

Corporate Aviation and the Very Light Jet

Timothy N. Timmons

Embry-Riddle Aeronautical University

Abstract

Very Light Jets (VLJ) gained immense popularity during the early part of the last decade. They held the promise of providing cheap and efficient jet travel across many markets including corporate aviation. Forecast for US VLJ sales were as great as 6,000 aircraft by 2016. Several aircraft manufactures began accelerated development of the new class of jet in an effort to be the first to market. The media called it the “VLJ revolution” and until 2008 all indications were that VLJs would change the face of corporate aviation. The Great Recession of 2008 changed everything. Economic turmoil and political backlash made corporate jet travel a “nice to have” and not a “need to have.” This paper explores the history of VLJs, why they were so attractive to corporate aviation and the major manufactures and products during the early years. The paper examines what happened to derail the VLJ revolution and the lasting impact on the growth of corporate aviation. Finally this paper attempts to answer the question of if the relationship between VLJs and corporate aviation can be rekindled in the future.

Corporate Aviation and the Very Light Jet

In the middle of the last decade Very Light Jets (VLJ) were projected to revolutionize corporate air travel. VLJs promised corporations of all sizes substantially decreased acquisition and operating cost, access to more airports, and greater speed and efficiency for business travel options. These benefits were slated to increase the attractiveness and viability of jet travel to a wider corporate audience. By all economic indicators at the time Corporate America was ready to receive VLJs with open arms. Several aircraft manufactures both well-established and start-ups were feverishly developing VLJs for the anticipated demand of the corporate market. Then came the Great Recession of 2008 and the political targeting of corporate aviation. The much hyped VLJ revolution failed to materialize. The anticipated market deflated and several VLJs manufactures disappeared in the aftermath. Four years later there are many questions that must be answered to understand the rocky relationship between VLJs and corporate aviation. Looking back how did the VLJ movement come to being? Who were the key players in the development and manufacturing of VLJs? What made the VLJ so attractive to Corporate America? Why did corporate aviation ultimately fail to embrace the VLJ? What impact has this had on corporate aviation? Is a VLJ resurgence still possible in this decade? This paper seeks the answers to these questions in an attempt to determine if the relationship can be rekindled in the future.

VLJ Defined

The original idea of a very light jet dates back to the 1970s. The original concept of the VLJ was to bring the capabilities and benefits of an efficient and small turboprop equipped aircraft to a wider segment of the business community. Advances in small turboprop engine design in the 1990s finally made the VLJ a possibility. The VLJ class of aircraft is defined in technical specifications as having twin turboprop engines, advanced avionics, a weight of under 10,000 lbs,

seating for four to six passengers, a range of 1000NM and a cruise speed of around 450MPH at a service ceiling between 30,000 and 40,000 feet (Majors, 2006; "VLJ," 2005). The most striking attribute of the new concept was the price. The VLJ was set to sell between \$1.5 million and \$3 million US dollars (Majors, 2006). This price point was half of the cost of the cheapest traditional business jet and in the same price category as turbo-prop aircraft. The advanced avionics of VLJs allowed many of the aircraft to be operated by a single pilot further reducing operating cost (Boehmer, 2006). The much reduced acquisition and operating cost of the VLJ was seen by manufactures as allowing them to create a market in the untapped business community still utilizing commercial air travel and dealing with post September 11th security requirements which were now making it a requirement to arrive at the airport up to three hours early (Creedy, 2004; Joyce, 2007).

Development History of the VLJ

Before the VLJ could be realized a very light and affordable turbofan engine had to be developed. Jet engine manufacture Williams International was the first to develop such an engine, leveraging military R&D used to develop jet engines for cruise missiles. The original VLJ concept, the pairing of two Williams cruise missile engines with a full-scale aircraft mockup, was called the Foxjet and appeared in the late 1970s (Swickard, 2006). The Foxjet's Williams engines were never certified for civilian use due to national security concerns by the Department of Defense and the Foxjet idea died (Luc van bavel design: personal jets, n.d.). The VLJ idea would remain dormant for 20 years until reborn with Vern Raburn, who as a Microsoft executive rediscovered the idea in the 1990s while flying to 15 separate board meetings (Henjum, 2007). To Raburn these multiple quick hop flights would be perfectly suited for a light

inexpensive jet, an aircraft that at the time did not exist. Raburn put his idea into action by founding the Eclipse Aviation Corporation in 1998.

