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A Historical Perspective On Aviation Flight Training And Education

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A HISTORICAL PERSPECTIVE ON AVIATION FLIGHT TRAINING AND EDUCATION

by

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This dissertation, submitted by Brandon Wild in partial fulfillment of the requirements for the Degree of Doctor of Philosophy 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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Title	A Historical Perspective on Aviation Pilot Training and Education
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Brandon Wild
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TABLE OF CONTENTS

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Chapter 1

Overview and Introduction to Training and Education

Introduction

On December 17, 1903, at 10:35 AM in Kitty Hawk, North Carolina, Orville Wright headed down a wooden track in a machine designed and built by him and his brother Wilbur. At the end of the 100 ft. track, the machine lifted into the air and flew 120 ft. with the flight lasting 12 seconds. This was the first powered airplane flight. Later, Orville was asked if he had been scared. He said: "Scared? There wasn't time!" (McCullough, 2015, p. 155).

Aviation training has been taking place since that very first flight undertaken by the Wright Brothers. Aviation education began even before that first flight. As a skill based endeavor, training is an essential aspect of aviation. Training and education prepare the future aviators to become involved in flying and aviation. Each generation of aviators must learn from the previous. Training and education in aviation is made up of several different aspects, taking place during different periods of time and evolving to fit the needs of these time periods. This dissertation is a historical examination of these different categories of aviation. These categories (each one being a separate chapter) include:

- The Early Years
- Government Acts and Regulation
- College and University Training and Education
- Wartime Training
- Airline Training
- Aviation Training in the Modern Age

The order for the chapters was based on the importance of each subject in the history of training and education, with the dates of occurrence being a secondary way to order these chapters. Beginning with the Early Years seems a logical place to start, as the Wright Brothers began powered flight, and thus, aviation training. Choosing to curtail the early Years in the 1930s, gave overlap to Government Act and Regulation in Chapter 3, as the first Act discussed is the Air Commerce Act of 1926. College and University Training in Chapter 4 may have begun before powered flight in 1903, but most college aviation programs began in earnest in the 1920s. War Time Training (Chapter 5) mainly cover the World War II, the Korean War, and the Vietnam War as earlier military flying is covered lightly in Chapter 1. As the Korean War came to a close, the jet age was beginning. This seemed a good place to pick up Airline Training, Chapter 6, as most airline training programs become extensive with the advent of the jet. The dissertation finishes with the Modern Age and a wrap up in Chapter 7.

Historical Themes in Aviation Training and Education

The decision to divide this dissertation was also based on the themes seen throughout the history of aviation training. These themes are technology as a driver of change and one on one training (experiential learning). These themes resonate though the entirety of this dissertation. These two themes are seen throughout the history of aviation education and training, and at times they work in concert with each other, while at times they can be in direct conflict with each other. This disparity can be interpreted as a theme in itself. I will explore and show this as well.

Technology has been one of the most prevalent aspects of aviation from the very beginning. Without technology such as the internal combustion engine, powered flight would not have become a reality. As technology evolved and new technologies emerged, aviation changed as well. With aviation changing and evolving, aviation training and education had to

change as well. But, separately, aviation training and education changed. These changes will be explored in the chapters to come.

Experiential learning as a theme evolved from the onset of aviation. As we will see in Chapter 2, the Wright Brothers were using experiential learning to teach new pilots one-on-one in their new invention, the airplane. The Federal government thought experiential learning to be such an important piece of aviation training that, with the passage of the Air Commerce Act of 1926, they set a minimum number of hours an aspiring pilot must have. Included in this hour requirement was a minimum number of one-on-one training, or experiential learning. This will be explored in more depth in Chapter 3.

From the first flights of the Wright brothers and Glenn Curtis training became an integral part of aviation. These pioneering aviators had to be the ones to teach their craft to those who would be the next pilots. World War I brought new challenges to the training environment, as did the post war period of air mail and the beginnings of what we now know as commercial airlines. World War II brought increased challenges, the main one being how to train the large amount of pilots needed for the war effort. World War II also brought technological advances in aviation that required new training techniques and advancements. As military aviation training could be an entire book in itself, I chose to concentrate on the effect that war time had a on flight training and education, concentrating on the technology changes and experiential learning that took place during war time periods in military aviation history.

Post World War II saw the rise of college and university training along with advanced training becoming more important due to the introduction of jet aircraft. Technology, along with changes to aviation policies has continued to contribute to the large changes to aviation training as we have moved towards modern times. Current works on the subject cover various time

periods or subjects, but do not cover the subject as a comprehensive work. Other works have covered important aspects of aviation such as World War II or the Airway Science Act of 1981, but again, have only covered small aspects or short periods of time aviation training. There is no comprehensive, broad, history of aviation training.

This dissertation examine the history of aviation training, from the earliest training and educational techniques used by the Wright Brothers to today's technologically oriented training methods. The central importance of this book is that it will be a comprehensive history of aviation training. As integral a part of aviation that training and learning is, this dissertation becomes an important aspect to the documentation of aviation history. In some way, this is my purpose. While I have an "official" research purpose and question (coming up next), I wanted to add something to the overall historical context of aviation.

Author's Perspective

As an aviation professional for over 20 years, I have the unique perspective and background to analyze and interpret the themes in aviation training history. I have experienced experiential learning in aviation training as I earned my private pilot certificate. Teaching aviation at two different universities gives me the knowledge of how the education piece fits into the overall training and education puzzle. As an analyst and, later in my career, a manager in the area of flight data analysis, I also understand the importance of technology in aviation. All told, my aviation experience spans over 20 years working for four different major airlines, one aviation insurance company and teaching aviation at two universities.

Research Purpose and Questions

The purpose of this dissertation is to examine aviation training from the Wright Brothers' first powered flight in 1903 until present, and even a bit of a look into the future. I use biographies, journals, textbooks, and archived documents to interpret and describe how aviation training has evolved based on technology advancements, government acts and policies, and relevant historical events. The research questions answered are:

1. How has aviation training evolved over the course of time from 1903 to present?
2. What technologies, government acts, policies, and events have had a major impact on aviation training?
3. Who are the aviation pioneers and personalities that have steered the evolution of aviation training?

Historical Research in Aviation Training and Education

Even as specific research questions are answered this dissertation will become a comprehensive history of aviation training. When researching the history of aviation, what is interesting to note is the lack of a comprehensive text, or piece of literature, on the history of aviation training. The existing material on the subject includes various biographies, history texts, and articles on individual facets of aviation training history. These facets include pieces of military training, historical pieces regarding civil aviation history, and personal accounts of training and learning. I have not only compiled information from existing historical pieces and documents, but I have added archival material from various university and public library sources to create a comprehensive history of aviation training and learning. By accomplishing this, I

show the key elements of aviation that bind all of the individual documents, personal accounts, and previous texts on the subject.

Types of Data Sources in Aviation Training History

Primary Sources

Primary sources are the best way to get what a historical researcher hopes is the most accurate account of the specific event or topic in question. Autobiographical pieces are historical in the sense that they are coming right from the person who was experiencing the event. They should be the best story of a person's life. Some primary sources from aviation history that include a training component:

Amelia Earhart's final work, "Final Flight," was published by her husband after her disappearance in 1937. It includes aspects of her training and preparation for her trip around the world. These are interesting on their own as the reader can glean some insight into how Amelia Earhart learned how to fly. But, Earhart also describes how aviation training was accomplished in the broad sense as well (Earhart, 1937). These descriptions become very important in the research aspect of aviation history. Amelia Earhart is considered a pioneer in aviation and having descriptions, in her own words, on aviation training becomes an important source to be used in aviation training historical research.

Another early aviator with a very useful autobiography for aviation history research is Beryl Markham. Her book, "West with the Night," (1942) describes her flying experiences during the 1920's and 1930's in Africa and as the first person to fly east to west solo across the Atlantic Ocean. Her book has firsthand (primary source) descriptions of early aviation training practices in Africa (Markham, 1983).

Government documents such as the various aviation acts that have shaped the history and path of aviation are primary sources that are also important. The Air Commerce Act of 1926, the Civil Aeronautics Act of 1938, and the Federal Aviation Act of 1958 (usa.gov) are all acts that have had a profound impact on aviation training.

Secondary Sources

Secondary sources are more numerous in historical research, but should be thought as secondary to primary sources. Aviation history books and articles are a secondary source, and there are a plethora of these. Beginning with the early days of aviation, there are books that outline early training history. Historic military training is outlined by Hennessy (1985) as he wrote about the early days of U.S. Army aviation in "The United States Army Air Arm, April 1861 to April 1917." The beginnings of aviation and aerospace formal education at colleges and universities is described in various secondary sources including from the websites of the University of Michigan (U-M Engineering), Massachusetts Institute Of Technology (A Brief History…), Embry-Riddle Aeronautical University (History), and the University of North Dakota (McGuire, 2007).

These secondary sources become important to gain additional context beyond the primary sources. This context is important, depending on where the secondary source is coming from. The previous examples are important as they support primary sources by giving a perspective from the institution itself. Such as a university or the U.S. Army. The secondary sources outlined below are important, because they support primary source documents by adding a human element to the overall picture.

Biographies are also a good secondary source. Many historical figures in aviation have been profiled by biographers and each seems to have a training aspect to their life. Examples of aviation biographies that are secondary sources include:

George Fife (1927) wrote about Charles Lindbergh's historic flight across the Atlantic Ocean, but also the aspects of Lindbergh's training. Fife describes how Lindbergh began flying, but ended up stopping until he actually purchased an airplane himself. At this point he finished his training by teaching himself the remaining knowledge that he required (Fife, 1927).

Wilbur and Orville Wright are profiled in McCullough's biography, "The Wright Brothers." His description of the Wright Brothers ascension to the first to participate in powered flight has a training aspect to it. As the brothers are attempting to sell aircraft to the French, McCullough describes the aspects of training being offered by the Wright Brothers (McCullough, 2015).

Tertiary Sources

Tertiary sources are those that compile, list, and summarize other sources. Journal articles written by aviation researchers are a source of information that can be a good tertiary source of information (University of Minnesota, 2015). These tertiary sources include:

Journal articles by Higgins, et al (2013) and Bjerke, et al (2016) include information about new rules effecting aviation training and pilot requirements. Textbooks such as Wensveen's (2015), "Air Transportation, a Management Perspective," and Wild and Ullrich's (2015) "Aviation Safety - the Basics" are also tertiary sources. These books offer information on modern training practices used by airlines and other aviation training organizations.

Each source is important in its own right as it covers a particular aspect of aviation history or aviation training history. Primary sources give us that first-hand look into what training was really like in the beginning, and what it is like now. Accounts from pioneer aviators like Amelia Earhart and Beryl Markham offer the reader these accounts. Secondary sources are much more numerous, but may not have all the details as the primary sources. They offer good descriptions and analysis of what was occurring and the author's insights can be a descriptor of the historical account. The majority of the information used in this dissertation was from secondary sources. Tertiary sources filled in the spaces with information not available from primary and secondary sources. These particular pieces were great sources for statistics and numbers about aviation and training. By compiling these sources into one document, the reader gets a whole picture of the history of aviation training and education and, a story is created. This story becomes a complete history of aviation training, one that gives the reader a comprehensive guide to the history and the themes that bind it together.

When able and available, primary source documents were used in this dissertation as these provide the descriptions and documentation of the subject in the most unbiased manner possible. If a primary source was not available for a subject that was needed, I relied on secondary sources. It is important to note that using both primary and secondary sources as a way to triangulate the data whenever possible. Triangulation using both primary sources, supported by supported by secondary sources lends credibility to the subject at hand. Secondary sources, being someone's observation and interpretation of a subject or occurrence, has to be understood that the secondary source will have some possible bias in that interpretation. Understanding this bias, secondary sources can be great support for primary sources.

Relying solely on a secondary source was used only if the primary source document was not available, or found. An example of this is in Chapter 3, the description of early pilot certificate requirements by the Department of Commerce after the passing of the Air Commerce Act in 1926. Finding a primary source document proved difficult. The original documentation by the Department of Commerce proved difficult to find, as oversight of aviation certificates and regulation has since moved to the FAA. A I was not able to find the primary source document from the Department of Commerce, I relied on a secondary source, Amelia Earhart (1932), as she described the Department of Commerce requirements for pilot certificates at the time.

Strategies for Researching Aviation Training History

I began this dissertation by first examining what historiography is, concentrating specifically on aviation training, and what makes it important. By researching historiography, I was able to determine the best primary, secondary, and tertiary sources to use for this dissertation. The information in the sources was investigated and analyzed for information on aviation training and education. Beginning with very broad key word searches, such as "aviation training," "aviation education," and "training history," I was able to begin to find sources that might work for a dissertation on the subject. Specific people and institutions identified as important in this dissertation was a subjective assessment based on my aviation knowledge and experience outlined earlier in this chapter. People and institutions that have contributed in important ways to aviation were chosen for this. Examples of people include Amelia Earhart and Charles Lindbergh as these individuals had notable aviation accomplishments and thus, their training could be perceived as being fairly interesting. Institutions of higher education outlined in Chapter 4 such as the University of Michigan and The Ohio State University were deemed important because of the early aviation education they offered at a time when aviation was just

beginning. Government acts and policy were examined and analyzed for pieces or areas that may have had an impact on training and education.

Close to 400 possible sources were examined, with 134 eventually used. Primary sources were the most important to this dissertation for reasons outlined earlier in this chapter. After identifying the primary sources for information on aviation education and training, secondary sources were then examined for triangulation and to supplement primary and secondary sources. Interpretation and analysis of secondary sources was accomplished, with the secondary sources that best supported the primary sources being used for this dissertation. Once the sources were identified, relevancy to the specific chapters was decided. The decision on where these specific sources or information sorted in to could depend the era or time period it occurred in, or it could be the subject, such as an item of military or airline history. Emergent themes, such as experiential learning and technology changes and advances began to emerge and guide the direction of the dissertation. As described earlier in this chapter, the specific requirements of each chapter were decided early on in the research, as I wanted to be able to categorize what I deemed important information in a timely manner. Early on in the research process, categories began to emerge that would eventually become the chapters found in the dissertation.

Aviation archives at various museums (aviation and otherwise) contain aviation history information, including that of training history. I visited the Glenview (Illinois) Public Library and was admitted to their local history section. This local history included information on the former Glenview Naval Air Station.

The websites of university libraries contain many early aviation archival material. For example, the Auburn University library website states: “Auburn University supports academic programs in aviation engineering, aviation management, and the history of technology,

particularly the history of flight. Consequently, Special Collections & Archives has developed manuscript and archival holdings related to aviation and aerospace" (www.lib.auburn.edu). Material that is related to aviation training in the Auburn archives include University Aviation Association records from 1947 -1979 and diaries and correspondence from Eddie Rickenbacker, former chairman of Eastern Airlines (www.lib.auburn.edu).

Libraries contain many books that can be used as primary, secondary, or tertiary sources. However, the caveat to this is that many libraries do not contain many aviation books, and the necessary books, at times, need to be tracked down through many different libraries. I was able to use the resources of libraries including the earlier listed Glenview Public Library and the Grand Forks Public Library.

Online access to many journals and magazines that contain articles and information is another source that I used for this dissertation. Having online access through a university library, like the University of North Dakota, allowed me to find many articles in different databases through the library's various academic memberships. These articles included many secondary and tertiary sources that contained aviation training and education information.

Methods of Research for Aviation Training History

When conducting research into aviation training history, data collection is the first step. This data includes primary sources, such as autobiographies, secondary sources, such as biographies and tertiary sources, various books and journals offering a particular interpretive lens on aviation training. Data sources included the Glenview (IL) Public Library, the libraries at the University of North Dakota, Auburn University, and Purdue University, as well as many online databases. Once the data was collected from the sources above, it was critiqued as described

earlier in this chapter. The presentation of this historiography has then become the final work itself, the dissertation itself.

Interpreting all of the different historiographies is an essential piece in making sense of aviation training in the historical sense. When looking at particular primary sources, I concentrated on those early pioneers of aviation, such as Amelia Earhart, Charles Lindbergh, and Beryl Markham, that described the details of how they themselves became pilots. I felt that well known aviators have a draw that attracts people to not just their accomplishments, but what happened before those accomplishments. Pulling early details of how aviators such as Earhart, Lindbergh, and Markham trained and learned not only shows how training occurred in aviation during their respective time period. It also makes a connection between pilots of all time periods of aviation. It shows just how important experiential, or one-on-one, learning is as a connecting theme. Every pilot from the early days of aviation, to today has started flying Secondary sources were chosen based on whether the information contained supported and added useful information to the stories and narratives from the primary sources. Tertiary sources were chosen for their supporting information and whether it contained necessary information to support the research questions of this dissertation. When the chosen primary, secondary, and tertiary sources were analyzed, the two themes of technology and experiential learning were discovered as a piece of all of these sources.

As discussed earlier in this chapter, there are different ways of organizing the chapters for a book on this subject. Two of the ways are chronologically (by historical date), or by subject matter. Megill (2007) discusses how historical research and writing analysis can be both analytical and narrative. Analytical being limited to just the facts of the historical matter. Narrative taking into account historians viewpoints of the historical event being studied. I use

both of these themes, as a dissertation in a book format will have to be written in a very readable narrative format. It also must be analytical in order to interpret the data presented, as that is also a central part of historical research (Megill, 2007). The primary, secondary, and tertiary sources discussed earlier in this chapter are analyzed and then written in narrative style that turn the sources into a descriptive, but readable, format. Analysis accomplished included identifying the aspects of my research questions that the various sources answer, plus looking at the themes of technology and experiential learning and if those pieces are found.

Concepts of Historiography

What is historiography? The literal translation is "the study of writing history" (Williams, 2003). Williams (2003) goes on to say that the term historiography is generally thought to mean the "history of how historians have dealt with history." (Williams, 2003). Revisionism becomes a normal part of history as the next generation of historians reinterprets and revises an earlier historian's work. Interestingly enough, this revisionist view of history becomes the new accepted version of history….until the next historian rewrites it (Williams, 2003). Williams goes on to argue that when writing a paper, a historiography should be included in order to frame an author's work in the historical context. In other words, to show where the work belongs in relation to the past.

The definition of historiography, according to Williams (2003) is "…the study of the writing of history. It describes historical arguments, theories, and interpretations over time, how schools of thought on particular events change over time- like history." According to Merriam-Webster, the definition of historiography is:

"a :the writing of history; especially :the writing of history based on the critical examination of sources, the selection of particulars from the authentic materials, and the synthesis of particulars into a narrative that will stand the test of critical methods

b :the principles, theory, and history of historical writing ·a course in historiography" (Merriam-Webster, n.d.).

In "The Development of Historiography," edited by Fitzsimons, Pundt, and Nowell (1954), a collection of authors looks at various historical events and explores the historiography of the story or event as told by different authors or historians. It is an interesting compilation in that it shows how primary and secondary sources can get mixed together as time goes on and depending on who is looking at what source and what lens they are using (Fitzsimons, Pundt, & Nowell, 1954). The book is described as a "history of historical writing," Iggers and Wang (2013) give a more modern view on historiography. The authors "conceive of historiography not only as representation of the past as it was, but also as it was remembered." This view fits into Fitzsimons, et al (1954) representation of types of sources being mixed together. How history is remembered can change the interpretation of the event from either primary to secondary or vice versa, depending on the lens it is being viewed through.

Hockett (1955) divides historiography into four different time periods. He uses historiography over four different centuries, beginning with the seventeenth and ending in the century that was current at the time his book was written. His division of the subject into different time periods show how historiography has changed over time, as historians develop better understanding and context on particular events (Hockett, 1955).

A good example of historiography is a described by Cohen (2010). Cohen describes a mural painted in the Congo in 1933 showing typical day-to-day life in the Congo at the time. In the lower left corner of the mural is painted a person (maybe European) taking pictures, presumably of the day-to-day scenes. The photographer is attempting to document the history of the Congolese people. However, the painter, by incorporating the photographer into the mural, has thus changed the depiction of Congolese history shown in the mural by incorporating the photographer in the picture (Cohen, 2010).

Historiography in aviation training is to be accomplished in a similar manner to other subjects. I will describe how historical research and historiography have been accomplished in the past and how I examine this process in my dissertation. The specific themes that wind their way through this history are technology and one-on-one (experiential learning). Technology is the driver of all change that we see throughout aviation and aviation history. Aviation itself began as a new technology when the first powered flight took place in 1903 by the Wright Brothers. With aviation as a new technology, training and education soon followed. The basic premise of technology in aviation training and education has to follow aviation in order to properly prepare trainees and students for aviation. Everett Rogers (2010) wrote of the "Diffusion of Innovations" theory. This theory explained how people adopt new methods of accomplishing things as well as acquiring knowledge about new tools (technology) created to help them achieve their goals. Rogers defines innovation as "an idea, practice, or project that is perceived as new by an individual or other unit of adoption" (Rogers, 2010).

As previously discussed, aviation historians have covered different aspects of aviation training. David McCullough (2015) wrote extensively about the Wright Brothers, including their use of one-on-one training. Being that he was a biographer of the Wright Brothers that is the

area of aviation training that he stuck with. Stephen Ambrose (2001) covered the wartime aspects of aviation and aviation training in writing about B-24 pilots in World War II. From a historiography perspective, first person accounts (primary sources) such as those written by Amelia Earhart (1932, 1937) and Beryl Markham (1942) offer accounts of what it was like to learn how to fly in the early days of aviation.

The second theme, experiential learning, is an important aspect of aviation training and one that we also see from the very beginning, up until modern times. David Kolb (1984) described experiential learning as "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience." Primarily, aviation is a one-on-one endeavor, an instructor sits with a student and transfers knowledge to them. When this occurs in an airplane, this experiential learning is hand on. I show examples of this type of experiential learning with the Wright Brothers in the early days of aviation, and in the most modern training techniques that today's airlines use. The themes of technology and experiential learning will be shown throughout the upcoming chapters. At times the two themes will seem like they are separate, but in other chapters, they will intertwine. Where they intertwine is in skills that are acquired and the competency of learning. Competencies are defined by Harvard University (2014) as "things that an individual must demonstrate to be effective in a job, role, function, task, or duty" (p. 4). Experiential learning in aviation is a great example of skills and competencies that are acquired. Competency based learning, described in Chapter 7 is an example of technology and experiential learning intertwining. As discussed earlier in this chapter, experiential learning is important enough of a concept that the Federal government introduces minimum hour requirements in 1926. Requirements for numbers of hours have changed and evolved since that time, but still

remain in one form or another. The technology used in aviation training today still requires some aspect of one-on-one, experiential learning.

As discussed earlier, these two themes can be complimentary, but at times can be in conflict with each other. This narrative dissertation is a historiography that tells the story that is the history of aviation training and education.

Concepts of Training and Education

What is Training and Education? As this dissertation is concentrating on training and education in aviation, those terms should be defined. The first term to be defined is training. Merriam Webster defines training as the act, process, or method of one that trains or skill, knowledge, or experience acquired by one that trains or the state of being trained (Merriam Webster, 2018).

