ACRP

REPORT 17

AIRPORT
COOPERATIVE
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PROGRAM

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Airports and the Newest Generation of General Aviation Aircraft

Volume 1: Forecast

TRANSPORTATION RESEARCH BOARD
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A I R P O R T   C O O P E R A T I V E   R E S E A R C H   P R O G R A M

ACRP REPORT 17

Airports and the Newest Generation of General Aviation Aircraft

Volume 1: Forecast

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AND

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Subject Areas
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AIRPORT COOPERATIVE RESEARCH PROGRAM

Airports are vital national resources. They serve a key role in transportation of people and goods and in regional, national, and international commerce. They are where the nation's aviation system connects with other modes of transportation and where federal responsibility for managing and regulating air traffic operations intersects with the role of state and local governments that own and operate most airports. Research is necessary to solve common operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the airport industry. The Airport Cooperative Research Program (ACRP) serves as one of the principal means by which the airport industry can develop innovative near-term solutions to meet demands placed on it.

The need for ACRP was identified in *TRB Special Report 272: Airport Research Needs: Cooperative Solutions* in 2003, based on a study sponsored by the Federal Aviation Administration (FAA). The ACRP carries out applied research on problems that are shared by airport operating agencies and are not being adequately addressed by existing federal research programs. It is modeled after the successful National Cooperative Highway Research Program and Transit Cooperative Research Program. The ACRP undertakes research and other technical activities in a variety of airport subject areas, including design, construction, maintenance, operations, safety, security, policy, planning, human resources, and administration. The ACRP provides a forum where airport operators can cooperatively address common operational problems.

The ACRP was authorized in December 2003 as part of the Vision 100-Century of Aviation Reauthorization Act. The primary participants in the ACRP are (1) an independent governing board, the ACRP Oversight Committee (AOC), appointed by the Secretary of the U.S. Department of Transportation with representation from airport operating agencies, other stakeholders, and relevant industry organizations such as the Airports Council International-North America (ACI-NA), the American Association of Airport Executives (AAAE), the National Association of State Aviation Officials (NASAO), and the Air Transport Association (ATA) as vital links to the airport community; (2) the TRB as program manager and secretariat for the governing board; and (3) the FAA as program sponsor. In October 2005, the FAA executed a contract with the National Academies formally initiating the program.

The ACRP benefits from the cooperation and participation of airport professionals, air carriers, shippers, state and local government officials, equipment and service suppliers, other airport users, and research organizations. Each of these participants has different interests and responsibilities, and each is an integral part of this cooperative research effort.

Research problem statements for the ACRP are solicited periodically but may be submitted to the TRB by anyone at any time. It is the responsibility of the AOC to formulate the research program by identifying the highest priority projects and defining funding levels and expected products.

Once selected, each ACRP project is assigned to an expert panel, appointed by the TRB. Panels include experienced practitioners and research specialists; heavy emphasis is placed on including airport professionals, the intended users of the research products. The panels prepare project statements (requests for proposals), select contractors, and provide technical guidance and counsel throughout the life of the project. The process for developing research problem statements and selecting research agencies has been used by TRB in managing cooperative research programs since 1962. As in other TRB activities, ACRP project panels serve voluntarily without compensation.

Primary emphasis is placed on disseminating ACRP results to the intended end-users of the research: airport operating agencies, service providers, and suppliers. The ACRP produces a series of research reports for use by airport operators, local agencies, the FAA, and other interested parties, and industry associations may arrange for workshops, training aids, field visits, and other activities to ensure that results are implemented by airport-industry practitioners.

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FOREWORD

By Theresia H. Schatz
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ACRP Report 17: Airports and The Newest Generation of General Aviation Aircraft is published as a 2-volume set. Volume 1 provides a Forecast of anticipated fleet activity associated with the newest generation of General Aviation (GA) aircraft over a 5- and 10-year outlook. Volume 2 offers a Guidebook in a user-friendly format that helps airport operators assess the practical requirements and innovative approaches that may be needed to accommodate these new aircraft.

This Volume 1 Forecast will be of interest to airport operators currently serving GA aircraft, as well as those that are considering the potential impact of incorporating commercial service that may be provided by Very Light Jets (VLJs) and other advanced small GA aircraft at their airports. Using 2007 as the baseline, this Forecast provides 5- and 10-year fleet size projections for the newest generation of GA aircraft and highlights a variety of fleets and their manufacturers. Both traditional GA uses as well as commercial air taxi uses are considered.

In addition to fleet estimates, operational activity projections by VLJs used in commercial air taxi services are provided for over 1,800 US airports. In conjunction with the Volume 2 Guidebook, these fleet and activity forecasts can be used by airport operators to assess both the practical requirements and the innovative options for accommodating these new types of GA aircraft. Airport planners can use this Forecast as the basis for upgrading existing, and creating new airport facilities (along with the services needed). Service providers and industry stakeholders focused on GA activity will find this Forecast helpful in seeking new business opportunities in the foreseeable future.

Some forecasts predict that an increasing number of new, smaller GA aircraft will take to the skies in the near future. These forecasts suggest that some airports will see an increase in traffic and greater demand for GA infrastructure, facilities, and services.

However, according to some aviation industry experts, many of these forecasts appear over-optimistic. Airport operators are concerned that the forecasts do not adequately address airport considerations. The fundamental questions for airports are, how much will traffic increase from these aircraft; which airports will experience the traffic increase; and what infrastructure, facilities, and services will be needed.

If there is a large increase in aircraft activity as a result of these new aircraft, already busy GA airports will be further congested, and the smallest GA airports may not be prepared to handle this potential increase in activity. Consequently, airports need to know what level of aircraft activity they can expect and what infrastructure, facilities, and services are needed to accommodate the newest generation of GA aircraft adequately. They need information on the likelihood of GA aircraft activity increases at airports by category of airport and geographical location. Moreover, no single resource document summarizes what can and should be done to prepare airport infrastructure, facilities, and services to accommodate the increased activity while maintaining productivity.

Under ACRP Project 10-04, a research team led by GRA, Inc. conducted the research with the objectives to (1) forecast GA aircraft activity by category of airport and geographical location due to the introduction of the newest generation of GA aircraft and (2) develop a user-friendly guidebook that will help airport operators to (a) estimate the level of activity from these aircraft at their particular airport; (b) assess the impact of these aircraft on their particular airport's infrastructure, facilities, and services; (c) accommodate existing and anticipated demand for facilities and services from these aircraft; and (d) attract new business from the newest generation of GA aircraft. For the purposes of this project, the newest generation of GA aircraft refers to small-sized (12,500 lbs or less) aircraft with high-technology "all glass" digital cockpits, including light jets, VLJs, and new advanced-technology piston and turbo-prop aircraft.

The need for this research began in 2006–07, when the hype surrounding VLJs reached a crescendo. With a significant downshift in the global economy in 2008–2009, the reduced demand has affected the aviation industry as a whole, particularly the GA market. Nonetheless, this Forecast and the Guidebook will help airport operators and planners prepare for the next wave of change. An increase in demand for this newest generation of GA aircraft and its impact on airports; the associated facilities; and information related to best plan for future growth, expansion, and potential new opportunities are likely to be needed.

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Airports and the Newest Generation of Aviation Aircraft, Volume 1: Forecast

A primary goal of ACRP Project 10-04 is to produce 5- and 10-yr fleet forecasts for the next-generation small general aviation (GA) aircraft. The baseline year is 2007, thus producing forecasts for the years 2012 and 2017. A key related requirement is to assess how the use of these aircraft will impact airports across the United States.

There are two major potential market segments for use of such aircraft: (1) traditional GA use, including personal, business, and corporate demand (including fractional ownership), and (2) commercial charter or air taxi use. The latter category includes both traditional charter use as well as "on demand per seat" services that have been widely discussed in the industry. These two segments are analyzed separately and with different techniques.

The forecast results are shown in Table 1. The sales forecast for the GA segment projects that approximately 1,650 very light jets (VLJs) may be sold for use in the United States by 2012; by 2017, this total is projected to grow to around 3,500. The air taxi forecast projects 751 VLJs by 2012 plus more than 400 new low-cost piston aircraft that may be used for air taxi services. By 2017, the cumulative air taxi VLJ fleet may total more than 1,300, with about half that number added to the air taxi piston fleet.

The air taxi forecast in particular is inherently speculative, and both parts of the forecast were completed prior to the major economic downturn in late 2008 as well as recent industry developments, including the bankruptcies of air taxi operator DayJet and VLJ manufacturer Eclipse Aviation.

The overall level of activity at small airports is not likely to be affected much by VLJs that are purchased for traditional GA use because their main effect will be a simple displacement

Table 1. Projected cumulative U.S. fleet additions of small GA aircraft from 2007.

	2012	2017
GA Use - Total	11,279	25,179
VLJ	1,647	3,547
Other	9,632	21,632
Air Taxi Use - Total	1,188	1,967
Piston		539
Turboprop	13	31
Light Jet	12	39
VLJ	751	1,305
VLJ Total	2,398	4,852

of sales that would have gone to other small GA aircraft instead. On the other hand, the analysis indicates that sales of VLJs (and low-cost piston aircraft) for air taxi use are likely to displace automobile and commercial air traffic, leading to substantial increases in activity at certain airports that handle large numbers of the new air taxi services. But overall, the projected increase in operations by 2017 at "VLJ-ready" airports relative to 2007 is relatively modest, on the order of 6%.

CHAPTER 1

Overview

A primary goal of ACRP Project 10-04 is to produce 5- and 10-yr fleet forecasts for next-generation small general aviation (GA) aircraft. The baseline year is 2007, thus producing forecasts for the years 2012 and 2017. A key related requirement is to assess how the use of these aircraft will impact airports across the United States.

There are two major potential market segments for use of such aircraft that have been widely discussed in the industry: (1) traditional GA use, including private, personal, and corporate demand (including fractional ownership) that is governed by FAA Part 91 regulations, and (2) commercial charter or air taxi use under FAA Part 135, as exhibited both by traditional charter services where one essentially rents an entire aircraft for a specific trip or for a specific amount of time, and new "per-seat" services. The per-seat model in particular has garnered much interest, with some analysts predicting that such services have the potential to dramatically expand the demand for and use of very light jets (VLJs) and other next-generation small aircraft.

It is very important to assess the potential for these segments separately. In the traditional GA market, it is believed that sales of VLJ aircraft will, for the most part, displace sales of other aircraft including high-end pistons, turboprops, and light jets. So even though ultimately there may be a significant VLJ fleet that is used for traditional GA purposes, growth in overall airport operations will not vary much from historical averages observed over the past several years. On the other hand, if the air taxi market develops into a significant segment, it may have a much larger impact on GA airport operations since much of the activity represent new small aircraft activity (displacing commercial air service and automobile trips). These issues are discussed in more detail below.

Aircraft Coverage

An initial determination was made to limit the aircraft covered to those weighing less than 12,500 lbs and to focus on those with advanced, modern avionics systems. While most of the attention in public discussions of such aircraft has focused on new VLJ designs, the present analysis brackets the VLJ segment on both ends and includes existing designs both at the low end (i.e., smaller piston aircraft such as the Cirrus SR-22, the Cessna/Columbia 350 and 400, the Diamond DA42 Twin Star, and the Mooney M20 series) and at the upper end (i.e., the "light jet" category up to 12,500 lbs that includes the Cessna CJ1 and CJ2 and the Hawker Beechcraft Premier 1A). **This report often refers to the "VLJ market," which is meant to include the larger market at both ends.** Within the VLJ segment, the primary focus is on the following twin-engine models that began actual production by the end of 2008:

- Eclipse 500,
- Cessna Citation Mustang, and
- Embraer Phenom[1] 100.

