed concern about the fact that volumes have fluctuated during the last five years. If demand does not increase or stabilize, the current over-capacity in the market is expected to worsen and may force some manufacturers to close. One executive commented that the public and private sector within the transit industry must develop better trust among the key players in order to stabilize the industry.

Capacity in the transit bus industry is tremendously underutilized. Current estimates place the industries capacity to produce heavy-duty transit buses (35ft to 60ft in length) at 7,500 and 10,000 vehicles. Capacity utilization in the transit bus industry based 2004 volume ranged from a low of 31% to a high of 41%. Neither utilization rate provided the industry with enough production to absorb the overhead required to support public transit agencies. According to one executive, "Nothing will help the OEMs get any healthier [more viable] until there is change [increase] in volume. Volume is the key!"

Procurement and Contracting

Two of the four bus manufacturers expressed major concern over transit agencies' low-bid procurement method. They commented that many transit agencies continue to award contracts to the lowest bidder despite rhetoric that contracts should be awarded to companies with the best products at the best price. Once awarded, all four manufacturers consider the contracts to be onerous. According to the interviewees, these contracts are "one-sided" in that, while transit agencies retain absolute control, the manufacturers are forced to assume 100% of the risk. The executives commented that the companies comply with this form of contracting mostly because they have no choice.

The bus manufacturers also addressed issues related to funding. One executive expressed concern over the lack of local funding and commented that federal funding authorized by the latest transportation legislation, *SAFETEA-LU*, is useless without local matching funds. Bonding is another challenge for the bus manufacturers in that bond capacity and

rates have created problems for some of the bus manufacturers. One manufacturer expressed serious concern about bonding issues associated with bidding and performance.

Warranties
All four manufacturers expressed serious concerns about extended warranties for bus components that are being required, or demanded, by the transit agencies. Components suppliers typically manufacture the component parts; however, the bus manufacturers are being held liable for fleet defects of 15% or more and are required to replace a component deemed faulty for the entire fleet. Exacerbating this challenge is the fact that components suppliers are resistant to covering (or supporting) the bus manufacturers regarding component parts defects.

Buy America
Buy America is a major issue for two of the four transit bus manufacturers. These two companies contend that *Buy America* is preventing agencies from receiving the best product at the best price. In addition, the executives representing these two transit bus manufacturers are convinced that *Buy America* is a protectionist policy that impairs the viability of their respective companies.

Perspectives on Procurement and Funding

Standard Bus Procurement Guidelines (SBPG)
All four bus manufacturers agreed that the Standard Bus Procurement Guidelines (SBPG) have some merit. Each manufacturer indicated that the respective company's basic bus design is based on SBPG. The manufacturers observed, however, that the only role that the SBPG plays is to serve as a model in their efforts to motivate customers to follow the guidelines. According to the bus manufacturers, transit agencies tend to ignore the guidelines and develop agency-specific technical specifications, terms and conditions.

According to the manufacturers, transit agencies often specify particular components and/or brand names as part of the procurement requirements. The interviewees expressed concern about this practice because it drives vehicle prices up and reliability down, according to the transit bus manufacturers. For example, by not following SBPG, transit agencies have forced all four manufacturers to spend more on warranties than the bus manufacturers consider necessary. All four manufacturers indicated preference for performance specifications over prescriptive specifications. According to the bus manufacturers, transit agencies should specify the level of performance required to meet specific needs and allow the manufacturers to design and build buses according to those needs.

While the interviewees agreed that they are in the customized bus business, as opposed to the standard bus business, they agreed that the transit agencies tend to customize the procurement terms and conditions to extraordinary extremes. Liquidated damages, large project retentions, unreasonable hold-backs, and no-harm indemnifications are just some of the requirements delineated in the contract documents.

All those interviewed expressed the opinion that the FTA needs to provide more oversight regarding transit agency compliance with SBPG and standard procurement practices. Executives from three of the four bus manufacturing companies recommended that the FTA monitor its funding more carefully. One executive suggested that the FTA should deny funding to any transit agency that ignores the SBPG. Another felt that the FTA should provide a 1% – 2% incentive to any agency that adheres to the guidelines. Several of the manufacturers recommended that the SBPG be updated continually to enhance effectiveness and to promote transit agency compliance.

Multiple-Year Contracts

Executives from three of the four bus manufacturers viewed multiple-year contracting favorably, citing the following reasons:

- Multiple-year contracts help the transit agencies stabilize fleet size. In other words, by staggering deliveries, the agencies mitigate the risk of vehicle failures that may impact the entire fleet and the ability to provide service.
- Multiple-year contracts provide manufacturers with the time and opportunity to plan and allocate critical resources such as production time and engineering resources.

One executive did not view multiple-year contracting favorably, citing the increased risks imposed on the bus manufacturer. The executive discussed the following factors that increase risk:

- Components suppliers are not always willing to fix costs throughout the length of the contract.
- The Producer Price Index (PPI), used as the escalator for multiple-year contracts, often fails to cover increases in the costs of materials and components.
- Multiple-year contracts sometimes contain onerous base order and option clauses. For example, a transit agency may place a base order for five buses with options for 300 more in the future. In cases when a transit agency does not choose to purchase the options, the manufacturer is forced to look for new buyers.

All four bus manufacturers expect transit agencies to continue using multiple-year contracts; however, they indicated that transit agencies should develop a better balance between base order quantities and option quantities. Despite the concerns described here, all four bus manufacturers currently are producing from their backlogs and option bookings. The option bookings are helpful in sustaining the viability of some of the bus manufacturing companies.

Assignment Rights or "Piggybacking"

The term "assignment rights" has had many iterations over the years, including "tag-ons," "add-ons," and "piggybacking." Piggybacking allows an agency to assign portions of competitive bid procurement to other agencies. During the late 1990s and early 2000s,

piggybacking became so commonplace, and generally out of control, that the FTA was forced to intercede.

Three of the four bus manufacturers regarded piggybacking favorably, citing the following reasons:

- Piggybacking provides the manufacturer and the agency with a mechanism for selling off options should the agency decide not to pick up options or become unable to take delivery of its options.
- Piggybacking helps smaller agencies' procurement processes. Smaller agencies may not have the staff or ability to develop their own procurement. By working with a larger agency, the smaller property may purchase the vehicles it needs by piggybacking on the established competitive contract.

One executive expressed reservations, however, about piggybacking, citing that the practice is prone to abuse. He indicated a need for specific contract language articulating reasons for (benefits of) piggybacking. Another concern he expressed was that an assignee might try to change the terms and conditions associated with the original procurement.

Federal (FTA) Funding

Three of the four manufacturers indicated that federal funding for transit has a major positive impact on business. According to the interviews, federal funding has a 100% positive impact on two of the three manufacturers. The one dissenting manufacturer indicated that federal funding has no impact on business, unless transit agencies have the necessary local matching funds.

All four manufacturers indicated that the lack of federal funding during the last 24 months has impacted transit bus procurements negatively. However, all four had established enough backlogs to carry them through the downturn. In particular, one manufacturer (among the four) that operates in diverse channels of distribution, including both the public and private sectors, successfully weathered the market downturn and continued to generate profits.

Nevertheless, all four manufacturers expressed a desire to see a turnaround in the market in the near future. The four manufacturers expressed a desire for fourth quarter (2005) growth specifically in terms of bidding and during late second or early third quarter of 2006 in terms of delivery. However, from the perspective of these four companies, the continued delay in the approval of the 2006 FTA budget has made these goals unattainable. Current "best-case scenario" would be an increase in bidding during the middle of the first quarter of 2006 with deliveries scheduled for early 2007. However, this scenario presumes that the transit agencies will have enough local matching funds to procure buses.

All four manufacturers consider their "limited" relationships with the FTA to be positive. However, all four expressed the view that the FTA should take a more active oversight role with regard to transit agencies. In addition, one manufacturer suggested that the

FTA investigate the need and/or importance of *Buy America*, the Altoona Test, cargo preferences, and DBE content issues. According to this particular bus manufacturer, these issues negatively impact the transit bus industry and in his view all, or part, of these regulations should be relaxed.

SAFETEA-LU

With the exception of Neoplan, all of the U.S. transit bus manufacturers survived the delay in the authorization of the transportation bill, *SAFETEA-LU*. However, executives of all four bus manufacturers indicated that the approximate 24-month delay in authorizing the legislation negatively impacted their businesses. According to one of the manufacturers, the company foresaw the impact early and adjusted its business model accordingly by shifting focus to the private sector market. The other three manufacturers, however, admitted that they were caught off guard and expressed relief that they had enough backlog work to sustain business. Currently, however, these companies have shipped most of their backlog orders and are seeking new orders. The manufacturers agreed that 2006 would be another tough year for sales.

All four bus manufacturers indicated that *SAFETEA-LU* will impact their future business positively. Nevertheless, they also agreed that it is too early to tell exactly when they will experience the positive impact. Although they expect that *SAFETEA-LU* will provide a stable funding base for the next six years, they understand that orders will not begin to flow immediately. As mentioned earlier, all four of the manufacturers expressed a sense of urgency for orders to increase. A number of bids and orders continue to slide despite the authorization of *SAFETEA-LU*.

External Issues – *Buy America,* Pooled Procurement and Export Opportunities

Buy America

Opinions about *Buy America*, expressed by the four largest transit bus manufacturers, were clearly divided, with two manufacturers in favor of *Buy America* and two against it. Executives from the two bus manufacturers that favor *Buy America* indicated that the policy helps keep U.S. dollars in the United States. The two companies have no trouble meeting the 60% content requirement and view the 40% foreign content to be more than adequate. Executives from both companies expressed firm convictions that if *Buy America* were repealed, the U.S.-based transit bus manufacturing would most likely end, and their two companies would be out-of-business.

The two transit bus manufacturers opposed to *Buy America* questioned why the industry needed the policy at all. They consider the policy as protectionist, preventing transit agencies from procuring the best product at the best price. The manufacturers stated that *Buy America* increases the price of U.S. buses and limits the most efficient use of resources. Furthermore, they face a dilemma when transit agencies specify foreign-made components but still require the bus manufacturers to meet *Buy America* requirements.