What about education? Merriam, Caffarella, and Baumgartner (2007), state that one of the biggest factors in education is technology. Looking at aviation historically, as well as in our modern world, it has always been thought of as a technological marvel. The authors also discuss the major types of training and education, such as formal, social, classroom learning, as well as the informal training that occurs in workplace and personal settings. Many of the historic events and acts that have shaped aviation itself have driven the formal training that occurs in aviation. Durkheim (1956) says that in defining education we must "consider educational systems, present and past, put them together, and abstract the characteristics which are common to them" (Durkheim 1956). Another description of education by Durkheim is that education is an effort to make an individual an autonomous personality (Durkheim, 1956).

The idea of education making the individual an autonomous personality can be a good description of what aviation training is supposed to create. The Federal Aviation Administration (FAA) drives what is required in today's aviation training environment. Depending on how formal a pilot or organization's training is, depends on Federal Aviation Regulations being followed (Mark, 1994). The FAA has designed aviation to be autonomous: it is the reason that the Airman Certification Standards exist. These standards are designed to make sure that every pilot learns the same concepts during training (Mark, 1994). As both training and education have both been defined, it is important to note the differences between the two. Wheeler (2013) describes the difference as being, training is; "specific transfer of same skills to similar settings for the purpose of addressing gaps in skills or knowledge learning" (p. 3), while education "focuses on learning new skills, knowledge, and attitudes that will equip an individual to assume a new job or to do a different task at some predetermined future time" (p. 4).

The training standards that have existed since the Air Commerce Act of 1926 (described in detail in Chapter 4), are based on experience in regards to the number of hours flown versus the knowledge that a pilot actually has acquired. There is a procedural aspect to what a Certified Flight Instructor (CFI) must teach a flight student. The CFI must have the proper ground and flight training in order to have the knowledge to pass on to the flight student, including the knowledge of how to teach said procedures to a flight student. These procedures include basic flight maneuvers, and basic flying skills. But, even with the procedural aspect of training, there is still the minimum hour requirements that are required by the FAA. A competency based approach to flight training and education is a concept that is gaining popularity, one which the FAA is beginning to address with the release of the Airman Certification Standards in 2017.

Organization of the Study

Aviation education began even before the Wright Brother's first powered flight in 1903. In Chapter 4, I show that some of the earliest classes, or education, in aeronautics were happening in the late 1800's, and continue today with college and university programs. Aviation training did not start until we actually had aircraft. In Chapter 2, I will show the earliest training taking place, within the first decades after the Wright Brothers first flight. This is also out first look at experiential training. Chapter 3 outlines the acts and government regulation that had an effect on training and education in aviation, much of this in response to events and technology explored in Chapter 2. Chapter 5 shows how important training became during wartime, both for the war effort itself, but also in the technologies developed. Chapter 6 looks into a how the airlines train, using both the latest technologies and experiential learning. Chapter 7 looks into the modern aspects of aviation training, including how technology is moving aviation training into the future.

The concepts of education and training are just as important to the history of aviation as any other aspect of the subject. By examining the history of aviation training, we can see the evolution of aviation itself. We will begin in Chapter 2 with the Early Years. This chapter will include some of the pioneers of aviation, including The Wright Brothers, Charles Lindbergh, Amelia Earhart, and Beryl Markham, as early aviation training is explored.

Chapter 2

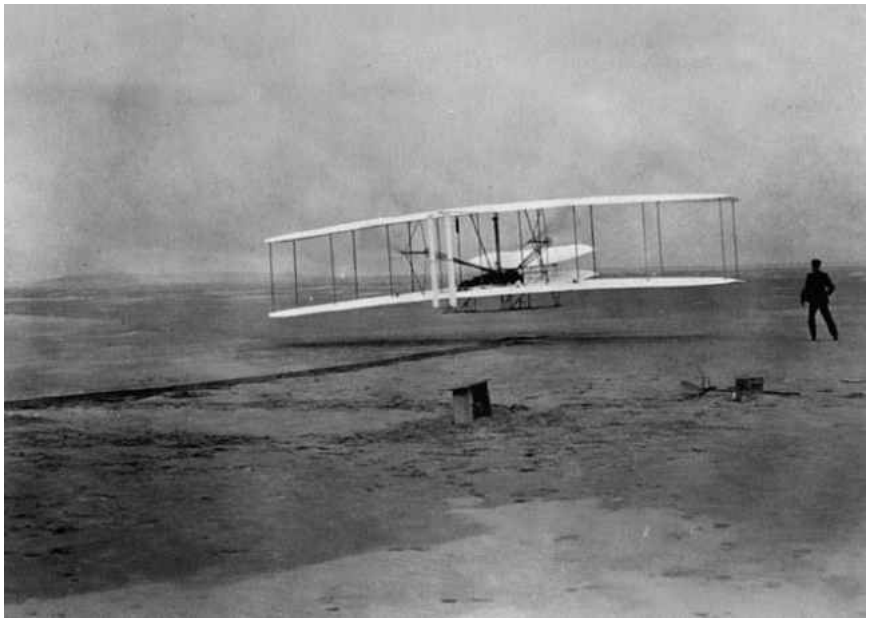
The Early Years

Flying is historically considered a skill-based endeavor. Beginning with the Wright brother's first flight on December 17, 1903, the ability to fly a heavier than air object has been considered a fairly intensive, learned skill. This skill, learned through experiential training, is the one constant that began with the Wright Brothers in 1903, and continues today. This experiential training, one-on-one with an instructor can be seen in the early years of aviation. Some of the most well-known pioneers in aviation, such as Lindbergh, Earhart, and Markham, all described their experiences learning to fly in an experiential manner, using the latest available technology of the day. This chapter explores how training was accomplished in the early years of aviation. How the pioneers of aviation listed above, along with the Wright Brothers, trained and learned about flying will also be covered.

The Wright Brothers and the Beginning of Aviation Training

The Wright brothers provided what can be considered the first formal aviation training course. In 1907, the Wright brothers offered the U.S. Army one aircraft "and the instruction of an operator for $100,000" (Hennessy, 1985, p. 26). The U.S. Army did not accept the offer. Wilbur Wright then traveled to France to demonstrate the abilities of the Wright Flyer. There, as per the contract signed with the French, he also trained three French soldiers how to fly their machine (McCullough, 2015). In February 1909, during additional European demonstrations, the King of Spain, Alphonso XIII, asked to see one of these trainees fly the aircraft. The student flew for 12 minutes with Wilbur Wright sitting next to him (McCullough, 2015). The next

month near Canticle military field in Italy, Wilbur trained Lt. Calderar of the Italian Navy to fly the airplane. This is an example of the first aviation training being accomplished.



First Powered Flight: Orville Wright and the Wright Flyer (McCullough, 2015)

Wright School of Aviation

In the spring of 1910, Wilbur and Orville Wright opened the nation's first civilian flying school on an old cotton plantation on the outskirts of Montgomery, AL. Just seven years after the Wright's successful flight at Kitty Hawk, North Carolina, others were challenging their invention. In hopes of retaining some of the newly emerging aviation market, the brothers began to conduct flying exhibitions to promote the sale of their airplanes. The Wright Brothers needed to train pilots who would fly in exhibitions and then instruct the airplane buyers how to fly. At this point in early aviation there were less than 10 qualified pilots in the world. The weather in Dayton, Ohio, was unfavorable for flying in the winter, and Wilbur left home on February 11, 1910 in search of a place more suitable for early spring pilot training. The flying school in

Montgomery began with two students, Walter R. Brookins from the Wright's hometown of Dayton and James W. Davis of Colorado Springs, Colorado. The type of training at the Wright's pioneering flight school can be best described as experiential, as the flying lessons consisted of the trainee sitting in the airplane next to Orville Wright. The trainee learned completely by the practice of actually flying the airplane. Early training provided by the Wrights was described as one student receiving three hours, four minutes, and seven seconds instruction before he soloed, while another had three hours, seven minutes, and thirty eight seconds training before making his solo flight. Wilbur Wright was also said to show his pupils how to cut off the motor and glide safely to earth without power, a skill considered essential in the early days of aviation with unpredictable engine performance (Hennessey, 1985). It is interesting to note that this experiential training is still how flight training is provided today, the same one on one training provided by Orville and Wilbur Wright in 1910 is still used extensively in modern times.

The flying school did not last long in Alabama, however, as mechanical and weather-related issues forced the Wright Brothers to close the facility earlier than planned. On the first day of training, the aircraft suffered a major mechanical failure during only the second attempt at flight with a student. Orville and the student were uninjured, but the engine required major repairs. The other issue became the very windy weather. Training flights couldn't continue with the wind blowing because Orville Wright wanted; "only the most quiet weather for his flights while training 'novices'" and felt that "a wind of six or eight miles an hour is most desirable" (Ennils, 2002, p. 26). He said that high winds, tended "to confuse the novice, who becomes uncertain whether the sudden movements such as the aeroplane makes is a brisk wind or the results of his own manipulation of the gear, or of the wind current themselves" (p. 26). He continued "aeroplane sailing ... is not all mere manipulation of the engine" but that it also

involved "judgment of currents to be taken, balancing to be gauged, and a dozen other little niceties of piloting that will come only with practice" (p. 26).

The Wright's flying school officially shut down in May 1910, but not before one of the two students, Walter Brookins performed his first solo flight. This flight came after nearly six hours of dual flight instruction and 40 flights with Orville Wright. After the school closed the location was later used for aircraft repair during World War I and on November 8, 1922, the installation became Maxwell Field, which would eventually become Maxwell Air Force Base. The training did last long, but the Wright's Flying School had a number of aviation training firsts. It was the first civilian flying school and the first to train flying instructors as Walter Brookins did some of his training from the center seat of the aircraft. "Orville figured that if he could break Brookins in as a 'left-hand' pilot, Brookins could go on to teach other members of the group to fly in the traditional 'right-hand' way." (Ennis, 2002, p. 29).

The Wright Flying School, Montgomery, AL (Ennis, 2002)

Shortly after the return of Orville from Montgomery, Alabama, on May 8, 1910, the Wrights opened the Wright Flying School in Dayton, Ohio in order to train pilots who would eventually conduct exhibition flights of the Wright Brother's aircraft. After training of the exhibition pilots was completed, the school then began to instruct customers of the Wright Flyers and others interested in learning to fly. One of the advantages the Wright Flying School touted was the use of a two-seat airplane, developed in 1907 for flight demonstrations in Europe, described earlier in this chapter. One of the Wright Flying School claimed that; "Learning to Fly at the Wright School is as simple as learning to drive an automobile" (Parks, 2013, p. 10). The training that Wilbur Wright provided for the pilots in France, though, included with the purchase of the aircraft, was still fairly informal. He would "sit with his hands between his knees, ready if necessary to take control" (McCullough, 2015, p.204). This was due to the fact that early Wright aircraft only had one control stick that sat between the two "pilot" seats.

Curtiss Flying School

The Wright's biggest competitor in the race for powered flight and, subsequent to that accomplishment, the selling of airplanes was Glenn Curtiss. In 1911, at one of the first "air meets," the National Aviation Company advertised: "LEARN TO FLY. Fame and Fortune for Aviators. Good Pilots Find Immediate Employment at Big Salaries" (Goldstone, 2014, p. 281). The National Aviation Company was a licensed Curtiss Agent. One of the most problematic issues that Glenn Curtiss and other early aviation inventors had were the lawsuits filed against them by the Wright Brothers. The Wrights claimed that their patent for their "aeroplane" was being infringed upon by all who created flying machines (Shulman, 2002). This included any and all training flights by Curtiss. In the end, the Wright Brothers had filed almost three dozen

lawsuits. One of Curtiss' early students said that because of the Wrights, "A man has to have ten years in law school before he has a chance at becoming an aviator" (Shulman, 2002).

The Wright's were uninterested in publicity for their early flights. Curtiss was initially credited with the first powered flight. The first publicly advertised flight (by Curtiss) occurred on July 4, 1908. After Curtiss' achievement, the Aero Club of America awarded Curtiss with the nation's first pilot license as he had just made the first officially observed powered flight. (Shulman, 2002).

Glenn Curtiss started a flight school in with instruction in two locations. The first was at Hammondsport, New York, where the Curtiss Company was located. The second location was at San Diego on North Island where Curtiss first trained Army and Navy fliers. In order to gain interest from the military in Curtiss aircraft, Curtiss offered to train Army and Navy pilots at no charge. When training new pilots, Curtiss believed they should have a practical knowledge of aviation before attempting a flight. It is interesting to see the education side intersecting with training early on in aviation history. Curtiss wanted the flight student to know the Curtiss machine, how it was built and its engine. Different than the Wrights single-place aircraft were used for training, and students were on their own. Instruction was slow and cautious, starting with taxi practice up and down a field followed by short hops into the air, and finally the student pilot actually got airborne. Curtiss students would work toward earning the Aero Club of America pilot's license, the same license that Curtiss had been issued the first one (Parks, 2013).

Curtiss flight schools trained many pilots during this time period, with the location in New York conducting 240 flights in one day (Goldstone, 2014).

Other Early Aviation Flying Schools

Other flight schools began soon after the Wrights and Curtiss began their schools. Some of these schools were; Lillie Aviation Company, in San Antonio, Texas; Martin Aviation Training in Los Angeles, California; the Moisant Aviation School at Augusta, Georgia; and Thomas School of Aviation in Bath, New York. These schools had enrollments with 20 to 30 students. Some of these schools were still using single-seat aircraft, while others taught with dual-control aircraft. Tuition was between $200 to $500 for land aircraft and from $300 to $500 for water airplanes (Parks, 2013).

Early aviation was considered a novelty, therefore formal training practices were not deemed useful or necessary. This was in part due to the fact that there were not many aircraft being flown or in production at the time. In fact, in her book, "*The United States Army Air Arm," April 1861 to April 1917*," Juliette Hennessey (1985) does not discuss heavier than air flight until chapter 4, even describing the early Army aviation training schools as concentrating mainly on balloons until 1912 (Hennessey, 1985). In fact, when the U.S. Army received its first airplane in 1909, they had only one pilot. Lieutenant Foulois, an Army Signal Corps officer who had had a little more than three hours of aviation training but had not yet soloed in an aircraft. This changed little in the years between 1909 and the U.S. getting involved in World War I. Hennessey describes the U.S. Army aviation program as having little or even nothing in its possession, airplanes, airfields, instructors, aviation curricula, or even the knowledge of what was needed to gain any of these necessary items. The United States had never trained an aviator for actual combat; and no one knew what kind of instruction was needed for radio operators, photographers, or any of the enlisted personnel. Consequently, the first instructors in the training

program had to learn themselves by the trial and error method before teaching others (Hennessey, 1985).

Late 1920s into the 1930s

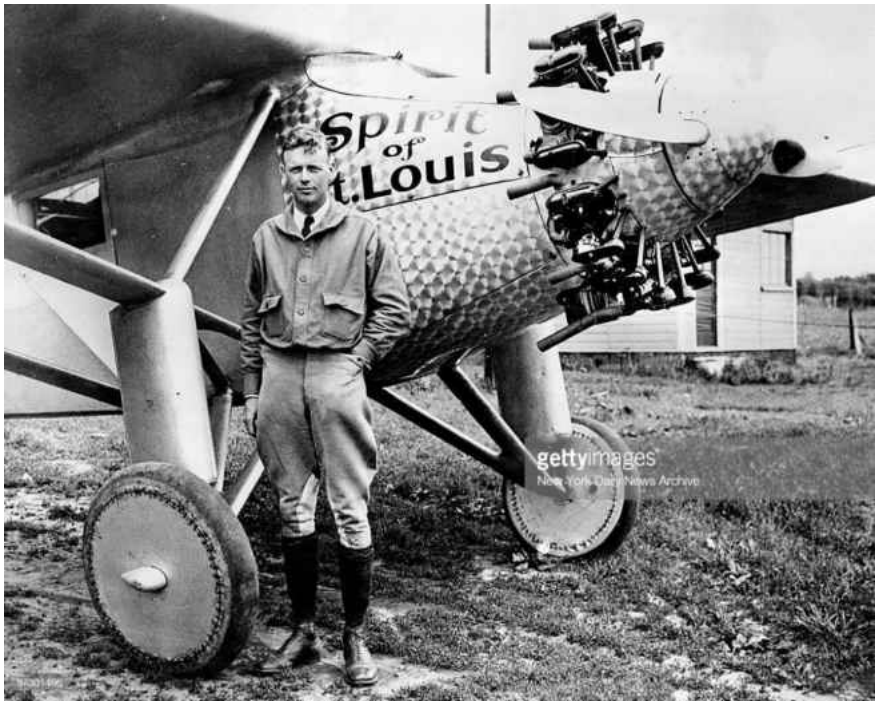
In 1927, Charles Lindbergh became the first person to fly solo across the Atlantic Ocean. Lindbergh dropped out of college in order to learn how to fly. He signed up for a flight school that was owned by the Nebraska Aircraft Corporation. Ray Page's Flying School offered Lindbergh a chance to work in the aircraft factory in exchange for flying lessons. He eventually earned his first flight, but the flying school ended up being a sham. In order to solo, Ray Page required Lindbergh to post a bond to cover the cost of a possible crash while on his solo flight. As he had paid all the money he had to get into the flying school, Lindbergh could not afford to solo (Groom, 2013).

In his biography of Lindbergh, George Buchanan Fife (1927) discussed the revolutionary flight and the preparation for it. According to Fife, Lindbergh began his aviation career by flying with an instructor, but never soloing. He spent eight hours flying with an instructor who would sometimes show up for lessons, sometimes not. When Lindbergh thought he was ready to solo, Ray Page informed him that he (Page) had sold the one training aircraft he had left, the one that Lindbergh had been learning to fly with. He refused to let Lindbergh solo in the aircraft in case Lindbergh crashed during the solo flight. He didn't want the aircraft destroyed before he had the money for it (Mosley, 1976). Six months later, Lindbergh purchased a surplus U.S. Army Curtiss Jenny and taught himself the rest of what he thought he should know in order to fly. (Fife, 1927). It is interesting to see that one of history's most famous aviators did not have much formal aviation training. Experiential training was the beginning of flying for Lindbergh, but he ended up finishing in an informal way, by teaching himself what he needed to know. He then

barnstormed across the country before starting work as an airmail pilot for the Post Office (Fife, 1927). As the early airlines were just beginning service, Lindbergh's long flight across the ocean proved that long distance flight was a reality. The flight also showed the importance and usefulness of aviation for connecting far-away places (Fife, 1927).

Lindbergh's flying legacy, from early training, to his record breaking Atlantic flight show how he had an impact on aviation training. His original training was experiential learning, just him and an instructor, one-on-one, learning how to fly.

But, just a few years later, he used the best technology the time period had to offer to fly solo across the Atlantic Ocean. This technology was mostly in the form of the aircraft he was flying, the "Spirit of St. Louis." The Ryan NYP was a specially built aircraft, made specifically for long distance flight, such as Lindbergh's New York – Paris record setting non-stop flight. The aircraft had a bigger engine and new aerodynamic features enabling better fuel efficiency than any other aircraft of its time. (Lindbergh, 1953). The technology inside the aircraft cockpit was much less than one might think, though were about the latest technology to be found at that time. A compass, sextant, and chart (map) were all he had in the cockpit (Mosley, 1976). By utilizing the latest technology, and expanding its usefulness, Lindbergh helped move aviation training forward.



Charles Lindbergh and the Spirit of St. Louis (Library of Congress)

Amelia Earhart's final published work, "Final Flight," was published by her husband after her disappearance in 1937. It includes aspects of her training and preparation for her planned round the world flight. These are interesting on their own as the reader can glean some insight into how Amelia Earhart learned how to fly. In her account, Earhart describes how aviation training was accomplished in the broad sense (Earhart, 1937). Early aviators learned how to fly from World War I veterans who had returned from the war with skills as pilots, but no place to actually use these skills. These so called barnstormers bought surplus airplanes for three to four hundred dollars and flew from town to town offering rides to people who, if they really enjoyed the ride, could then become students of the pilot, thus beginning flight training. This is how Amelia Earhart began her journey to become a pilot (Rich, 1989). After one of these introductory flights, in 1921, Earhart became enamored with flying and declared to her family that she too was going to become a pilot. At Kinner Field, outside of Los Angeles, Earhart told

Neta Snook, a twenty-four year old female aviator that she wanted to fly. Snook told Earhart she would teach her for one dollar a minute. Earhart agreed, and the next day she showed up at the field and took her first lesson (Rich, 1989). Flight training in 1921 was completely hands on, with Snook remarking that Earhart had a pretty good feel for flying within the first four hours of training. As we look at experiential training in aviation, note that even a famous aviator like Amelia Earhart started with one-on-one training, just like every other pilot before and after her has done.

In her second book, "The Fun of It" (1932), Earhart describes her initial training and what it was like to be a flight student in the 1920's. She says that "after learning as much as I could possibly absorb on the ground, I was taken aloft" (p. 33). She describes her first flying lesson as "lasting a long time," but in reality was probably only 20 minutes. In this lesson she only observed her instructor flying from the back seat of the aircraft. During her next lesson she was "permitted" to fly the aircraft and tried, not so successfully to keep the aircraft straight and level. Earhart then practiced turns, and then what she described as the most difficult maneuver, landing. Primary instruction also included a student soloing the aircraft and "stunting." According to Earhart, the Department of Commerce (the aviation regulatory body in those days) described stunting as "any maneuver not necessary for normal flight" (Earhart, 1932). A student was required to practice stunting maneuvers such as slips, stalls, and spins, making sure that they understood what to do in case the aircraft ended up in an undesired state. After flying for the Department of Commerce required ten hours of solo flying (more on this in Chapter 3), Amelia Earhart was granted her private license.

Just as Lindbergh did, Earhart used the latest technology in her many record breaking flights. It has been argued that her disappearance on her final attempt at the record books was

due to a lack of training on the technology (such as the radio equipment) in Earhart's aircraft. There were also trepidation by fellow pilots of issues with the technology working correctly on the aircraft itself (Burke, 1970). As discussed in Chapter 1, Rogers (2010) "Diffusion of Innovations" theory says that people adopt new methods of accomplishing things as well as acquiring knowledge about new tools (technology). Technology is a big driver of aviation, but that technology may not work as intended, due to a lack of training, or being too advanced for the task at hand.

Amelia Earhart and her Lockheed Vega aircraft (Smithsonian Museum)

Beryl Markham was an early aviator in Africa. Her book, "West with the Night," (1942) describes her flying experiences during the 1920's and 1930's in Africa. In 1936 Markham became the first person (male or female) to fly solo from east to west across the Atlantic Ocean. She departed from England and flew 20 hours before crash landing in Nova Scotia, Canada due to fuel starvation (Markham, 1942).

Her book has firsthand (primary source) descriptions of early aviation training practices in Africa (Markham, 1942). Markham describes learning to fly with Tom Black, the founder and owner of Wilson Airways, the first commercial airline operating in East Africa. She describes the experience of flying in the mountains of Africa with the compass of the Gypsy Moth aircraft being the only reliable instrument. She also describes learning firsthand what effect downdrafts in the mountains have on an aircraft. Markham describes flying among the mountains of East Africa and noticing that her aircraft had what felt like "…there was a weight on her wings, weighing her down" (Markham, 1942, p. 188). She says that her instructor never moved until "you can see the branches of trees from a cockpit, and the shape of rocks no bigger than your own hand, and where grass thins against sand and becomes yellow, and watch the blow of wind on leaves, you are too close." (Markham, 1942, p. 188-189). This is when, Markham says, that her instructor sat up and took over the controls. After bringing the aircraft to a safe altitude, Markham's instructor stated "now you know what downdraft is." (Markham, 1942, p. 189).