HondaJet is another twin-engine program whose prospects appear viable within the next few years; current plans call for first deliveries in 2010. In addition, there are a number of single-engine VLJ models currently under development, the most prominent of which are the Diamond D-Jet, Eclipse 400, Piper Jet, and Cirrus SJ50. Prospects for these programs are less certain although the D-Jet is further along than the other programs. After modifying the engine design in 2008, Diamond's current plans call for first deliveries in mid-2009. It should also be noted that two companies with VLJ programs were liquidated in 2008—Adam Aircraft (which was developing the A700 twin-engine VLJ) and ATG (which was developing a two-seat military trainer-style jet called the Javelin).

[1]The Embraer "executive jet" program also includes the Phenom 300, which is a larger version of the 100 series. Its projected size and weight are well above the 12,500 lb limit that prescribes the bounds of the current analysis.

Table 2. Active U.S. fleet in 2006.

Primary Use	Aircraft Type: Piston	Turboprop	Jet	Other	Total
GA (Part 91)					
Personal / Business / Corporate	141,476	5,183	7,581	30,253	184,493
Other	19,251	1,457	309	7,350	28,367
On-Demand (Part 135)					
Air Taxi	2,659	1,272	2,426	1,282	7,639
Other	356	152	63	1,143	1,714
Total	163,742	8,064	10,379	40,028	222,213

Geographic Coverage

The forecast is limited to fleets covering aircraft activity in the lower 48 states. In addition, only public-use airports are considered. To further limit the number of airports that must be analyzed, only those airports with jet fuel availability and at least one 3,000-ft lighted runway are included. While this potentially excludes some small airports that could accommodate modern piston aircraft such as the Cirrus SR-22, it includes the most heavily used airports that make up about 85% of total GA operations across the United States.

Review of Existing GA and Air Taxi Markets

According to FAA data for 2006, the current active U.S. fleet certified for GA use under Part 91 or On-Demand use under Part 135 totals about 222,000 aircraft. A breakout by primary use and aircraft type is shown in Table 2. This analysis of small next-generation aircraft focuses on potential *additions* to the shaded areas in Table 2 from small next-generation aircraft.

Table 3. Estimated average hours flown in 2006.

Aircraft Type: Piston	Turboprop	Jet
101	268	393

It is difficult to assess activity in terms of hours flown by use category because many aircraft are used in different categories at different times. The FAA has published average activity estimates by aircraft type, as shown in Table 3. In general, it is expected that financial considerations would cause the air taxi category to exhibit higher than average utilization rates across all aircraft types.

The forecasting effort undertaken here treats the private/corporate/fractional market and the charter/air taxi market separately, and two separate forecasts have been produced.

CHAPTER 2

GA Forecast

Introduction

The use of next-generation aircraft for personal, private, and corporate purposes is more in line with the traditional reasons for purchasing small GA aircraft compared with the new market potential for air taxi services. However, projections of such sales can still be very uncertain because the reasons for purchase are quite varied and will depend on individual or company circumstances that are typically unobservable, on intended use, on equipment characteristics that will have differing importance to differing buyers, and so forth.

These difficulties argue against a detailed bottoms-up "micro" approach. A better alternative is a macro-type analysis that relates aircraft sales to larger economic factors such as overall growth in the economy and interest rates. For the current analysis, such relationships are likely to track better at more aggregate levels. Consequently, the relevant market into which VLJs will fit into is defined to include shipments of GA piston, turboprop, and light jet aircraft (plus the initial shipments of VLJs themselves in 2007—the Eclipse 500 and Cessna Citation Mustang). The light jet models included in this definition are the Cessna CJ1 and CJ2 series, plus the Hawker Beechcraft Premier 1A.[2]

Projections for the Overall Market

Because the primary interest is in aircraft fleets that will be active at U.S. airports, the U.S. fleet is defined as total U.S. shipments minus exports plus imports.[3] Shipment counts by U.S. manufacturers were obtained from the General Aviation Manufacturers Association (GAMA) Annual Shipment Reports, which also include reports of GA exports and imports. To assess how U.S. net shipments are tied to movements in the overall economy, data were assembled on annual shipments,[4] on U.S. real gross domestic product (GDP), and on long-term interest rates (using the rate on 10-yr U.S. treasury notes) from 1999 through 2007. These data are shown in Table 4.

There is typically a strong trend component in time series data that can falsely imply a relationship among components where none really exists. To account for this, all data series were converted to annual percentage changes and then a linear regression of the percentage change in net shipments as a function of the percentage change in GDP and the 10-yr treasury rate was run. The regression line provided a reasonably good fit to the data with an adjusted R^2 of 0.701. The actual versus predicted results are shown in Figure 1.

To project future net shipments through 2017, the latest 10-yr forecast issued in September 2008 from the U.S. Congressional Budget Office (CBO) was used to get projections of real GDP growth and the interest rate on 10-yr treasury notes. The CBO forecast reflects some recognition of the steep economic downturn in the second half of 2008, projects very slow growth through the end of 2009 followed by a rebound in 2010–11 but with interest rates also increasing, and then projects a gentle softening throughout the remainder of the forecast through 2017. Substituting these forecasts into the regression equation yields estimates of net U.S. aircraft shipments encompassing the piston, turboprop, and light jet categories (plus the first-year VLJ shipments from Eclipse and Cessna). These projections are shown in Figure 2. As will be seen, shipments through the first half of 2008 indicate an overall decline in sales, but the regression model shows virtually no

[2]The remainder of the jet aircraft are all priced well beyond what any VLJ might sell for and really do not compete in the same market.

[3]Aircraft are considered to be manufactured in the United States when produced under an FAA production certificate. Export and import data are not identified for individual makes and models. In addition, the import statistics used are shown in the GAMA shipment reports obtained from the Aerospace Industries Association (AIA); these statistics include single-engine aircraft plus small and medium multi-engine aircraft weighing up to 10,000 lbs.

[4]Because this portion of the analysis focuses only on GA use, the shipment totals were decremented by the share of air taxi (FAA Part 135) use reported for each aircraft group in the annual GAMA Databooks.

Table 4. Historical data.

Year	Net US Shipments*	Real GDP (Billions of 2000$)	Rate on 10-Year Treasury Note
1999	1837	9,470	5.65
2000	1948	9,817	6.03
2001	1889	9,891	5.02
2002	1763	10,049	4.61
2003	1895	10,301	4.01
2004	2027	10,676	4.27
2005	2273	10,990	4.29
2006	2358	11,295	4.80
2007	2298	11,524	4.63

*Includes piston, turboprops, VLJs and light jets, adjusted for GA use only

Sources: Net US Shipments - GAMA General Aviation Airplane Shipment Report, various years.
Real GDP - US Department of Commerce, Bureau of Economic Analysis, www.bea.gov/national/nipaweb/index.asp
Treasury Rate - US Federal Reserve Board, www.federalreserve.gov/releases/h15

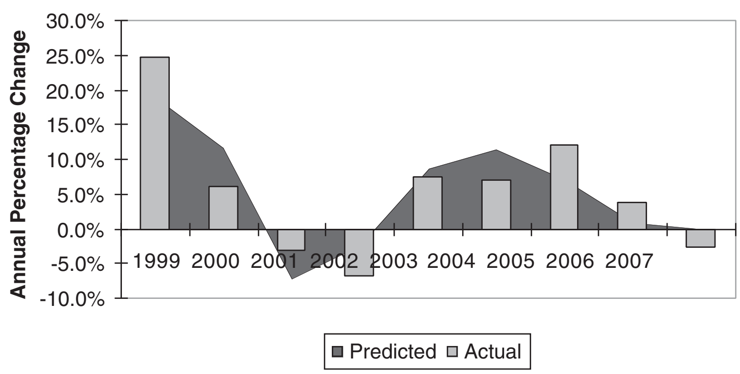


Figure 1. Actual versus predicted change in net U.S. shipments of small GA aircraft.

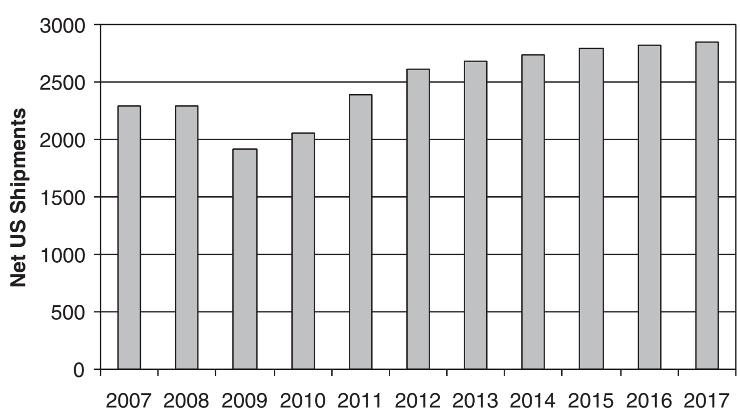
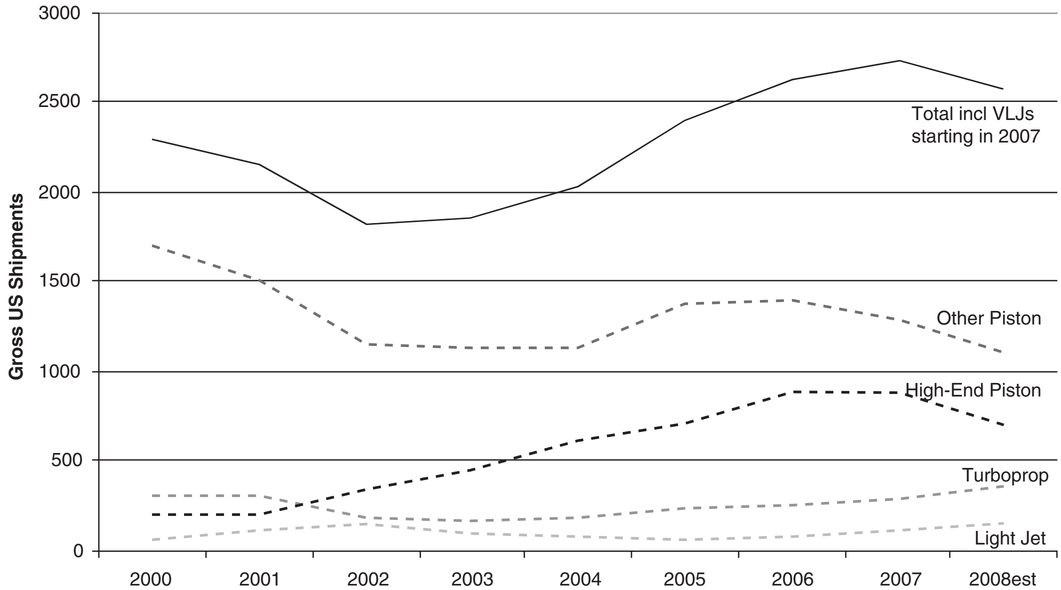


Figure 2. Projected net U.S. shipments of small GA aircraft.



