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Automatic Dependant Surveillance-Broadcast Training

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AUTOMATIC DEPENDENT SURVEILLANCE-BROADCAST TRAINING

by

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This thesis, submitted by Andrew P. Leonard in partial fulfillment of the requirements for the Degree of Master of Science in Aviation from the University of North Dakota, has been read by the Faculty Advisory Committee under whom the work has been done and is hereby approved.

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ABSTRACT

According to the Federal Aviation Administration (FAA), current delays in air traffic across the United States cost the country's economy roughly 9.4 billion dollars annually. With air traffic expected to triple again over the next several decades, the FAA has been in the process of implementing The Next Generation Air Traffic Control System (NextGen) in order to handle this increase in traffic.

One of the key elements to NextGen is the transition from the current ground based radar monitoring system to a satellite based system using the Automatic Dependent Surveillance - Broadcast System (ADS-B). The FAA has set a mandate which requires all aircraft to be ADS-B equipped by the year 2020 in order to continue operating in the National Airspace System. However, the FAA has not set forth any training requirements for aviation instructors or designated examiners.

As ADS-B continues to be implemented across the United States, it is important that pilots gain knowledge and training about this new system. When the Global Positioning System (GPS) was fully implemented in 1994, there was a delay in reaching the FAA's goal of using this as a primary source of navigation because of a lack of training and training standards.

This study looked at how ADS-B is currently being taught among aviation higher education across the United States, and how important this training is to current aviation curriculum. With the information collected, it was determine that only a minimal amount

of ADS-B training is currently taking place across the country, and the training that is taking place is non-standardized and limited do to the perception that ADS-B is only to be used as a traffic advisory tool. Several factors were discovered as to why there seems to be no current urgency among aviation educators to train their students in this new technology, as well as what recommended steps the FAA could take in order to help aviation educators with the ADS-B training process.

CHAPTER I

INTRODUCTION

Technology and training have allowed for the aviation industry to grow at an unprecedented rate over the last several decades (FAA, 2010). With nearly 87,000 flights filling America's skies every day, the U.S. is enjoying the safest period in aviation history (ITT Corporation, 2010). However, the current ground-based air traffic control radar system that has been in place for the past 60 years is beginning to lose its ability to keep up with the continued growth of air traffic across the country.

As the number of flights across the U.S. continues to grow, the age of the current system is causing regular traffic delays in order to maintain a high level of safety. The Federal Aviation Administration (FAA) estimates that by 2025, the U.S. will average over 128,000 flights per day (FAA 2010). If a fundamental change to our current system does not occur, there will be a large scale gridlock of the skies that could cost the U.S. economy $22 billion annually (FAA, 2010).

Statement of the Problem

The current solution to this issue is the FAA's Next Generation Air Transportation System (Next Gen). NextGen is a broad term that represents a large scale redesign of the National Airspace System (NAS), including upgrades in safety, environmental

performance, and airport infrastructure (FAA, 2010). The largest and most critical aspect of the NextGen plan is transitioning our air traffic control ground-based radar system to a satellite-based system that will allow pilots and controllers to have access to, and share all available information.

With this transition from the current ground-based radar system to the satellite-based system comes required pilot training in new technology like ADS-B. The FAA has set a mandate requiring airplanes to be ADS-B equipped by 2020 in order to continue moving forward with the NextGen project. However, there are currently no stated training requirements or proposed training lists for instructors or FAA examiners to determine when a student has adequate ADS-B knowledge.

According to Norton (1997), the FAA's "Hands Off" approach to training in the past has been successful through the use of Practical Test Standards (PTS). However, this approach may not be as appropriate for the transition to the NextGen System. While an equipment mandate for the transition is only less than ten years away, a lack of training standards could delay NextGen's completion by decades.

Purpose of the Study

When the Global Positioning System (GPS) became fully operational in 1994, the FAA set a goal that this new technology would become the primary source of navigation within 10-15 years (GPS History, 2009). No specific deadline was set for this goal, nor was there any immediate need for making the initial transition (GPS History, 2009). However, the FAA knew that GPS technology allowed them to begin working toward a better air transportation system.

Even when GPS was fully operational, many flight training programs and flight instructors were left to decide when and how to train their students with this new technology (Norton, 1997). Many aviation instructors did not know how to use this emerging technology, and with the cost of individual units being extremely high, instructors found themselves with very few options to provide training. There was very little input from the FAA on how instructors should provide training to their students, or what standards should be used in order to determine if their students had sufficiently learned the new technology (Norton, 1997).

Today GPS is a staple in many cockpits, but the FAA has been slow in reaching its goal of having GPS as a primary source of navigation and tracking (Aerospace, 2010). While there were many reasons for the delay in GPS implementation, some suggest that one of the most significant was a lack of pilot training (Norton, 1997). In the beginning many instructors chose not to train their students on this new technology. This lack of training caused pilots to avoid GPS, which ultimately meant they were not able to experience all it had to offer first hand (Norton, 1997). As time went on, GPS became more and more prevalent in the cockpit, and pilots began to understand the benefits of GPS. Today, GPS training is a part of most aviation training, and has been added as to the FAA's Practical Test Standards (PTS).

The Automatic Dependent Surveillance-Broadcast System (ADS-B) is the new technology on the horizon, and, like GPS, the FAA has a goal for its implementation. However, unlike GPS, the FAA has set a mandatory date of 2020 that all aircraft need to be equipped with ADS-B in order to operate in the United States Air Transportation System (FAA, 2010). The FAA is working to move forward with NextGen, but is limited

on how far it can progress until the ADS-B installation is complete (FAA, 2010). While the FAA has set the 2020 mandate, they again have left very little guidance as to how pilots should go about acquiring this new technology, or how instructors and aviation programs should train for proficiency.

This study will look at what types of ADS-B training is currently being offered by aviation educators cross the country and whether the 2020 mandate is a realistic goal. It will also examine whether the FAA should take a more active approach to implementing ADS-B training in order to avoid a delay in implementation, similar to what occurred with GPS.

Significance of the Study

This study will closely examine the current stage of ADS-B implementation to decide if it is on track for the 2020 mandate. If a current state of implementation can be determined, it will be possible to use what was learned from GPS implementation to make necessary changes in order to avoid a delay in the NextGen system. History has shown that the FAA's lack of guidance in training was one of the reasons for the delay in GPS implementation. This study will determine if this lack of guidance is occurring again, and suggest what steps could be taken for the FAA to meet its goal to complete ADS-B implementation by the year 2020.

Research Questions

1. What level of ADS-B training is currently taking place in collegiate aviation institutions in the United States?

2. Is the perceived value of ADS-B training significantly different between aviation educators that currently provide ADS-B training and those educators that do not?

3. What types of media and methods are currently being used to teach ADS-B information, and how effective are they?

4. Would more specific ADS-B training requirements from the FAA help increase the efficiency of ADS-B training?

Assumptions

1. Participants fully understand ADS-B and the future governmental plans for implementation.
2. Participants were the qualified to answer the survey questions.
3. Participants honestly assessed the current ADS-B training, and honestly answered all survey questions.
4. Information provided in the University Aviation Associations Collegiate Aviation Guide is accurate and current.

Limitations

1. ADS-B is currently not operational in all parts of the country.
2. The study relied on the honesty of each participant.
3. The original sample size is small, so a high percentage of responses was necessary.

4. There was a larger response from some parts of the country due to 141 aviation institutions causing some parts of the country to be under represented.

Definitions and Acronyms

- ADS-B - Automatic Dependent Surveillance – Broadcast System. The system that is being implemented into the Air Traffic Control System to replace radar.
- ADS-R – Automatic Dependent Broadcast – Rebroadcast. A system that converts radar information so it can be seen on an ADS-B display.
- CDTI- Cockpit Display of Traffic Information. This is a display that would be placed in the cockpit of an aircraft to show pilots other air traffic in the vicinity.
- FAA- Federal Aviation Administration. The governmental agency that regulates air traffic and air transportation in the United States
- FITS- Federal Aviation Association Industry Training Standards
- GNSS- Global Navigation Satellite System. Different name for GPS.
- GPS- Global Positioning System. Navigation system used by pilots in flight that operates using satellites in space.
- NextGen- The Next Generation Air Transportation System. The broad term used to describe the current transition to our National Airspace System.
- TAA- Technically Advanced Aircraft.
- TIS-B - Traffic Information Broadcast-Service. A service that collects information on any aircraft that is not ADS-B equipped.
- UAT – Universal Access Transceiver – Converts ADS-R Information.

Literature Review

The Next Generation Air Transportation System

The Next Generation Air Transportation System (NextGen) is the FAA's answer to continued growth of air travel across the United States (FAA, 2010). NextGen is a broad term that represents a large scale redesign of the National Air Transportation System, including upgrades in safety, environmental performance, and airport infrastructure (FAA, 2010). The largest and most influential aspect of the NextGen plan is moving our air traffic control system from a ground-based radar system to a satellite-based system that will allow pilots and controllers to have access to and share all available information (FAA 2010).