In the years following the Foxjet Williams International continued to lead the industry in developing smaller and smaller jet engines. Williams partnered with NASA in 1996 to build an experimental engine designated the FJX-2. The FJX-2 weighed only 85 lbs yet produced 770 pounds of thrust creating a 9:1 thrust-to-weight ratio (Noland, 2007). Raburn would initially partner with Williams and use the EJ22, the commercial version of the FJX-2, for his prototype VLJ, the Eclipse 500. The EJ22 would ultimately fail to be a dependable powerplant for the Eclipse 500 but it provided the motivation for more wide spread development of very light turbofan jet engines by more established certificated aircraft engine makers like Pratt & Whitney (Noland, 2007). The engine technology which had limited the realization of the VLJ for so long had finally come of age. As the 20th Century came to a close Eclipse Aviation stood alone as the only manufacturer with a developing VLJ airframe. It was not long before more aircraft manufactures such as Cessna, Adam Aircraft and Embraer came on board to vie for a piece of the potential market action.

Initial VLJ Manufactures and Products

The initial VLJ manufacturing field was a mix of start-up and established aircraft manufactures. The four most prominent players at the start of the new century were Eclipse Aviation, Adam Aircraft Industries, Cessna, and Embraer. The future market for VLJs looked amazingly bright. In 2005 the total US GA active turbojet aircraft fleet numbered 9,823 (United States Government Accountability Office [GAO], 2007). Forecast for US VLJ sales were as great as 6,000 aircraft by 2016 an astonishing 61% increase in the overall fleet (GAO, 2007).

The four VLJ manufactures would each achieve varying degrees of success with designing, certifying, manufacturing and selling VLJs. Two would ultimately cease to exist, while the other two would weather the Great Recession and go on to market and sell VLJs in a greatly diminished market.

As previously mentioned Eclipse Aviation was the first to enter the VLJ market and is commonly seen as founding the VLJ movement. Eclipse designed and manufactured the Eclipse 500. The Eclipse 500 was a twin turbofan engine design utilizing two Pratt & Whitney 900-lb PW610Fs, provided seating for six, a maximum takeoff weight of 5,640 lbs, could cruise at 375 knots at altitudes up to 41,000 and had a range of 1,280 NM (Croft, 2006). The 500 had a length of 33ft and a wingspan of 37ft. The aircraft was also certified for single pilot operations. The estimated price tag was \$1.5 million (GAO, 2007). The maiden flight occurred in 2002 with the original Williams engines. FAA certification was achieved in September 2006 (Noland, 2007). The first customer delivery occurred on January 4, 2007. With reported orders for almost 2,400 aircraft by all accounts the future in 2006 looked very bright for Eclipse and VLJs (Croft, 2006).

Adam Aircraft Industries (AAI), founded in 1998, was also a relative new comer to aircraft manufacturing and jet production. The company had built a piston twin aircraft called the A500 before commencing work on the A700 VLJ which used the same airframe as the A500 (Phillips, 2005). Of the four original VLJs only Adams was unique with its twin boom tail configuration. Unlike the Eclipse the A700 utilized two Williams FJ-33-4A turbofan engines producing a total of 1350lbs thrust each. It was projected to cruise at 340kts up to 41,000 feet for a range of 1400 NM (Croft, 2006; Phillips, 2005). The A700 had a wingspan of 44ft, a length of 40ft 9 in and a maximum takeoff weight of 9,350lbs. The aircraft could be flown by one or two pilots and could seat between four and six passengers. The estimated price tag was

\$2.2 million (GAO, 2007). The maiden flight of the A700 occurred on July 28, 2003 but the aircraft never achieved FAA certification.

Unlike Eclipse and Adam, Cessna was no new comer to jet aircraft production. Cessna had been manufacturing business jets since 1969 with the introduction of the Citation. It announced development of the Mustang VLJ in 2002. The Mustang utilized two Pratt & Whitney PW615F turbofans producing 1,460lbs of thrust each for a total of 2,920 lbs. It was projected to cruise at 340kts up to 41,000 feet with a VFR range of 1300 NM and a maximum takeoff weight of 8,645lbs (Phillips, 2005). The Mustang had a wingspan of 43 ft 2in and a length of 40ft 7 in. The estimated price tag was \$2.5 million in 2007 (GAO, 2007). Cessna completed the maiden flight on 10 April 2005 with FAA certification achieved on September 8, 2006 (GAO, 2007). The first customer delivery occurred on April 23, 2007.