Source: GRA analysis of GAMA General Aviation Airplane Shipment Reports, various years.

Figure 3. Breakout of gross U.S. shipments of small GA aircraft.

change from 2007 (largely due to low interest rates). Looking further ahead, the model projects a significant decline in shipments in 2009, substantial growth by 2011–12, and then modest increases through the end of the forecast period in 2017.

Market Segmentation Analysis

As VLJ production develops over the coming years, it is expected that shipments will be subject to these same economic fluctuations. For more understanding, it is useful to disaggregate the historical data for the existing market segments. Unfortunately, the export and import data are not available for individual makes and models; instead, historical changes in the market are assessed based on gross U.S. shipments (ignoring exports and imports), but breaking out the piston segment into two sub-groups—"high-end" and "other"—as shown in Figure 3.[5] The estimates for 2008 assume that the production rates for each segment observed in the first half of the year relative to the first half of 2007 remains constant through the rest of 2008. In addition, the line total includes Eclipse and Cessna Mustang VLJ production starting in 2007.

The figure shows that the overall growth in U.S. shipments over the past several years has been driven almost entirely by the high-end piston segment, which saw the introduction and growth of the Cirrus SR-22. In 2000, this segment accounted for about 10% of shipments and grew to about 34% by 2006. It is noteworthy that from 2000 to 2007, sales in the high-end segment quadrupled, but the overall relevant market grew by only about 18% (about the same percentage as overall real GDP). This suggests that even with the introduction of highly successful new aircraft models, total growth in the small GA market is still driven primarily by changes in the overall economy. The other salient feature of Figure 3 is that both turboprop and light jet shipments have remained fairly constant over the past several years.

However, there are indications that the economic slowdown in 2008 has affected high-end piston shipments fairly dramatically. Through the second quarter of 2008, high-end piston shipments dropped by 26% relative to the same period in 2007 and overall share dropped to about 27%. It is interesting to note that the turboprop and light jet sales continued to increase slowly in the first half of 2008, and the drop in the high-end piston sales was partially offset by the early appearance of VLJ shipments from Eclipse and Cessna.

From a longer-term point of view, however, it is believed that VLJs will compete more closely with the turboprop and light jet segments. To see why, it is useful to understand how VLJs may fit into the competitive landscape. One way to approach this is to compare aircraft characteristics that may be important in determining how potential customers choose among all available alternatives. To understand this comparison, data were assembled on average current selling prices

[5]The high-end piston segment is defined to include the following models: Cirrus SR22, Cessna/Columbia 350 and 400, Mooney M20 series, Beechcraft Baron G58, and Piper Malibu Mirage. Within this group, it is the Cirrus and Cessna/Columbia aircraft that account for virtually all of the growth shown in Figure 3.

Table 5. Comparative price and performance characteristics of existing models.

Type	Make/Model	Price ($000)	Cabin Volume incl External Baggage (cu. ft.)	Speed (mph)	Range (NM)
Piston	Cirrus SR22 G2	460	169	180	930
	Cessna 400	620	169	187	1143
	Beechcraft Baron G58	1,078	196	197	888
Turboprop	King Air 90	2,952	227	260	840
	King Air 200	5,089	303	283	920
	King Air 350	6,115	351	310	1440
	Piper Meridian	1,897	120	262	550
	Cessna 208B Caravan	1,844	340	182	780
Light Jet	Cessna CJ1+	4,528	243	381	857
	Cessna CJ2+	6,068	311	413	1074
	Beechcraft Premier I/IA	6,205	370	426	850

Note: Average prices for Cirrus SR22 and Cessna 400 prices obtained from www.controller.com; range for Baron G58 obtained from www.cessna.com

and certain key performance characteristics for a representative sample of existing high-end piston, turboprop, and light jet models, shown in Table 5.

To ensure consistency in the measurements, all of the data (with a few noted exceptions) were obtained from the same source (Conklin and de Decker Aircraft Cost Evaluator).

A linear regression of price against the performance attributes of speed, range, and cabin volume (including external storage space) was run. The actual versus predicted price results shown in Figure 4 are quite interesting.

The 45° line on the graph indicates an actual price equal to the expected price from the regression. Points below the line reflect aircraft that are priced below their expected price from the regression; points above the line show aircraft priced above their expected price. From a competitive analysis standpoint, it appears that the high-end piston aircraft (which are at the low end of the price structure) are priced below what one might expect based on their performance characteristics. At the same time, all but one of the turboprops in the sample are priced above expectations.

One should not read too much into these interpretations because there may be other important attributes that would help explain the relatively higher-than-expected price of turboprops (e.g., higher payload, better short-field capability, easier to fly than jets, etc.). Nevertheless, such an analysis can highlight potential market opportunities by identifying gaps

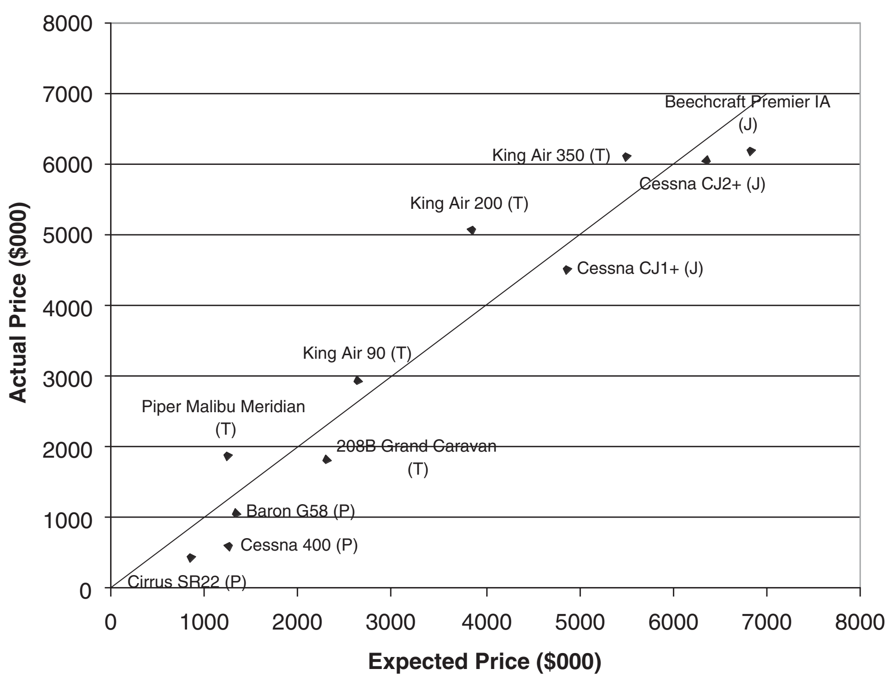


Figure 4. Expected versus actual price of small GA aircraft.

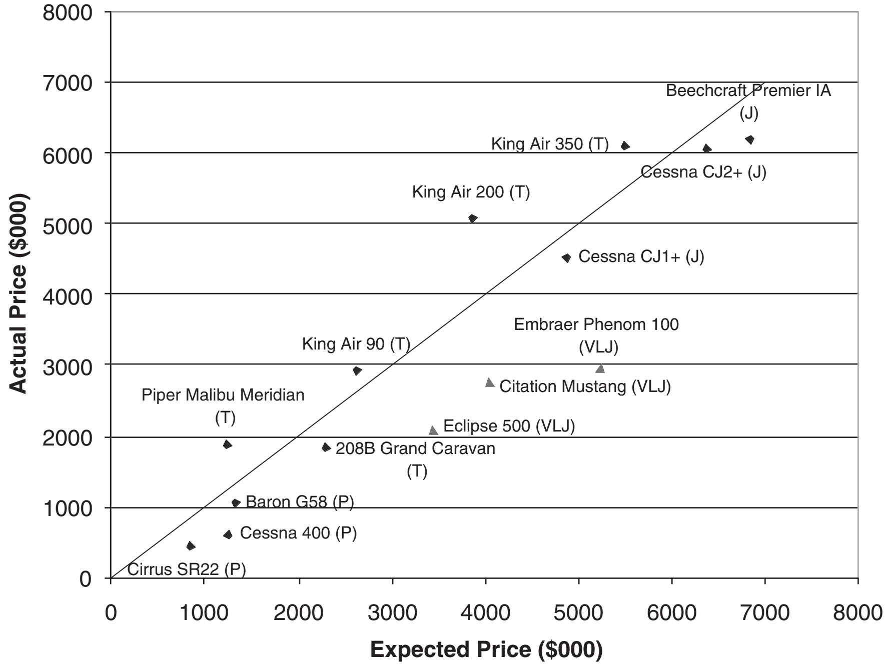


Figure 5. VLJs added to the product space.

in the product space. In the case of VLJs, this may be seen by observing their performance characteristics and plotting their price points on the same graph, as shown in Figure 5.

This exercise suggests that VLJs may indeed be able to garner significant sales for two reasons: they are priced well below the expected price line given their performance characteristics and they occupy a relatively empty area in the product space, although closer to turboprops and light jets than to pistons.[6]

In terms of a shipment forecast, Figure 5 suggests that, at a minimum, VLJs should be able to produce as many shipments as the turboprop segment since their actual prices overlap with each other but the VLJs (on average) offer better performance characteristics. Recalling Figure 3, it is believed that the fairly constant 200–300 annual shipments produced by the turboprop segment should be easily reachable. On the other hand, just based on the price differential alone, it is not likely that the demand for VLJs for personal, private, and corporate use will come anywhere close to the 700–900 units achieved by the high-end piston segment.

An important question is the extent to which sales of VLJs will cut into sales in the high-end piston segment and/or the turboprop and light jet segments. It is possible that the new VLJ segment may expand the size of the overall GA market. As discussed earlier, the evidence from 2000 to 2007 shows that the GA market was driven primarily by changes in aggregate economic activity rather than by the composition of existing models or the introduction of new models, so it is believed that any expansion of the overall GA market due strictly to the introduction of VLJs will be limited. By similar reasoning, neither the low end segment of the piston market nor the mid- to large-sized corporate jet market will likely be affected much by the introduction of VLJs since both markets really serve different clientele.

Outlook for VLJ Manufacturers

Actual VLJ shipments observed over the next several years will depend heavily on the actual progress made in development, certification, and production capabilities of the various VLJ programs that currently exist. **This section has been updated to account for important recent developments in these programs; the following fleet forecasts presented below, which were completed in the Fall of 2008, do not fully reflect these events.**

Eclipse 500

Eclipse Aviation originated the VLJ segment more than 10 years ago. The Eclipse 500 was certified in late 2006 and received its FAA production certificate in the spring of 2007. An updated avionics package was certified at the end of 2007.

[6]Single-engine VLJ models have not been included in this analysis because their price and performance specifications are still too uncertain. The Diamond D-Jet, whose development is furthest along, appears to be most similar to the smallest of the twin-engine VLJs—the Eclipse—albeit with a significantly slower cruise speed and an uncertain price. Diamond has announced that it will be increasing its price for the jet because of the recent change in engines, but it has not announced the exact increase.

Eclipse announced a price increase from $1.6 million to $2.15 million in mid-2008. A total of 260 units were delivered through the end of 2008.

Although press reports indicated that the company had an order backlog of 2,600 units in June 2008, approximately 1,400 of those were from the air taxi startup DayJet, which ceased operations in September 2008 after purchasing 28 Eclipse aircraft. DayJet announced that it is unlikely that the company will operate in the future. This left approximately 1,200 orders on the Eclipse books.