An executive from one of the four manufacturers admitted that the company's business model makes meeting *Buy America* requirements difficult. Nonetheless, the executive contended that recent decisions made by major components suppliers have exacerbated the situation. Recently, for example, Detroit Diesel Corporation announced that the firm was exiting the transit bus market. In addition, Allison, a major supplier of transmissions, just announced that its product no longer meets the requirements imposed by *Buy America*.

The two transit bus manufacturers that favor *Buy America* see no reason to change the law. The two that oppose it would like to see it modified or abolished. They recognize that abolishment is unlikely and would, therefore, like *Buy America* to be amended. Some suggestions for policy amendments include:

- Reduction of the U.S. content requirement from 60% to 50%
- Inclusion of NAFTA countries into the *Buy America* content model
- Change from component and final assembly content to U.S. labor and final assembly content

Regarding *Buy America* waivers and protests, none of the four largest transit bus manufacturers claimed to make much use of either. Two companies have had, or currently have, temporary waivers. One company was denied an extension of a waiver, which ultimately led to the discontinuation of a product line. None of the four company representatives reported regular involvement in *Buy America* protests. Based on their comments, they generally consider protests to be a waste of time and effort. An executive from one of the four manufacturers claimed that he is consistently puzzled by the waiver requests granted, or denied, by the FTA.

Pooled Procurement Program

The Cooperative Procurement Pilot Program was introduced to APTA business members during the Business Member Board of Governors meeting in January 2004. Opinions vary on this program; however, executives from all four of the transit bus manufacturers expressed disappointment with the FTA for not clearly explaining the program to them before implementing it. According to the *Federal Register*, the Secretary of Transportation is supposed to provide Congress with a progress report on the program. All four companies would like the FTA to explain to them exactly what constitutes a successful pooled procurement program.

Nevertheless, all four companies agreed that pooled purchases may help smaller agencies; however, they expressed concerns about program control. The executives stated that, in a period of lackluster demand, a pooled purchase of 1,000-2,000 buses would be detrimental to the transit bus industry. Such a large quantity of vehicles could represent 25% of the production volume in 2005. According to the executives interviewed, the fact that these pooled purchases are designed to be "winner-takes- all" procurements compounds the problem further.

Another concern expressed by all four companies centered on the possibility of mass customization in pooled purchases. For example, if four or five agencies were to procure 100 buses, and each agency required a separate paint scheme — that is not a problem. However, if Agency A wants *Luminator*, Agency B wants *Twin Vision*, and Agency C wants *Thermo King* (and so on), then the bus manufacturer actually is managing multiple procurements — and that is a problem.

Export Opportunities

All four manufacturers indicated that no export opportunities for U.S. transit buses exist and expect none in the future. Despite multiple attempts to export buses, the foreign market has not shown interest in transit buses designed and built to meet U.S. standards and regulations. Although two of the four U.S. transit bus manufacturers are owned by foreign parent companies, these two companies also have been unsuccessful in exporting U.S. transit buses.

Regarding the FTA and DOT International Programs, none of the four major U.S. transit bus manufacturers indicated that they are useful. The manufacturers concede that these programs may be beneficial to U.S. transit agencies, but consider them to be of no value to U.S. bus manufacturers primarily because, based on their experiences, there is no export market for U.S. transit buses.

Internal Issues – Sales & Marketing, Labor, Materials, Warranty Issues, and Research & Development

Sales & Marketing

All four bus manufacturers have dedicated field sales organizational structures. Executives from two of the four manufacturers indicated that the downturn has had no negative impact on their sales organizations. In fact, one executive suggested that the downturn sharpened the focus and increased the efforts of his sales team. Executives from the other two manufacturers used the downturn to re-evaluate the company's business model and made minor changes accordingly. Both executives saw a market improvement on the horizon and structured their respective sales organizations to capitalize upon opportunities associated with the pending market improvement.

The procurement timeframe for all four companies typically ranges from several weeks to four months, depending on the transit property. A transit agency's contract awards can take up to four months. Lead times run from twelve weeks to 52 weeks depending on the procurement.

A related organizational issue that surfaced as a result of this portion of the interview concerns the bidding and contract management departments of all four manufacturers. A typical bid document contains critical details and is at least four to five inches thick. A finalized bid package may require as many as five file boxes of information. All four manufacturers stated that the companies are restructuring the departments in order to be well-prepared for a busy year in 2006.

Tradeshows and Conferences

Mixed responses were given regarding the importance of tradeshows/conferences and the ROI associated with those events. Executives from two companies found tradeshows to be a "very expensive, necessary evil." Both executives commented that tradeshows have absolutely no bearing on the success or failure of a bus manufacturer. They were both particularly pleased that the APTA International Expo occurs only every three years.

The other two bus manufacturers found tradeshows, though time-consuming and expensive, to be very valuable. Executives from both of these bus manufacturing companies contended that tradeshows, particularly the APTA International Expo, provide an excellent opportunity to have all their customers and prospective customers in one place at one time. Both asserted that companies not only show their products at tradeshows, also have a chance to showcase the respective company. One of these two executives commented that tradeshows and conferences provide good opportunities to publicize important issues. He cited the APTA Legislative Conference, held each year in Washington, D.C., as an example.

Labor

Employee retention at all four bus manufacturers has been stable. Two of the four companies have experienced no employee turnover. However, the two companies are concerned about retaining skilled workforces. Executives from the other two bus manufacturers indicated that minimal changes commensurate with production volume have been made. One executive noted that higher paying jobs in the automotive sector were impacting the turnover in the transit bus industry. Another company executive attributed his company's turnover rate to internal reorganization but expressed confidence in that the company has experience in addressing the issue.

Seasonality (except for the opening day of deer hunting season) is not a major issue for the interviewed bus manufacturers, and the production schedules remain stable. However, the interviewees indicated that transit agencies do not always adhere to the specified procurement schedules, forcing production schedules to be altered. Consequently, schedules may fluctuate in terms of volume.

Healthcare costs have been, and will likely continue to be, an issue for major transit bus manufacturers. While all four companies indicated that the companies have done a good job of managing their respective healthcare costs, three of these companies operate unionized facilities and that can pose challenges. In particular, the bus manufacturers working with the UAW face a particular challenge. Given the severe downturns in the automotive industry and the number of UAW retirees, the impression among the executives in the four companies is that the union is taking a tough stance. One executive of a unionized company indicated that the UAW refused to accept any healthcare co-payments for its members and threatened to strike if the company insisted on co-pays. Another challenge that the four bus manufacturers face is that none of the manufacturers has the ability to pass on healthcare cost increases to their customers during this highly competitive period. Instead, each company is forced to find alternate ways to mitigate cost increases.

Materials

All four manufacturers have experienced significant price increases in steel, particularly stainless steel that is used to build bus frames. For three of the four manufacturers, price increases in carbon fiber, used to build CNG tanks, also have impacted their businesses. The cost of carbon fiber has increased significantly, in general, as a result of the federal government redirecting all carbon fiber production to meet its needs. In addition, carbon fiber was identified during the interviews as the single biggest, unexpected issue in terms of availability of materials and lead-time for purchasing. Availability of carbon fiber has been a concern for the last nine to twelve months. However, *Buy America* limits the bus manufacturer's ability to import carbon fiber from Canada.

In addition, rising fuel prices have been negatively impacting not only inbound freight, but also (and perhaps more significantly) bus deliveries to the transit agencies. All four of the major transit bus manufacturers previously negotiated delivery contracts on a fee-per-mile basis. Rising fuel prices have resulted in indexed fuel surcharges. Surcharges are added to the base per-mile fee and increase as the fuel index moves. All four transit bus manufacturers indicated that they are limited in passing such cost increases onto the transit agency clients. Most multiple-year contracts have option escalations tied to the Producer Price Index (PPI). Often, the PPI fails to cover the price increases encountered by the bus manufacturers.

The 12-year/500,000 Mile Service Life

Providing a 12-year/500,000 mile service life is a design requirement specified for all U.S. transit buses. Each manufacturer must build its buses to meet or exceed this specification. However, all four major transit bus manufacturers questioned this requirement. All of the executives acknowledged that although this specification ensures that the transit agencies could possibly have the most durable buses in the world, typically, power trains rarely last more than eight years. The executives commented that most transit agencies are not attentive to the maintenance of bus fleets. A remanufactured engine often costs approximately half as much as a new engine. Therefore, the bus manufacturers have begun to question when the transit agencies reach the "point of diminishing returns." Moreover, agencies are beginning to require extended warranties significantly beyond the useful life of most components. If the bus manufacturers cannot purchase these extended warranties, the companies have to insure vehicles themselves — placing the companies at significant risk.

The Altoona Bus Test

According to the opinions expressed during the interviews, the cost of the Altoona Bus Test has become another challenge for transit bus manufacturers. The manufacturers spend roughly $200,000 for testing, transportation and other expenses. While all manufacturers are required to test their respective buses in Altoona, Pennsylvania, manufacturers also conduct their own tests. Because manufacturers' tests typically are more stringent than the Altoona Test, one executive stated that his company's vehicle, which had passed the Altoona Test, exhibited structural damage when the company ran an independent test. Three of the four manufacturers questioned the credibility of the Altoona test and were dubious about the need for this test.

Material and Component Warranty Issues

As mentioned earlier, issues related to materials and component parts are challenging for the four major U.S. transit bus manufacturers. Transit agencies specify components that are untested or under-tested. Often these technologies are still in the process of being modified as they move down to the production line. Nevertheless, a transit agency may require the bus manufacturer to warrant these components, including fleet defects as part of its bus procurement. Because a warranty that the bus manufacturer receives from the supplier generally covers less than what the transit agencies require, the bus manufacturer must insure the components at its own cost. All four manufacturers stated that the transit agencies and suppliers place unreasonable liability on the bus manufacturers. Also, all four manufacturers asserted that the FTA should require far more stringent tests on new components and a timeframe that affords opportunities for the bus manufacturers to test new components on, or in, the transit vehicles before transit agencies specify a particular component. One manufacturer suggested that the FTA should limit funding to agencies that use warranties approved by the FTA. In his view, any warranty requirements exceeding FTA specifications should be at the transit agency's expense.