The last entrant was the only non-US manufacturer, a Brazilian company named Embraer. Embraer had been manufacturing aircraft since 1969 and was well known for its regional jet aircraft like the ERJ 145. For Embraer the decision to build a VLJ did not occur until 2005 well behind the already established US VLJ efforts ("Phenom," 2009). Embraer's executive jet experience allowed it to quickly catch up and surpass most of its other competitors. The Embraer Phenom 100 recorded its first flight on July 26, 2007 with FAA type certification occurring on December 12, 2008 and first customer delivery on December 24, 2008 ("Phenom," 2009). The Phenom can carry four passengers and a single pilot over 1,178 NM. Two PW617F-E turbofans provide the required thrust for the Phenom to cruise at 390 knots and climb to 41,000 feet (Phillips, 2005). Its wings span 40ft and fuselage extends 42ft. The maximum takeoff weight is 10,472lbs making the Embraer aircraft the heaviest of the four original VLJs. The

Phenom was also the most expensive of the new VLJs with an estimated price tag was \$2.9 million in 2007 (GAO, 2007).

Attractiveness to Corporate Aviation

The VLJ concept is very attractive to many corporations for the same reasons that traditional business jets have been. The most prominent advantage is the ability to travel direct and on demand. Scheduled airline service does not provide the flexibility to conduct multi-stop itineraries on compressed timelines. Many business people may visit multiple sites in the span of just one business day. This is impossible with the airlines (Sheehan, 2003). Another advantage of travel by VLJ is avoiding long security lines at airports. Airport security delays now make it almost mandatory to arrive at the airport three hours early. By bypassing security employees can save up to three hours on each end of the flight that equates to almost an entire work day worth of productivity saved. VLJs like other business jets also open up a vast number of additional airport options. Airlines provide regularly scheduled flights to “about 10 percent of the 429 commercial airports that have scheduled operations by air carriers” (Sheehan, 2003, p. xi). If you further expand this 1065% to the 5000 airports available to jet aircraft you have just opened up points of entry within minutes of almost anywhere in the continental US.

In addition to the advantages of traditional business jet travel VLJs offer a multitude of additional and unique benefits. The biggest advantage is the price point. The reduced acquisition price for a VLJ, similar in cost to a turboprop, now puts jet travel within reach of even more companies. A VLJ is also faster than a comparable priced piston-engine turboprop being used by small flight departments. The closest competitor is the traditional “light jet” category with gross weights of more than 10,000lbs and acquisition cost within the \$4-\$5 million

range (Croft, 2006). VLJ operating and fuel expenses are also much lower than traditional jets because a lighter aircraft is more fuel efficient. Cessna in 2007 stated that the Mustang's direct operating cost per mile were \$2.06 compared to \$2.62 for a traditional light jet (Henjum, 2007). Another advantage VLJs provide is their smaller runway length requirements provides even greater access to thousands of airports previously not an option for air carriers or large business jets. For established large flight departments VLJ's also fill niche requirements not previously financially justifiable for jet utilization such as short flight segments and low passenger counts which were overkill for bigger jets and the movement of middle management which instead traveled by more inefficient airline service (Henjum, 2007). VLJs now provide a cost effective solution to support all of these requirements. With all of these potential advantages ready to be exploited it is no wonder the introduction of the VLJ was predicted to be a revolution in the industry.

To best illustrate the multiple advantages of the VLJ a hypothetical comparison of a business traveler utilizing two separate travel options, one being a VLJ and the other being air carrier follows. Widget Inc. is a regional manufacturing company headquartered in Sierra Vista, AZ. They have sales and manufacturing offices in Albuquerque, NM, Flagstaff, AZ and San Diego, CA. The CEO would like to visit these locations at least once a month. He has two options available. He can fly commercial air or use the company's Citation Mustang located at the local airport KFHU. The closest air carrier airport is Tucson, AZ (KTUS) which is one hour and fifteen minutes away.

In the first option the CEO chooses to travel by commercial air carrier. The CEO departs his home at 6AM to arrive at the Tucson airport, check-in, pass through security and catch US Airways flight 2702. The flight lands in Phoenix, the regional hub, before continuing on to

KABQ. It arrives at 11:14 AM. The CEO spends one hour visiting his employees. The next available flight to Flagstaff departs at 3:40 PM and arrives at 6:50 PM after once again connecting in Phoenix. The CEO spends the night in a hotel and visits his sales team first thing the following morning. He departs for the airport at 11 AM to catch flight 2858 to San Diego, once again connecting through the hub in Phoenix. He arrives at San Diego international at 3:02 PM and fights rush hour traffic to get across town to his factory. He arrives haggard at 5 PM requiring a late tour of the facility. Unable to catch the last flight out at 7:20 PM the CEO spends a second night on the road. He catches an early morning flight at 6:25 AM, arrives in Tucson at 10:54 AM and drives the hour and a half to Sierra Vista arriving at 1PM on the third day. He is tired and worn out, he heads immediately home. He has not seen his family in two and a half days. Was this a productive trip? The CEO traveled over a thousand miles and visited all three locations but it took 55 hours and two overnight stays along with a tremendous amount of hassle.