The current system uses specifically placed radar, which send radio waves out from a fixed antenna. These radio waves bounce off of airborne aircraft and are sent back to the radar stations to be interpreted. Based on the time it takes for the radio waves to return to the radar station, the system is able to build a grid that gives air traffic controllers a rough idea of where current aircraft are located. This system has been effective for the past 60 years, but as air traffic continues to increase, it has become necessary to put airborne aircraft in closer proximity to each other without increasing the risk of a mid-air collision (FAA, 2010).

Radio waves used in this system degrade due to range, atmospheric conditions, and altitude (ADS-B Technologies, 2010). The system is also only updated every 12 seconds which currently causes the FAA to put specific restrictions on how close controllers can place aircraft together while in flight (ADS-B Technologies, 2010). In order to accommodate the growing number of aircraft, regulations need to allow for

aircraft to fly within closer proximity to each other. This will be achieved by the implementation of the new Automatic Dependent Surveillance Broadcast System (ADS-B) (ITT Corporation, 2010).

ADS-B Structure

ADS-B is a broadcast surveillance system with both air-to-ground and air-to-air applications (Civil Aviation Safety Authority, 2006). Unlike the current radar based system which works by bouncing radio waves from fixed-based antennas off of airborne targets and then interpreting the reflected signals, ADS-B gathers information from the Global Navigation Satellite System (GNSS). Once the system has gathered its precise position from GNSS, this information can be combined with aircraft airspeed, heading, altitude, and flight number to be broadcast out roughly every half second (ADS-B Technologies L.L.C., 2010).

This portion of the system is referred to as ADS-B "Out" and only requires aircraft to be equipped with an ADS-B transmitter in order for pilots to participate at the very basic level. Once equipped, information such as position, altitude, identity, velocity vector, and vertical rate can be transmitted to ground stations that feed the information to Air Traffic Control (ATC) Centers. ATC can use this information to monitor and position real time air traffic with position accuracy as close as three meters (Civil Aviation Safety Authority, 2006).

Ground station equipment for ADS-B consists of a receiver unit, an antenna, and a site monitor that is used to assure proper equipment function. This equipment is fairly small in size and can be placed on a multitude of different structures. In some places

specific towers are being erected to hold ADS-B ground equipment, but whenever possible the FAA is contracting with other companies, such as cellular providers, to place this equipment on pre-existing towers (Martin, 2009). Ground station equipment is also being placed on oil platforms in the Gulf of Mexico, so the safety and efficiency benefits of the system can be extended out over international waters.

ADS-B "In" is the second half of the system which allows aircraft flight information to be displayed among aircraft sharing the same airspace. Information transmitted from ADS-B "Out" would be received by a receiver placed on properly equipped aircraft, and information would be displayed on a Cockpit Display of Traffic Information (CDTI) (ITT Corporation, 2010). CDTIs are either hand-held or mounted within the aircraft panel. These displays can also be integrated into an aircraft's Multi-Function Display and combined with other systems such as a moving map or navigation display (Civil Aviation Safety Authority, 2006). The information displayed within the cockpit is identical to the information being sent to the ATC centers, allowing pilots to have access to the same real time information as their controlling agent.

There are four broadcast and surveillance services that will be implemented by the FAA using ADS-B. The first service is ADS-B itself. This service is the broadcasting of messages from airborne aircraft to other airborne aircraft and ATC ground stations.

The second service is Automatic Dependant Surveillance-Rebroadcast (ADS-R), and is used to link all aircraft regardless of their broadcasting frequency. ADS-B broadcasts on both a1090 MHz for military, air transport, and high end general aviation and the Universal Access Transceiver (UAT) for less expensive avionics on aircraft

flying below 24,000 ft. ADS-R will translate and re-transmit both the 1090 MHz signal and the UAT so that no matter which signal is being transmitted, all aircraft will be seen (ITT Corporation, 2010). This service along with ADS-B are considered to be surveillance services, and are a critical part for ATC usage (ITT Corporation, 2010).

Traffic Information Broadcast-Service (TIS-B) is a service that collects information on any aircraft that is not ADS-B equipped and makes it possible for that information to become available on ADS-B displays. The ADS-B ground systems can collect all FAA radar data and broadcast basic information for non ADS-B equipped aircraft. Flight Information Service-Broadcast (FIS-B) is a service that broadcasts changing weather and aeronautical data so a pilot constantly has an idea of changes that are occurring during the route of flight. FIS-B and TIS-B are considered broadcast services that would essential services for ATC coverage during an ADS-B transition period (ITT Corporation, 2010).

Benefits of ADS-B

According to the FAA (2010), ADS-B has been operational in Alaska for nearly a decade, and over that time the benefits of this satellite based system have saved countless lives. The FAA (2010) also claims that when compared to the current radar based system, ADS-B has higher accuracy, lower governmental cost, and more up-to-date information. Traditional radar stations require significant mechanical infrastructure as well as heavy maintenance and signal processing. ADS-B infrastructure is fairly simple and significantly cheaper to install and maintain than traditional radar stations

(ITT Corporation, 2010). The largest part of the system is the global positioning satellites which are already in place and operating (ITT Corporation, 2010).

ADS-B is also more accurate than the current system in that it updates information every second compared to once every 12 seconds like the current system. This increased update allows ADS-B to provide three meter accuracy that will produce increased operating efficiency in all controlled airspace (ADS-B Technologies, 2010).

ADS-B allows for a more complete coverage of airspace due to the ease of equipment installation. With the current system there are several areas where installation of a traditional radar unit is not feasible or even possible due to the mechanical operation required of the infrastructure. ADS-B ground units can easily be placed on oil rigs, within populated areas, and attached to current towers that will allow for an increase in coverage that has never been possible (FAA, 2010).

This increased coverage allows for an increase in airspace capacity while increasing airspace efficiency and safety (FAA, 2010). One of the largest benefits that ADS-B offers is the ability for information to be displayed in the cockpit of individual aircraft. This display will give pilots a visual picture of all other aircraft within their airspace. Information such as altitude, airspeed, call sign, and intended track will all be available to pilots (Civil Aviation Safety Authority, 2006). FIS-B will also make it possible for pilots to receive up-to-date weather information and atmospheric changes that could impact the pilot's route of flight (FAA, 2010).

With pilots and controllers able to share the same information, the FAA hopes it will be possible for our air traffic system to begin increasing cockpit involvement in the

air traffic control process (2010). While total free flight might not be a concept our airspace system is ready for at this time, there has already been improvements in areas such as visual approaches, runway occupancy, and surface awareness (Civil Aviation Safety Authority, 2006).

With the ADS-B cockpit displays, studies have shown that pilots are able to maintain a precise distance from other aircraft during visual approaches in heavily populated airspace (Fero, 2000). With this improved accuracy ATC may be able to place aircraft closer together on a visual final approach. The display also makes it possible to see current traffic on active runways, taxiways, and on parking ramps. ADS-B will give pilots increased situational awareness that will decrease the potential for deviations, errors, and collisions.

Past Training

While pilot training has been regulated by the FAA since the 1920's (FAA, 2010), it appears the FAA has always seemed to take a "hands-off" approach to how instructors train individual pilots (Norton, 1997). Instructor flexibility can be seen in the past and in the current FAR's requirement that the FAA only get directly involved towards the end of a students training when they are required to take a written test and go through an in-flight evaluation with an FAA designated examiner (Norton, 1997).

Norton (1997) claims that with this type of approach, the FAA examiner only gets to see a small portion of a student pilot's knowledge level and ability to determine if the pilot is safe and proficient. He argues that due to this design, a significant amount of trust is placed on an instructor to be certain that each individual student is a safe and

competent pilot when he or she applies for his or her final check ride. However, this approach has obviously been effective. There are many qualified flight instructors and check airmen, as well as thousands of safe and competent pilots all around the United States (Norton, 1997).

One of the reasons the FAA's hands-off approach was so successful before GPS was introduced was because the topics and technologies that had to be covered were simple enough that they did not require a structured FAA syllabus (Norton, 1997). However, when GPS became fully available in 1995, and the first discussion of using GPS as the sole navigation unit began, training hit a new level of complexity (GPS History, 2009).

In 1997, it was estimated that the transition time between using GPS as a secondary navigation system and a primary navigation system would be roughly ten to fifteen years (Norton, 1997). Because of this long transition period many instructors had to decide whether it was necessary to train their current students on GPS. Those instructors that felt the training was important faced other issues of equipment availability and standardization (Norton, 1997). How would instructors afford the necessary equipment to teach their students, and with so many different GPS units which unit should be taught? Because of these barriers, and a minimal amount of incentives, in the early phases many student pilots did not receive adequate GPS training (Norton, 1997).

Today, GPS training is a common part of flight training at all levels (FAA, 2010). Over the last 15 years, GPS units have become less expensive and significantly more standardized (GPS History, 2009). Instructors and students have become very

knowledgeable on all of the things that GPS has to offer the aviation community. The majority of instructors now include some sort of GPS training in their curriculum, with some standards of training on GPS from the FAA now available in the Instrument PTS.

However, current FAA training standards for a private pilot certificate on navigation systems only require the following standards.