Research and Development

All four manufacturers indicated that investments on R&D related to regulatory compliance are higher than their R&D investments in new products, Bus Rapid Transit (BRT), new propulsion systems (such as hybrids), and plant and process improvements. In 2007, new engine emission standards not only will require the development of new engines by engine manufacturers, like Cummins and Caterpillar, but also will require huge capital investments by transit bus manufacturers. The four transit bus manufacturers indicated that, unfortunately, the demand for transit buses will not provide them with much, if any, ROI. To compound this problem, the bus manufacturers will have only three years to amortize the millions of dollars in redesign and retooling before the 2010 emissions standards require additional investment.

New Technologies

The most critical area of new technology for all four major bus manufacturers relates to the upcoming 2007 and 2010 emissions standards that will require larger cooling systems and active after-treatment systems. Continued development of alternative fuel vehicles, hybrids, electric trolleys, and hydrogen fuel cell technology also is expected. In addition, all four manufacturers are considering new vehicle styling BRT. Two of the four bus manufacturers currently offer BRT models and expect that this business will grow significantly.

The four manufacturers' perspectives with regard to the FTA, in terms of new technology investment were similar, but suggestions for the FTA varied. All four manufacturers commented that funding from the FTA, or other federal government entities, to support R&D efforts would be desirable. However, they also referenced circumstances related to the ATTB project and expressed opinions that the FTA has a difficult time developing and managing new technologies. One of the interviewees suggested that a pool of government funding be established specifically for the development of certain technology

projects. Another executive indicated that perhaps the APTA Technology Committee could review and recommend new technology projects to the FTA. Another executive asserted that the FTA should help to stabilize the market and allow the manufacturers to perform their own R&D.

Competitive Landscape for Transit Bus Manufacturers in the United States

Historical Background

Over the last 25 years, there have been three major downturns in transit bus manufacturing. The downturns occurred in 1986/1987, 1992/1993 and 2004/2005. Regardless of the causative factors, each of these downturns severely impacted the transit bus manufacturing industry.

The 1986/1987 industry downturn was caused by a reduction in the amount of federal funding made available to the transit agencies. In 1981, the federal government provided roughly $4.6 billion for transit funding. However, by the mid-eighties, available federal funds dropped toward a decade low of $3.1 billion. As funding declined, so did agency procurements, which led to the first (of several) business failures in the U.S. transit bus manufacturing industry.

Changes to engine emission regulations caused the second industry downturn during 1992/1993. (The federal government required that transit buses meet the new emission standards one year earlier than over-the-road trucks.) According to the bus manufacturers, the only way that they could meet the new emission requirements was by installing a very expensive and little-tested particulate filter. Many of the transit agencies balked at the solution and, as a result, many (if not most) agencies refused to procure transit buses for roughly one year. As it turned out, the agencies' skepticism with regard to the filter was correct as many of the particulate systems failed horribly. All four of the bus manufacturers interviewed in this study expressed serious concerns about the changes upcoming in emission standards scheduled for 2007 and 2010. (See page 66.)

The third downturn impacting the transit bus industry occurred during 2004/2005. Caused primarily by a lack of federal and local funding, this downturn was the most severe. Few in the industry expected FTA funding delays to exceed two years. Compared to the 2004/2005 period, the 1986/1987 downturn was not so severe because local funding had reached new highs despite the decline in federal funding.

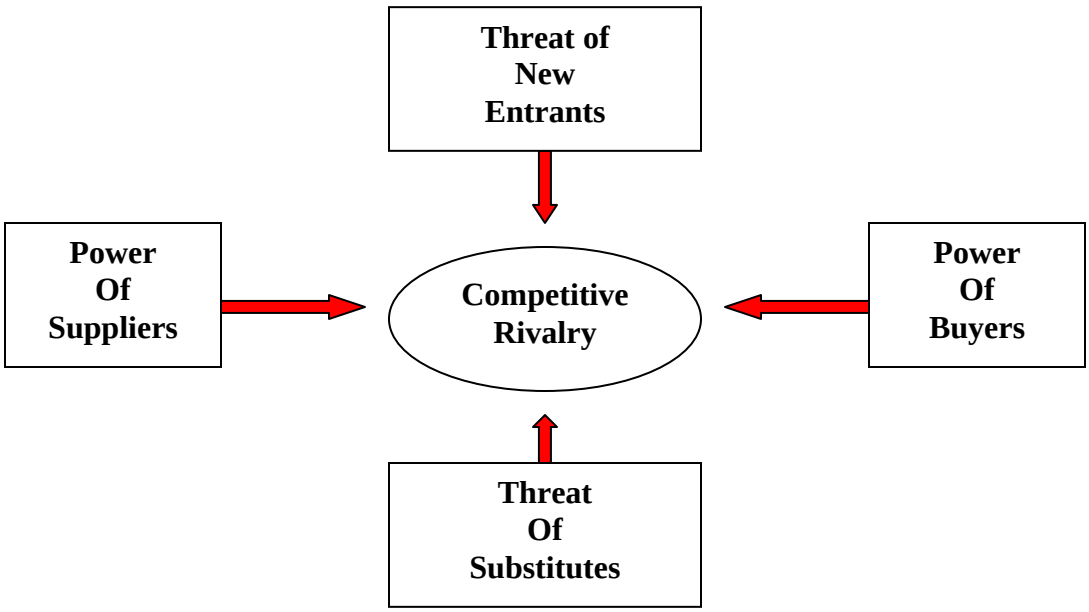
Current Competitive Landscape

The current competitive landscape within the transit bus manufacturing industry is, in a word, intense. However, the intensity within this industry is not solely due to the bus manufacturers attempting to out-perform one another. Rather, this intense competitive rivalry is the result of what Harvard Professor Michael Porter referred to as the *Five Forces.*

Although Porter developed his well-known *Five Forces Model* in 1980, the model can be applied to today's transit bus manufacturing industry. According to Porter, "The

collective strength of these forces determines the ultimate profit potential in an industry, where profit potential is measured in terms of long-term return on invested capital."[146] In other words, according to Porter, the viability of a particular industry is dependent on five key competitive market forces that reflect the underlying structural features of the industry — threat of new entrants, bargaining power of buyers, bargaining power of suppliers, threat of substitutes, and competitive rivalry. These forces may impact the industry with different levels of strength. Nevertheless, all five affect the overall competition and profitability level of the industry.

Porter's *Five Forces Model*



It is important to note here that not all industries have the same profit potential, and the U.S. transit bus industry has long been recognized as an industry that is not highly profitable. As described in the *Market Overview* chapter of this study, during the past decade many U.S. transit bus manufacturers have experienced low or negative rates of return, and currently most of the U.S. transit bus manufacturers are suffering from low rates of return. Reflecting on Porter's *Five Forces Model*, the chronic lack of profitability in the transit bus manufacturing industry can be attributed to strong market forces. As Porter argues, the key is to determine which force, or forces, is strongest so that an appropriate strategy can be formulated to increase profitability. The following sections analyze market forces that are impacting the transit bus manufacturing industry in the United States today.

1. New Entrants to the Transit Bus Market

Compared to other market forces, the threat of new entrants plays a relatively minor role in the transit bus market due to the formidable barriers to entry. Nevertheless, bus

manufacturers both domestic and foreign have attempted, and will continue to attempt, entry into the U.S. transit bus market.

For example, existing transit bus manufacturers have been facing increasing competition from two U.S.-based small and medium-sized bus manufacturers — El Dorado National (a Thor Company) and Optima Bus Corporation. The two companies account for significant market shares in the 30-ft. and 35-ft. transit bus market. As a result of competitive pressure from these two manufacturers, at least one of the largest bus manufacturers in the U.S. (among the four major transit bus manufacturers participating in this study) stopped manufacturing this size range and discontinued one of its product lines.

According to Porter, "New entrants into an industry bring new capacity, a desire to gain market share and potentially substantial resources."[147] New entrants often attempt to drive prices down in order to secure market share. This sometimes leads to declining profitability throughout an industry. The level of threat posed by new entrants depends on the barriers to entry established by, or associated with, an industry. Porter asserts that barriers to entry include:

- Economies of scale
- Product differentiation
- Capital requirements
- Switching costs
- Access to distribution channels
- Government policy

Of the barriers to entry that were highlighted in Porter's writings, the most significant ones associated with the U.S. transit bus market and those that relate not only to new potential entrants to the market, but also to those manufacturers struggling to survive, the following three factors apply:

1.1 Economies of Scale

The four largest U.S.-based transit bus manufacturers currently have a combined production capacity of approximately 10,000 transit buses per year. Market demand over the last several years failed to exceed 5,000 units. Additionally, the demand for individual vehicle types (e.g., 35-ft. vs. 40-ft.) fluctuated, negatively impacting the manufacturers' ability to achieve economies of scale. A stable annual demand volume of 7,500 transit buses (i.e., 35-ft. to 60-ft.) would provide the U.S. manufacturers the ability to achieve economies of scale.

1.2 High Capital Investment

Manufacturing transit buses for the U.S. market is capital intensive. The necessity to invest a large amount of capital in order to start a new U.S.-based transit bus manufacturing facility is a barrier to entry. Given the significant reduction, as well as mercurial fluctuations in market demand, new capital investment in the U.S. transit bus industry is, at best, risky and may even be unrecoverable. The resulting

risk premiums associated with capital investment are high for existing transit bus manufacturers and may prohibit new entrants from coming into the market.

On-going capital needs also are very high in the transit bus industry. According to one U.S.-based manufacturer, the re-design and tooling associated with converting a European-designed bus to meet U.S. requirements cost his company roughly $20 million.

1.3 Government Policy

Government policy may limit new product entries, particularly those from other countries. The *Buy America* policy discourages importation of foreign products to the domestic transit market, but, to an extent, encourages foreign direct investment in the form of establishing a manufacturing presence in the United States. However, some transit bus manufacturers, both domestic and foreign, consider the policy to be isolationist and regard it as a significant barrier to market entry and/or to stability of the market as components manufacturers and suppliers increasingly produce offshore. In addition, environmental regulations also pose significant barriers. Scheduled for implementation in 2007, the emissions requirements will be stiffened again by the EPA three years later in 2010. Furthermore, The *Americans with Disabilities Act* and its corresponding Technical Standards represent other barriers to entry as well as challenges for existing U.S. bus manufacturers. Most foreign countries do not require, for example, securement positions for mobility devices. All U.S. transit and over-the-road buses are required to have varying numbers of securement positions, depending on the size of the vehicle and passenger capacity.