In the second option the CEO chooses to travel by VLJ. At 8 AM the CEO travels 10 minutes to the local airport at Sierra Vista. Flight time to Albuquerque takes 50 minutes in the Mustang. After his one hour visit he boards the plane for the flight to Flagstaff. The second leg takes 44 minutes. After having a working lunch with his sales team the CEO again boards the plane at 1 PM for the trip to San Diego. He elects to fly into Gillespie Field (KSEE) on the east side of town which is very close to his manufacturing plant. Gillespie Field is a small airport not serviced by the air lines but perfectly suitable for his Citation Mustang. The flight takes 53 minutes. After a short drive from the airport the CEO spends two hours at the plant before boarding the aircraft at 4 PM to return home to Sierra Vista. At 5PM the CEO lands at KFHU and is back in the office by 5:15 PM to check E-Mail. It was a productive day. The CEO

traveled a total of 1,172 nautical miles and visited three locations in the span of nine hours. In addition he will enjoy dinner at home and spend the night with his family.

The Widget Inc. CEO example shows clearly and dramatically the advantages of on-demand business aviation to productivity and the bottom line. The VLJ CEO accomplished in one working day what required 2 ½ days for the air carrier CEO. How much did that day and a half of productivity lost by the company's most critical employee really cost? Business understands the value of on-demand aviation and believed the VLJ would make the capability even more financially justifiable. Smaller companies using slower turbo-props also saw the VLJ as improving their speed and efficiency at cost on par with their current aircraft.

Economic Meltdown

With much enthusiasm the aviation industry and VLJ manufactures entered into 2008 expecting more of the same explosive economic growth that had occurred in previous years. It was not to be the case. The industry would be assailed on three separate fronts that would create long lasting damage. The global recession actually began in December 2007 but it would take many months before the economic indicators became clear. Skyrocketing commodity prices and a collapsing housing market were key factors behind the recession. In addition to the recession oil prices were also at a historical high, this lead to aviation fuel cost spiraling out of control and flight department operational budgets seeing red (McAllister, 2009). Corporations were bracing for the worst by cutting operating cost, slashing budgets and laying off employees. New aircraft acquisitions were the last thing on any CEOs mind. The knockout blow to the industry came in November 2008 when ABC news reported that senior executives of the Big Three automakers were flying in million dollar jets to Washington to ask the government for bail out money (Pope,

2011). The negative publicity and the response by corporate America saw flight departments shut down and jet's mothballed. What would follow would "plunge the [business aviation] industry into the worst decline in its 65-year history" (Pope, 2011, p. 56). Sales of business jets went from a high in 2008 of \$24.8 billion to \$19.7 billion in 2010, a decrease of 20% (Pope, 2011).

The fledging VLJ market and start up manufactures were still in a very vulnerable position and not prepared to weather the storm they now found themselves in. Adam Aircraft was the first to fall victim shutting its doors on 11 February 2008 (Larson & Wallace, 2008). Eclipse Aviation was able to last a little longer but halted operations in November 2008 after entering into Chapter 11 bankruptcy (George, 2009). Eclipse did not fail due to the design or appeal of their aircraft but more so due to the mismanagement of company finances. Adam Aircraft had not yet achieved certification of the A700 so it is hard to determine if their VLJ design would ultimately have been successful. The incumbent manufactures Cessna and Embraer were much more financially stable companies and were able to ride out the financial storm. Both companies continued production and sales of their respective VLJ models but the demand for such aircraft had dramatically reduced. VLJ sales projections were quickly being revised in an ever increasing downward trend vector. By December 2008 forecast that had only months before projected 5,970 deliveries between 2008 and 2017 were reduced 23% to 4,610 (Sarsfield, 2008). The ever bleaker revisions continued into 2009 and 2010.

Impact on Corporate Aviation

Ironically the economically turbulent times created the perfect justification for owning a VLJ. The VLJ provided peak fuel efficiency in a time of record oil prices. The smaller more

modest and frugal jet was just the answer to public perception that corporate elite were lavishly wasting money on expensive business jets. The core VLJ benefit of substantially reduced cost for acquisition and operation still held true. Unfortunately, no one was buying new aircraft, even a class of jet that was millions of dollars cheaper than its closest competitor.