1. Student must exhibit knowledge of the elements related to navigation systems and radar services.
2. Student must demonstrate the ability to use an airborne electronic navigation system.
3. Student must be able to locate the airplanes position using a navigation system.
4. Student must be able to intercept and track a given course, radial or bearing as appropriate.
5. Student must be able to recognize and describe the indication of a station passage if appropriate.
6. Student must be able to recognize signal loss and take appropriate action. (Private Pilot PTS, 2002, 1-24)

In the past, it has been believe that these standards are too vague for the instructional expectations of navigation, because they have again left instructors to decide how much GPS knowledge a student should have before they are considered qualified (Norton, 1997). However, with GPS now in the mainstream of aviation education it is hard to say that these standards have not been effective, but even with all the advantages

to a fully implemented GPS system, the Air Transportation System still heavily relies on 1940's technology for day to day operations (FAA, 2010).

Technically Advanced Aircraft Training

The majority of flight training that currently takes place in the United States follows either Part 61 or Part 141 of the Federal Aviation Regulations (FAA, 2010). These regulations provide the required amount of aeronautical experience and tasks that must be completed in order for an individual to receive a pilot's certificate. For years, these regulations have been complied with by having maneuver – based training at the core of most aviation educator's syllabus (Craig, Bertrand, Dornan, Gossett, and Thorsby, 2005). Maneuver – based training teaches students how to fly by practicing specific flight maneuvers that allows student pilots to develop proper flight techniques.

Over the last few decades, advances in computer technology have led to sophisticated flight deck technology (Young and Fanjoy, 2003). Global Positioning Systems (GPS), Glass Cockpits, Flight Automation, and now ADS-B are giving pilots more information and tools to use then ever before. However, as these Technically Advanced Aircraft (TAA) are beginning to show up in the general aviation population, it has become clear that one of the key issues is teaching pilots how to best take advantage of the increased safety opportunities that are available with this new technology (Dornan, Beckman, Gossett, Craig, 2005). Part of this inquiry into training was caused by an observed increase in fatal accidents in TAA at a time when it was expected new technology should be causing a decrease in fatal accidents (Fiduccia et al, 2003).

A, a study of current four year collegiate aviation programs suggests that elements of glass cockpit technology, in some cases, received little or no consideration within the institutions flight training curriculum (Young and Fanjoy, 2002). The study also found, that due to the cost of acquiring appropriate instructional materials, a number of college aviation departments had decided that the responsibility for this advanced training more appropriately belonged with the employing airlines (Young and Fanjoy, 2002).

Over the last several years, many government institutions and universities have organized cooperative agreements to investigate how flight training might need to be changed for TAA. One of these teams, the General Aviation Joint Steering Committee (GAJSC) suggested that the current training format in the general aviation industry was insufficient to exploit the additional safety features of TAA's and that there was a need to develop a specific TAA training program (Fiduccia et al, 2003).

In 2003, The FAA Industry Training Standards (FITS) research group recommended that a new training approach that emphasizes realistic flight scenarios would be a more effective training approach in TAA's, and could eliminate that gap between available safety and actual safety (Fiduccia et al, 2003). This training approach uses real world scenarios and places an emphasis on aeronautical decision making, risk management, situational awareness, and single pilot resource management (Ayers, 2006). By using real world scenarios student pilots would learn how the new technology in TAA's could be used to increase safety and efficiency. However, the question still remained whether individuals could learn to fly from the very beginning using this same scenario based training, or would "stick-and-rudder" skills suffer if the traditional method of training was abandoned (Craig et al, 2005)?

In 2004 the Middle Tennessee State University Aerospace Department received FAA Part 141 approval to train students using an FAA Industry Training Standards (FITS) curriculum that was developed by the FITS consortium at the University of North Dakota to help determine its effectiveness. (Dornan et al, 2006). In this study it was found that FITS trained pilots had fewer setbacks over their initial and instrument training than traditionally trained pilots (Craig et al, 2005). A limitation to this initial study was that students following the FITS curriculum did their training in TAA's while student's following the traditional curriculum did their training in aircraft with round dial instruments. This led to the question of whether it was actually the training or the automation of the TAA that allowed students following the FITS curriculum to be more successful (Dornan et al, 2005).

A second study was performed that found it was the training and not the aircraft that was the driving force behind the benefits of a FITS syllabus. Pilots who trained using the FITS syllabus had significantly fewer set backs over their instrument training compared to pilots who trained using the traditional syllabus in a TAA (Dornan et al, 2005). This study also found that pilots who trained using the FITS syllabus were arguably more conservative in their personal minimums and that technology alone does not produce training benefits (Dornan et al, 2005).

The FITS approach to training has shown that it can reduce set backs in training and save students money, but what really matters is that studies have shown that following the FITS syllabus produces pilots that make better aeronautical decisions in TAA's. (Dornan et al, 2005). TAA's take aircraft to a higher level, and FITS takes flight

training to a higher level, and many believe that these two can come together to produce safer skies for all.

CHAPTER II

METHODOLOGY

Introduction

With air traffic on the rise, the FAA is working toward a free flight system using ADS-B. This is the most aggressive goal set by the FAA since 1994 when GPS became fully implemented, and it was estimated that it would be the primary navigation source within ten to fifteen years (Aerospace, 2010). Unlike GPS, the FAA has set a mandatory date of 2020 that all aircraft must be ADS-B equipped in order to continue to operate within the NAS.

While GPS has become an important part of the national airspace system, it cannot successfully call it the primary source of navigation while radio navigation aids such as VOR's and NDB's are still very much in use today. Air Traffic Control still relies on ground based radar as their primary source of aircraft monitoring, and some general aviation airplanes still fly without any GPS technology on board.

One of the issues associated with the delay in GPS implementation was the FAA's hands- off approach to GPS training, leaving instructors responsible for deciding what their students should learn in order to become proficient with GPS (Norton 1997). This study will look at whether this same trend is repeating itself with ADS-B and whether or not the FAA's mandatory implementation date of 2020 is realistic.

Population

The population that is used for this study is aviation educators who provide training at all different levels. The population is not restricted to Part 61 or 141 educators due to the similarity in training requirements the FAA's hands off approach can have, but the study might relate more strongly to those educators working in a collegiate setting.

Sample

The sample consists of aviation educators working in four-year aviation colleges and universities that are members of the University Aviation Association. In order to keep the sample size at a reasonable number, only those members listed in the University Aviation Association's Collegiate Aviation Guide (2008) that offer flight/pilot programs were considered. Following this criteria, the sample for the study was 96 educators from various aviation institutions around the country.

Methods and Data Collection

To collect data for this study, emails containing a link to an electronic survey were sent to individuals who were listed as the point of contact in the University Aviation Association's Collegiate Aviation Guide (2008) for 96 different aviation institutions which can be found in Appendix B. These individuals were asked to forward the email and survey link on to any educators within their institution who worked directly with students in their pilot training program. Due to the newness of ADS-B, it might have been ineffective to try to target only one particular person or position within each institution, so by opening the survey to all educators within the institutions allowed for

the largest amount of useable data to be collected. This response group will be referred to as the "General Sample".

A separate email and survey link was also sent directly to the Chief Flight Instructors at two aviation institutions that currently have ADS-B coverage and that have the majority of their aircraft equipped with ADS-B. The Chief Instructors were asked to send the email and survey link directly to their flight instructors. The survey they received was identical to the survey sent out to the other points of contact; however the data was tabulated separately. This response group will be referred to as the "Flight Instructor Sample". Based on previous research it was expected that because of their size, there would be a higher response rate from these two particular institutions than other institutions surveyed (FAA, 2010). Because of this there was a fear that the data could become skewed showing that a significant amount of aviation educators currently have and are using ADS-B. By separating the data of these two institutions the study is able to get a more accurate picture of current ADS-B use, while also having the ability to make some comparisons between the two groups.

The survey tool and methodology used was adapted with permission from the study completed by Young and Fanjoy (2002) that was discussed earlier. Their study looked at how glass cockpit training was being addressed in collegiate flight programs, and has a significant amount of similarities to this current study. In 2002, glass cockpit aircraft were considered to be a new technology and many aviation educators were in the beginning stages of trying to implement these systems into their training regimen. Today glass cockpits are more common in aviation training, allowing students to spend a greater amount of time training with this technology.

The survey used for this study consisted of 19 questions. The first several questions related to demographics of individual educator and institution. These questions collected information on the geographic location, individual positions, number of years each subject has worked as an educator and number of hours receiving ADS-B training. It collected the number of students enrolled in each program, location of flight training at each institution, percentage of ADS-B equipped aircraft and the current state of ADS-B coverage.

The next set of questions asked about the importance of ADS-B training and identifies where the majority of ADS-B training is currently taking place. These questions allowed for a comparison of the perceived importance of an older technology such as GPS compared to a newer technology like ADS-B. While past research has shown that GPS training was often ignored in the early stages of its implementation, it is now a significant part of aviation training at all levels. This lack of training in the beginning is said to be one of the reason GPS was delayed in its implementation. These questions look to see if there could be a repeat with ADS-B that could delay the implementation of NextGen.