These experiences in training was what (she claims) were the biggest lessons along the way to earning her "B" license. This license gave her the right, as she says, "to make a living." As East Africa was under British control, she earned her British "B" license. Markham had around 1,000 flight hours at this time. According the British Civil Aviation Authority, the "**Type B** Operating Licence is required by operators of aircraft with 19 or fewer seats" (Operating Licence, n.d., p. 2). The minimum flight hour requirement for this license is 200 hours (Operating Licence, n.d.).

Beryl Markham in 1930 (Markham, 1942)

One of the most significant technological achievements that occurred in aviation in the 1920's was the first instrument only flight. This flight was accomplished using only the instruments in the cockpit of the aircraft. As discussed earlier in this chapter there were not many instruments available at this time. Two additional instruments that made flying by instruments possible: the gyroscope and the artificial horizon. The first flight under these conditions was accomplished on a foggy morning, September 24, 1929 when James Doolittle flew an airplane for the first time using only the instrumentation of the aircraft, and no outside references. Even with a "safety" pilot keeping watch outside the aircraft, Doolittle flew the aircraft all the way in for a landing only using the instruments. The feat was deemed important enough that the flight made the cover of the New York Times the next day. The newspaper said that the "demonstration was more than an exhibition of blind flying and instrument perfection. It indicated that aviation had taken its greatest single step in safety" (Thomas & Jablonski, 1976, p.

103). The ability to fly using only instruments would enable future aviators to fly in very low visibility, whether that is due to fog, rain, or snow. No longer would pilots have to be grounded when the weather was less than perfect. This is an example of a technological advancement that would enhance aviation, but require additional training for pilots in the future in order to keep up with advancing technology.

The early pioneers of aviation honed their skills using some of the latest technology available to them All of the aviators highlighted in this chapter recount the importance of this training, but also of the importance of the technologies available to them. This technology enabled them to accomplish their early, record setting feats. But, as has been shown by some of these early pioneers, experiential learning was how they learned to fly. The Wright Brothers were teaching people how to fly one-on-one within a few years of their first flight in 1903. Even before early government regulation such as the Air Commerce Act of 1926 mandated and regulated pilot certificates and the requirements to obtain them, aviation training was using experiential training. Chapter 3 will explore that particular act, along with other Federal Acts and Regulation that have had a profound effect on aviation training.

Chapter 3

Acts and Government Regulation

Regulation of aviation has historically been instigated for a safety or certificate oversite. In this chapter some of the various acts and regulations will be investigated for their implications on aviation training. The act chosen for this chapter are those that have had a profound change on aviation, and thus aviation safety. Some of the acts are related to how the federal government administers aviation, while others that will be explored were because of safety. As safety regulations change, along with certification requirements, training must be changed or improvements made in order to keep up with this new regulatory oversite. Major acts and regulation don't move away from experiential learning, but instead, enhance how this learning is accomplished. As will be seen in this chapter, through various types of regulation, has attempted to keep up with evolving technology, but still keep the fundamentals of what aviation training started with, one-on-one, or experiential learning.

Major acts and regulation that will be explored in this chapter include the Air Commerce Act of 1926, Civil Aeronautics Act of 1938, Federal Aviation Act of 1958, and Airline Safety and Federal Aviation Administration Extension Act of 2010. All of these acts had a profound impact on how aviation training is performed and managed. Keeping in mind our continued theme of technology being a driver in aviation, many acts and regulation were passed into law due to the improvements and advancements in technology, be it the Civil Aeronautics Act of 1938 being passed partly due to technological improvements such as instrument flight and large transport category aircraft entering the commercial market. Or, the Federal Aviation Act of 1958 because of the introduction of jet aircraft, or Pilot certification requirements are also outlined, including those from the earlies days of certification, as well as the current regulations.

The first regulation pertaining to certificating pilots was a regulation passed by the War Department. In 1912 The War Department created a new rating of "Military Aviator." Applicants for this rating had to be commissioned officers of the Regular Army or Organized Militia; those who qualified were to receive certificates from the Secretary of War as "Military Aviators." In regard to the flying training, the Army's instructions stated that when a student reported for flying instruction he would either be sent to one of the airplane manufacturers' schools (Wright or Curtiss) for preliminary instruction or would be assigned to an instructor at the Signal Corps Aviation School for such training (Henessey, 1985).

The test for an applicant to receive this Military Aviator rating required that the:

> "…candidate attain an altitude of at least 2,500 feet, fly in a 15 mile-per-hour wind, carry a passenger to a height of at least 500 feet and immediately make a dead-stick landing within 150 feet of a previously designated point, and make a military reconnaissance cross-country flight of at least 20 miles at an average altitude of 1,500 feet" (Hennesey, 1985, p.59).

Although the War Department was now certifying pilots, civil pilots were not officially certified for another fourteen years with the passing of the Air Commerce Act of 1926.

Air Commerce Act of 1926

Until the passage of the Air Commerce Act of 1926, there was not much public interest or belief that aviation could be a serious mode of transportation. Because of the amount of accidents that actually occurred during the early years of aviation, fear was the "biggest deterrent" to aviation being perceived as safe and viable (Davies, 1994). Because of this, it was generally accepted that the only way to solve the safety issue was to have the federal government

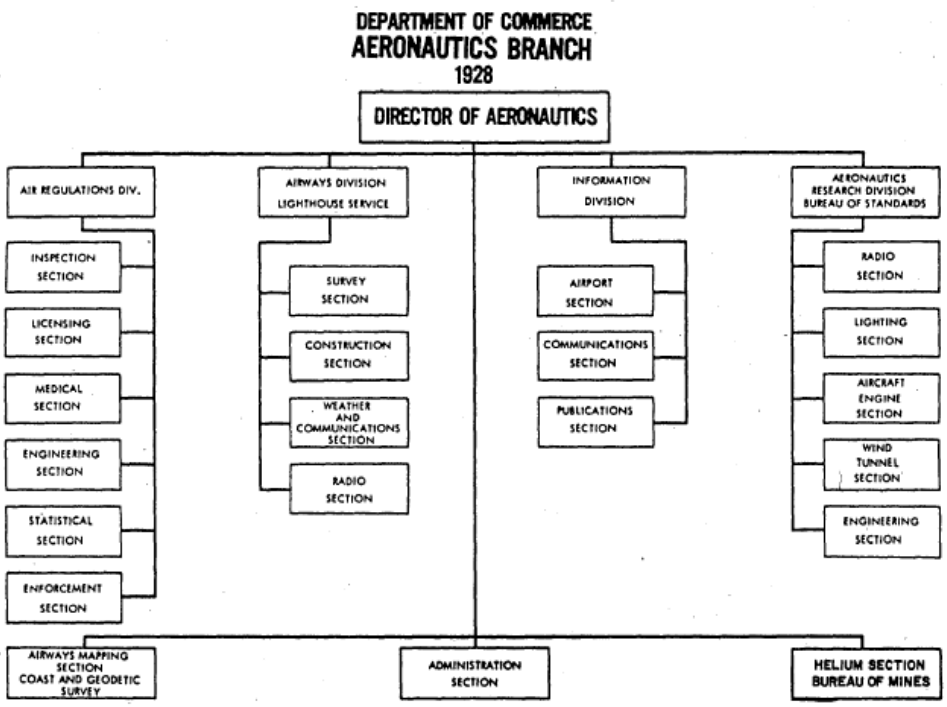
involved. These perceptions and issues led to the creation of the Air Commerce Act of 1926 (O'Neil and Crain, 2012).

Early civil aviation regulation was formally instituted with the passage of the Air Commerce Act of 1926. Before this law all regulation, when it came to aviation, fell under the purview of the War Department. Because of the novelty of aviation leading up to World War I, and the beginning of airmail flying, it was thought that there was not as much of a reason for the federal government to be involved. In addition, as discussed in chapter 2, according to the Columbia Law Review, the federal government did not think it had constitutional authority to regulate aviation (The Air Commerce Act of 1926, 1927).

The Air Commerce Act was the federal government's first attempt at air regulation and, ultimately, safety. According to Columbia Law Review:

> "…the regulation must aim to win public confidence by establishing safe air travel. Experts are in agreement that the six requisites for safe flying are: (1) a machine sound aerodynamically and structurally, (2) a reliable engine of sufficient power, (3) a competent, conservative pilot and (4) airports and emergency landing fields, close enough insure gliding to safety, (5) nation-wide weather forecasts, and adapted to the needs of fliers,13 and (6) adequate route" (The Air Commerce Act of 1926, 1927, p.990-991).

This statement shows that safety of flight was one of the leading reasons for the Department of Commerce to get involved in the regulation of aviation.



Department of Commerce, Aeronautics Branch Organization Chart

One of the major tenants of the Air Commerce Act was the regulation and certification of aviators (pilots) (The Air Commerce Act of 1926, 1927). This is important in that this is the first attempt by the federal government to regulate civil aviation. As was shown earlier in this chapter, the Army had been doing this since the early 1910s, but the Air Commerce Act was the first federal policy to regulate civil aviation. Interesting to note, although the Air Commerce Act requires certification and regulation of aviators, all the Columbia Law Review says about this section is:

"The Air Commerce Act takes a definite step towards these needs by providing for the registration and rating of the examination and rating of airmen serving within the purview of the Act…Details are wisely left to departmental with an eye to the flexibility necessary to a science developing by leaps and bounds" (The Air Commerce Act of 1926, 1927, p. 991).

This is significant in that it pilots have to meet some sort of a standard in order to be licensed, and therefore, legal to fly. The actual language of the Air Commerce Act of 1926 as it pertains to pilot certification is: "Provide for the periodic examination and rating of airmen serving in connection with aircraft of the United States as to their qualifications for such service" (Air Commerce Act of 1926, n.d, p. 569).

The pilot standards and certificates (licenses) that were issued by the Department of Commerce were as follows:

Private License; required ten hours of solo time.

Industrial License; required fifty hours of solo time.

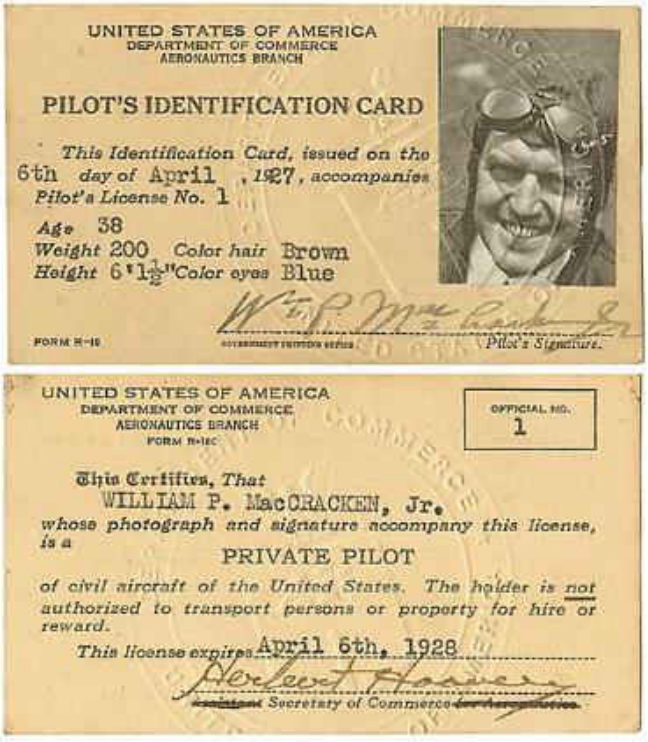
Limited Commercial License; required fifty hours of solo time.

Transport License; 200 hours total time. This license was the only one that unrestrictedly allowed the holder to transport passengers for hire or give instruction (Earhart, 1932).

Not only did the Air Commerce Act of 1926 formalize the certification process for pilots, but it also was the Federal Government's first time requiring a minimum number of hours for a pilot to be deemed "proficient." It is interesting to see that the requirement for a minimum number of hours remains in today's training environment. This will be shown later in this chapter. Even though the hour requirements remain, there is a push for pilots to be evaluated on their flight performance rather than hours. This will also be explored later.

Amelia Earhart (1932) described the process for obtaining a pilot license after the requirements were first set by the Department of Commerce. After finishing all the instruction and solo flight from a flight school, the individual was then examined by a Department of

Commerce inspector. The inspector administered both a written and flying exam. The written exam consisted of questions about the airplane, the engine, navigation, meteorology, air traffic rules, and Department of Commerce regulations. The flying portion consisted of takeoffs and landings, and air maneuvers that "easily show the pilot's proficiency" (Earhart, 1932, p. 30).



UNITED STATES OF AMERICA
DEPARTMENT OF COMMERCE
AERONAUTICS BRANCH

PILOT'S IDENTIFICATION CARD

This Identification Card, issued on the 6th *day of* April, 1927, *accompanies Pilot's License No.* 1

Age 38
Weight 200 *Color hair* Brown
Height 6' 1½" *Color eyes* Blue

W. P. MacCracken Jr.
Pilot's Signature.

FORM N-10

UNITED STATES OF AMERICA
DEPARTMENT OF COMMERCE
AERONAUTICS BRANCH
FORM N-1EC

OFFICIAL NO. 1

This Certifies, That
WILLIAM P. MacCRACKEN, Jr.
whose photograph and signature accompany this license, is a
PRIVATE PILOT
of civil aircraft of the United States. The holder is not authorized to transport persons or property for hire or reward.

This license expires April 6th, 1928

Herbert Hoover
Secretary of Commerce

The first pilot certificates issued by the U.S. Department of Commerce (faa.gov)

It is not until the Federal Aviation Act of 1958 that the Federal Government talks about how they will enforce airman standards. This policy will be discussed in more detail later.

With the Air Commerce Act's certification requirements for airman (pilots) and mechanics, training requirements had to change. Some of these additions and changes will be discussed in Chapter 6. Technology played a significant role in these changes, including simulator training.

Civil Aeronautics Act of 1938

As the airlines, and aviation in general, were rapidly growing, the Federal Government passed the Civil Aeronautics Act of 1938 (Civil Aeronautics Act, 1938). Improvements to aircraft design, brought into production aircraft such as the Boeing 247 and the Douglas DC-3. These aircraft had larger cabins that could hold (in the case of the DC-3, up to 35 people. These aircraft allowed airlines to concentrate on hauling passengers as a primary revenue source, versus moving airmail as their main function (Wensveen 2015). Wensveen (2015) goes on to write that the Civil Aeronautics Act consolidated all previously passed aviation acts and government agencies overseeing aviation, into one overriding Act and federal agency. This agency was the Civil Aeronautics Agency (CAA), overseen by the Civil Aeronautics Board (CAB). One of the major facets of this Act, with respect to training, was the transfer of all certificate and registration functions from the Department of Commerce to the newly formed Civil Aeronautics Authority (Wensveen, 2015). Title IV, section 602 of the Civil Aeronautics Act reads as follows:

AIRMAN CERTIFICATES

Power to Issue Certificate

SEC. 602. (a) The Authority is empowered to issue airman certificates specifying the capacity in which the holders thereof are authorized to serve as airmen in connection with aircraft.

Civil Aeronautics Act, Certificate Language

Civil Aeronautics Act (1938)

Calkins (1955) referred to what he called the most overlooked facet of the Civil Aeronautics Act: the Act granted international route authority to the Civil Aeronautics Board.

This opened up the possibility of international airline travel, which brings a whole new need for aviation training, should the technologies exist for long haul travel (Calkins, 1955). Pilots would have to be trained on long-range, over water flying and any technology that would be developed to aid over water flying. As was seen in Chapter 2, by 1938 Lindbergh, Earhart, and Markham had shown showed flying across the ocean was feasible. The Civil Aeronautics Act of 1938 now made it legal, as far as the U.S. government was concerned.

Because of World War II beginning soon after the passing of the Civil Aeronautics Act, the ramifications of the policy were not fully realized for another 10 – 15 years after its passage (Bunke, 1954). The technology improvements developed during World War II that allowed for great advancements in aviation will be discussed further in Chapter 4.

Federal Aviation Act of 1958

After the war ended, the jet age soon began. This technological advance that Wensveen (2015) spoke of, along with the increasing number of passengers flying on U.S. airlines, led to the passage of the Federal Aviation Act of 1958 (Federal Aviation Act of 1958, 1958, p. 3). The Federal Aviation Act of 1958 itself in its long form title actually reads:

> "An Act to continue the Civil Aeronautics Board as an agency of the United States, to create a Federal Aviation Agency, to provide for the regulation and promotion of civil aviation in such manner as to best foster its development and safety, and to provide for the safe and efficient use of the airspace by both civil and military aircraft, and for other purposes" (Federal Aviation Act of 1958, 1958, p. 3).

This policy was put in place for the purposes of safety. It consolidated most of the safety functions of the Federal Government under the newly created Federal Aviation Agency (FAA).

It also outlines the FAA's duties of "regulation and promotion" of civil aviation. Cobb and Primo (2004) discuss this dual mandate in their book "The Plane Truth: Airline Crashes, the Media, and Transportation Policy." While these mandates can be in conflict with each other from a business perspective, from the educational point of view they are able to work in tandem (Cobb and Primo, 2004).

As stated earlier, the Federal Aviation Act was the first government policy to outline how pilots were going to be certificated. Section 602 of the Act states,

> "Any person may file with the Administrator an application for an airman certificate. If the Administrator finds, after investigation, that such person possesses proper qualifications for, and is physically able to perform the duties pertaining to, the position for which the airman certificate is sought, he shall issue such certificate, containing such terms, conditions, and limitations as to duration thereof, periodic or special examinations, tests of physical fitness, and other matters as the Administrator may determine to be necessary to assure safety in air commerce." (Federal Aviation Act of 1958, 1958, p. 776).

This section falls under the regulation portion of the "regulation and promotion" mandate that the FAA is required to operate under according to the Act. In basic terms, this act says that in order for a pilot (airman) to be certified they have to meet the regulations required by the FAA. (Simons and Withington, 2004).

FEDERAL AVIATION ACT OF 1958 [1]

Public Law 85–726; 72 Stat. 737

49 U.S.C. App. 1301 et seq.

AN ACT To continue the Civil Aeronautics Board as an agency of the United States, to create a Federal Aviation Agency, to provide for the regulation and promotion of civil aviation in such manner as to best foster its development and safety, and to provide for the safe and efficient use of the airspace by both civil and military aircraft, and for other purposes.

Federal Aviation Act of 1958

Section 602 of the Federal Aviation Act of 1958 is the same as Section 602 of the Civil Aeronautics Act of 1938. It appears that the Federal Government thought the standards for airmen were sufficient with the only change being needed was to change the oversight body from the Civil Aeronautics Authority (CAA) to the newly formed Federal Aviation Agency (FAA). With the formalization of certification and regulation in 1958 with the Federal Aviation Act, more formal training institutions began. As will be seen in Chapter 4, there were now colleges and universities with aviation curricula.

The Airline Safety and Federal Aviation Administration Extension Act of 2010

In terms of modern aviation and the effects of a major policy change, Public Law 111-216, otherwise known as The Airline Safety and Federal Aviation Administration Extension Act of 2010 has had a profound change on aviation training, especially with respect to the airline industry (Depperschmidt, Bliss, & Casebolt, 2015). On February 12, 2009, Colgan Air (operating as Continental Express) flight 3407 crashed while on approach to Buffalo, NY enroute from Newark, NJ. There were 50 people killed in the accident (NTSB Aircraft Accident Report Detail, 2010). This accident, and the investigation into its cause by the National Transportation

Safety Board, caused the FAA to amend the existing flight, duty and rest regulations as it pertained to flight crew members operating under 14 CFR Part 121. Part 121 is federal rule that most air carriers must operate under. The significant portion of this regulation that affected air carrier training was the requirement that pilots hired by airlines must have an Airline Transport Pilot Certificate which requires at least 1,500 hours of flight experience (More on this later in the chapter). An interesting caveat to this is that if a pilot has graduated from an approved college or university aviation and flight program with a Bachelor's degree, the minimum flight experience required drops to 1,000 hours or 1,250 hour for an Associate's degree (Bjerke, et al, 2016). Currently, the number of colleges and universities meeting the FAA criteria for this restricted Airlie Transport Pilot Certificate is 101 (Institutions Authorized…, 2019).

Federal Aviation Regulations (FARs)

Pilot training and the requirements for such training is outlined not just in government acts, but also in other forms of regulation, such as the Federal Aviation Regulations (FARs). As discussed earlier in this chapter, early regulation was accomplished by the Department of Commerce. Currently, these regulations outline not just the basic requirements that the FAA currently enforces, but also the requirements for advanced training like that found in the airlines. Flight training in the U.S. is accomplished under FAR Part 61, or FAR Part 141.

Current Airman Certificates that are earned and issued include:

- Student Pilot; must be at least 16 years old.
- Sport Pilot; requires 15 hour of flight training and 5 hours of solo flight.
- Recreational Pilot; 15 hours of flight training, 3 hours of solo time, 2 hours of cross-country flight, greater than 25 nautical miles.

- Private Pilot; 40 hours minimum which consists of at least:

  20 hours minimum of flight training with an instructor on areas of operation, including:

  - 3 hours of cross country flight training in a single-engine airplane.
  - 3 hours of night flight training in a single-engine airplane.
  - 3 hours of flight training by reference to instruments in a single-engine airplane.
  - 3 hours of flight training in a single-engine airplane within the 60 days prior to the practical test.

  10 hours minimum of solo flying in a single-engine airplane on areas of operation, including:

  - 5 hours of solo cross country flying.
  - 1 solo cross-country flight of at least 150 nautical miles total distance with full stop landings at 3 points and one segment of at least 50 nautical miles between takeoff and landings.
  - 3 takeoffs and landings to a full stop at an airport with an operating control tower.

- Commercial Pilot (grants you the ability to fly for compensation or hire); 250 hours of recorded flight time:

- 100 hours in powered aircraft.
- 100 hours of pilot-in-command training.

- Certified Flight Instructor; Hold either a commercial pilot certificate or airline transport pilot certificate with an instrument rating.

- Airline Transport Pilot; Minimum 1500 hours of experience in aircraft, 250 hours as

  pilot-in-command. (Rossini, 2018)

Endorsements and ratings that can be added to some of these certificates include; instrument and multi-engine. (Martin, 2014). Earning certificates, endorsements and ratings is where experiential learning fits into training. Just as the Wright Brothers did in the early days of aviation described in Chapter 2, a flight student today does basically the same. One-on-one training with a CFI is the way a person learns and eventually earns the necessary certificates and added ratings and endorsements. By flying a certain amount of hours, a flight student gains the experience necessary for the particular certificate or endorsement, or rating they working toward

earning. Some of this experience is just becoming comfortable with flying and the minimum hours include cross-country flying, between two or more different airports. FAR parts 121 and 135 have additional requirements for pilots of certificated air carriers and air charter organizations. These additional requirements outline the required annual training in order to maintain currency to fly passengers under a Commercial or Airline Transport Pilot certificate. There will be more about this in Chapter 6.

