VERY LIGHT JET: PILOT TRAINING

TO ENHANCE SAFE AND

EFFICIENT OPERATION

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"In this chaotic world, we need leaders… We need leaders to help us develop the clear identity that lights the dark moments of confusion" (Wheatley, 1999).

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CHAPTER I

INTRODUCTION

Background

"Powered flight, as we know it, is a product of the 20th century. Most historians agree that it began with the historic flight of those two mechanical geniuses, Wilbur and Orville. Their epic flight took place at Kitty Hawk, North Carolina on 17 December 1903 and has forever changed our world" (Orlady, 1999, p.1).

The evolution of aviation of flight has continued into the 21st century. "For several years, a number of aviation manufacturers have been designing and testing very light jets, a new type of small jet aircraft that are priced below other business jets and which will come equipped with advanced avionics and be certified for single-pilot operation" (J. Mica, personal communication, September 12, 2006). The aviation community has not experienced this type of innovation since Bill Lear launched the original Lear Jet 23, a business jet, in 1962.

The Federal Aviation Administration (FAA) is preparing to deal with the challenges presented by a new type of jet aircraft. The very light jet (VLJ) is yet another step in the perennial evolution of the aviation industry, and the FAA is working closely with the aviation community to develop safety standards and operating

procedures to ensure its safe integration into the nation's air traffic system (NAS). The FAA former Administrator, Marion Blakey, predicted that 5,000 VLJs would be in operation by 2017 (M. Blakey, personal communications, September 18, 2006).

Creating a small and affordable jet was a landmark general aviation idea, that remained unrealized until an engine that was small and fuel efficient enough to power a four to six passenger jet became available. Commitment from the large engine manufacturers has finally precipitated a new smaller jet engine that has made this dream of affordable jet ownership and travel a reality.

These jets are powered by a newly developed small power plant. These new turbofans produce 700 to 1700 pounds of thrust and weigh 100 to 200 pounds. The engines were developed in response to National Aeronautics and Space Administration (NASA) General Aviation Propulsion Program (GAP), which ran from 1996 to 2002, with a goal of delivering a variety of new improved performance engines for General Aviation (GA). NASA partnered with Williams International in the turbine area and developed the FJX-2 turbofan. A prototype engine that weighed 85 pounds, produced 700 pounds of thrust, and is now being used by many of the new VLJ aircraft companies. As a result of the Williams turbofan, many other new engines have been developed by Pratt & Whitney, General Electric, and others.

VLJs employ carbon composite material for the outer skins and structure, which will provide increased flexibility and reduced manufacturing costs. Composites have a known and positive track record and are used in a range of aircraft from the Cirrus single reciprocating engine of general aviation aircraft to the Boeing 777. The VLJ is capable of a cruising range of 340 to 380 knots over a 1200 to 1300 nautical mile range, which

equates to approximately 3 hours of flying time. Advanced avionics and glass cockpit technology will be the norm for these aircraft. Manufactures are estimating that it will take only a few weeks to construct a VLJ. Currently, worldwide, 21 aircraft companies are planning to operate VLJs.

VLJs range in price from $1.2 to $3.5 million, a price tag not much more expensive than some of the light piston twins aircraft and small turbo-props. In addition to their relatively low purchase price, VLJs will have improved fuel efficiency and be quieter than existing business jets.

These inexpensive single and twin-engine VLJs have the potential to redefine the business jet segment with significant new air transport technology. The VLJ is a small jet aircraft approved for single-pilot operation, although most owner/operators and their insurance companies will most likely prefer two pilots at the controls in case of medical or operational emergencies. Companies that use VLJs for commercial ventures are likely to use a two-pilot crew as a selling point for safety.

Existing markets for the VLJs include private jet owners and fractional ownership operators, which typically offer ownership shares of one-quarter or more in an aircraft. Also interested are companies or government agencies that already operate twin-turboprop aircraft and want to step up in speed and comfort to small jets. Air taxi "on demand" commercial operators are expected to be a large consumer of these jets and they will have to comply with the FAA Part 135 rules. Air taxi operations provide passengers with the ability to travel from their local airport directly to their target location, bypassing the traditional hub and spoke airline air travel system. Over time, the VLJ may replace existing aircraft because of the economy and flexibility that it offers.

Professor Antonio Trani of Virginia Tech, an expert in VLJs and a participant in an FAA workshop predicts that approximately two-thirds of the 2017 VLJ fleet will operate as air taxis, with the remainder serving as replacement equipment for existing corporate and personal jets (A. Trani, personal communications, September 26, 2006).

Some aviation experts have referred to the VLJ as a "disruptive technology," Clayton M. Christensen of Harvard Business School originated the term in his 1997 book, *The Innovator's Dilemma.* Christensen described "disruptive technology" as "a technology bringing to market a very different value proposition, products typically cheaper, simpler, smaller, and frequently, more convenient to use." He went on to say that a disruptive technology can initially appear to be of limited application and minimal consumer appeal, but can ultimately trigger changes to industries that fail to recognize these changes and continue to rely on existing business models and associated "sustaining technology" (Christensen, 1997, p. 32).

It is chaos' great destructive energy that dissolves the past and gives us the gift of a new future. It releases us from the imprisoning patterns of the past by offering us its wild ride to newness. Only chaos creates the abyss that we can create ourselves (Wheatley, 1999, p. 119).

Many of the perspective buyers for the VLJs will be owner-operators. Many of these pilots may be expected to have relatively limited or even no time in flying a jet, no high altitude experience, they may also lack understanding of flying in a pressurized cabin.

Statement of Problem

"How does a VLJ pilot training department make sure that a pilot, quite likely a non professional, is ready to safely fly an all new, relatively high performance jet, all alone at 41,000 feet?" (Captain W. Michaels, personal communication, December 3, 2007).

The introduction of the VLJ into the aviation community revealed a need to proactively address risks and anticipate potential safety problems. Most owner-pilots holding orders for VLJs are new to the performance envelope of these aircraft and many lack jet experience, that may create significant safety issues.

How owner-pilots adapt to the VLJ also affects the commercial viability of such aircraft for sky-cabs and charter companies. Regardless of the owner-pilots' qualifications, prolific incidents and accidents involving VLJs would discourage the public interest in using them for transportation.

These innovative aircraft are equipped with automated cockpits and cruising speeds that require flight management and decision making skills normally expected from a Airline Transport Pilot (ATP); yet they will be flown by pilots with significantly lower qualification and experience levels. This calls for a new training philosophy that must reduce human error elements and accelerate acquisition of higher-level judgment and decision making skills.

A comparison of accident rates across different sectors of aviation shows that GA had a significantly higher accident rate than either commercial and corporate aviation. The technologies now being introduced to GA cockpits may reduce the GA accident rates, primarily through the touted benefit of improved situational awareness (SA).

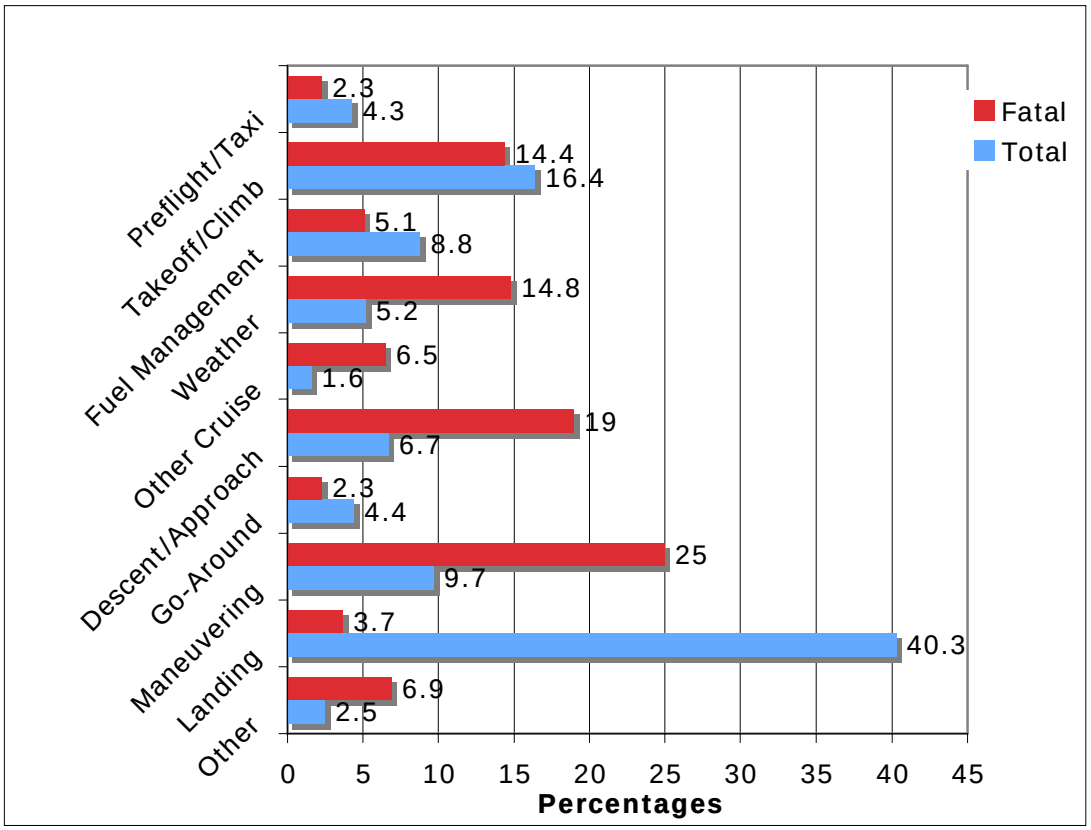


Figure 1. Accident Categories - Pilot Related

Source: NALL Report, 2007

Overall pilot related accidents accounted for 73.8% of the total and 79.1% of fatal GA accidents. The accidents categories shown in Figure 1 are defined by the phase of flight in which the accident occurred. Accidents in the categories of weather, other cruise, descent/approach, maneuvering and other resulted in disproportionately high number of fatal accidents when compared to total accidents for that category. To be classified as a GA aircraft the plane must weigh 12,500 pounds or less. The VLJ weighs less than 10,000 pounds so it would be included in this category.

Purpose of the Study

The purpose of this study was to determine if the voluntary Federal Aviation Administration Industry Training Standards (FITS) and Controlled Flight into Terrain (CFIT) were included in the pilot's VLJ training programs. In addition, some demographic variables like age, hours of flying experience and others, were looked at in relation to selected preference variables like preferred method of training, safety features and others, to see if there were any significant relationships. This study examines the VLJ pilot training programs to enhance safe and efficient operation of this new category of aircraft.

Research Questions

1. To what extent are VLJ pilots aware of the FITS program?
2. How are VLJ training programs addressing the CFIT problem?
3. How was feedback provided to the pilots for FITS/CFIT training?
4. Do VLJ pilots think it is important to have another pilot in the cockpit?
5. What type of training do VLJ pilots prefer?
6. Is there a relationship between selected variables in the VLJ study?

Assumptions

1. The VLJs are a new category of jet aircraft and limited information is available to evaluate the effectiveness of pilot training.

2. The VLJ aviation community will welcome the findings of this study to enhance their current training programs.

3. The VLJ pilots who volunteered to participate in the study will complete the 19 closed-ended and two open-ended questionnaire.

4. The selected sample size is small (25). Purposive sampling was used because in the opinion of the researcher, based on prior information, it will provide the data needed.

5. Eclipse Aviation of Albuquerque, New Mexico; Seven Bar Aviation and Embry Riddle Aeronautical University in Daytona Beach, Florida; Cessna Aircraft Company and Flight Safety International in Wichita, Kansas provided an ideal location to interface with VLJ pilots and training officials.

6. Information gathered from this study will be used in safety seminars and workshops for the aviation community.

Scope and Limitations

To be included in this study, a pilot must have had training in a single or twin engine VLJ, which is approved for single-pilot operation, weighing less than 10,000 lbs.

The latest statistics (2008) presented by Very Light Jet Aircraft Industry News identified these 15 VLJ manufacturing companies; Adams Aircraft, Aviation Tech Group, Cessna Aircraft, Cirrus Design, Diamond Aircraft, Eclipse Aviation, Embracer, Epic Aircraft, Excel-Jet Ltd., Grob Aerospace, Honda Jet, Maverick Jets, Piper Aircraft, Spectrum Aeronautical LLC., VLJ Comparison (Very Light Jets Aircraft Industry News and Information, 2008).

Definitions

AC - Advisory Circular, The FAA issues Advisory Circulars (AC) to inform the aviation public in a systematic way of non-regulatory material.

ACARS - Aircraft Communication Addressing and Reporting System, aircraft digital data link system for transmission between aircraft and ground stations,

Advanced Flight Training Device - is a training device that has a cockpit that accurately replicates a specific make, model, and type of aircraft cockpit, and handling characteristics that accurately model the aircraft handling characteristics.

AIM - Airmen Information Manual. This is an FAA manual is designed to provide the aviation community with basic flight information and ATC procedures for use in the National Airspace System (NAS) of the United States.

ALA - Approach and landing accidents, some CFIT accidents may fall into the category of ALS.

AME - Aviation Medical Examiner, is a physician who conducts medical examinations for the FAA.

AQP - Advanced qualification program, an innovative program designed to increase aviation safety through training and evaluation.

ATP - Airline Transport Pilot, a pilot holding the Airline Transport Pilot Certificate (ATP) has the highest level of aircraft pilot certification. Those certified as Airline Transport Pilots are authorized to act as pilot-in-command of an aircraft in air carrier service.

CFI - Certified Flight Instructor, a pilot who holds an FAA certified pilot instructor certificate.

CFIT - Controlled Flight into Terrain, an accident in which an otherwise serviceable aircraft under the control of the crew, is flown (unintentionally) into the terrain, obstacles or water, with no prior awareness on the part of the crew of the impending collision. -

CFR - Code of Federal Regulations, the FAA publishes the Code of Federal. Regulations (CFRs) to make regulatory requirements used in aviation readily available to the aviation community.

Chi-Square - is used to analyze data that are reported in categories.

COE - Center of Excellence, in the study the reference is the FAA COE.

Contingency Coefficient – is a nonparametric measure of correlation that tells the researcher the extent of the relationship between two sets of variables.

CRM - Crew Resource Management, concept to utilize and improve the resource management skills of pilots and others in the aviation system.

FAA - Federal Aviation Administration, an independent agency of the U.S. government charged with controlling the use of U.S. Airspace to obtain the maximum efficiency and safety.

FADEC - Full-authority digital engine control, automatically determines engine parameters and can control engine power for all flight phases.

FITS - FAA/Industry Training Standards is a voluntary program, a joint project of the FAA sponsored Center for General Aviation Research (CGAR).

FBO - Fixed Base Operator, also known as fixed base of operation, is a service center at an airport that sells fuel, oil, access to parking for an aircraft and other services.

Force Choice/Closed Ended - A selected response format used in questionnaire Surveys.

GA - General Aviation, airplane operations other than military or commercial airlines that weigh less than 12,500 pounds.

GAMA - General Aviation Manufactures Association, international trade association representing over 60 general aviation aircraft and related equipment.

GAO - Government Accountability Office, assist to improve the performance and assures the accountability of the federal government, also known as the investigate arm of Congress.

GAP - General Aviation Propulsion Program, this program was developed to revitalize general aviation.

GPS - Global Positioning System, US satellite based navigational system owned and operated by the US Defense Department offers precise, global, and continuous position capability.

IFR - Instrument Flight Rules, is a set of aviation regulations for flying the aircraft using only the airplane instruments in the cockpit.

ANL - Automated Navigation Leg, is a route of flight that is flown on autopilot from 400 ft AGL on departure until reaching the decision altitude on a coupled ILS approach or missed approach point on the instrument approach.

IOE - Initial Operating Experience, pilot flying with a check airmen.

JPDO - Joint Planning & Development Office, was established to facilitate the next generation activities.

Large Aircraft - Aircraft weighing more than 12,500 pounds maximum certificated takeoff weight.

Light Aircraft - aircraft of 12,500 pounds or less maximum certificated takeoff weight, also known a general aviation aircraft.

Light Turbine TAA - A jet or turboprop aircraft weighing 12,500 lbs or less and equipped with cabin pressurization, and conventional (non-swept) wings. This aircraft contains all the features of a TAA and will be capable of operating in Class A airspace on normal mission profiles. A light Jet TAA will be certified for single-pilot operation.

NTSB - National Transportation Safety Board, is an autonomous agency established in 1975 by the Independent Safety Board Act. The board seeks to ensure that all types of transportation in the United States are conducted safely.

PIC - Pilot-In-Command, the pilot at the controls of the aircraft.

PT - Pilot in Training, Pilot taking flight lessons.

PTS - Practical Test Standards is the FAA standards for testing a pilot.

Reliability - The degree to which a test reliable measure something consistently, but not necessarily what it is supposed to be measuring.

SBT - Scenario Based Training, a training system that uses a highly structured script of real-world experiences to address flight training objectives in an operational environment. Such training may include initial, transition, upgrade or recurrent training.

SRM - Single Pilot Resource Management is the art and science of managing all of the resources (both on-board the aircraft and from outside sources) available to a single

pilot to ensure that the successful outcome of the flight is never in doubt.

TAA - Technically Advanced Aircraft. A General Aviation aircraft that combines some or all of the following design features: advanced cockpit automation system (Moving Map GPS/Glass Cockpit) for IFR/VFR flight operations, automated engine and systems management, and integrated auto flight/autopilot systems.

Validity - The degree to which a test measures what it is intended to measure.

VFR - visual flight rules, is a set of aviation regulations in which a pilot may operate an aircraft by visual references to the environment outside the cockpit

VMP - Virtual Mentor Pilot, is a trained pilot located at a ground based station providing guidance to the pilot flying the aircraft.

CHAPTER II

REVIEW OF LITERATURE

A comprehensive search of literature was conducted to better understand the scope and effectiveness of the Very Light Jet (VLJ) pilot training. There are a considerable number of flight training books, aeronautical programs, and aviation journal articles written on effective airline pilot training. Since the first VLJ was delivered in March 2007, very little has been written about the effectiveness of training in this new category of aircraft.

This study sought to determine if the voluntary Federal Aviation Administration Industry Standards (FITS) and Controlled Flight into Terrain (CFIT) were included in the VLJ pilot training programs. In addition, some demographic variables like age, hours of flying experience and others, were looked at in relation to selected preference variables like preferred method of training, safety features and others, to see if there were any significant relationships.

The topics for the review of literature were: pilot training, research techniques, statistical methods of research, simulator devices, government documents, FAA Industry Training Standards (FITS), National Business Aviation Association (NBAA), pilot qualifications, mentor program, manufacturer training, recurrent pilot training, and airport specifications. The combination of these research topics was necessary to

understand, organize and evaluate pilot training. Pilot training is the first topic addressed and focused on the interface of other elements in flying.

Pilot Training

There are currently only two manufacturers that have their aircraft Federal Aviation Administration (FAA) certified and have been delivering to customers. In 2007, Cessna Citation Mustang in Wichita, Kansas and Eclipse Aviation in Albuquerque, New Mexico delivered VLJs to their initial customers. These two companies have developed their training programs for initial and recurrent training. Their goal was to model their training programs after the large air-carrier operators.

Training is important and sensitive because it furnishes the primary interface between aircraft manufacturers, the companies that buy transport airplanes and the pilots who must fly them. Training also is the interface with the environment in which these airplanes must be operated, that environment has become increasingly complex. The airplanes themselves have become both more sophisticated and more expensive (Buck, 1995).

The interfaces between the manufacturers, the airline companies, the pilots, and the environment as well as the pilot training associated with them is critical factors in the safe and efficient operation of air transport (Orlady, 1993).

Crew resource management (CRM) is defined as "the effective utilization of all available resources, hardware, software, and liveware, to achieve safe, efficient flight operation" (Lauber, 1984). CRM is a philosophy of operation and a body of knowledge that is an essential part of all flight operations. The VLJ is certified for a single pilot

operation, however, conducting research for this study, insurance companies report that only 10-15% of the VLJ owners/companies will choose to fly the aircraft with one pilot, because of the reduction in insurance rates with two qualified pilots. Therefore, CRM principles will be an integral part of the entire training program, especially in that they have proven velocity even with a single pilot, as the Australian military has so aptly demonstrated!