The same questions could also be compared with the demographic questions to see if there is a difference in perceptions of the importance of ADS-B between educators that currently have ADS-B coverage and those that do not. Many pilots did not understand all the benefits GPS had to offer until they were able to experience it first hand (Norton, 1997). However, due to the expense of a GPS unit, many pilots never used it until several years after it became available, leaving many pilots with the belief that GPS can wait. ADS-B is only currently available in certain parts of the United States, so

many pilots are not able to experience it. This could cause them to think the new technology is not important.

The final section on the survey focused on the training materials that educators are using in order to train their students on ADS-B and the effectiveness of these tools. Subjects were asked to use a five point scale to rate different media tools and methods that are available. Pre-selected options consisted of a lecture method, video presentations, internet trainers and courses, flight training devices or simulators, and training aircraft. There was also a section available for subjects to list any other training methods or materials that they might use that is not pre-selected.

This section also asked questions on the degree that the FAA's input or lack of input has on each educator's level of ADS-B training. This allowed for the comparison of the FAA's training approach with GPS to the current approach with ADS-B. A determination of whether the 2020 deadline is realistic will be made, along with the options that could be offered by the FAA to help aviation educators continue to strengthen their current ADS-B training. The complete survey can be seen in Appendix C.

Data Analysis

Results for research questions one through four will be reported in chapter three and will be discussed and analyzed in chapter four. SPSS statistical software was used with a significant level set at the 0.01 and 0.05 levels (2-tailed) amongst variables in survey questions 4, 7, 8, 10, and 11. The data collected from theses questions will be

pared with qualitative data that was also collected from other survey questions and will be used to find conclusions for research questions one through four.

CHAPTER III

RESULTS

Demographics

There were *N*=85 aviation educators that completed the survey representing approximately 78% of the FAA regions across the country. Of the responding educators, n=1 was from the Alaskan Region (1.1%), n=6 from the Central Region (7.0%), *n*=51 from the Eastern Region (60%), *n*=1 from the Great Lakes Region(1.1%), *n*=0 from the New England Region (0%), *n*=1 from the Northwest Mountain Region (1.1%), *n*=13 from the Southern Region(15.2%), *n*=12 from the Southwest Region (17.6%), and *n*=0 from the Western Pacific Region (0%). Fifteen (*n*=15) of the responses came from the general survey while seventy (*n*=70) of the responses came from the survey sent directly to two institutions with known ADS-B coverage and equipment.

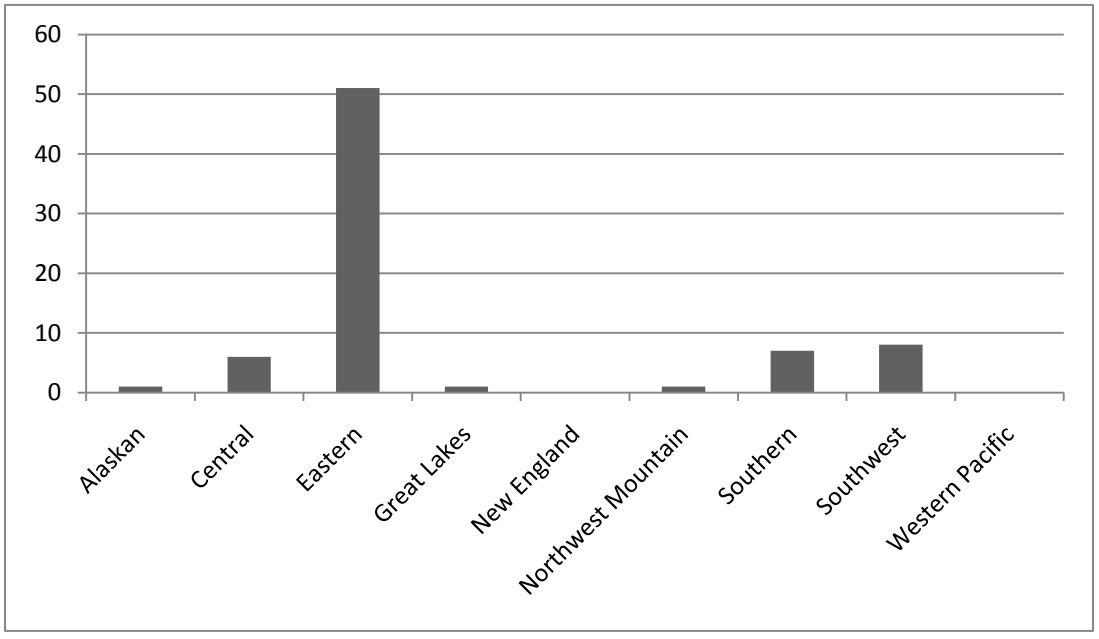

Figure 1. Location of Respondents by FAA Region

A majority, *n*=56 (65.8%) of the participants were line flight instructors, *n*=17 (20%) were chief flight instructors or managers, *n*=6 (7%) were department chairs or directors, and *n*=6 (7%) were professors. The mean number of years the participants had worked as aviation educators was 5.11 with the maximum number of years being 35 and the minimum number of years being less than 1.

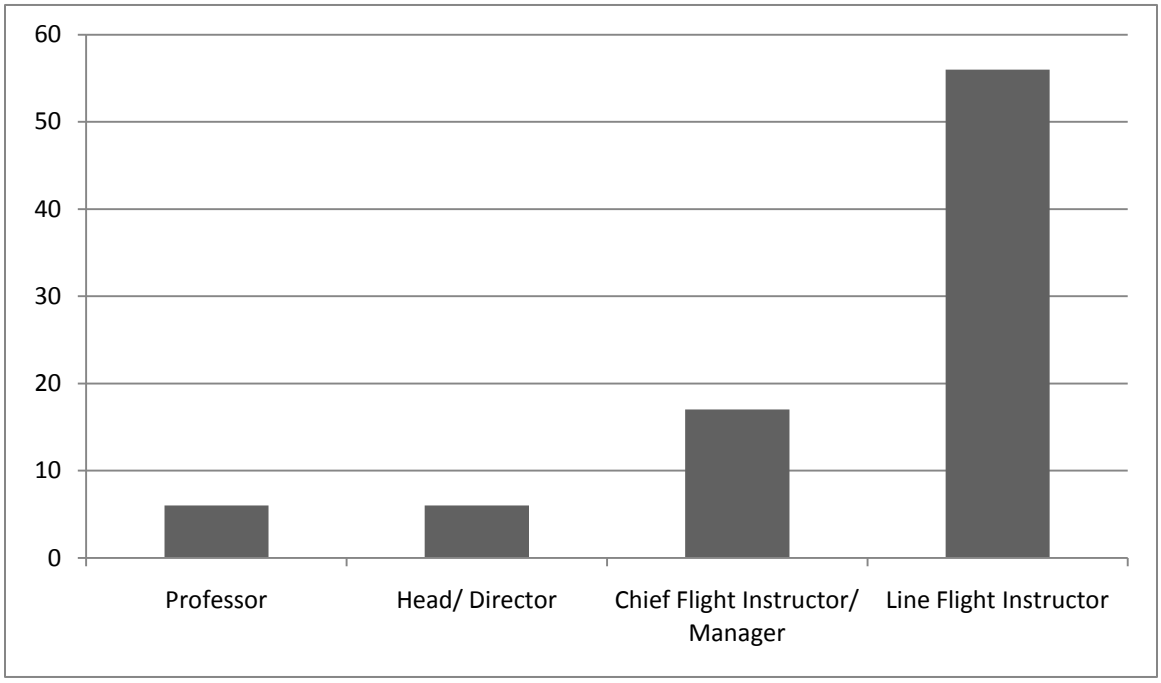

Figure 2. Position of Respondents Within Their Perspective Institutions

The mean number of students enrolled in the flight programs which the participants worked was 757.9 with the maximum number of students being 3,000 and the minimum number of students being 6. Almost all of the participants, (98.8%) *n*=84 indicated their institutions flight training was done in-house with only (1.2%) *n*=1 contracting flight training with someone else.

Current State of ADS-B

When asked about the current state of ABS-B coverage in the participants' geographic areas, *n*=61 (71.8%) stated they had ADS-B coverage while *n*=14 (16.5%) stated they did not have coverage, and 11.9% (*n*=10) of the participants did not answer the question. When broken down further, those participants from the general survey stated that 13.3% (*n*=2) had ADS-B coverage in their regions while 66.6% (*n*=10) stated they did not have coverage, and 20% (*n*=3) chose not to respond. The total sample reported that 78.49% of the aircraft used for training at the participants' institutions are equipped with ADS-B hardware, but only 6.25% of aircraft were reported to have ADS-B hardware from the general survey.