The failure of the VLJ market has negatively affected corporate aviation in multiple ways that will be felt for some time to come. Without the VLJ the predicted explosive growth of business aviation failed to materialize. Many flight departments were shuttered because of their inability to prove they were efficient and cost effective to their company using traditional jet aircraft. Smaller companies that would have established a new flight department based on the VLJ continued using old and inefficient means of scheduled airline service to move management and employees. Larger flight departments still remain inefficient on the low end of the travel spectrum for short hops and low passenger counts with their legacy fleet of jet aircraft. This remains a dangerous position for these organizations as they are continually scrutinized to prove their utility and cost effectiveness in difficult economic times.

It appears that the opportunity for VLJs to be an overnight success has passed. With VLJs having been around for over 10 years the media and the public have moved on to the next big thing leaving the VLJs to quietly make inroads into the business aviation community. The product was right, the timing looked perfect. In the end the VLJ fell victim to an economic and public perception environment that derailed everything. It appears the recession has knocked the top off the pre-2008 forecasted acquisition spike and flattened the acquisition trajectory over many years. What will now happen is much more mundane slow acceptance into the corporate aviation fleet. But the product retains its merit and is assured a place in business aviation. It

cannot be argued that a niche exist which the VLJs can fill. Over time more and more VLJs will join the national airspace. VLJs are here to stay.

Conclusion

Webster's Dictionary defines a revolution as "a sudden, radical, or complete change" (Mish, 1993, p. 1005). VLJs have certainly failed to achieve this during the last decade. VLJs have been waiting for their day for over 40 years. The first opportunity was stunted by the lack of maturity in small jet engine technology and the second by economic and political factors but perseverance and persistence is on the side of VLJs. The VLJ concept is too good and makes too much sense to be discarded in the historical wastebasket of almost good enough aviation ideas. VLJs need corporate aviation just as much as corporate aviation needs VLJs. The benefits to be gained are many. The rate at which this embracement will occur has been slowed but by no means stopped. Production and sales of VLJs by established manufactures continues today with the VLJ design maturing with each passing year. Both the Embraer Phenom 100 and Cessna Mustang VLJs remain in production with over 500 aircraft having been delivered since 2008. The near term future is still a mix of contradictions; Eclipse has been revived and is again taking orders for the Eclipse 550 while Piper has announced the end of development for its own VLJ the Altaire. Only the next decade will provide definitive answers on the ultimate long term success of the VLJ.

References

- Boehmer, J. (2006, October 23). Very light jets preparing for takeoff in the U.S. *Business Travel News*, 23(20), 14.
- Creedy, S. (2004, September 24). Dawn of very light jet era. *The Australian*, p. 29.
- Croft, J. (2006, May). Very light jets boom or blip? *Aerospace America*, 32.
- George, F. (2009, January 1). Eclipse bankrupt: now what? *Business & Commercial Aviation*, 104(1), 62.
- Henjum, S. (2007, April/May). Very light jets take off. *Directorship*, 33(2), 66.
- Joyce, M. (2007). Corporate aviation's smooth landing. Retrieved from <http://www.cnbc.com/story/corporate-aviations-smooth-landing/168/1/>
- Larson, E., & Wallace, B. (2008, February 20). Adam Aircraft seeking bankruptcy protection. *Deseret News*.
- Luc van bavel design: personal jets. (n.d.). <http://machdiamonds.com/foxjet.html>
- Majors, S. (2006, November 6). Very light jets poised for aviation stardom? *Associated Press Newswire*.
- McAllister, B. (Ed.). (2009, February). Adapting to the downturn. *Airport Business*, 23(3), 16-17.
- Mish, F. C. (Ed.). (1993). *Merriam Webster's Collegiate Dictionary* (10th ed.). Springfield, MA: Merriam-Webster.
- Noland, D. (2007, June). Mini-jet revolution, or dot-com with wings? *Popular Mechanics*, 184(6), 96.
- Phenom 100's debut at Delhi airport. (2009, November). *SP's Aviation*.

Phillips, E. H. (2005, July 25). Battle of the VLJs. *Aviation Week & Space Technology*, 163(4), 47.

Pope, S. (2011, November). The future of the flight department. *Flying*, 138(11), 56-60.

Sarsfield, K. (2008, December 9-15). Very light jet prospects dim as recession triggers alarm. *Flight International*, 174(5168), 25.

Sheehan, J. J. (2003). *Business and corporate aviation management: on demand air travel*. New York, NY: McGraw-Hill.

Swickard, J. E. (Ed.). (2006, June 1). With so much interest in very light jets. *Business & Commercial Aviation*, 98(6), 13.

United States Government Accountability Office. (2007). *Very light jets : several factors could influence their effect on the National Airspace System* (GAO-07-1001). Washington, D.C.: GAO.

What's a VLJ? (2005, September 1). *Business & Commercial Aviation*, 54.