2. Bargaining Power of Buyers

Buyers of virtually all products and services demand lower prices while simultaneously requiring higher quality and greater service. Buyers accomplish this by pitting competitors against each other, which results in potentially lowering profits in an industry. According to Porter, buyers are considered powerful when the following circumstances exist:[148]

- Concentrated or large purchases are made relative to the seller's volume.
- The products purchased represent a significant fraction of the buyer's purchases.
- The products purchased are relatively standard and undifferentiated.
- The buyer faces few switch costs.
- The buyer earns low profits.
- The buyer has full information.

These factors apply, in varying degrees, to the U.S. transit agencies, and, obviously, put the agencies in a powerful position. In particular, the fifty largest U.S. transit agencies[149] have tremendous bargaining power associated with procurement of transit buses. Therefore, transit agencies exert significant pressure on the revenues and margins of U.S. transit bus manufacturers. Transit agency power is reflected in the following ways:

2.1 Concentration of Agencies Buying Large Volumes

The fifty largest transit agencies' bus purchases represent a supermajority of the transit bus market. For example, New York City Transit (NYCT) is the nation's largest transit agency; it operates more than 5,000 buses. In its most recent procurement, NYCT ordered 500 hybrid transit buses for delivery in mid-2007. If vehicle demand were to reach 5,000 units in 2007, NYCT's single order would account for 10% of the annual demand. (The NYCT contract also includes options for an additional 389 vehicles.)

2.2 Low Bid Procurement

According to a manufacturer participating in the research for this study, "Despite the concept that the best product [provided] at the best price wins the procurement, it [the award] always comes down to the lowest bid." In low bid contracts, the manufacturers are prohibited from requesting deviations to a specification. This is necessary in order to maintain a "level playing field" for all bidders. As a result, the bus manufacturers are forced to bid to the specification even though it may not provide the transit agency with the best solution. Low bid procurements are not only challenging for the bus manufacturers, but also can be disadvantageous to the transit agencies. As one manufacturer observed during an interview for this study, "…the transit agency may receive the lowest price, but the agency may pay dearly in the long-run because the OEM may not be able to support the procurement or [may] in fact go out of business." Regardless, in today's low demand market, bus manufacturers are forced to bid these projects in order to survive.

2.3 Contracting and Warranty Issues

The bargaining power of U.S. transit agencies has enabled the agencies to develop and impose what U.S. bus manufacturers consider to be, onerous contract terms and conditions. According to one bus manufacturer interviewed for the study, "These contracts are designed like a Manhattan apartment lease. As soon as the ink is dry, you [the manufacturer] are automatically in breach of the contract." From the perspective of the bus manufacturers that were interviewed for this study, the *Commercial Terms and Conditions* included in many of today's bus procurement contracts border on castigatory. In addition, bus manufacturers claim that many transit agencies ignore the Standard Bus Procurement Guidelines (SBPG), creating significant customization demands on the bus manufacturers.

Specific contract terms and conditions that challenge the bus manufacturers and that demonstrate the power of the transit agencies in today's marketplace include bonding, payment retentions, liquidated damages, "no-fault" clauses, extended warranties and fleet defects. Bonding requirements included in transit agency solicitations have increased substantially. Currently, transit agencies are requiring bid, performance, supplier and warranty bonds. One agency recently required a bus manufacturer to provide a warranty bond covering a twelve-year extended warranty. A bus manufacturer interviewed for this study insisted, however, that no surety in the U.S. would issue a twelve-year warranty bond.

In addition, payment retentions not only are included increasingly in agency procurement contracts, but also are beginning to be extended in terms of duration. In some cases, retention clauses now extend two years beyond delivery and acceptance of the procured buses.

Liquidated damages clauses (in transit contracts) are predetermined and mutually accepted amounts of money intended to compensate a transit agency for true and actual damages incurred when a manufacturer fails to meet the conditions of a contract. Liquidated damages clauses are being perceived as excessive by the industry. According to one executive, who participated in the study, "…today, we are seeing liquidated damages from $200 to $1,000 per bus per calendar day. That is simply punitive." Conversely, the manufacturers have little claim compensation from the transit agencies when payments are delayed.

Transit agencies' solicitations and contracts are beginning to include "no-fault" clauses, which protect the agencies from errors and omissions in the documentation. The "no-fault" language places the burden for identifying and correcting any error or omission in the contract on the bus manufacturers.

Several of the fifty largest transit agencies have started to require extended warranties from transit bus manufacturers. During the interviews for this study, the four bus manufacturers acknowledged that their companies essentially are paying for problems of the past. According to one executive, "…in the past many OEMs failed to deliver quality products and failed to support their products." However, all four expressed the view that the extended warranties required today have become unmanageable. The bus manufacturers expressed opinions suggesting that they are being held responsible for managing extended warranties even though their companies do not manufacture many of the components and sub-components of the vehicles. While the bus manufacturers can purchase extended warranties (e.g., engine, transmission, and axles), other sub-systems or components require the manufacturers to self-insure. For example, a transit agency recently required a bus manufacturer to provide a three-year or 150,000-mile warranty on the vehicle's starter and alternator. Because the component supplier offered only a limited warranty term of 80,000 miles, the bus manufacturer was forced to self-insure and accept the risk in order to honor the contract requirement. In another cited example, a transit agency requested an extended warranty on an engine that represented one-third to one-half of the cost of a new engine.

Primary research gathered through interviews that were conducted during this study indicates that only 30% (or less) of the components included in a transit bus can actually meet today's extended warranty requirements. These components typically are lower-value components. As a result, bus manufacturers are forced to purchase or self-insure 75% of the dollar value associated with extended warranties. In addition, agencies are beginning to require that bus manufacturers

purchase extended warranties prior to delivery of an order. Ordinarily, extended warranties are purchased at the end of the standard warranty period, or according to the suppliers' requirements. The new warranty demands imposed by the transit agencies have resulted in significant expenses for the manufacturers that negatively impact the companies' cash flow.

Fleet defect coverage is a major factor in current bus procurement contracts. A fleet defect is defined as the failure of identical items covered under warranty and occurring within the warranty period on a specific percentage of buses delivered under a contract. Contracts stipulate the maximum acceptable failure percentage. Generally, this percentage ranges from 10% to 25%, depending on the agency. As "remedy," the manufacturer is required to replace the faulty component or part throughout the fleet, should defects associated with that part reach a specified failure percentage.

According to an executive that participated in the study, "No engine, transmission or axle manufacturer will cover fleet defects. The OEM has no way of estimating future losses created by a fleet defect. The OEM has no choice but to accept the contract and accept the risk." Depending on the component or part and the size of the fleet, fleet defects potentially can reach millions of dollars. A common perception exists among bus manufacturers that it would be difficult, if not impossible, to absorb a multi-million dollar fleet defect.

3. Bargaining Power of Suppliers

Powerful suppliers can exert pressure on manufacturers through any number of methods. The methods include, but are not limited to, raising prices, reducing product availability, reducing production output, and increasing product lead times. As a result, powerful suppliers can literally squeeze profitability out of an industry, such as that of transit bus manufacturing, in which recovery of cost increases is not always possible.

According to Porter, "Conditions making suppliers powerful tend to mirror those making buyers powerful." A supplier is powerful if the following apply:[150]

- The industry is dominated by a few companies and is more concentrated than the industry to which it sells.
- Suppliers are not obliged to contend with other substitute products for sale to the industry.
- The industry is not an important customer to the supplier group.
- The suppliers' product is an important input to the buyer's business.
- The supplier groups' products are highly differentiated, or it would be cost prohibitive to switch suppliers.

Powerful suppliers impact each of the four largest transit bus manufacturers. As demand for transit buses declined over the past several years, pressures exerted by these suppliers on the manufacturers increased as well, resulting in reduced profitability or losses for the bus manufacturers.

3.1 Component Suppliers' Marketing Efforts & Issues Associated with Globalization

The emerging trend of specifying particular products or brand-name parts may reflect the marketing efforts of the component suppliers working directly with the transit agencies. To quote one transit bus manufacturer, "The business model in the U.S. is geared toward the component suppliers marketing equally, if not more to the end-users [transit agencies] than the OEMs. Right or wrong, we [the OEM] have component suppliers with as many, or more, field sales people as we do calling on the end-users [transit agencies]. Sometimes, some of those [component] suppliers lose sight of who is the real customer."

If an agency specifies a particular brand of component, the bus manufacturer loses the ability to negotiate with the supplier. According to one bus manufacturing executive, "The component supplier knows it is specified and, therefore, has no reason to negotiate with us." To compound matters, transit agencies have specified, and continue to specify, components that do not meet *Buy America* requirements. More and more components suppliers are going to the world economy in order to reduce costs. This places undue burden on the bus manufacturer to meet *Buy America*. One executive participating in the study contended that "…we [the OEM] have, on occasion, not attempted to negotiate any cost savings with a component supplier in order to meet *Buy America* requirements for a contract."

3.2 Limited Number of U.S.-based Major Components Suppliers

The number of U.S.-based major components suppliers (e.g., engines, transmissions, axles, air conditioning systems, etc.) is limited. As discussed earlier, transit agencies that procure buses using federal funding are required to comply with *Buy America*. In order to comply with *Buy America*, at least 60% of the content of the transit vehicles must be manufactured in the United States. The number of major suppliers, defined by dollar value of components, is shrinking regularly as these companies move their production to foreign countries.

For example, Detroit Diesel Corporation (DDC), Cummins, Inc., Caterpillar, Inc., and Deere & Company (John Deere) all manufacture bus engines, and all four companies comply with *Buy America.* However, recently, DDC announced that it would no longer provide engines to the transit bus market. This causes a serious problem for the transit bus manufacturers, particularly those with DDC engines as part of multiple-year contracts.

Allison Transmission and Goodyear Tire & Rubber Company are further examples of this problem. Allison recently informed the industry that its most popular transmission, the B-500, no longer meets *Buy America*. Goodyear informed the transit industry (agencies and bus manufacturers) that they can no longer purchase tires "factory direct" — all parties now must purchase tires from Goodyear dealers.