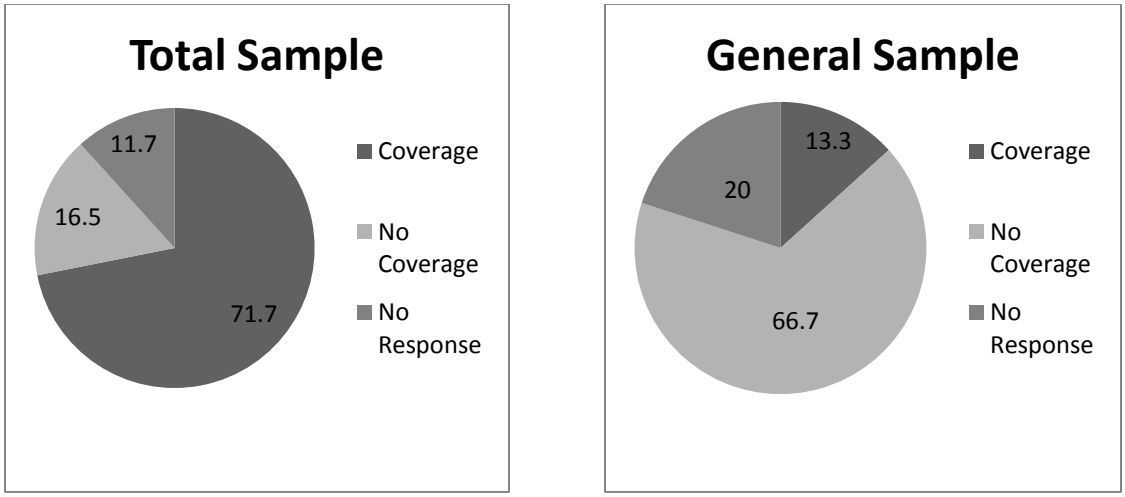

Figure 3. Percent of ADS-B Coverage by Geographic Area

ADS-B Training

Subjects were asked how many hours of ADS-B training their students received. The mean was 19.629 hours with the maximum being 200 and the minimum being .5. Three outliers of 30, 190, and 200 are shown in Figure 4. With the outliers removed from data, the mean drops to 3.06 hours. Subjects were also asked to report how many hours of

training they themselves had received. The mean for this question was 35.88 with the maximum being 1400 and the minimum being 0. Again with this analysis we see outliers of 1400, 450, 270, and 100. With the outliers removed, the mean drops to 1.8. A discussion about the outliers and the difference in the means will take place in the discussion section.

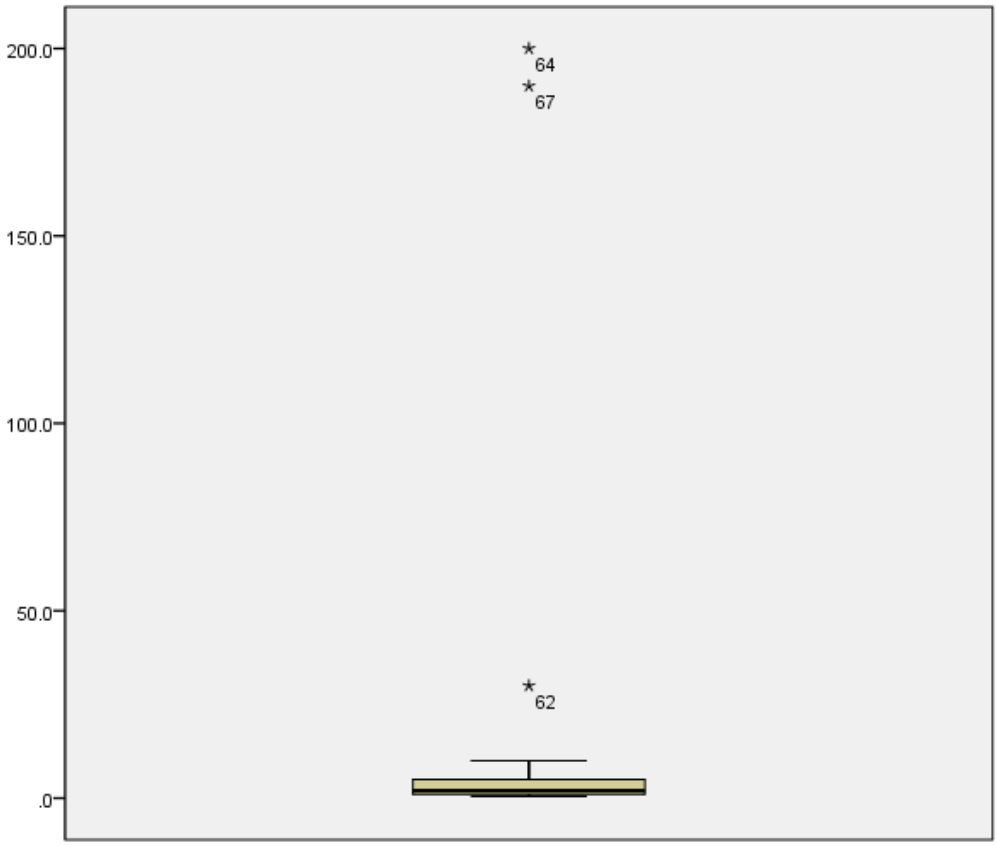

Figure 4. Hours of ADS-B Instruction Received by Students

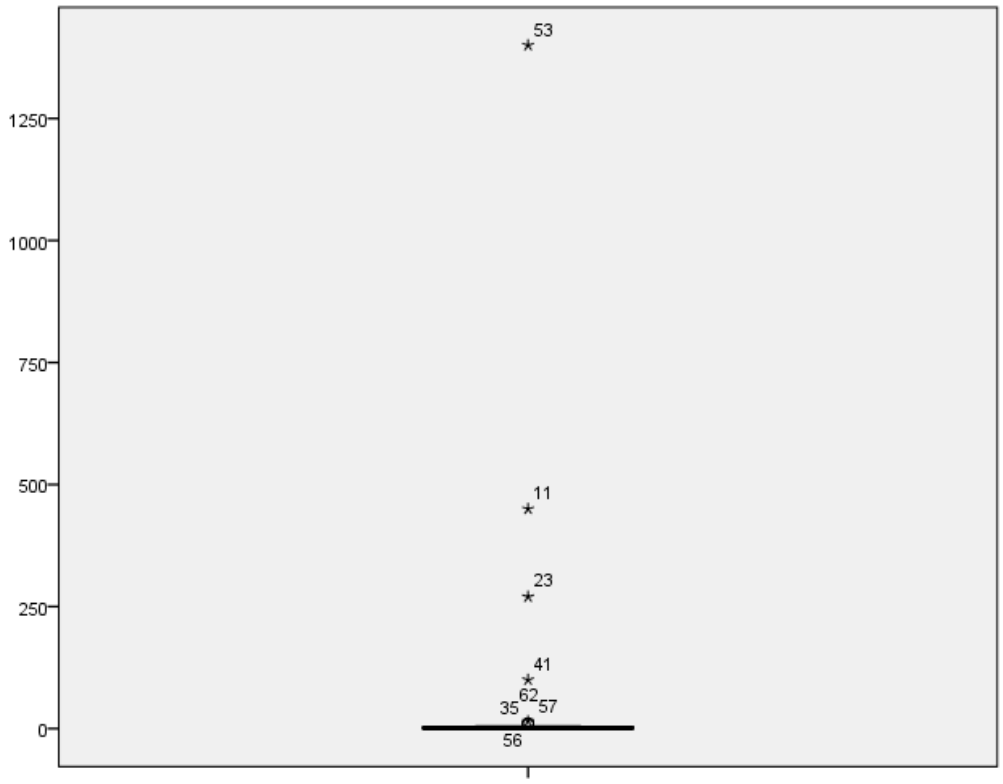

Figure 5. Hours of ADS-B Instruction Received by Educators

Educators were asked if the institutions they work for are currently teaching anything about ADS-B. The response was *n*=50 (58.82%) said ADS-B was being taught while *n*=25 (29.41%) reported ADS-B was not being taught at all, with *n*=10 (11.76%) not responding. When looking at the general survey responses, *n*=5 (33.33%) responded that there was some sort of ADS-B training taking place while *n*=7 (46.66%) reported that no training was taking place. In this group, *n*=3 (20%) chose not to respond. Of the educators that said training was currently taking place in their institutions, *n*=11 (22%) said the training was happening on the flight side, *n*=8 (16%) said it was taking place in ground school, and *n*=22 (44%) said the training was taking place in both ground school and in the flight training, with *n*=9 (18%) not answering.

The educators that stated their institutions did not currently teach ADS-B to their students were asked if they planned to teach it in the near future. Qualitatively, two themes emerged from this question indicating that currently there are no formal plans to start teaching ADS-B in the future, or respondents did not know if their institution had plans to start teaching this technology in the near future.

The majority of the reasons for not training could be placed in three categories. Lack of equipment due to high cost; "Due to the cost of installation, we are likely to only purchase ADS-B out. Since the equipment will work automatically and we will probably not have ADS-B in, the pilots will require only minimal education and instruction" (Respondent 1). Lack of information; "Currently we only have a couple of Power Points that explain the basic function of it. Students could be taught about how it works through a standardized presentation from the FAA and/or the manufacturer of the equipment" (Respondent 2). Lack of understanding the future purpose of ADS-B; "I want my student to develop good visual traffic scanning procedures from the beginning, rather than relying upon ADS-B. Once they can find traffic visually, than I let him/her take advantage of the technology" (Respondent 3).