Insurance company statistics have shown that regular, simulator-based initial and recurrent training for turbine powered aircraft, have reduced both the number and severity of accidents. Some of the insurance companies are requiring a pre-VLJ training evaluation. Currently, there are five Level D Full Motion Simulators in operation, three at the Cessna Aircraft Company in Wichita, Kansas and two at Eclipse Aviation in Albuquerque, New Mexico. The simulator replicates a specific make, model, and type of VLJ cockpit, and its handling characteristics accurately model the aircraft. This type of simulator allows for the pilot to obtain all of the training including his/her final check ride in the simulator. Under Federal Aviation Regulation (FAR) Part 142, a standardized curriculum and schedule is a requirement for all VLJ pilot trainees in a simulator environment. A pilot must log a minimum of 16 hours of VLJ flight training and pass a check ride as a the sole manipulator of the controls in order to get a VLJ type rating added to their FAA pilot's certificate.

Following the completion of training in a flight simulator some of the VLJ pilots will be required to obtain additional hours of supervised operating experience (SOE) in order to exercise his/her pilot-in-command privileges according to Federal Aviation Regulations (2006) FAR 61.63 (e).

Cognitive operational behavior can be divided into three categories: skill based, rule based, or knowledge based behavior (Rasmussen, 1987). More than one behavior category can be involved in a single instance. These behaviors must be incorporated into an effective VLJ training program.

In an analysis of 388 Aviation Safety Reporting system (ASRS) incident and NTSB accident reports, one rather surprising finding was that almost two-thirds of the events involved some type of difficulty with cognition in the cockpit. These problems included: confusion, poor decision-making, distraction, and memory problems. In this NASA study, 281 of the 388 aircraft involved were general aviation aircraft (Burian, 2007).

Government Documents

The foundation of US aviation safety regulations is the voluminous collection of government documents on the matter. The main regulator for the VLJ is the FAA. Some of the main documents derived from the FAA are regulations, aircraft certification documentation, General Counsel Legal Office briefs, Practical Test Standards, (PTS) FAA Industry Training Standards (FITS), and FAA Advisory Circulars. Crew Resource Management, FAA Advisory Circular, 120-51E presents guidelines for developing, implementing, reinforcing, and assessing crew resource management (CRM) training.

Training may be done under the FAA Industry Training Standards (FITS) concept. The FAA is working with industry as they develop scenario-based training programs for acceptance under FITS. Manufacturers may also specify in the limitations

sections of their airplane flight manual (AFM) that selective training be required to act as pilot-in-command of the aircraft.

The FAA has established a cross-organizational group to address the issues of safety and system capacity created by the anticipated introduction of thousands of VLJs over the next the ten years. This group includes elements from the Air-Traffic Organization (ATO), Flight Standards Service (AFS), Aircraft Evaluation Group (AEG) and Aircraft Certification Office (ACO). The group's 35 members has organized its work under separate committees that focus on specific issues; Pilot Training and Checking; Flight Operations; Maintenance Inspector Training; and Air Traffic. (M. Baxter, personal communications, August 9, 2007).

VLJs were spawned from the NASA Small Aircraft Transportation System (SATS) program. This initiative was intended to provide safe air travel in new single pilot jet aircraft, with advanced technology, in all weather. One of the objectives of the SATS program was to access approximately 5,400 smaller airports in the US. The SATS observed that 75% of all people and cargo pass through 29 only hub airports, which are becoming over-crowded (Strait, 2006). "The ability to operate multiple small aircraft, in near all weather conditions, at virtually any small airport, offers a unique opportunity for revolutionary transportation growth and passenger convenience" (Abbott, Jones, Consiglio, Williams, and Adams, 2004). A very important question is whether we can afford to take the risk of pilots, with little or no jet experience, flying safely at speeds and altitudes usually reserved for the more heavy airliners carrying over 500 passengers. A collision between two small aircraft with less than five people is bad enough, but a VLJ hitting an Airbus 380 would be a flying apocalypse.

Since the VLJs must be turbojet-powered by definition, an aircraft type rating is required to fly them and pilots will tested in accordance with the Airline Transport Pilot (ATP) and Type Rating Practical Test Standards (PTS). The FAA is in the process of refining the PTS to include more aeronautical decision-making, single pilot cockpit resource management (CRM) and a greater emphasis on performance analysis and scenario-based testing.

"Part of the problem in forecasting the demand for VLJs is the lack of information available to make more accurate decisions," Government Accountability Office (GAO) told house members. "Since VLJ manufacturers have just begun delivering the new aircraft, there is little information about product demand," GAO said. "Forecasters indicated that they base their assumptions about VLJ demand on information about past deliveries of aircraft in comparable price classes, such as light jets and turbo prop airplanes. These aircraft, however, do not have exactly the same performance as the VLJs" (Government Accounting Office, 2007).

The same holds true for predicting the future of the VLJ in the air taxi market. Since the first delivery of the VLJ to an air taxi company did not take place until 2007, there is no past market information to draw upon, GAO said. The delay in getting such aircraft to the market has made it difficult to project in the future.

A senate hearing, September 28, 2006, was held to learn whether the National Air Transportation System (NAS) will be able to accommodate the coming crop of VLJs … dubbed "the mosquito fleet" by US Senator Ted Stevens, (R-Alaska). Jack Pelton, Chairman of the General Aviation Manufactures Association (GAMA), and Chairman President and CEO of the Cessna Aircraft Company, pointed out that the

VLJs will not “darken the skies,” as many have predicted. Pelton added that he believed that the VLJ market would develop like every other turbine powered general aviation aircraft; in an evolutionary, rather than a revolutionary, manner. “The introduction of VLJs will be at a rate in which they will be transparently and smoothly absorbed into the national air system.” (New Entrants in the U.S. Aviation System, 2006).

If VLJ operate shorter flights and travel at lower altitudes then they will have little effect on capacity. But if they fly higher and longer, the impact will be felt. VLJs have a slower climb rate and cruise speed, which could influence their ability to mix in with other aircraft in terminal and en route environment (GAO Report, 2007). There is a very real possibility that the VLJs will increase the complexity of the airspace due to there performance limitations.

European authorities are squawking over what they call a “loophole” that allows very light jets to operate without traffic alert and collision avoidance systems (TCAS). TCAS is required on aircraft bigger than 12,500 pounds and VLJs are loosely defined as jets that weigh less than 10,000 pounds. Eurocontrol, which oversees air traffic control in Europe, is pushing to make this equipment required in VLJs. Alex Hendriks, the deputy director of air traffic management strategies at Eurocontrol, told the London Times: "TCAS is mandatory for airlines because of safety considerations. Why should we exclude a certain category of aircraft just because they are small?" (Hendricks, 2008)

FAA Industry Training Standards (FITS)

The FITS Program is a joint project of the FAA sponsored Center of Excellence (COE) for General Aviation Research (CGAR), Embry Riddle Aeronautical University,

University of North Dakota, and the general aviation industry. Their mission statement is to ensure that pilots learn to safely, competently, and efficiently operate a technically advanced piston or light jet aircraft in the modern National Airspace System.

FITS is a new approach to training pilots. It is scenario-based rather than maneuver based and structured to emphasize development of critical thinking and flight management skills. The goal of this new training philosophy is accelerated acquisition of the higher level decision-making skills necessary to prevent pilot error incidents and accidents with technically advanced avionics.

With jet engines, glass cockpit technology, and high performance capabilities, the VLJ is considered technically an advanced aircraft. Training for the pilots in this type of jet aircraft will be conducted under the FITS model. The FITS curriculum consists of "what if" questions, which are designed to accelerate development of decision-making skills by posing situations for the trainee to ponder.

> These types of discussions help build judgment and offset low experience. Questions of this nature will force the trainee pilot to focus on the decision process, which accelerates acquisition of judgment. Judgment, after all, is simply the decision-making process, which is learned primarily from experience. It is not innate. All life experiences mold the judgment tendencies brought into flight situations. By artificially injecting decision opportunities into routine training lessons, we speed up acquisition of experience, and thus enhance judgment and decision-making (FAA Aeronautical decision making, 1991).

Title of the Code of Federal Regulations (14 CFR) Part 61 specifies the areas in which knowledge and skills must be demonstrated by the VLJ pilot applicant prior to the

issuance of a type rating in the jet. The CFRs provide the flexibility to permit the FAA to publish practical test standards (PTSs) containing specific tasks in which the VLJ pilot competency must be demonstrated (The Airline Transport Pilot and Aircraft Type Rating Airplane Practical Test Standards, 2006, p. 6). These are the standards that will be used by the FAA inspectors and designated pilot examiners when they conduct the type rating check ride for the VLJ pilot. Pilot applicants should be familiar with this book and refer to these standards during their VLJ training and especially prior to their final check ride.

Research has proven that learning is enhanced when training is realistic and authentic. It also has been proven that the underlying skills needed to make good judgment and decisions are teachable (Carmichael & Kutz, 2003).

National Business Aviation Association (NBAA)

The NBAA, founded 61 years ago, serves its 7,400 member companies by promoting the aviation interests of organizations utilizing business aircraft in the United States and worldwide. The NBAA develops industry guidelines to help its members understand and utilize "best practices" that may exceed the FAA regulatory requirements.

Edward Bolen, President and CEO of NBAA, reported at their National Conference in Orlando, Florida, October 2006, that the infusion of the VLJ has been an evolutionary change for the aviation industry. Bolen said, "Manufacturers are working closely with insurance companies as well as the best flight-training programs in the world, such as Flight Safety, Simu-Flite and United Airlines."

National Business Aircraft Association (NBAA) fact book 2005, reports that

30 out of the 550 commercial airports in the US account for 70% of all our air travel. Our skies are crowded around many major airports and the air traffic control system is rapidly approaching capacity. NBAA also reports that there are 5300 available satellite airports in the US. Many of these airports could be used by small jets to relieve this situation.

The International Air Taxi Association, reported, there are more business jets and turbo-props in Brazil than in any other single country outside the United States and Canada. As a region, Latin America and the Caribbean operate more turbo props than either Europe or Asia.

With Very Light Jet Manufacturers forecasting more than 60% of their sales outside the US, Latin America and the Caribbean offer an exciting market. The poor road network and limited railways in Latin American have long made private aircraft an essential tool for business. As the Latin American economy gains momentum and the boom in agriculture generates business in areas far removed from the big industrial centers, demand for aircraft is expected to grow at a phenomenal pace. Conservative estimates predict the market for private jets in the region will grow at 10% per year for the next five years. As the existing fleet of twins and turbo props comes up for renewal or replacement the VLJ is going to look increasing attractive to owners/operators and owners/pilots (Very Light Jets –Latin America and the Caribbean, 2008).

Pilot Qualifications

A new pilot will be required to have a private pilot certificate, multi-engine rating, instrument rating, and is encouraged to have airline transport pilot certificate. The

VLJ is a turbojet powered aircraft, therefore, according to FAA regulations a type rating is required for pilots. The pilots will be tested in accordance with the FAA Airline Transport Pilot (ATP) tolerances and the type rating limitations in the Practical Test Standards (PTS). The revised PTS will include more aeronautical decision-making, single pilot resource management, and a greater emphasis on performance analysis and scenario-based testing. Additional areas that will be tested include; auto-flight procedures, flight management procedures, weather radar, and line orientated flight will be part of the training (FAA Practical Test Standards, 2006).

VLJ pilots will also be required to have a minimum of an FAA second class medical certificate. If the pilot holds an ATP, he/she will be required to have a first class medical certificate.

The NBAA VLJ Training Guidelines dated January 2005, states that a critical consideration in the pilot candidate evaluation process must be the availability of insurance and satisfying underwriting requirements. Early input from the insurance underwriting community, will prevent a candidate from investing significantly in both the planning and acquisition of a VLJ, only to find he/she is uninsurable when the time comes to take the delivery of the jet (NBAA Training guidelines, 2005).

Insurance underwriters have been interested in the development of the VLJs and have taken a proactive role in learning about the capabilities and limitations of these jets. The NBAA suggests that pilot members who are interested in the buying a VLJ should engage the insurance companies in the purchase process with the goal of finding mutually agreeable terns and conditions for operating the VLJ. Before the pilot enrolls in a VLJ training course, he/she should have an initial proficiency evaluation in several areas,

including:

Flight Skills Assessment

Practical in-flight scenario exam to test instrument skills and airmanship

Oral exam to evaluate judgment skills

Written exam to determine aeronautical knowledge

If deficiencies are detected, the manufacturer or training provider should arrange additional flight training to bring the pilot up to the necessary flight skills level. This evaluation will also help determine which pilots will be most likely to succeed in the training program based upon general aviation knowledge, time and type of experience.

Cockpit resource management (CRM) principles apply to the pilot-in-command (PIC) of any single or multi engine pilot certified aircraft, including a VLJ. In a VLJ it is called single pilot resource management (SRM). VLJ pilots should be trained in understanding and applying CRM/SRM principles. Accidents/incident data has shown that CRM/SRM enhances the safety and efficiency of both single and dual pilot operations. CRM includes optimizing the person-machine interface and the acquisition of timely, appropriate information, also the personal activities including leadership, situational awareness, and problem solving (FAA CRM, 2004).

Mentor Program

Upon successful completion of the manufacturer's training program, the need for a mentor pilot will be discussed. A mentor would observe the pilot's aircraft handling, use of automation, and single-pilot resource management principles, providing feedback to the pilot. Mentors are not meant to instruct on the specific aircraft per se, but rather to

act as a coach. A mentor should not ordinarily fly as a crewmember. The overall objective of the mentor program is to allow the new captain to become comfortable in the airplane while operating in new environments such as high-density airports (B. Palmiero personal communication, October 5, 2007).

Accordingly to Vern Raburn, President and CEO of Eclipse Aviation, a 40 year veteran pilot, said the mentor program will be a critical part of the success of the Eclipse 500 Type Training Program. President Raburn stated: "many Eclipse 500 operators will require supervised operating experience, because of a lack of jet piloting experience, and the Eclipse pilots will benefit from the Eclipse 500 mentoring experience."

Even after completing all phases of training and obtaining a type rating, a new Eclipse pilot may require additional flight hours with an authorized Eclipse 500 Mentor Pilot, subject to the Eclipse training director's final assessment of the pilot's readiness to safely fly solo in an Eclipse 500 (Eclipse Aviation, The Eclipse 500 Mentor program, 2007).

Mentoring is one of the most important tenets of the Cessna Citation Mustang initial training process. The mentor will help the newly rated pilot gain confidence in his or her ability to cope with and resolve a variety of situations normally encountered during aircraft operation (R.Burke, personal communication, February, 28, 2008).

This position is not an employee position with Eclipse Aviation. Mentor pilots will be independent contractors, trained by Eclipse and Higher Power Aviation at the at the mentor's expense. Mentor pilots will fly all supervised operating experience (SOE) flights with Eclipse 500 operators including any mentoring required or desired beyond that. The

mentor pilot will get an average of $600 to $800 dollars a day plus expenses working the Eclipse pilots. The Cessna Citation Mustang mentor pilot is employed by Flight Safety International who is on contract to do all of their VLJ training; they will get approximately $1000 to $1200 dollars per day plus expenses. The Honda VLJ Jet has also contracted Flight Safety International to do all of their pilot training. The Honda Jet is scheduled to be ready for flight in late 2010.

Mentor Responsibilities

1. Fly with newly type-rated VLJ operators in the owner's jet to provide wisdom and guidance to those pilots not familiar with the high altitude or high speed jet environment.
2. Counsel the operator on methods and techniques to enhance safety and improve the customer's aviation experience.
3. Evaluate performance and report progress to the company.
4. Recommend any additional training that may be required.
5. When required by FAR, provide supervised operating experience (SOE) per FAR 142 curriculum.
6. Maintain proficiency standards established by the training company aviation policy.
7. Comply with standard operational procedures established by and set forth in the Pilot's Operating Handbook (POA).
8. Represent the industry as a model of professionalism.

9. Maintain currency in the VLJ that you are representing (FAA Airline Transport Pilot and Aircraft Type Rating for Airplane, 2006, p. 12).

Selection Criteria

Mentors will be chosen on the basis of his or her record as a professional airman and aviation knowledge. Specifically, the following considerations will contribute to the selection process:

Education/Ratings/Desired Qualities

1. FAA Airline Transport Pilot Certificate (required)
2. Type rating in light to medium jet (preferred but not required)
3. CFII and MEI (preferred but not required)
4. Four year college degree (preferred but not required)
5. Effective communication skills and teaching skills exercised in a professional manner (R, Burke, Chief VLJ Program Manager, personal communications, February 25, 2008.).

Pilots wanting to work as a mentor must be highly qualified, hold an FAA Airline Transport Pilot Certificate, with a type-rating in a light to medium jet, a minimum of 5,000 total flight time, with 3,000 hours pilot-in-command time (PIC) time and 1,500 hours as PIC in a turbojet. While Eclipse Aviation is only one of the new entrants for VLJs, they are, however, one of the first companies to receive FAA certification. As a result, many other VLJ companies are emulating their mentor program.

The NBAA also recommends that upon completing the VLJ training program, the pilot, training provider, and the insurance underwriter work in concert to determine the need for a mentor pilot. The prospective mentor, must be accepted by both the aircraft manufacturer and the insurance underwriter meet criteria prescribed for this position.

Many Part 135 VLJ operators have expressed an interest in hiring pilots from a cadre of retired former airline pilots. Their expectation is that the high levels of maturity, airline based training and flight experience will add an element of safety.

Manufacturers

Manufactures are designing these aircraft for single pilot certification, although there may be an interim requirement for a second-in-command, a pilot trainer. Some other transition steps such as virtual mentor by a wireless transmission as mandated by the manufacturer or insurance companies, depending on the pilot's experience level.

The manufacturer's training can be described as the "nuts and bolts" portion of the training. It is technical in nature and designed to instruct the pilot on the specific aircraft characteristics.

With Very Light Jet manufactures forecasting more than 60% of their sales outside the US, Latin America and the Caribbean offer an exciting market. The poor road network and limited railways in Latin American have long made private aircraft an essential tool for business. As the Latin American economy gains momentum and the boom in agriculture generates business in areas far removed from the big industrial centers, demand for aircraft is expected to grow at a phenomenal pace. Conservative estimates predict the market for private jets in the region will grow at 10% per year for

the next five years. As the existing fleet of twins and turbo props comes up for renewal or replacement the VLJ is going to look increasing attractive to owners/operators and owners/pilots (Very Light Jets – Latin America and the Caribbean, 2008)

VLJ manufacturers are particularly sensitive to the need for high-quality training, however, so they are taking training curricula one-step further. As an example, Eclipse Aviation has signed a training agreement with Higher Power Aviation, Dallas, Texas, to provide a mandatory training program similar to that given to airline pilots.

Eclipse Aviation, manufacturer of the first VLJ announced on January 17, 2008, that the FAA has certified its first flight simulator, with a level D full motion flight simulator. Level D is the highest qualification granted for simulators, and this certification will allow Eclipse to certify student pilots without having to train in an aircraft, so long as they are enrolled in a training program that has the FAA approval to use such a device. Immediately after achieving Level D certification, Eclipse initiated the certification process for its Part 142 syllabus integration of the simulators and learning environment (Very Light Jet Industry News and Information, 2008).

Once very dangerous aircraft training has become completely safe for those members of the major air carrier community using high quality simulation for all flight training. Some critics have observed that with no training there could be no training accidents. Such cynics are quickly silenced however, when a review of NTSB accident records reveal that in addition to eliminating training accidents, high fidelity simulation users are experiencing pronounced decline in operational accident rates in conjunction with their implementation of an FAA approved simulation plan.

The decades following the inception of flight simulation within commercial aviation have seen technology advance to the point that flight simulators can now accurately support the complete qualification of pilot in a given crew position. After certification in a simulator, a pilot with previous experience in the respective airplane type could fly in revenue service when accompanied, for an initial period of time, by a supervisory pilot (Bonnefoy & Hansman, 2007).

Recurrent Pilot Training

In addition to the initial training, there will be a requirement for recurrent training. Recurrent training will be required annually at a minimum to retain qualification and insurability. A pilot may elect to reduce the interval between recurrent sessions, particularly if he/she is flying less frequently. Recurrent training will include incident review, manufacturer's maintenance and operations bulletins, critical maneuvers training, and reviewing operating minimums, and practical application of single pilot resource management.

As a part of the recurrent training classroom sessions VLJ pilots may review man-machine relationship. The "man-machine-environment triad" evolved when T.P. Wright of Cornell University first introduced the word to safety language of the 1940s. While many see the pilot as the only "man" in the system; others include all persons directly involved with the operation of the aircraft including flight crew, ground crew, air traffic control, meteorologist, etc. Although aviation technology has made substantial advances, there are occasions when hazards are still found in the design, manufacture or maintenance of aircraft. As a result of refinements over the years, the number of

accidents caused by the machine has declined, while those caused by man have risen proportionately. As a result of the significant shift in the relationship between man and machine a consensus has emerged that accident prevention activities should be mainly directed towards the man.

Airport Specifications

The National Aeronautics and Space Administration (NASA) has proposed a travel alternative to relieve congested interstate highways and established hub-and-spoke airports, with the potential to revolutionize transportation accessibility and mobility.

As a result of this vision, Small Aircraft Transportation System (SATS) was formed and led to development of the VLJ. SATS offers on-demand, point-to-point, widely distributed transportation system. This system promises improved safety, efficiency, reliability and affordability for small aircraft operating within the nation's 5,400 public-use-landing facilities. About 98% of the US population lives within 20 miles of a least one of these airports (Strait 2006).

It is anticipated that the VLJs will be using smaller runways with takeoff and landing distances in the 3,000 to 5,000 foot range. Grass strips may also be used for this type of aircraft and the number of small fly-in-community runways may increase as a result. On intersecting runways, VLJ aircraft are capable of routine land and hold short operations (AOPA Land and Hold Short Operation, 2006).

The VLJ will meet the SATS requirement for the five-year research plan:

1. High-volume operations at airports without control towers or terminal radar facilities.

2. Technologies enabling safe landings at more airports in almost any weather condition.
3. Improved single-pilot ability to function competently in evolving, complex national airspace (Xu, Baik, Trani, 2006).

The VLJ business model is based on providing convenient, personal point-to point services through non-congested airports. VLJ passengers will be time sensitive and convenience-minded, and they will use VLJs precisely to avoid the hassles associated with large airports.

CHAPTER III

METHODOLOGY

Introduction

This chapter outlines research information related to the design of the study; describing the population, sampling procedures, instrument description, data gathering procedures and data analysis techniques, used to support the purpose of the study. Specifically, 19 forced-choice and two open-ended survey questions were used to determine if the voluntary Federal Aviation Administration Industry Training Standards (FITS) and Controlled Flight into Terrain (CFIT) were included in the pilot's Very Light Jet (VLJ) training programs. In addition, some demographic variables like age, hours of flying experience and others, were looked at in relation to selected preference variables like preferred method of training, safety features and others, to see if there were any significant relationships.

The researcher attended the Aircraft Owners & Pilots Association (AOPA) Conference, in Hartford, Connecticut, October 4-6, 2007, more than 10,000 people were in attendance, including several VLJ operators/companies. VLJ representatives reported that pilot training was not offered at the site of the aircraft company, rather training was being conducted at flight centers across the USA. A list of those companies

providing VLJ pilot training was obtained from new aircraft entrant applications and National Business Aircraft Association (NBAA) records.

The problem or topic studied and the content of the questionnaire must be of sufficient significance to both motivate potential respondents to respond and justify the research effort in the first place (Gay & Airasian, 2000). The researcher's experience indicates that both of these conditions were met.

Design of the Study

The study was designed to determine if the voluntary FITS and CFIT programs were used in the VLJ training curriculum. In addition, some demographic variables like age, hours of flying experience and others, were looked at in relation to selected preference variables like preferred methods of training, safety features and others to see if there were any significant relationships.

Questionnaires for the study were provided to the population sample that represented the VLJ aviation training industry. Currently, there are approximately 21 companies worldwide who manufacture and/or plan to operate the VLJ. To be included in the sample, a pilot must have had training in the VLJ.

The study was a mixed method, using both quantitative and qualitative questions. Quantitative descriptions of the survey involved collecting data in order to answer questions about the current status of the subject or topic of study. In an explanatory design, the researcher first collects and analyzed quantitative data, and obtains qualitative data to follow and refine the quantitative findings (Fraenkel & Wallen, 2003).

Population

The sample was selected from a population of 325 pilots who have had VLJ training. As of February 15, 2008, there were approximately 310 pilots with VLJ ratings (single pilot) on their FAA pilot's certificate, thus the population size was limited by the topic selection.

This study focused on training for those initial VLJ pilots, who were the owner/operators, commercial VLJ pilots, and mentor pilots.

On site surveys were conducted at these VLJ training sites: Seven Bar Aviation Company (Fixed Base Operator) and Embry Riddle Aeronautical University in Daytona Beach, Florida; Eclipse Aviation in Albuquerque, New Mexico; Cessna Aircraft Company and Flight Safety International in Wichita, Kansas. Each pilot was given an explanation of the survey and its importance to future VLJ training. All 25 pilots asked to participate in the study were willing to do so. Each pilot was presented with a consent form, assured that their identity would be anonymous and offered access to the results of the study if they so desired.

Sample

The population of the study was limited to pilots who have either been trained or are currently in training for the VLJ. Purposive sampling also referred to as judgment sampling, was used. Purposive sampling is different from convenience sampling in that researchers do not simply study who ever is available, but use their judgment to select a sample that they believe, based on prior information, will provide the data they need

(Fraenkel & Wallen, 2003). Purposive sampling is used when the researcher selects a sample based on his or her experience or knowledge of the group to be sampled. Utilizing a purposive sample one should obtain the opinions of the target population (Gay & Airasian, 2000).

Instrument

Instrument Selection

In a search for an instrument that would assist in determining if the voluntary FITS and CFIT programs were used in the VLJ pilot's training curriculum, a questionnaire with a semi-structured interview was chosen. The survey included questions on pilot demographics, training preferences, desirability of having another pilot in the cockpit, and two open-ended questions to allow comments on improving VLJ training.

The use of a paper-and-pencil questionnaire has some definite advantages over other methods of collecting data, such as the interview technique. Although a personally administered questionnaire has some of the same advantages as an interview, such as the opportunity to establish rapport with the respondents and explain unclear terms (Gay & Airasian, 2000).

A list of VLJ manufacturers, operators, and training providers was obtained from the VLJ records. Five sites selected from this list were chosen to conduct the surveys. The researcher contacted the aviation facilities and arranged to interview pilots, at random. This plan of action was chosen because it provided the researcher access to the target audience and provided the subjects with a familiar environment.

Instrument Description

The questionnaire developed was based on forced-choice structured design, along with two open-ended unstructured questions. Any multi choice question could also be called a forced-choice question because the respondent is expected to choose from one of the response alternatives. An advantage of forced question is studies have indicated that reliabilities and validities obtained from the use of forced choice questions compare favorably with other methods (US Army Research Institute, 1986, p. 47). Forced choice questions were selected because all of the FAA pilot written tests are in this format, so VLJ pilots are familiar with this design. Forced choice questions allow a respondent to select his or her answer from a number of options and was used to measure opinions, attitudes and knowledge. This type of question is easy to use, score, and code for analysis. Because all subjects responded to the same options, standardized data was derived. In the VLJ survey some of the forced choice questions provided the subject a space to write an additional response that personally answers the question. Open-ended unstructured questions allow for more individualized responses, but may be difficult to interpret. They are also often hard to score, since so many different kinds of responses are received (Fraenkel & Wallen, 2002). The VLJ questions in this design format were clear and concise and were expected to take approximately 15 to 20 minutes on the average to complete.

In many interviews that utilize surveys, some participants do not respond to all of the items on the survey. This is referred to as a 'non-response' and may be caused by a

number of reasons, factors such as: lack of interest in the topic being surveyed, forgetfulness, unwillingness to be surveyed, and so on, but it is a major problem that seems to be increasing in recent years as more and more people seem (for whatever reason) to be unwilling to participate in surveys (Fraenkel & Wallen, 2002).

At the University of Tennessee in Knoxville, "…the researcher found that there was no evidence that data collected after about 50% of the sample had responded resulted in any meaningful difference in survey results" (Clark, 1995, p. 27). In this VLJ survey, because of a small size, 25 respondents, this finding may not hold true.

Specifically, the literature indicated that response rate enhancement techniques have been grouped into several general categories; "(1) motivating a response; (2) content and appearance of correspondence and (3) postage supplied. Additional research recommendations mentioned that the use of multiple contacts was the most effective way to increase response rates as well as making the questionnaires briefer and easier to complete" (Cole, 1997, p. 31).

Essentially, individuals respond to questionnaires if the perceived cost of responding (in terms of time and effort) is low relative to the perceived reward. (Dillman 1978) Hopkins and Gullickson (1992), in a meta-analysis of the effects of monetary gratuities on response rates concluded that a gratuity of one dollar could provide approximately 20% increase in returns. To that end, a new "golden" $1 coin with President Monroe picture on one side and the Statue of Liberty on the side was awarded to the respondents for their participation.

Instrument Reliability and Validity

Validity and reliability have a complicated relationship. If a test is valid it must

also be reliable. However, it is possible for a test to be reliable without being valid, that is, a test can give the same result time after time but not be measuring what it was intended to measure (Kitao, 2000). According to Dr. James Key, to determine content validity a panel of experts in the field to be studied should be used (Key, 2005).

A panel of four aviation specialists with a degree of jet knowledge and experience equal to or higher than surveyed VLJ pilots were selected, by the researcher, to review and determine the content reliability and validity of the questionnaire. This panel of aviation specialists was selected both from both government and civilian aviation communities.

Procedures for Gathering Data

1. Standardized survey briefing
2. Consent review and signature
3. Questionnaire instructions presentation
4. Administration and collection of questionnaire
5. Discussion of questions/comments with the respondents
6. Reward for participating in the study

Prior to being presented with the questionnaire, subjects were advised both verbally and in the written consent form that their responses would be anonymous. Neither the subject's name nor the company appeared on the questionnaire. The data from the open-ended questions was held on the researcher's Mac lap top computer, which is password protected. When the research project ended, April 18, 2008, all subject information was shredded and deleted and the results of the study was offered to

the respondents. The consent form and a copy of the survey can be found in the appendix.

Data Analysis Techniques & Mathematical Procedures

Nineteen closed-ended questions in the survey were used to determine if FITS and CFIT were including in the VLJ pilot's training programs. In addition, some demographic variables like age, hours of flying experience and others, were looked at in relation to selected preference variables like preferred method of training, safety features and others, to see if there were any significant relationships. The two open-ended questions were offered to allow respondents to express their answers to questions in their own words, and to indicate any qualifications they wished. The data collected for this study was used to answer the six research questions:

1. To what extent are VLJ pilots aware of the FITS program?
2. How are VLJ training programs addressing the CFIT problem?
3. How was feedback provided to the pilots for FITS/CFIT training?
4. Do VLJ pilots think it is important to have another pilot in the cockpit?
5. What type of training do VLJ pilots prefer?
6. Is there a relationship between selected variables in the VLJ study?

Graph charts were used to display frequency distribution and percentages for the 19 forced-choice questions. Survey questions 14, 15, and 16, were used to determine if the voluntary FITS and CFIT programs were incorporated into the VLJ pilot training curriculum. The two open-ended questions allowed the pilot to express his opinion on what improvement may be made in the VLJ training program. Cross tabulation was used

to measure the relationship between selected variables, such as age of the pilot, number of hours logged as a pilot, safety features in a VLJ, preferred method of learning.

Chi square (x^2), a nonparametric test of statistical significance, is appropriate when the data are in the form of frequency counts. It compares frequencies actually observed in a study with expected frequencies to see if they are significantly different. If the chi square value is equal to or greater than the table value using a level of significance of .05, reject the null hypothesis (Fraenkel & Wallen, 2003).

The *contingency coefficient* © is a nonparametric measure of correlation that tells the researcher the extent of the relationship between two sets of variables. In testing the significance of this correlation you are testing the null hypothesis, which states there is zero correlation in the population (Sharp, 1979, p. 243).

When a contingency coefficient is used, the data in the study must be discrete and categorical. In computing and determining the significance of the contingency coefficient we use the chi-square. The contingency coefficient © is very different from other measures of correlation because it does not refer to the sampling distribution of © to determine significance; instead it refers to the chi-square distribution (Fraenkel & Wallen, 2002).

TABLE I

CHI SQUARE COMPUTATION

Category	O	E	(O - E)	$(O - E)^2$	$\frac{(O - E)^2}{E}$

Symbol	Method
O	Observed frequencies in each category
E	Expected Frequencies corresponding observed frequencies
∑	Sum of
k	Number of categories
df	Degrees of freedom, (k – 1)

To obtain the contingency coefficient you must first determine chi square. Arrange the scores in a contingency table and determine the expected frequencies for each observed frequency. This data may then be used in chi square formula to find chi square. After finding chi square, one must determine significance by using the level of significance of .05. If significant, a relationship is more likely than not so the contingency coefficient © is calculated to indicate the degree of the relationship.

Contingency coefficient © is found by inserting the value of chi square into the contingency coefficient formula. Reviewing © shows the strength of the relationship between the two variables. Contingency coefficient has a minimum value of 0 and never reaches 1. If © is equal to zero there is no relationship, if © is close to its upper limits the relationship is strong (Sharp, 1979).

Limitations

The limitation of this study was the small sample population (fewer the 30). The sample was limited by the small population of pilots who were trained or who are in training to operate VLJs.

Summary

The purpose of this chapter was to outline the methods used to answer the six research questions of the study, as well as to determine if the voluntary FITS and (CFIT) were included in the pilot's VLJ training programs. In addition, some demographic variables like age, hours of flying experience and others, were looked at in relation to selected preference variables like preferred method of training, safety features and others, to see if there were any significant relationships.

The study design, population, sample determination, instrument description, and finally data gathering analysis were developed to explain how the study sought to discover the findings.

CHAPTER IV

FINDINGS

Introduction

To review, Chapter I presented the need and importance of the study, background information, the statement of the problem, and definitions of relevant terms. Chapter II provided a review of the literature that was used to identify the theoretical framework for the study. Chapter III reviewed the methodology and procedures that were used to collect and analyze the data. Now, Chapter IV categorized, integrated and summarized the pilot demographics and their responses to a set of questions about Very Light Jet (VLJ) training. This data was used to compute a Pearson chi-square, mode and contingency coefficient.

The purpose of this study was to determine if the voluntary Federal Aviation Administration Industry Training Standards (FITS) and Controlled Flight into Terrain (CFIT) were included in the pilot's VLJ training programs. In addition, some demographic variables like age, hours of flying experience and others, were looked at in relation to selected preference variables like preferred method of training, safety features and others, to see if there were any significant relationships. To collect data, an on-site survey was conducted at five different facilities to a defined population of 25 pilots, each of whom was in or had already completed VLJ training.

The survey included 19 closed-ended questions that asked pilots about whether or not FITS and CFIT were included in the VLJ pilot training programs they completed. Two open-ended questions were also provided to allow for more individualized responses. The data collected for this survey were used to answer the following six research questions:

1. To what extent are VLJ pilots aware of the FITS program?
2. How are VLJ training programs addressing the CFIT problem?
3. How was feedback provided to the pilots for FITS/CFIT training?
4. Do VLJ pilots think it is important to have another pilot in the cockpit?
5. What type of training do VLJ pilots prefer?
6. Is there a relationship between selected variables in the VLJ study?

Demographic Data and Return Percentages

In this study, on-site surveys were conducted by the researcher at: Seven Bar Aviation (Fixed Based Operator) and Embry Riddle Aeronautical University in Daytona Beach, Florida; Eclipse Aviation in Albuquerque, New Mexico; Cessna Aircraft Company and Flight Safety International in Wichita, Kansas. These selected facilities provided VLJ training and access to the target population. Each pilot was given an explanation of the survey and its importance to future VLJ training. All 25 pilots who participated in the study were willing to do so. Each pilot was presented with a consent form and assured of anonymity. The researcher offered to share the results of the study with the respondents once the findings were published. Interestingly, all of the 25 pilots with VLJ training who were interviewed were males.

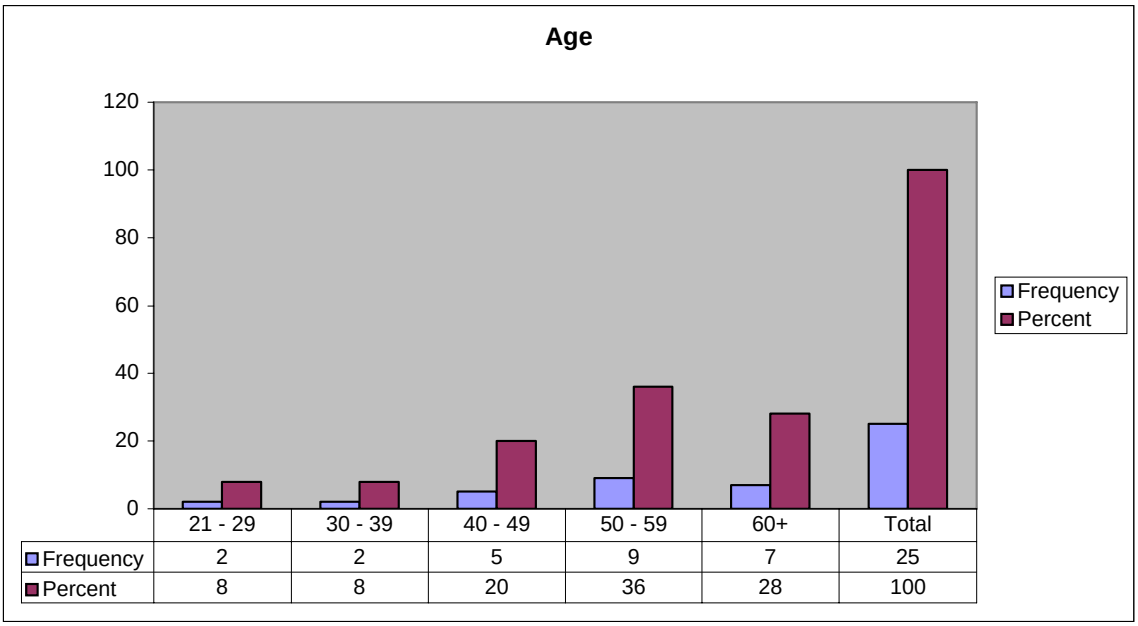
Data Summarization

The questionnaire consisted of a total of 21 questions, 19 of which were closed-ended; that is, multi-choice. The number of response alternatives varied from two to five. The last two questions were open-ended which provided the respondents the opportunity to share their thoughts on VLJ training.

Survey Question Number One

1. *Age*

☐ 1-29 ☐ 30-39 ☐ 40-49 ☐ 50-59 ☐ 60 +



	21 - 29	30 - 39	40 - 49	50 - 59	60+	Total
Frequency	2	2	5	9	7	25
Percent	8	8	20	36	28	100

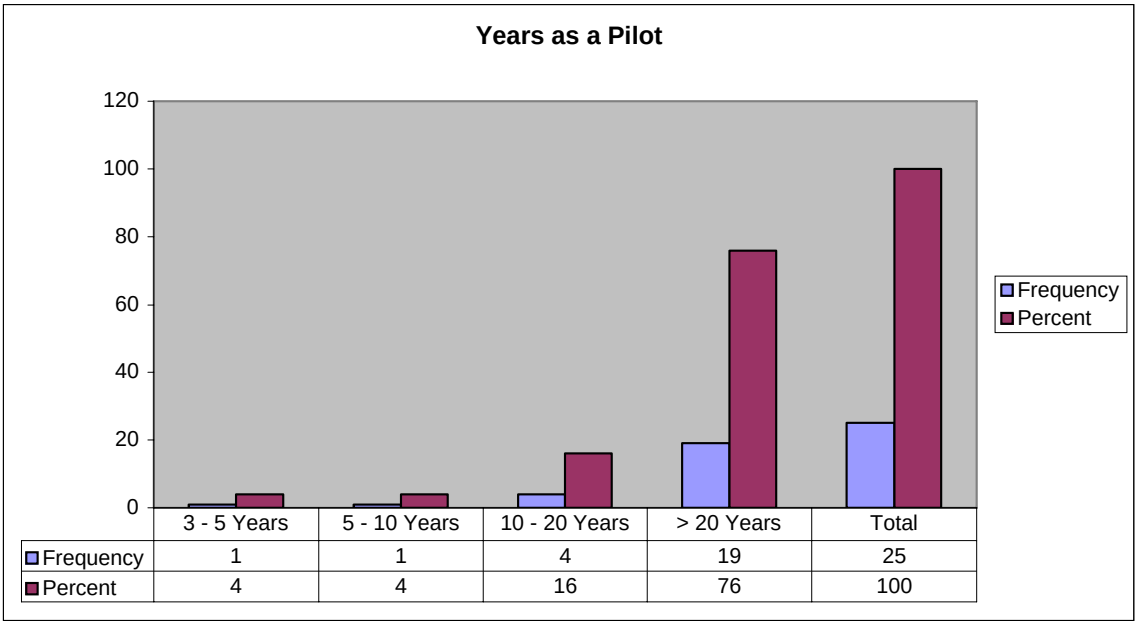
Figure 2. Graph Representing the Age of the 25 Pilots In Study.

The findings presented show that nine of the pilots (36%) were between 50 and 59 years old; a statistic that correlates well with the cadre from which the sample was drawn. Further analysis revealed a surprising 16 (64%) of all pilots sampled were over the age of 50. Five pilots (20%) were between 40 and 49, two pilots (8%) were 30 and 39, and two pilots (8%) were 21 to 29 years old. The range of pilots encompassed 21 to over 60 years old.

Survey Question Number Two

2. *How many years have you been a pilot?*

- ☐ Less than one year
- ☐ 1 to 2 years (12-24 months)
- ☐ 3 to 5 years (25 – 60 months)
- ☐ 5 to 10 years (61-120 months)
- ☐ 10 to 20 years (121-240 months)
- ☐ More than 20 years (241+ months)



	3 - 5 Years	5 - 10 Years	10 - 20 Years	> 20 Years	Total
Frequency	1	1	4	19	25
Percent	4	4	16	76	100

Figure 3. Graph Representing the Number of Years the Subject Has Been A Pilot.

The data indicated that the number of years as a pilot for this group of 25 was relatively large; 19 (76%) have been flying for over 20 years. Only six (24%) have been flying for less than 20 years. Four pilots (16%) have been flying 10 to 20 years; one pilot (4%) has been flying for five to ten years; and the remaining pilot (4%) has been flying three to five years. There were no pilots in the study who had flown for less than three years.

Survey Question Number Three

3. *Did you fly a jet aircraft prior to the Very Light Jet (VLJ)?*

☐ Yes ☐ No

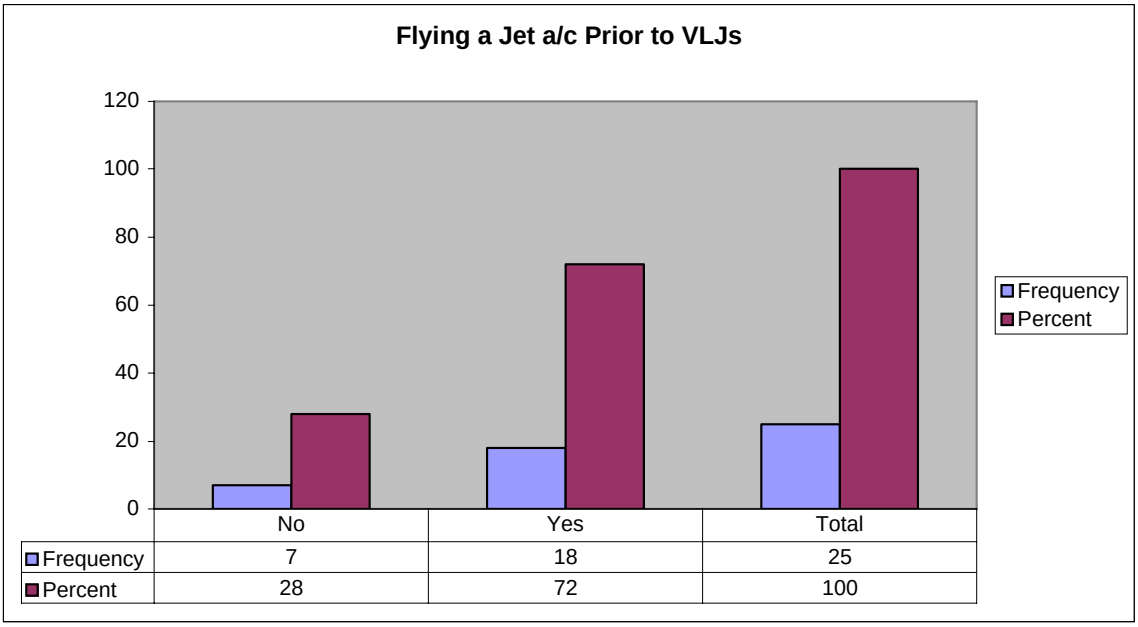


Figure 4. Graph Representing if the Pilot Flew A Jet Prior to the VLJ.

The finding presented shows that 18 (72%) of the pilots had prior jet experience. Only seven (28%) pilots had no previous jet time. Most of the pilots (64%) were over the age of 50, therefore, more likely to have had jet experience.

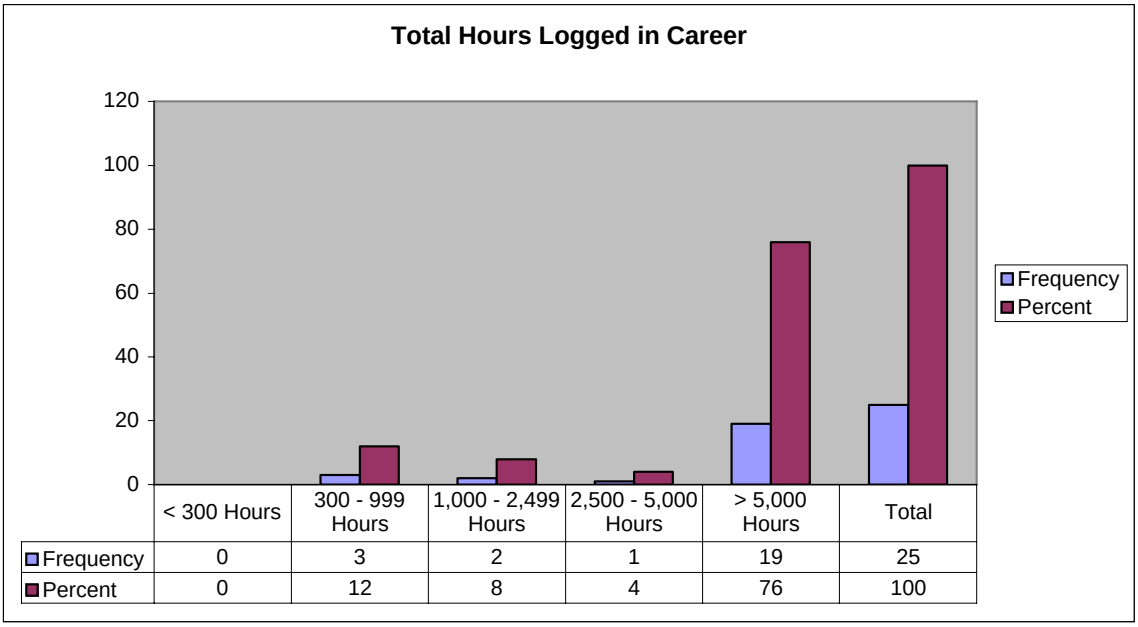
Survey Question Number Four

4. *How many hours have you logged in your flying career?*

☐ Less than 300 hours ☐ 300 to 999 hours

☐ 1,000 to 2,499 hours ☐ 2,500 to 5,000 hours

☐ More than 5, 000 hours



	< 300 Hours	300 - 999 Hours	1,000 - 2,499 Hours	2,500 - 5,000 Hours	> 5,000 Hours	Total
Frequency	0	3	2	1	19	25
Percent	0	12	8	4	76	100

Figure 5. Graph Representing the Pilot's Total Number of Hours Logged.

The facts show that 19 (76%) of the pilots logged more than 5,000 hours; one (4%) of the pilots logged 2,500 to 5,000 hours; two (8%) of the pilots logged 1,000 to 2,499 hours; and three (12%) logged 300 to 999 hours. None of the pilots had less than 300 hours.

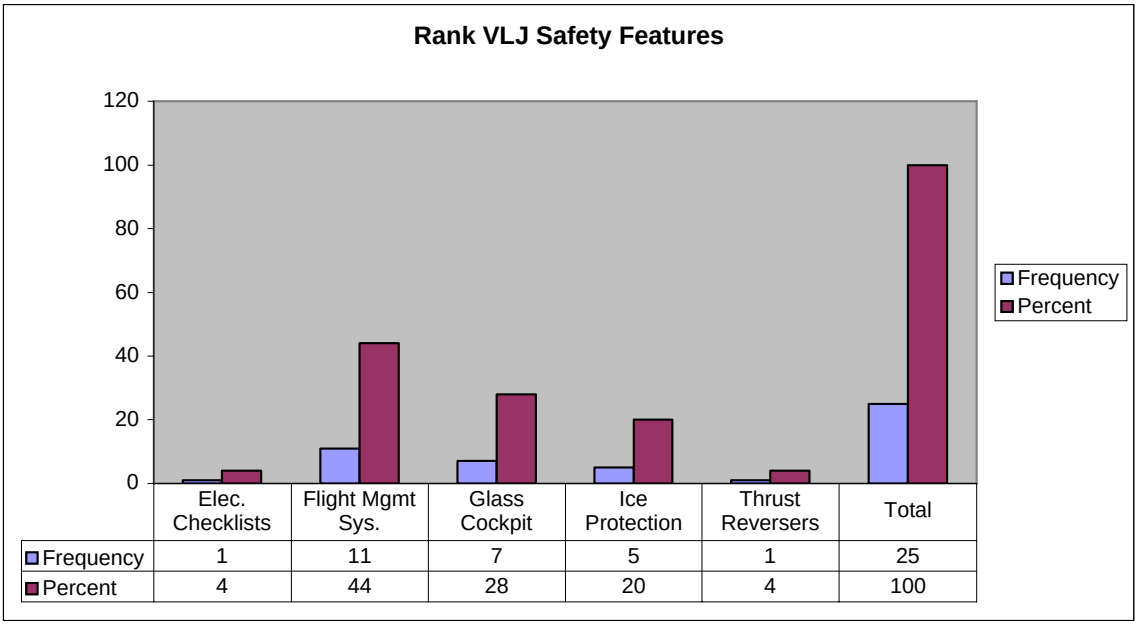
Survey Question Number Five

5. *Rank order the safety features of the VLJ with 1 being the best and 5 being the worst.*

☐ Electronic Checklists ☐ Ice Protection

☐ Flight Management System ☐ Thrust Reverses

☐ Glass Cockpit



	Elec. Checklists	Flight Mgmt Sys.	Glass Cockpit	Ice Protection	Thrust Reversers	Total
Frequency	1	11	7	5	1	25
Percent	4	44	28	20	4	100

Figure 6. Graph Representing the Pilot's Ranking of the Safety Feature in a VLJ.

The findings presented show that 11 (44%) pilots selected flight management system as their number one safety feature in a VLJ. The next preferred safety feature was the glass cockpit with seven (28%) of the pilots selecting response; five (20%) of the pilots selected ice protection; one (4%) selected thrust reversers; the remaining pilot (4%) selected the electric checklist.

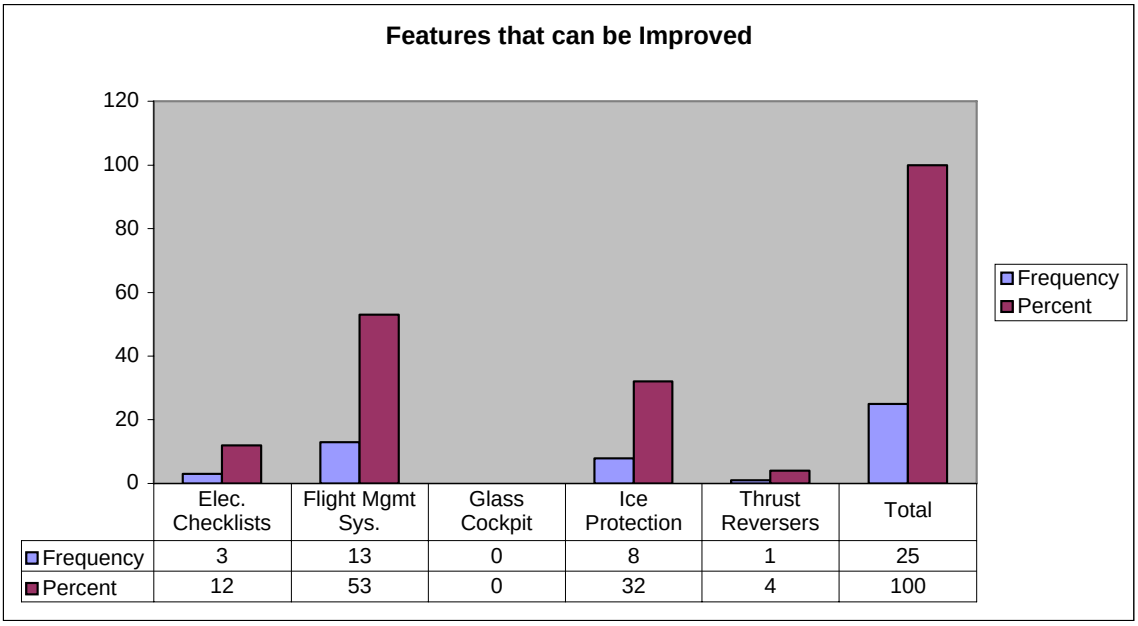
Survey Question Number Six

6. What feature could be improved upon? (Select one item)

☐ Electronic Checklists ☐ Ice Protection

☐ Flight Management System ☐ Thrust Reverses

☐ Glass Cockpit



	Elec. Checklists	Flight Mgmt Sys.	Glass Cockpit	Ice Protection	Thrust Reversers	Total
Frequency	3	13	0	8	1	25
Percent	12	53	0	32	4	100

Figure 7. Graph Representing What Feature Could be Improved Upon Most in the VLJ.

This graph indicates that 13 (52%) pilots selected the flight management system as the one feature that could be improved upon in the VLJ. Ice protection was the second most selected feature with eight (32%) making this choice. Three (12%) of the pilots selected electronic checklist and the remaining pilot (4%) selected thrust reversers. The glass cockpit was not selected by any of the pilots.

Survey Question Number Seven

7. *Are you currently flying the VLJ?*

☐ Yes ☐ No

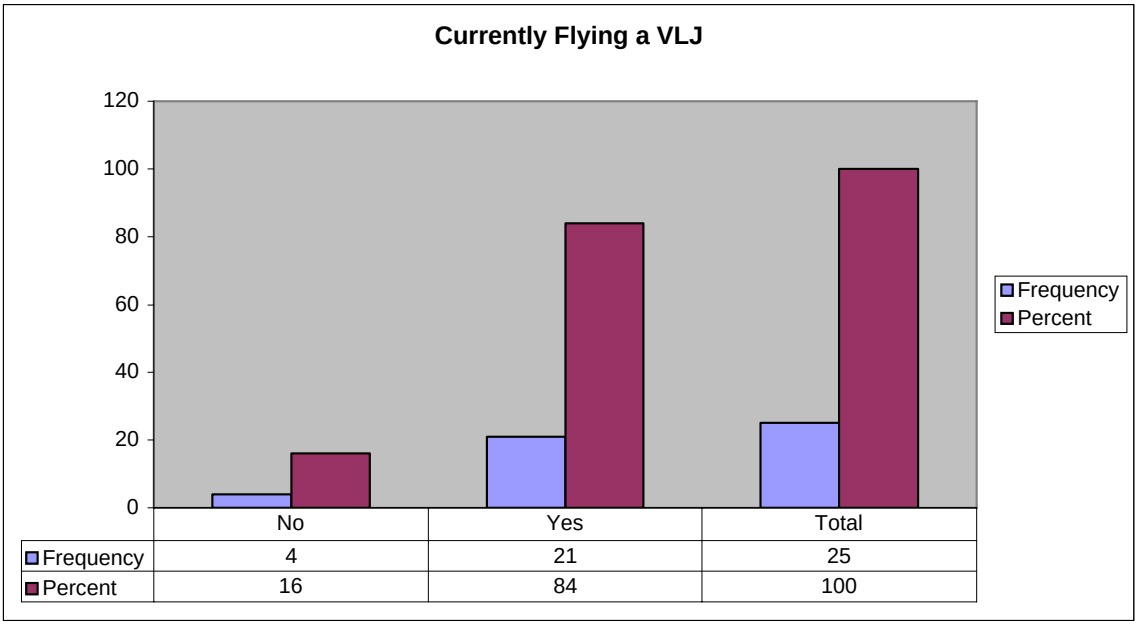


Figure 8. Graph Representing if the Pilot is Currently Flying a VLJ.

The data shows that 21 (84%) of the pilots are currently flying the VLJ. Although four pilots (16%) had VLJ training, none were currently flying the VLJ. Most of the pilots who have completed VLJ training are using their flying skills.

Survey Question Number Eight

8. *Are you flying a single or twin engine VLJ?*

☐ Single Engine ☐ Twin Engine

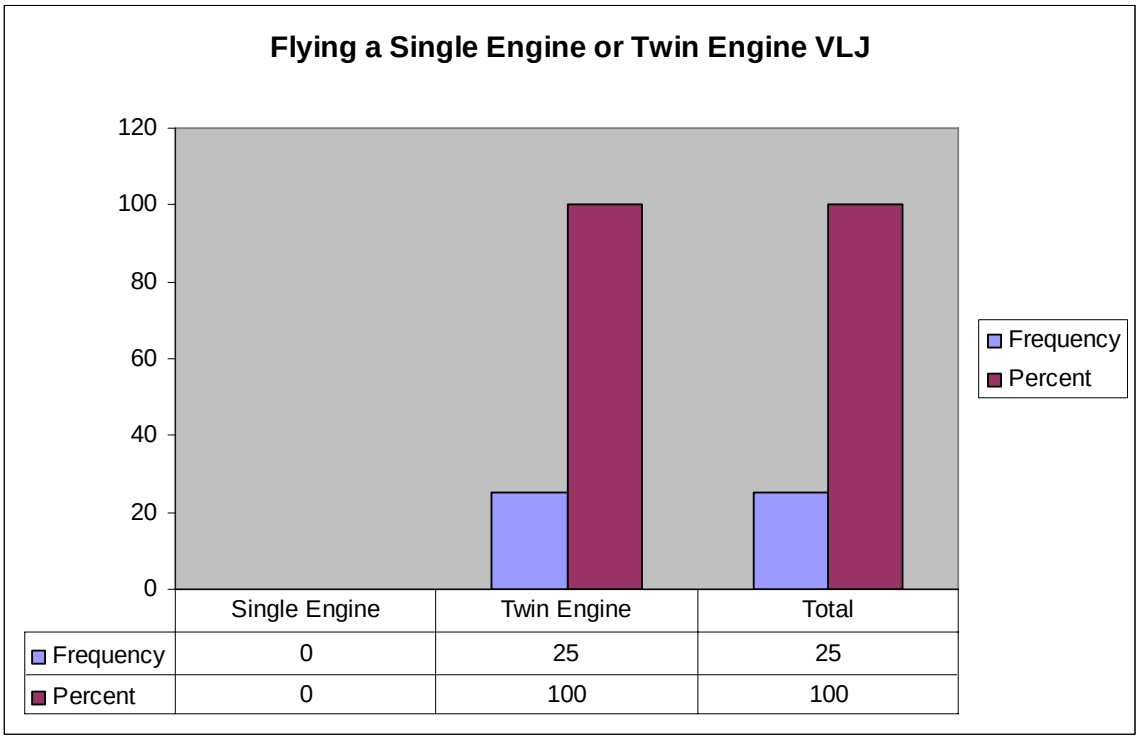


Figure 9. Graph Representing if the VLJ Pilot is Flying A Single or Twin Engine Jet.

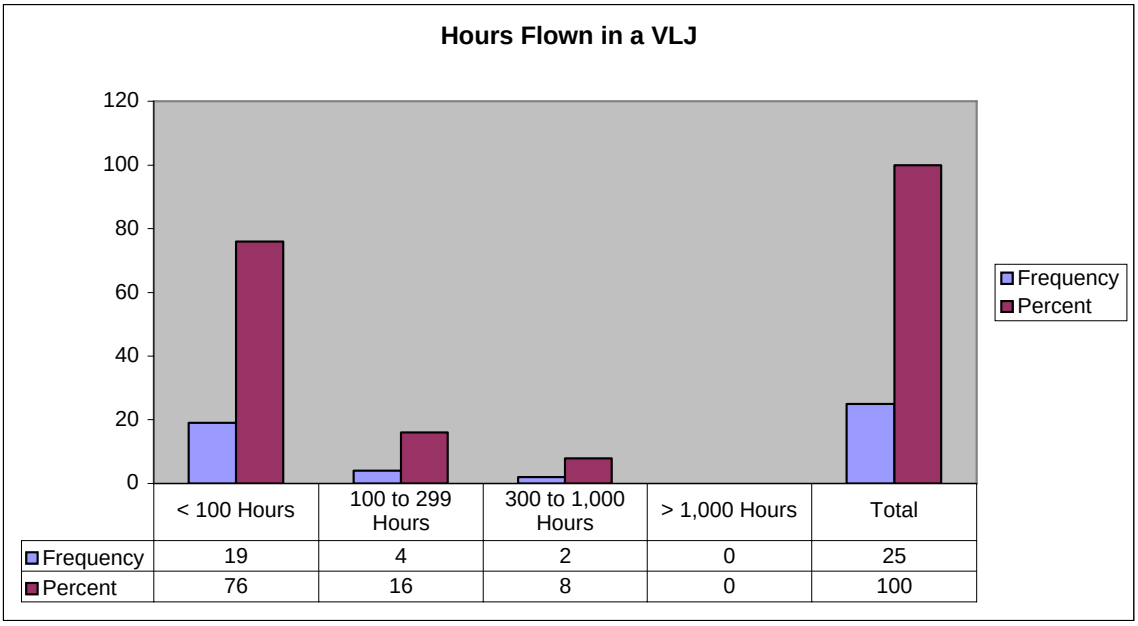
The data shows that all of the 25 (100%) pilots are flying, or have flown, a twin engine VLJ. The single engine VLJ is still classified as an experimental aircraft.

Survey Question Nine

9. *How many hours do you have in the VLJ?*

☐ Less than 100 hours ☐ 100 to 299 hours

☐ 300 to 1,000 hours ☐ More than 1,000 hours



	< 100 Hours	100 to 299 Hours	300 to 1,000 Hours	> 1,000 Hours	Total
Frequency	19	4	2	0	25
Percent	76	16	8	0	100

Figure 10. Graph Representing the Total Number of Hours Flown in A VLJ.

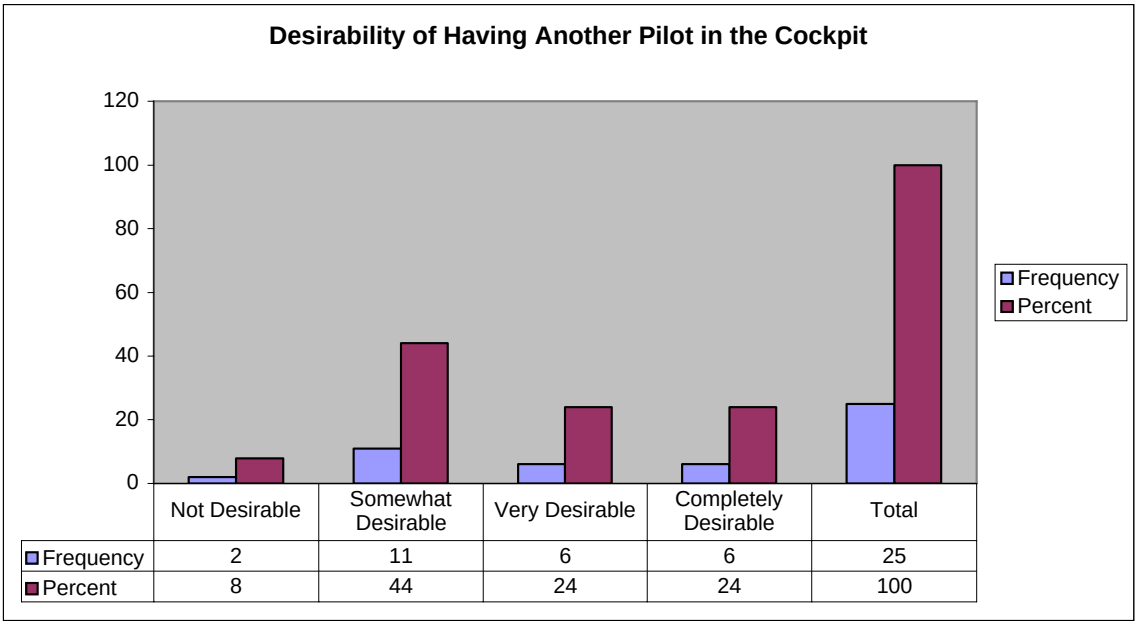
The data shows that 19 (76%) of the pilots have less than a 100 hours in a VLJ. Four (16%) pilots have between 100 to 299 hours; while only 2 (8%) pilots have between 300 to 1,000 hours. None of the pilots in this study have logged more than 1,000 hours.

Survey Question Number Ten

10. As Pilot in Command (PIC) of the VLJ, how desirable would it be to have another pilot in the cockpit?

☐ Completely desirable ☐ Very desirable

☐ Somewhat desirable ☐ Not desirable



	Not Desirable	Somewhat Desirable	Very Desirable	Completely Desirable	Total
Frequency	2	11	6	6	25
Percent	8	44	24	24	100

Figure 11. Graph representing as Pilot in Command of a VLJ how Desirable Would it be to have Another Pilot in the Cockpit.

The graph shows that 11 (44%) of the pilots selected 'somewhat desirable to have another pilot in the cockpit. Six (24%) pilots selected 'very desirable;' another 6 (24%) pilots selected 'completely desirable to have another pilot in the cockpit.' Finally, two (8%) pilots thought it was not desirable. Clearly, the majority of the pilots thought it was desirable to have another pilot present in the VLJ.

For this survey question number 10, the pilots were provided an opportunity to give further explanation. As a result, 13 (52%) of the pilots offered the following comments:

TABLE II

COMMENTS TO SURVEY QUESTION NUMBER TEN

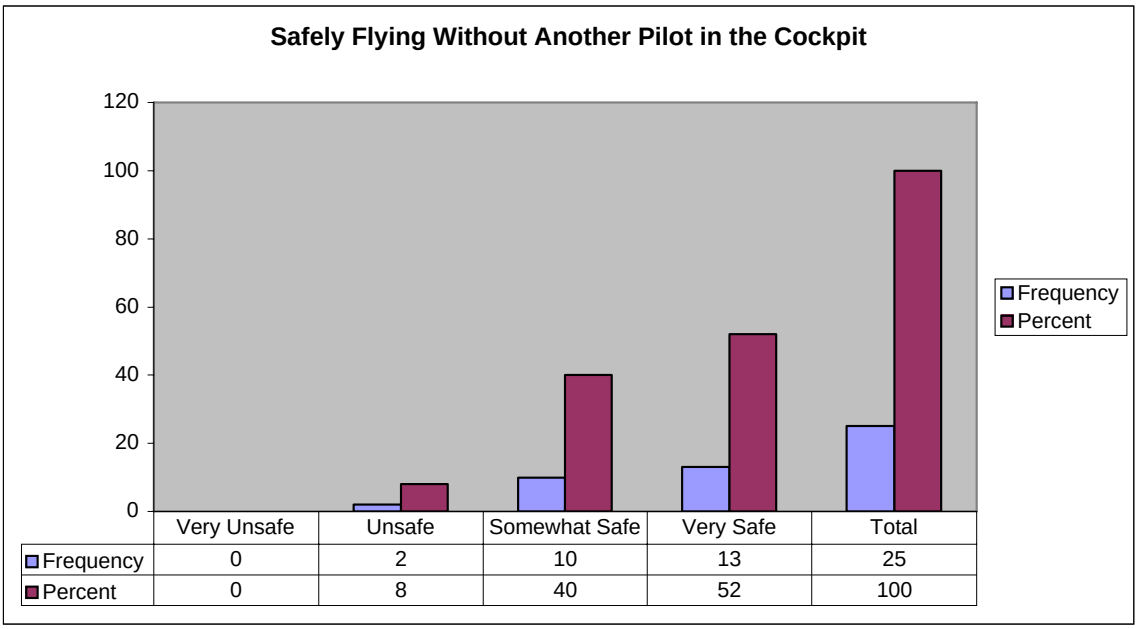
Pilot Age Range	**Prior Jet Experience**	**Currently Flying a VLJ**	**Comments**
21-29	Yes	Yes	I am only rated as a second-in-command although I have been through the initial as PIC crew, it is very desirable to have another pilot
	No	Yes	I can operate single pilot in most normal conditions, however in certain flights risks/hazards may dictate a desire to have another pilot
30-39	No	Yes	operating in a very busy airspace with poor weather or low experience in type a second pilot lend towards less stress in the cockpit
	No	Yes	it would be more safe esp. in bad weather, and unfamiliar airports
40-49	No	Yes	good to have another pilot for fatigue and other human factors
	Yes	Yes	VFR I'd rather be myself IFR, I could use the company
	Yes	Yes	In times of high workload and especially in weather it is nice to have a second set of eyes
50-59	Yes	Yes	this is a very comfortable single pilot aircraft
	Yes	Yes	Anything that reduces workload is a safety improvement
	Yes	Yes	two heads are always better than one, two pilot crew reduces the work which leads to fewer errors
	Yes	No	Depends on the type of operations/ environments the aircraft is operated in
60+	Yes	Yes	Airplane is easily flown by one… with more flying time second pilot would possibly be a hindrance
	Yes	Yes	Cuts cockpit workload in VFR conditions, a real must due to increase workload in IFR conditions, need one pilot on gauges and the other looking out low visibility
	Yes	Yes	Sharing duties in high workload situations

Survey Question Number Eleven

11. As Pilot in Command (PIC) of the VLJ, how safe is it to fly without another pilot in the cockpit?

☐ Very safe ☐ Somewhat safe

☐ Unsafe ☐ Very unsafe



	Very Unsafe	Unsafe	Somewhat Safe	Very Safe	Total
Frequency	0	2	10	13	25
Percent	0	8	40	52	100

Figure 12. The Graph Represents How Safe it is to Fly as Pilot in Command of a VLJ without Another Pilot in the Cockpit.

The chart illustrates that 13 (52%) of the pilots felt it was very safe to fly without another pilot in the cockpit. Ten (40%) felt it was somewhat safe while two (8%) thought is would be unsafe to fly without another pilot in the cockpit. None of the pilots selected very unsafe to fly as a single pilot.

For this survey question number 11, the pilots were provided an opportunity to give further explanation. Of the 25 pilots, 11 (44%) offered the following comments:

TABLE III

COMMENTS TO SURVEY QUESTION NUMBER ELEVEN

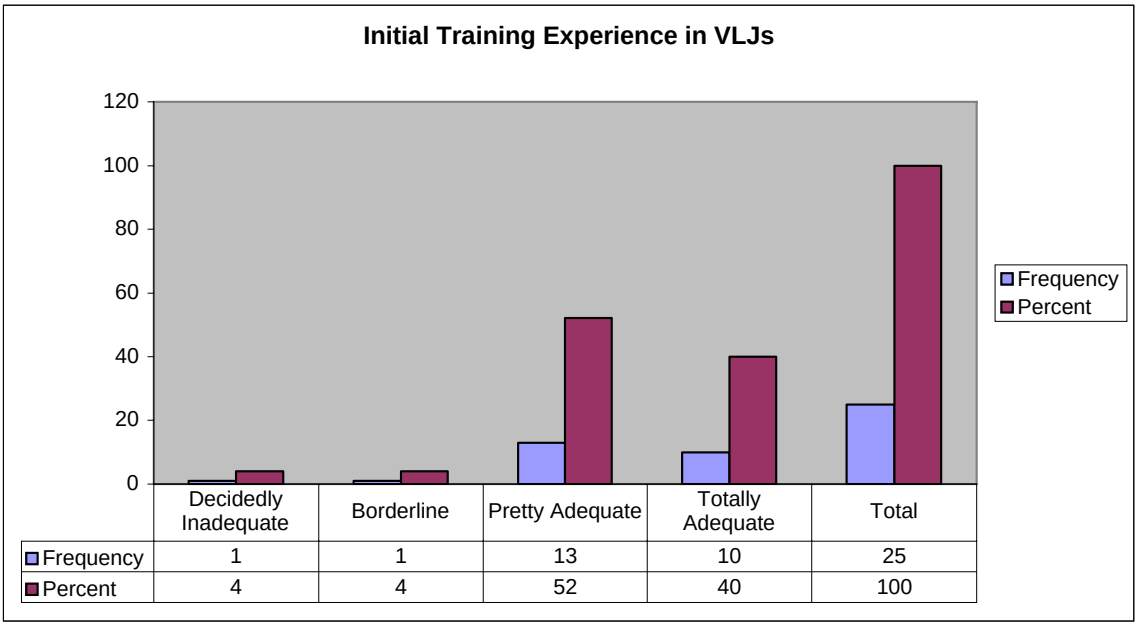
Pilot Age Range	**Prior Jet Experience**	**Currently Flying a VLJ**	**Comments**
21-29	Yes	Yes	the crew member is not required if properly rated, therefore the second pilot increases safety
	No	Yes	given good knowledge A/C systems, a properly rated and current pilot and capable aircraft
30-39			No comments
40-49	No	Yes	depends on the experience/PIC
	No	No	day VFR is acceptable level of risk, night IFR may not be
	Yes	Yes	they are a resource not a distraction
50-59	Yes	Yes	very safe if the pilot is qualified and current
	Yes	Yes	very safe as long as good risk management, automation management, and single pilot resource management is employed
	Yes	Yes	somewhat safe, kinda somewhat unsafe
	Yes	No	I am just really good
60+	Yes	Yes	Varies with conditions unsafe in IFR
	Yes	Yes	workable in normal circumstances – tough in abnormal

Survey Question Number Twelve

12. *My initial training experience in the VLJ was*:

☐ Totally adequate ☐ Pretty adequate ☐ Borderline

☐ Somewhat inadequate ☐ Decidedly inadequate



	Decidedly Inadequate	Borderline	Pretty Adequate	Totally Adequate	Total
Frequency	1	1	13	10	25
Percent	4	4	52	40	100

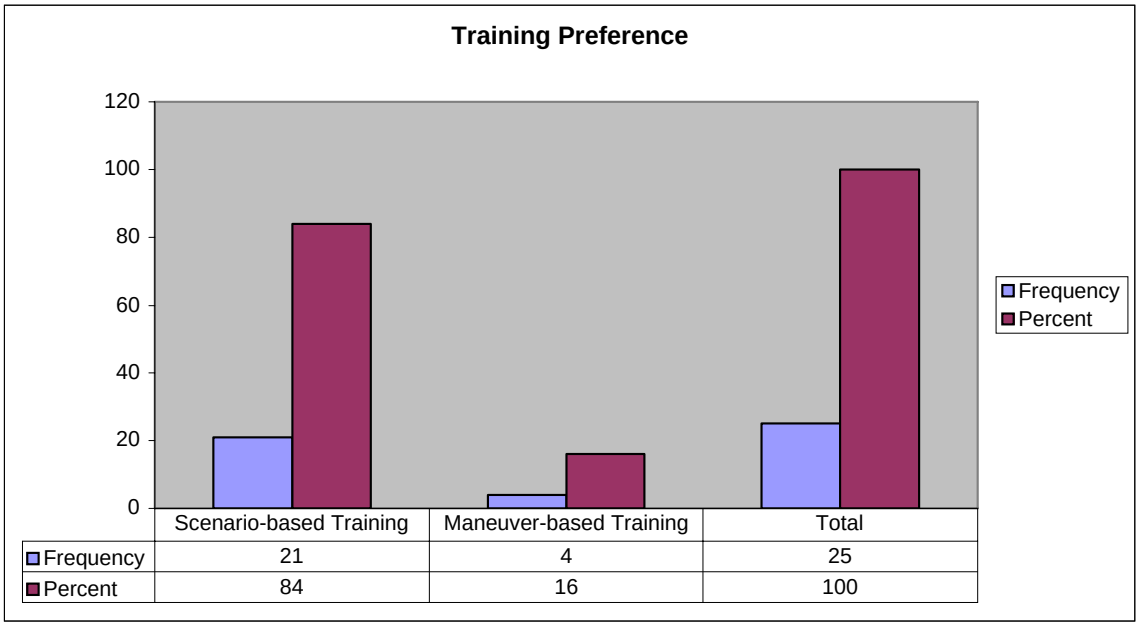
Figure 13. Graph Representing the Initial Training Experience for the VLJ Pilot.

The data shows that 13 (52%) of the pilots reported their initial training experience in the VLJ as 'pretty adequate.' Ten (49%) selected 'totally adequate;' one (4%) selected 'borderline' and the remaining pilot (4%) selected 'decidedly inadequate.' When taken together, 92% of the 25 pilots reported their training was adequate.

Survey Question Number Thirteen

13. Which training do you prefer: scenario-based training or maneuver-based training?

☐ Scenario-based training ☐ Maneuver-based training



	Scenario-based Training	Maneuver-based Training	Total
Frequency	21	4	25
Percent	84	16	100

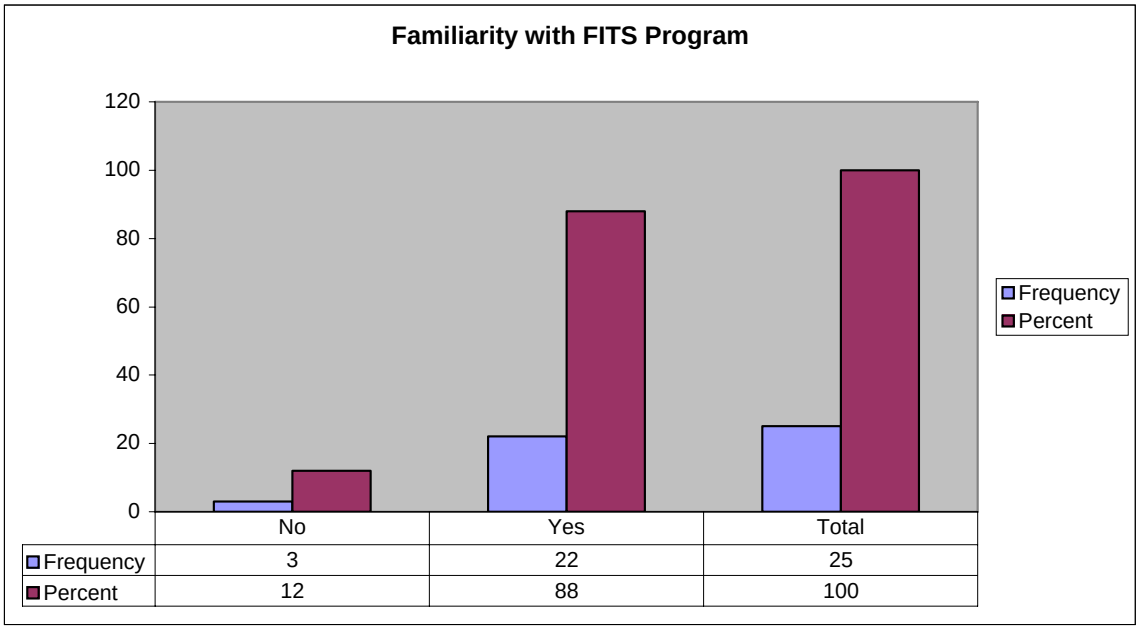
Figure 14. Graph Representing the VLJ Pilot's Training Preference.

The graph indicates that 21 (84%) of the pilots preferred scenario-based training. The remaining four (16%) pilots selected maneuver-based training as their preference. Scenario-based training is consistent with the concept of training the way you fly and flying the way you train.

Survey Question Number Fourteen

14. Are you familiar with the voluntary Federal Aviation Administration Industry Training (FITS) program?

☐ Yes ☐ No



	No	Yes	Total
Frequency	3	22	25
Percent	12	88	100

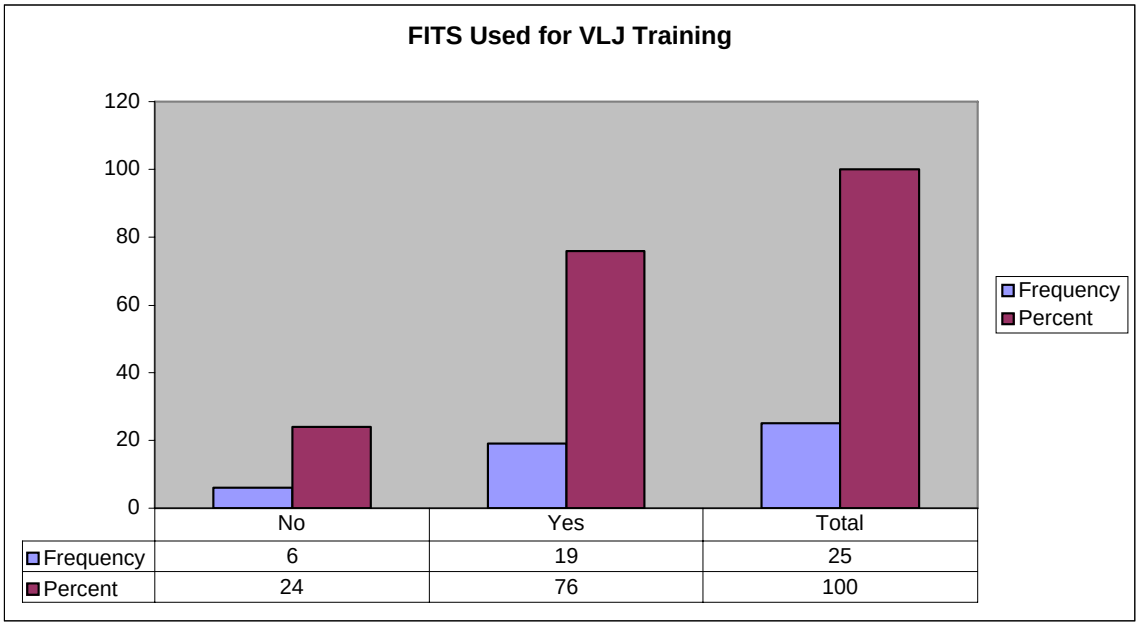
Figure 15. Graph Representing the Pilot's Familiarity with the FITS Program.

When asked about their familiarity with the FITS program, the graph shows that 22 (88%) of the pilots reported that they were familiar with it. Only three (12%) reported that they were not familiar with the FITS program. The voluntary FITS program has gained wide acceptance in the aviation industry.

Survey Question Number Fifteen

15. Was the FITS program used in your VLJ training?

☐ Yes ☐ No



	No	Yes	Total
Frequency	6	19	25
Percent	24	76	100

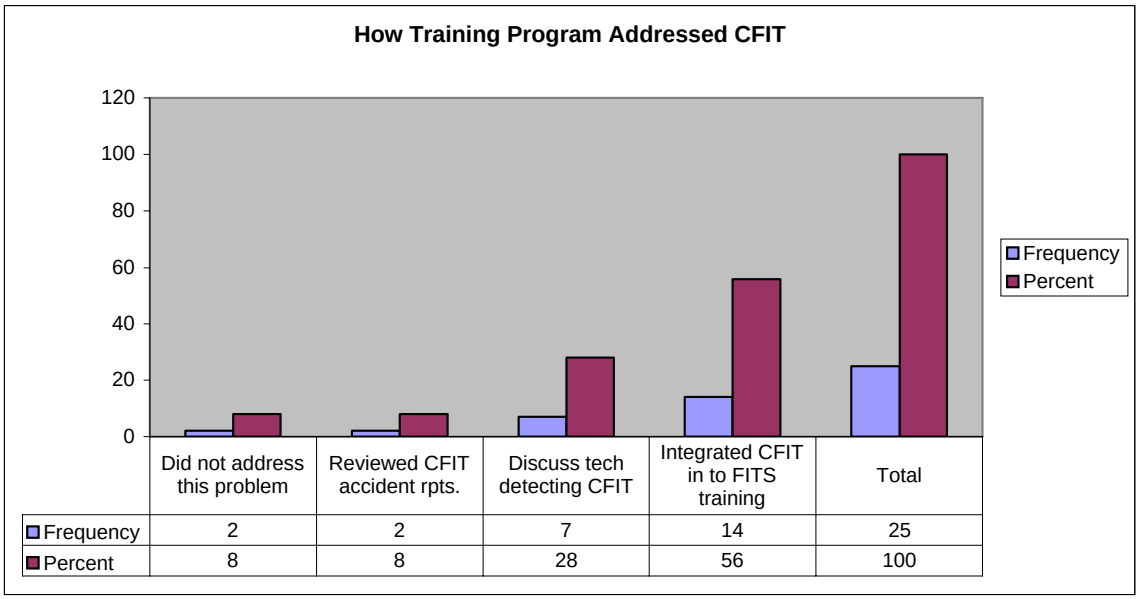
Figure 16. Graph Representing if the FITS Program was Used in the VLJ Pilot Training.

The graph shows that (76%) of the pilots reported that the FITS program was used in their VLJ training. While only six (24%) reported that it was not used. FITS is a voluntary program, not mandated by FAA regulations.

Survey Question Number Sixteen

16. During the time period of 1995 to 2005, Controlled Flight into Terrain (CFIT) was one of the leading causes of accidents in the business jets. How did your training program address the CFIT problem?

- ☐ We did not address this problem
- ☐ We integrated the CFIT program into our FITS training
- ☐ We discussed and demonstrated the aircraft technology in detecting CFIT situations
- ☐ We reviewed CFIT accident/incident reports



	Did not address this problem	Reviewed CFIT accident rpts.	Discuss tech detecting CFIT	Integrated CFIT in to FITS training	Total
Frequency	2	2	7	14	25
Percent	8	8	28	56	100

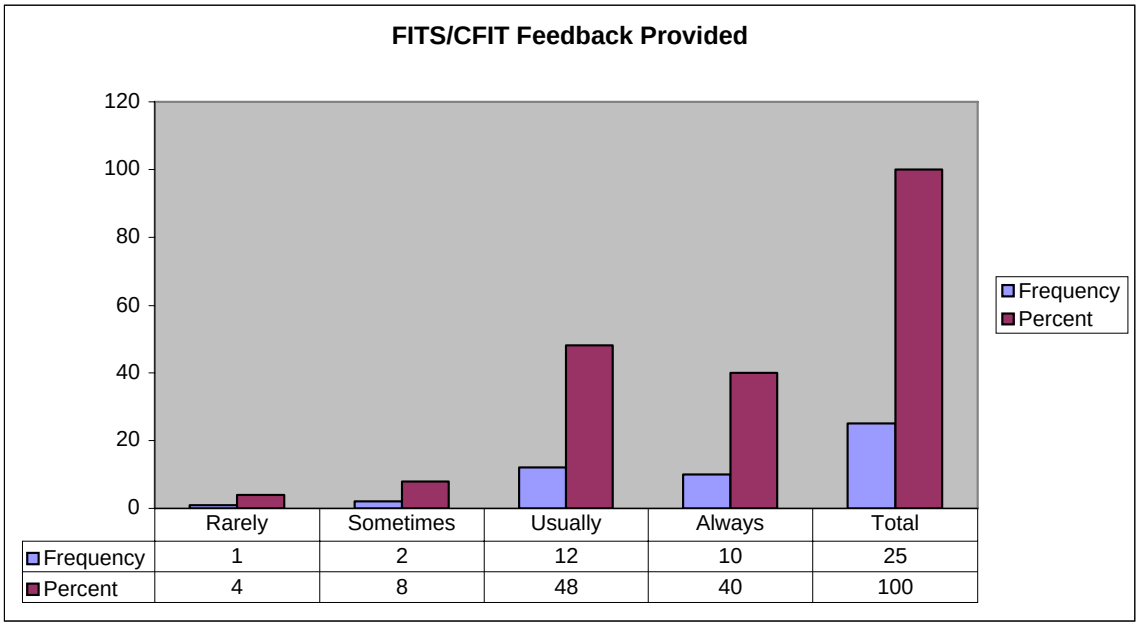
Figure 17. Graph Representing How the VLJ Training Program Addressed CFIT.

The data shows that 14 (56%) of the pilots reported that their training program had integrated CFIT into FITS training. Seven (28%) pilots indicated that their training program discussed and demonstrated aircraft technology into detecting CFIT situations. Two (8%) of the pilots reported that the VLJ training program they completed had reviewed CFIT accident/incident reports. The remaining two (8%) pilots noted that their VLJ training programs did not address this problem.

Survey Question Number Seventeen

17. During your FITS/CFIT training, was feedback provided?

☐ Always ☐ Usually ☐ Sometimes ☐ Rarely



	Rarely	Sometimes	Usually	Always	Total
Frequency	1	2	12	10	25
Percent	4	8	48	40	100

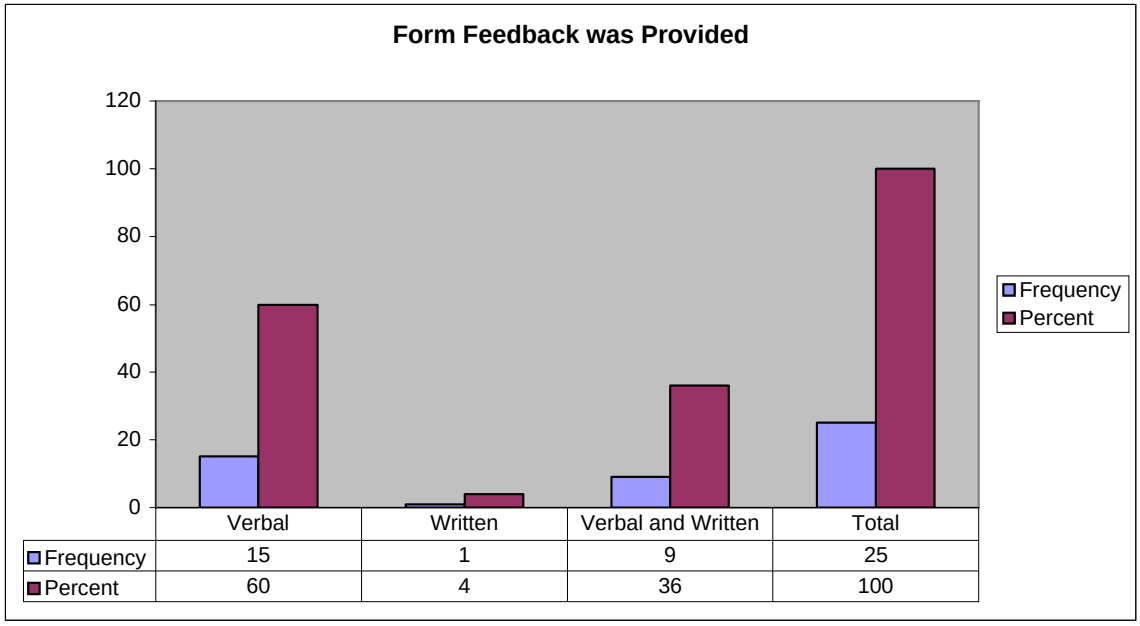
Figure 18. Graph Represents How FITS/CFIT Feedback was Provided to the VLJ Pilot.

The graph shows 12 (48%) of the pilots reported that they were usually provided with feedback during their FITS/CFIT training. An additional ten (40%) of the pilots reported that feedback was always provided; two (8%) reported that it was only provided sometimes; while one (4%) pilot reported that feedback was rarely provided during FITS/CFIT training.

Survey Question Number Eighteen

18. In what form was feedback provided?

☐ Verbal ☐ Written ☐ Verbal and written



	Verbal	Written	Verbal and Written	Total
Frequency	15	1	9	25
Percent	60	4	36	100

Figure 19. Graph Represents in What Form Feedback was Provided to the Pilots.

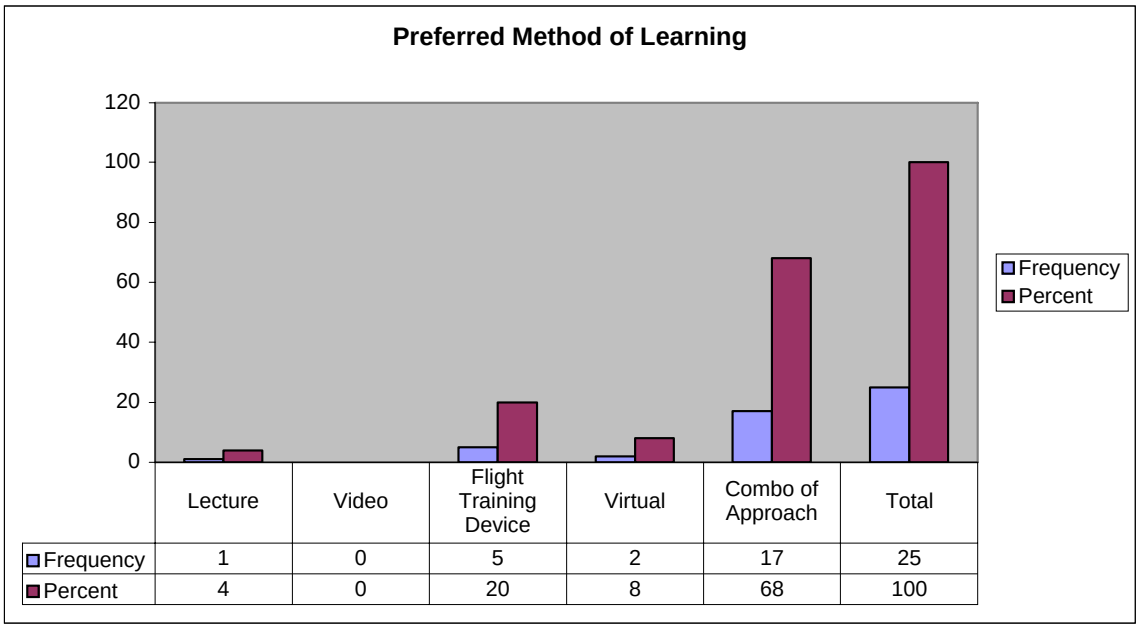
The data shows that 15 (60%) pilots reported that verbal feedback was provided during their FITS/CFIT training. While nine (36%) pilots reported receiving both verbal and written feedback, only one pilot (4%) reported only written feedback was provided on the FITS/CFIT training. All 25 pilots (100%) reported receiving some form of feedback during the FITS/CFIT training.

Survey Question Number Nineteen

19. What is your preferred method of learning?

☐ Lectures ☐ Videos ☐ Flight Training Device

☐ Virtual ☐ Combination of approaches



	Lecture	Video	Flight Training Device	Virtual	Combo of Approach	Total
Frequency	1	0	5	2	17	25
Percent	4	0	20	8	68	100

Figure 20. Graph Represents the VLJ Pilot's Preferred Method of Learning.

When asked about their preferred method of learning, the data shows that the majority of pilots, 17 (68%) selected a 'combination of approaches' as their preferred method of learning. Five (20%) pilots chose 'flight training device;' two (8%) chose 'virtual,' and the remaining pilot (4%) selected 'lectures.' Clearly, pilots' preferences vary.

Survey Question Number Twenty

20. *How could your VLJ training be improved?*

Of the 25 pilots, 19 (76%) provided responses on how their VLJ training could be improved. The VLJ pilots indicated that a wide range of training improvements would be beneficial. The pilots' responses to survey question 20 were reviewed to determine whether common themes emerged. Those that were similar in content were combined and six categories were identified: 1) More simulator time, 2) Scenarios, 3) Mentoring pilots, 4) Maneuver-Based, 5) Automation, and 6) Other.

TABLE IV

PILOT SUGGESTED IMPROVEMENTS TO VLJ TRAINING

Category	**Comments**
More Simulator Time	More sim time and cockpit CPT Flight simulation every day. More sim time, with high altitude mal-functions Line-orientated flight training (LOFT) scenario with abnormal situations More time in the sims… VLJ should implement a voluntary system of initial operating experience, like used in the airlines, new VLJ pilots should voluntary fly with a check airman for their 50 hours in the VLJ More training time FAA scenarios to better reflect scenarios-risk management being used in the VLJ training industry School half, sim based training half More sim time for low time pilots lacking jet experience
Scenarios	More graded scenarios, Line orientated flight training (LOFT) scenario with abnormal situations Scenario based in sim not flight training device
Mentor Pilot	More standardized instructors & mentors Mentor pilot utilization soon after training
Maneuvers Based	ATP and type rating practical test standards are the same, have to spend more of the training time on maneuvers-based training. Scenario based training does not get pilots through the check ride, although it is necessary for higher-order skills Current PTS is too maneuver bound. More rapid FAA modification of practical test standards (PTS) to reflect performance of tasks, such as risk management

TABLE IV (Continued)

Category	Comments
Automation	Management and crew resource Management.
Others	Self paced CBI supplement to ground school with tough sensitive screen saving device More in depth system training

Survey Question Number Twenty-One

21. *What additional comments or observations would you like to make?*

A small number of pilots responded to this question. Only five (20%) of the pilots made additional comments on their training.

TABLE V

PILOT RESPONSES TO SURVEY QUESTION NUMBER TWENTY ONE

Category	Comments
Training	VLJ safety could be improved immensely with frequent recurrent training…at best annually… more often if this pilot is not flying regularly This training is essential for single pilot PIC in turbo jet aircraft Emphasis on recurrent Pre-study is an absolute must prior to beginning training, interactive Computer Base training with systems knowledge and procedures would be very desirable Sit in lecture hall is dead, remedial training may be good

The survey included 19 closed-ended questions and two open-ended questions to allow for more individual more individualized responses. The data collected for this survey was used to answer the six research questions.

Research Question Number One

1. *To what extent are VLJ pilots aware of the FITS program?*

To answer to research question number one, data was collected from survey question number 14. Are you familiar with the voluntary FITS program?.

The data showed that 88% of the pilots who participated in this survey were aware of the FITS program. Only three (12%) reported that they were not familiar with the FITS

program. The voluntary FITS program has gained wide acceptance in the aviation industry.

Research Question Number Two

2. How are VLJ training programs addressing the CFIT problem?

To answer to research question number two, data was collected from survey question number 16. How did your training program address the CFIT problem?

The finding s revealed that 92% of the VLJ training programs are addressing the CFIT problem either through integrating it into their FITS training, discussions and demonstrations of aircraft technology in the detection of CFIT situations, or by reviewing CFIT accident/incident reports. The remaining two (8%) pilots noted that their VLJ programs did not address this problem.

Research Question Number Three

3. How was feedback provided to the pilots for FITS/CFIT training?

To answer to research question number three, data was collected from survey question number 18. In what form was feedback provided?

The data showed that verbal or verbal coupled with written feedback were the most frequently cited approaches to providing pilots with feedback on FITS/CFITS training. All 25 pilots (100%) reported receiving some form of feedback for the FITS/CFIT training.

Research Question Number Four

4. Do VLJ pilots think it is important to have another pilot in the cockpit?

To answer research question number four, data was collected from survey questions number 10 and 11.

Question number 10 As Pilot in Command (PIC) of the VLJ, how desirable would it be to have another pilot in the cockpit?

Question number 11 As Pilot in Command (PIC) of the VLJ, how safe is it to fly without another pilot in the cockpit?

The data revealed that 92% of the pilots thought it was desirable to have another pilot in the cockpit especially during off-normal situations (e.g., bad weather, fatigue). Surprisingly, only 8% thought it was unsafe to fly without another pilot in the cockpit. A review of their comments provides suggests that piloting skill was a key factor. Flying solo is "very safe as long as good risk management, automation management, and single pilot resource management is employed."

Research Question Number Five

5. What type of training do VLJ pilots prefer?

To answer to research question number five, data was collected from survey question number 19. What is your preferred method of learning?

The pilots' responses showed that they preferred a combination of approaches and flight training devices over that of videos, lectures, and virtual.

Research Question Number Six

6. Is there a relationship between selected variables in the VLJ study?

In this study cross tabulation, often abbreviated as cross tab, was used to measure the relationship between selected variables. Cross tabulation displays the joint distribution of two or more variables, and is presented as a contingency table in matrix format.

The Pearson chi-square, also known as chi-square, test was used to determine whether there was a significant difference between the expected frequencies and the observed frequencies in one or more categories.

TABLE VI

CROSS TABULATION CASES

Case One	**Answers** **F = Frequency P = Percent**
Variable one: How many years have you been a pilot?	1. Less than one year 2. 1 to 2 years 3. 3 to 5 years (F-1, P-4) 4. 5 to 10 years (F-1, P- 4) 5. 10 to 20 years (F-4, P-16) 6. More than 20 years (F-19, P-76)
Variable two: Rank in order the safety features of the VLJ with 1 being the best and 5 being the worst.	1. Electronic Checklists (F-1, P-4) 2. Flight Management System (F-11, P-44) 3. Glass Cockpit (F-7, P-28) 4. Ice Protection (F-5, P-20) 5. Thrust Reverses (F-1, P-4)
Findings	A Pearson Chi Square Value of 4.1, with df=12, and a Contingency Coefficient Value of .377 indicates that there is no relationship between the variables, that is, number of years of being a pilot and raking of safety features of the VLJ.
Case Two	**Answers**
Variable one: How many years have you been a pilot?	1. Less than one year 2. 1 to 2 years 3. 3 to 5 years (F-1, P-4) 4. 5 to 10 years (F-1, P-4) 5. 10 to 20 years (F-4, P-16) 6. More than 20 years (F-19, P-76)

TABLE V (Continued)

Variable two: Which training do You prefer, scenario-based or maneuver-based training?	1. Scenario-based training (F-21, P-84) 2. Maneuver-based training (F-4, P16)
Findings	A Pearson Chi Square Value of 1.50 with df=3, and Contingency Coefficient Value of .238 indicates that there is no relationship between the variables, that is, number of years being a pilot and which type of training preferred.
Case Three	**Answers**
Variable one: What is your age?	1. 21-29 years (F-2, P-8) 2. 30-39 years (F-2, P-8) 3. 40-49 years (F-5, P-20) 4. 50-59 years (F-9, P-36) 5. 60 + years (F-7, P-28)
Variable two: As Pilot in Command of the VLJ, how safe is it to fly without another pilot?	1. Very Safe (F-13, P-52) 2. Unsafe (F-2, P-8) 3. Somewhat Safe (F-10, P-40) 4. Very Unsafe (None)
Findings	A Pearson Chi Square Value of 8.4 and df=8, and Contingency Coefficient Value of .52 indicates that there is no relationship between the variables, that is, the age of the pilot and in his opinion that it is safe to fly without a second pilot would be desirable.
Case Four	**Answers**
Variable one: What is your age?	1. 21-29 years (F-2, P-8) 2. 30-39 years (F-2, P-8) 3. 40-49 years (F-5, P-20) 4. 50-59 years (F-9, P-36) 5. 60 + years (F-7, P-28)
Variable two: What is your preferred method of learning?	1. Lectures (F-1, P-4) 2. Videos (None) 3. Flight Training Device (F-5, P-20) 4. Virtual (F-2, P-8) 5. Combination of Approaches (F-17, P-68)
Findings	A Pearson Chi Square Value of 18.08 with a df=12, and Contingency Coefficient Value of .648 indicates that there is no relationship between the variables, that is, the age of the pilot and his preferred method of learning.

TABLE V (Continued)

Case Five	**Answers**
Variable one: What is your age?	1. 21-29 years (F-2, P-8) 2. 30-39 years (F-2, P-8) 3. 40-49 years (F-5, P-20) 4. 50-59 years (F-9, P-36) 5. 60 + years (F-7, P-28)
Variable two: Did you fly a jet prior to the VLJ?	1. Yes (F-18, P-72) 2. No (F-7, P-28)
Findings	A Pearson Chi Square Value of 6.3, with df=4, and Contingency Coefficient Value of .451 indicates that there is no relationship between the variables, that is, the age of the pilot and whether or not he had prior jet time.

CHAPTER V

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

Introduction

The purpose of this study was to determine if the voluntary Federal Aviation Administration Industry Training Standards (FITS) and Controlled Flight into Terrain (CFIT) were included in the pilot's Very Light Jet (VLJ) training programs. In addition, some demographic variables like age, hours of flying experience and others, were looked at in relation to selected preference variables like preferred method of training, safety features and others, to see if there were any significant relationships. To collect data, an on-site survey was conducted at five different aviation facilities to a defined population of 25 pilots, each of whom was in or had already completed VLJ training.

This study examined VLJ pilot training programs to enhance safe and efficient operation of this new category of aircraft.

A questionnaire, composed of nineteen closed-ended and two open-ended questions, was provided to the pilots to answer six research questions.

The Study Sought to Answer Six Research Questions

1. To what extent are VLJ pilots aware of the FITS program?
2. How are VLJ training programs addressing the CFIT problem?
3. How was feedback provided to the pilots for FITS/CFIT training?
4. Do VLJ pilots think it is important to have another pilot in the cockpit?
5. What type of training do VLJ pilots prefer?
6. Is there a relationship between selected variables in the VLJ study?

To be included in this study, the pilot must have had VLJ training. A VLJ is considered to be either a single or a twin-engine jet aircraft weighing 10,000 pounds or less, and approved for single-pilot operation. The questionnaire was given to 25 pilots at five different aviation facilities. This forum was selected to provide familiar surroundings so that the pilots would feel more comfortable in completing the questionnaire.

Summary

The FITS Program is a voluntary joint project of the FAA sponsored Center of Excellence (COE) for General Aviation Research (CGAR), Embry Riddle Aeronautical University, University of North Dakota, and General Aviation Industry. Their mission is to ensure that pilots learn to safely, competently, and efficiently operate a technically advanced piston or light jet aircraft in the modern National Airspace System.

The voluntary FITS program is a new approach to training pilots. It is scenario based rather than maneuver based and structured to emphasize development of critical thinking and flight management skills. The goal of this new training philosophy is

accelerated acquisition of the higher level decision-making skills necessary to prevent pilot error/possible accidents in technically advanced aircraft. Programs such as this will force the trainee pilot to focus on the decision process, which accelerates acquisition of judgment. Judgment, after all, is simply the decision-making process, which is learned primarily from experience. It is not innate. All life experiences mold the judgment tendencies brought into flight situations. By artificially injecting decision opportunities into routine training lessons, we accelerate the acquisition of experience, and thus enhance judgment and decision-making (FAA Aeronautical Decision Making, 1991).

By examining the preferences of how pilots learn best, aviation training authorities will be able to evaluate and manage the strengths and weakness of the curriculum (G.E. Russell, personal communication, January 3, 2008).

Problem

The introduction of the VLJ to the aviation community revealed a need to proactively address risks and anticipate potential safety problems. Most owner-pilots holding orders for VLJs are new to the performance envelope of these aircraft, and may lack jet experience. How owner-pilots adapt to the VLJs also affects the commercial viability of such aircraft for sky-cabs and charter companies. Regardless, of the owner-pilots' qualifications, prolific incidents and accidents involving VLJs will discourage the public interest in using this type of aircraft for transportation.

One way to enhance VLJ safety may be to utilize the FITS training program and incorporate CFIT into that program to prevent incidents/accidents. This study was a method of gaining insight into the VLJ pilot's training.

Conclusion

It has been said that in the absence of a well-defined, measurable, ultimate criterion (that rarely exists in the real world), it is important to assess training at multiple a level for each additional source of data serves to increase confidence in the overall evaluation (Cannon-Bowers et al., 1989). This study examined VLJ pilot training programs to enhance safe and efficient operation of this new category of aircraft.

The primary purpose of this study was to determine if the voluntary FITS and CFIT programs were included in the pilot's VLJ training programs. Data collected from survey questions 14, 15, and 16, was used to make this determination.

Survey Question Fourteen

Are you familiar with the FITS program?

Of the 25 pilots, an over whelming number, 22 (88%) reported 'yes' they were familiar with the FITS program. The age range of the pilots was from 21 to over 60 years, with 16 (64%) over the age of 50. Most likely these pilots were instructed utilizing the maneuver-based techniques, the only method available at that time. So for these pilots to accept the FITS philosophy represents a major paradigm shift in their thinking. The FITS standards are based on quality of instruction rather than quantity (proficiency based rather than hour based). The FITS program was established to address the need for targeted training on technically advanced aircraft (TAA), which would include the VLJs.

Survey Question Fifteen

Was the FITS program used in your VLJ training?

The FITS program was used in 19 (76%) of the pilots training programs. Although FITS, is scenario based rather than maneuver based training, 21 (84%) of the pilots preferred this method. In survey question number 20, one of the open-ended questions, asked the VLJ pilot, "how could your VLJ training be improved?" Additional scenario based training was the response of 8 (32%) of the pilots.

The VLJ training centers understand the need to provide training that goes beyond the technical aspects of handling the aircraft, and passing the Airline transport Pilot (ATP) and Aircraft Type Rating Practical Test Standards. The FITS program includes the concepts of single pilot resource management, line-oriented flight training (LOFT), and risk management. These simulated "real world flying" exercises allow the VLJ pilot to practice their decision-making abilities and to correctly utilize the flight management system.

Survey Question Sixteen

How did your training program address the CFIT problem?

CFIT has been the one of the leading causes of accidents/incidents in business jets. It may be inferred that the same will hold true for the VLJ, due the similarities they have such as: speed, weight, and function. Business aircraft are often operated at airports that lack the safety equipment common to airports that serve scheduled commercial aircraft. Overall, 23 (92%) of the pilots were exposed to the CFIT concepts during their VLJ

training. With the awareness of CFIT programs and the proper management of the technically advanced avionics, glass cockpit display, and global positioning devices the safety records of general aviation may be improved.

The following findings answer the question, "were FITS and CFIT included in the VLJ training programs?" Of the 25 VLJ pilots who responded to the questionnaire 22 (88%) reported that they were familiar with FITS; and 19 (76%) reported that the FITS program was used during their VLJ training. CFIT awareness and integration into their training program was reported by 23 (92%) of the pilots. With the findings obtained in survey questions 14, 15, and 16, it may be concluded that FITS and CFIT were included in the VLJ pilot training programs.

Research Question Number One

To what extent are VLJ pilots aware of the FITS program?

Awareness of the FITS program was reported by 22 (88%) of the pilots stating that they were aware of the FITS program. While only three (12%) of the pilots said they were *not* aware of the program. The findings represent a paradigm shift; traditionally pilot training was maneuver-based using "round dials" in the cockpit for reference. The new generation aircraft, VLJ, have the technically advanced avionics, with moving map display, and digital readouts. In scenarios-based training system safety is applied from preflight to engine shutdown. In open-ended survey question number 20, "how could your VLJ training be improved?" Five (20%) of the pilots requested additional scenario based training.

Overall, the data clearly indicated that there was awareness of the FITS program, in answer to this research question.

Research Question Number Two

How are VLJ training programs addressing the CFIT problem?

Of the 25 pilots, 23 (92%) responded that CFIT was addressed to some extent during their VLJ training. Their responses varied from total integration of CFIT program into their scenario-based training; discussion and demonstration of aircraft technology in detecting CFIT situations; to review of accident/incidents report involving CFIT problems.

Overall, the data clearly indicated that the VLJ training programs are addressing the CFIT problems in a variety of ways.

Research Question Number Three

How was feedback provided to the pilots for FITS/CFITS training?

The findings indicated that all 25 (100%) of the pilots received either verbal, written, or both forms of feedback during their FITS/CFIT training.

Overall, the data clearly indicated that some form of feedback was provided to the pilots for FITS/CFIT training.

Research Question Number Four

Do VLJ pilots think it is important to have another pilot in the cockpit?

There was a lot of energy surrounding this question as indicated by the comments from the pilots. Of the 25 pilots, over half of them, (56%) chose one of the answers provided and also wrote out comments supporting their selection. The comments indicated a common theme that the pilots thought it was desirable to have another pilot in the cockpit, especially during busy phases of flight operating in complicated airspace.

Overall, the data clearly indicated that the VLJ pilots felt that is desirable but certainly not necessary to have a second pilot in the cockpit.

Research Question Number Five

What type of training do VLJ pilots prefer?

Overall, the data clearly indicated that the VLJ pilots preferred a combination of approaches including; lectures, videos, flight training device, and virtual technology.

Research Question Number Six

Is there a relationship between the variables in the VLJ study?

Cross tabulation was used to compare different variables with each other. Pearson chi square was used to determine whether or not a relationship existed between two variables and contingency coefficient indicated the strength of that relationship. This study showed no statistically significant relationship between variables which included:

pilot's age, jet experience, total hours logged, flying status on a VLJ and preferences about a second pilot in the cockpit.

There appeared to be no generational preferences for the VLJ pilots when selecting learning methods, safety preferences and preferred flight instruments.

Unlike other groups of professionals, these pilots appeared to think, act and share the same preferences regardless of any variable included in the study. In general, VLJ pilots, like other fliers, at any age or skill level appear to be willing to accept change if they think it will improve safety.

Overall, the data clearly indicated that there was no statistically significant relationship between the demographic variables and preference variables studied.

Respondents Special Interest Areas

The four areas of special interest in this study as identified by the respondents through written comments and the open-ended questions were: 1) Safety features in the VLJ, 2) Desirability of a second pilot in the cockpit, 3) Safety without another pilot in the cockpit, 4) Suggestions to improve VLJ training.

Safety Features in the VLJ

The pilots (44%) in this study selected the 'flight management system' as the number one safety feature in the VLJ. Of interest, 52% of the pilots selected the 'flight management system' as the one feature that could be improved upon. The flight management system is the "brain" of the aircraft, that is, it is the computerized avionics system found on most jets. This system assists the pilot with navigation, flight planning

and aircraft control. The next most preferred safety feature was the glass cockpit with 28% of the pilots selected this response. While none of the pilots selected the glass cockpit as the feature to be improved upon.

Another Pilot in the Cockpit

The survey question that generated the largest number of response was number ten which refers to the desirability of having another pilot in the cockpit. Responses varied from "I can operate as a single pilot in most normal conditions, however, in certain flights risks/hazards may dictate as desire to have another pilot." Another pilot replied, "two heads are always better than one, a two pilot crew reduces the work which leads to fewer errors." Although two (8%) of the pilots responded that another pilot in the cockpit was not desirable they offered no written explanation. The comments offered were unrelated to age, prior jet experience, or current VLJ flying status.

Safety Without Another Pilot in the Cockpit

Although none of the pilots selected 'very unsafe' to fly without another pilot in the cockpit, they offered a wide range of comments. One of the pilot who is over the age of 50 commented: "Very safe as long as good risk management, automation management and single pilot resource management is employed." Another pilot in the same age group commented, "I am just really good." "Day visual flight rules (VFR) is an acceptable level of risk, night instrument flight rules (IFR) might not be," was another comment. In general, 92% of the VLJ pilots felt it was safe to fly without another pilot in the cockpit.

Suggestions to Improve VLJ Training

One of the important questions in this study was, "how could VLJ training be improved?" The 25 pilots surveyed represented the initial cadre of VLJ pilots, their suggestions to improve training would be especially important. Data from the survey revealed that 86% of the pilots selected a 'combination of approaches' as their preferred method of learning. The combination included: lecture, video, flight training device and virtual.

Some of the comments for improving VLJ training were: "airline transport pilot (ATP) and type rating practical test standards (PTS) are the same, have to spend more of the training time on maneuver-based training." "Scenario-based training does not get pilots through the check ride, although it is necessary for higher order skills." Line orientated flight training (LOFT) scenarios with abnormal situation was another suggestion for the improvement of VLJ training.

In conclusion, most of the pilots preferred more scenario-based training; however, understand that the final check ride will test their abilities on maneuver-based flying. As one pilot in the survey remarked "current PTS is to maneuver bound. More rapid FAA changes and modifications of the PTS are needed to reflect performance of tasks, such as risk management."

Recommendations

Flying is inherently risky, but most of the known risks are manageable, provided you are a disciplined, safety conscious and responsible aviator (R. Jensen, 2000, p.2).

The following voluntary FAA aviation safety programs are recommended for VLJ training:

- Most of the VLJ pilots in the study requested additional scenario-based training; therefore, it is recommended that an advanced qualification program (AQP) be developed for VLJ pilots. This program would integrate cognitive and technical skills, which contains self-correcting quality assurance components. Most major US air carriers are currently using this type of program. Every six months a VLJ pilot would be in the simulator practicing maneuvers and selected scenarios targeted in accordance with "real world" observations.
- During the study several of the participants commented on the fact that they were at ease answering the survey because they remained anonymous. It can be inferred that pilots would report safety information as long as their job would not be in jeopardy. An aviation safety action program (ASAP) would allow VLJ pilots to report safety concerns without reprisal The ASAP program would be of special value to the VLJ community because it is a new class of aircraft.
- The VLJ requires only 2,000 to 3,000 feet of runway for take offs and landings, therefore, they will have over 5,000 runways in their range of operating capability. A runway incursion information evaluation program (RIIEP) gathers safety information regarding the causal factors of airports' surface events. Runway incursion continuous to be a major problem with both general aviation and air carriers. Instituting this type of program may reduce ground accidents/incidents.

Future Topics for Research Involving the VLJ

The VLJ has been in operation for less than a year, so further study will be forthcoming to address the safety issues associated with flying them.

1. One potential limitation of this study was the small sample size, but only 310 pilots have been type rated in the VLJ to date. This study reflects the views and opinions of 25 of these pilots, more than half of whom were over the age of 50, which can be largely explained by the fact that they were in training to be instructors and or mentor pilots. VLJ manufacturers and training companies now operate FAA approved level D simulators. In some cases, all of the pilots training may be accomplish in a level D simulator including the final check ride. The training department's plan is to train 20 pilots in each simulator every month. By June 2009, it is estimated that 3,000 pilots will be flying VLJs. All of the respondents in this study were males from the USA. Therefore, future research should include females, international pilots, and a larger selection of pilots under the age of 50.

2. Researchers examining VLJ pilot training may want to focus on the pressurized cabin. Pilots in an unpressurized aircraft use supplemental oxygen when flying higher than 12,500 feet mean sea level (msl) for 30 minutes or more and at all times above 14,000 feet msl. Even passengers must be provided supplemental oxygen above 15,000 feet msl. Requisite physiological training including simulated high-altitude flying is normally accomplished in an altitude chamber often located on a military base. Some VLJ training facilities are using a table top trainer known as a reduced oxygen breathing device to simulate high altitude flying. This type of unit cost approximately 25,000 dollars and is effective at inducing Hypoxia at ground level. The pilot must put on a mask

to get hypoxic. Other training devices such as portable reduced oxygen training tent (PROTT) the pilot will go inside a tent that has specific gas mix to simulate 25,000 to 30,000 feet. The pilot walks in with no mask, experiences hypoxia, then put on a mask (just like being in aircraft cockpit) and his/her reaction is noted. Are these approaches as effective as a traditional altitude chamber? A pilot reaction to high-altitude training would make for an educational and vital study. High altitude flying in a VLJ, though not addressed in this study, is clearly an area for research, because in the past these high altitudes were reserved only for larger jet aircraft.

3. Determining required training for inexperienced pilots who are transitioning from a conventional small piston-powered general aviation aircraft to a complex high performance jet in instrument flight conditions as the sole manipulator of the controls is another challenge that must be addressed. An important consideration in this type of study is the environment and the type of airspace complexity in which a pilot is to operate. This suggests the need for a considerable flexibility in programs to accommodate individual differences. For instance, a pilot flying a twin engine Beech Baron out of LaGuardia (New York City) up and down the east coast is more likely to be equipped for a rapid transition to a VLJ than a pilot flying a single engine Cessna 172 in the mid-west. Thus, it is not just the total number of hours a pilot may have, logged but rather the quality of such time.

The researcher had the opportunity to fly a VLJ for over an hour and can report that it is truly complex high performance aircraft that requires total pilot resource management.

4. The best way to integrate contemporary scenario based training must be determined. The traditional FAA Airline Transport Pilot (ATP) and Aircraft Type Rating Practical Test Standards, which are maneuver based, will not address important factors such as, crew resource management (CRM), situational awareness (SA), and single resource management (SRM). Even though "maneuvers validation" will always be required, it is highly likely future VLJ training programs will soon take advantage of the advances of training methodologies associated with advanced qualification programs (AQP) almost universally used by a major US airlines. This AQP program includes everything mentioned here in a single integrated program.

5. The VLJ pilots commented in the survey a need for "more standardized mentors and instructors" and "mentor pilot utilization soon after training." Based on these comments the researcher recommends that a study be accomplish to review the manufacturer's mentor program. This would assure standardized training for the single pilot operator to acquire the necessary skills and proficiency for safe operation in all flight conditions.

Further analysis reveals that a surprising 64% of the pilots sampled were over the age of 50. This phenomenon may be due to the relatively recent introduction of this aircraft category, resulting in a possible disproportionate number of instructor mentor pilots when compared with what is like to be observed in future studies.

Implications

Pilot Judgment

Scott Shappell and Douglas Wiegmann recently completed a work that shed

valuable light upon human factors errors in aviation. Poor pilot judgment is attributed to 75 to 80% of all aviation errors.

Although the GA accident rate is relatively low, it does remain significantly higher than that of the airlines. This is partly due to more limited pilot experience, training and less restrictive regulations, different aircraft capabilities and a more challenging operating environment.

According to the 2007 Nall Report, the leading causes of fatal accidents in 2006, were maneuvering, take-off/climb, weather and descent/approach. The common thread in each casual situation of those accidents is pilot judgment. One approach to reducing such judgment errors and maximizing the result of flight training would be to conduct courses on pilot decision making and professionalism.

Pilot judgment, training and evaluation programs, address behavioral aspects of judgment, including hazardous thoughts and stress. Many "cheap" lessons come out of the "expensive" errors of others in any field, but this is especially true in aviation. Thus, it is recommended that the NTSB accidents/incidents reports be reviewed e a part of every recurrent training program.

Ultimately, good judgment depends on building an accurate mental model of the flight equipment in a pilot's mind. This model will explain most of what is going on in a rational context, identify viable options and the relative risks of these options as well as simulating potential future flight plans.

Education

Typically, a VLJ pilot will come from the ranks of the GA pilot community and

may have little or no cockpit resource management exposure. It is recommended that VLJ pilots take continuing education hours in safety risk management, which will include crew resource management (CRM). The objective of this training will be to enhance VLJ pilot's awareness of hazardous attitudes and thought patterns.

One of the respondents in the study suggested that the newly rated VLJ pilot engage the services of a mentor pilot for the first 50 hours of his/her initial operating experience. This is common practice in the airline world. The researcher would recommend that the fifty hours should not be just "straight and level" type of flying but include both Visual Flight Rules (VFR) and Instrument Flight Rules (IFR) flying. Also, the respondent concluded that a minimum of 20 hours should be in instrument conditions, executing instrument approaches.

Flight Safety Foundation designed a controlled flight into terrain assessment risk assessment safety tool as a part of its international program to reduce CFIT accidents which present the greatest risks to aircraft, crew and passengers. The use of the checklist is recommended to evaluate specific flight operations and enhance pilot's avoidance of CFIT risks (a copy of the CFIT checklist is provided in the appendix).

One of the simulator instructors at Flight Safety in Wichita, Kansas suggested a proactive measure to enhance the knowledge of the VLJ pilot would be to require a minimum number of continuing credits hours each year. Airline pilots and other professionals frequently face a need for continuing education as a caveat to maintaining right to practice their chosen profession. While it may be impractical to actually "require" such training from a VLJ pilot, insurers, manufacturers, and other interested parties might do well to encourage this invaluable education.

The long term trend for weather related accidents are increasing. One reason is more cross-country flying in new technologically advanced aircraft, such as the VLJ. The VLJ pilot must take recurrent training every year, so this would be an opportune time to evaluate weather changes in applicable areas of the world, especially in high altitude type of flying. Due to higher speeds the VLJ will be able to cover more miles than previous GA airplanes. Although the VLJ does have the advantage of flying above some weather at flight levels of 35,000 to 41,000 feet, most of them will be equipped with anti-icing equipment to avoid attendant weather hazards. This may be new for a VLJ pilot; hence, additional training in this environment may be required.

In summary, we are at the dawn of a new era in personal aviation. In today's litigious environment, *everything depends on safety.*

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APPENDIXES

APPENDIX A

CONSENT FORM

CONSENT FORM

Research Study: Very Light Jet (VLJ) Pilot Training

TO: Respondent

FROM: Tweet T. Coleman

SUBJECT: Participation in Very Light Jet (VLJ) Study

DATE: November 18, 2007

I am a doctoral candidate at Oklahoma State University in the field of Aerospace Education. My research study is entitled: *Very Light Jet: Identify Trends in Pilot Training to Ensure Safe and Efficient Operation of this New Category of Aircraft.*

The objective of this study is to proactively identify trends in the pilot training for the VLJ, to ensure safe and efficient operation of this new category of aircraft.

You were chosen to be part of this study, because as a VLJ pilot you are on the leading edge of this new era of aviation. Currently, there are 21 companies worldwide that have an expressed interest in manufacturing, owning, and operating a VLJ.

We share a common bond, for I am also a pilot. I have flown for more than 26 years with 12,240 hours in the right, left and side saddle seats of Boeing Jets 727, 747, Lear, Hawker, and Falcon corporate jets, and over 1,820 hours as a flight instructor. As pilots, we are always looking for ways to enhance safety in our industry. Currently, I am working for the Federal Aviation Administration (FAA) as the International Program Manager for Flight Standards.

The questionnaire consists of two parts: 18 multi-choice questions, along with two open-ended questions, and is designed to take 20-30 minutes to complete. Your participation is strictly voluntary; the questionnaire will not reveal name, position, or company with respect to the respondent. Your name will be taken only for the purpose of sending you an executive summary.

The questionnaires will be kept by the researcher in a locked Halliburton briefcase and placed in a locked home office. A Mac laptop computer, with password protection, will be used to record responses for the two open-ended questions. This computer will be retained in a locked office at the researcher's home. At the end of the research project, April 19, 2008, all respondent's information will be shredded and deleted.

CONSENT FORM

Research Study: Very Light Jet (VLJ) Pilot Training

Please read and sign this consent form, a VLJ questionnaire will then be provided to you. Thank you for your interest in aviation safety, and especially in the new day dawning for the Very Light Jet.

I understand that participation is voluntary, there is no penalty for refusal to participate, and I am free to withdraw my consent and participation in this project at any time without penalty after notifying the researcher, Tweet Coleman.

I may contact Tweet Coleman (405.406.8938) or Dr. Steven Marks (405.744.8125). I may also contact the IRB, if I have any questions about this research and my rights as a research volunteer, I may contact Dr. Sue C. Jacobs, IRB Chair, 219 Cordell North, Stillwater, OK 74078 (405.744.1676) or email IRB@okstate.edu

Signature of Respondent _____ Date _____

I have explained this consent form to the respondent before requesting his/her signature.

Signature of Researcher _____ Date _____

APPENDIX B

IRB

Oklahoma State University Institutional Review Board

Date:	Tuesday, December 18, 2007
IRB Application No	ED07128
Proposal Title:	Very Light Jet: Identify Trends in Pilot Training to Ensure Safe and Efficient Operation of this New Category of Aircraft
Reviewed and Processed as:	Exempt

Status Recommended by Reviewer(s): Approved Protocol Expires: 12/17/2008

Principal Investigator(s

Tweet T. Coleman
301 N. Walker Ave. Apt. 1307
Okla. City, OK 73102

Steven Marks
300 Cordell North
Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

[X] The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Beth McTernan in 219 Cordell North (phone: 405-744-5700, beth.mcternan@okstate.edu).

Sincerely,

Sue C. Jacobs, Chair
Institutional Review Board

APPENDIX C

QUESTIONNAIRE

VLJ Training Questionnaire

Greetings Pilot Number _____

Thank you for taking the time to participate in this study.

The driving force in today's pilot training is the need to identify the trends in the safety of Very Light Jets (VLJ) and to ensure the flying public of the safe and efficient operation of this aircraft. The air-traffic system and the owner-operators of the VLJs must recognize the vulnerability of these lightweight high-performance aircraft and integrate this knowledge into the company's training program. This research is but one step in that process.

Instructions: Please put a check mark in the box that best fits your answer.

7. Age

☐ 21-29 ☐ 30-39 ☐ 40-49 ☐ 50-59 ☐ 60 +

8. How many years have you been a pilot?

☐ Less than one year

☐ 1 to 2 years (12-24 months)

☐ 3 to 5 years (25 – 60 months)

☐ 5 to 10 years (61-120 months)

☐ 10 to 20 years (121-240 months)

☐ More than 20 years (241+ months)

9. Did you fly a jet aircraft prior to the Very Light Jet (VLJ)?

☐ Yes ☐ No

10. How many hours have you logged in your flying career?

☐ Less than 300 hours ☐ 300 to 999 hours

☐ 1,000 to 2,499 hours ☐ 2,500 to 5,000 hours

☐ More than 5, 000 hours

11. Rank order the safety features of the VLJ with 1 being the best and 5 being the worst.

☐ Electronic Checklists ☐ Ice Protection

☐ Flight Management System ☐ Thrust Reverses

☐ Glass Cockpit ☐ Other (Explain)

_____
_____

6. What feature could be improved upon? (Select one item)

☐ Electronic Checklists ☐ Ice Protection

☐ Flight Management System ☐ Thrust Reverses

☐ Glass Cockpit ☐ Other

(Explain)_____
_____

20. Are you currently flying the VLJ?

☐ Yes ☐ No

21. Are you flying a single or twin engine VLJ?

☐ Single Engine ☐ Twin Engine

22. How many hours do you have in the VLJ?

☐ Less than 100 hours ☐ 100 to 299 hours

☐ 300 to 1,000 hours ☐ More than 1,000 hours

23. As Pilot in Command (PIC) of the VLJ, how desirable would it be to have another pilot in the cockpit?

☐ Completely desirable ☐ Very desirable

☐ Somewhat desirable ☐ Not desirable

Explain.

_____

24. As Pilot in Command (PIC) of the VLJ, how safe is it to fly without another pilot in the cockpit?

☐ Very safe ☐ Somewhat safe

☐ Unsafe ☐ Very unsafe

Explain.

_____

25. My initial training experience in the VLJ was:

☐ Totally adequate ☐ Pretty adequate ☐ Borderline

☐ Somewhat inadequate ☐ Decidedly inadequate

26. Which training do you prefer: scenario-based training or maneuver-based training?

☐ Scenario-based training ☐ Maneuver-based training

27. Are you familiar with the voluntary Federal Aviation Administration Industry Training (FITS) program?

☐ Yes ☐ No

28. Was the FITS program used in your VLJ training?

☐ Yes ☐ No

29. During the time period of 1995 to 2005, Controlled Flight Into Terrain was one of the leading causes of accidents in the business jets. How did your training program address the CFIT problem? (Select all that apply)

- ☐ We did not address this problem
- ☐ We integrated the CFIT program into our FITS training
- ☐ We discussed and demonstrated the aircraft technology in detecting CFIT situations
- ☐ We reviewed CFIT accident/incident reports

30. During your FITS/CFIT training, was feedback provided?

☐ Always ☐ Usually ☐ Sometimes ☐ Rarely

31. In what form was feedback provided?

☐ Verbal ☐ Written ☐ Verbal and written

32. What is your preferred method of learning?

☐ Lectures ☐ Videos ☐ Flight Training Device

☐ Virtual ☐ Combination of approaches

33. How could your VLJ training be improved?

34. What additional comments or observations would you like to make?

Keep the blue side up.

APPENDIX D

SPSS RESULTS

Test Statistics

	Type Training13 Which training do you prefer?
Chi-Square	11.560[a]
df	1
Asymp. Sig.	.001

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 12.5.

```
FREQUENCIES VARIABLES=Age1 YearsPilot2 PriorVLJ3 TotalHours4 VLJSafety5 ImproveFeature6 C
urrentlyVLJ7 SingleTwinVLJ8 VLJHours9 Anoth
   erPilot10 SafeWithout11 TrainVLJExp12 TypeTraining13 FamiliarFITS14 UsedFITS15 CFITpro
blem16 Feedback17 FormFeedback18
    PreferLearnMethod19
  /STATISTICS=MEDIAN
  /ORDER=ANALYSIS.
```

Statistics

	N		
	Valid	Missing	Median
Age1 Age	25	0	4.00
YearsPilot2 How many years have you been a pilot?	25	0	6.00
PriorVLJ3 Did you fly a jet a/c prior to VLJ?	25	0	1.00
TotalHours4 How many hours logged in career	25	0	5.00
VLJSafety5 Rank safety features	25	0	3.00
ImproveFeature6 What feature could be improved upon?	25	0	2.00
CurrentlyVLJ7 Are you currently flying the VLJ?	25	0	1.00
SingleTwinVLJ8 Flying a single or twin engine VLJ	25	0	2.00
VLJHours9 How many hours do you have in the VLJ?	25	0	1.00
AnotherPilot10 As PIC of VLJ, how desirable to have another pilot in cockpit?	25	0	2.00
SafeWithout11 As PIC of VLJ, how safe to fly WITHOUT another pilot in cockpit?	25	0	4.00
TrainVLJExp12 My initial training experience in VLJ	25	0	4.00
TypeTraining13 Which training do you prefer?	25	0	1.00
FamiliarFITS14 Are you familiar with FITS program	25	0	1.00
UsedFITS15 Was FITS program used in your VLJ training?	25	0	1.00
CFITproblem16 How did your training program address the CFIT problem?	25	0	4.00
Feedback17 During FITS/CFIT training, was feedback provided?	25	0	3.00
FormFeedback18 In what form was feedback provided?	25	0	1.00
PreferLearnMethod19 What is your preferred method of learning	25	0	5.00

Frequency Table

Age1 Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 21-29	2	8.0	8.0	8.0

APPENDIX F

CFIT CHECK LIST

Flight Safety Foundation

CFIT Checklist

Evaluate the Risk and Take Action

Flight Safety Foundation (FSF) designed this controlled-flight-into-terrain (CFIT) risk-assessment safety tool as part of its international program to reduce CFIT accidents, which present the greatest risks to aircraft, crews and passengers. The FSF CFIT Checklist is likely to undergo further developments, but the Foundation believes that the checklist is sufficiently developed to warrant distribution to the worldwide aviation community.

Use the checklist to evaluate specific flight operations and to enhance pilot awareness of the CFIT risk. The checklist is divided into three parts. In each part, numerical values are assigned to a variety of factors that the pilot/operator will use to score his/her own situation and to calculate a numerical total.

In *Part I: CFIT Risk Assessment,* the level of CFIT risk is calculated for each flight, sector or leg. In *Part II: CFIT Risk-reduction Factors,* Company Culture, Flight Standards, Hazard Awareness and Training, and Aircraft Equipment are factors, which are calculated in separate sections. In *Part III: Your CFIT Risk,* the totals of the four sections in *Part II* are combined into a single value (a positive number) and compared with the total (a negative number) in *Part I: CFIT Risk Assessment* to determine your CFIT Risk Score. To score the checklist, use a nonpermanent marker (do not use a ballpoint pen or pencil) and erase with a soft cloth.

Part I: CFIT Risk Assessment

Section 1 – Destination CFIT Risk Factors	Value	Score
Airport and Approach Control Capabilities:		
ATC approach radar with MSAWS	0	
ATC minimum radar vectoring charts	0	
ATC radar only	-10	
ATC radar coverage limited by terrain masking	-15	
No radar coverage available (out of service/not installed)	-30	
No ATC service	-30	
Expected Approach:		
Airport located in or near mountainous terrain	-20	
ILS	0	
VOR/DME	-15	
Nonprecision approach with the approach slope from the FAF to the airport TD shallower than 2 ¼ degrees	-20	
NDB	-30	
Visual night "black-hole" approach	-30	
Runway Lighting:		
Complete approach lighting system	0	
Limited lighting system	-30	
Controller/Pilot Language Skills:		
Controllers and pilots speak different primary languages	-20	
Controllers' spoken English or ICAO phraseology poor	-20	
Pilots' spoken English poor	-20	
Departure:		
No published departure procedure	-10	
Destination CFIT Risk Factors Total (−)		

VITA

Tweet T. Coleman

Candidate for the Degree of

Doctor of Education

Dissertation: VERY LIGHT JET: PILOT TRAINING TO ENHANCE SAFE AND EFFICIENT OPERATION

Major Field: Applied Educational Studies

Biographical:

Personal Data: Born in Detroit, Michigan, October 2, 1945, the daughter of Irene and Sali Suleyman.

Education: Graduated from Louisville High School, Louisville, Ohio, May 1963; Nursing Degree from the College of Guam, Agana, Guam, May 1972; received Bachelor of Science degree in Psychology from Mills College, Oakland, California, May 1976; received Master of Aeronautical Science from Embry-Riddle Aeronautical University, Daytona Beach, Florida, December 1995. Completed the requirements for the Doctor of Education degree at Oklahoma State University, May, 2008.

Experience: Twenty-nine years in the aviation industry employed as an International Airline Pilot, with 12,240 hours flying a B-727 and B-747, Flight Engineer B-727, Federal Aviation Administration (FAA) Certified Flight Instructor, FAA Aviation Safety Inspector, FAA Safety Program Manager, FAA Pacific Representative, Adjunct Professor for Embry-Riddle Aeronautical University, Communication Instructor for the Dale Carnegie Courses. Currently, FAA International Flight Standards Program Manager.

Professional Membership: Phi Kappa Phi Honor Society.

Name: Tweet T. Coleman Date of Degree: July, 2008

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: VERY LIGHT JET: PILOT TRAINING TO ENHANCE SAFE AND EFFICIENT OPERATION

Pages in Study: 116 Candidate for the Degree of Doctor of Education

Major Field: Applied Educational Studies

Scope and Method of Study: The research was conducted to determine if the voluntary Federal Aviation Administration Industry Training Standards (FITS) and Controlled Flight into Terrain (CFIT) were included in the pilot's Very Light Jet (VLJ) training programs. In addition, some demographic variables like age, hours of flying experience and others, were looked at in relation to selected preference variables like preferred method of training, safety features and others, to see if there were any significant relationships. A purposive sampling of the population was obtained through personal visits to five aviation training sites where VLJ pilots were known to be in attendance. This data was collected using an on-site survey administered to a defined population of 25 pilots, each of whom was in or had already completed VLJ training.

Findings and Conclusions: The survey used included 19 closed-ended and two open ended questions, which provided sufficient information to adequately, address all six of the research questions. The results of the study indicated that of the 25 VLJ pilots who responded to the questionnaire, 22 (88%) reported that they were familiar with FITS, and 19 (76%) reported that FITS program was used during their VLJ training. The data revealed that 23 (92%) of the pilots were aware and had CFIT integrated into their training program. It was concluded that FITS and CFIT were included in the VLJ training program. The age range of the pilots surveyed was from 21 to over 60 years, with 16 (64%) over the age of 50. Overall there was no statistically significant relationship between the demographic variables and preference variables studied. Unlike other groups of professionals, these pilots appeared to think, act and share the same preferences regardless of any demographic variables included in the study. In general, these VLJ pilots, like other fliers, at any age or skill level appear to be willing to accept change if they think it will improve safety.

ADVISER'S APPROVAL: _____Steven K. Marks_____