3.3 Price Increases & Multiple-Year Contracts

Transit bus manufacturers continue to experience price increases, resulting in negative impacts on profitability. While some materials cost increases, or a portion of the increases can be passed on to the transit agencies, the bus manufacturers absorb most of these increases. Double digit increases in steel, carbon fiber and fuel impacted all four of the largest transit bus manufacturers during the past 2 years. Often these increases came with little or no warning.

Multiple-year procurement contracts issued by transit agencies can intensify the negative impact of materials price increases. Some of the fifty largest transit agencies require bus manufacturers to bid "fixed" pricing for the length of the multiple-year procurement. This requirement presents a serious problem for the bus manufacturers because components suppliers generally are unwilling to provide fixed pricing over the duration of the contract. As one of the participating manufacturers observed, "…multiple-year contracts actually hurt us [the OEM] because it is difficult to price things [vehicles] 2-5 years out [into the future]. We [the OEM] were severely impacted by large increases in steel, fuel, wage increases, etc. that we [the OEM] absorbed."

Some agencies, in the context of multiple-year contracts, include a price escalator based on the Producer Price Index [PPI]. The concern, in these cases, is whether or not the PPI escalator clause in the contract is sufficient to cover future price increases from suppliers during the term of the multiple-year contract. To compound this problem, PPI escalator clauses apply to future options within the procurement and not to the base order. As one manufacturer stated, "…where the OEM can encounter issues is during the cycle time from receipt of an order through shipment of the base order. That time period may last 40-50 weeks during which the OEM is unprotected from supplier price increases."

3.4 Component Testing, Warranties, Consequential Damages, and Fleet Defects

Component testing is critically important to bus manufacturers. The bus manufacturer is the "contractor" within a procurement, and therefore, accepts complete responsibility for the vehicle. As mentioned earlier, transit agencies increasingly specify components by manufacturer or brand. The design criteria required for transit buses is far more stringent then the criteria associated with other industries. No other vehicle manufacturer has to meet a 12-year/500,000-mile design standard. Often, components are not designed for transit buses, but instead, for example, for over-the-road trucks. As a result, bus manufacturers are purchasing components from suppliers that do not meet a 12-year/500,000-mile design standard. The bus manufacturer, however, is required to support that standard. One of the manufacturers participating in an interview for this study insisted that component testing "… is the weak link. [Transit agencies] specify a new component in our bus…without proper testing, which is a major problem for our company. If that component does not perform correctly while the bus is 'in-service,' it becomes the OEM's issue."

Component warranties create another dilemma for transit bus manufacturers. As presented in the *Bargaining Power of Buyers* section, transit agencies are demanding more extensive warranties. According to one of the manufacturers participating in the study, "…transit agencies are demanding more and more coverage for longer periods of time. The components suppliers, however, are attempting to restrict warranties in order to reduce costs." Agencies not only require expanded warranties for major components (e.g., drive train and power plant), but also are demanding extended warranties for doors, wheelchair ramps, securement systems and internal and external signs.

Fleet defects also pose major concerns to the four largest transit bus manufacturers. Many components supplies will not honor the fleet defect clauses in transit bus procurement contracts. In short, the bus manufacturers assume all the risk while the components suppliers assume little risk. Furthermore, warranties provided by most of the components suppliers take effect when the component part is delivered to the bus manufacturer. Typically, the transit agency does not recognize the warranty until the bus is delivered and the agency accepts the vehicle. According to one bus manufacturer, that practice can reduce the standard warranty period by one to two months.

Consequential damages are another significant issue for the four largest transit bus manufacturers. Consequential damages are defined as, "…those damages or those loses which arise not from the immediate act of the party, but in consequence of such act."[151] Components suppliers generally refuse to cover consequential damages. For example, if a motor "self-destructs" while the bus is being transported to a transit agency, the damage caused to the engine is considered direct and covered by the engine manufacturer. The cause of damage to the engine compartment, cooling system, and other parts of the bus is considered consequential, and, therefore, engine manufacturers do not cover the cost of repairs to these items. Instead, the bus manufacturer must cover the cost of repairing these systems as well as any additional charges submitted by the transportation company for the delay.

3.5 The Relative Importance of the Transit Bus Industry to Major Components Suppliers

The transit bus industry has very little significance to the suppliers of major components, such as engines, transmissions or axles. The production volume required to supply the transit bus industry is insignificant. As one bus manufacturer explained it, "…if my company produced…all the transit buses manufactured in 2004…approximately 3,000 vehicles, and we procured all 3,000 engines from one engine manufacturer, we would be insignificant — given that International Harvester purchases 50,000 engines per year."

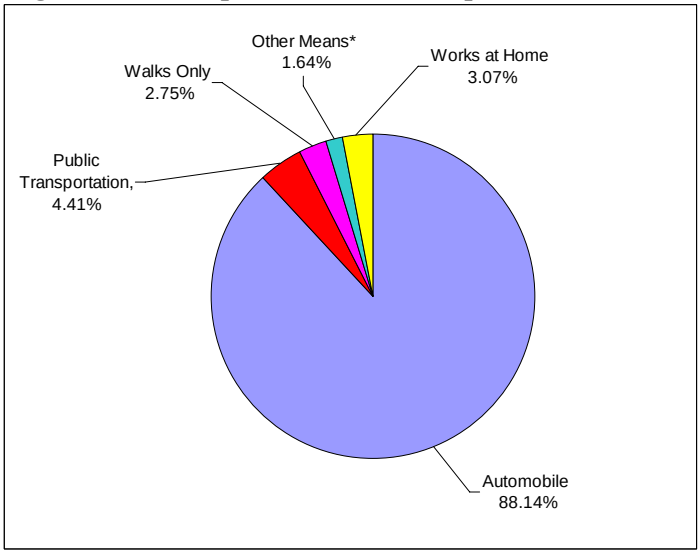
Transit bus manufacturers have even less leverage with component suppliers when transit agencies specify the component supplier(s). In fact, transit bus manufacturers often receive different pricing for the same component depending

on the transit agency. As an example, one executive participating in the study stated, "…**XYZ** [engine manufacturer] responded to an RFQ as follows: *If you require an engine for **XXX agency**, the price for that engine is $19,000… If you require the same engine for **YYY agency**, the price is $21,000, [because] they [the transit agency] do not perform regular maintenance*."

4. Threats from Substitutes

Based on Porter's definition of "substitute," a substitute in the bus industry would be a product that could perform the same function as that produced by the transit bus manufacturers. There are many substitutes for the transit bus; however, those worthy of the most attention provide improved service, actual or perceived, to the transit bus. The automobile is the major "substitute" or competitor for buses (and all modes of public transportation) as a means of transport in the United States. The U.S. economy has long been dependent on the use of personal automobiles. According to the Bureau of Transportation Statistics, roughly 88% of Americans use an automobile as the primary means of transportation to work, and 79.4% of all American workers drive their personal automobile to work.[152]

Figure 36: Principal Means of Transportation to Work



Source: *2004 National Transportation Statistics*
***** Other means taxicabs, bicycle, motorcycle, ferryboats, surface trains & vans.

5. Competitive Rivalry

The fifth force in Porter's *Five Forces Model* is competitive rivalry among the transit bus manufacturers. Porter indicates that competitive rivalry generally is driven by the following factors:[153]

- Equally balanced competitors
- Slow industry growth
- High fixed or storage costs
- Lack of differentiation

- Diverse competitors
- High exit barriers

These six drivers impact virtually all U.S. transit bus manufacturers. All four of the largest U.S. transit bus manufacturers that participated in the study can be viewed as "equally balanced competitors" in the marketplace. As described in the *Market Overview* chapter of this study, the four largest U.S. transit bus manufacturers account for approximately 87% of the transit bus production in this country. According to an executive from one of the four, "I know this may be a grand statement, but at the end of the day, we [all four OEMs] are building relatively good products."

Demand in the transit bus industry experienced significant double-digit declines between 2002 and 2005. In fact, during that three-year period, the transit bus industry experienced a compounded rate of return approaching negative 21%. These declines occurred without a significant reduction in bus manufacturing capacity. As a result, according to transit bus executive, "The low demand volume forced one manufacturer (Neoplan) out-of-business in 2005 and others to attempt winning business at very low margins in order to secure [a] backlog and keep their [the OEM] operations going…even though they may not have been stable."

Differentiation among the four largest U.S. transit bus manufacturers is limited — all four of these manufacturers offer essentially the same vehicles. However, none of the four manufacturers is in the standard bus business. As one of the four manufacturers mentioned, "OEMs are not in the standard bus business. The transit bus business is a custom business."

Despite the customized nature of the transit bus business, the manufacturers attempt to differentiate their products. According to one executive, "…we try to differentiate our product [bus] so…we offer different benefits [compared to competitors]. It is like any other industry; you want to make your product better than the next guy [competitor]. You try to differentiate in order to get the proper value for what the company has put into the bus." All four manufacturers are limited in the amount of research and development (R&D) resources they can invest in product differentiation. Customization and adjustments to regulatory change demand most of the industry's R&D resources.

Diversity among the four largest transit manufacturers exists in their corporate structures and operations. One manufacturer is a privately held corporation. One is a public corporation. Two manufacturers operate as divisions of a major parent corporation, each of which is owned by a foreign corporation.

Operationally, two of the four produce and assemble transit buses in multiple facilities. Each operates a facility in the United States and Canada. The remaining two bus manufacturers operate single production and assembly plants in the United States.

Three of the four major U.S. transit bus manufacturers generate nearly 100% of their revenue by selling to public transit agencies. All three pursue the largest transit agencies

(e.g., New York City, Los Angeles, Chicago, etc.) for most of their backlogs and revenues. The fourth manufacturer does business with public transit agencies as well as with the private sector.

High exit barriers (in other words, the cost of leaving the transit marketplace) are a business reality for all four of the largest transit bus manufacturers. Each company has millions of dollars in plants, equipment, marketing and human resources. The customized nature of the transit bus industry requires each of these companies to maintain highly skilled engineering and technical staffs. The replacement of capital assets is no doubt costly. However, replacement of both engineering and technical staffs would be even more difficult.