Training Material & Methods

In order to determine where ADS-B training materials are coming from, educators were asked to list where they find information about ADS-B to teach and train from. The majority of the respondents stated they did not know where to find training material for ADS-B. Those that were able to find ADS-B material indicated they used the internet, or they created their own material. The most positive response came from

educators who had attended workshops put on by the Alaska Capstone Project. It was stated that these seminars provided excellent training and materials.

Subjects were also asked to rate how effective different media and methods were in trying to educate students about ADS-B. The subjects had the option to rate five different training methods on a five point scale, with one representing "Very Effective" and 5 representing "Not Effective". Subjects also had the option to choose "Not Applicable". The greatest response for effective training material was in Training Aircraft with *n*=35, followed by Lecture with *n*=31, Internet with *n*=28, Flight Simulator with *n*=19, and Video with *n*=18. Table 1 shows the subjects response.

Table 1. Selected Responses: Effectiveness of Training Methods

	Very Effective	_	Effective	_	Not Effective	Not Applicable	Response Count
Lecture	2 (6.452%)	2 (6.452%)	23 (74.2%)	2 (6.452%)	2 (6.452%)	0 (0%)	31
Video	2 (11.11%)	9 (50%)	6 (33.33%)	1 (5.56%)	0 (0%)	0 (0%)	18
Internet	3 (10.72%)	7 (25%)	16 (57.14%)	2 (7.14%)	0 (0%)	0 (0%)	28
Flight Simulator	5 (26.32%)	7 (36.84%)	4 (21.05%)	0 (0%)	3 (15.79%)	0 (0%)	19
Training Aircraft	22 (62.86%)	8 (22.86%)	4 (11.43%)	0 (0%)	1 (2.85%)	0 (0%)	35

The highest percentage of effectiveness was seen in Training Aircraft with a mean score of 1.57. The lowest percentage of effectiveness was seen in lecture with a mean score of 3.00. All descriptive statistics for these responses can be seen in Table 2.

Table 2. Descriptive Statistics: Effectiveness of Methods and Media

	N	Minimum	Maximum	Mean	
	Statistic	Statistic	Statistic	Statistic	Std. Error
How Effective is lecture?	31	1	5	3.00	.147
How Effective is video?	18	1	4	2.33	.181
How effective is internet?	28	1	4	2.61	.149
How effective is FTD?	19	1	5	2.42	.309
How effective is training aircraft?	35	1	5	1.57	.155

FAA Input and Training Support

Educators were asked to respond to how the FAA's input or lack of input is affecting their ADS-B training. Themes that were discovered from educators' responses were that the FAA's lack of input had a significant effect on them not being able to train students, and that more guidance from the FAA would help with their abilities to effectively teach about this new technology. One educator responded by saying, "The FAA has done little to educate on this new technology. It seems regulations usually are implemented then education is offered after problems arise" (Respondent 4). Another responded by saying, "The FAA's lack of input affects our training to a very high degree" (Respondent 5). With a third stating, "More guidance on how much detail we should be teaching about ADS-B would be helpful in my training" (Respondent 6).

Respondents were also asked to select types of things the FAA could provide to support ADS-B training. They could select PTS Standards, access to training material, and access to ADS-B equipment. Respondents also had the option to write in responses.

Responses include the following, 35.3% (*n*=30) stated that training material provided by the FAA would help to support their ADS-B training, 27% (*n*=23) said access to ADS-B equipment would help, while 18.9% (*n*=16) said PTS Standards would be helpful. Other write-in comments suggested the FAA could provide online training materials, ADS-B simulators, and ADS-B broadcasted nation wide.

Importance of ADS-B Training

Respondents were asked how important ADS-B training is to meeting the goals of their curriculum. Of the total sample, *n*=28 (32.9%) said it was "Very Important", *n*=29 (34.1%) said it was "Somewhat Important", *n*=18 (21.2%) said it was not important, and 11.8% (*n*=10) did not answer the question. From the general sample, *n*=1 (6.7%) said it was "Very Important," *n*=5 (33.3%) said it was "Somewhat Important," *n*=6 (40%) said it was "Not Important," and 20% (*n*=3) did not respond. In the flight instructor sample, *n*= 27 (38.6%) said it was "Very Important," *n*=24 (34.3%) said it was "Somewhat Important," *n*=12 (17.1%) said it was "Not Important," and 10% (*n*=7) chose not to respond.