At various times, press reports had indicated Eclipse's production goal to be anywhere between 2 and 4 units per day, with a break-even point of 500 units per year (although this was before the 2008 price increase). But in August 2008, Eclipse announced it was laying off 38% of its workforce. By October 2008, at least two industry analysts projected that Eclipse would cease U.S. production of the Eclipse 500 entirely in 2009.[7] Production actually stopped in October 2008, and the company filed for Chapter 11 bankruptcy protection in November. By March 2009, company management and a number of creditors were seeking a Chapter 7 liquidation.

Cessna Citation Mustang

The Cessna Citation Mustang twin-engine VLJ was certified in late 2006. The current base price of the aircraft is approximately $2.8 million, and its primary target market does not include air taxi services. The company delivered a total of 45 Mustangs in 2007 and 101 aircraft in 2008. The company announced in October 2008 that it had achieved its planned full-rate annual production level and expected to produce 150 units per year starting in 2009.

Embraer Phenom 100

The Embraer Phenom 100 is larger than other VLJs; it is also somewhat faster in terms of cruising speed and has a fairly sophisticated wing design. It is clearly aimed at the upper end of the VLJ market, with a unit price of about $3.2 million. FAA certification was achieved in December 2008 and two aircraft were delivered by the end of the year. Embraer has consistently announced order statistics for the aircraft only in combination with the larger Phenom 300. In June 2008, the company claimed close to 800 firm orders for the two jets.

The company announced that combined production for the two Phenom aircraft could ramp up to the 120–150 range in 2009. As with Cessna, Embraer believes there is a viable market for their aircraft independent of the success or failure of the air taxi market. Separately, press reports indicate that the company has revised its latest 10-yr market forecast for worldwide business jet sales, indicating faster growth in emerging markets and slower growth in North America. Based partly on Embraer's historical pattern of sales and press reports of interest from other areas, it is expected that perhaps half of the Phenom production will be destined for the U.S. market. This compares with an aggregate historical average of about 25% non-U.S. sales in the GA market overall.

[7]Teal Group Corporation, "World Military & Civil Aviation Briefing," October 2008; Forecast International, "Forecast International Projects End of Eclipse 500 Production" press release, October 28, 2008.

The Fractional Ownership Market

In addition to traditional GA sales for private, business, and corporate use, there are some indications that VLJs may be a viable option in the fractional ownership market. But there is little evidence that any of the major participants—NetJets, Flexjet (Bombardier), Sentient (fleet shares), or Flight Options (used aircraft)—has indicated direct interest in purchasing VLJs for their fleets.[8] On the other hand, some smaller companies do have plans to include VLJs as an option in their fractional ownership programs. In addition, there are a number of other fractional providers of high-end piston and/or turboprop aircraft that compete near the same market space as VLJs.

Based on these and other reports of small GA fractional ownership plans, the GA fleet forecast below accounts for a small but increasing number of VLJ sales for fractional use above and beyond the forecasts for specific manufacturers.

Baseline GA Fleet Forecast

Based on the competitive analysis and the projected overall size of the net U.S. market as shown in Figure 2, the baseline forecast for net U.S. VLJ shipments for GA use are based on the following assumptions:

- Overall market size will rise according to the estimates shown earlier in Figure 2.
- By 2011, the approximately 120 annual Eclipse deliveries originally envisioned for the U.S. market will be replaced by other manufacturers with ongoing VLJ development programs such as Honda and Piper.
- Shipments of the Cessna Mustang for GA use will reach the company's stated goal of 150 annually in 2009, with 40% eventually going to foreign customers.[9]

[8]CitationShares, which is a joint venture of Cessna and TAG Aviation, focuses on fractional ownership of smaller aircraft including the Cessna CJ1, which is considered part of the "light jet" category in this analysis.

[9]According to Cessna, 60% of current Mustang orders are designated for non-U.S. customers (http://www.very-light-jet.com/vlj-news/vlj-manufacturer-news/cessna-citation-mustang-fleet-reaches-100.html).

Table 6. Annual VLJ sales forecast for U.S. market: GA only, excluding air taxi.

Year	Major Manufacturers (Eclipse - Cessna - Embraer)	Others	Annual Total	Cumulative Total
2007	143	0	143	143
2008	256	0	256	399
2009	250	0	250	649
2010	263	50	313	962
2011	255	75	330	1,292
2012	255	100	355	1,647
2013	255	125	380	2,027
2014	255	125	380	2,407
2015	255	125	380	2,787
2016	255	125	380	3,167
2017	255	125	380	3,547

Note: Projections exclude shipments to non-US customers.

- Shipments of the Embraer Phenom 100 for GA use will reach an annual rate of 90 by 2011, with 50% going to foreign customers.
- There will be some additional VLJ shipments from other manufacturers beginning in 2010, which will be further supplemented by a small number of shipments explicitly for fractional use.

The baseline forecast for the United States based on these factors is shown in Table 6.

Again, it is important to remember that these projections are for the U.S. market only and reflect the likelihood that a significant share of VLJ shipments will be overseas in the coming years. The projections suggest that VLJs will represent around 14% of the total small GA market over the coming decade. As noted earlier, no specific account has been taken of the potential for sales of single-engine VLJs, which may somewhat offset the uncertainty with other projections.

Operational Impacts on Airports

How will the GA fleet forecast affect operations activity at GA airports? As noted earlier, it is believed that most non-air taxi VLJ sales will be substitutes for purchases of high-end piston, turboprop, and/or light jets; their effect on the size of the overall market will be quite limited. In addition, the activity counts at many small airports typically do not grow even in proportion to overall fleet growth (presumably because the new additions to the fleet are most often used at larger airports).

Consequently, it is believed that the overall level of future activity at most small GA airports will not be significantly affected by specific fleet projections of VLJ aircraft that are sold for traditional GA use. However, the composition of activity may change as VLJ operations come to displace piston or turboprop activity. Current FAA projections of operations such as those contained in the Terminal Area Forecasts (TAFs) are still probably the best indicators of future overall activity (but this is *before* accounting for potential growth from the air taxi market, which is discussed in the next chapter).

CHAPTER 3

Air Taxi Forecast

Introduction

To develop a fleet forecast for air taxi services involving next-generation small aircraft, the primary focus relies on the view that the demand for aircraft will ultimately be derived from the consumer demand for such services. This approach is quite different from the GA analysis of the previous chapter where the forecast depended importantly on supply factors related to the financial outlook and production capabilities of the major VLJ manufacturers. The analysis that follows is best thought of as a market "potential" forecast and, because the air taxi market is just now emerging, it is inherently somewhat speculative. Because the focus is on potential market demand, it is implicitly assumed that manufacturers will be able to expand production as needed to meet the demand.

The consumer demand for air taxi services can be viewed as a part of overall travel demand by consumers. The primary components of travel demand that are relevant for the current analysis include trip generation, mode choice, and trip distribution. Trip generation refers to the overall number of travel trips and reflects the initial decision about whether to travel. Mode choice refers to which mode will be used for the trips. Trip distribution refers to where the trips will occur; for present purposes, the primary interest is only in the origin and destination of each trip as opposed to the actual routing.

Standard analysis of travel demand recognizes that it is a *derived* demand—people travel not because they enjoy travelling, but because it is a necessary component of some other end-use desire (e.g., meeting with clients or other business associates, going on a vacation, visiting relatives, etc.). Because of this, one cannot conclude that a newly available mode of travel (e.g., VLJs) will necessarily increase the overall demand for travel. Rather, it is more likely that VLJs may "steal" traffic from other existing modes of travel. Overall growth in travel demand and trip generation is likely to depend mostly on demographic trends in population and income. For the present study, a constant per-capita trip rate is assumed for the domestic United States, and overall growth in travel trips is assumed to be proportional to population growth. As discussed in more detail below, income effects are treated as determinants of travel mode choice rather than overall trip generation.

Normally, one might expect that air taxi services offered on next-generation small aircraft would compete primarily with existing air taxi services—those offered by small piston, turboprop, and/or light jet aircraft. However, many analysts believe that air taxi services provided by next-generation small aircraft also have the potential to compete for trips that are currently taken via commercial air service and/or automobile. These latter categories provide many times more trips than current air taxi services, so it is important to include these travel modes in the analysis.[10] However, it also is important to recognize that not all commercial air and automobile trips will be relevant. In fact, it is likely that only a relatively small portion of such trips—in particular, business trips by high income travelers over relatively short distances—will be realistic candidates for switching to VLJ services. The specific filters used to restrict the "universe" of potential VLJ travelers on each mode are discussed below.

The primary analysis approach used is a mode choice analysis. The basic approach involves defining the "universe" of potential existing trips for each mode in which next-generation air taxi services may be able to compete. Each mode is defined by a set of attributes relevant for travelers deciding among the available choices. Typically the primary attributes thought to affect mode choice in transportation studies are price (i.e., cost) and travel time. In addition, characteristics of the individuals making the mode choices (typically income) may be important.

For the present analysis, it was also important to consider the impact of party size on the mode choice decision. For example,

[10]White papers appearing on air taxi startup DayJet's website specifically mention the potential demand for their services from business travelers who currently travel via automobile because of the relative lack of commercial air service between many smaller destinations in DayJet's primary service area.

suppose a group of four travelers has chosen to travel on a six-passenger light jet; statistical estimates of the likelihood of choosing a three-passenger VLJ if it were available may then depend critically on whether the group of four is travelling together and whether the light jet or VLJ services are sold on a per-seat basis or a traditional charter basis. This is discussed in more detail below.

An important requirement in estimating a mode choice model is that the attributes of all modes that are available (and not just the one that was actually chosen) must be measured. The essential output from the mode choice model gives statistical coefficients for the mode attributes and individual characteristics that can then be used to estimate the probability that the individual will choose each available mode. These probabilities then can be translated into “shares.” For example, suppose there are 1,000 observed trips involving commercial air as the mode of travel; this means that 1,000 individuals actually chose commercial air as their preferred mode. The statistical model will generate predictions about the probability that these trips are taken by each of the available modes. It may indicate, say, an 80% probability that these trips will be taken by commercial air; an 8% probability for the automobile mode; and a 4% probability for each of the three currently available air taxi modes (piston, prop, light jet). Multiplying the probabilities (shares) by the number of trips yields projected trip totals for each mode (i.e., 800 commercial air trips, etc.).

Then, to simulate the impact of the entry of VLJs into the market for the forecast years 2012 and 2017, a new “mode” is added with particular attributes representing VLJs, and the shares are recalculated based on the estimated coefficients. To account for generic growth in travel over time, the overall number of trips is grown for the forecast years 2012 and 2017 based on population growth projections assuming the overall per-capita trip rate remains constant. Finally, estimates of passengers per flight and annual aircraft utilization rates are applied to transform these projected VLJ trips into fleet forecasts.