Low volume impacts the entire industry. As one manufacturer observed during an interview for this study, "OEMs do not have enough volume to cover all the overhead required to support the technology and engineering changes required by the transit agencies. In addition, OEMs must support national distribution, warranties, replacement parts and other customer support programs."

To quote another executive, "We [the company] are trying to sustain a business model that ensures we [the company] are around for a long time in this industry. It is our intension to support the buses the company has sold and maintain those customer relationships. But, we have to make a profit and I don't think any of our customers would deny us making a profit. A reasonable profit is all we request."

The transit bus manufacturing industry in the United States is considered to be a "mature" industry. Maturity in an industry is evident "…when competitors begin to leave the market, sales velocity is dramatically reduced and sales volume reaches a steady rate."[154] Therefore, as pressure from the four other forces increases, the impact on competitive rivalry in the transit bus industry intensifies substantially.

Funding as an Additional Market Factor

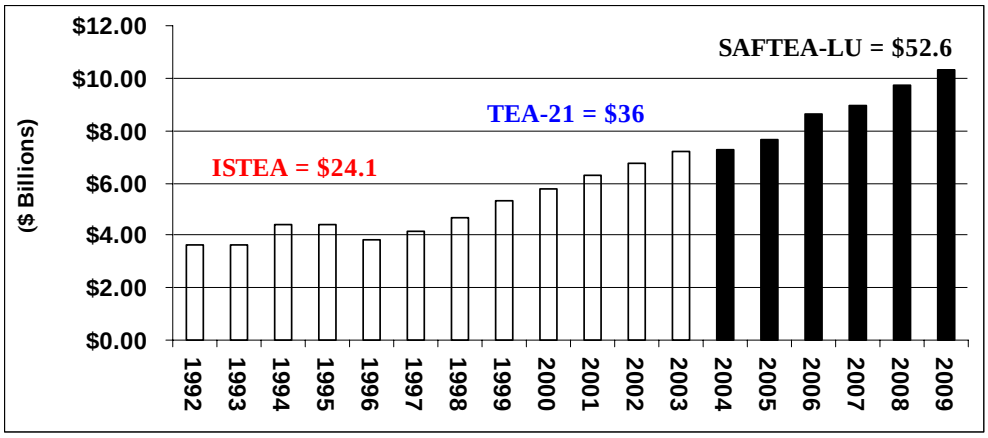
Because funding from federal, state and local sources impacts the bus manufacturers as well as the transit agencies, as discussed on page 60 of the *Manufacturer Questionnaire and Interview Results* chapter, it is important to review additional aspects of funding as a market force of relevance to the transit industry.

Impact of *SAFETEA-LU* on Public Transit and the Transit Bus Industry

Rolling stock procurement generally results from a combination two funding sources — federal and state/local. In August 2005, federal funding was authorized by the *Safe, Accountable, Flexible, Efficient Transportation Equity Act – A Legacy for Users* (*SAFETEA-LU).* Of the total $286.4 billion budget, $52.6 billion was authorized to fund public transportation from FY 2005 through FY 2009. This allocation signifies a 46% increase from the $36 billion provided for public transportation by the *Transportation Equity Act for the 21st Century (TEA-21).*[155] As exhibited in Figure 37, this level of federal investment is more than double of that authorized under the *Intermodal Surface Transportation Efficiency Act* (*ISTEA*) in 1992. According to William Millar, President

of APTA, "*SAFETEA-LU* builds on the success of two previous surface transportation authorization laws, *Intermodal Surface Transportation Efficiency Act* (*ISTEA)* and the *Transportation Act for the 21st Century (TEA 21).*"[156]

Figure 37: Federal Funding Programs



Source: APTA, *SAFETEA-LU, A Guide to Transit Related Provisions*

New changes in the funding mechanism will have a considerable and positive impact on the amount of federal funds made available to public transit. Prior to 2006, federal transit programs were funded from a combination of two funds, the Highway Trust Fund and the General Fund. Beginning in FY 2006 however, *SAFETEA-LU* funds all New Starts, Research, and FTA Administrative Expenses from the General Fund, and all other programs from the Mass Transit Account of the Highway Trust Fund (HTF).[157]

Furthermore, transit agencies and bus manufacturers alike will benefit from some of the provisions included in *SAFETEA-LU.* Provisions relating to buses include the Bus and Bus Facilities Program of which few changes were made by *SAFETEA-LU*; however, the funding was increased significantly. (About 600 earmarks comprise half of the program resources in each fiscal year through FY 2009.)[158]

Provisions related to clean buses are notable. Funding for the Congestion Mitigation and Air Quality Program (CMAQ) was increased minimally to $8.6 billion to spend over five years, compared to the $8.5 billion funding spread over six years — the *TEA-21* legislation. Among the requirements, the provision stipulates maintenance areas and non-attainment areas to prioritize the usage of diesel retrofits verified by the Environmental Protection Agency or the California Air Resources Board (CARB). However, the provision authorized only seven states receiving CMAQ funds to purchase biodiesel, which is an EPA-verified retrofit technology.

In addition to authorizing funds for the CMAQ program, *SAFETEA-LU* authorized the use of $49 million over four years (starting in 2006) for fuel cell bus research and development in order to accelerate the commercialization of the technology. In addition, the legislation authorized $238.1 million for the Clean Fuels Grant Program to be used over five years. The funding was reduced significantly compared to the previous funding level of $100 million per year. However, it is important to note that the *TEA-21* funding

level actually was not implemented due to significant delays in rulemaking and appropriation.[159] The *SAFETEA-LU* provisions changed the funding mechanism from formula-based to discretionary grants, and federal match for projects also increased from 80% to 90%. Up to 25% of the annual grants are provided for the purchase of clean fuels vehicles, including clean diesel buses.[160]

Highlighted Federal and Local Funding Issues

Although *SAFETEA-LU* has authorized long-awaited and much-needed federal funds for public transit, the future availability of federal and local funding nevertheless remains a major concern. The concern centers on the ability of federal and state gas taxes to reach levels necessary to sustain public transit funding. In the past few years, the Brookings Institution and the Hudson Institute have each conducted independent research studies regarding this issue.

A 2003 Brookings Institution report focused on gas tax revenues, which can impact federal funding for mass transit. The report cited five indicators that impact gas tax revenue: [161]

- Vehicle miles traveled (VMT)
- Number of vehicles
- Gas consumption
- Number of licensed drivers
- Population

The study revealed that the rapid increases in these indicators seem to be leveling off since in recent years. In particular, there has been a decline in vehicle miles traveled (VMT), which translates to lower gas tax revenues. Recent data from the Federal Highway Administration (FHWA) shows only a 2% average yearly increase in VMT since 1999. Several factors explain this phenomenon, including the increased fuel efficiency of many vehicles and a slow, but steady, growth in the proliferation of alternative fuel vehicles. The reduction of VMT is generally a positive trend for metropolitan areas in terms of effects on the environment and traffic congestion.[162] Nevertheless, lower gas tax revenues impact the major source of funding for mass transit — federal funding.

In 2005, the Hudson Institute published a report that addresses the potential issues that public transit faces in regard to an unstable or declining HTF. The report focused on two primary funding requirements — expenditures needed to *maintain* the physical conditions and performance of the nation's public transit system and the expenditures needed to *improve* the physical conditions and service performance of the nation's transit system (Figure 38). Each of the two focal points of the report was measured against transit productivity in constant 2000 dollars.[163]

According to the study, the calculations of funds needed to *maintain* transit capital assets were based on the assumption that transit assets will continue to be replaced in the same manner as today. Typically, capital assets in transit are replaced later than is recommended, and service is provided only at existing levels. Two estimates relevant to

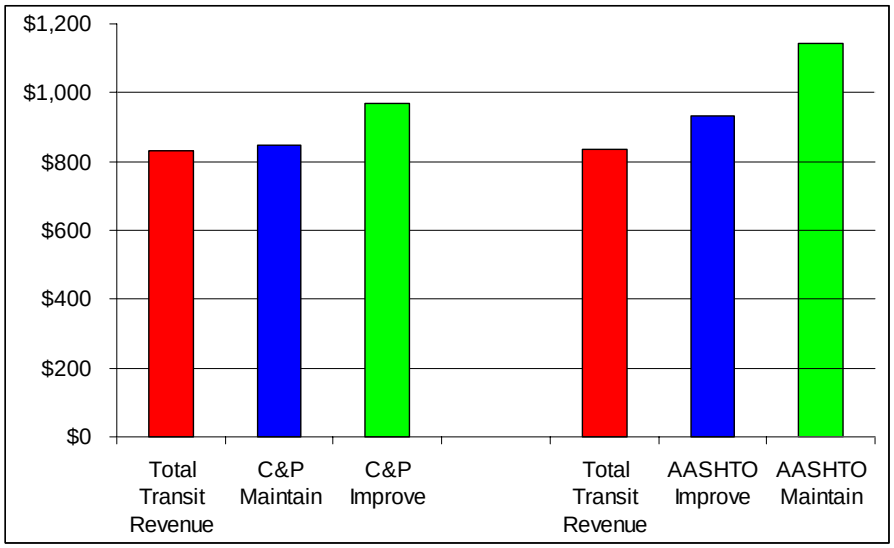
maintaining transit assets are available — one from the *FHWA Condition and Performance (C&P) Report*[164] and the second from the Association of State Highway and Transportation Officials (AASHTO) *Bottom Line Report*.[165] These reports vary significantly in terms of the stated funding requirements.[166]

- The *FHWA C&P Report* indicates that a minimum of $35 billion in capital investments is needed to maintain the nation's transit systems, increasing to $45 billion in 2025, based on population and economic growth.
- By employing slightly different analytical assumptions, AASHTO's *Bottom Line Report* estimates that a minimum of $39 billion annually in capital investments is needed to maintain the nation's transit systems, increasing to $49 billion in 2025.

The calculations that determined funding requirements to *improve* transit assets, as identified by the Hudson Institute, are predicated on the assumption that transit capital assets will be replaced according to recommended cycles, resulting in an overall improvement in conditions. These improvements would include both a reduction in passenger densities on the most crowded systems as well as improved speed of service for systems falling below the acceptable national average.