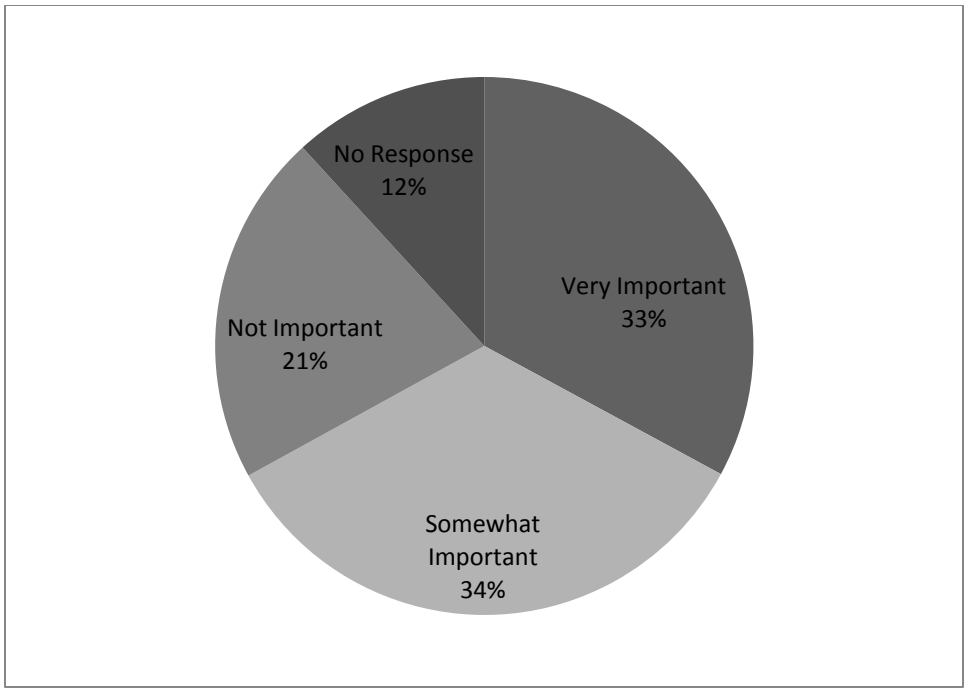

Figure 6. Total Sample: Importance of ADS-B in Curriculum

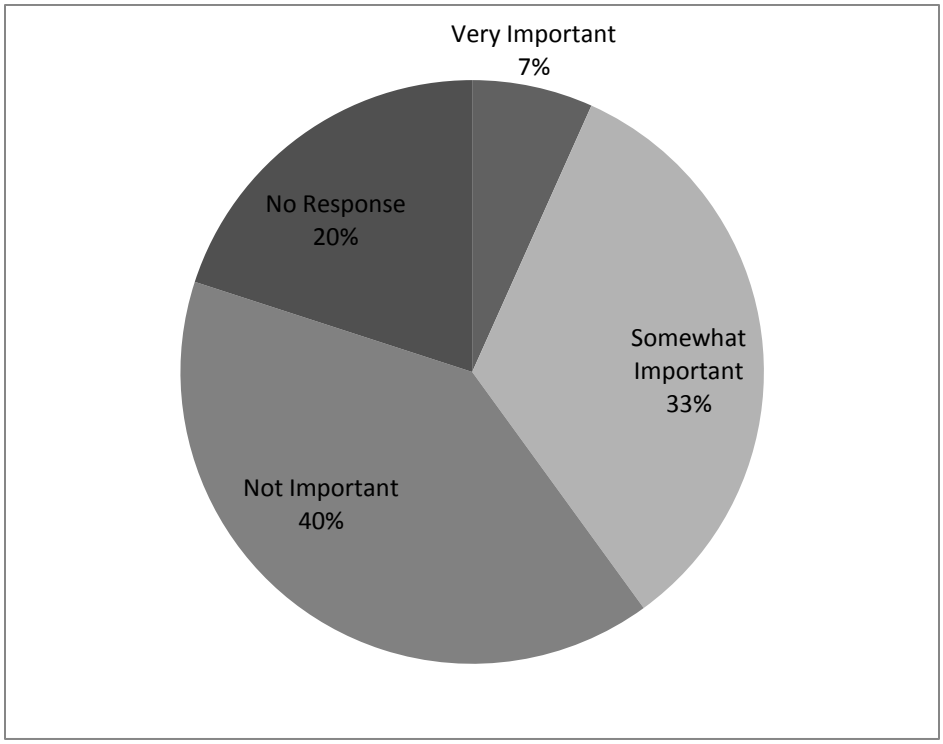

Figure 7. General Sample: Importance of ADS-B in Curriculum

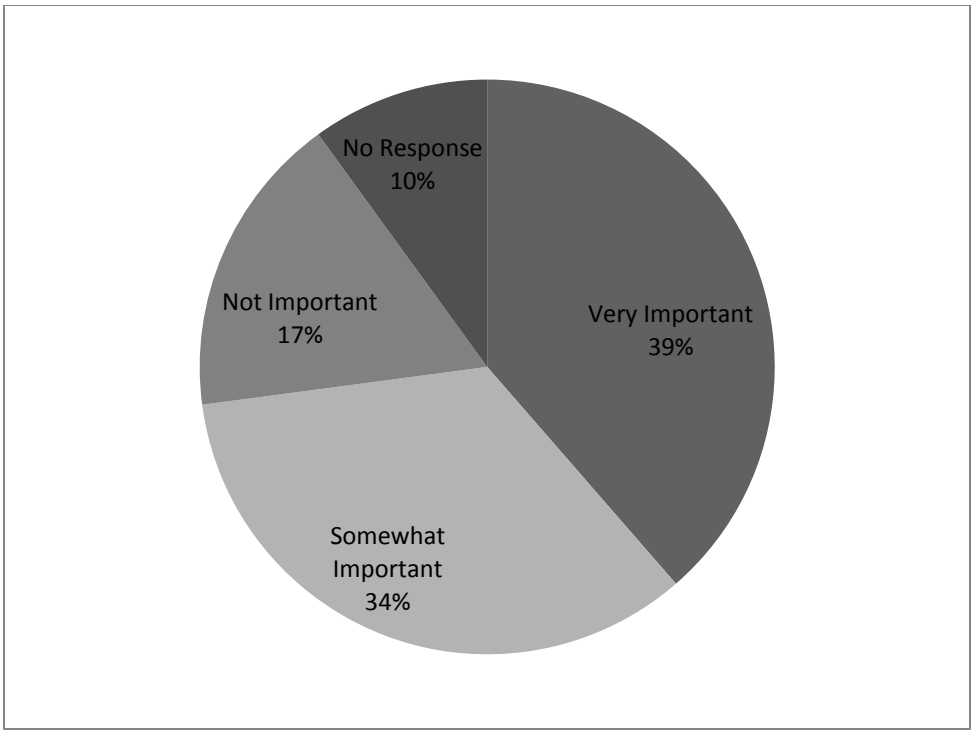

Figure 8. Flight Instructor Sample: Importance of ADS-B in Curriculum

Perceived Importance of ADS-B Training

Survey questions (4, 7, 8, 10 and 11) can be viewed in Appendix C and results will be discussed in Chapter IV. The variables evaluated were: institutions that currently teach ADS-B vs. those that do not, years worked as an aviation educator, hours of ADS-B training received, ADS-B coverage, and a comparison of the general population vs. the flight instructor population. T-Tests were utilized for comparisons with two means, while One-Way ANOVA was used for groups with more than two means.

There was significant effect found for the perceived importance of ADS-B training between samples, t (73) = -2.79, $p < .007$ with the flight instructor group perceiving ADS-B training to be more important than the general sample which consisted of mostly professors and administrators.

Significance was also found between perceived importance and whether educators worked in institutions that were currently teaching ADS-B, t (73) = -3.11, $p < .003$ with educators working in institutions that teach ADS-B finding the training more important than those that do not.

There was no significance found when comparing the perceived importance of ADS-B training to the number of years a respondent had worked as an aviation educator, $F(1,73) = .44$, $p < .508$ or the number of hours a respondent had received ADS-B training, $F(1,60) = .15$, $p < .699$. There was also no significance found when comparing the perceived importance of ADS-B training to whether an educator's geographic location has ADS-B coverage, t (73) = -1.88, $p < .063$. While the study found no significance for these variables, some interesting trends were discovered that will be discussed in chapter IV.

CHAPTER IV
DISCUSSION
Current Level of ADS-B Training

The results of this study indicate that currently there is a minimal amount of ADS-B training taking place across the country. Some of the training that is happening appears un-standardized, sporadic, and untested. Of the total sample (N=85), it was reported that the average number of hours that students were receiving ADS-B training was 19.629 (Figure 4). In the earlier chapter, it was also reported that with three outliers removed the average drops dramatically to 3.06 hours of training. It is believed that the mean with the outliers removed produces a more accurate reading of the current state of ADS-B training. It is extremely unlikely that any student would receive 30, 190, or 200 hours of ADS-B instruction during their flight training. It is more likely that the respondents interpreted the question as asking how many hours their students train in an aircraft with ADS-B technology. The three outlier responses would be more appropriate for this question.

The same response occurred with the number of hours of ADS-B training the aviation educators stated they had received. The mean for this question was 35.88 with multiple outliers (Figure 5). If the outliers are removed, the average again drops significantly to 1.8. As discussed before, this would seem to be a more appropriate mean to the question. The means for these questions were reached by using the numbers from the total sample. This indicates, even with the responses from two institutions that are

known to have ADS-B coverage and have roughly 92% of their aircraft equipped with ADS-B technology, that still only a small amount of time is spent educating students about this technology. When looking at the responses from the general sample, the mean drops to 0.46 hours of training. Again, due to the small size of the general sample, this number may fluctuate with future studies, but it is an indication that currently very little time is spent on ADS-B training.

The conclusion that only minimal training is currently taking place is also seen in the percentage of institutions that are currently teaching ADS-B technology. It was reported that of the total sample, 58.82% were teaching ADS-B in some form. This would seem to suggest that over half of all institutions were training on this new technology. However, once again the total sample of this study includes numerous survey responses from two institutions which were known to have ADS-B coverage and have ADS-B equipped aircraft. These institutions were also sent the survey directly instead of through the UAA representative. Because of this, we must look at the responses from the general sample that were collected through the use of the UAA representatives. This group indicated that only 33.33% of the institutions are teaching ADS-B technology to its students.

This is a more accurate representation of the general population of aviation educators across the country. However, with only having n=15 responses in the general sample, it is likely that the percentage of institutions currently teaching ADS-B is even lower than what this study reported. Further study would have to be done in order to confirm this hypothesis, but the results of this study combined with previous research would suggest this to be true.

The educators that stated their institutions are not currently teaching ADS-B were asked if they felt their institution was planning on teaching ADS-B in the future, and to explain their answer. The majority of the qualitative responses indicated that there are currently no formal plans to teach ADS-B in the future, with one of the largest reasons being a lack of equipment and coverage. Data from his study indicated that currently only 13.3% of the respondents from the general sample had ADS-B coverage in their geographic areas, with 66.7% reporting they did not have coverage. Again, due to the small number of responses from the general survey, it is difficult to say for certain that this is an exact representation of the country, but the responses in the general survey did cover five of the nine FAA regions.

Current Training Methods

When looking at the training that is currently taking place, this study showed that the information being presented by educators was being collected from several different sources. The majority of the respondents indicated they collect material through the use of the internet, or create their own material, with only one educator indicating they use the FAA website.

Results from this study also supported past research, with educators reporting that using training aircraft is the most effective way to train students on ADS-B technology. Previous research showed that, with the implementation of GPS, educators felt that hands-on training with the equipment was the best way for students to learn about the technology, and because of the cost of the GPS units, many educators were unable to

train their students (Norton 1997). While responses did indicated that lecture, video, internet, and FTD are also effective, training aircraft was seen as the most effective.

One of the most common trends seen in the current training responses was that the majority of the educators currently teaching ADS-B considered it to be nothing more than a traffic advisory service. They stated, since there were no standards or guidelines for training, they educated their students to use ADS-B as a traffic advisory service. Only a couple of responses seem to have an understanding of what the FAA hopes the future of ADS-B will entail. Many compared ADS-B to TCAS and felt as though their students could simply learn how to use the technology through trial and error.

Importance of ADS-B Training

Along with determining the current level of ADS-B training that is taking place in the United States, the purpose of this study was to determine how important aviation educators believe this training to be. Figures 4, 5, and 6 show the responses from the three different groups that were polled.

In this study we saw that when we compared how important educators believed ADS-B training was to how many hours of ADS-B training they had received, there was no significance. The same was true when importance was compared to the number of years worked as an aviation educator. Based on past research, it was thought that those educators with more ADS-B training and those educators with more years working as an educator would find ADS-B training to be more important. However, with the average number of hours of ADS-B training received by the respondents only being 1.8, it seems

that more training will need to take place in order to determine if ADS-B will follow the trend of past technology such as GPS.

While there was no significance found between importance and hours of training received by educators, or importance and years worked as an educator, there was significance found between the two different sample groups. It was discovered that the flight instructor group indicated ADS-B training to be significantly more important to their curriculum than the general group sample. Because this relationship cannot be tied to more training, or more time spent as a flight instructor, it is assumed that the relationship is due to more time using the ADS-B technology.