For present purposes, it was much more efficient to use existing survey data rather than to design and undertake a survey from scratch. For the existing air taxi and commercial air modes, the best available data are those from mode-specific datasets: daily Enhanced Traffic Management System (ETMS) traffic in FY2007 collected by the FAA in the case of air taxi and quarterly Origin-Destination Survey (DB1B) for FY2007 collected by the U.S. DOT in the case of commercial air. For automobile traffic, the potential universe of trips is drawn from the 1995 American Travel Survey (ATS) conducted by the U.S.DOT. Although this survey covers all modes of personal transportation (including commercial air and charter travel), it does not provide nearly the same level of geographic detail that the ETMS and DB1B datasets provide. However, it does provide a much larger sample of long-distance trips and more useful information on trip origins and destinations than its successor survey that was conducted in 2001.[11]

Data Details

Airport Data

The universe of potential airports for handling VLJ activity was restricted to public-use facilities in the lower 48 states with at least one 3,000-ft lighted runway and jet fuel availability. For air taxi use, FAA medium- and large-hub commercial service airports were excluded from the database based on observed usage patterns from various air taxi operators showing that such airports are avoided (presumably to avoid airside and/or landside congestion at these facilities). These restrictions resulted in a “VLJ airport” universe totaling 1,842 facilities. This list in fact includes a combination of commercial service, reliever, and GA airports; it is meant to represent the airports that are most likely to be impacted by growth in the activity of VLJs and similar aircraft.

It is likely that owners and operators of next-generation equipment will want to take advantage of the advanced avionics packages in their aircraft; this suggests that airports with precision approach capabilities will be most attractive to these users. In addition, airports with other amenities such as hangar facilities, ground transportation services, de-icing and snow removal capabilities, mobile auxiliary power units, and so forth will be attractive to VLJ air taxi operators. While sufficient data on these latter attributes for the 1,842 identified facilities are not available, it is possible to assess airport “readiness” for VLJs based on observed characteristics and some proxy measures. Table 7 breaks out the airports regionally based on the availability of at least one precision runway, plus the number of based GA jet aircraft. It is reasonable to presume that airports that have precision approach runways and higher numbers of based GA jet aircraft are more likely to be “VLJ-ready” than those that do not.

As seen in the table, the highest number of airports with precision approaches and higher numbers of based jet aircraft are in the Southern, Southwestern, Eastern, and Great Lakes regions. It is not surprising that many industry observers expect these areas to attract the highest number of VLJ operations, and compatible assumptions are made below in the statistical analysis where projections of future operations are estimated.

For each VLJ airport, the two closest commercial airports (those with at least three daily scheduled departures) were

[11]Clearly there is a need for more recent survey data—not only for this study, but also for work in other areas. In 2008, U.S.DOT launched the most recent National Household Travel Survey; data will continue to be collected through the Spring of 2009, and the first set of results is expected to be available late in 2009.

Table 7. Distribution and attributes of VLJ airports.

Region	Number of Airports WITHOUT a Precision Runway and: No Based GA Jet Aircraft	1-10 Based GA Jet Aircraft	11+ Based GA Jet Aircraft	Number of Airports WITH a Precision Runway and: No Based GA Jet Aircraft	1-10 Based GA Jet Aircraft	11+ Based GA Jet Aircraft	TOTAL
Central	85	2	32	11	11	25	166
Eastern	50	0	34	10	23	50	167
Great Lakes	172	1	74	34	33	73	387
New England	15	1	10	15	6	10	57
Northwestern Mountain	108	5	40	10	13	36	212
Southern	161	8	119	18	37	60	403
Southwestern	147	3	65	13	28	43	299
Western Pacific	59	16	38	6	13	19	151
Total	797	36	412	117	164	316	1842

identified in order to facilitate a search for attributes related to the commercial air mode for each trip. A total of 416 different commercial facilities were identified, distributed as shown in Table 8. (Note that in some cases, a VLJ facility could simultaneously be identified as a commercial facility.)

Census Data

One of the most important practical issues to address is the physical location of travel trips. For the current analysis, it is necessary to assign trips projected to be taken by the VLJ mode to the specific airports that are able to accommodate such flights.

Demographic data at the census tract level were obtained from Applied Geographic Solutions (AGS). This dataset includes estimates of population and income for 2007 and 2012, as well as population projections for 2017. Catchment area demographics for each VLJ and commercial airport were then identified by finding the nearest such airport to each census tract. The data was combined with the airport data to obtain catchment area estimates of current and projection-year populations and incomes applicable to each VLJ and commercial airport. Aggregations of population and income were also made to the Metropolitan Statistical Area (MSA) and at State levels to allow for projections from the automobile traffic data in the ATS. MSAs are collections of counties, cities, and other smaller defined geographic areas that together compose a single metropolitan area.

Table 8. Distribution of associated commercial airports.

Region	Count
Central	31
Eastern	57
Great Lakes	72
New England	22
Northwestern Mountain	65
Southern	68
Southwestern	54
Western Pacific	47
Total	416

Current Air Taxi Population

The population of current air taxi activity that potentially could be affected by VLJ competition was derived from the ETMS data collected by the FAA for the period October 2006 through September 2007 (FY2007). The ETMS system collects individual data on all flights that enter the domestic en route system. GRA, Inc. has performed an extended analysis of air traffic for the FAA using this data; part of this analysis categorizes each flight into a user category based on *N*-number, aircraft type, and owner or operator identifications. GRA identified six different user groups composing passenger charter and/or non-scheduled Part 135 passenger operations. The flights in these categories were then further trimmed by applying the following filters:

- Departure or arrival airport must be in the list of "VLJ-ready" airports identified above,
- Size of the aircraft must be between 3 and 8 seats, and
- Great-circle flight distance must be between 150 and 800 mi.

The logic behind these filters is that the introduction of a new VLJ alternative is likely to attract only those existing air taxi passengers who already are flying to VLJ airports, on aircraft of similar size to VLJs, and within the non-stop flying range of VLJ aircraft. A total of 146,763 annual flights were identified with this methodology, and each was assigned to the piston, turboprop, or light jet air taxi mode.

It is important to recognize that the ETMS data essentially covers only those flights operating under Instrument Flight Rules (IFR). To account for the potentially large amount of current activity that operates under Visual Flight Rules (VFR)—which is not in the ETMS data but that nonetheless might be captured by VLJ air taxi services—the flight counts were then scaled up using data from the 2006 General Aviation and Part 135 Activity Survey conducted by the FAA. Specifically, activity ratios of total air taxi flights to IFR air taxi flights by engine type (jet, prop, or piston) were computed and applied to the filtered ETMS data. This resulted in estimates of current relevant air taxi flights as shown in Table 9.

Table 9. Relevant universe of air taxi flights for 2007.*

Region of Departure	Count	Percent of Total
Central	28,098	10
Eastern	28,463	10
Great Lakes	67,881	25
New England	11,860	4
Northwestern Mountain	22,791	8
Southern	71,249	26
Southwestern	28,051	10
Western Pacific	13,524	5
Total	271,917	100

*Note: Figures and percentages may not add to totals due to rounding.

The ETMS observations are flights that are shown on an airport-to-airport basis; in order to calculate total trip time (which should include airport access and egress times for the commercial air and air taxi modes), it was necessary to distribute the passengers on these flights to surrounding areas. As noted earlier, this was done using Census population estimates to generate synthetic observations of air taxi travel at the Census tract level. The conversion of ETMS flights into passenger trips is discussed below in the Model Assumptions section.

Current Commercial Air Population

The population of current commercial air traffic that potentially could be affected by VLJ competition was derived from the Ten Percent Origin-Destination Ticket Sample (DB1B) collected by the U.S.DOT for the period October 2006 through September 2007 (FY2007). Unlike the ETMS dataset, the DB1B data is measured in passenger trips directly, not flights. As an initial screen, only domestic trips within the lower 48 states and between 150 and 800 miles were considered; these trips were then further filtered by keeping only those trips in the top decile (10%) of fares for each origin-destination market and by excluding any origin-destination markets where the corresponding number of average daily passengers was less than one.

The logic behind the decile filter is that VLJ services are likely to be considered only by current commercial air business passengers who are already paying something close to full coach fares or business fares. However, the actual fare class data in the DB1B are not reliable, so the decile filter was used instead. The minimum market size restriction of one passenger per day should not significantly affect the results since markets smaller than that collectively compose less than 6% of total trips. This resulted in estimates of current relevant commercial air passenger trips as shown in Table 10.

The raw DB1B commercial air dataset is constructed on an airport-to-airport basis. As with the ETMS data, the DB1B passengers were ultimately distributed geographically using Census population estimates to generate synthetic observations of commercial air travel at the Census tract level.

Current Automobile Population

The population of current automobile traffic that potentially could be affected by VLJ competition was derived from the 1995 ATS. This survey provided only limited geographic information, including the MSA of the trip origin and/or destination if relevant. If the origin/destination was outside of an MSA, then only the State where the trip started or ended was identified. These automobile trips were ultimately assigned to specific VLJ catchment areas based on population and distance ratios.

Table 10. Relevant universe of commercial air trips for 2007.*

Region of Departure	Count	Percent of Total
Central	479,019	3
Eastern	3,292,341	18
Great Lakes	2,796,151	15
New England	695,091	4
Northwestern Mountain	1,410,906	8
Southern	3,558,592	19
Southwestern	1,948,360	11
Western Pacific	4,342,707	23
Total	18,523,167	100

*Note: Figures and percentages may not add to totals due to rounding.

Table 11. Relevant universe of automobile trips for 1995.

Region of Departure	Count	Percent of Total
Central	801,109	5
Eastern	2,961,779	19
Great Lakes	3,394,996	21
New England	684,720	4
Northwestern Mountain	764,044	5
Southern	2,543,010	16
Southwestern	2,138,512	13
Western Pacific	2,680,552	17
Total	15,968,722	100

Only domestic trips within the lower 48 states and between 150 and 400 miles (using the great-circle distance of the corresponding departure and arrival VLJ airports) were considered; these trips were then further filtered by keeping only those trips taken by "high-income" business travelers, defined as individuals with annual incomes greater than $75,000 (in 1995 dollars). The logic behind imposing the 400-mile upper limit is that any automobile trips longer than that probably indicate that such travelers have particular reasons for selecting private surface travel (e.g., making multiple stops as a traveling salesman, etc.) and would not be good candidates for VLJ services. This resulted in estimates of relevant automobile trips as shown in Table 11.

It is important to note that the mode choice decisions made by ATS automobile users reflect choices that were available to them in 1995. Consequently, the attributes of each mode alternative should reflect values relevant for that time period.

As with the other datasets, the raw ATS data provide only limited information on the geographic distribution of passenger trips. Again, Census population estimates were used to generate synthetic observations of automobile travel at the Census tract level.

Model Assumptions

The data from the three sources described above—ETMS 2007 air taxi flights, DB1B 2007 commercial air trips, and ATS 1995 automobile trips—were combined into a single large dataset to reflect the potential universe of trips from which a new VLJ mode would attract customers. To convert flights into passenger trips for current air taxi users, an average load factor of 70% was applied to the seat size of each representative aircraft selected.

As noted earlier, the primary attributes used to distinguish one mode offering from another are cost and travel time. A representative aircraft was selected for each air taxi mode—piston, turboprop, and light jet. A review of aircraft-specific cost data indicated that real (inflation-adjusted) costs had not changed much between 1995 and 2007 for representative piston or turboprop aircraft types, so the same costs were used for both automobile users and air taxi/commercial air users. Cost and travel time attributes were developed for each aircraft type based on data obtained from the Conklin & de Decker Aircraft Cost Evaluator database.