- The *FHWA C&P Report* estimates that $41 billion was needed to improve the performance of the nation's transit systems in 2000 and that $50 billion will be needed in 2025.
- AASHTO's *Bottom Line Report*, again using slightly different analytical assumptions, estimates that $49 billion was needed in 2000 to improve the nation's transit systems, and $59 billion will be required in 2025.

Figure 38: Transit Needs Compared to Transit Revenue



Source: Hudson Institute, *2010 and Beyond: A Vision of America's Transportation Future*
FHWA, *2003 C&P Report*, AASHTO, *The Bottom Line Report*

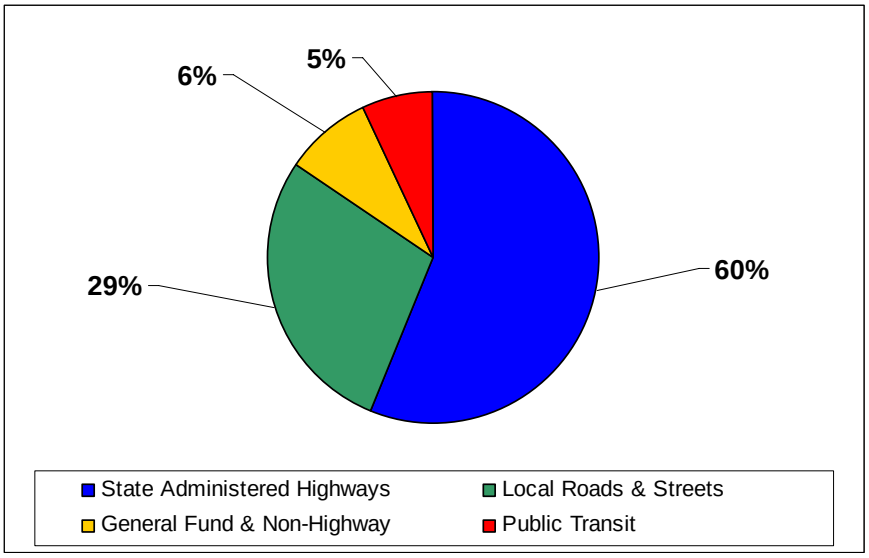
As illustrated in Figure 38, when the study compared the cumulative transit needs to cumulative transit revenues from 2005 – 2025, gaps between estimated needs and expected revenues ranged from a low of $13 billion to a high of approximately $309 billion.[167] As noted throughout this study, buses have the highest ridership compared to

other modes of public transportation. As a result, these expenditure gaps are of grave concern for the four largest manufacturers of transit buses.

The uncertainty of local funding for public transit is another major concern for the transit bus industry. Currently, federal assistance provided for the procurement of transit buses equals 80%, and the remaining 20% must come from local funding. Local funding includes state, county, municipal and city sources. In addition to the federal gas tax, all fifty states have a state gas tax. Each state allocates its own gas tax independently, designating funds for highway infrastructure or for other public purposes.

Unfortunately, very few states allocate a balanced portion of their gas tax receipts to public transit (Figure 39). In fact, thirty states or 60% of the U.S. states earmark gas tax revenues for highway or roadway projects only. The remaining states allocate portions of the gas tax to a variety of expenditures.[168] According to Robert Puentes and Ryan Prince of the Brookings Institution, in 2003 "…only eleven states spent more than 5% of their gas tax receipts on transit, and only five states — New York, Connecticut, Rhode Island, New Jersey and Maryland — spent more than 15%…" on mass transit. In each of those five states, statutory provisions set aside substantial portions of net gas tax revenues for mass transit funding.[169]

Figure 39: State Gas Tax Allocations



Source: FHWA, Office of Highway Policy Information, *Highway Statistics*

Furthermore, state allocation of the gas tax is not designed to benefit public transit. States typically manage gas taxes in one of three ways — constitutional, statutory or through a multi-modal distribution formula.[170] Twenty-two states maintain a constitutional restriction limiting the use of gas tax exclusively to public roadway development, maintenance and administration. Eight other states have statutory restrictions enacted by the legislature dedicating revenues to highway uses. The remaining twenty states and the District of Columbia have less stringent distribution requirements and allow for multi-modal distribution. Puentes and Prince observed that "… overall, exclusive dedication of gas tax revenues to highway purposes matters

because it may prevent states from using federal funds – often difficult to raise locally or through other sources – for transit."[171] This point resonates loudly with transit agencies and transit bus manufacturers alike.

Summary and Conclusion

The viability of the U.S. bus manufacturing industry is questionable. Increasingly, U.S. bus manufacturers are under pressure to meet varying demands associated with public transit buses. This report examined current trends in bus procurement patterns and requirements of transit agencies as well as the capability of four U.S. bus manufacturers to serve those demands.

Non-Rail Vehicle Market Overview

Highlights of the secondary research (presented in the *Market Overview* chapter of this study) included the following key findings:

Production Issues

- Among all modes of public transportation, transit buses serve the largest population. Over the past five years, the number of bus orders has decreased significantly while operating costs have continued to increase.
- The overall demand of new transit buses gives no indication of ever reaching the 1980s-forecasted demand. In fact, production of transit buses has declined since 2001. Transit bus production in 2004 was approximately 50% of the 2001 total.
- Five bus manufacturers provided more than 87% of U.S. transit bus production during 2004. Since this study began, Neoplan, one of the five bus manufacturers, went out of business.
- 40-ft. buses continue to be the most frequently ordered bus type by U.S. transit agencies. Accordingly, the 40-ft. low-floor transit bus dominates the major manufacturers' vehicle production. Production of the 60-ft. articulated bus has increased since 2001, while production levels of 30-ft. and 35-ft. transit buses have fluctuated.

Fuel and Technology Trends

- While diesel remains the dominant power source for buses, regulatory pressures (particularly those focused on the environment) have led to an increase in the production of alternative fuel transit vehicles. The production of alternative fuel transit buses is expected to continue growing as more stringent emission standards impact the market.
- Compliance with EPA and state air quality regulations is a major driver for transit agencies' purchases of buses powered by alternative fuel systems, while high costs, funding issues, and uncertain reliability of technology continue to pose challenges.
- Emerging trends include Bus Rapid Transit (BRT) aimed to relieve traffic congestion in urban areas. Advocates contend that capital investment costs and operational costs for BRT tend to be less expensive than costs associated with rail.

- Increasingly, ITS technologies have been sought and procured by transit agencies; however, both prevalent and developing technologies tend to be cost prohibitive for many agencies, especially smaller ones.
- New technologies, required by the federal government and demanded by transit agencies, will continue to impact bus manufacturers. Some mandated technologies may have a negative impact on the research and development budgets of bus manufacturers.

Procurement Issues

- In recent years, representatives of the transit industry, including APTA, FTA, NTI, and other stakeholders, have asserted that current procurement practices require review.
- Pooled purchasing, often described as an effort to standardize specifications and contracting, is emerging as a topic of interest (or concern) for transit agencies and bus manufacturers.
- Debate continues with regard to the relevance of the federal *Buy America* policy in light of increasing globalization of manufactured products, as well as components/materials.

Highlighted Similarities and Differences in Perspectives

The study's primary research results were consistent with findings determined by secondary research. Survey and interview results demonstrated that although study participants (from the manufacturers as well as from the transit agencies) shared some views, significant differences also were documented in terms of opinions and experiences. The data derived from the study participants highlight the complexities of the issues currently associated with the U.S. non-rail vehicle market.

Viability of the Transit Bus Industry

Both the representative transit agencies and the bus manufacturers expressed grave concerns for the viability of the transit bus industry. According to some transit agency representatives that participated in this study, the limited number of U.S. bus manufacturers poses a challenge for transit agencies, with one agency voicing concerns about the U.S. bus manufacturers' ability to meet the *Buy America* requirements. The bus manufacturers cited the diminished, at times fluctuating, volume of the transit bus market as a major challenge to business profitability. Currently, only three of the four U.S. bus manufacturers report a profit.

Environmental Technology

Manufacturers and transit agencies shared similar perspectives about the challenges of implementing new technologies, including those that meet stringent environmental standards. The most critical new technology focus for all transit agencies and bus manufacturers relates to the upcoming 2007 and 2010 emissions standards that will require larger cooling systems and active after-treatment systems. Continued development of alternative fuel vehicles, hybrids, electric trolleys, and hydrogen fuel cell technology also is expected. Roughly 11.4% of the transit agencies in the U.S. operated

alternative fuel vehicles as of 2003.[172] Currently, the most prevalent alternative fuel type is compressed natural gas (CNG); however, hybrid electric buses are becoming increasingly popular among transit agencies purchasing alternative fuel vehicles. Diesel-electric hybrid was cited as the most commonly used alternative power source among the survey respondents. In addition, production of new vehicles suitable for the increasingly popular Bus Rapid Transit (BRT) service is expected to expand. Two of the four U.S. bus manufacturers currently offer BRT models and expect this business to grow significantly.

Procurement and Contracting

The most contentious problems for the bus transit industry today relate to bus procurement and contracting, as well as to maintenance and warranty issues. Discussions about procurement and contracting methods underscored the frustration of the bus manufacturers. Company executives expressed concern with what they perceived to be onerous contracting practices by transit agencies. The bus manufacturers observed that transit agencies have become increasingly demanding and are transferring more risks to the bus manufacturers. In addition, bus manufacturers asserted that transit agencies tend to ignore the Standard Bus Procurement Guidelines (SBPG) and develop agency-specific technical specifications. They perceived that the trend in specifying particular components and/or brand names has driven vehicle prices up and reliability down. All the bus manufacturers indicated preference for performance specifications over prescriptive specifications. With regard to procurement methods, all four executives indicated a preference for RFP or negotiated procurement methods rather than the low-bid procurement method.

Maintenance and Warranty Issues

Both the transit agencies and the bus manufacturers considered maintenance and warranty issues as major challenges, but opinions varied regarding liability. One transit agency commented on high maintenance and operations costs due to current warranty standards and the impression that, while vehicle manufacturers are trying to keep costs down, the post-delivery and long-term maintenance and operations costs are not of apparent concern to the manufacturers. On the other hand, the bus manufacturing representatives expressed serious concerns about extended warranties for bus components and fleet defects that are being required, or demanded, by transit agencies. All of the bus manufacturers expressed the opinion that transit agencies and component suppliers place unreasonable liability on the bus manufacturers. Bus company executives commented that transit agencies are beginning to require extended warranties for components significantly beyond the useful life of most components. In addition, bus manufacturers questioned the 12-year/500,000-mile design standard, indicating that power trains rarely last more than eight years.