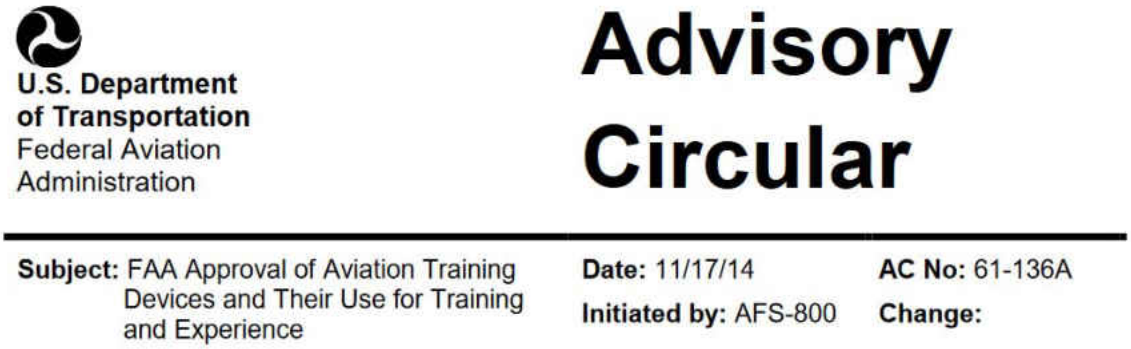
Modern Regulatory Challenges

The FAA is working on modernizing how flight training is accomplished. The understanding that experiential learning is an integral part of the training experience, but there was a need to move into a more modern training approach led to the development of the FAA-Industry Training Standards (FITS). FITS was created in 2002 as a partnership between the FAA, industry, and academia designed to make general aviation safer. By developing flight training programs that are scenario based, using real world situations. FITS focuses on redesigning general aviation training to move pilots away from just trying to pass the required test, but manage real-world challenges. An interesting part of the FITS ideology, according to the FAA is "the goal is to help pilots of technically-advanced aircraft (TAAs) -- which have more automation and often greater performance capability -- develop the risk management skills and in-depth systems knowledge needed to safely operate and maximize the capability of these aircraft…" (FAA-Industry Training Standards (FITS), 2017, p. 1). This enhanced training was created by the FAA in order to make better use of the technology now available to pilots.

More recently, in 2017, the FAA released the Airman Certification Standards (ACS). The ACS is an enhanced version of the Practical Test Standards (PTS). The original PTS were designed and added to over the years and had redundancies and outdated competency

requirements. The ACS was created to add task-specific knowledge and risk management elements to each are that a pilot should know and train for. The resulting standards are comprehensive presentation that integrates the standards for what an applicant needs to know and accomplish in order to pass both the knowledge test and the practical test for a particular certificate or rating (Airman Certification Standards, 2018).

In 2014, Advisory Circular 61-136A was released by the FAA. This purpose of this advisory circular was to provide "information and guidance for Aviation Training Device (ATD) manufacturers seeking Federal Aviation Administration (FAA) approval of basic aviation training devices (BATD) or advanced aviation training devices (AATD) under Title 14 of the Code of Federal Regulations (14 CFR) part 61, § 61.4(c)" (Department of Transportation, 2014).



U.S. Department
of Transportation
Federal Aviation
Administration

Advisory Circular

Subject: FAA Approval of Aviation Training Devices and Their Use for Training and Experience	**Date:** 11/17/14	**AC No:** 61-136A
	Initiated by: AFS-800	**Change:**

On June 27, 2018 the FAA released a new rule according to the Federal Register. This rule, entitled: "Regulatory Relief: Aviation Training Devices; Pilot Certification, Training, and Pilot Schools; and Other Provisions" (Federal Register, 2018). This rule was designed to make it easier for pilots to obtain aeronautical experience, training, and certification by allowing for more use of aviation training devices, such as simulators. The FAA decided that research had shown training devices to be an effective way for pilots to learn, while being safe and more affordable than the actual aircraft. The rule also allows for updated, more modern aircraft to be

used in place of the previously allowed complex aircraft requirement for those individuals training to be commercial pilots. The rule also made it easier for military pilot instructors to obtain their civilian instructor certifications. Lastly, the rule made some changes to earlier certification to bring regulations in line with current needs and activities of the general aviation training community and pilots (Federal Register, 2018).

Because of this rule and the changes it brought about, Advisory Circular 61-136A was canceled in September 2018. Information that was included in this advisory circular was included in the rulemaking, and therefore the advisory circular was cancelled (Federal Register, 2018).

Aviation training and education has changed a great deal due to various government acts and regulation. Fundamental changes have occurred due to regulation, in training and aviation in general. Some of these changes were passed for administrative and government oversight reasons. The Air Commerce Act of 1926 tasked the U.S. Department of Commerce with certificating pilots, while the Civil Aeronautics Act of 1938 consolidated aviation function under the Civil Aeronautics Board.

Other acts were passed due to safety. The Federal Aviation Act of 1958 created the Federal Aviation Agency and set aviation safety as a priority for the Federal government, and the Airline Safety and Federal Aviation Administration Extension Act of 2010 was passed for the enhancement of safety. Whether the reason was for administration or for safety, these acts and regulation had a profound effect on aviation, and in turn, aviation training. As technology improves and aviation moves along with these improvements, government regulation has to change as well. The required changes that effect training and education then have to be

implemented by operators. Because of this, these implementations could occur well after the technology changes have happened in aviation.

Chapter 4

College and University Education and Training

When writing a history of aviation training and education, one would be remiss not to include colleges and universities. Looking at the type of training done by institutions of higher learning, it is apparent that technology (like gliders and airplanes themselves) is the catalyst for some of the first higher education courses in aviation subjects. Aeronautical education began even before the Wright brother's first powered flight in 1903. The first classes in the late 1800's were in response to the technological achievements being accomplished in aviation at the time, such as gliders and the theories about powered flight. Most of these first subjects, as will be explored deeper in this chapter, are related to these technological advances that were being had at the time.

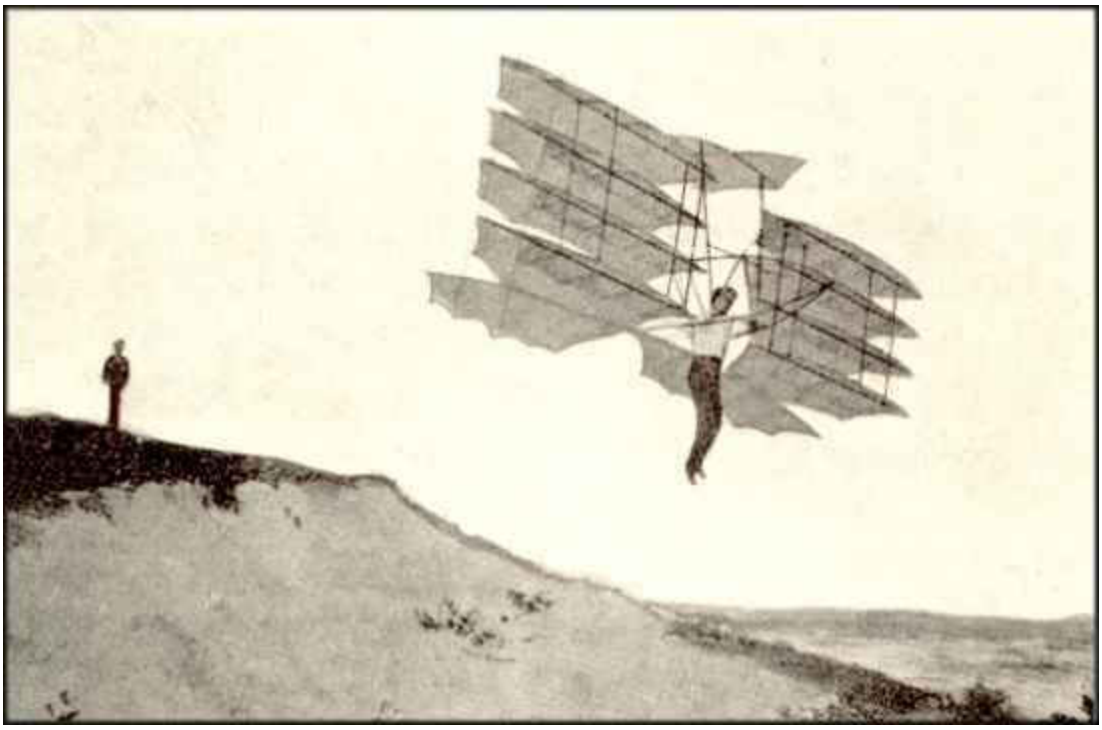
The second theme, experiential learning, the one-on-one aspect of learning to fly, comes a little later in the history of aviation in higher education. But, with the number of college and university programs now offering aviation programs, this has become an integral part of the aviation educational experience, along with the academic courses themselves. Students now attend academic classes as well as learn one-on-one with an instructor in an aircraft in most aviation colleges and universities. The differences between training and education were defined in Chapter 1, but are both seen in practice in the college and university experience. Students are practicing both of these as they learn in both the classroom and in the airplane itself. This chapter will explore some of the earliest courses being offered at institutions of higher learning, along with the histories of some of the more prominent aviation education institutions. The institutions explored not only have long histories of aviation education innovation, but are still educating today's students with the most up to date facilities and practices.

First Collegiate Aeronautics Programs

The first aviation education in the university area occurred before the Wright Brothers actually flew. In 1890, Octave Chanute presented a number of lectures to students of Sibley College at Cornell University entitled "Aerial Navigation" and in 1894 he published the book "Progress in Flying Machines." (Barata and Neves, 2017). In 1893, he proposed and organized an *International Conference on Aerial Navigation*, at the Columbian Exposition in Chicago. Upon receiving his invitation to the conference by Chanute and his organizing partner Albert Zahn (a Cornell graduate) Professor R.N. Thurston of the Mechanical Engineering Department at Cornell University said "The institution of an Aeronautical Congress would seem to me to be likely to prove an admirable move. I should think it certain to attract a great deal of attention and a large attendance. I would suggest the invitation of all members of the various aeronautical societies…" (Moon, 2015, p. 15).

In 1896, Percy Pilcher, an Assistant Lecturer in Naval Architecture and Marine Engineering at the University of Glasgow built and flew the first successful hang gliders in Britain (Johnson, 2015).

Just six years after the Wright Brothers, in 1909, Imperial College in London, England first taught a course in aeronautics in 1909 with a first chair in aeronautics established in 1920. The first formal courses in aerodynamics at the collegiate level were taught in France by Professor Lucien Marchis at the University of Paris in 1910 (Barata and Neves, 2017).



Octave Chanute, 1896 (Collection of Jean-Pierre Lauwers)

During the 1910s, several colleges and universities began rudimentary aviation training, as well. Though these university programs specialized in aeronautical engineering, not professional pilot or flying degrees, this was the beginning of college-level aviation education and shows that aviation was already becoming a credible field of study. Massachusetts Institute of Technology (MIT) began offering an Aeronautical Engineering degree in 1914 (A Brief History…), as did the University of Michigan (U-M Engineering). Noteworthy early classes offered in the University of Michigan's program included "Theory and Design of Kites" and "Advanced Stability." They also offered "Theory of Aviation," which, at least in title, sounds like a course that might be offered in an aviation program today (U-M Engineering). In a history of the Aeronautical Engineering Department written by John D. Anderson, Jr., the author writes; "Since 1914, the University has offered a degree program in a field that was to become one of

the most important technological developments in the 20th century: the airplane…" (Anderson, 2015, p. 805).

The first course at the University of Michigan was taught by Felix Pawlowski, who had been a student of Professor Lucien Marchis at the University of Paris. In offering aeronautics at Michigan, Pawlowski was building off the recently organized Michigan Aero Club. Pawlowski had seen the Wright brothers fly their airplane on several occasions, which had excited him about aeronautics. Originally, the courses were only for members of the Aero Club and were offered without credit. A translation of Emile Auguste Duchene's *Flight Without Formula* (1916) was used as a textbook for the first course. The regular courses in aeronautical engineering were originally electives in the Department of Naval Architecture and Marine Engineering, with only junior and senior engineering students able to take the courses (U-M Engineering).

In 1915, additional courses in aeronautics were added. These courses were Propulsion of Aeroplanes, which dealt with propeller and motor design, and Aeroplane Design, which was made up of lectures and drawing work. Coursework entailed learning of the actual construction of an airplane a design was made. At the beginning, only sixteen students were enrolled in these courses. In 1916, a complete four-year program began. In May 1917, the degree of Bachelor of Science in Aeronautical Engineering was established, with the first student earning the degree in June 1917. The early years of the program were filled with research and experimentation in balloons, gliders and, powered airplanes, including a model "B" hydroplane built by the Wright brothers (U-M Engineering).

THE UNIVERSITY OF MICHIGAN COURSE IN AERONAUTICS

THE faculty of the College of Engineering of the University of Michigan is developing the course in aeronautics which they offer and it is to be their endeavor to make it as comprehensive as possible. It is expected that the students will gain much information and also practical experience in connection with the work done at the Packard Motor Car Company of Detroit. The aim of the course is to teach the theory of aeroplanes and to enable students to secure positions in manufacturing plants.

The course is under the direction of Professor H. C. Sadler and Assistant Professor Felix Pawlowski, one of our contributing technical editors. The summary of the course is as follows:

1. GENERAL AERONAUTICS. Lectures and recitations. *Two hours.* First semester.

   An introductory course giving the essential principles of aeronautics (balloons, dirigibles, ornithopters, helicopthers, aeroplanes, helicoplanes and kites), history of flight and description of modern aircraft.

   Open to junior students. Must be preceded by E. M. 2 and 3.

2. THEORY OF AVIATION. Lectures and recitations. *Two hours.* Second semester.

   The course deals with the following questions: properties of the air, general discussion of aerodynamics, aerodynamical properties of planes and various constructive elements of an aeroplane, power necessary for flight, equilibrium of aeroplanes, stability of aeroplanes, air currents.

   Must be preceded by Course 1.

3. THEORY AND DESIGN OF PROPELLERS. Lectures, recitations and drawing. *Two hours.* First semester.

   Theory of propellers on the Drzewiecki system; Eiffel's method of propeller analysis and graphical method of determining propellers for specified conditions; strength of propellers and influence of gyrostatic moments in quick turns. The student will design a propeller and analyze the distribution of stresses in the blades. Must be preceded by Course 2.

4. AEROPLANE DESIGN. Lectures and drawing. *Three hours.* First semester.

   This course includes the investigation of the design of the aeroplane from the aeronautical and strength standpoints. The strength and design of all the detail are discussed and a completed design prepared.

   Must be preceded or accompanied by Course 3 and preceded by M. E. 6.

5. AERODYNAMIC LABORATORY. *One hour.* Second semester.

   An elementary course covering use of instruments, investigation of aerodynamical properties of the various bodies used in aeroplanes and airships, test of propellers.

   Must be preceded or accompanied by Courses 2 and 3, and preceded by M. E. 7.

6. DESIGN OF AERONAUTICAL MOTORS. Lectures and drawing. *Two hours.* Second semester.

   Complementary course to M. E. 15, dealing with special features of the aeronautical motors, critical study of various types of motors and design of a complete motor of certain type.

   Must be preceded by M. E. 15.

7. THEORY OF BALLOONS AND DIRIGIBLES. Lectures and recitations. *Two hours.*

   Study of equilibrium and stability of spherical balloons and dirigibles; description of French, German and Italian types; resistance and propulsion, dynamical stablity of dirigibles; operation and maintenance of balloons and dirigibles.

   Must be preceded by Courses 1, 2, and 3.

8. DESIGN OF BALLOONS AND DIRIGIBLES. Lectures and drawing. *Two hours.*

   Investigation of the design of a balloon and a dirigible from the aeronautical and strength standpoints. Questions of strength and design of all the details of the non-rigid, semi-rigid, and rigid types are discussed and a completed design of one type prepared.

   Must be preceded by Course 7.

9. THEORY AND DESIGN OF KITES. Lectures, recitations and drawing. *Two hours.*

   Critical study of various types of man-carrying kites and the launching devices. Investigation of the design from the aeronautical and strength standpoints. Completed design of a kite train of one type is prepared.

   Must be preceded by Courses 1, 2, and 7.

10. DESIGN OF AERODROMES AND HANGARS. Lectures, recitations and drawing. *Two hours.*

    Planning and equipment of aerodromes and aero-ports; construction of transportable, stationary, revolving and floating hangars. Completed design of one type is prepared.

    Must be preceded by Courses 2 and 7.

11. ADVANCED STABILITY. Lectures and recitations. Advanced study of more complicated phenomena of stability according to Ferber, Bothesat, Bryan, and Bairstow.

    Must be preceded by Course 2 and Math. 9 (Differential Equations).

12. AERONAUTICS. Advanced Reading and Seminary.

13. AERONAUTICS. Advanced Design.

14. AERONAUTICS. Advanced Research.

The program which students taking the complete course have to take is as follows:

FIRST YEAR

FIRST SEMESTER		SECOND SEMESTER	
*Modern Language	4	*Modern Language	4
Gen. Chem. (2E), or Engl. 1	5 or 4	Engl. or Gen. Chem. (2E)	4 or 5
Alg. and Anal. Geom. (Math. 1)	4	Alg. and Anal. Geom. (Math. 2)	4
Shop 1 or 2 and Des. Geom. 4	4	Des. Geom. 5 and Shop 1 or 2	4
Total hours	17 or 16	Total hours	16 or 17

SECOND YEAR

*Language	4	*Language	4
Calculus I (Math. 3E)	5	Calculus II (Math. 4E)	5
Mech., Sound, Heat (Phys. 1E)	5	Magn., Elec., Lt. (Phys. 2E)	5
Surveying 4	2	Kinematics, etc. (E. M. 1)	4
Machine Draw. (M. E. 1)	2		
Total hours	18	Total hours	18

SUMMER SESSION

Shop 3	4
Elect. App. I (E.E. 2)	4
Total hours	8

THIRD YEAR

Shop 4	4	Hydromechanics (E. M. 4)	2
Strength, Elec. (E. M. 2)	3	Thermodyamics (M.E.) 5)	3
Dynamics (E. M. 3)	3	Machine Design (M. E. 6)	4
El. Mach. Des. (M. E. 2)	3	Eng. Materials (Ch. E. 1)	3
Heat Engines (M. E. 3)	4	Theory of Struct. (C. E. 2)	3
Gen. Aeronautics (Aero. 1)	2	Theory of Avia. (Aero. 2)	2
Total hours	19	Total hours	17

FOURTH YEAR

Mech. Lab. (M. E. 7)	2	English 5, 6, 9 or 10	2
Internal Com. Eng. (M. E. 15)	3	Mech. Lab. (M. E. 32)	2
Theory and Design of Propell. (Aero. 3)	2	Aerodynam. Lab. (Aero. 5)	1
Aeropl. Design (Aero. 4)	3	Design of Aeronaut. Mod. (Aero. 6)	2
Elective	5	Elective	5
Total hours	15	Total hours	12

Reprinted from *Aerial Age*, 1915.

Early University of Michigan Aeronautical Courses (U-M Engineering, n.d.)

Up until this point in this chapter the colleges and universities that were highlighted as early aeronautical pioneers offered programs and courses in aeronautical engineering. These engineering programs were more about the theory of aviation and aeronautics. Degree programs and courses in aviation were soon to follow. At the beginning, there were very few colleges and universities offering aviation as a discipline. This has changed greatly, as the Aviation Accreditation Board International, the main accrediting body for college and university aviation programs, now has 38 accredited aviation programs in the U.S and Canada (Detailed list of AABI…). The University Aviation Association, the professional association for college and university programs, lists 119 college and university programs that are members (List of Universities). The next section will look at some of the colleges and universities that first offered aviation, along with some of the bigger programs in the modern era. According to the Aircraft Owners and Pilots Association (AOPA), there are currently more than 230 two- and four-year colleges and universities offering aviation programs (Aviation Colleges, 2016).

What is interesting about many of the colleges and universities who offer aviation courses or have some sort of aviation program is that they began first as an institution to train military pilots. In April 1917, just after declaring war on Germany, the U.S. War Department established a School of Military Aeronautics (SMA), choosing six institutions of higher learning to host these aviation schools (Jordan, 2014). The University of Illinois student newspaper, the Daily Illini, reported on this War Department development, saying; “The aviation section of the military department of the United States has become active during the present crisis and is desirous of interested students at all the universities in aviation” (Jordan, 2014). The six universities chosen to host and SMA were University of Texas, Massachusetts Institute of Technology, Cornell University, The Ohio State University, University of California, and

University of Illinois (Jordan, 2014). Cadets in the program received "three weeks of intensive military training and five weeks of theoretical and technical instruction in military aeronautics (signaling, gunnery, airplanes, engines and aerial observation)" (History, n.d.).

The Ohio State University

As stated above, the Ohio State University (OSU) aviation program began in 1917 training pilots for World War I. The first class graduated in July 1917, after beginning training in May. Ohio State also was a training center for U.S. Navy pilots during World War II. The success of these wartime training endeavors led OSU to create an undergraduate aviation program in 1942. The same year, the university built an airfield for use in training Navy pilots, but also for use by its newly formed aviation program for undergraduates. The newly created a School of Aviation offered undergraduate curricula in five fields: aeronautical engineering, meteorology, air transport, photogrammetry, and aviation psychology and physiology. The first flight instruction offered by Ohio State came during spring 1945 (History, n.d.).

Research activities were an important part of the new aviation program at OSU, with one project described as being "concerned with the training of personnel to operate airplanes were of notable achievement. One such project determined criteria for flight competence or the selection and training of aircraft pilots" (History, n.d.).

The Ohio State University Airport (History, n.d.)

Embry-Riddle Aeronautical University

What was to become Embry-Riddle Aeronautical University began in late 1925 when T. Higby Embry and John Paul Riddle began the Embry-Riddle company. The company was founded as a flight training organization as well as an airline. After substantial fund raising, the company lost all the money in 1929 and was forced to sell off its remaining assets. Embry left the company, but Riddle decided to remain with one of the companies that was sold off, American Airways, in St. Louis. Riddle left American in 1932 to restart a flight training organization in South Florida (History, n.d.). After moving from Ohio to Miami, Embry-Riddle began offering flight training for military aviators. As World War II was approaching, Embry-Riddle began training pilots in preparation for the U.S. entering the war. The successful program

continued through the war. Five hundred cadets could be trained during each nine-week course that included 60 flight hours (History, n.d.).

After the war Embry-Riddle began offering aviation instruction under the name of Embry-Riddle Aeronautical Institute. Catering to international students as well as domestic, Embry-Riddle offered different aspects of aviation education besides training. The campus moved to Daytona Beach in 1965 and become a fully accredited university in 1968. The name was changed to Embry-Riddle Aeronautical University in 1970 and a second campus opened in Prescott, AZ in 1978. Today Embry-Riddle operated the two campuses in Daytona Beach, FL and Prescott, AZ, along with smaller "campuses" all over the world offering aviation education to 34,000 current students in over 100 Bachelor's, Master's, and Doctoral majors and programs (History, n.d.). This makes Embry-Riddle the largest aviation university by its number of students.