Party size is an important factor in the statistical model because the air taxi and automobile modes have capacity constraints that could affect total costs depending on the party size (e.g., if more than one unit of the mode is required to accommodate the entire party). In addition, when the VLJ mode is added, it is important to consider the availability of per-seat service offers as this will also affect total costs.

For existing air taxi users identified in the ETMS data, it was assumed that all passengers on board (estimated by applying a 70% load factor to the aircraft passenger seat size) were part of the same travelling party and that the mode choice decision was made for the group as a whole and not at the individual level. Current air taxi services are offered almost exclusively on a per-aircraft basis, so a reasonable assumption is that such flights mainly reflect demand by groups of travelers where it makes sense to rent the services of an entire aircraft for the group.

For current (2007) commercial air users, the DB1B dataset does not include any information on party size. However, the ATS survey indicates that almost 75% of commercial air passengers on business trips between 150 and 800 miles fly alone, so a party size of one was assumed for all current commercial air passengers. This is a somewhat optimistic assumption in favor of VLJ per-seat services because it does not consider that some commercial air trips are in fact taken by larger parties who might not realize the cost savings of per-seat services, but instead could realize savings as a group purchasing the services of more traditional air taxi services that are sold on a per-aircraft basis.

For current (1995) automobile users, certain high-passenger-count records in the ATS dataset have large party sizes that are probably not typical; consequently, a maximum party size of two was used for automobile users in the ATS. This was also used as the capacity limit for the automobile alternative for current users of other modes.

Table 12. List of explanatory variables used in air taxi analysis.

Variable	Automobile	Commercial Air	Air Taxi Piston	Air Taxi Prop	Air Taxi Light Jet
Constant Term (Mode-specific)	✓	✓	✓	✓	
Cost (Mode-specific)	✓	✓	✓	✓	✓
Total Travel Time	✓	✓	✓	✓	✓
Avg Time Between Departures (Commercial Air)		✓			
Income (Mode-specific)	✓	✓	✓	✓	
log(Based GA Piston + Prop Aircraft)			✓	✓	
log(Based GA Jet Aircraft)					✓

Table 13. Explanatory variable calculations.

Automobile	***Cost:*** AAA total driving cost per mile for intermediate car (2006) x mileage computed from Microsoft MapPoint software. ***Travel Time:*** Drive times from Microsoft MapPoint software (+ periodic rest stops for trips greater than 3 hours).
Commercial Air	***Cost:*** Top decile DB1B FY2007 market-specific fare from nearest commercial airports + access/egress cost to airports from Census locations. ***Travel Time:*** Weighted-average travel time for market-specific non-stop/one-stop/two stop services (from May 2007 OAG schedule) + access/egress times to airports + airport terminal wait times. ***Average Time Between Departures:*** Market-specific estimate based on number of daily service offers assuming 16-hour day.
Air Taxi	***Cost:*** See Model Assumptions section. ***Travel Time:*** Based on average aircraft speeds + access/egress times to airports. ***Based Aircraft:*** The number of based aircraft was measured in logs, allowing the positive impact of this "attractiveness" proxy to lessen at the margin.

Explanatory Variables and Model Estimation

Travelers choose from among five existing modes: automobile, commercial air, air taxi piston, air taxi turboprop, and air taxi light jet.[12] Each mode is characterized by a set of attributes that affect travelers' choices. Aside from the standard cost and time attributes applicable to each mode, a variable representing average time between departures was included for the commercial air mode to account for the effects of service availability of this mode. In addition, the number of based prop or jet aircraft (averaged between the departure and arrival airports) was calculated to serve as proxies for airport amenities that may affect the attractiveness of the three air taxi modes. Finally, personal income was also included as a user characteristic that may affect mode travel choice. A small number of different specifications were considered before settling on the list of explanatory variables shown in Table 12.

As indicated in the table, the effect of the constant term, cost, and income variables was allowed to vary by mode; for example, the effect of a change in the cost of driving for those passengers selecting automobile was allowed to be different from the effect of a change in the cost of commercial air for those selecting that mode. Additional details about the assumptions and calculations employed are shown in Table 13.

Although cost and travel time are typically primary factors in any mode choice analysis, it is important to recognize that other more difficult-to-measure attributes such as travel convenience, reliability, and unforeseen congestion may also be significant factors in choosing among available modes. These are accounted for indirectly in the model by including mode-specific constant terms that, in principle, pick up average unobserved effects of each individual mode.[13]

The model is estimated with a "multinomial logit" specification, and attempts to ascribe coefficient values to the attributes that best fit the observed choices made in the datasets (ETMS, DB1B, and ATS) described above. Because there are literally hundreds of thousands of observations derived from these datasets, it was not feasible to incorporate all of them into the estimation process. Instead, a sample of observations was drawn from each dataset in such a way as to ensure that

[12]The automobile mode is excluded from the choice set when the auto alternative would involve driving more than 400 miles.

[13]As with the income variable whose value for a given individual does not vary across modes, it is necessary to "normalize" on one of the modes as the baseline (statistically it does not matter which one). Then, the income or constant term effects are interpreted relative to the baseline mode.

Table 14. Logit model coefficient estimates.

Variable	Coefficient Estimate	t-statistic
Constant - Automobile	7.4401	5.798
Constant - Commercial Air	-5.3354	-3.895
Constant - Air Taxi Piston	3.4218	2.588
Constant - Air Taxi Prop	-0.6141	-0.278
Cost - Automobile	-0.5573	-21.424
Cost - Commercial Air	-0.0127	-11.361
Cost - Air Taxi Piston	-0.0137	-15.137
Cost - Air Taxi Prop	-0.0078	-7.422
Cost - Air Taxi Light Jet	-0.0071	-11.970
Total Travel Time	-0.0093	-6.062
Avg Time Between Departures - Commercial Air	-0.0049	-10.923
Income - Automobile	-0.0058	-0.340
Income - Commercial Air	0.0944	5.322
Income - Air Taxi Piston	-0.0405	-2.201
Income - Air Taxi Prop	-0.0354	-1.196
Based GA Piston + Prop Aircraft	0.9307	3.664
Based GA Jet Aircraft	0.8537	5.092

the overall sample is representative of the total population shares of each mode derived from the datasets. These existing mode shares are as follows:

- Automobile: 44.9%;
- Commercial Air: 52.1%;
- Air Taxi, Piston: 2.0%;
- Air Taxi, Turboprop: 0.2%; and
- Air Taxi, Light Jet: 0.8%.

Statistical Results

The coefficient estimates and statistical significance indicators are shown in Table 14. *T*-statistics greater than about 2.0 in absolute value indicate statistical significance at the 95% confidence level. As can be seen, most coefficients are statistically significant, with the exception of two alternative-specific income variables and the constant for the air taxi piston mode. All variables listed in Table 14 (even those with insignificant coefficient estimates) were included when making projections for future years.

There is no easy straightforward interpretation for the coefficients themselves; not even the sign of the coefficients necessarily indicates the direction of effects. A more meaningful interpretation can be gained by computing so-called "direct mode elasticities," which reflect how a 1% change in the value of a particular attribute for a particular mode will affect the likelihood of selecting that mode. For example, a price elasticity of −2 for the commercial air mode means that a 1% increase in the price of commercial air would lead to a 2% decline in the probability of selecting that mode. Direct elasticities for all of the explanatory variables in the model are shown in Table 15.

For the most part, the elasticity estimates have the expected sign. Increases in price, travel time, and average time between flights all lead to decreases in the probability of selecting the associated mode. Increases in the number of based aircraft (piston/props or jets) at GA airports are associated with increases in the probability of selecting one of the air taxi modes. If in fact these based aircraft counts are reasonable proxies for airport amenities such as hangar facilities, ground transportation services, precision approaches, and so forth, the relatively large values of the elasticities suggest that the ability of airports to provide such amenities may in fact lead to significant new air taxi traffic.

Somewhat surprisingly, the elasticity estimates also indicate that a given price change for the air taxi modes will elicit

Table 15. Direct elasticity estimates.

Variable	Automobile	Commercial Air	Air Taxi Piston	Air Taxi Prop	Air Taxi Light Jet
Cost (Price)	-0.70	-0.18	-2.52	-5.51	-3.17
Travel Time	-0.32	-0.17	-0.48	-1.10	-0.50
Income (relative to AT light jet)	-0.03	0.35	-0.90	-1.94	*NA*
Avg Time Between Departures		-0.09			
Based Aircraft - GA piston/prop			1.54	3.89	
Based Aircraft - GA jet					1.17

larger changes in the likelihood of selecting those modes than comparable changes in the automobile or commercial air modes—in other words, air taxi users are relatively more price-elastic than automobile or commercial air users. While this may initially seem counter-intuitive, one must recognize that the elasticities are "point estimates" that reflect current observed price levels and mode shares. For example, decreasing an air taxi jet price of $1,200 by 1% would lead to a 3.15% increase in the likelihood of selecting that mode (which currently has less than 1% market share); this compares with decreasing the corresponding commercial air price of, say, $300 by 1% leading to a much smaller (0.18%) increase in the likelihood of selecting that mode (which currently has a 52% market share).

The interpretation of the effects of income on the choice decision is fairly difficult due to the choice-specific specification for income; this means that the direction of effect is relative to the normalized air taxi jet alternative. However, there is only one income elasticity indicating a relatively large nominal effect (−1.86 for air taxi turboprop); in addition, there are only a small number of travelers who selected air taxi turboprop. Consequently, it is believed that income effects in the model are relatively unimportant and do not have a large effect on the overall results.

To assess the overall fit of the model to the data, a "pseudo-R^2" statistic was computed, which is somewhat analogous to the standard R^2 statistic often reported in linear regressions. Using a scale of 0 to 1, the statistic is an indicator of how well the model fits the observed data. The pseudo-R^2 estimate is 0.675, which most analysts would consider quite good for a multinomial logit model.

Another useful measure is to compute the implied values of time for each mode. This is accomplished by dividing the common time coefficient by the alternative-specific cost coefficients. Table 16 shows the estimated value of time; these are consistent with the expectation that travelers selecting the air taxi modes have higher values of time than those selecting the automobile or commercial air modes.

These estimates are also generally consistent with FAA guidance on value-of-time estimates for business travelers using commercial air as published in its latest "Economic Values for FAA Investment and Regulatory Decisions." They are somewhat above the FAA estimates published for GA.

Table 16. Implied value of time estimates.

Mode	Estimated Value of Time ($/hr)
Automobile	10.02
Commercial Air	44.04
Air Taxi Piston	40.78
Air Taxi Prop	72.53
Air Taxi Light Jet	78.97

Baseline Forecast Assumptions

With the coefficient estimates in hand, the overall number of trips from the ATS dataset (which was based on trips taken in 1995) was scaled up to account for growth in the overall magnitude of travel between 1995 and 2007. All 1995 data values used for automobile users were updated to 2007 values, and increases in the time spent in terminal areas at commercial airports (due to increased security measures since 2001) were accounted for in the commercial air mode. Then the revised population total (including commercial air and air taxi) was combined with the coefficient estimates from the model populations to generate estimates of trips by mode for the baseline year 2007.[14] Each trip is tied to specific GA and commercial airports that would be relevant when making the mode choice decision, so baseline estimates of air taxi activity at each of the 1,842 "VLJ-ready" airports for 2007 can be produced. These estimates will be provided electronically as the appendix to the second volume of this report, *ACRP Report 17: Airports and the Newest Generation of General Aviation Aircraft, Volume 2: Guidebook.* When reviewing these estimates, it is important to recognize that they account only for air taxi activity.