Buy America

Strong opinions about the *Buy America* policy did not necessarily reflect a divide between transit agencies and bus manufacturers. Most of the surveyed transit agencies indicated that the *Buy America* policy has not affected procurement practices and that they fully comply with, and support, the policy. However, one transit agency

representative commented that the policy severely restricts agencies' ability to procure new technology and equipment. Compared to the transit agency perspectives, the bus manufacturers' response to *Buy America* was more divided. Two manufacturers in favor of the policy commented that if *Buy America* were repealed, the U.S.-based transit bus manufacturing would most likely end, and their two companies would be out-of-business. The other two manufacturers, who expressed opposition to *Buy America*, indicated that the policy increases the cost of U.S. buses and impedes the most efficient use of resources.

Pooled Procurement

Transit agencies and bus manufacturers agreed that pooled procurement may help smaller transit agencies. Most of the surveyed transit agencies expressed optimism, indicating that pooled purchases help reduce costs and procurement time. However, the responses also included concerns about the availability of options and the ability of a single specification to satisfy the requirements of all participating agencies. The bus manufacturers also voiced concerns about program control and mass customization. In addition, bus company executives expressed frustrations about a lack of explanation from the FTA regarding the federal Cooperative Procurement Pilot Program (CPPP) that was initiated in 2004.

Demands and Challenges of Public Bus Transit

Research related to the needs of transit agencies, with respect to non-rail vehicles demonstrated that a variety of factors influence the agencies' purchasing decisions, including fleet size, vehicle age, service requirements, and financial capacity. Vehicle types and sizes that are critical for the agencies' current and future operations reflect each agency's operating environment, including service area climate, population size, and community needs. Study participants indicated that, in 2005, primary reasons for selecting certain vehicle types included replacing aging vehicles, accommodating service expansion, and implementing new technology and design features. The variable circumstances and requirements among the nation's transit agencies undoubtedly poses a challenge for the U.S. bus manufacturing industry.

In addition, social factors — although not a focus of this study — contribute to the challenges faced by the entire transit bus industry. In particular, changes in demographics impact all modes of public transportation, and because bus transportation involves the largest number of unlinked passenger trips, these issues are particularly salient for the transit bus industry.[173] According to a study conducted by American Public Transportation Association (APTA) in November 2004, problems related to shifts in demographic needs increasingly are becoming urgent concerns for transit agency planning and operations.[174] The following sections highlight two demographic concerns presented in APTA's study — suburban growth and aging/disadvantaged populations.

Suburban growth

In the past decade, suburban population growth increased by 22%, representing 62% of the metropolitan population and 57% of the total metropolitan employment.[175] APTA's

study suggests that continually expanding suburban job growth will lead to an increased demand for suburb-to-suburb travel by commuters. Because commuters constitute a major segment of public transit ridership, transit agencies will need to tackle this dynamic in commuter work travel.

Heavier reliance on privately-owned automobiles for travel and for commuting increases traffic congestion and is related to suburban growth. According to APTA's study, the impact is significant. However, because the effect is not uniform throughout various regions of the U.S., according to this study, major policy shifts directed toward relieving congestion have not occurred.[176] Nevertheless, in some areas, transportation problems have long been a political issue, as in the case of northern Virginia. A priority of Virginia's Governor-Elect Tim Kaine is to improve the commonwealth's transportation infrastructure, especially in Northern Virginia where exponential growth has led to severe traffic problems.[177] During the 2005 gubernatorial race, Kaine's political platform focused on transportation issues.

Aging and Disadvantaged Populations

Seniors are the fastest growing population segment in the United States — by 2030, Americans aged 65 or older are expected to represent 20% of the total population compared to 12.4% in 2000.[178] Currently, passengers over the age of 65 constitute a 7% national average of the total transit ridership.[179] A survey conducted in 2005 by Harris Interactive found that 82% of the seniors who participated in the study feared losing mobility after they could no longer drive.[180] A loss of mobility can lead to isolation and reduced independence, as well as to a lower quality of life and health, resulting in significant social and economic consequences at the societal level.[181]

Accessibility and mobility issues also apply to disadvantaged populations, including the physically disabled and the economically disadvantaged population. Transit agencies continue to face challenges in meeting the transportation needs of the physically disadvantaged, despite the implementation of the *Americans with Disabilities Act of 1990*.[182] Equity issues related to the lack of auto ownership among the economically disadvantaged demonstrate a need for public transit to meet the mobility needs of those who rely heavily on public transportation.[183]

Transit Agency Response

Properly responding to the needs created by demographic changes in many U.S. cities and suburbs is a continually challenging task for transit agencies. In addition to new service areas and types, as well as enhanced public outreach, new demands for different vehicle types will likely impact the transit bus industry. Indeed, transit agency survey results showed that most agencies — large, medium, and small — have plans to address bus service needs by increasing the number of routes and/or providing new types of service. In particular, Bus Rapid Transit (BRT) has become a popular service type among larger transit agencies in addressing the needs of suburban commuters.

Public demand for cleaner buses that mitigate the environmental impact of greenhouse gas emissions has led to the procurement of buses with alternative fuel/propulsion

systems by an increasing number of transit agencies nationwide. Fuel economy and federal, state, and/or local environmental requirements are considered equally important factors for purchasing decisions, particularly decisions made by large transit agencies. The inter-related issues of maintenance, technical training, implementation of new technology/alternative fuel sources, as well as budgetary constraints, however, pose challenges.

In terms of bus vehicle design, many agencies already have started to implement features such as low-floor buses that allow passengers to board and egress more easily. Challenges remain, however, for the transit bus industry to continue implementing new technology and designs that address the changing needs caused by major demographic shifts throughout the nation.

Challenges Faced by Bus Manufacturers

Needless to say, bus manufacturers have expressed serious concerns about the state of the industry. Fluctuation in demand and the general lack of volume in orders and purchases of transit buses threaten the bus manufacturing business. Various issues — such as procurement and contracting, warranties, the *Buy America* policy, funding, and demand for new technologies — have compounded the difficulties faced by bus manufacturers today. In addition, costs of doing business are rising, specifically materials costs, fuel prices and healthcare costs. Requirements such as the Altoona Bus Test, 12-year/500,000 mile service life, and the 2007 and 2010 emissions standards also pose major challenges for the bus manufacturers.

The bus manufacturers increasingly are experiencing difficulties as a result of funding delays. The lack of federal funding due to the 24-month delay in the authorization of *SAFETEA-LU* has impacted transit bus procurements negatively. Although all of the manufacturers participating in this study had established enough backlogs to continue business, the continued delay in the approval of the 2006 FTA budget made market growth target goals in 2005 unattainable. The bus manufacturers indicated that *SAFETEA-LU* funding will be helpful for future business; however, the manufacturers expressed the urgent need for increased numbers of bids and orders in order for the industry to remain viable.

In order to address growing concerns, each of the bus manufacturers expressed a desire for the FTA to provide more oversight in terms of federal funding issues. Two executives suggested that FTA become more supportive of policy revisions that relax some of the *Buy America* content requirements or to include provisions that are based on local measurements (such as the U.S. labor content). All four manufacturers would like to see an increase in heavy-duty transit bus orders and sales.

Two out of four of the manufacturing companies interviewed are not making a profit. One manufacturer that has made a profit commented that the company's goal is to remain profitable so that the business can continue supporting the industry. All participating executives articulated the need to foster increased levels of trust among all stakeholders

in the transit industry. The manufacturers insisted that, if the industry continues operating at current levels of profitability, more U.S transit bus manufacturers would exit the market, particularly the foreign-owned companies, or be forced to go out of business.

Conclusion

The principal objectives of the non-rail transit industry are to provide the public with buses that can be operated and maintained cost-effectively while providing clean, reliable, and value-oriented service. Research results suggest that the current crisis faced by the transit bus industry must be addressed immediately in order to achieve these objectives. Transit agencies are facing public demand for improved service and new technologies, while contending with the realities of budgetary constraints and rising costs. U.S. bus manufacturers, on the other hand, are struggling to meet the demands of transit agencies, in context of rising costs and reduced profits.

Among the various issues explored in this study, the greatest challenges cited by both transit agencies and bus manufacturers were related to bus procurement and contracting, as well as to maintenance and warranty issues. These concerns underscore the financial strains and complexities caused by high maintenance and operations costs that both transit agencies and bus manufacturers continue to experience. This environment is a vicious circle in which low market demand for transit buses negatively impacts the industry's viability. If vehicle demand remains at or close to the levels experienced over the last three years, the industry only will require the production capacity of two heavy duty bus manufacturers to support vehicle demand. In fact, if market conditions do not improve by 2007, another transit bus manufacturer will most likely exit the transit marketplace.

Transit buses are the simplest and quickest transportation mode for an agency to implement. However, transit bus manufacturers contend that industry is headed in the wrong direction. In order for the FTA and transit agencies across the U.S. is to maintain or increase ridership, maybe transit agencies should procure buses that are less complex and less expensive to operate and maintain, rather than more complex and expensive. Increased complexity leads directly to the procurement of fewer, but more expensive vehicles. Perhaps the industry should consider adopting a business model (most notably used by Southwest Airlines) that utilizes simple and reliable vehicles, increased routes and service, and lower fares for passengers.

Another urgent concern that was emphasized throughout this study is the high level of distrust among stakeholders in the transit bus industry – that of the agencies vis-à-vis bus manufacturers and bus manufacturers vis-à-vis suppliers. It is this distrust that has led directly to the issues documented in this report by both transit agencies and transit bus manufacturers. Based on the results of this study, the FTA appears to be the only entity that can possibly bring all the parties together and foster an atmosphere of partnership and trust over the near term and, ultimately, the long term.

Expanded examination of these issues, as well as studies of other issues related to public transit needs and trends will enhance FTA's ability to assess policies and develop new initiatives in order to respond to the increasing demands of the transit bus industry.

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