Embry-Riddle Aeronautical University – Daytona Beach Campus (History, n.d.)

Purdue University

Purdue University Aviation began in 1935 when Amelia Earhart was invited to join Purdue as a visiting counselor for women students. Earhart herself described her relationship with Purdue in her third book, "Final Flight," saying; "For a couple of years I have been pleasantly associated with Purdue University at Lafayette, Indiana, as a periodic and rather peripatetic faculty member. Purdue is a forward looking institution building an important aviation department" (Earhart, 1937, p. 46). Earhart developed what she called her "flying laboratory" at Purdue: a Lockheed Electra twin-engine airliner. The seats were removed and extra fuel tanks installed in their place. With these changes the airplane had a fuel capacity of 1204 gallons, which gave it a range of 4,500 miles (History, Purdue, n.d.).

Amelia Earhart Statue and Dining Center at Purdue University (History, Purdue, n.d.)

In the 1940s, Purdue Aeronautical Engineering developed a four year non-engineering program in Air Transportation. With options in flight, maintenance, and management, the program used the Purdue Airport and aircraft as a laboratory and classroom for students. A fleet of DC-3 aircraft, owned and operated by the Purdue Aeronautics Corporation (PAC) and the Purdue Airport, were learning resources that were also utilized by aviation students. The Purdue Airport was the first university-owned airport in the country.

By the 1950s, the engineering school had decided that the Air Transportation program was not consistent with their overall mission. The management portion of the program was moved into the School of Management. The flight and maintenance training programs were then established in the Division of Technical Institutes (DTI). This would eventually become the Department of Aviation Technology. A two-year program in Aviation Maintenance Technology (AMT) was created in 1954 and followed by Professional Pilot Technology in 1956. The AMT program concentrated on students earning the Civil Aeronautics Administration (precursor to today's FAA) Airframe and Powerplant Mechanic certification. The PPT program utilized Purdue Aeronautics Corporation's DC-3 aircraft and required the students to have a commercial pilot certificate prior to entering the program. Both the AMT and PPT programs were located on the Purdue campus. But, the program was not considered a part of the University. Academic subjects were taught as special courses, and aviation students paid extra fees in addition to their normal tuition. During the late 1950s, specialized course and laboratory development and integration into the University mainstream. This was accomplished in 1960, with all aviation subjects being taught in the normal Purdue University structure (History, Purdue, n.d.).

University of Southern California

In 1951 the U.S Air Force began to realize that in the years since World War II they had lost not only a lot of the personnel needed to complete missions, but the knowhow that that had helped them actually win the war. It was at this time that they decided to establish an air safety program to train what they called "Air Force Safety Officers" that could perform aircraft accident investigations and other necessary safety functions. After appraising available institutions and facilities, it was decided that the University of Southern California (USC) would be an ideal place for this. The reason for choosing USC was that it had done a lot of aeronautical engineering research during the war years and had the facilities that the Air Force was looking for at that time. The first pilots began at USC in March 1954. The six week program that they began instruction in included courses, such as; Aeronautical Engineering, Aviation Physiology, Aviation Psychology, Aircraft Accident Prevention and Investigation, and Educational Principles and Techniques. Less than a month after starting, the Air Force asked that the program length be extended to eight weeks (No Margin For Error, 1959).

Later in 1954 a parallel course to the Air Force Safety Officers course for Naval Aviation Safety Officers began with the same basic program that was offered to Air Force Officers. The U.S. Army began a third program in 1956 for its aviation officers to learn the same basic aviation safety techniques the other branches of service were learning (No Margin For Error, 1959).

In 1955 USC began offering courses to civilian organizations based on the military courses and program that the university was offering. This program was expanded to a formal master's degree program, which expanded to being offered in many location worldwide until being cut back to a professional certificate program offered only in the Los Angeles area today (Mittler, 1991).

After the passage of the Federal Aviation Act in 1958, many institutions began offering aviation curriculum that mostly revolved around teaching future pilots how to fly. At this time, this mainly consisted of ground school classes combined with experiential learning with an instructor Embry-Riddle, whose early contributions to aviation training led to its training of many Army Air Corp pilots for World War II, became Embry-Riddle Aeronautical University. After the war, Embry-Riddle became one of the first institutions to be able to offer education under the new GI Bill. The school remained small due to space limitations, until 1963, when the new president moved the operation to Daytona Beach, Florida. This is where the main campus of the university is today, though greatly expanded. There are now almost 7,000 students enrolled on campus at the university, with tens of thousands of others enrolled at education centers around the world and online (History, n.d.).

University of North Dakota

In Grand Forks, North Dakota, John D. Odegard was contemplating beginning a flight training operation of his own. In 1968, Odegard began the Aviation Department at the University of North Dakota (UND). The department began inside the Business Department at UND with two donated airplanes and twelve students. Eventually, UND Aerospace became its own college inside UND and currently has four departments; Aviation, Atmospheric Science, Earth Systems Science and Policy, and Space Studies. The aviation program at UND currently has 1,700 students and the largest collegiate aircraft fleet in the world with 120 aircraft (University of North Dakota Aerospace, n.d.).

UND Aerospace Logo (University of North Dakota Aerospace, n.d.)

Airway Science

In 1981, the Professional Air Traffic Controllers Organization (PATCO), the union representing air traffic controllers went on strike. This action had a very large impact on aviation related training and education. Two days into the strike, President Ronald Reagan fired the 11,300 striking controllers. This led to the FAA having to hire 11,000 new controllers in order to keep the aviation system running safely (McCartin, 2011). After hiring and training 11,000 new controllers, the FAA found that only 25% of air traffic control employees had any education beyond high school. In 1983 the FAA proposed a whole new training program for potential aviation employees. With technology improvements and the maturity of the college and university programs, the FAA wanted to create a program to combine flight training and academia to meet modern challenges. Lehrer (1994) describes the Airway Science Curriculum Demonstration project as being created to train these future employees in five different areas that the FAA deemed as important. These areas, Airway Science Management, Airway Computer Science, Aircraft Systems Management, Airway Electronics, and Aviation Maintenance Management were chosen as FAA research showed that only 25% of employees working in

those five areas had any education greater than a high school diploma (Lehrer, 1994). The idea behind the project was to partner with aviation colleges and universities to offer programs in the five target areas, thereby educating future FAA aviation professionals (Clough, 1988). According to Lehrer, over the life of the project the Federal government spent $140 million, investing in the aviation programs of many colleges and universities. In an interim report about the project to the FAA, Clough (1988) referenced data that showed that the new hires from the Airway Science programs were not performing as well as expected, though Clough is quick to point out that it was still early in the project (Clough, 1988). Whether the program was successful or not is debatable, but many college and university aviation programs attribute their growth and success to the investment made by the FAA during the Airway Science Curriculum Project. One such program that grew considerably during this period is the University of North Dakota (UND) (McGuire, 2007). According to McGuire (2007), UND was one of only four schools that initially became accredited through the Council on Aviation Accreditation (CAA) which established their accreditation council because of the FAA's Airway Science Program. (McGuire, 2007).

Current State of Collegiate Training

As discussed in Chapter 3, the Airline Safety and Federal Aviation Administration Extension Act of 2010 has had an effect on aviation training, including collegiate flight training. The portion of this regulation that affected college and university aviation programs was the requirement that pilots hired by airlines must have at least 1,500 hours of flight experience. The caveat to this is that if a pilot graduated from an approved college or university aviation and flight program with a Bachelor's degree, the minimum flight experience required drops to 1,000 hours (Bjerke, et al, 2016). This, combined with an increase in the demand for pilots from the

airlines (due to shortage of pilots mainly due to retirements) has created a shortage of pilots in the industry.

With the increased demand for pilots and the FAA's new minimum hour requirements, including the reduced minimums for the time required by starting commercial pilots, many colleges and universities are not only seeing an influx of students, they are having trouble attracting and retaining faculty and flight instructors (Bjerke, et al, 2016) .

Colleges and universities are beginning to modernize their facilities to take advantage of the demand for pilots that is just in its infancy. One example of this is the changes Auburn University is making to its campus. Auburn partnered with Delta Air Lines to create and build the a new Delta Air Lines Aviation Education Building using a $6.2 million grant by Delta Air Lines, the Delta Air Lines Foundation and the Jacobson Family Foundation. This facility recently opened on the Auburn campus and features faculty offices, new classrooms, and an Airbus 320 airliner simulator. The gift is also providing funding for the university's Radio Frequency Identification, or RFID Lab. The investment in the RFID Lab provides a dedicated Delta Air Lines Aviation Sensor ID Bay which, according to Auburn, will "facilitate research and create an experiential learning center that will include executive, student, and industry teaching capabilities." This experiential learning will take place in the facility's new flight simulators. The new facility combines experiential learning with the latest technology in aviation training. Bill Hutto, interim chair of Auburn's Department of Aviation and director of the Auburn University Regional Airport and Auburn University Aviation Center said of the new facility: "Delta is revolutionizing the way we teach aviation at Auburn. We will see the impact of their gift for decades" (Auburn University, 2018, p. 3).

Delta Air Lines Aviation Education Building, Auburn University (Auburn University, 2018)

University Aviation Archives

Combining history with the educational facilities that colleges and universities offer, we see that some universities contain archival material from early aviation pioneers. These archival materials are important in training and education for their use by researchers and instructors for learning and teaching the next generation of pilots and aviation professionals. Purdue University contains archival materials from Amelia Earhart. As discussed earlier, Amelia Earhart was employed by Purdue, so it makes sense that these documents would be preserved at Purdue. The documents at Purdue include:

- The Collection documents related to Amelia Earhart's arrival at Purdue University, her time at Purdue, and the efforts to memorialize Earhart after her disappearance on her round the world flight.

- Collection documents from former Purdue University President Edward C. Elliott's memories of Amelia Earhart and bringing her to Purdue University.
- George Palmer Putnam collection documents from the personal life, aviation career, and business activities of Amelia Earhart.
- Correspondence from Amy Otis Earhart (mother of Amelia Earhart), photographs, and periodicals (Amelia Earhart: Archival Collections).

Amelia Earhart at Purdue University (Amelia Earhart: Archival Collections)

Auburn University houses the archived special collections of Eddie Rickenbacker. Rickenbacker was an early aviator who made his mark in aviation as a World War I flying ace, owner / Chief Executive Officer of Eastern Airlines, and aviation consultant to the U.S. Army Air Corp during World War II. He was also the survivor of two airplane accidents, both of which he was a passenger in the aircraft, not actually piloting either aircraft. The second accident occurred in the Pacific Ocean and Rickenbacker and the rest of the crew involved were presumed dead until being found 21 days later.

Interestingly enough, Rickenbacker dropped out of seventh grade and never went back to school in the traditional sense, and yet, his archived materials are housed at a research university. The archived materials include: scrapbooks and newspaper clippings, photographs, sound recordings, 16 mm motion pictures, correspondence, diaries, legal documents in original and copies, condolence letters upon Eddie's death, maps, declassified reports from Rickenbacker to the Army Air Force in World War II, other various reports of travels by Rickenbacker, affidavits taken by movie studio regarding loss of Eddie at sea, publications by and about the Rickenbacker family, and material relative to Eastern Air Lines. The items in the collection were donated by Eddie Rickenbacker's wife, Nancy Rickenbacker, as well as the National Air and Space Museum (Eddie Rickenbacker Papers).

Eddie Rickenbacker during World War I (Eddie Rickenbacker Papers)

College and university aviation courses began even before the Wright Brothers first flight in 1903. As technology improved and changed in aviation, so did college and university training. As technology improvements changed aviation, colleges and universities were forced

to change with them in order to stay relevant. As discussed in Chapter 1, Rogers (2010) "Diffusion of Innovations" theory is about adopting new technologies. Colleges and universities are about learning and adapting to new methods of accomplishing things as well as acquiring knowledge about new tools (technology) created to help them achieve their goals. What Rogers defined as innovation is exactly what education at colleges and universities is all about.

Today's college and university training encompasses some of the latest technology available in aviation. If this type of training is going to continue to attract students and prepare those same students for the modern aviation industry, colleges and universities will need to adapt and change.

Even as technology improvements and changes drive the training at colleges and universities, experiential learning is still as big a part in this sector of training and education as it was in the early days of training. Students learning to fly at higher education institutions still learn one on one in an aircraft, like the industry has always done. The aircraft and the technological components may change, but the experiential learning is still there. Colleges and universities, like other aviation training entities, have used one-on-one (experiential) training from their beginnings for flight training. That experiential training is still used today, as flight training still involves an instructor and a student in an airplane. The technological piece has evolved as collegiate aviation has embraced the use of simulators to aid in the instruction of students. But, these institutions are where training and education meet and work together. The experiential learning occurring between the instructor and the student is also combined with the educational (academic) piece, with the student also taking aviation (and other) courses in a classroom environment. As has been shown in this chapter, many colleges and universities started their aviation programs with training military pilots. In the next chapter this military

flight training will be explored in greater detail, with the concentration being how this training looked during World War II.

Chapter 5

War Time Training

Technology improvements tend to speed up during wartime as nations involved in the conflicts put large amounts of funding into the necessary elements needed to win the war (Wensveen, 2015). This was evident in World War I as aviation made the leap from a less than fifteen year old novelty, to a viable transportation option. In the years leading up to the war, the U.S. Army began formal training programs for their aviation program.

Technology changes and training were no exception in World War II. At the beginning of the war, larger, closed cabin aircraft were just being introduced into the air transport industry. The U.S. Federal Government had just recently consolidated aviation oversight into one agency, the Civil Aeronautics Authority (Civil Aeronautics Act of 1938, 1938). Technology changes and improvements to aviation during World War II included pressurized cabins and jet aircraft were introduced by the British and the Germans toward the end of the war. (Wensveen, 2015).

An interesting aspect of early aviation training is that the purpose behind it seems to be in preparation for something like war, in the case of the Army, or in response to some sort of government regulation. Safety of flight was not the driving force behind the advent of aviation training. One could look at the world situation at the time the Army began its early efforts at training and see that hostilities were beginning in Europe. The Army's early efforts could be construed as a response to the world situation. However, even the idea of assigning or allocating additional resources to the Army was met with resistance according to Hennessey (1985). Bills to increase the Army Signal Corp (the department that aviation fell under at that time) failed three times to make it to the House of Representatives in 1908, 1909, and 1910. Without passage

of these bills, the Army insisted that it did not have the resources to increase Army aviation beyond the 10 men allocated to it (Hennessey, 1985). Only after reviewing what other nations were doing, did the government increase the Signal Corp personnel allotment (Hennessey, 1985). One could argue, this was only because of the worry about the hostile situation in Europe. Yet, even this was not a completely convincing argument to some, as the U.S. was a neutral country at the time (Hennessey, 1985).

Build up to the War

There are many challenges that wartime brings, and the training environment had a plethora of these issues. Some of these issues included how to recruit and train so many new pilots, building new airfields for this training, and freeing up the instructor pilots to train all the new pilots. World War II brought similar challenges to aviation that World War I brought twenty years earlier. With the advent of World War II, the United States found itself unprepared when comparing air power to Japan and especially Germany. The U.S. Army Air Corp requested $500 million from President Franklin Roosevelt and Congress. Congress ended up appropriating over $1 billion to the Army Air Corp. The problem, as it turned out, was that the president wanted close to 50,000 aircraft annually purchased and made ready with that money. By 1941, President Roosevelt had increased the amount to 80,000 planes in 1942 and 125,000 in 1943 (Craven and Cate, 1948).

Though money was appropriated for aircraft, there was no appropriated money to actually conduct training operations for the new aircraft. It was soon decided that more pilots, mechanics, and navigators were needed. But, with 50,000 aircraft in the works, training requirements were seen as too stringent to turn out the necessary amount of pilots. Pilots originally were required to have two years of college, as that was the requirement for

commissioned officers. This was quickly changed as world events demanded the U.S. to have more pilots at the ready. In 1939, the Army Air Corp changed the pilot training requirement to be a high school graduate who was of good character, unmarried and between 18-22 years of age. They also had to be in the upper half of their high school class, accumulated 1.5 math credits in high school, and passed the Army General Classification Test and physical fitness requirements. About the time the attack on Pearl Harbor occurred, 9,000 pilots had been trained using these requirements (Tate, 1998).

Most civil aviation training in the United States was converted to military training at that time in support of the war effort. Mostly this involved using the available instructors to teach military pilots instead of civilian. In 1939, even before the U.S. entered the war, the Army Air Corp had nine civilian flight schools take over primary flight training from the military. The civilian flight schools were also handling the training of bombardiers, navigators, and flexible gunners for the military as well. The idea was that military flight training could concentrate on more advanced flight training and piloting skills needed for combat. At its peak in 1943, fifty-six civilian flight schools were performing primary flight training duties for the Air Corp (Craven and Cate, 1948). Craven and Cate go on to state that flight schools, universities, and airlines were also used for technical training, beginning in 1939 (Craven and Cate, 1948). The effect the war had on civil aviation went beyond just the training aspect, as the airlines converted a number of their aircraft to military use (Wensveen, 2015).

Wensveen further describes how the war effort brought many technological advances to aviation, the biggest advance being the jet engine. This advance in technology went on to revolutionize air travel, making it faster, safer, and more efficient. Training had to become much

more advanced as well, in order to keep up with this new, complicated, technology. (Wensveen, 2015).

In the procurement and training of men the Air Corps played a more important role than in the production of aircraft. Extensive use was made of the civilian facilities and instructors as were available for turning out the crews and technicians needed to man and support the vast number of combat aircraft that manufacturers were building. But, it was the Army Air Corps that set all standards for training, worked out schedules of classes, and that actually trained the new pilots in advanced flight procedures and combat flying. They also supervised instructors, and provided most of the actual instruction. The exception to this was in primary flight training and for some of the technical disciplines, such as bombardiers, navigators, and flexible gunners. The Army Air Corp training program expansion was as spectacular as that of the production program itself. The Air Corps grew from a strength of 20,196 in June 1938 to 2,372,293 in June 1944, and from 11 per cent of the total Army strength to 31 per cent (Craven and Cate, 1948). This growth was made possible by changing procurement priorities going from training processes that were like going from a piecework to a production line technique.

The prewar training program was excellent if judged by the performance of the men it turned out as pilots. But, they were carefully selected and highly motivated professionals who didn't not have to be rushed through their pilot training. All pilot training was conducted at Randolph Field, Texas where the largest class before 1939 numbered 246 graduates, and technical training was centered at Chanute Field, Illinois. The only postgraduate work was at the Air Corps Tactical School at Maxwell Field in Alabama. With World War II on the horizon, and with the passage of the Selective Service Act in September 1940, there became a demand for pilots in the Navy and Marine Corp. Plus there were now time limitations as the demand for

pilots was going up quickly, so it could be argued that the quality of the recruits was not as high, and the pilots being turned out did not have the time to take for each trainee that they had previous to 1939. The reason for this was due to the fact that the training period was dropped from twelve weeks to nine weeks by 1942 (Craven and Cate, 1948).

Even if the quality of the recruits may not have been as high as the U.S. Army Air Force would have liked, the training regimen still required high standards once you were a part of it. Stephen Ambrose interviewed many former B-24 crewmembers for his book, "Wild Blue." These former crewmembers described the training as intense and stressful. If a cadet was to continue on in pilot training, they had to pass the required experiential learning with an instructor and the ground school. The experiential training was usually in a PT-19. This was an open cockpit aircraft where the instructor sat behind the student who was in front. The aircraft had no canopy, so the student and instructor had to wear goggles and helmets. They also had to pass a stringent medical exam to continue training. If a cadet washed out of training, whether due to not meeting training standards or because they didn't pass the medical exam, they had the option to become a non-pilot member of the aircrew. Examples of these positions included radio operator, bombardier, or tail gunner (Ambrose, 2001).

U.S. Navy Wartime Training

The U.S. Navy had a daunting task in that they had to not only train pilots how to fly, they had to be trained how to fly from and back on to a ship. Training usually began with learning to fly an N3N Canary, a biplane that was made in the Navy's aircraft factory and was used mainly as a training machine. Basic flight training was the training stage with the highest drop-out rate for the pilot recruits. Flying the N3N was very much like flying the PT-19 that the Army Air Corp used for primary training. One difference was that, as it was a U.S. Navy

primary trainer, it could also be have floats, instead of landing gear, for learning to fly on and off water. It sorted out men who struggled with flying at all, before they even got to combat flying conditions and aircraft carrier landings (Knighton, 2017).

U.S. Navy N3N Canary trainer (open source)

Theoretical aviation knowledge was needed before a pilot could actually begin combat flying. It was classroom based, and much of it was related to math and science. For this reason, it was preferred that recruits had a college degree, because it was here in the classroom that a trainees' college degree became important. This is an example of where learning and training come together. Durkheim (1956) states that "…(education) tries to make of the individual an autonomous personality" (p. 64). Recruits that were educated could hopefully make better pilots as they would be able to be autonomous and, once trained in flying, could be better decision makers while in the air. Some of the learning that the new pilots were taught was broad: covering the science of aerodynamics and how to think in three dimensions while flying. Other portions were more directly practical: the capabilities of the aircraft itself; angles of attack; the best positions from which to take down an enemy aircraft; and how to pull out of an impending

crash. If they got through the basic training, pilots moved on to the intermediate and advanced stages (Knighton, 2017).

In response to the demand for wartime pilots, the U.S. Navy decided to make Naval Air Station Glenview, Illinois into its primary aircraft carrier flight training facility. The base was originally built as a civilian airfield in 1929, then purchased by the Navy in 1936. With the outbreak of World War II, the base became the perfect pace to host aircraft carrier training. Far from the coasts where enemy submarines and ships could disrupt training activities, the base's proximity to Lake Michigan gave a large body of water to operate carrier training.

In order to qualify pilots to land and take off from aircraft carriers, two converted paddle wheel coal burning passenger ships were used. These two ships, originally the Seeandbee and the Greater Buffalo, became the USS Wolverine and the USS Sable. The Seeandbee was originally launched in 1913, and was converted to an aircraft carrier in 1942. The Greater Buffalo, launched in 1923, was converted by the Navy in 1943. Each pilot was required to perform eight landings and takeoffs from an aircraft carrier. Between the two aircraft carriers in Lake Michigan, more than 17,000 Navy and Marine Corp pilots were qualified in aircraft carrier operations with over 116,000 landings occurring during the war years. Interestingly enough future presidents Gerald Ford and George Herbert Walker Bush both became carrier qualified at Naval Air Station Glenview and aboard the USS Wolverine and USS Sable.

USS Sable (open source)

Aviation training in World War II was not just for pilots. Enlisted men who were to be crewmembers aboard aircraft carriers served aboard the two Lake Michigan aircraft carriers in order to learn how operations worked. Sailors on U.S. Navy ships were taught how to identify the differences between Allied aircraft and Japanese aircraft. This became an important tool in the war as the U.S. moved closer to defeating Japan (Pitkin, 1942). McCracken (1944) describes U.S. Navy training aboard aircraft carriers during the war in his book "Baby Flat Top." McCracken was a Commander in the U.S. Navy Reserve when he wrote his book during World War II. He gives a firsthand description of life onboard an aircraft carrier during the war, including three chapters on how flight operations work, from catapult takeoffs to arrester cable landings. The training involved in flight operations is described and shows just how far these pilots had come from their primary flight training in civilian flight schools to landing on a ship in the middle of the ocean. These pilots have gone from flying with an instructor to solo takeoffs landings on a ship far from any land. The ability to accurately land on a pitching flight deck is described by McCracken as one of the hardest tasks a pilot can do (McCracken, 1944).

Personal Account of Wartime Training

Personal accounts of training during the war offer a window into what the training environment for aviators during World War II. Hadley Dixon was an aviation cadet right out of high school in 1942 when he entered Army Air Corp aviation training. He describes his grades in high school saying that "no one had worse grades than I had" (p. 50). This shows that although the Army Air Corp officially wanted the only those high school graduates in the upper half of their class, they were willing to let those standards slip as the war went on. This was probably due to the amount of pilots needed during this time. Dixon describes how each cadet was required to first pass a physical before even beginning ground or flight school. Once flight training began, the first portion had a 50% failure rate. A cadet had to solo before they had eight hours in the primary trainer. After that they had their first check ride at 20 hours, again, having to pass this before moving on. After 65 hours of primary training, cadets moved on to advanced training. Moving on to advanced aircraft meant stricter and stricter check rides. Dixon also describes his ground school grades as being just above passing at this point, 70%. It would be interesting to see how much of an effect on the quality of pilots low ground school scores really had. As the U.S. needed pilots, they were willing to accept those cadets that might not have otherwise met the standards that they had set (Dixon, 2014).

U.S. Army Air Corp Recruiting Poster (open source)

The numbers of aviators trained during the war were staggering. 317,000 men entered pilot training during the war. 193,400 of those graduated from advanced training. Over 124,000 men washed out, or failed, along the way. Before actually seeing combat, the average U.S. pilot had 360 hours of flight training. For comparison, the average German pilot or aircrew member had 110 hours, and the average Russian, Japanese, and Italian pilot had less than that 110. These other countries did not have the number of recruits that the U.S. had, plus they were losing a lot of aircraft and pilots in combat. Therefore, they had to abbreviate the training time in order to get their pilots into combat. These numbers show one of the reasons for the U.S. Army Air Force's perceived superiority during the war; the much greater experience of their flight crews when first seeing combat (Ambrose, 2001).

Tuskegee Airman

At a time when African-Americans were prevented from doing many things in society, military aviation was not any different. This changed when the U.S. Army realized the numbers of pilots that they anticipated being short. During World War II the first African-American aviators allowed in the U.S. Military were trained for combat. The "Tuskegee Airmen" were involved in the Army Air Corps program to train African-Americans to become pilots and mechanics on combat aircraft. The Tuskegee Airmen included pilots, navigators, bombardiers, maintenance and support staff, instructors, and all the personnel who were needed in the war effort to fly combat aircraft.

The Army selected Tuskegee Institute in Alabama to train pilots because it had the facilities, and engineering and technical instructors. Plus, as aviation personnel were needed as quickly as possible, it was located in a climate that was conducive to year round flying. Interestingly enough, the Army originally wanted to use the Curtiss Airfield in Glenview, Illinois as the site to train the first African-American pilots. As the Navy was in the process of taking it over for aircraft carrier training operations as discussed earlier in this chapter, the plan had to be changed. The first students entered the flight training program in January 1941. The program at Tuskegee was expanded and became the training center for African-American aviation during World War II (Jakeman, 1996). For the African-American aviators involved, this was more education than they could ever have expected as the Supreme Court ruling to desegregate education, Brown v. Board of Education, was still thirteen years away. Thelin (2011) wrote that "Enrollment prospects for black students remained limited, not only in the segregated states, but nationwide" (p. 232). Just before World War II, a white between the ages of 18-20 was four times as likely to go to college as an African American of the same age (Thelin, 2011).

Trainees at Tuskogee, Alabama (open source)

Women's Airforce Service Pilots (WASP)

Like African-Americans were at the beginning of World War II, women were not accepted as military pilots. As the demand for pilots kept increasing, and there were fewer and fewer male applicants, the Women's Airforce Service Pilots (WASP) were formed. WASP pilots became non-combat pilots performing operational flights, towing aerial targets, transporting cargo, smoke laying and a variety of other missions. There were 25,000 applicants to become WASP pilots and 1,102 were chosen. The applicants had to be at least 5 feet, 4 inches tall, pass Army physicals and have a pilot's license. Women also had to have at least a high school diploma and be between the ages of 18 to 35 to qualify (Johnson, 2018).

Once accepted, the women had to pay their own way to get to training in Sweetwater, Texas. They also had to pay for their own room and board and dress uniforms. Training for the WASP pilots was described by a former WASP pilot:

> "They wanted to experiment with the women to see if they could eliminate one of the phases of training, so we went from the Stearman, which is an open cockpit biplane, in

> primary [training], and after about 60 to 70 hours of that, we went directly into the advanced, which was the AT-6 [Texan] -- that's 650 horsepower comparted to 220 horsepower," she said. "It was successful. Most of the washouts were in primary training. The men adapted the same training" (Collins, 2016, p. 8)

It is interesting to note that by increasing the experiential learning flight time in primary training, the new pilots were better prepared for more advanced aircraft. As successful as the WASP program and pilots were, and even though they flew military aircraft, they were not considered to be part of the military. They were considered civilians, and therefore were not eligible for military benefits or retirement (Collins, 2016).

Link Trainer

Another training technique used by the Army Air Corp, was the Link Trainer. This training device was one of the first simulators to move, in some ways one of the first to be known as "full motion." Edwin Link developed the Link Trainer in the 1920's. His description of the trainer was "an efficient aeronautical training aid and a novel, profitable amusement device" (Link and Kail, 1944, P. 4) This trainer was electrically driven and was the closest anyone had gotten at the time to simulate actual flying, while still on the ground. The importance of "blind flying," what we now call instrument flying began to catch on, and the Link Trainer was an important aspect in training for this. The Army Air Corp signed a contract with Link, which helped them to grow their business. The first airline to purchase the Link Trainer, American Airlines, soon followed the Army Air Corp in signing a contract with Link (Link and Kail, 1944).

Link Trainer in Use (Open Source)

In filing the patent, E.A. Link described his invention as:

"One of the primary objects of my invention is to provide an apparatus for the training of student aviators and by means of which the student is subjected to all the natural sensations of flying and at the same time the apparatus is placed under his control to an extent which permits him to operate the device exactly as an airplane is operated, whereby he is able to learn easily and with perfect safety to himself the various operations which must be performed in order to correct the tilts, dips, swings, roll and other movements of the device, proper and necessary operating knowledge which will enable him to keep an airplane on an even keel or respond to the necessary manipulation of rudder, elevators and ailerons. Another object of my invention 1s to provide an apparatus of this character with a dummy rudder, elevators and aileron stall under the control of the operation stick, whereby the student may see the actual operation of these

parts as the position of the "plane" is corrected or manipulated" (Link and Kail, 1944, p. 4).

The use of simulators was one of the first times in aviation training history that the two themes of this dissertation interact. The technology of the simulator developed by Link allowed for realistic training without the expense and risk of an actual aircraft. But, one-on-one, or experiential training is still occurring and relevant. The student sits in the simulator, but there is an instructor sitting outside manipulating the controls and teaching the pilot.

The idea that instrument fight could be duplicated on the ground was an idea that had been proposed by Billy Mitchell as early as the 1920's. As highlighted in Chapter 2, James Doolittle proved in 1929 that this could work. This type of training could also prove to be very cost effective, and had the possibility to train the large amount of pilots that the U.S. needed during World War II. Mitchell advocated for pilots to be in charge of all aspects of Army Air Corp aviation, from the top to the bottom. The commander of the Army Air Corp Aviation at the time, Benjamin Foulois, disagreed with Mitchell's Assessment of what the Air Corp should be, saying: "We had no planes to fly, no organization to train them, and no facilities to sustain air operations." What they did agree on was that the best way to train the pilots was to use the link trainer. And this was before the war had even started (Schrader, 2011, p. 47).

The Link Trainer was so successful in training pilots for the U.S. during World War II, that other countries made the decision to use it for their pilot training. England, Japan, France, Germany and the USSR all began using the Link trainer in the 1930's and beyond. Of course, during the war itself, the trainer was delivered solely to the U.S. and Great Britain. But, even this was misleading. Because of the German submarine activity around Great Britain during World War II, there was no way to deliver new trainers or supply parts for the existing British

ones. Therefore, only two working Link trainers were operational during the war in Great Britain (Link and Kail, 1944).

Technology and training changed vastly during World War II. The numbers of pilots trained during the war would not have been possible without the technology of aircraft and training devices changing. As discussed earlier, wars tend to accelerate technology improvements (Wensveen, 2015). World War II changed the way pilots were trained, along with how that training was accomplished. It should be noted that even though the numbers of pilots trained increased over 10-fold, the number of training hours that each pilot flew before flying actual combat missions was still more than the other nations pilot trainees.

By 1944, German pilots were seeing 110 hours of flight training time to the U.S. pilots 360. This shows that even though the U.S. was training pilots faster, they were still able to offer the pilots sufficient flight time before combat (Dunnigan, 1996).

It could be argued that these previous figures could be a result of the time period during the war. Being that it was 1944, Germany was beginning to see the end of their power. In a desperate attempt to turn the war in their favor, the German were willing to sacrifice training time in order to get their pilots into combat. The superior training that the Allies were accomplishing was due to many factors, including the time given to their trainees in terms of experiential training in the aircraft in the form of the high number of hours.

The technology improvements realized in the war that have been highlighted in this chapter played a part in the superiority of the Allied air power. From the Link Trainer, to the ability to use former passenger ships as training aircraft carriers, the U.S. had advantages in training pilots not seen before in aviation history. As discussed, these technology improvements

were happening in aviation, and in turn, the training environment itself. Experiential training was still an important portion of the training environment. Flight training in aircraft was still accomplished one-on-one with an instructor. Even the Link trainer had an instructor working with the student. Technology may have taken a big leap forward during World War II, but experiential training carried on.

Pilot Training during the Korean War

In 1947, the U.S. Air Force was created and with it the Air Force's Air Training Command (ATC). What had been the Army Air Corp up to that point was now a separate branch of service in the U.S. military. Initially, when the Air Force was created, there was only one basic pilot training base, Randolph Air Force Base, Texas. By the end of 1949, worried about the Cold War, additional basic pilot training bases were added, making four total, Randolph, Goodfellow, Perrin, and Connally Air Force Bases .

Three years after its creation and only five years after World War II, North Korea invaded South Korea, beginning the Korean War. Unlike World War II, when the amount of time spent on pilot training went down, ATC maintained the same pre-Korean War pilot course length. This lasted through 1950 and into early 1951 and included keeping the qualification of at least two years of college. Pilot training was divided into two parts during this time period. The first part was a four-week preflight session conducted at Lackland Air Force Base, Texas. After successful completion of the first part, pilot candidates spent six months at basic flying training followed by six months of advanced training (Sligh, 2003).

The goal for most of the Korean War was to produce 7,200 pilots per year, but this proved difficult. ATC and the Air Force were close with the pilot cadet class entering training in

November 1951, but in the end were not able to reach the mark. As the Korean War came to an end in 1953, technology improvements, in the form of jet aircraft, forced the end of aircraft that had held prominent roles in both World War II and the Korean War. The B-26 and B-29 aircraft were pulled out of service and training on these aircraft began to be phased out. As the training programs on the venerable aircraft were phased out, individuals who would have started training on these aircraft were shifted to a new heavy aircraft training program using T-29, B-50, TC-54, and B-25 aircraft. (Sligh, 2003). The jet age had begun as, once again, technology had moved on.

Training Pilots for Vietnam

In 1964, the U.S. began its involvement in the war in Vietnam. One aircraft that had a large impact on the war was the UH-1 Huey helicopter. The Huey was used to transport troops to and from battle battle, evacuate wounded soldiers, and as a gunship. In total, over 7,000 Huey helicopters were used in the Vietnam War (Sotham, 2000).

The U.S. Army had to train pilots to fly all those Huey Helicopters. That training was performed at the Primary Helicopter Center at Fort Wolters, Texas. Of all the helicopter pilots who flew in Vietnam, 95 percent passed through the center at Fort Wolters, which trained Huey pilots from 1956 until the end of the Vietnam War in 1973. Training at Fort Wolters was accomplished using three models of small training helicopters, all powered by gasoline-fueled piston engines. These were less expensive to operate than the Huey helicopters and could be a bit more difficult to fly, which made them good aircraft to train with. None of the three had instruments for flying in inclement weather and clouds. New pilots learned how to fly using instruments in advanced training, usually at Fort Rucker, Alabama. There they learned instrument flight rules, tactics, formation flying, and how to operate the bigger, turbine-powered

Huey. Fort Wolters was all school had two phases of instruction, each eight weeks long: Primary I and Primary II.

Fort Wolters trained pilots for all branches of the armed services and for allied countries, including the South Vietnamese army. A total of 41,000 helicopter pilots were trained at Fort Wolters in 17 years of operation. At the peak of training activity, just before U.S. forces began a long withdrawal from the Vietnam War in 1969, Fort Wolters was sending 575 pilots per month for advanced training at Fort Rucker. The entire training process, from basic Army training to basic helicopter training at Fort Wolters through graduation from Fort Rucker was less than a year. In that time, a high school graduate was transformed into a UH-1 Huey pilot, holding the rank of warrant officer (Chiles, 2015).

Conclusion

Pilot training changed considerably due to the demands of war. The technological changes that occurred in World War II were realized over a relatively short period of time and aviation training had to change as well. The number of pilots needed by the U.S. also necessitated changes and modifications to the type of pilot training occurring because of the war. Even with the large numbers of pilots being trained, technological, as well as experiential learning allowed the U.S. to retain its aviation advantage over Germany and Japan during World War II. In the Korean War, jet aircraft were the new normal for the newly created U.S. Air Force by the end of that conflict. In the jungles of Vietnam, the helicopter, in particular, the UH-1 Huey was best suited for that war. It is interesting to see how the technologies changes with these three conflicts, and how pilot training adapted to produce skilled pilots using the same technologies the aircraft they were being trained to fly used. In Chapter 6, we will see how airlines used some of these same technologies (and pilots) to train the pilots they require.

Chapter 6

Airline Training

Training in the early years of aviation was related mostly to the military and the required training that they required. Even as airlines became to be the people and cargo haulers we know them to be today in the 1930's, training was still following the templates of how military training was completed. The airlines began to drive training and the technology needed for aviation to be safe and efficient, as aviation entered into the 1950s as the first jets were introduced into airline service. This chapter will explore the airline's use of training, including the regulation and certification requirements from the FAA and what this training looks like. Technology continues to be the driving force, including in the airline world. Simulator training will be explored, as well as ground instruction and line operation experience training. The technology that allowed simulators to begin with the Link Trainer, has only increased the realism in today's simulators. But, as has been the case throughout the history of aviation training, experiential learning is still a mainstay among the airlines, even in the technology driven world of airline simulators.

Early Airline Training

In the early days of the airlines, if a pilot had been granted a pilot license or certificate, airline managers generally agreed that he was "trained." Even airlines like TWA, which had more rigorous recurrent training programs than others, lagged behind the military in introducing modern training programs and devices (Hopkins, 1982). Most pilots were not hired by airlines unless they had military flight experience. With the addition of jet aircraft to airline fleets, training programs had to become more sophisticated. But, as will be seen in this chapter, this was possible with the technology available which propelled simulator training to keep up with

training requirements, without sacrificing the experiential training that had been a part of aviation training since the early days. As stated in Chapter 3, the first Federal government requirements, outlined in the Air Commerce Act of 1926, to fly passengers as required by the Department of Commerce were: Transport License; 200 hours total time. This license was the only one that unrestrictedly allowed the holder to transport passengers for hire or give instruction (Earhart, 1932). Here again we see the Federal Government concentrating more on a minimum number of hours as the most important aspect of proficiency, versus being able to perform specific maneuvers or flight skills. Individual airlines could see the importance of both of these aspects. They were required to hire pilots that met the minimum hour requirements, but then had their own training, thus creating an airline pilot.

Trans World Airlines (TWA) described pilot training in the 1950s in a booklet entitled "Transportation Training Center." The training center was built in 1957 in order for TWA to have a "strong, well-equipped, and efficiently operated flight crew training program…that would be…a pre-requisite to successful entry into the jet transportation field" (Transportation Training Center, n.d., pg. 1).

Descriptions of the training programs include the inclusion of three piston (propeller) engine aircraft simulators. Flight crews trained as a team to standardize flight procedures, with time spent on emergency procedures, including how to handle inflight fires, engine failures, and other "malfunctions" (Transportation Training Center, n.d., pg. 5). The jet simulator training was described as being "more than a faithful picture of the real jet. Reactions on the instruments, control forces and even sounds are the same as the pilot would experience in the air." (Transportation Training Center, n.d., pg. 13).

It should be noted that the two recurring themes of technology and experiential learning are evident in this early airline training. TWA is using the most modern training available, even building a new training center in order to train pilots on the latest technology, the jet aircraft. But, even in their "modern" simulators, there is still an instructor (experiential learning) sitting with the "student," in hands on on-on-one learning.

Modern Airline Aircraft Simulators

As discussed earlier in Chapter 5, the first realistic simulator device used by the aviation industry, including the airlines was the Link Trainer. The Link was originally developed for military use, but became quickly adopted by the airlines as its usefulness was discovered. Simulators today are almost as sophisticated as the aircraft themselves. They are also very costly. United Parcel Service (UPS) recently announced that they are adding three new full motion simulators to their new training facility in Louisville, KY. This is a big investment, as these simulators cost a minimum of $10 million apiece. When looking at the technology that actually goes into the devices, it becomes apparent as to why the devices cost so much (Mann, 2018).

UPS uses an A300-600 aircraft simulator manufactured by Tampa-based TRU Simulation + Training Inc. The simulator is used by UPS pilots to train and simulate different conditions they might and will encounter during an actual flight. The flight deck is essentially a 60-square-foot box hoisted up on 117-inch legs that move with hydraulic motors. The front windscreen is an imaged displayed on a mylar mirror, created by a Rockwell Collins EP8100 visual image generator. The hydraulic legs allow the simulator to move up and down and bank left and right, all while firmly anchored to the ground (Mann, 2018).

Full Motion Aircraft Simulator (open source)

Federal Regulations and Airline Training

When it comes to airline operations in the United States, the Code of Federal Regulations (CFR Section 14) Parts 119, 121 and 135 cover commercial operations, while Part 91 addresses general operating and flight rules. Parts 61, 65 and 67 govern air crew certification.

At a large airline, such as American Airlines, these employee numbers might be over 17,000 pilots. On many flights, crew members may have never worked together previously. For a flight to operate safely, efficiently, and on time, the procedures that flight crews must follow have to be performed without improvisation. These procedures, include the normal and abnormal situations that a flight crew member might encounter. Each crew member must be trained in these procedures, with this training backed up through a system of checklists which are cross-checked between flight crew members. It is the responsibility of the training or flight standards department to establish crew member proficiency and currency. The captain is always the

ultimate authority on any airline flight and as such has the ultimate responsibility for the flight (Belobaba et al, 2015).

Aircraft operated by most airlines today have two flight crewmembers, a captain and first officer. Older large transport aircraft have an additional flight crewmember, the flight engineer. This person's duties were / are to operate the aircraft systems that have mostly been replaced by computer systems in modern aircraft. In addition, extra crewmembers pilots may be required to operate long-haul flights due to duty time restrictions put in place by union working agreements and/or government regulations. Although the captain is always what the FAA refers to as the Pilot in Command (PIC), augmented, or extra, crew members must also hold an Airline Transport Pilot (ATP) type-rating certification in the aircraft. This FAA requirement is because a licensed type-rated pilot is always at the controls during the captain's rest period. These crew rest requirements fall under Federal Aviation Regulation (FAR) Part 117 (Midkiff, Hansman, & Reynolds, 2015).

The training process for a newly hired airline pilot is understandably comprehensive. In the modern age, it also includes training on the technical systems of the aircraft. But, it still retains the experiential learning piece. Once a new hire pilot begins training for their new role as an airline pilot, they are introduced to and learn from many of the airline's employees, both inside and outside of the training organization. The first group of employees the new hire pilot will mostly work with at an airline are the ground school instructors. The ground school instructors provide instruction on general topics such as company policies and procedures, plus specific technical topics relating to aircraft systems for the airplane that the new hire will be flying. These systems include the automation and technology that is a big part of modern transport aircraft. Once the student has completed initial ground training, they proceed to aircraft

specific training in general subjects, aircraft systems, flight training devices (FTD) and full motion flight simulators, like the one described above that UPS recently purchased (Wilson and Daku, 2016).

Upon completion of the flight training, the new hire is evaluated by an Aircrew Program Designee (APD) and then moves on to in-aircraft training which is called operating experience (OE). This training is conducted during normal, revenue-generating (with passengers or cargo), line operations and is done by a qualified training captain, often referred to as an OE Line Check Airman (Wilson & Daku, 2016).

In the United States airline pilots come from either a military or civilian background before they fly with the bigger airlines. In the past, many flight crew members at Part 121 (the Federal Aviation Regulation (FAR) requirement for most large, scheduled, airlines) carriers had experience from some form of military flight training through regular, reserve or air guard duty. Civilian pilots come from a variety of places including regional airlines, corporate flight departments and general aviation. General aviation includes flight instruction, like that in colleges and universities. Most airline pilots today have at one time been on both ends of experiential learning, first as a flight student, then later as a flight instructor. A pilot's flight time and experience is usually measured in hours of flying time and the type of aircraft and flight conditions, such as instrument flight rules or night versus day. Regulations now require that airline pilots have a minimum of 1,500 hours of flight time before being hired by and flying for an airline. Military pilots do tend to have a lower amount of hours than those pilots coming from the civilian world, and are only required to have 750 hours of flight time. For pilots that earned a college degree in an aviation related discipline at an FAA approved FAR Part 141 college or university, the requirement is 1,000 hours of flight time (Midkiff, Hansman, & Reynolds, 2015).

Flight crew members typically have a four-year college degree, with flight crew members having less than this education level being very rare. Flight crews require licensing by their respective national authorities, including some level of commercial/transport certification as well as individual qualifications in specific aircraft for larger, transport category aircraft. This is called a type rating. Flight crews must complete the training regimen established by their airline and approved by the FAA or if in a country other than the US, the specific regulatory body, before meeting the qualification requirements for operating that specific airline's aircraft. Initial qualification training times vary between aircraft and airlines but usually require 4 to 6 weeks, including ground training and simulator sessions. As discussed earlier in the chapter, today's simulator technology allows airlines (like UPS) to use full motion simulators instead of actual aircraft during flight training in all but the most unusual circumstances. Modern simulators replicate a wide variety of environmental, flight and mechanical conditions in order to achieve flight crew proficiency in both normal and abnormal procedures. Interestingly enough, the first instance a pilot operates the controls of an actual aircraft at an airline is on a revenue flight with paying passengers aboard. Recurrent training also contain both ground and simulator components and, depending on the carrier's FAA-approved program (in the United States), usually occur on a basis of 6, 9, or 12 months. In most airlines, flight crews also participate in crew resource management (CRM) training as part of their recurrent training. CRM is the effective use by the flight crews of all resources available to them, including other people and pieces of the aviation system. CRM training emphasizes the skills necessary to optimize the human/machine interface including situational awareness, use of automation systems, team building, task delegation, information transfer, problem solving and decision making (Midkiff, Hansman, & Reynolds, 2015).

Contract Airline Education and Training

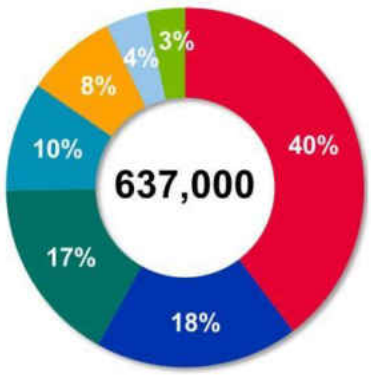
Training programs are offered by some educational institutions, as well as airline training departments which train pilots with limited or no flight experience to a level of proficiency with which they can operate as part of a flight crew, usually at a regional airline. One such program is offered by Republic Airline, a regional carrier in Indianapolis (Mark, 2018). Republic's training program will be explored later in this chapter. Many non-US carriers use this type of training for their flight crews and often send them to the United States to offset the higher costs associated with operating in their respective airspace. The University of North Dakota is one such institution offering this service to non-US flight crews.

Airline Pilot Shortage

The biggest training issue the airlines face in the coming years is the current pilot shortage that is forecast to continue. The number of U.S. private pilots with active certificates decreased by 27 percent and the number of commercial pilots fell by 21 percent over the last decade. The Boeing Aircraft Company projects North America will need 127,000 new pilots by 2037 and 637,000 pilots will be needed worldwide in roughly the same time period. Plus, the demand for air travel is ever increasing as well. Worldwide, airline passengers are expected to nearly double from 4 billion in 2017 to 7.8 billion by 2036 (Shepardson, 2018).

New Pilots by Region
2017–2036

Asia Pacific	253,000
North America	117,000
Europe	106,000
Middle East	63,000
Latin America	52,000
Africa	24,000
C.I.S. / Russia	22,000
World Total	**637,000**



Source: Boeing 2016

So, with so many new pilots expected to be hired in the coming years, how do the airlines train that many people? United Airlines recently expanded its Flight Training Center in Denver, Colorado. The training center is almost half a million square feet, with 31 simulators, each costing $15 million to $20 million. United plans to have a total of 40 simulators in the next 12 to 18 months. All of United's 12,000 pilots come through for initial training and return every nine months to stay up to date on flight procedures and safety protocols. This is also where all of United's new hire pilots must complete their initial training at that particular airline (Black, 2018).

Airline Career Path Programs

Delta Air Lines is attempting to gain more pilots in a slightly unconventional manner. Concerned about a shortage of pilots, Delta is offering its employees the chance to take an unpaid leave of absence to attend a Delta approved flight school. If they complete their flight training and minimum required hours, they will have the chance to become a Delta pilot. Delta estimates it will need to hire more than 8,000 pilots over the next 10 years. The airline currently

has over 13,000 pilots, but with the FAA mandated retirement age for airline pilots being 65, that number will fall rapidly (Josephs, 2018).

Both United and Delta have also began programs with colleges and universities with accredited aviation programs. These programs offer accepted college students a chance to interview for a pilot position at the respective airline. With Delta's program in particular a college student will go from interview to Delta pilot in 42 months of they meet all the training and flight hour requirements along the way (Josephs, 2018).

Other airlines are developing their needed pilots by themselves. Emirates Airlines of the United Arab Emirates opened the Emirates Flight Training Academy in Dubai. This flight training center is a full-residential facility spread over an area of 1.7 million square feet. It includes 36 ground school classrooms, ground based simulators, a fleet of 27 training aircraft, a 5,900 ft. runway with modern navigation aids and lighting. It includes its own air traffic control and sports and leisure facilities. The Academy can accommodate up to 600 cadets at one time (Ramanujan, 2017).

The Emirates Flight Training Academy is also changing the way flight training is done as they are using higher performance aircraft for initial training (Cirrus SR-22 aircraft) and are then transitioning students into Embraer Phenom jet aircraft, instead of the traditional light twin-engine piston driven aircraft (Ramanujan, 2017).

Emirates Flight Training Academy, Dubai (Ramanujan, 2017)

In the United States, Republic Airline is looking to find pilots in a similar manner to Emirates Airways. As mentioned earlier in the chapter, Republic has started its own flight academy in Indianapolis, IN. The official name of this is the Leadership in Flight Training (LIFT) academy. Republic says that they began this academy "to make a career as a commercial pilot more accessible to all by reducing the high cost of flight training, encouraging greater pilot diversity and raising awareness of the need for a greater supply of pilots" (Mark, 2018, p. 1). Republic is currently hiring over 600 pilots annually and anticipates that number to grow by 50% in the next 10 years. The Republic program is similar to the Emirates Flight Training Academy in that it will offer classroom instruction, simulator instruction, and actual flight training. Although, Republic uses traditional light single engine training aircraft for initial training, and twin-engine piston aircraft for the more advanced training. The cost for Republic's LIFT Academy is currently $65,000 (Mark, 2018).

No matter the method a pilot uses to get to the airlines, whether civilian or military, he or she will go through very intensive training before actually flying for an airline. Once a pilot is flying for an airline, they will go through intensive recurrent training in order to keep their proficiency and skills sharp. Following our theme throughout the different time periods and chapters of aviation history, technology and experiential learning are the keys to how airline training works. Every airline pilot learns through experiential training and today's full-motion simulators used to train pilots, use the latest technology, combined with that one-on-one, or experiential training.

Chapter 7

Aviation Training in the Modern Age

In the modern age, with its quick technological turnover in aviation, aviation training is changing to meet the needs of new aviators. Computerized training has become the new normal. Computer based training is what students expect, and computer and information skills is what will be expected of them when they begin careers in the aviation world. This evolution in training is something that can be seen across disciplines and is indicative of the world we live in. The technology that allows for this computerized training is becoming ever more sophisticated and capable of simulating real flight has never been more possible than it is today. There is also a downside to this reliance on technology which will be explored as well.

This chapter begins by reviewing each chapter, from Chapter 2 through Chapter 6. The chapter then explores the modern age of aviation and shows how technology, both good and bad, and experiential learning fit into aviation training today.

Overview of Aviation Training and Education History

Aviation training and education began with the Wright Brothers and their first powered flight. Experiential learning is apparent from the very beginning with Orville Wright sitting side by side with some of the first flight students. The training of aviators such as Amelia Earhart were profiled, with a focus on their personal description of that training. The technology improvements in aviation and training were discussed, from the airplane itself as a new technology to crossing oceans with the latest designs and training techniques.

Many acts and government regulations had an effect on aviation training and education. The first major act discussed was the Air Commerce Act of 1926, which outlined the

requirements for pilot certificates, including the training hours required for each pilot certificate. Technology improvements helped bring the passing of later regulations, and their training requirements. Thus, even as these requirements changed, facets of aviation looked similar, whether in 1926, or in 2011, as experiential learning was still a normal part of these requirements.

College and University Education and Training, began early in the history of aviation with early courses offered even before the Wright Brothers first powered flight. Some of the more prominent collegiate aviation programs from the past still play an important role today in aviation education. Technology as a driver of training and education in the collegiate world were shown to have a place, but experiential learning, whether in the classroom or the aircraft itself, is still the root of training in the college and university aviation setting.

Training that was accomplished on a large scale during times of conflict, by the United States armed forces played an important role in the history of aviation training and education. Large technological changes took place during World War II, and training had to keep up, all while training larger number of pilots than had ever been trained before. But, as is seen throughout aviation history, experiential learning plays an important role in training these large numbers of pilots. Training in the Korean War and the Vietnam War are highlighted to show the technological changes occurring in military flying that require the Air Force and Army to change training practices as well.

Airline training changed greatly with the new jet technology that the U.S. Air Force began to adapt in its training programs to at the end of the Korean War. TWA built a new training center in 1957, to adapt its training for the jet age. Modern airline training program

work using the latest simulator technology, yet still require the experiential learning piece, with an instructor working one on one with a pilot in the technologically advanced simulator.

The first six chapters of this dissertation have shown how important the two themes are in the history of aviation training and education. Aviation changed with the evolution of technology and along with that change to aviation, training and education had to evolve. This evolution in training has had profound changes in some of the aspects of education and training, but not in the basics of how it is performed. Experiential learning is still the way new pilots learn, a hands on approach to learning. Maneuvers such as climbs, descents, steep turns, and straight and level flight must be performed to proficiency. The other standard that has persevered over the years is the minimum hour requirement for the different certificates. As stated earlier, this is beginning to change, as the idea of maneuver and competency based training is slowly being adopted by the FAA and industry. In the next section of this chapter we see how technology is evolving still, and how this effects training today.

Modern Age Aviation Training

An issue effecting training in the modern age is the pilot shortage that has begun and will be on-going for some time to come. This is a world-wide phenomenon that can be attributed to a couple reasons. One part of this is the impending retirement of the baby boomer generation from professional flying. This generation had a very high birth rate and therefore has dominated the workforce across many industries, including aviation. The other reason is the burgeoning middle class in China and other highly populated Asian countries. Because more people can now afford to fly than ever, there has been a large scale expansion of aviation and airlines in Asia, thus a great need for pilots to fly for these airlines (Wensveen, 2015). The numbers of pilots that will need to be trained has not been this high since the Army Air Corp trained pilots in World War II.

As early as 1994, computers and computer based simulation was recognized as an advantage for flight training. A study by Gustavo Ortiz (1994) took 60 students who had no previous flight training experience performed a designated-aircraft maneuver in a flight training aircraft. Thirty of the subjects were first trained in a computer-based training device (CBTD) before flying the maneuver. The remaining 30 were taken directly to the aircraft and performed the maneuver with no prior CBTD. Analysis of the data showed a statistical advantage at the .01 level of confidence for the CBTD-trained experimental group, which performed significantly better than the group of 30 that did not have the CBTD before flying the maneuver in the training aircraft (Ortiz, 2009).

Validating Ortiz's finding in 1994, Dennis Beringer (1994) looked at two flight simulators that could be used on personal computers. His assessment of pilot training using these fairly low cost simulators was that they could have positive results in aviation training. In Beringer's experiment, ten experienced pilots were used. Total flight experience ranged from 410 to 1000 hours for the experienced pilots with 80 to 400 hours having been flown in the previous 90 days. The lone private pilot had 91 hours total flight time. Pilots who trained first with the flight simulator had 50% fewer errors than those who did not first use the flight training simulators (Beringer, 1994). It is interesting to note that not only did both Ortiz and Beringer publish their findings in 1994, but the positive simulator results were found in both individuals with no flying experience, but those that were experienced pilots as well.

Unsurprisingly, reliance on automation and simulation in aviation training does have its critics. Salas, E., Bowers, C. A., & Rhodenizer, L. (1998) warn against the overreliance on automation. The authors agree with the earlier authors that home based simulators can have a positive effect on aviation training and that the capabilities offered by simulation have created

unlimited opportunities for aviation training. In fact, they go on to day that aviation training is now more realistic, safe, cost-effective, and flexible than ever before. But, Salas, et al go on to say that a number of misconceptions or invalid assumptions exist with the proponents of simulation that prevent the industry from fully utilizing the recent (remember this was from an article published in 1998) scientific advances in a number of related fields in order to further enhance aviation training. Invalid assumptions related to the overreliance on high-fidelity simulation and to the misuse of simulation to enhance learning of complex skills were thought to be an issue at the time.

As stated above, this was a viewpoint from twenty years ago, in 1998, and was written just four years after the 1994 articles. But, what about modern flight training? Are these same results and perspectives seen if we look at flight training today?

Korteling, Helsdingen, and Sluimer (2017) described the usefulness of two flight simulator programs. The objective of their study was to see if there was any evidence of transfer-of-training to professional performance provided by two stand-alone flight simulator programs designed for personal computers. These flight simulators, which the authors describe as “games”, Falcon 4.0 (F-16 (military fighter jet) specific) and Microsoft Flight Simulator (civil aircraft), are designed for entertainment purposes, and are not designed for formal flight training The study used three pre-existing groups of gamers (n = 37; Falcon 4.0 gamers, Microsoft Flight Simulator gamers and a control group: gamers without flight game experience, that performed three typical F-16 flight tasks in a high-fidelity fixed-base flight simulator.

Microsoft Flight Simulator X A320 Screenshot (Korteling, Helsdingen, & Sluimer, (2017)

The results of the study were very similar to the two 1994 studies referenced earlier. The Falcon 4.0 gamers performed substantially better on almost all tasks compared to the control group, and to a lesser degree to Microsoft Flight Simulator gamers. The Falcon 4.0 group showed near- and far-transfer on almost all flight performance measures. The game had prepared them for the generic and specific military aspects of the test flight tasks that were performed in the fixed-base flight simulator. Performance of the Microsoft Flight Simulator gamers indicated only far-transfer. That being a transfer of more generic flight skills from the game to the test flight tasks. The authors concluded that both near- and far-transfer of job related competences may occur by playing realistic flight simulator games on a personal computer (Korteling, Helsdingen, & Sluimer, (2017).

Flight simulation is obviously very reliant on technology. But, what about the learning environment for the classroom or traditional learning environment for aviation training? What has changed with regard to technology? Looking at e-learning, Suzanne Kearns (2016) looked at

technology replacing the traditional classroom in aviation. Specifically, Dr. Kearns addresses the areas of cost and safety and the e-learning platform. Traditional classroom instruction requires that pilots to be taken away from actually flying. Plus, a training facility has to be maintained and instructors to be paid. E-learning is extremely cost-effective and can be a viable alternative. Though, this technique is only cost effective if it is done in a correct manner. It needs to be understood that courses should not directly convert classroom-based presentations to an online format. It needs to be recognized that computer-based instruction is an entirely different way of completing aviation training and instruction. A blended learning strategy, which incorporates both face-to-face and computer-based instruction, should be utilized. The goal of this approach is to utilize e-Learning as a tool to reduce time at the training center and thereby increase pilot productivity and potentially improve the quality of training (Kearns, 2016).

Reducing training times and costs becomes very important when we look at the second issue effecting modern aviation training. The world-wide pilot shortage is becoming a very real problem. By reducing training times with simulation and e-learning, airlines can train more pilots in a (hopefully) shorter amount of time. The reduced costs will mean a much less strain on an airline's budget with the increased load on training.

But, will the reduced training times become a factor in aviation safety? As there has only been one passenger fatality on a U.S. based airline since the Colgan Air accident in 2009, one could argue that the Airline Safety and Federal Aviation Administration Extension Act (discussed in Chapter 3) has had a positive effect. The issue with that is this may be a case where increased and more stringent training requirements may not be the complete answer to the airline's remarkable safety record. During this time period, the use of safety data in pilot training and flight operations decisions has markedly increased. Wild and Ullrich (2015) in their book

"Aviation Safety – The Basics" discuss how Aviation Safety Action Program (ASAP) data can be used for retraining crews after an event. This is safety data from voluntarily submitted by pilots if they want to report issues, small or large. Aircraft operators also use data from Flight Operational Quality Assurance (FOQA) programs which is data recorded by the aircraft itself to identify potential safety issues. ASAP and FOQA offer the airlines a myriad of options for using safety data in their training programs. By knowing the safety risks in an operation, training programs can be designed to mitigate the risks (Wild & Ullrich, 2015).

Risk reduction and training for such has been a big part of the current exemplary safety record of the airlines. Dismukes, Berman, and Loukopoulos (2007) discuss how the aviation, and especially the airline, industry needed to rethink how pilot error is perceived. The authors analyzed airline accidents that occurred between 1991 and 2000 in their book, "The Limits of Expertise, Rethinking Pilot Error and the Causes of Airline Accidents" and concluded that the aviation system as a whole was to blame. The authors concluded that pilot error was too simplistic a cause as these accidents entailed "…competing task demands, ambiguity and organizational pressures interact with cognitive processes to make all experts (pilots) vulnerable to characteristic forms of error." The use of safety data in training programs (later validated by Wild and Ullrich) was cited as a way to possibly reduce accidents (Dismukes, Berman, & Loukopoulos, 2007).

Wilson and Binnema (2014) give some practical advice for pilots to follow in terms of reducing risk in flight operations themselves. In "Managing Risk, Best Practices for pilots" the authors give techniques for pilots that will reduce chances for accidents. This particular book is designed to be used by aviation classes at universities to give a best practices approach to managing risk in aviation operations for flight students (Wilson & Binnema, 2014).

Safety implications of the overreliance on technology can be an unfortunate by product of using simulation and e-learning techniques to train the ever increasing numbers of needed pilots. In 2009, Air France flight 447 crashed enroute from Rio De Janeiro to Paris. The accident occurred while the aircraft was flying through an area of thunderstorms. The crew lost control of the aircraft at a cruise altitude of 35,000 feet and subsequently crashed into the Atlantic Ocean, killing all 228 people on board. The investigation into the accident took many years, partly due to the fact that it took two years before the main portion of the wreckage was located. One of the areas of concern identified during the investigation was the crew's lack of awareness and training on high altitude stalls and the automated aspects of the aircraft. The crew had an overreliance on the automation and had not been properly trained for what happened when that automation was lost (Palmer, 2013).

A recent accident also highlighted the overreliance on technology by aircraft manufacturers in modern aircraft. A Lion Air (flight 610) Boeing 737 crashed off the coast of Indonesia in October 2018, killing 189 people. The aircraft was a Boeing 737 MAX 8, the latest version of the B737. This new version of this aircraft has upgraded, more fuel efficient engines. Boeing convinced regulators like the FAA and the airlines that the new aircraft did not require additional training for existing B737 pilots. The problem, as accident investigators have figured out when investigating the Lion Air accident, the pilots were never informed of a change in the aircraft's flight control system that would automatically try to control the aircraft in the event of a perceived stall. When the aircraft received erroneous information about the pitch angle of the aircraft, the automatic flight control tried to rectify a problem that actually didn't exist. As the crew did not have the proper information or training about the new system, they reacted improperly to the problem, and the aircraft, and everyone aboard, was lost (Glanz, Creswell,

Kaplan, & Wichter, 2019). Technology has shown itself to be an integral part of aviation training and education. As technology gets more and more advanced, there seems to be a tendency to move to relying on that technology to keep the aircraft. Being able to actually fly the airplane without having to rely on the aircraft's automation (technology) is becoming harder with newer designs of aircraft. Technology and experiential learning have been shown to intermingle, but maybe it's time to step back from an overreliance on the technology in aviation.

Lion Air Boeing 737 MAX 8 (open source)

Competency Based Learning in Training

So, how does the aviation industry improve on training and use technology to its advantage, instead of the disadvantage as seen in the Air France 447 or Lion Air 610 accidents? In the case of the Air France 447 accident the flight crew had a lot of experience, at least in the number of hours of flying they had. But, on the other hand, the first officer on the Lion Air accident flight had a very small number of hours or experience. Yet, the outcome for both of these flights was the same, a total loss of life to all onboard. The crews both reacted in a wrong manner to a technological problem. So, is this a technological problem, or an experiential

learning issue? The real issue might be the overreliance on hours of flight as a means of deciding if a pilot is qualified, or "trained." One solution is to go away from a minimum number of hours being the way we decide if a pilot has been properly trained. Dr. Suzanne Kearns of the University of Waterloo writes about competency based training in her column in SKIES magazine. With the global pilot need expected to be 620,000 new pilots by 2036, there has to be a better and faster way to train pilots in order to meet the demand. But, this needs to be accomplished in a safe manner, not just expeditiously. Competency based training may be the way to do just that. This means that knowledge, skills and attitudes required for professional competence are identified and organized into a series of competency statements, which themselves become training objectives to be measured against. Pilots in training could practice climbs, descents, steep turns, and other maneuvers, but spend more time on those they are having a harder time learning, and less time on others. According to Dr. Kearns, "a competency-based approach offers several advantages over traditional hours based methods, as training becomes more personalized and adaptive" (Kearns, 2018). While the traditional hours based approach has long been used to judge whether a person has the necessary experience to be considered for a particular license, it can't be adapted for an individual's needs. It is also not flexible, and an individual who is ahead in their training still has to finish the required number of hours. Conversely, someone who does not have the required competency, but has the minimum number of hours may still be awarded a license. Competency based training uses skills and knowledge as the basis for earning a particular license, instead of a minimum number of hours (Kearns, 2018). In the past we have strictly gone by the minimum number of hours as required by the regulations. Technologies have changed, but regulatory authorities have stuck with a specific

hour requirement. Some movement has taken place, as the FAA has recently adopted the Airman Certification Standards (ACS), as described in Chapter 3.

The International Civil Aviation Organization (ICAO) recommended in 2010 that competency based training be integrated into aviation. In 2014, ICAO created guidance for dangerous goods state employees, designated medical examiners, flight procedure designers, air traffic controllers, aircraft maintenance personnel and is currently in place for commercial pilot license training. This does not mean that it is required, just that it has been designed to be used for these areas of aviation. Also in 2014 ICAO recommended CBT for flight attendant safety and security training. ICAO described this being "primarily to increase on-the-job performance, safety proficiency and also to institute an international baseline for flight attendant competencies" (Gibbs, Slevitch, and Washburn, 2017).

When looking at aviation training today, it can be described in one word; technology. If you look at what drives the various facets of aviation training, from colleges and universities, to the airlines, it is the technologies such as simulators and virtual classrooms. Technology drives a lot of what we see in today's modern world, including aviation and aviation training and education. But, I don't think that is just in today's modern world. As has been shown in previous chapters, history shows that technology has driven the advances that occurred in training. Some of the most notable figures in aviation from Lindbergh to Earhart started their training in aviation because of the technologies available at the time. Whether it be reliable engines or radio navigation, the latest technology was available and used by aviation and aviation training. Open cockpit airplanes and barnstorming pilots were normal at the time and drew Lindbergh in to aviation. Edwin Link, inventor of the Link Trainer would not have been able to invent and produce the simulator that changed training history had technology not

progressed. Simulator technology became the major way training turned to, but even this still required the experiential learning aspect of an instructor sitting with the student.

The future of aviation training and education seems to be headed towards more virtual reality and virtual classrooms. Again, driven by technology, the industry is riding the modern wave towards more internet and web based applications. It should be noted though that even as technologies change, there will always be a requirement for hands on learning. Whether it be the student pilot learning to fly and airplane, or the maintenance technician honing their skills, aviation is still a hands on endeavor. Experiential learning is still the key element behind how aviators train and learn. In the Air France 447 and Lion Air 610 flights, the pilots might have been able to save the aircraft, had they understood what the circumstances were, and been able to disengage the aircraft automation (technology). Technology is important, but a hands on approach still should work. As has been shown throughout the history of aviation training and education, even as technology improves and changes the way training is accomplished, experiential learning is still an important piece that doesn't go away. It could be argued that hands on learning seems to be getting more important as technology has changed and advanced. In our modern world, accidents such as Air France 447 and Lion Air 610 show that pilots need more hands-on training on what the technology in a modern airplane offers, but what should be done if that technology does not work as intended. Modern pilots still need to know how to actually fly an airplane, not just let technology fly the airplane for them. These accidents show experiential learning is just as important in modern aviation as it was when Orville Wright sat next to his first student in the early 1900's. Technology has created efficiencies in aviation and aviation training, but it needs to be combined with the hands on approach of experiential learning.

It's also easy to see that technology will drive the future of aviation training as well. Dr. Suzanne Kearns (2018) says; "Due to mandatory recurrent training cycles and the resulting escalating costs, the aviation industry has become an innovator and early adopter of training technologies." In her article "The Future of Technology in Aviation Training" she goes on to talk about these technologies that aviation training will adopt as well as how people will actually learn. Tomorrow's learners will be tech savvy and expect information to be personalized and available quickly. Dr. Kearns sees wearable technology, like Google Glass, big data, like machine learning, and e-learning to be the next big training advancements in aviation (Kearns, 2018).

Conclusion

So, where does this leave aviation training? It seems that technology is still driving the changes and advances that are occurring, as we have seen throughout aviation history. But, unless we see a big shift in artificial intelligence, or the way flight simulator technology works, we are still using experiential learning as we have since the Wright Brothers first flew a powered aircraft in 1903. One-on-one training is still shown to be the best way for new pilots to learn, but also for experienced pilots to go through recurrent training.

I had three research questions in Chapter 1. Answering these questions, I have created a broad, comprehensive history of aviation training and education. In accomplishing this, the technologies, government acts, policies, and events have had a major effect on aviation training were explored, along with the aviation pioneers and personalities that have steered the evolution of aviation training.

Throughout this dissertation I have shown how the themes of experiential learning and technology have been the connecting themes in all eras of aviation training and education. The Wright Brothers began powered aviation with both the latest technology (the airplane, itself) and the experiential learning that they pioneered. As aviation progressed technology changed and advanced, but not only stayed as part of the training and education equation, it has shown to be just as important a piece, if not more important. The FAA still requires one-on-one training to become a pilot and advance onto more complicated certificates and ratings. Modern simulators used by airlines use the most advanced technology, but still require training one-on-one with an instructor and a pilot. With technology evolving, and simulators and computer systems evolving into the wholly realistic scenarios that they can now recreate, even experiential learning can evolve into something that may look a bit different, but that even the Wright Brothers would still recognize as aviation training.

Appendix

List of Documents

- Air Commerce Act of 1926
- Civil Aeronautics Act of 1938
- Federal Aviation Act of 1958
- Airway Science Curriculum Demonstration Project (1983)
- Advisory Circular 61-136A: FAA Approval of Aviation Training Devices and Their Use for Training and Experience (2014)
- FAA-Industry Training Standards (FITS) (2017)
- Airman Certification Standards (ACS) (2018)
- Regulatory Relief: Aviation Training Devices; Pilot Certification, Training, and Pilot Schools; and Other Provisions" (2018)

References

A Brief History of MIT Aeronautics and Astronautics. (n.d.). Retrieved September 16, 2017, from http://aeroastro.mit.edu/about-aeroastro/brief-history

Air Commerce Act of 1926. (n.d.). Retrieved from http://legisworks.org/congress/69/publaw-254.pdf

Airman Certification Standards. (2018, August 30). Retrieved from https://www.faa.gov/training_testing/testing/acs/

Ambrose, S. E. (2002). *The Wild Blue: The Men and Boys who Flew the B-24s Over Germany 1944-45*. Simon and Schuster.

Amelia Earhart: Archival Collections. (n.d.). Retrieved from https://guides.library.harvard.edu/c.php?g=311115&p=2081753

Anderson Jr, J. D. (2015). Riding the Crest: A History of Michigan's Aerospace Engineering Department. *AIAA Journal*, *53*(4), 805-816.

Auburn University. (2018, October 16). *Auburn University, Delta Air Lines partnership elevates future of aviation, develops next generation of pilots* [Press release]. Retrieved from https://www.prnewswire.com/news-releases/auburn-university-delta-air-lines-partnership-elevates-future-of-aviation-develops-next-generation-of-pilots-300732319.html

Auburn University Library. (n.d.). Retrieved November 25, 2017, from http://www.lib.auburn.edu/archive/flyhy/cover.htm

Barata, J. and Neves, F. (2017) The History of Aviation Education and Training. *Open Journal of Applied Sciences*, **7**, 196-205.

Beringer, D. B. (1994). Issues in Using Off-the-Shelf Pc-Based Flight Simulation for Research and Training: Historical Perspective, Current Solutions and Emerging Technologies. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *38*(1), 90–94.

Bjerke, E., Smith, G., Smith, M., Christensen, C., Carney, T., Craig, P., & Niemczyk, M. (2016). *Pilot source study 2015: US regional airline pilot hiring background characteristic changes consequent to Public Law 111-216 and the FAA first officer qualifications rule.* Journal of Aviation Technology and Engineering, 5(2), 1.

Black, E. (2018, December 30). United Airlines' 12,000 pilots go through flight training every 9 months - we tried it out. Retrieved from https://www.cnbc.com/2018/12/21/inside-united-airlines-flight-training-facility.html

Blalock, G., Kadiyali, V., & Simon, D. H. (2007). The impact of post-9/11 airport security measures on the demand for air travel. *The Journal of Law and Economics*, *50*(4), 731-755.

Bunke, H. (1954). Commercial aviation and the Civil Aeronautics Act of 1938. *Southern Economic Journal, 20*(4), 356-368.

Burke, J., & O'Connor, R. (1970). *Winged legend: the story of Amelia Earhart*. Putnam.

Brundage, A. (2002). *Going to the sources. A guide to historical research and writing.* Third Edition. California State Polytechnic University, Pomona.

Calkins Jr, N. (1955). The role of the Civil Aeronautics Board in the grant of operating rights in foreign air carriage. *J. Air L. & Com.*, *22*, 253.

Cannadine, D. (Ed.). (2002). *What is history now?* Springer.

Chiles, J. R. (2015, August 20). Where Huey Pilots Trained and Heroes Were Made. Retrieved from https://www.airspacemag.com/history-of-flight/heroes-fort-wolters-180956245/

Christy, T. E. (1975). *The methodology of historical research a brief introduction.* Nursing Research, *24*(3), 189-192.

Civil Aeronautics Act of 1938. (1938). Harvard Law Review, 52(1), 137-144.

Clough, D. L. (1988). Airway science curriculum demonstration project: Summary of initial evaluation findings (Report No. DOT/FAA/AM-88/5). *Washington, DC: Federal Aviation Administration*.

Cobb, R. W., & Primo, D. M. (2004). *The plane truth: Airline crashes, the media, and transportation policy*. Brookings Institution Press.

Cohen, D.W. (2010). Memories of things future: future effects in the "production of history". In S. Jobs, & A. Ludtke (Eds.), *Unsettling history: archiving and narrating in historiography* (pp. 29-48). Frankfurt: Campus.

Collins, S. (2016, March 2). WASPs Were Pioneers for Female Pilots of Today, Tomorrow. Retrieved from https://dod.defense.gov/News/Article/Article/684700/wasps-were-pioneers-for-female-pilots-of-today-tomorrow/

Craven, W. F., & Cate, J. L. (1948). *The Army Air Forces in World War II: Vol. VI–Men and Planes.* Chicago: University of Chicago Press, 58, 424.

Davies, R. E. G. 1994. *Fallacies and Fantasies of Air Transport History*. McLean, VA: Paladwr.

Delta Air Lines Flight Museum. (n.d.). Retrieved November 25, 2017, from https://www.deltamuseum.org/about-us/archives

Dixon, H. (2014). Letters home: An aviation cadet's letters to his family provide a window on Army Air Forces pilot training during World War II. *Aviation History, 25*(1), 50.

Depperschmidt, C. L., Bliss, T. J., & Casebolt, M. K. (2015). The effect of Public Law 111-216 on collegiate flight programs: Perceptions of aviation faculty and flight center personnel. *Collegiate Aviation Review*, *33*(2), 53.

Detailed list of AABI Accredited Programs and interactive map. (n.d.). Retrieved January 1, 2019, from http://www.aabi.aero/accreditation/accredited-programs/

Dismukes, K., Berman, B. A., & Loukopoulos, L. D. (2007). *The limits of expertise: Rethinking pilot error and the causes of airline accidents*. Ashgate Publishing, Ltd.

Duchêne, É. A. (1918). *Flight without formulae: simple discussions on the mechanics of the aeroplane*. Longmans, Green.

Dunnigan, J. F. (1996). *Dirty Little Secrets of World War II: Military Information No One Told You...* Harper Collins.

Durkheim, E. (1956). *Education and sociology*. Simon and Schuster.

Earhart, A. (1932). *The fun of it*. Brewer, Warren, and Putnam.

Earhart, A. (1937). *Last flight*. Harcourt, Brace and Company, Inc.

Eddie Rickenbacker Papers, RG 101 Administrative Information. (n.d.). Retrieved January 1, 2019, from http://www.lib.auburn.edu/archive/find-aid/101/admin.htm

Ennels, J. A. (2002). The" Wright stuff" pilot training at America's first civilian flying school. *Air Power History*, *49*(4), 22-31.

Fife, G. B. (1927). *Lindbergh, the Lone Eagle: His Life and Achievements*. AL Burt Company.

Fitzsimons, M. A. (Ed.). (1954). *The development of historiography*. Stackpole Co.

FAA-Industry Training Standards (FITS). (2017, January 13). Retrieved from https://www.faa.gov/training_testing/training/fits/

Federal Aviation Act of 1958. 72 U.S.C. (1958).

Garraghan, G. J. (1946). *A guide to historical method*. Fordham University Press.

Gibbs, L., Slevitch, L., & Washburn, I. (2017). Competency-based training in aviation: The impact on flight attendant performance and passenger satisfaction. *Journal of Aviation/Aerospace Education & Research*, *26*(2), 55-80.

Gil, A. (1990). Air transport deregulation and its implications for flight attendants. *Int'l Lab. Rev.*, *129*, 317.

Glanz, J., Creswell, J., Kaplan, T., & Wichter, Z. (2019, February 03). Behind the Lion Air Crash, a Trail of Decisions Kept Pilots in the Dark. Retrieved from https://www.nytimes.com/2019/02/03/world/asia/lion-air-plane-crash-pilots.html

Glesne, C. (2016). *Becoming qualitative researchers: An introduction*. Pearson.

Glines, C. V. (1989). The Day the Airmail Started. *Air Force Magazine*, 99.

Goldstone, L. (2015). *Birdmen: The Wright Brothers, Glenn Curtiss, and the battle to control the skies*. Ballantine Books.

Groom, W. (2013). *The Aviators: Eddie Rickenbacker, Jimmy Doolittle, Charles Lindbergh, and the Epic Age of Flight*. National Geographic Books.

Harvard University Competency Dictionary. (2014). Retrieved from https://apps2.campusservices.harvard.edu/cas/empldocs/cs/harvard_competency_dictionary_complete.pdf

Hennessy, J. A. (1985). *The United States Army Air Arm, April 1861 to April 1917*. Air Force Historical Studies Office Building AFB DC.

Historiography [Def. 1 and 2.]. (n.d.). *Merriam-Webster Online.* In Merriam-Webster. Retrieved November 19, 2017, from http://www.merriam-webster.com/dictionary/historiography.

History. (n.d.). Retrieved from https://aviation.osu.edu/about-us/history

History. (n.d.). Retrieved from http://erau.edu/90th-anniversary/history.

History, Purdue. (n.d.). Retrieved from https://polytechnic.purdue.edu/schools/aviation-and-transportation-technology/about/history

Hockett, H. C. (1955). *The critical method in historical research and writing*. Macmillan.

Hopkins, G. E. (1982). *Flying the line*. Air Line Pilots Association.

Iggers, G. G., Wang, Q. E., & Mukherjee, S. (2013). *A global history of modern historiography*. Routledge.

Institutions Authorized to Certify its Graduates for an Airline Transport Pilot (ATP) Certificate with Reduced Aeronautical Experience. (2019, February 26). Retrieved from https://www.faa.gov/pilots/training/atp/media/Institutional_Authority_List.pdf

Jakeman, R. J. (1996). *The divided skies: Establishing segregated flight training at Tuskegee, Alabama, 1934-1942*. University of Alabama Press.

Jobs, S. (2010). *Unsettling history: archiving and narrating in historiography*. Campus.

Johnson, C. (2018, August 05). Women with Wings: The 75-Year-Legacy of the WASP. Retrieved from https://airandspace.si.edu/stories/editorial/women-wings-75-year-legacy-wasp

Johnstone, R. W. (2006). *9/11 and the Future of Transportation Security*. Greenwood Publishing Group.

Jordan, A. (2014, September 29). School of Military Aeronautics. Retrieved from https://archives.library.illinois.edu/blog/military-aeronautics/

Jordanova, L. (2006). *History in practice*. Hodder Education.

Josephs, L. (2018, July 17). Looking for a new job? Delta's hiring 8,000 pilots. Retrieved from https://www.cnbc.com/2018/07/16/help-wanted-delta-seeks-8000-pilots-flight-attendants-may-apply.html

Kearns, S. K. (2016). *E-learning in aviation*. Routledge.

Kearns, S. (2018, July 11). The future of technology in aviation training. Retrieved from https://www.unitingaviation.com/strategic-objective/capacity-efficiency/the-future-of-technology-in-aviation-training/

Kearns, S. (2018/2019, December/January). Training the next generation of aviation professionals. *SKIES Magazine*, *8*(6), 8.

Knighton, A. (2017, October 05). How the US Navy Trained its Pilots in WWII - the Bar for Entry was High. Retrieved from https://www.warhistoryonline.com/world-war-ii/how-the-us-navy-trained-its-pilots-in-wwii-the-bar-for-entry-was-high.html

Kolb, D. A. (1984). The process of experiential learning. *Experiential learning: Experience as the source of learning and development*, 20-38.

Komons, N. (1978). *Bonfires to beacons: Federal civil aviation policy under the Air commerce act, 1926-1938*. U.S. Dept. of Transportation, Federal Aviation Administration, U.S. Govt. Print. Off.

Korteling, H. J., Helsdingen, A. S., & Sluimer, R. R. (2017). An empirical evaluation of transfer-of-training of two flight simulation games. *Simulation & Gaming*, *48*(1), 8-35.

Lehrer, H. R. (1994). Airway Science (AWS): A Promise Kept or an Opportunity Missed? *Journal of Aviation/Aerospace Education & Research*, *4*(3).

Lindbergh, Charles A. *The Spirit of St. Louis*. Simon and Schuster, 1953.

Link, E. A., & Kail, K. A. (1944). *U.S. Patent No. 2,358,016*. Washington, DC: U.S. Patent and Trademark Office.

List of Universities. (n.d.). Retrieved January 1, 2019, from https://www.uaa.aero/list_of_universities.php

Mann, D. A. (2018, March 14). UPS has the coolest video game you'll probably never play. Retrieved from https://www.bizjournals.com/louisville/news/2018/03/14/ups-has-the-coolest-video-game-youll-probably.html

Mark, R. (2018, June 5). Republic Airways Launches Flight Training Academy. Retrieved from https://www.flyingmag.com/republic-airways-launches-flight-training-academy

Martin, E. (2014, November 10). 6 Different Types Of Pilot Certifications. Retrieved from https://www.pea.com/blog/posts/6-different-types-pilot-certifications/

Markham, B. (1942). *West with the Night*. Macmillan.

Mason, R. O., McKenney, J. L., & Copeland, D. G. (1997). An historical method for MIS research: Steps and assumptions. *MIS quarterly*, 307-320.

McCartin, J. A. (2011). *Collision course: Ronald Reagan, the air traffic controllers, and the strike that changed America*. Oxford University Press.

McCormick, B. W., Newberry, C. F., & Jumper, E. (Eds.). (2004). *Aerospace engineering education during the first century of flight*. Aiaa.

McCracken, K. (1944). *Baby flat top.* Farrar & Rinehart.

McCullough, D. (2015). *The Wright Brothers*. Simon and Schuster.

McGuire, P. (2007). *Flight of the Odegard. UND Aerospace.*

Megill, A. (2007). *Historical knowledge, historical error: A contemporary guide to practice*. University of Chicago Press.

Midkiff, A., Hansman, J., & Reynolds, T. (2015). Airline Flight Operations. In Belobaba, P., Odoni, A., & Barnhart, C. (Eds.), *The Global Airline Industry* (pp. 213-251). West Sussex, UK: John Wiley and Sons.

Mittler, E. (1991). Survival in the face of success: The case of the Institute of Safety and Systems Management at the University of Southern California. *International Journal Of General System*, *19*(1), 11-24.

Moon, F. C. (2015). A Brief History of The Sibley College and School of Mechanical Engineering at Cornell: Including the Graduate School of Aeronautical Engineering and the Department of Theoretical and Applied Mechanics. Cornell University

Mosley, L. (1976). *Lindbergh*. Doubleday.

National Air and Space Museum Archives. (2016, June 30). Retrieved from https://airandspace.si.edu/archives

NTSB Aircraft Accident Report Detail. (2010, February 2). Retrieved from https://www.ntsb.gov/investigations/accidentreports/pages/aar1001.aspx

O'Neil, P. D., & Krane, D. (2012). Policy and Organizational Change in the Federal Aviation Administration: The Ontogenesis of a High-Reliability Organization. *Public Administration Review*, *72*(1), 98-111.

Operating licences. (n.d.). Retrieved from https://www.caa.co.uk/Commercial-industry/Airlines/Licensing/Licence-types/Operating-licences/

Ortiz, G. A. (1994). Effectiveness of PC-based flight simulation. *The International Journal of Aviation Psychology*, *4*(3), 285-291.

Palmer, B. (2013). Understanding Air France 447. Author.

Page, R. L. (2000). Brief history of flight simulation. *SimTecT 2000 Proceedings*, 11-17.

Parks, D. (2013, March 31). Getting airborne: Early flight training. Retrieved from https://generalaviationnews.com/2013/03/31/getting-airborne-early-flight-training/

Pitkin, W. B. (1942). What's That Plane. Penquin Books, Inc.

Project Narrative. (n.d.). Retrieved November 24, 2017, from http://projectnarrative.osu.edu/

Ramanujan, S. (2017, November 13). Emirates Flight Training Academy officially inaugurated. Retrieved from https://www.emirates.com/media-centre/emirates-flight-training-academy-officially-inaugurated#

Regulatory Relief: Aviation Training Devices; Pilot Certification, Training, and Pilot Schools; and Other Provisions. (2018, June 27). Retrieved December 8, 2018, from https://www.federalregister.gov/documents/2018/06/27/2018-12800/regulatory-relief-aviation-training-devices-pilot-certification-training-and-pilot-schools-and-other

Rich, D. L. (1989). *Amelia Earhart: A Biography*. Smithsonian Institution.

Rogers, E. M. (2010). *Diffusion of innovations*. Simon and Schuster.

Rossini, T. (2018, July 27). A Breakdown of the 7 Different Types of U.S. Pilot Certificates. Retrieved from https://inflightpilottraining.com/2018/07/27/a-breakdown-of-the-7-different-types-of-u-s-pilot-certificates/

Russel, J.C. (1954). Renaissance of the Twelfth Century. In Fitzsimons, Pundt, & Nowell (Eds.) *The development of historiography.* Stackpole

Salas, E., Bowers, C. A., & Rhodenizer, L. (1998). It is not how much you have but how you use it: Toward a rational use of simulation to support aviation training. *The international journal of aviation psychology*, *8*(3), 197-208.

Schrader, Karl R. (2011). "Good men ... running around in circles" Benjamin Foulois, Billy Mitchell, and the flight for the future of the Army Air Service. (Biography). *Air Power History, 58*(3), 42.

Shepardson, D. (2018, September 13). U.S. airlines, officials grapple with looming pilot shortfall. Retrieved from https://www.reuters.com/article/us-usa-airlines-pilots/u-s-airlines-officials-grapple-with-looming-pilot-shortfall-idUSKCN1LT3FW

Shulman, S. (2002). *Unlocking the sky: Glenn Hammond Curtiss and the race to invent the airplane*. HarperCollins, Publishers.

Simons, D., & Withington, T. (2004). The history of flight. Parragon Pub.

Sligh, R. B. (2003). *Air Training Command and the Korean War*. Randolph Air Force Base, TX: Office of History and Research, headquarters, Air Education and Training Command.

Sotham, J. (2000, May 01). Huey. Retrieved from https://www.airspacemag.com/military-aviation/huey-1023487/?all

Tate, J. P. (1998). *The Army and Its Air Corps: Army Policy toward Aviation, 1919-1941*. AIR UNIV MAXWELL AFB AL.

The Air Commerce Act of 1926. (1927). *Columbia Law Review, 27*(8), 989-996.

The History of the Purdue School of Aviation and Transportation Technology. (n.d.). Retrieved November 23, 2018, from https://polytechnic.purdue.edu/schools/aviation-and-transportation-technology/about/history

Thelin, J. R. (2011). *A history of American higher education*. JHU Press.

Thomas, L. J., & Jablonski, E. (1976). *Doolittle: A Biography*. Doubleday.

Transportation Training Center. (n.d.). Retrieved from http://photos.twamuseumarchives.org/GalleryFilmstrip.aspx?gallery=4770948&mid=100628433&mt=Photo&ci=008

U-M Engineering. (n.d.). Retrieved September 16, 2017, from http://www.engin.umich.edu/aero/about/aero/history

United States, Department of Transportation, Federal Aviation Administration. (November 17, 2014). *Advisory Circular 61-136A*.

University of Minnesota. (2015, July 15). Primary, Secondary, and Tertiary Sources. Retrieved from https://www.crk.umn.edu/library/primary-secondary-and-tertiary-sources

University of North Dakota Aerospace. (n.d.). Retrieved from http://aero.und.edu/Mediakit/AboutJDOSAS.aspx

Wensveen, J. G. (2015). *Air transportation: A management perspective*. Ashgate.

Wheeler, K. (2013, June 18). What's the Difference Between Training, Education, Development and Learning? Retrieved from https://futureoftalent.org/whats-difference-training-education-development-learning

Wild, B.W., & Ullrich, G.M. (2015). *Aviation safety-the basics*. Bookboon.com.

Williams, R.C. (2011). *The historian's toolbox: A student's guide to the theory and craft of history*. ME Sharpe.

Wilson, N. D., & Daku, S. A. (2016). Industry in Motion: Pilot Study on Instructor and Management Perceptions of New Hire Pilot Technical and Professional Preparation. *International Journal of Aviation, Aeronautics, and Aerospace*, *3*(3), 11.

Wilson, D., and Binnema, G. (2014). *Managing risk, best practices for pilots.* Aviation Supplies and Academics.

Zemskov-Zege, A. (2010). Narrating the siege of Leningrad: official and unofficial practices in the memorialization of the "Great Patriotic War." In S. Jobs, & A. Ludtke (Eds.), *Unsettling history: archiving and narrating in historiography* (pp. 29-48). Frankfurt: Campus.