Outlook for Air Taxi Services Utilizing Small Next-Generation Aircraft

The next step is to add in the new VLJ mode and prepare projections of trips by mode for the forecast years 2012 and 2017. Although the 2007 baseline estimates themselves do not include any VLJ activity by startup air taxi operators, there are in fact a number of existing startups that have already begun to use VLJs or other small next-generation aircraft for air taxi–type services. There are a variety of business models being tried.

The traditional "air charter" model typically involves exclusive rental of an entire aircraft for a fixed hourly rate that covers the cost of the aircraft, including pilot salaries and fuel costs. Additional costs can include taxes, repositioning fees, and overnight/waiting fees. Even if a return trip is not needed, there will likely be a charge for the cost of repositioning the aircraft to its home (or other) location, and there may also be a daily minimum charge.

The "air taxi" on-demand model involves rental of an entire aircraft for a fixed hourly rate, but no charges for repositioning or overnight/waiting times; all costs are built into the hourly rate. If there is a return trip, it may be on a different aircraft (or even provided by a different company). This type of service may only be available between certain specified airports.

The newest business model attempted by some operators is the "per-seat on-demand" model, which is somewhat similar

[14]Where necessary, small adjustments were made to the alternative-specific constants to obtain passenger trip estimates for each mode that were consistent with the observed baseline of 2007 trips.

to buying a ticket for an individual seat from a commercial airline, but there is no fixed flight schedule. The price may depend on the number of other passengers actually on board the flight, or it could be pre-determined based on the average number of passengers the operator expects. There may also be other pricing structure variations such as offering a lower pre-determined price if the passenger is willing to travel any time within some pre-defined time window.

These service models have initially sprung up primarily in the Southeast and Northeast sections of the country, although similar operations have been planned (and some are already operating) in the Midwest and on the West Coast. Some are using small, efficient, next-generation piston-based aircraft while others have taken deliveries of small numbers of VLJs.

Despite the 2008 bankruptcy of DayJet, which was a pioneer in the development and offering of per-seat on-demand services, current plans from other startups appear to indicate that many still believe that the concept of the per-seat business model can be viable.

It is useful to consider these operators and their service plans in order to make reasonable assumptions about how such service offers may spread throughout the United States for the 5- and 10-year forecasts. Careful consideration has been given to the pricing approaches, geographic location, and fleet types of such operators in the consideration of how to model a new "VLJ" mode that will be added to the choices available to consumers.

VLJ Mode Attributes

The new VLJ mode was represented by taking an average of the estimated operating cost and capacity attributes of several models. In addition, the VLJ mode was assumed to inherit the same alternative-specific constant, cost, and airport jet presence coefficients as the air taxi light jet mode. As with the other air taxi services, cost to the traveler was estimated using a 75% markup to the aircraft operating costs estimated in the Conklin & de Decker data.

Spread and Distribution of VLJ Per-Seat versus Traditional Charter Services

It is believed that a per-seat pricing approach still could be the foundation for a successful business model for VLJ air taxi services, although the prices may need to be somewhat higher than initially estimated or selection and utilization of aircraft type may need to be altered.

To assess the potential impact of the per-seat approach to air taxi services, an analysis of actual fares offered for per-seat services in 2008 was undertaken. On average, it was found that per-seat prices with a 3- to 4-h departure window were priced at about a 40% discount to those with a 1-h departure window in the same market. The latter was assumed to be similar to the prices that would be charged for renting the entire aircraft (along the lines of a more traditional charter or air taxi service).

For the 2012 baseline forecast, it was assumed that the VLJ mode would be offered with per-seat pricing (and the associated 40% discount) in the following FAA regions: Southeast, Southwest, and Western Pacific. Notionally, these are consistent with prospects for viable per-seat operations that were found via interviews and discussions with various industry participants, but it should be noted that the implicit assumption is that *all* VLJ service offers in these regions are via the per-seat model and none are with the traditional charter model.

It was assumed that per-seat pricing would also entail wait time equivalent to commercial service that offered approximately four flights per day; this was valued using the same time-between-departure coefficient that applies to commercial air travel. Thus, the benefit of a lower price is partially offset by the wait time that one must incur relative to traditional charter service.

In all other regions, it was assumed that the VLJ mode would be available by 2012, but only via traditional charter (per aircraft) with the associated higher cost. For the 2017 forecast, it was assumed that per-seat pricing would spread to the Great Lakes region. Overall, in light of the recent downturn in the economy and bankruptcies in the market, these baseline assumptions of VLJ availability by 2012 and 2017 may be relatively optimistic.

Spread and Distribution of Low-Cost Piston Services

The analysis also takes account of the likelihood that low-cost piston air taxi services using efficient new-generation aircraft will expand beyond current service areas centered in the Southeast region of the United States. For the baseline forecast, it was assumed that low-cost service would replace higher-cost traditional piston service in the rest of the Southeast, Southwest, Western Pacific, and Great Lakes by 2012. By 2017, it is assumed that traditional piston services are replaced by low-cost alternatives entirely throughout the United States.

Other Modes

With the exception of the impact of fuel prices on total cost (see below), the attributes of the remaining modes—automobile, commercial air, and air taxi turboprop and light jet—were assumed to remain constant for all geographic regions through the forecast years 2012 and 2017.

Impact of Increasing Fuel Prices

The baseline model projections for 2007 were estimated using costs that were based on late 2006–2007 fuel prices. The operating costs for the air taxi modes were based on aviation gasoline (or "avgas," which is used in piston aircraft) and jet fuel prices of $2.45 per gallon while automobile operating costs were based on a pump price of $2.94 per gallon. Given the volatility in the price of oil, it is difficult to project future costs and prices for the 2012 and 2017 forecasts. Since late 2007, the world price of oil swung wildly upward during the first half of 2008 and then plummeted dramatically in the second half.

For projection purposes in 2012 and 2017, costs for the air taxi modes were re-computed assuming an average price of $3.35 per gallon for both avgas and jet fuel. This is equal to the U.S. Department of Energy's (DOE's) jet fuel price average for the first eight months of 2008 and equates to an overall operating cost increase from 2007 of about 3.8% for the low-cost piston mode and about 6.5%–7.0% for the turboprop and light jet modes. For the automobile mode, the average cost per mile was re-computed assuming an average pump price of $3.61 per gallon, again based on the DOE's estimates for the first eight months of 2008; this equates to an overall operating cost increase from 2007 of 8.8%.

Changes in oil prices would also be expected to influence commercial air fares. For the commercial air mode, the latest available fare data from the DB1B ticket sample were obtained for the second quarter of 2008; a comparison with FY2007 fares showed an average fare increase of 6.0%, and this percentage increase was assumed to apply for the 2012 and 2017 projection years.

Overall Travel Growth

As described earlier, the baseline forecast assumed a constant per-capita trip rate for the domestic United States, and overall growth in travel trips is therefore proportional to population growth. Census-specific growth projections were used from the AGS dataset; across the entire sample, the corresponding population is projected to grow by about 1.1% annually from 2007 to 2012 and by about 1.4% annually from 2007 to 2012.

Projected Mode Shares and Trip Totals

Table 17 shows the projections of mode shares and trip totals given all of the inputs and assumptions described above. The forecast projects that VLJs may capture a small but significant percentage of the relevant market over the next 5 to 10 years. This is due primarily to the assumption that low-cost per-seat services will become available in several regions in the country. Similarly, the assumption that low-cost piston services will spread leads to significant gains for that mode as well. These gains in market share come largely at the expense of the automobile mode and, to a lesser extent, of commercial air travel. Without reading too much into the data, these results are generally consistent with the observation that automobile traffic in particular may be quite responsive to large increases in fuel prices such as those that occurred in mid-2008.

Table 17. Estimated air taxi annual trips and market shares.*

Annual Trips (000)				
Mode	**2007 Actual**	**2007 Projected**	**2012 Projected**	**2017 Projected**
Automobile	18,690	18,538	16,644	17,648
Commercial Air	18,523	18,621	20,060	20,120
Air Taxi Piston	695	729	1,268	1,505
Air Taxi Prop	73	106	134	173
Air Taxi Light Jet	278	265	297	369
Air Taxi VLJ	0	0	1,969	3,419
TOTAL	38,259	38,259	40,372	43,235

Market Shares				
Mode	**2007 Actual**	**2007 Projected**	**2012 Projected**	**2017 Projected**
Auto	48.9%	48.5%	41.2%	40.8%
Commercial Air	48.4%	48.7%	49.7%	46.5%
Air Taxi Piston	1.8%	1.9%	3.1%	3.5%
Air Taxi Prop	0.2%	0.3%	0.3%	0.4%
Air Taxi Light Jet	0.7%	0.7%	0.7%	0.9%
Air Taxi VLJ	0.0%	0.0%	4.9%	7.9%
TOTAL	100.0%	100.0%	100.0%	100.0%

*Note: Figures and percentages may not add to totals due to rounding.

Table 18. Air taxi fleet forecast.*

Mode	Avg Passengers per Flight @70% LF	2007 Projected	2012 Projected	2017 Projected	Net Increase 2007-2012	Net Increase 2007-2017
Air Taxi Piston	2.1	556	968	1,149	411	593
Air Taxi Prop	3.5	49	61	79	13	31
Air Taxi Light Jet	4.2	101	113	141	12	39
Air Taxi VLJ	2.8	0	751	1,305	751	1,305
TOTAL		706	1,894	2,673	1,188	1,967

*Note: Figures and percentages may not add to totals due to rounding.

Table 19. Estimated incremental air taxi operations by region.

Region	TAF 2007 Total Operations	2017 Incremental Air Taxi Operations	Air Taxi % 2007 Operations
Central	2,973,922	144,751	4.9
Eastern	8,002,088	418,472	5.2
Great Lakes	12,556,805	749,353	6.0
New England	3,106,122	81,938	2.6
Northwestern Mountain	8,391,973	252,373	3.0
Southern	17,920,957	914,709	5.1
Southwestern	10,159,174	652,743	6.4
Western Pacific	11,318,066	936,144	8.3
Total	74,429,107	4,150,483	5.6

Baseline Air Taxi Fleet Forecast

In order to translate the traffic projections into air taxi fleet forecasts, assumptions must be made regarding aircraft use and load factors. For the baseline forecasts, it is assumed that the air taxi modes use their fleets at the rate of two flights per day for piston, turboprop, and light jet and three flights per day for VLJs (due to the spread of per-seat services). An average passenger load factor of approximately 70% is also assumed. With an average flight time of about 1.3 h, this works out to approximately 1,200 h of utilization per year for VLJs and 800 h for the other aircraft types. This is well above current utilization rates for small GA aircraft (which are more on the order of a few hundred hours per year), but still only a fraction of the utilization rates typical of large commercial aircraft. The required fleets to provide the projected trips at these rates are shown in Table 18.[15]

It is important to recognize that the actual air taxi fleet projection levels depend heavily on a number of basic assumptions, the most prominent of which are

- Definitions of the relevant universe for the automobile and commercial air travel markets;
- "Full price of travel" estimates of the various modes, which depend on (among other things) uncertain estimates of the unit costs of providing traditional charter operations, wait and/or delay times associated with commercial air travel, and road congestion associated with automobile travel;
- Actual availability of new "per-seat" VLJ services and/or low-cost piston services; and
- Perceived similarities or differences between new services and traditional charter services.