The flight instructor group consists of educators that work at institutions with ADS-B coverage and with 92% of their aircraft equipped with ADS-B technology. Because of these numbers and several qualitative responses, the study can assume that the majority of their flight time is spent in aircraft with ADS-B technology. Therefore, it is concluded that the more time someone spends using ADS-B, the more important they believe it is. These results are consistent with past studies involving technology such as GPS (Norton, 1997).

In order to further the idea that the perceived importance of ADS-B training is increased by the amount of time an individual spends using the technology, the study compared if those educators that work in areas with ADS-B coverage feel ADS-B training is more important than those educators that work in areas that do have ADS-B coverage. This comparison was made because it seems likely that those educators training students in areas that have ADS-B coverage are more likely to be using the technology. The results of this comparison were not found to be significant, however it is

believed that a trend did occur that would support this theory, and if further research is done involving a larger number of participants, a significant result may occur.

A significant finding also occurred when the study compared educators that are currently working in institutions that teach ADS-B to educators that work in institutions that do not currently teach ADS-B. Results show that educators working in institutions that currently teach ADS-B believe the training is significantly more important than those that are working in institutions where no ADS-B training is taking place. These results add support to the earlier findings that educators who spend more time working with ADS-B, view the training in a more positive light.

As was seen in earlier questions, the majority of institutions that are currently teaching ADS-B are the same institutions that are in geographic areas with ADS-B coverage and with a high percentage of ADS-B equipped aircraft. This again suggests that educators who spend more time working with ADS-B perceive its training to be more important than those that spend less time working with the technology.

Implications and Solutions

ADS-B implementation seems to be following a path that was seen with earlier technologies such as GPS. According to Norton (1997), it was similar issues, such as the cost of GPS equipment, and lack of training standards, that caused the delay in the implementation of GPS. Currently, only a minimal amount of ADS-B training is taking place across the country. This study has shown that the reason for this is due to a lack of ADS-B coverage, high cost of ADS-B equipment, lack of material, and no definable

training standards or goals. Also, the training that is taking place is defining ADS-B as a traffic advisory service and allowing most students to learn by trial and error.

The concern with following this trend is that air traffic is projected to triple over the next several decades. Next Gen is the FAA's solution to handling this traffic increase while trying to maintain the current level of aviation safety. Because of this, ADS-B implementation seems to have less flexibility then GPS, and, therefore should be approached in a more aggressive fashion.

Educators reported that traditional training methods, such as lecture, videos, and internet, are effective, but it is the hands-on experience in flight simulators and training aircraft that provide the most effective training environment. Past research dealing with technically advanced aircraft support these findings when implemented with scenario based training (Ayers, 2006). Respondents also stated that more training materials and training guidelines would allow for a more efficient approach to training students.

The most successful ADS-B educators that responded to this study were those involved with the Alaskan Capstone Project. This has been one of the most aggressive ADS-B programs in the country. This program holds seminars and training courses for pilots to learn about the new technology. It afforded pilots access to equipment and low interest loans in order to provide access to ADS-B equipment. This program made it possible for ADS-B to become a primary tool for almost all pilots in Alaska. This study suggested that a similar approach should be taken to increase the efficiency of ADS-B implementation for the rest of the country.

Along with creating similar capstone programs, the aviation community needs to become aware of the overall goal of ADS-B. One of the most alarming findings of this

study was the common idea that ADS-B is simply a traffic advisory service, or a luxury. There is no sense of urgency from educators that ADS-B is needed. Capstone Programs would not only help support educators in the ADS-B training process through purchasing equipment and creating training standards, but they would also help all aviators understand the current level of need for ADS-B and NextGen.

Future Research

ADS-B is currently in the very early stages of the implementation process. A significant amount of information was gathered about current training methods and about what could be done to help improve those methods. However, as ADS-B coverage continues to increase across the country, there are many different areas that will need to be studied.

Currently, there are no training standards in place for ADS-B. In order for the FAA to implement NextGen and to reach its ultimate goal of free flight, future studies will need to be done to create effective training methods and standards. In this study, we saw that training aircraft were rated to be the most effective training tool for ADS-B. However, it was also discussed that lack of other training options such as simulators or classroom material could be one of the reasons for this finding. Future research should be done to determine if an increase in training options such as classroom material, and simulators would affect these findings.

Another area for future study is the perceived importance of ADS-B training. Currently, ADS-B is looked at as a luxury, and no real urgency exists among aviation educators. In order for ADS-B to develop in a timely manner, educators need to

understand the importance that training plays in the implementation process. While this study suggests that increased exposure to the technology causes educators to view ADS-B training as more important, studies should be done to determine other possible avenues to improve aviation educators understanding of the importance of ADS-B training.

NextGen and ADS-B are the future of our air transportation system. As their implementation process continues and ADS-B coverage expands, continued studies will be necessary to insure that pilots are properly prepared for the Next Generation Air Transportation System.

APPENDICES

Appendix A

Recruitment Notice

The following letter was distributed via email by the researcher to the contact persons for 49 institutions listed in the University Aviation Association's Collegiate Aviation Guide (2008) that offer flight/pilot programs.

Greetings,

My name is Andy Leonard, and I am a graduate student in the Department of Aviation at the University of North Dakota. Currently, I am in the process of collecting data for my thesis and am contacting you to ask for your help and participation. You are listed as the point of contact for your institution in the University Aviation Association's "Collegiate Aviation Guide" and I collected your contact information from this source.

As I am sure you are aware, one of the key components to the FAA's Next Generation Air Traffic Control System (NextGen) is the implementation of a satellite based system referred to as the Automatic Dependent Surveillance – Broadcast System or (ADS-B). The FAA currently has in place a mandate requiring all aircraft to be equipped with part of this ADS-B technology by the year 2020. While the ADS-B System has slowly been implementing itself across the United States over the last several years, it has proven its ability to provide pilots with a significant amount of information.

My thesis is looking at how aviation educators are choosing to teach their students about this new technology. With no current ASDS-B training standards in place, I hope to be able to find trends that could help to develop a training regimen for aviation educators to use in the future. I am also interested to learn where there is currently no ADS-B training taking place, and why. Part of my research has been looking at the struggles that aviation educators face when a new technology is mandated by the FAA. If I can find trends in why educators are not yet teaching ADS-B to their students, it might show ways the FAA could help educators with implementing this new technology.

Below is a link to a survey that I developed to answer the above questions. I am hoping you would be willing to forward this email and survey to anyone in your institution who plays a role in educating your aviation students. This could be professors, flight instructors, administration, or anyone else in this role. Even if your institution does not currently have ADS-B coverage or some individuals do not teach ADS-B, I would like to

get their responses. As I mentioned above, part of my study is looking at why some educators are not yet teaching this new technology.

I would like to thank you in advance for your help and participation in my project. The survey itself is fairly short and should only take a few minutes of people's time. If you have any questions, please feel free to contact me either by phone or by email.

Thank you,

Andy Leonard
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Appendix B

Survey Introduction

The following is the message all participants saw prior to starting the survey.

I am conducting a survey of UAA schools to determine the methodology and types of training materials used by collegiate aviation educators to teach ADS-B technology in their flight curriculum. The information will remain anonymous. I would like, however, to publish the results so that other educators can see what is being done in this area. Would you being willing to participate? YES _____ NO _____

Appendix C

Survey Questions

Select the region your institution is located in.

Alaskan / Central / Eastern / Great Lakes / New England / Northwest Mountain / Southern / Southwest / Western Pacific

1. What is your position within the institution?

   Professor Flight Instructor Course Manager Administration Other:

2. How many years have you been working as an aviation educator?

3. How many hours of ADS-B training have you received?

4. How many students are currently enrolled in your institutions flight/pilot program?

5. Where is your institutions flight training currently completed?

   In-House Contracted Optional

6. Does your institutions geographic area currently have ADS-B coverage?

   YES NO

7. What percent of your institutions training aircraft are ADS-B equipped?

8. Does your institution currently teach ADS-B technology to your flight students?

YES NO

9. How important is ADS-B training to meeting the goals of your own curriculum?

very important		somewhat important		not important
5	4	3	2	1

10. **If NO to #8**, does your institution plan to teach ADS-B technology to your flight students in the near future? If so, how will you go about training students?

-end of interview-

11. **If YES to #8**, where is ADS-B training taught in your curriculum?

Flight Side Ground School Both

12. Approximately how many hours of ADS-B instruction do your students receive?

13. How did you go about finding appropriate ADS-B training materials/equipment?

14. What media and methods are used to share ADS-B information with students? How effective do you feel that each of these is – based on a 5-point scale? (circle all that apply)

	very effective		somewhat effective		not effective	
lecture:	5	4	3	2	1	N/A
video:	5	4	3	2	1	N/A
Internet:	5	4	3	2	1	N/A
Simulator:	5	4	3	2	1	N/A
Aircraft:	5	4	3	2	1	N/A
Other:	5	4	3	2	1	N/A
Other:	5	4	3	2	1	N/A

12. To what degree is the FAA's input, or lack of input a factor in your ability to provide suitable ADS-B training?

13. What types of things could the FAA provide to support your ADS-B training needs?

PTS Standards | Access to Training Material | Access to ADS-B Equipment

Additional Comments:

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