Using different assumptions for any of these factors could have significant impacts on the estimated results.

Operational Impacts on Airports

Given the baseline projections, the trip estimates are all tied to specific locations and airports, so the total number of associated air taxi operations on an airport-specific basis can be aggregated. The projected operational increases for 2017 compared with the TAF 2007 total operation estimates are summarized in Table 19; the average operational increase by 2017 relative to the 2007 baseline is on the order of 6%.

[15]The 2007 projections from the model are well below the current aggregate air taxi fleet shown earlier in Table 2. The two really cannot be compared for a variety of reasons, including that (1) the FAA air taxi definitions from Table 2 are quite different and cover a much larger portion of overall flight activity than the actual usage assignments used here based on ETMS activity and (2) the utilization rates used in this analysis are much higher than the historical averages for piston, turboprop, and jet categories shown in Table 3, which are confounded because they reflect combined activity of aircraft across different usage categories.

Table 20. Added VLJ air taxi operations by 2017—top five airports by region.

Region	Locid	Facility	City	State	FAA Itinerant + Local Ops 2007	Added VLJ Air Taxi Ops by 2017
Central	SUS	Spirit of St. Louis	St. Louis	MO	146,384	12,830
	MKC	Charles B. Wheeler Downtown	Kansas City	MO	95,438	8,283
	DSM	Des Moines Intl	Des Moines	IA	106,211	6,695
	OJC	Johnson County Executive	Olathe	KS	70,438	3,058
	SGF	Springfield-Branson National	Springfield	MO	74,504	2,198
Eastern	HPN	Westchester County	White Plains	NY	202,572	25,259
	TEB	Teterboro	Teterboro	NJ	202,193	23,672
	SYR	Syracuse Hancock Intl	Syracuse	NY	107,749	16,506
	IAG	Niagara Falls Intl	Niagara Falls	NY	39,413	15,134
	AGC	Allegheny County	Pittsburgh	PA	82,185	13,858
Great Lakes	PWK	Chicago Executive	Chicago/Prospect Heights	IL	118,496	42,987
	LUK	Cincinnati Muni Airport Lunken Field	Cincinnati	OH	72,717	30,942
	YIP	Willow Run	Detroit	MI	84,968	13,504
	DET	Coleman A. Young Muni	Detroit	MI	77,571	12,033
	ATW	Outagamie County Rgnl	Appleton	WI	46,440	11,897
New England	OWD	Norwood Memorial	Norwood	MA	84,784	12,873
	BED	Laurence G. Hanscom Fld	Bedford	MA	169,471	4,775
	BVY	Beverly Muni	Beverly	MA	69,351	3,554
	ASH	Boire Field	Nashua	NH	104,237	1,933
	OXC	Waterbury-Oxford	Oxford	CT	60,829	1,708
Northwestern Mountain	APA	Centennial	Denver	CO	329,959	19,551
	BJC	Rocky Mountain Metropolitan	Denver	CO	167,968	6,188
	DRO	Durango-La Plata County	Durango	CO	57,123	4,845
	GJT	Walker Field	Grand Junction	CO	74,007	4,556
	HIO	Portland-Hillsboro	Portland	OR	224,461	4,534
Southern	PDK	Dekalb-Peachtree	Atlanta	GA	223,399	35,184
	FTY	Fulton County Airport-Brown Field	Atlanta	GA	122,196	29,093
	LZU	Gwinnett County - Briscoe Field	Lawrenceville	GA	85,686	26,682
	IGX	Horace Williams	Chapel Hill	NC	0	17,217
	RYY	Cobb County-Mc Collum Field	Atlanta	GA	110,069	17,018
Southwestern	ADS	Addison	Dallas	TX	131,833	92,170
	SSF	Stinson Muni	San Antonio	TX	148,631	26,462
	SGR	Sugar Land Rgnl	Houston	TX	86,538	23,318
	EFD	Ellington Field	Houston	TX	144,974	18,357
	HYI	San Marcos Muni	San Marcos	TX	120,420	12,984
Western Pacific	VGT	North Las Vegas	Las Vegas	NV	219,240	92,655
	CRQ	Mc Clellan-Palomar	Carlsbad	CA	215,859	28,667
	MYF	Montgomery Field	San Diego	CA	223,410	25,674
	HND	Henderson Executive	Las Vegas	NV	67,482	22,006
	FAT	Fresno Yosemite Intl	Fresno	CA	156,648	18,705

Obviously the results may vary significantly for specific facilities; airport-specific air taxi estimates for all 1,842 airports included in the study are provided electronically in the appendix for Volume 2 of this report. The five airports in each FAA region with the largest increases in projected activity by 2017 from VLJ operations are shown in Table 20; corresponding forecasts that account for increased activity by all air taxi modes including pistons, turboprops, and light jets are shown in Table 21. In some cases, the large increases shown are due primarily to the VLJ or low-cost piston modes capturing significant shares of popular automobile traffic corridors such as between Southern California and Las Vegas and the Texas triangle connecting Dallas, Houston, and San Antonio.

Table 21. Added total air taxi operations by 2017—top five airports by region.

Region	Locid	Facility	City	State	FAA Itinerant + Local Ops 2007	Added Total Air Taxi Ops by 2017
Central	SUS	Spirit of St. Louis	St. Louis	MO	146,384	16,897
	MKC	Charles B. Wheeler Downtown	Kansas City	MO	95,438	14,359
	DSM	Des Moines Intl	Des Moines	IA	106,211	8,784
	SGF	Springfield-Branson National	Springfield	MO	74,504	5,970
	OJC	Johnson County Executive	Olathe	KS	70,438	5,784
Eastern	HPN	Westchester County	White Plains	NY	202,572	31,561
	TEB	Teterboro	Teterboro	NJ	202,193	29,347
	SYR	Syracuse Hancock Intl	Syracuse	NY	107,749	23,103
	AGC	Allegheny County	Pittsburgh	PA	82,185	18,691
	HEF	Manassas Rgnl/Harry P. Davis Field	Manassas	VA	110,132	18,275
Great Lakes	PWK	Chicago Executive	Chicago/Prospect Heights	IL	118,496	51,870
	LUK	Cincinnati Muni Airport Lunken Field	Cincinnati	OH	72,717	42,304
	PTK	Oakland County Intl	Pontiac	MI	209,198	17,808
	YIP	Willow Run	Detroit	MI	84,968	17,730
	DET	Coleman A. Young Muni	Detroit	MI	77,571	17,449
New England	OWD	Norwood Memorial	Norwood	MA	84,784	15,697
	BED	Laurence G. Hanscom Fld	Bedford	MA	169,471	7,010
	BVY	Beverly Muni	Beverly	MA	69,351	4,484
	ASH	Boire Field	Nashua	NH	104,237	2,967
	MVY	Marthas Vineyard	Vineyard Haven	MA	52,060	2,706
Northwestern Mountain	APA	Centennial	Denver	CO	329,959	30,405
	PAE	Snohomish County (Paine Fld)	Everett	WA	131,836	13,455
	BJC	Rocky Mountain Metropolitan	Denver	CO	167,968	10,957
	HIO	Portland-Hillsboro	Portland	OR	224,461	10,177
	TTD	Portland-Troutdale	Portland	OR	86,721	10,154
Southern	PDK	Dekalb-Peachtree	Atlanta	GA	223,399	47,433
	FTY	Fulton County Airport-Brown Field	Atlanta	GA	122,196	34,773
	LZU	Gwinnett County - Briscoe Field	Lawrenceville	GA	85,686	34,213
	RYY	Cobb County-Mc Collum Field	Atlanta	GA	110,069	20,955
	ORL	Executive	Orlando	FL	151,734	20,277
Southwestern	ADS	Addison	Dallas	TX	131,833	111,988
	SSF	Stinson Muni	San Antonio	TX	148,631	37,656
	SGR	Sugar Land Rgnl	Houston	TX	86,538	31,147
	EFD	Ellington Field	Houston	TX	144,974	25,096
	HYI	San Marcos Muni	San Marcos	TX	120,420	18,187
Western Pacific	VGT	North Las Vegas	Las Vegas	NV	219,240	250,199
	MYF	Montgomery Field	San Diego	CA	223,410	78,118
	CRQ	Mc Clellan-Palomar	Carlsbad	CA	215,859	60,820
	SEE	Gillespie Field	San Diego/El Cajon	CA	295,342	56,044
	HND	Henderson Executive	Las Vegas	NV	67,482	47,108

CHAPTER 4

Conclusions

Estimation of Projected Fleet Changes

Table 22 provides summary estimates of the projected fleet changes from this analysis. The sales forecast for the GA segment projects that approximately 1,650 VLJs may be sold for use in the United States by 2012; by 2017, this total is projected to grow to around 3,500. The air taxi forecast, which is more speculative, projects 751 VLJs by 2012 plus more than 400 new low-cost piston aircraft that may be used for air taxi services. By 2017, the cumulative air taxi VLJ fleet may total more than 1,300, with about half that number added to the air taxi piston fleet.

These projections are subject to a large degree of uncertainty, and the forecasts were completed prior to very recent industry developments including the bankruptcies of an important air taxi provider and VLJ manufacturer.

The overall level of activity at small airports is not likely to be affected significantly by VLJs that are purchased for traditional GA because their main effect will be a simple displacement of sales that would have gone to other small GA aircraft instead. On the other hand, the analysis indicates that sales of VLJs (and low-cost piston aircraft) for air taxi use are likely to displace automobile and commercial air traffic, leading to substantial increases in activity at certain airports that can handle large numbers of the new air taxi services. But overall, the projected increase in operations by 2017 at VLJ-ready airports relative to 2007 is relatively modest, on the order of 6%.

Comparison with Other Fleet Forecasts

Even as stated, the total VLJ fleet projections are somewhat lower than some other forecasts that have been published in the last one to two years, but this is not surprising given recent events. Overall it is believed that the VLJ market will grow over the next few years, albeit somewhat more slowly than the optimistic projections forecasted by others. A comparison of forecasts is shown in Table 23; it is important to keep in mind that a substantial portion of the observed variations may be due to differences in geographic coverage (United States only versus worldwide).

Table 22. Projected cumulative U.S. fleet additions of small GA aircraft from 2007.*

	2012	2017
GA Use - Total	11,279	25,179
VLJ	1,647	3,547
Other	9,632	21,632
Air Taxi Use - Total	1,188	1,967
Piston	411	593
Turboprop	13	31
Light Jet	12	39
VLJ	751	1,305
VLJ Total	2,398	4,852

*Note: Figures and percentages may not add to totals due to rounding.

Table 23. Comparison with other VLJ fleet forecasts.

Source	Issue Date	1000 2000 3000 4000 5000 6000 7000 8000 9000 10000
Current Analysis	Nov 2008	US Only thru 2017 GA 3547 / AirTaxi 1305
Forecast International	Sep 2008	Worldwide thru 2017 5600
FAA	Mar 2008	US Only thru 2025 4500-5000 prorated thru 2017
Embraer	Nov 2007	Worldwide thru 2017 GA 3380 / AirTaxi 3950
PMI-Media	Sep 2007	Worldwide thru 2016 7650
Honeywell Aerospace	Sep 2007	Worldwide thru 2017 9800

Abbreviations and acronyms used without definitions in TRB publications:

AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation