CHARACTERISTICS AND ANALYSIS OF MAJOR

U.S. AIR CARRIER ACCIDENTS

BETWEEN 1991 AND 2010

By

KEVIN KOREY BOSS

Bachelor of Science in Professional Flight Technology
Purdue University
West Lafayette, Indiana
2002

Master of Aeronautical Science in Aerospace Management
Embry-Riddle Aeronautical University
Daytona Beach, Florida
2006

Master of Science in Aerospace Administration & Logistics
Southeastern Oklahoma State University
Durant, Oklahoma
2007

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
DOCTOR OF EDUCATION
July, 2012

CHARACTERISTICS AND ANALYSIS OF MAJOR

U.S. AIR CARRIER ACCIDENTS

BETWEEN 1991 AND 2010

Dissertation Approved:

Dr. Timm Bliss

Dissertation Adviser

Dr. Steve Marks

Committee Member

Dr. Todd Hubbard

Committee Member

Dr. James Key

Outside Committee Member

Dr. Sheryl A. Tucker

Dean of the Graduate College

TABLE OF CONTENTS

Chapter Page

LIST OF TABLES

LIST OF FIGURES

Figure Page

Figure Page

CHAPTER I

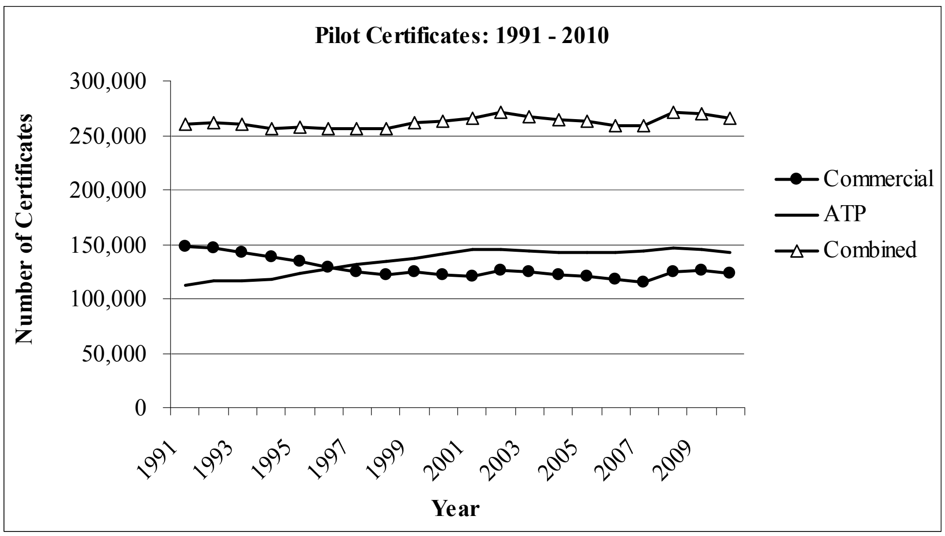
INTRODUCTION

The demand for air travel in the U.S. grew from 172 million passengers in 1970 to more than 630 million passengers in 2010 (Bureau of Labor Statistics, 2011; Bureau of Transportation Statistics, 2011). The Federal Aviation Administration (FAA) has projected the number of passengers to reach "…more-than one billion by 2015, and 1.2 billion by 2020" (Price, 2007).

As a result, the Bureau of Labor Statistics (2011) has predicted the employment of pilots to grow by 12% between 2008 and 2018. The International Air Transport Association (IATA) has estimated the industry would need 17,000 new pilots annually to meet the industry's projected growth (Kirby, 2007). According to the IATA, if nothing is done, this will translate into a world-wide shortage of approximately 42,000 pilots by 2020 (2008). "Experts estimate that from now until 2025, airlines around the world will need to hire more than 300,000 new pilots to fly all the new jets – about 19,000 – expected to join the fleet by then; and replace retirees and others who leave" (Kaur, 2007).

While demand for air travel has steadily increased over the past several decades, the total number of pilots certified for commercial operations has remained relatively stable when both groups of Airline Transport Pilot (ATP) and commercial certificate holders are combined. While there has been an overall increase in the total number of ATP certificated pilots, the overall number of commercially certificated pilots has decreased.

Figure 1



Note. Data derived from "1991 – 2000 Estimated Active Airmen Certificates Held" and "2001 – 2010 Estimated Active Airmen Certificates Held" by the Federal Aviation Administration, 2011.

As indicated by Figure 1, fluctuations between any given years were relatively slight. The estimated active airmen certificate data published by the FAA indicated there were 123,705 commercially certificated pilots and 142,198 ATP certificated pilots in 2010 (FAA, 2011). Thus, commercially certificated pilots represented slightly over 46% of the combined potential workforce of 265,903 pilots in 2010.

Between 2006 and 2007, a number of U.S. air carriers were forced to reduce minimum flight time hiring requirements in order to recruit enough pilots to meet passenger demand for air travel. Trans States Airlines indicated during an AABI meeting in 2007 that minimum flight time hiring requirements were reduced from 1,500 hours to 500 hours. Atlantic Southeast Airlines' hiring requirements were reduced from 1,200 hours to 500 hours and American Eagle's hiring requirements were reduced from 2,000 hours to 800 hours (AABI, 2007).

Typically, a reduction in an air carrier's minimum flight time hiring requirements occurs when the supply of pilots is insufficient to meet the passenger demand for air travel. Reducing flight time requirements allows an air carrier to increase the labor pool by attracting pilots with fewer flight hours, pilots who would otherwise be less than competitive for employment.

New Pilot Certification Requirements for U.S. Air Carriers

In 2009, following the crash of a Colgan Air DHC-8, legislation was introduced to increase the minimum flight time and certification requirements for all flight crewmembers serving in 14 CFR 121 air carrier operations. On October 14, 2009, the U.S. House of Representatives signed H.R. 3371, the "Airline Safety and Pilot Training Improvement Act of 2009", which sought in part, to require all flight crewmembers serving in 14 CFR 121 air carrier operations to hold an ATP certificate and possess at least 1,500 hours of total flight experience. The bill was then forwarded to the Senate Committee on Commerce, Science, and Transportation for further consideration (FAA, 2010).

The review of literature failed to address what action was taken by the Senate Committee on Commerce, Science, and Transportation. However, on February 8, 2010, the FAA published an Advance Notice of Proposed Rulemaking (ANPR), requesting public comment, data, or views regarding new pilot certification requirements for air carriers. The intent of the ANPR was to "…gather information on whether current eligibility, training, and qualification requirements for commercial pilot certification are adequate for engaging in such [Part 121] operations" (Government Printing Office, 2010). According to the FAA, the Colgan Air Flight 3407 accident "…focused attention on whether a commercially-rated copilot in Part 121 operations receives adequate training…to be able to recognize a potentially dangerous situation and respond in a safe and timely manner" (2010).

On August 1, 2010, the President of the United States signed H.R. 5900, the "Airline Safety and Federal Aviation Administration Extension Act of 2010", which was adopted by the 111th Congress as Public Law 111-216 (The White House, 2010). Public Law 111-216, Title II, Sec. 216, mandated all flight crewmembers serving in 14 CFR Part 121 air carrier operations to hold an ATP certificate. Title II, Sec. 217, mandated that in order to qualify for an ATP certificate, an individual shall possess at least 1,500 total hours of flight experience (Government Printing Office, 2010)

"The requirement that each flight crewmember for a Part 121 air carrier hold an airline transport pilot certificate under Part 61 of title 14, Code of Federal Regulations, shall begin to apply on the date that is 3 years after the date of enactment" (Government Printing Office, 2010). Until the requirements of the Airline Safety and Federal Aviation Administration Extension Act of 2010 take effect, individuals holding a commercial pilot certificate and instrument rating are authorized to serve as first officers of an aircraft operated under 14 CFR 121.

For decades, this made it possible for aspiring airline pilots to apply for an entry level first officer position with as little as 250 hours of total flight time. Although highly unlikely for a brand new commercial pilot with 250 hours to gain employment with a major U.S. air carrier, several collegiate institutions throughout the U.S. provided training in advanced transport category aircraft and maintained preferential hiring programs with a variety of U.S. air carriers. This made it possible for a handful of college graduates with advanced training to apply for employment with a reduced number of total flight hours. This also afforded aspiring airline pilots an opportunity to seek employment with an air carrier where they could start building seniority and working towards retirement.

Access to commercially rated first officers also made it possible for air carriers to draw from a larger pool of applicants when the demand for air travel dictated a need for additional pilots. This was important, as on occasion the demand for air travel exceeded what air carriers could collectively provide for without hiring additional pilots. When faced with a shortage of pilots, air carriers were able to increase the hiring pool by utilizing commercially certificated pilots. Under the Airline Safety and Federal Aviation Administration Extension Act of 2010, air carriers will no longer be able to extend employment to the pool of commercially certificated pilots.

Statement of the Problem

The Airline Safety and Federal Aviation Extension Act of 2010 will require all flight crewmembers, to include first officers, serving in 14 CFR 121 U.S. air carrier operations to hold an ATP certificate and possess at least 1,500 hours of total flight experience. There is, however, a provision within the Act which authorizes the FAA to grant credit for specific academic training courses toward the 1,500 total flight hour requirement if a determination is made "…that allowing a pilot to take specific academic training courses will enhance safety more than requiring the pilot to fully comply with the flight hours requirement" (Government Printing Office, 2010).

As mentioned, the FAA issued an ANPR for New Pilot Certification Requirements for Air Carrier Operations in 2010. The FAA highlighted the Colgan Air DHC-8 accident, the need to improve pilot performance and professionalism, and requested public comment, data, or views regarding the certification of pilots engaged in 14 CFR 121 operations. Specifically, the FAA sought to gather "…recommendations on whether the existing flight-crew eligibility, training, and qualification requirements should be increased for commercial pilots engaged in Part 121 operations" (Government Printing Office, 2010).

In the case of the Colgan Air DHC-8 accident, the captain held an ATP certificate and "…had accumulated 3,379 hours of total flying time, including 3,051 hours in turbine airplanes, 1,030 hours as pilot-in-command (PIC), and 111 hours on the [DHC-8] Q400" (NTSB, 2010). The first officer held a commercial pilot certificate and "…had accumulated 2,244 hours of total flying time, including 774 hours in turbine airplanes and on the [DHC-8] Q400" (NTSB, 2010). While the first officer held only a commercial certificate, both pilots involved in the Colgan Air DHC-8 accident possessed more than 1,500 hours of total flight experience.

The Colgan Air DHC-8 accident raised many concerns among legislators and regulators with regard to existing flight time and certification requirements for pilots engaged in 14 CFR 121 air carrier operations. The decision to increase those requirements appeared to support the notion that commercially certificated pilots and/or pilots with less than 1,500 hours of total flight experience pose a greater level of risk than pilots who hold an ATP certificate and have more than 1,500 hours of flight time. Unfortunately, it was not known whether the flight time, level of certification, or other characteristics of the pilots involved in the Colgan Air DHC-8 accident were characteristic of pilots who were involved in other major U.S. air carrier accidents. Therein laid the problem. What were the characteristics of major U.S. air carrier accidents? With regard to a future increase in flight time and certification requirements for 14 CFR 121 air carrier operations, there was a need to better understand the characteristics of previous air carrier accidents. The existing body of literature, or lack thereof, presented an opportunity for additional research regarding this issue.

Purpose of the Study

The purpose of this study was to describe the characteristics of major U.S. air carrier accidents between 1991 and 2010 operated under 14 CFR 121. For the purpose of this study, an accident was included if the following criteria were met: the accident involved a U.S. air carrier operating under 14 CFR 121 between 1991 and 2010 and the NTSB conducted a major investigation. Major investigations were defined as investigations in which the NTSB adopted an aircraft accident report (AAR) or aircraft accident brief (AAB).

A select number of operational related variables and pilot related variables were used to describe the characteristics of major U.S. air carrier accidents in terms of operational characteristics and pilot characteristics. According to the NTSB, "previous accident investigations have identified a large set of operational and human performance factors as being related to the occurrence or seriousness of errors" (1994). Variables related to the operational characteristics of major U.S. air carrier accidents included: phase of flight; period of day; type of operation; equipment type; and involvement of environmental factors, mechanical factors, and other persons. Variables related to the characteristics of pilots included: flight experience; level of certification; duration of employment with the accident air carrier; crew assignment; crew familiarity; the involvement of pilot performance; past unsatisfactory ratings; FAA accidents, incidents, and violations; and prior driver's license suspensions and revocations.

Research Questions

This study was exploratory in nature and was guided by the following research questions:

1. What were the operational characteristics of major U.S. air carrier accidents between 1991 and 2010 based on select operational related variables?

2. What were the characteristics of the pilots involved in major U.S. air carrier accidents between 1991 and 2010 based on select pilot related variables?

3. Based on the select variables, were the characteristics of pilots involved in major U.S. air carrier accidents in which pilot performance was cited as a causal or contributing factor significantly different than the characteristics of pilots involved in accidents in which pilot performance was not cited as a causal or contributing factor?

Significance of the Study

Upward pressures on the demand for air travel will result in upward pressures on the demand for labor. As witnessed in 2006 and 2007, several air carriers were forced to reduce minimum flight time hiring requirements in order to hire a sufficient number of pilots. Under the Airline Safety and Federal Aviation Extension Act of 2010, air carriers operating under 14 CFR 121 will potentially lose access to the more than 100,000 commercially certificated pilots with an instrument rating, according to FAA data, or approximately 45% of the potential labor supply under existing regulations (FAA, 2011). This is a significant number of personnel and could have potentially negative consequences given the cyclical nature of the aviation industry. The findings of this study may prove useful in a cost-benefit safety analysis.

Additionally, the Airline Safety and Federal Aviation Extension Act of 2010 is geared, in part, toward protecting passengers and decreasing the level of risk present in the U.S. air carrier industry by increasing flight time and certification requirements for pilots engaged in 14 CFR 121 air carrier operations. From a risk management perspective, it involves the implementation of a control measure. As later discussed in the review of literature, there are six steps involved in the Operational Risk Management (ORM) process: identify the hazards; assess the risks; analyze risk control measures; make control decisions; implement risk controls; and supervise and review (FAA, 2000). "Risk management must be a fully integrated part of planning and executing any operation, routinely applied by management, not a way of reacting when some unforeseen problem occurs" (FAA, 2000).

This study identified the characteristics of major U.S. air carrier accidents between 1991 and 2010. Using pilot related variables previously mentioned, this study compared the characteristics of pilots involved in major accidents citing pilot performance as a causal or contributing factor with the characteristics of pilots involved in major accidents in which pilot performance was not a causal or contributing factor in order to determine whether any significant differences existed. The findings of this study may aid in the identification of hazards, assessment of the risk, and analysis of risk control measures.

Finally, the findings of this study may prove useful to aviation administrators responsible for the supervision and review of such control measures, which will require a pre-data post-data comparison in order to determine their effectiveness. The findings of this study may prove useful in such comparisons.

Assumptions

The following assumptions applied to this study:

1. NTSB aircraft accident reports (AAR), aircraft accident briefs (AAB), factual reports, and probable cause reports are an accurate and reliable source of accident data and information.

2. The characteristics of pilots involved in past major U.S. air carrier accidents is relevant to flight-crew eligibility, training, and certification requirements for pilots engaged in 14 CFR 121 air carrier operations.

Limitations

The following limitations applied to this study:

1. This study was limited to major U.S. air carrier accidents between 1991 and 2010 operating under 14 CFR 121. Non-major accidents, incidents, and other operations were not included in this study. For the purpose of this study, an accident was included if the following criteria were met: the accident involved a U.S. air carrier operating under 14 CFR 121 between 1991 and 2010 and the NTSB conducted a major investigation. Major investigations were defined as investigations in which the NTSB adopted an aircraft accident report (AAR) or aircraft accident brief (AAB). Therefore, caution should be used with regard to generalizations about other pilot populations and accidents/incidents without further study.

Operational Terms and Definitions

Aircraft accident – “an occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight and all such persons have disembarked, and in which any person suffers death or serious injury, or in which the aircraft receives substantial damage" (Code of Federal Regulations, 2011).

Accident air carrier – refers to the air carrier involved in an accident. Also see air carrier.

Aircraft engine - "an engine that is used or intended to be used for propelling aircraft. It includes turbosuperchargers, appurtenances, and accessories necessary for its functioning, but does not include propellers" (Code of Federal Regulations, 2011)

Active failure – a failure or error “…whose effects are felt almost immediately…active errors are associated with the performance of the ‘front-line’ operators of a complex system: pilots, air traffic controllers, ships’ officers, control room crews and the like” (Reason, 1990).

Air carrier – “a person who undertakes directly by lease, or other arrangement, to engage in air transportation” (Code of Federal Regulations, 2011)

Air travel – refers to transportation by means of an aircraft.

Airmen – refers to the holder of a pilot certificate.

Approach – under instrument flight rules it means “from the Initial Approach Fix (IAF) to the beginning of the landing flare”. Under visual flight rules it means “from the point of VFR pattern entry, or 1,000 feet above the runway elevation, to the beginning of the landing flare” (NTSB, 2011).

Aviation Accident/Incident Database (AIDS) - "contains incident data records for all categories of civil aviation...that occurred between 1978 and the present" (FAA, 2012).

Aviation Accreditation Board International (AABI) - "a nonprofit 501 © (3) organization that meets twice a year and sets standards for all aerospace programs taught in colleges and universities around the United States and around the world" (AABI, 2012).

Bureau of Transportation Statistics (BTS) - "a component of the Research and Innovative Technology Administration (RITA)...BTS creates, manages, and shares transportation statistical knowledge with public and private transportation communities and Nations" (BTS, 2012).

Captain – “a person who (1) has final authority and responsibility for the operation and safety of the flight; (2) has been designated as pilot in command before or during the flight; and (3) holds the appropriate category, class, and type rating, if appropriate, for the conduct of the flight” (Government Printing Office, 2011).

Characteristic(s) – "a distinguishing trait, quality, or property" (Merriam-Webster, 2012).

Code of Federal Regulations (CFR) - "the codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the Federal Government" (GPO Access, 2012).

Control measure – “any action or activity that can be used to prevent, eliminate or reduce a significant hazard” (Food and Drug Administration, 1997)

Copilot – “a pilot who is designated to be the second in command of an aircraft during flight time” (Government Printing Office, 2011).

Crew assignment – refers to the distribution of flying and monitoring duties.

Crewmember – “a person assigned to perform duty in an aircraft during flight time” (Code of Federal Regulations, 2011).

Cruise – “any level flight segment after arrival at initial cruise altitude until the start of descent to the destination” (ICAO, 2011).

Descent – under instrument flight rules it means “descent from cruise to either Initial Approach Fix (IAF) or VFR pattern entry”. Under visual flight rules it means “descent from cruise to the VFR pattern entry or 1,000 feet above the runway elevation, whichever comes first” (ICAO, 2011).

Fatal injury – “any injury which results in death within 30 days of the accident” (Code of Federal Regulations, 2011).

Federal Aviation Administration (FAA) - a regulatory agency under the Department of Transportation responsible for providing "...the safest, most efficient aerospace system in the world" (FAA, 2010). The FAA establishes and enforces rules and regulations pertaining to the U.S. aerospace system.

First officer – “a pilot who is designated to be the second in command of an aircraft during flight time” (Government Printing Office, 2011).

Flight crewmember – “means a pilot, flight engineer, or flight navigator assigned to duty in an aircraft during flight time” (Code of Federal Regulations, 2011).

Flight time – “pilot time that commences when an aircraft moves under its own power for the purpose of flight and ends when the aircraft comes to rest after landing” (Government Printing Office, 2011).

Go-around – “a maneuver following an uncompleted approach, which involves transition to a climbing flightpath” (NTSB, 1998).

Incident – “an occurrence other than an accident, associated with the operation of an aircraft, which affects or could affect the safety of operations” (Code of Federal Regulations, 2011).

International Air Transportation Association (IATA) - "an international trade body, created over 60 years ago by a group of airlines...IATA represents some 240 airlines comprising 84% of total air traffic. The organization also represents, leads and serves the airline industry in general" (IATA, 2012).

Landing – means “from the beginning of the landing flare until the aircraft exits the landing runway, comes to a stop on the runway, or when power is applied for takeoff in the case of a touch-and-go landing” (NTSB, 2011).

Latent failure – a failure or error “…whose adverse consequences may lie dormant within the system for a long time, only becoming evident when they combine with other factors to breach the system’s defenses…most likely to be spawned by those whose activities are removed in both time and space from the direct control interface: designers, high-level decision makers, construction workers, managers and maintenance personnel” (Reason, 1990).

Major investigation - investigations in which the NTSB adopted an aircraft accident report (AAR) or aircraft accident brief (AAB).

Major U.S. air carrier accident – an accident involving an aircraft operated under 14 CFR Part 121 between 1991 and 2010 for which the NTSB conducted a major investigation of the accident. Major investigations were defined as investigations in which the NTSB adopted an aircraft accident report (AAR) or aircraft accident brief (AAB).

Maneuvering – “intentional low altitude or aerobatic flight operations” (NTSB, 2011).

National Transportation Safety Board (NTSB) - "an independent federal agency charged with determining the probable cause of transportation accidents, promoting transportation safety, and assisting victims of transportation accidents and their families (NTSB, 2012).

NTSB Aviation Accident Database - "contains information from 1962 and later about civil aviation accidents and selected incidents within the United States, its territories and possessions, and in international waters" (NTSB, 2012).

Operational Risk Management (ORM) - "a decision-making tool to systematically help identify operational risks and benefits and determine the best course of action for any given situation" (FAA, 2000).

Operator – “any person who causes or authorizes the operation of an aircraft, such as the owner, lessee, or bailee of an aircraft” (Code of Federal Regulations, 2011).

Phase of flight – “refers to a period within a flight” (ICAO, 2011).

Pilot in command – “a person who (1) has final authority and responsibility for the operation and safety of the flight; (2) has been designated as pilot in command before or during the flight; and (3) holds the appropriate category, class, and type rating, if appropriate, for the conduct of the flight” (Government Printing Office, 2011).

Precondition – refers to a prerequisite or “…proper or desired condition or frame of mind especially in preparation” (Merriam-Webster Dictionary, 2011). “These are a set of qualities possessed by both machines and people: reliable equipment of the right kind; a skilled and knowledgeable workforce; an appropriate set of attitudes and motivators; work schedules, maintenance programs and environmental conditions that permit efficient and safe operations; and codes of practice that give clear guidance regarding desirable (safe and/or efficient) and undesirable (unsafe and/or inefficient) performance” (Reason, 1990).

Rating - "means a statement that, as a part of a certificate, sets forth special conditions, privileges, or limitations" (Code of Federal Regulations, 2011).

Risk - "the probability and severity of accident or loss from exposure to various hazards, including injury to people and loss of resources" (FAA, 2000).

Risk management - "management activity ensuring that risk is identified and eliminated or controlled within established program risk parameters" (FAA, 1998).

Second in command – “a pilot who is designated to be the second in command of an aircraft during flight time” (Government Printing Office, 2011).

Serious injury – “any injury which: (1) Requires hospitalization for more than 48 hours, commencing within 7 days from the date of the injury was received; (2) results in a fracture of any bone (except simple fractures of fingers, toes, or nose); (3) causes severe hemorrhages, nerve, muscle, or tendon damage; (4) involves any internal organ; or (5) involves second- or third-degree burns, or any burns affecting more than 5 percent of the body surface” (Coded of Federal Regulations, 2011).

Standing – “Prior to pushback or taxi, or after arrival, at the gate, ramp, or parking area, while the aircraft is stationary” (NTSB, 2011).

Substantial damage – “damage or failure which adversely affects the structural strength, performance, or flight characteristics of the aircraft, and which would normally require major repair or replacement of the affected component. Engine failure or damage limited to an engine if only one engine fails or is damaged, bent fairings or cowlings, dented skin, small punctured holes in the skin or fabric, ground damage to rotor or propeller blades, and damage to landing gear, wheels, tires, flaps, engine accessories, brakes, or wingtips are not considered ‘substantial damage’ for the purpose of this part” (Code of Federal Regulations, 2011).

Takeoff – “from the application of takeoff power, through rotation and to an altitude of 35 feet above runway elevation” (NTSB, 2011).

Taxi – “the aircraft is moving on the aerodrome surface under its own power prior to takeoff or after landing” (NTSB, 2011).

Type - "as used with respect to the certification, ratings, privileges, and limitations of airmen, means a specific make and basic model of aircraft, including modifications thereto that do not change its handling or flight characteristics. Examples include: DC-7, 1049, and F-27" (Code of Federal Regulations, 2011).

United States air carrier – “means a citizen of the United States who undertakes directly by lease, or other arrangement, to engage in air transportation” (Government Printing Office, 2011).

Unsatisfactory ratings – means the failure to successfully demonstrate the minimum level of proficiency required for issuance of an airmen certificate, rating, or other qualification required to perform the duties commensurate with the certificate, rating or qualification sought.

Acronyms

AABI – Aviation Accreditation Board International

AIDS – Accident/Incident Data System

ANPR – Advance Notice of Proposed Rulemaking

ATP – Airline Transport Pilot

BTS – Bureau of Transportation Statistics

CFI – Certified Flight Instructor

CFR – Code of Federal Regulations

FAA – Federal Aviation Administration

FAR – Federal Aviation Regulation

IATA – International Air Transportation Association

IMC – Instrument Meteorological Conditions

NTSB – National Transportation Safety Board

ORM – Operational Risk Management

PIC – Pilot-in-Command

PTS – Practical Test Standards

CHAPTER II

REVIEW OF LITERATURE

The Airline Safety and Federal Aviation Extension Act of 2010 was geared, in part, toward protecting passengers and decreasing the level of risk present in the U.S. air carrier industry by increasing flight time and certification requirements for pilots engaged in air carrier operations. This chapter provides an overview of the existing body of literature as it relates to: flight training and certification; operational flight experience; air carrier operations; air carrier safety; causes and contributors of aircraft accidents; and accident findings between 1978-1990 and 1991-2001. The conceptual framework for this study was built upon our understanding of accident causation and effective risk management.

Flight Training and Certification

Aircraft operations in the U.S. are conducted under a variety of rules and regulations. Pilots engaged in those operations are required to receive an appropriate level of training and certification. The FAA is the federal administration charged with the establishment and enforcement of these rules as they pertain to aeronautics and space. Each of the various rules and regulations are contained within Title 14 of the Code of

Federal Regulations (CFR), commonly referred to as the Federal Aviation Regulations (FARs). The majority of commercial and air carrier operations in the U.S. are conducted under either 14 CFR Parts 135 or 121. Regulations governing the certification of pilots, flight instructors, and ground instructors; pilot schools; and general operating and flight rules are contained within 14 CFR Parts 61, 141, and 91 respectively.

Pilot training begins when an individual enrolls in a flight training program that is operated under either 14 CFR Parts 61 or 141 and obtains a student pilot certificate. Student pilot certificates are issued by an aviation medical examiner following medical examination and qualify a student to begin flight training. Student pilots must be at least 16 years of age and they are provided instruction on the basics of flight, to include but not limited to: preflight planning and preparation; taxi procedures; takeoffs and landings; straight and level flight; climbs and turns; descents; transition to various airspeeds; emergency procedures; ground reference maneuvers; approaches and landings; go-around procedures; cross-country flight; and night flight (Code of Federal Regulations, 2011). Student pilots also learn about weather, collision avoidance, navigation, navigation aids, air traffic control (ATC) procedures, and all other general operating and flight rules. Once a student pilot has acquired the appropriate level of aeronautical knowledge, flight proficiency, and aeronautical experience, he or she is then eligible to apply for a private pilot certificate, which requires at least 40 hours of total flight time and the successful completion of a private pilot practical test. In order to receive a private pilot certificate, an individual must also be at least 17 years of age and hold a third class medical certificate (Code of Federal Regulations, 2011).

If an individual wishes to pursue a career as a professional pilot, he or she must then obtain a commercial pilot certificate. The commercial pilot certificate requires additional aeronautical knowledge, flight proficiency, and aeronautical experience beyond that which is required for a private pilot certificate. The commercial pilot certificate enables an individual to carry passengers and engage in flight operations for the purpose of compensation or hire. Applicants for a commercial pilot certificate are required to be at least 18 years of age, obtain at least 250 hours of total flight time, and demonstrate proficiency in all areas of the commercial pilot Practical Test Standards (PTS). However, with regard to operations conducted under 14 CFR Part 121, the holder of a commercial pilot certificate must also possess an instrument rating and is limited to only those duties of a first officer, or second-in-command (Code of Federal Regulations, 2011).

The Airline Transport Pilot (ATP) certificate is the highest level of certification available and requires the highest level of demonstrated aeronautical knowledge, flight proficiency, and aeronautical experience. Possession of an ATP certificate enables pilots to upgrade from the first officer position and perform the duties of a captain, or pilot-in-command, of aircraft operated under 14 CFR Part 121. In order to establish eligibility for an ATP certificate, individuals must be at least 23 years of age, obtain at least 1,500 hours of total flight time, and demonstrate proficiency in all areas of the applicable ATP PTS (Code of Federal Regulations, 2011).

There are a number of additional certificates and ratings a pilot may obtain in addition to the private pilot, commercial pilot, and ATP certificates, including but not limited to: an instrument rating; multi-engine rating; and Certified Flight Instructor (CFI) certificates. As previously mentioned, the instrument rating is required for operations conducted under 14 CFR Parts 135 and 121 and a multi-engine rating is required if operations involve multi-engine aircraft. Type ratings are typically required as well. For a complete listing of the various requirements for each level of certification and operation discussed, refer to Title 14 of the Code of Federal Regulations.

Operational Flight Experience

Initial flight training and certification are only the beginning of a pilot's journey to air carrier operations. Professional pilots begin their career with a commercial pilot certificate and various other flight instructor certificates, instrument ratings, multi-engine ratings, and type ratings. The ATP certificate is not obtained until the commercially certificated pilot acquires at least 1,500 hours of total flight time. This requires pilots to build flight time and develop a wide range of operational flight experience along the way.

> If you want to fly for an airline, you'll need to do more than simply earn the required ratings. Although the Federal Aviation Administration (FAA) requires a minimum of 250 hours to qualify for a commercial pilot certificate, the reality is that to be competitive for an airline job you will need to have somewhere between 1,500 and 3,000 hours of total flight time, including 200 to 500 hours of multiengine time. The FAA calls the difference between what is legally required and what is actually expected of professional pilots "the gap" (Phillips, n.d.).

The majority of pilots begin their career building flight time as an instructor with a local flight school or collegiate flight program. "Then he or she will probably spend a year or two working as a CFI to shore up the logbook and boost the number of coveted multiengine hours" (Phillips, n.d.). With hard work and determination, it is possible for a flight instructor to build as many as 1,500 hours in as little as one or two years. Other opportunities do exist for the newly certificated commercial pilot to begin building operational flight experience. Some of the more common examples include banner towing, aerial photography, ferry flights, agricultural application, pipeline patrol, and sight-seeing tours. However, many of the entry level positions mentioned provide little exposure to the many other types of experience considered important at the air carrier level.

Air carrier operations often involve busy airports and interaction with passengers and flight attendants. Aircraft are operated at higher altitudes, faster speeds, and in instrument meteorological conditions. The majority of air carriers also operate highly automated turbine-powered multi-engine aircraft which require multiple crewmembers. While flight instruction provides an excellent opportunity to acquire a significant amount of flight time in a relatively short period of time, it has its limitations. According to Atlantic Southeast Airlines, "ASA is looking for pilots with stick & rudder skills (basics), proficiency in automation, task management, decision-making, crew resource management, and an understanding of 'why'" (AABI, 2007).

Corporate, air taxi, and charter operations provide pilots with additional opportunities to acquire more complex operational flight experience. "The types of airplanes flown vary between turbo-prop planes (i.e. King-Air), executive jets (i.e. Citations to Gulfstreams), and large jets (i.e. Boeing 737)" (AvScholars, n.d.). Flights are usually conducted in turbine-powered multi-engine aircraft at higher altitudes and faster speeds. Pilots are likely to gain a significant amount of exposure to passengers, various weather conditions, and operations involving multiple crewmembers. "Once acquiring about 1,200 hours of total time and 200 hours of multiengine experience, that airline-bound pilot will flood the regional airlines with applications" (Phillips, n.d.).

Air Carrier Operations

Air carrier operations are conducted under the regulations of 14 CFR Parts 135 or 121. Part 135 regulations apply to commuter and on-demand operations. Part 135 operations typically involve flights by businesses, corporations, and commuter airlines. However, it has become quite common for commuter airlines, normally operating under Part 135, to code-share with a major air carrier operating under Part 121. This was a result of deregulation and development of the "hub and spoke" system. Code-sharing enabled major carriers to service locations otherwise not possible and typically provided some type of economic advantage (NTSB, 1994).

However, Part 135 operations require less oversight and are subject to a less stringent set of regulations than those conducted under Part 121. According to the NTSB, "…despite past efforts of government and industry to bring about safety improvements, accident rates for commuter airlines continue to be twice as high as the rates for domestic Part 121 airlines" (1994). The ticketing process is often extremely transparent in most cases. Passengers believe they have booked a flight with a major carrier operating under Part 121, only to find they are boarding one or more aircraft operated by a code-share partner.

> Commuter airlines that have a code-sharing arrangement with a major airline typically paint their aircraft with the color scheme of the major airline, and they do business under a company name that closely resembles the major airline, such as "Northwest Airlink," "Delta Connection," "United Express," "American Eagle," and so on. Although these names might imply ownership and control by a major airline, this is not necessarily the case. A code-sharing arrangement may or may not involve some degree of ownership of the commuter airline by its major airline code-sharing partner (NTSB, 1994).

In the case of the Colgan Air DHC-8 accident in 2009, "Colgan Air became a Continental Connection through a marketing alliance-code share agreement with Continental Airlines" (Colgan Air, 2008). This enabled Colgan Air to operate as Continental Connection Flight 3407 under Part 121. This accident gained a significant amount of attention and prompted, in part, legislation for the Airline Safety and Federal Aviation Extension Act of 2010.

Part 121 regulations apply to domestic, flag, and supplemental operations. Part 121 operations typically include flights conducted by major air carriers who are subject to the most stringent set of requirements and regulations of all other commercial operations. "Some of the regulatory differences between Part 121 domestic air carrier operations and Part 135 commuter air carrier operations occur in the areas of flight operations, pilot training programs, flight time limits, operational control, and maintenance" (NTSB, 1994). For example, pilots engaged in Part 121 operations are limited to no more than 1,000 flight hours in any calendar year, whereas Part 135 pilots are limited to no more than 1,200 flight hours in any calendar year for scheduled operations (Code of Federal Regulations, 2011).

Air Carrier Safety

Today, air carrier operations are extremely safe. "Since the 1950s…the drive to reduce the accident rate has yielded unprecedented levels of safety…In fact, the number of commercial accidents has decreased to a point where today, fewer than two accidents occur worldwide for every one million departures" (Wiegmann & Shappell, 2003).

> The passenger fatality rate per million enplanements declined from 0.42 in 1970-78, to 0.30 in 1979-85, to 0.18 in 1986-88. Based on 1986-88 fatality rate, the average passenger boarding a U.S. air carrier had a 99.999982 percent [*sic*] chance of surviving the flight. These data indicate that the U.S. commercial air transportation system is extremely safe (NTSB, 1994).

According to more recent safety data published by the BTS, there were more than 197 million Part 121 aircraft departures between 1990 and 2009. During that same period, there were 723 accidents resulting in 1,718 fatalities and 576 serious injuries. The fatality rate for Part 121 operations was 0.0087 fatalities per 100,000 departures during this period (BTS, 2011). There were 31 million Part 135 commuter departures between 1990 and 2009. During that same period, there were 200 accidents resulting in 256 fatalities and 97 serious injuries. The fatality rate for Part 135 commuter operations was 0.0082 fatalities per 100,000 departures during this period (BTS, 2011). Safety data for Part 135 and 121 operations is provided in Table 1.

Table 1

Air Carrier Safety Data: 1990 - 2009		
Type of Operation	Part 135 Commuter	Part 121 Air Carrier
Total fatalities	256	1,718
Total serious injuries	97	576
Total accidents	200	723
Total accidents, fatal	43	57
Aircraft-miles (millions)	4,485	134,889
Rates per 100 million aircraft-miles		
Fatalities	0.0571	0.0127
Serious injuries	0.0216	0.0043
Total accidents	0.0446	0.0054
Total accidents, fatal	0.0096	0.0004
Aircraft departures (thousands)	31,403	197,447
Rates per 100,000 aircraft departures		
Fatalities	0.0082	0.0087
Serious injuries	0.0031	0.0029
Total accidents	0.0064	0.0037
Total accidents, fatal	0.0014	0.0003
Flight hours (thousands)	22,498	324,726
Rates per 100,000 flight hours		
Fatalities	0.0114	0.0053
Serious injuries	0.0043	0.0018
Total accidents	0.0089	0.0022
Total accidents, fatal	0.0019	0.0002

Note. Data derived from “Table 2-9: U.S. Air Carrier Safety Data” and “Table 2-10: U.S. Commuter Air Carrier Safety Data,” by the Bureau of Transportation Statistics, 2011.

Although extremely rare, air carrier accidents do still occur on occasion. Several decades’ worth of aviation research has identified a significant number of factors as either causal or contributing in the occurrence of such accidents.

Causal and Contributing Factors in Aviation Accidents

There are a number of ways in which aviation researchers have classified the many factors involved in aviation accidents. For example, the FAA has identified a number of threat categories and common themes (2011). Threat categories include: bird hazards; cabin safety; hazardous cargo; flight deck layout; avionics confusion; crew resource management; fuel exhaustion; fuel tank ignition; inclement weather and icing; incorrect piloting techniques; in-flight upsets; lack of system isolation and segregation; landing and takeoff excursions; midair and ground incursions; pressurization and decompression failures; structural failures; uncommanded thrust reversal; uncontained engine failure; uncontrolled fire; and wind shear. Common themes include: flawed assumptions; human error; organizational lapses; pre-existing failures; and unintended effects (FAA, 2011). While this list is not all inclusive, it illustrates that a great number of factors have been identified as causal or contributing in the occurrence of past aviation accidents. While a full review of each and every factor is well beyond the scope of this chapter, the majority of aviation accidents involve some type of environmental, mechanical, or human factor.

Environmental Factors

The environment plays an important and significant role in aviation safety, as environmental factors are often cited as a causal or contributing factor in aircraft accident reports. Environmental factors include phenomenon such as thunderstorms, cloud ceilings, icing, wind shear, turbulence, microburst, and volcanic ash activity to name a few. According to the FAA, "Between 1994 and 2003, there were 19,562 aircraft accidents involving 19,823 aircraft. Weather was a contributing or causal factor in 4,159 (21.3%) of these accidents" (n.d.). The FAA's findings are consistent with those in a 1996 study conducted by the Bureau of Air Safety Investigation, in which weather was a factor in 17% of the 75 fatal accidents studied (1996). However, Haiss, Chapman, and

Wells (2010) identified 126 accidents through content analysis and reported only 5% of the accidents were attributed to environmental factors.

Wildlife, such as birds and deer, are another environmental factor which have received significant attention over the past few decades. In fact, the FAA has maintained a Wildlife Strike Database since 1990 in order to track and record wildlife strikes (2011). According to the FAA, there have been more than 99,000 wildlife strikes involving aircraft since 1990 (FAA, 2011). In 1995, a U.S. Air Force E-3 ingested Canadian geese into the No. 1 and No. 2 engines, resulting in a loss of power, collision with terrain, and the deaths of 22 crewmembers (Flight Safety Foundation, 1996). More recently, in 2009, a U.S. Airways flight encountered a flock of birds shortly after takeoff in New York City, resulting in a full loss of power and an emergency landing on the Hudson River (CBS News, 2009).

Mechanical Factors

> On July 19, 1989, at 1516 [3:16 PM], a DC-10-10, N1819U, operated by United Airlines as flight 232, experienced a catastrophic failure of the No. 2 tail-mounted engine during cruise flight. The separation, fragmentation and forceful discharge of the stage 1 fan rotor assembly parts from the No. 2 engine led to the loss of three hydraulic systems that powered the airplane's flight controls. The flight crew experienced severe difficulties controlling the airplane, which subsequently crashed during an attempted landing at Sioux Gateway Airport, Iowa. There were 285 passengers and 11 crewmembers onboard. One flight attendant and 110 passengers were fatally injured (NTSB, 1990).

Airplanes are extremely complex machines and contain a tremendous number of mechanical parts. Mechanical failures have been documented as causal or contributing factor in a number of aircraft accidents. "For example, in the early years of aviation it could reasonably be said that the aircraft itself was responsible for the majority of aircraft accidents. That is, early aircraft were intrinsically unforgiving and, relative to their counterparts today, mechanically unsafe" (Wiegmann & Shappell, 2003). However, Wiegmann and Shappell also point out, "…the number of aviation accidents attributable solely to mechanical failure has decreased markedly over the past 40 years…" (2001). Mechanical failures have been reported to account for about 28% of aviation accidents (Haiss et al, 2010). According to the FAA, modern transport aircraft are based on a "fail-safe design concept". In other words, failures which would otherwise have catastrophic consequences are designed to ensure failure is extremely improbable (FAA, 2004). According to the Bureau of Transportation Statistics, 46% of the U.S. commercial fleet was over 17 years of age in 1997. By 2001, only 31% of the fleet was over 15 years of age (BTS, n.d.).

Human Factors

> In the 1960s when the problem of error first began to attract attention, the estimated contribution of these human factors problems to transport accidents was around 20 per cent [*sic*]. In 1990, however, this estimate had increased fourfold to 80 per cent [*sic*]. It wasn't so much that people had become more fallible as that greatly improved materials and engineering techniques had brought the human factor into greater prominence (Reason, 2008).

"As aircraft have become more reliable, humans have played a progressively more important causal role in aviation accidents" (Wiegmann & Shappell, 2003). Human factors have become an important issue with regard to aviation, as human error is often cited as one of the leading causes in aviation accidents. A 1996 study conducted by the Bureau of Air Safety Investigation found that in 75 fatal aircraft accidents, "Over 70% of the accidents involved pilot factors. The most common pilot factors were related to poor judgment and decision making…Other common factors were in-flight decisions or planning and attempted operation beyond experience or ability" (1996). Haiss, et al, (2010) found that of 126 aviation accidents identified through content analysis, 67% were attributed to human error.

Characteristics of Major U.S. Air Carrier Accidents: 1978 – 1990

In 1994, the NTSB conducted a review of 37 major U.S. air carrier accidents between 1978 and 1990 in which flight-crew performance was cited as either a causal or contributing factor. The NTSB found that the captain was the flying pilot and the first officer was the non-flying pilot in 81% of the accidents when unadjusted and 87% of the accidents when adjusted for factors which might have favored a particular crew assignment (1990). "Half of the captains had logged at least 14,000 hours; the least experienced captain had 4,028 hours…Half of the first officers had logged more than 5,110 hours; the least experienced first officer had 1,800 hours" (NTSB, 1994).

In addition, the NTSB reviewed several other factors such as time in accident aircraft type, time in type and crew position, duration of employment in crew position, and crew familiarity. According to the NTSB, "Experience in the accident aircraft type can be relevant to a crewmember's familiarity with aircraft handling characteristics and the unique systems, controls, and displays of each type of aircraft" (1994). The NTSB found that 43% of first officers had less than 500 hours in accident aircraft type. When experience in accident aircraft type and time in crew position where considered together, first officers had a median of 419 hours in the accident aircraft type and crew position (NTSB, 1994). "For 17 (53 percent) [*sic*] of the 32 first officers, the accident occurred within their initial year as a first officer for the carrier" and "In 11 (73 percent) [*sic*] of the 15 accidents for which data were available, the accident occurred on the crew's first day flying together; and in 7 (44 percent) [*sic*] of the 16 accidents for which data were available, the accident flight was the crew's first flight together" (NTSB, 1994).

Regardless of total flight experience, be it 500 hours or 5,000 hours, all U.S. air carrier pilots have to endure a 'first year' of employment. Many pilots, if not most, will begin their air carrier career in an aircraft make and model in which they have little to no previous flying experience. Schedule changes and positional upgrades will require all new crews to experience a first flight together or first day flying together.

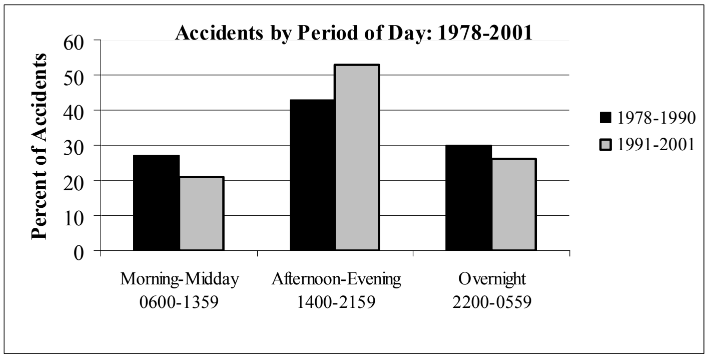
The NTSB's 1994 review represented the entire population of major U.S. air carrier accidents between 1978 and 1990 in which flight-crew performance was cited as a causal or contributing factor. A high percentage of the major accidents either occurred within the first officers first year of employment, while the first officer had less than 500 hours of flight time in the accident aircraft type, during the crew's first flight together, or during the crew's first day flying together. Yet, all of the pilots included in this study possessed more than 1,500 hours of total flight experience.

However, the NTSB's 1994 review is nearly twenty years old and the aviation industry has progressed significantly since the early 1990s. Unlike many aircraft operated between 1978 and 1990, most modern aircraft are equipped with advanced technologies which were just being introduced in the early to late 1990s. Such technologies include advanced alert and warning systems and fully digital instruments, displays, and flight control systems. According to the NTSB, "None of the accidents examined in this study involved airplanes equipped with the latest generation of glasscockpit flight deck automation…The Safety Board recognizes that the highly automated flight deck has potential for affecting the monitoring/challenging function of crewmembers" (1994). In addition, navigation aids and Air Traffic Control (ATC) facilities have been modernized. There has also been an increase in access to information critical for flight safety. All U.S. air carrier pilots are now required to complete initial and refresher Crew Resource Management (CRM) training.

Characteristics of Major U.S. Air Carrier Accidents: 1991 – 2001

More recently, Dismukes, Berman, and Loukopoulos (2007) conducted a similar study in which they compared major U.S. air carrier accident data between 1991 and 2001 with the NTSB's findings between 1978 and 1990. The findings revealed there had been a significant decrease in the number of accidents per year during the more recent timeframe. When adjusted for an increase in the number of flights, Dismukes et al found that between 1984 to 1990 and 1991 to 2001, the accident rate per 100,000 departures decreased from 0.0396 to 0.0183 respectively (2007). "This apparent improvement may have come about through the widespread adoption of crew resource management training" (Dismukes et al, 2007). With regard to period of day, the findings revealed an overrepresentation of accidents during the overnight (2200 – 0559) period of day, which was "within the limits of statistical uncertainty" when compared with the findings of the NTSB's 1994 study (Dismukes et al, 2007). Figure 2 depicts the percentage of accidents by period of day between 1978 and 2001.

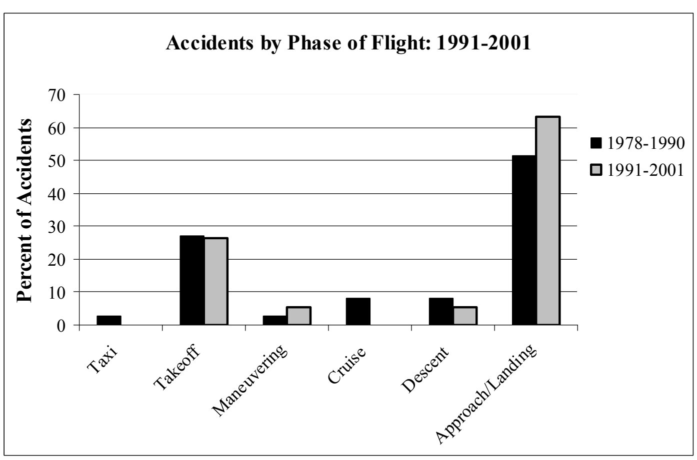
Figure 2



Note. Data derived from "The Limits of Expertise, Table 20.3" by Dismukes et al, 2007.

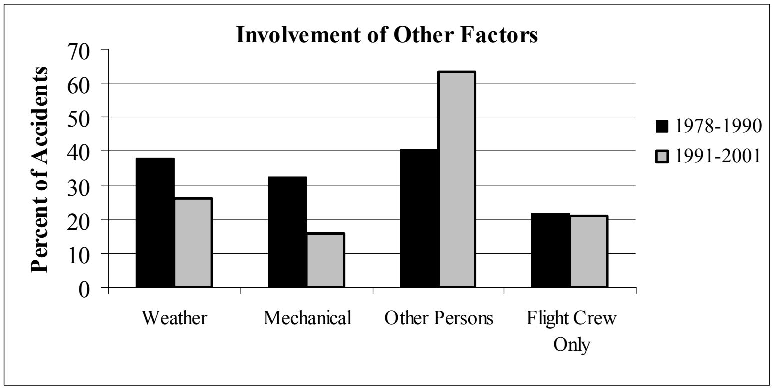
Dismukes et al also found the distribution of accidents by phase of flight to be within the limits of statistical uncertainty when compared with the findings of the NTSB. "Even though the takeoff and approach/landing phases present the shortest periods of exposure to risk, these phases incurred the highest number of accidents" (Dismukes et al, 2007). Figure 3 depicts the percentage of accidents by phase of flight.

Figure 3



Note. Data derived from "The Limits of Expertise, Table 20.4" by Dismukes et al, 2007.

Figure 4



Note. Data derived from "The Limits of Expertise, Table 20.5" by Dismukes et al, 2007.

With regard to flight delay status, Dismukes et al also found that delay status "was similar for both periods" studied. 55% of flights between 1978 and 1990 and 53.3% of accidents between 1991 and 2001 were in a delayed status (Dismukes et al, 2007).

> Pressure to maintain scheduled arrival time might conceivably lead flight crews to make less conservative decisions and, in particular, might contribute to plan continuation errors such as failing to discontinue a planned approach when it becomes inappropriate/dangerous to do so. This pressure could be externally generated or self-imposed, conscious or unconscious (Dismukes et al, 2007).

Regarding duration of employment with the accident air carrier, Dismukes et al reported findings consistent with those of the NTSB. 41% of first officers had less than one year of experience with their airline. "These seven pilots had a median of 118 hours of experience as first officers at their current airline" (Dismukes et al, 2007). However, Dismukes et al also reviewed the circumstances surrounding the accidents involved and suggest "…that in most cases greater experience among the first officers would probably not have affected the outcome" (Dismukes et al, 2007). When consideration was given to which pilot was flying and which pilot was monitoring, Dismukes et al found the captain was the flying pilot in 79% of accidents between 1991 and 2001. This finding was also consistent with the NTSB's 1994 findings, in which the captain was the flying pilot in 81% of accidents (Desmukes et al, 2007).

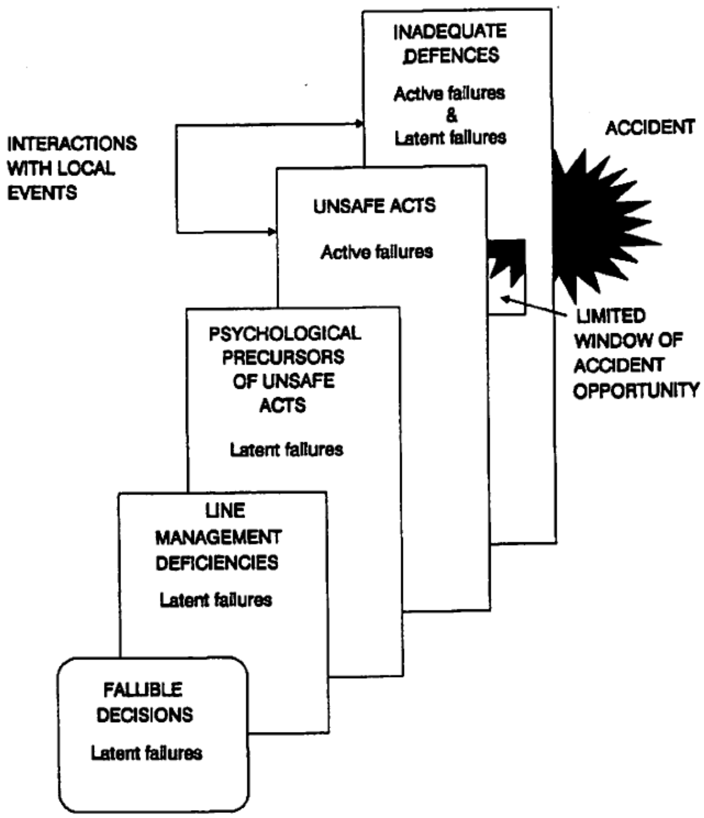
Conceptual Framework of Current Study

The existing body of literature provides insight into the complexities associated with aviation safety. While there has been a significant reduction in the accident rate over the past few decades, pilot performance remains an important area of interest for legislators, administrators, and managers in the combined effort to create an ever safer industry. The Airline Safety and Federal Aviation Extension Act of 2010 is geared, in part, toward protecting passengers and reducing the level of risk associated with U.S. air carrier operations through an increase in flight time and certification requirements for pilots engaged in air carrier operations. The conceptual framework for this study comes from our understanding of accident causation and effective risk management.

James Reason’s Model

Figure 5

Reason’s Model



From "Human Error," by James Reason, 1990, p. 202. Copyright 1990 by the Cambridge University Press. Reprinted with permission of the Cambridge University Press.

Reason’s Model is frequently used in the aviation industry as a model of accident causation (Chesterfield, 2002). The model involves “…a succession of defensive layers separating potential losses from the local hazards…Only when a series of holes ‘line up’ can an accident trajectory pass through the defenses to cause harm to people, assets and the environment” (Reason, 2008).

Active failures, or unsafe acts, are felt almost immediately (Reason, 1990). "In general, active errors are associated with the performance of the 'front-line' operators of a complex system: pilots, air traffic controllers…" (Reason, 1990). An example of an active failure might include the failure of a first officer to challenge the captain when he or she has reason to believe something unsafe has occurred or is about to occur.

Latent failures include the preconditions and are "…most likely to be spawned by those whose activities are removed in both time and space from the direct control interface: designers, high-level decision makers, construction workers, managers and maintenance personnel…latent errors pose the greatest threat to the safety of a complex system" (Reason, 1990). Latent failures "…occur because the designers, builders, managers and operators cannot foresee all possible accident scenarios" (Reason, 2008). An example of a latent failure might include the existence of a corporate culture in which first officers are afraid to challenge the captain when he or she believes something unsafe has occurred or is about to occur because they fear company reprisal.

In 2009, the FAA issued an ANPR to address whether a commercially certificated first officer engaged in Part 121 operations receives sufficient training and experience to recognize and respond to a potentially dangerous situation (FAA, 2009). As viewed through Reason's model, training and experience represent the preconditions. "Adverse consequences may lie dormant within the system for a long time, only becoming evident when they combine with other factors to breach the system's defenses" (Reason, 1990).

Risk Management

Risk management plays an important role in the aviation industry. Risk is present anytime there is a danger or probability of loss to something. In order to reduce or eliminate the likelihood something is lost, stakeholders often implement a systematic approach to manage such risk. Risk Management has been defined as "the selection and implementation of a strategy of control of risk, followed by monitoring and evaluation of the effectiveness of that strategy" (Government of Canada, 2005). The FAA defines risk as "…the probability and severity of accident or loss from exposure to various hazards, including injury to people and loss of resources" (2000).

According to the Parenteral Drug Association (PDA), concern for risk and risk management began with the inception of the Industrial Revolution (n.d.). Steam engines of the late 1700s and early 1800s were particularly dangerous. "Steam engines, particularly those used on ships, had a potential to cause a greater number of casualties than other man made inventions that had been devised" (PDA, n.d.). Between 1816 and 1848, nearly 2,563 people were killed in accidents involving steamboats (PDA, n.d.).

Eventually, Congress grew concerned over the number of fatalities involving steam engines, and in 1838, established the Steamboat Inspection Service. According to PDA, the Steamboat Inspection Service established the first set regulations for any industry. Unfortunately, early regulations were ineffective and the number of casualties continued to remain high. In 1852, Congress took action and moved oversight from the Department of Justice (DOJ) to the Department of Treasury (DOT) (PDA, n.d.).

Since the early days of the Industrial Revolution, much progress has been made in reducing risk, risk management, and the prevention of injuries and/or loss of life. Today, nearly every industry has some type of regulatory body in place, responsible for keeping the workplace a safer place to work. The FAA is the regulatory body for the U.S.

aviation industry. The mission, "…provide the safest, most efficient aerospace system in the world" (FAA, 2005).

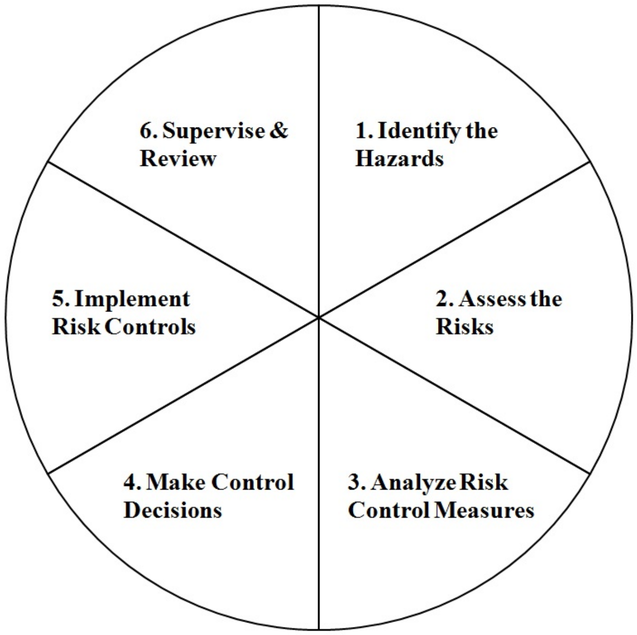
Operational Risk Management

Operational Risk Management (ORM) "…is a decision-making tool to systematically help identify operational risks and benefits and determine the best course of action for any given situation" (FAA, 2000). It is most beneficial to reduce or eliminate known risks in the developmental phase of any process. Unfortunately, this is not always possible. In the aviation industry, risk is always present. Each flight is unique and all flights are subject to risk. For this reason, ORM is quite useful in the aviation industry as it can be used to identify and manage inherent risks.

There are six steps involved in ORM: identify the hazards; assess the risks; analyze risk control measures; make control decisions; implement risk controls; and supervise and review (FAA, 2000). "Risk management must be a fully integrated part of planning and executing any operation, routinely applied by management, not a way of reacting when some unforeseen problem occurs" (FAA, 2000). There are four basic principles upon which the ORM model is based: accept no unnecessary risk; make risk decisions at the appropriate level; accept risk when benefits outweigh the costs; and integrate ORM into planning at all levels (FAA, 2000).

Figure 6

6-Step Operational Risk Management Process



Note. Derived from "FAA System Safety Handbook" by the Federal Aviation Administration, 2000.

Air carrier accidents are extremely rare. While prediction of a particular accident is highly unlikely, Reason's Model of accident causation and concepts of risk management form the conceptual framework for this study, as they are useful in the identification and control of potential vulnerabilities in the aviation system. "One of the most important aspects of safety management is to identify error-prone situations" (Reason, 2008). This study identified the characteristics of major U.S. air carrier accidents between 1991 and 2010. The existing body of literature provided a basis for the selection of variables in this study. The results, findings, and conclusion of this study may prove useful in the first two steps of the ORM process; identify the hazards and assess the risk. In addition, the results of this study may prove useful in the future as aviation administrators supervise and review the effectiveness of controls resulting from the Airline Safety and Federal Aviation Administration Act of 2010; the sixth step in the ORM process.

CHAPTER III

METHODOLOGY

The studies conducted by the NTSB (1994) and Dismukes et al (2007) pertaining to major U.S. air carrier accidents laid the groundwork for the current study. However, both studies were limited to only those accidents citing pilot performance as a causal or contributing factor. This study provides a more recent look at the characteristics of major U.S. air carrier accidents between 1991 and 2010 operated under 14 CFR 121. In addition, this study expands upon the population studied to also include air carrier accidents in which pilot performance was not cited as a casual or contributing factor.

This study was carried out using archival data and contributes to the existing body of literature as it pertains to the characteristics of major U.S. air carrier accidents. The conceptual framework for this study was built upon our understanding of accident causation and effective risk management. A case control methodology was used to compare the characteristics of air carrier accidents citing pilot performance as a causal or contributing factor with air carrier accidents not citing pilot performance as a causal or contributing factor.

> The case control methodology is commonly used in epidemiological research to compare a group of interest, such as people with a certain disease (that is, "cases") with a group of individuals from the same population who do not exhibit the disease (that is, "controls"). Control groups may be randomly selected from within the population of interest or may be selected to "match" cases on certain variables, such as age, sex, or exposure to potential risk factors…For example, one study, which compared fatal-to-the-pilot GA crashes to those in which the pilot survived, found that aircraft fires, off-airport locations, nighttime flight, and IMC were linked to pilot fatality. Another study examining predictors of pilot fatality among weather related GA accidents resulted in similar findings (NTSB, 2005).

Major U.S. air carrier accidents citing pilot performance as a causal or contributing factor were the group of "cases". Accidents not citing pilot performance as a causal or contributing factor were the group of "controls". The two groups represented the entire population of major U.S. air carrier accidents between 1991 and 2010 operating under 14 CFR 121 and were compared with one another to determine whether any statistical differences existed between select variables. The researcher was particularly interested in determining whether a statistical difference existed between groups with regard to flight experience and level of certification.

The remainder of this chapter describes the methodology used in this study, to include: the population; sampling procedure; selection of the variables; sources of data; data collection; procedures for missing data; measurement of the variables; data analysis; and reliability and validity. The findings, conclusions, and recommendations are reported in Chapters IV, V, and VI respectively.

Population

Between 1991 and 2010, there were more than 139 million aircraft departures within the U.S. air carrier industry (BTS, 2011). During that same period, only 747 accidents occurred while operated under 14 CFR 121 (NTSB, 2011). 51 of the 747 accidents were operated under 14 CFR 121 and resulted in an NTSB aircraft accident report (AAR) or aircraft accident brief (AAB). These accidents included scheduled and non-scheduled passenger and cargo flights. Flights originated from several airports within the U.S. during various hours of the day and months of the year. There were a number of U.S. air carriers involved, as well as a variety of different types of aircraft.

The group of captains and first officers included in this study represented a relatively small group of pilots with regard to the overall population of pilots holding an ATP or commercial pilot certificate. According to FAA data, there were no fewer than 256,158 individuals in possession of either an ATP or commercial certificate in any given year between 1991 and 2010 when both groups were combined (FAA, 2011). While the number of commercial certificates decreased from 148,365 to 123,705 between 1991 and 2010, the number of ATP certificates increased from 112,167 to 142,198 between 1991 and 2010. Fluctuations between any given years were relatively slight.

In order to qualify for employment with a U.S. air carrier, first officers are required to hold at least a commercial pilot certificate with an instrument rating and must have reached their 18th birthday. However, the majority of air carrier pilots are at least 23 years of age and in possession of an ATP certificate, as this is a mandatory requirement in order to serve as the captain of an aircraft operated under 14 CFR 121. Additionally, air carrier pilots were required to retire upon reaching their 60th birthday until just recently. Pilots between the age of 60 and 65 have only been eligible for continued employment since December, 2007 (FAA, 2007).

Although there were only 50 accidents selected in this study, it represents the entire population, or census, of major U.S. air carrier accidents between 1991 and 2010 operated under 14 CFR 121.

Adherence to Principles of Ethical Conduct

Institutional Review Board (IRB) review was not required to perform this study as the researcher did not obtain: (1) "data through intervention or interaction with the individual"; or (2) "identifiable private information" (OSU, 2008). Each of the reports included in this study were produced and made public by the NTSB. Identities of each of the accident pilots were not made public by the NTSB nor the researcher of this study.

Sampling Procedure

Sampling procedures were not required in this study, as all major U.S. air carrier accidents between 1991 and 2010 operated under 14 CFR 121 for which the NTSB conducted a major investigation of the accident were selected. Major investigations were defined as investigations in which the NTSB adopted an aircraft accident report (AAR) or aircraft accident brief (AAB).

Selection of Variables

The variables considered in this study included many of the variables considered by the NTSB (1994) and Dismukes et al (2007). They have also received significant attention from accident investigators and a number of other researchers. Variables related to the operational characteristics of major U.S. air carrier accidents included: phase of flight; period of day; type of operation; equipment type; and involvement of environmental factors, mechanical factors, and other persons. Variables related to the characteristics of pilots included: flight experience; level of certification; duration of employment with the accident air carrier; crew assignment; crew familiarity; the involvement of pilot performance; past unsatisfactory ratings; FAA accidents, incidents, and violations; and prior driver's license suspensions and revocations.

This study was exploratory in nature and relied upon both quantitative and qualitative data to answer the research questions. The following variables were considered by the NTSB in 1994 but not considered in this study: crewmember workload; time-since-awakening; flight delay status; information available when errors occurred; stress; and organizational structure and function of the organization.

Sources of Data

This study was carried out using archival data. "Archival data are those that are present in existing records or archives. The researcher simply examines or selects the data for analysis" (McBurney & White, 2007). McBurney and White further state, "Archival research is appropriate in many instances…logistics may make it infeasible to conduct an experiment relating to the variables of interest" (2007).

The NTSB's Aviation Accident Database and Embry-Riddle Aeronautical University's Hunt Library were used to gather the archival data for this study. The NTSB Aviation Accident Database provided access to the factual reports and probable cause reports. The Hunt Library provided access to the NTSB's full aircraft accident reports

(AAR) and aircraft accident briefs (AAB), as several of the older reports were not readily available on the NTSB's website.

The NTSB Aviation Accident Database is web-based and contains factual reports and probable cause reports for accidents and selected incidents from 1962 and later. Narrative reports are provided in PDF format and must be downloaded individually.

Factual reports are typically a couple pages in length and provide a brief overview factual data, including but not limited to: date of the event; aircraft registration number; occurrence type; location and time; aircraft information summary; weather; and pilot information.

Probable cause reports are typically a couple pages in length as well, and provide a brief overview of the probable cause of the accident. Data and information contained within these reports include: aircraft information; injuries and fatalities; accident location; weather conditions; pilot information; sequence-of-events; causal and contributing factors; and brief narrative stating the probable cause.

Full accident reports are published by the NTSB following a major accident investigation. These reports are often a hundred pages or more in length and provide both quantitative and qualitative accident data. They provide a detailed narrative account of the events which transpired and rely on information from a variety of credible sources. The NTSB may hold a public hearing to gather additional information from experts and witnesses. Following months of testing and analysis, the NTSB releases an abstract, followed by a full report "…containing the Board's conclusions, probable cause, and safety recommendations" (NTSB, 2011).

"For archival data to be scientifically useful, the agency collecting the data must ask questions similar to the scientists or must inadvertently collect data that are valuable to the scientist" (McBurney & White, 2007). The NTSB is considered to be a neutral party and leading authority with regard to the accident investigation process. This allows the NTSB to identify factual data and report information objectively with regard to the findings, probable cause, and recommendations.

> In 1974, Congress reestablished the NTSB as a completely separate entity, outside the DOT, reasoning that "…No federal agency can properly perform such (investigatory) functions unless it is totally separate and independent from any other…agency of the United States". The NTSB, which has no authority to regulate, fund, or be directly involved in the operation of any mode of transportation, conducts investigations and makes recommendations from an objective viewpoint. Since its inception, the NTSB has investigated more than 132,000 aviation accidents and thousands of surface transportation accidents (NTSB, 2011).

There were other sources which could have been used to gather data, such as the FAA Accident/Incident Data System (AIDS). Unfortunately, this database contains a significant number of fields which contain missing data and is primarily concerned with data related to aircraft incidents. Additionally, the AIDS database contains a limited amount of data pertaining to the captain only. It would have been nearly impossible to determine whether all of the data contained within the AIDS database was accurately input without cross-referencing other documents, such as the ones used in this study. Therefore, NTSB full accident reports, accident briefs, factual reports, and probable cause reports were considered to be the best source of data for this study.

Data Collection

The first step in the data collection process was to identify all U.S. air carrier accidents between 1991 and 2010 operated under 14 CFR 121. The NTSB Aviation Accident Database was used to filter the system for: (1) accidents with an event start date of "01/01/1991"; (2) an event end date of "12/31/2010"; (3) investigation type - "Accident"; and (4) operation - "Part 121: Air Carrier". All other fields were left at the default value in order to include all accidents that fit within the limits of the search. This resulted in the identification of 747 "Part 121: Air Carrier" "Accidents" between "01/01/1991" and "12/31/2010".

The second step in the data collection process was to identify which accidents resulted in a major investigation. The NTSB's web-based list of aircraft accident reports and aircraft accident briefs was cross-referenced with the Hunt Library's web-based list of reports and briefs. Each of the reports and briefs were assigned a designator by the NTSB which specifies the year in which the report was adopted and a sequential number in which they are ordered. For example, the seventh report to be adopted in 2009 was AAR-09-07. The fourth brief to be adopted in 2007 was AAB-07-04. This enabled the researcher to sequentially check all of the reports for each year between 1991 and 2010. No reports were missing based on a sequential check. While there was no way to ensure the sequence in a given year ended with the last available report, both the NTSB list and Hunt Library list were cross-referenced to ensure both lists ended with the same sequential report. Both lists were consistent with one another and the researcher determined the probability of missing a report in any given year to be extremely low. See Appendix B for a sequential list of NTSB reports and briefs.

The third step in the data collection process was to go through each report and determine which of the accidents involved a U.S. air carrier operating under 14 CFR 121. This resulted in the identification of 51 accidents which met the criteria required for inclusion in this study (see Appendix B). Further analysis revealed that one of the 51 accidents (AAR 09/04) was the result of a ground fire prior to engine start. The information contained within this report focused on the ignition of supplemental oxygen stored within a supernumerary compartment while the aircraft was still parked, prior to engine start. Thus, AAR 09/04 was excluded from this study. This resulted in the selection of 50 accidents.

Microsoft Excel was used to record all of the data, thereby enabling the researcher to centrally organize and record data from 47 aircraft accident reports, 3 aircraft accident briefs, 50 factual reports, and 50 probable cause reports into one database with standardized rows and columns for future analysis. Once all data inputs were complete, the researcher then cross-referenced each of the narrative documents with the final Microsoft Excel database to ensure all of the variables were transferred accurately with a minimal risk of input error. Appendices B through Z have been provided to document all the recorded measurements. This provides other researchers with an opportunity to validate the accuracy of this study and/or aid in the analysis of future studies.

Procedures for Missing Data

The archival data used in this study was collected from historical NTSB accident reports. Given the historical nature of the data, it was acknowledged by the researcher that certain NTSB accident reports might contain missing data for one or more of the variables under investigation. In such cases, the findings were reported only for those accidents in which such data was available and the researcher was explicit in reporting such findings. For example, if data for a particular variable was available in only 40 of the 50 accident reports, the researcher stated in the findings that for this particular variable, data was only available for 40 of the accidents. This procedure for reporting the findings was consistent with the procedures used by the NTSB in 1994 and Dismukes et al (2007).

Measurement of the Variables

"Minimizing measurement error is critical. This is best accomplished by developing a well-thought-out operational definition of the measurement procedure and by diligently using the operational definition in the research" (Graziano & Raulin, 2007). Each of the variables considered in this study were operationally defined in order to provide a reliable means of measurement. Operational definitions were modeled after the definitions established by the NTSB in 1994. The following operational definitions were used in the measurement of the variables:

Operational Related Variables

1. Phase of flight – This variable was categorized as: taxi; takeoff; climb; maneuvers; cruise; descent; approach; and landing. Measurements were recorded on a nominal scale of 1, 2, 3, 4, 5, 6, 7, and 8 respectively.

2. Period of day – This variable was measured on a nominal scale. Score data was translated into categorical data. Period of day was recorded as afternoon-evening (1400 – 2159 local), overnight (2200 – 0559 local), or morning-midday (0600 – 1359 local) and recorded on a nominal scale of 1, 2, and 3 respectively.

3. Type of operation – This variable was categorized as: scheduled or non-scheduled passenger; and passenger or cargo service. Measurements were recorded on a nominal scale of 1 and 2 for each of the two categories respectively.

4. Equipment type – There were several aspects concerning the type of aircraft used. Therefore, a number of variables were considered with regard to equipment type:

a. Number of flight crewmembers – This variable was categorized as: two pilots; or two pilots and an engineer. Measurements were recorded on a nominal scale of 1 and 2 respectively.

b. Number of engines – This variable was categorized as: two engines; three engines; and four engines. Single engine operations are not authorized under 14 CFR 121. Measurements were recorded on a nominal scale of 1, 2, and 3 respectively.

c. Type of engines – This variable was categorized as: turbo-prop; turbofan; and turbojet. Measurements were recorded on a nominal scale of 1, 2, and 3 respectively.

5. Involvement of environmental, mechanical, and factors related to other persons – This variable was categorized as: environmental; mechanical; and other persons. "The term 'other persons,' in this context, includes air traffic controllers, air carrier and airport management, regulatory authorities, ramp/maintenance personnel, and pilots of other aircraft" (NTSB, 1994). Environmental factors, mechanical factors, and other persons were recorded if the NTSB cited such factors as a causal or contributing factor in the probable cause statement and assigned a value of (C) = Cause or (F) = Factor for the findings reported in the "Brief of Accident" report. Measurements were recorded on a nominal scale of 1, 2, and 3 respectively. In the event a variable was cited as both a cause and factor, the variable was recorded as a nominal 4.

Pilot Related Variables

1. Flight experience – There are several aspects concerning the types of flight experience a pilot might accumulate. Flight hours were used as the measurement of flight experience in this study. Flight hours were recorded on a ratio scale using score data. Flight hours were measured the following way:

a. Total hours of flying experience – A measurement of the cumulative number of flight hours accumulated in all aircraft at the time of the accident.

b. Hours of experience in the accident aircraft type – A measurement of the cumulative number of flight hours accumulated in the accident aircraft make and model at the time of the accident, regardless of crew position.

c. Hours of experience in aircraft type and crew position – A measurement of the cumulative number of flight hours accumulated in a specific crew position in the accident aircraft make and model (e.g. B-737 first officer) at the time of the accident.

2. Level of certification – This variable was categorized as ATP certificate or commercial certificate. Other levels of certification were not measured, as pilots are required to hold either an ATP certificate of commercial pilot certificate in order to engage in U.S. air carrier operations. Data was recorded for the highest level of certification held, not to include additional ratings or flight instructor certificates. For example, a commercial pilot with an instrument rating and flight instructor certificate was recorded as a commercial pilot certificate. Measurements were recorded on a nominal scale of 1 or 2 respectively.

3. Duration of employment with accident air carrier – This variable categorized on a nominal scale as less than one year of employment with the accident air carrier or more than one year with the accident air carrier. Measurements were recorded on a nominal scale of 1 or 2 respectively.

4. Crew assignment – This variable was categorized as captain flying/first officer monitoring or captain monitoring/first officer flying. Measurements were recorded on a nominal scale of 1 or 2 respectively.

5. Crew familiarity – The NTSB (1994) identified two measures of crew familiarity in their study in which a high percentage of accidents seemed to occur. This study measured crew familiarity in the following manner:

a. First sequence/pairing together – This variable was categorized as the first pairing together or not the first pairing together. Measurements were recorded on a nominal scale of 1 or 2 respectively.

b. First day flying together (current pairing/sequence) – This variable was categorized as the first day flying together or not the first day flying together on the trip sequence. Measurements were recorded on a nominal scale of 1 or 2 respectively.

c. First leg of the day – This variable was categorized as the first leg of the day or not the first leg of the day. Measurements were recorded on a nominal scale of 1 or 2 respectively.

6. Pilot performance involved – This variable was categorized as pilot performance cited as a causal/contributing factor or not cited as a causal/contributing factor. Measurements were recorded on a nominal scale of 1 or 2 respectively.

7. Past unsatisfactory ratings – This variable was categorized as previous unsatisfactory rating or no previous unsatisfactory rating. For the purpose of this study, unsatisfactory ratings were recorded only if the NTSB reported so in the aircraft accident report or brief. Measurements were recorded on a nominal scale of 1 or 2 respectively. Multiple unsatisfactory ratings were not measured separately; they were recorded as a nominal 1.

Data Analysis

The purpose of this study was to identify the characteristics of major U.S. air carrier accidents between 1991 and 2010. "The appropriate statistical procedure depends on the research question(s) we are asking and the type of data we collected" (Siegle, 2011).

This study relied upon quantitative and qualitative data in order to answer the following research questions:

1. What were the operational characteristics of major U.S. air carrier accidents between 1991 and 2010 based on select operational related variables?

2. What were the characteristics of the pilots involved in major U.S. air carrier accidents between 1991 and 2010 based on select pilot related variables?

3. Based on the select variables, were the characteristics of pilots involved in major U.S. air carrier accidents in which pilot performance was cited as a causal or contributing factor significantly different than the characteristics of pilots involved in accidents in which pilot performance was not cited as a causal or contributing factor?

Descriptive statistics were used to describe the characteristics of major U.S. air carrier accidents in terms of measures of central tendency, variation, range, variance, and percentiles.

> Descriptive statistics are used to describe the basic features of the data in a study. They provide simple summaries about the sample and the measures. Together with simple graphic analysis, they form the basis of virtually every quantitative analysis of data…With descriptive statistics you are simply describing what is or what the data shows (Trochim, 2006).

The first two research questions were designed to answer basic questions regarding the characteristics of major air carrier accidents. Thus, descriptive statistics were considered to be the appropriate statistical method.

Inferential, non-parametric, statistics were used to answer the third research question, which was designed to answer whether a statistical difference existed between two groups. "With inferential statistics, you are trying to reach conclusions that extend beyond the immediate data alone" (Trochim, 2006). The nature of the data collected in this study was previously identified in the operational definition for each of the variables. Chi-square was used to determine statistical differences between variables with nominal data. According to Graziano and Raulin, a chi-square test is appropriate for determining statistical difference between nominal data (2007). Data was analyzed using the PASW 17.0, previously referred to as the Statistical Package for the Social Sciences (SPSS).

Reliability and Validity

"Researchers study relationships among variables. Assessing variables means quantifying them. The quantification process, called measurement, involves applying the number system to the variable…nominal, ordinal, interval, and ratio measurements"

(Graziano & Raulin, 2007). In order for the measurements to be scientifically useful, they must be reliable and valid (McBurney & White, 2007).

Reliability

> Reliability is the extent to which an experiment, test, or any measuring procedure yields the same results on repeated trials. Without the agreement of independent observers able to replicate research procedures, or the ability to use research tools and procedures that yield consistent measurements, researchers would be unable to satisfactorily draw conclusions, formulate theories, or make claims about the generalizability of their research (Colorado State University, 2011).

"Good measures give consistent results, regardless of who does the measuring. This is referred to as the reliability of the measure" (Graziano & Raulin, 2007). Reliability was established through the development of an operational definition for each of the variables. Operational definitions enable the researcher to translate abstract concepts "…to a concrete level so that they can be manipulated or measured" (Graziano & Raulin, 2007). For example, flight experience may be gained in a number of ways. It is an abstract concept. While one pilot may have more experience than another flying in poor weather conditions, he or she may have less experience with regard to the aerodynamic characteristics of a particular aircraft. For this reason, flight experience is often measured in terms of flight time. According to the NTSB, "total flight hours, however gained, represent each pilot's general seasoning" (1994). Operational definitions for each of the variables have been discussed. This provides independent researchers with the ability to replicate the measurement procedures of this study with consistent results. Reliability was also established through the selection of NSTB accident reports, factual reports, and probable cause reports as the source of data. These reports are readily available to other researchers and are produced by the leading authority with regard to accident investigation.

Validity

"Validity of an instrument means it measures what it was meant to measure…Through the collection of evidence over time, a case is built for the validity of measures, which is dependent upon the theoretical models and hypothesis" (Spector, 1981). Each of the variables included in the design of this study were selected following an extensive review of literature. The variables were selected, in part, due to the significant amount of attention they have received in previous research studies concerning aviation accidents and pilot performance.

> Previous accident investigations have identified a large set of operational and human performance factors as being related to the occurrence of seriousness of errors. These factors…include the following: type of operation; phase of flight; flight delay status; equipment type; crewmember position and function; workload of the crewmember and quality of information available to the crewmember when an error occurred; fatigue; fitness; stress; past performance evaluations; mutual familiarity of the crewmembers; training; experience; and air carrier organizational structure and function (NTSB, 1994).

Validity was established using operational definitions for each of the variables and through the selection of measurement procedures consistent with those used in previous research studies and within the aviation industry. Validity was also established through the selection of NSTB accident reports, factual reports, and probable cause reports as the source of data. These reports are readily available to other researchers and are produced by the leading authority with regard to accident investigation.

Construct Validity

In order for a measurement to have good construct validity, it should measure whatever construct it is supposed to measure and not something else (McBurney & White, 2007). Each of the measurements selected in this study are consistent with measurements used in previous studies. For example, flight time was an operationally defined measurement of flight experience. According to the NTSB, "Crewmembers gain flight experience in a variety of general aviation, military, and air carrier settings. Total flight hours, however gained, represent each pilot's general seasoning" (NTSB, 1994). This study measured flight experience on a ratio scale using flight hours, which is consistent with the score data pilots use to record experience in their logbooks. In addition, the FAA associates flight hours with aeronautical experience for the purpose of certification. For example, with regard to aeronautical experience, 14 CFR 61.129 states, "…a person who applies for a commercial pilot certificate with an airplane single-engine class rating must log at least 250 hours of flight time as a pilot…" (FAA, 2011).

Content Validity

"Content validity is the notion that a test should sample the range of the behavior that is represented by the theoretical concept being measured. An intelligence test, for example, should measure general knowledge, verbal ability, spatial ability, and quantitative skills among others" (McBurney & White, 2007). Content validity was established through the selection of variables and measurements which measure a range of the concepts in this study. For example, crew familiarity was measured in terms of a crew's first day flying together and a crew's first together. Flight experience was measured in terms of total hours of flying experience, hours of experience in the accident aircraft type, and hours of experience in the crew position. Equipment type was measured in terms of number of flight crew required to operate the aircraft, number of engines, and type of engines. Thus, a range of behavior was sampled for many of the variables being studied.

Criterion Validity

According to Creswell, “criterion-related validity determines whether the scores from an instrument are a good predictor of some outcome (or criterion) they are expected to predict” (2008). The purpose of this study was exploratory in nature and designed to describe the characteristics of major U.S. air carrier accidents between 1991 and 2010. This study did not involve hypothesis testing, nor was it designed to predict certain outcomes. Therefore, criterion validity was not established in this study, as regression and other such tests for prediction were not performed.

CHAPTER IV

FINDINGS

The purpose of this study was to identify the characteristics of major U.S. air carrier accidents between 1991 and 2010 operated under 14 CFR 121. For the purpose of this study, an accident was included if the following criteria were met: the accident involved a U.S. air carrier operating under 14 CFR 121 between 1991 and 2010 and the NTSB conducted a major investigation. Major investigations were defined as investigations in which the NTSB adopted an aircraft accident report (AAR) or aircraft accident brief (AAB). A search for accidents which met the criteria for inclusion in this study resulted in the identification of 51 cases. As previously discussed, one of the 51 accidents (AAR 09/04) was the result of a ground fire prior to engine start. The information contained within this report focused on the ignition of supplemental oxygen stored within a supernumerary compartment while the aircraft was still parked, prior to engine start. Thus, AAR 09/04 was excluded from this study, resulting in the final selection of 50 accidents. The 50 accidents selected for inclusion in this study are presented in Table 2.

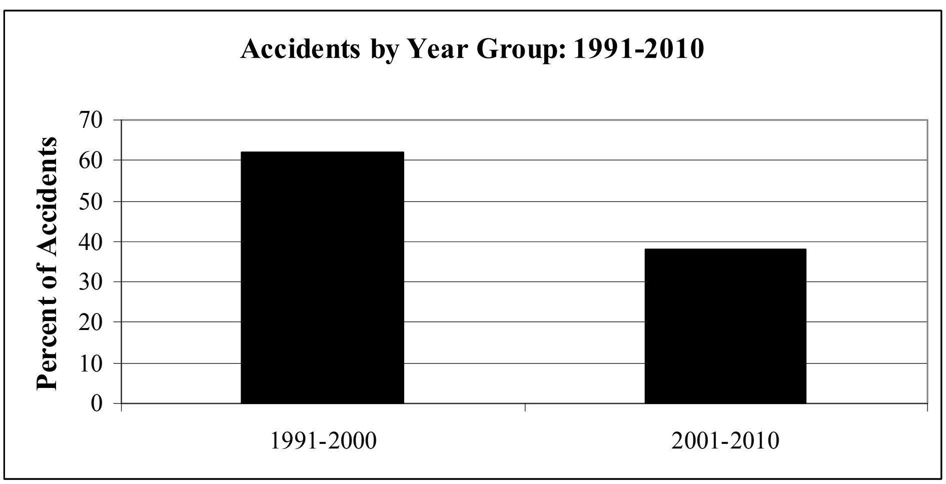
Table 2

Selected Major U.S. Air Carrier Accidents			
NTSB Report	Event Date	City	Carrier
AAR-11/02	27-Jan-09	Lubbock, TX	Empire Airlines
AAR-10/04	20-Dec-08	Denver, CO	Continental Airlines
AAR-10/03	15-Jan-09	Weehawken, NJ	US Airways
AAR-10/01	12-Feb-09	Clarence Center, NY	Colgan Air, Inc
AAR-09/03	28-Sep-07	St Louis, MO	American Airlines
AAR-08/02	12-Apr-07	Traverse City, MI	Pinnacle Airlines
AAR-08/01	18-Feb-07	Cleveland, OH	Shuttle America
AAR-07/07	7-Feb-06	Philadelphia, PA	United Parcel Service
AAR-07/06	8-Dec-05	Chicago, IL	Southwest Airlines
AAR-07/05	27-Aug-06	Lexington, KY	Comair
AAR-07/04	19-Dec-05	Miami, FL	Flying Boat, Inc
AAR-06/03	13-Aug-04	Florence, KY	Air Tahoma, Inc
AAR-06/01	19-Oct-04	Kirksville, MO	Corporate Airlines
AAB-06/02	24-May-03	Amarillo, TX	Southwest Airlines
AAR-05/02	9-May-04	San Juan, PR	Executive Airlines
AAR-05/01	18-Dec-03	Memphis, TN	Federal Express
AAR-04/04	12-Nov-01	Belle Harbor, NY	American Airlines
AAR-04/02	26-Jul-02	Tallahassee, FL	Federal Express
AAR-04/01	8-Jan-03	Charlotte, NC	Air Midwest
AAR-03/02	16-Feb-00	Rancho Cordova, CA	Emory Worldwide Airlines
AAB-02/04	5-Mar-00	Burbank, CA	Southwest Airlines
AAR-02/01	31-Jan-00	Port Hueneme, CA	Alaska Airlines
AAR-01/02	1-Jun-99	Little Rock, AR	American Airlines
AAR-01/01	3-Mar-91	Colorado Springs, CO	United Airlines
AAB-01/01	9-Feb-98	Chicago, IL	American Airlines
AAR-00/03	17-Jul-96	East Moriches, NY	Trans World Airlines
AAR-00/02	31-Jul-97	Newark, NJ	Federal Express
AAR-99/01	8-Sep-94	Aliquippa, PA	USAir (US Airways)
AAR-98/03	5-Sep-96	Newburgh, NY	Federal Express
AAR-98/02	7-Aug-97	Miami, FL	Fine Airlines
AAR-98/01	6-Jul-96	Pensacola, FL	Delta Air Lines
AAR-97/06	11-May-96	Miami, FL	ValuJet Airlines
AAR-97/03	19-Oct-96	Flushing, NY	Delta Air Lines
AAR-97/01	19-Feb-96	Houston, TX	Continental Airlines
AAR-96/07	7-Jan-96	Nashville, TN	ValuJet Airlines
AAR-96/05	12-Nov-95	East Granby, CT	American Airlines
AAR-96/04	20-Dec-95	Jamaica, NY	Tower Air
AAR-96/03	8-Jun-95	Atlanta, GA	ValuJet Airlines
AAR-96/01	31-Oct-94	Roselawn, IN	Simmons Airlines
AAR-95/05	22-Nov-94	Bridgetown, MO	Trans World Airlines
AAR-95/03	2-Jul-94	Charlotte, NC	USAir (US Airways)

NTSB Report	Event Date	City	Carrier
AAR-95/01	2-Mar-94	Flushing, NY	Continental Airlines
AAR-94/06	1-Feb-94	New Roads, LA	Simmons Airlines
AAR-94/04	18-Aug-93	Guantanamo Bay, Cuba	American International Airways
AAR-94/01	14-Apr-93	Dallas Ft Worth, TX	American Airlines
AAR-93/04	30-Jul-92	Jamaica, NY	Trans World Airlines
AAR-93/02	22-Mar-92	Flushing, NY	USAir (US Airways)
AAR-92/05	15-Feb-92	Swanton, OH	Air Transport International
AAR-91/09	17-Feb-91	Cleveland, OH	Ryan International Airlines
AAR-91/08	1-Feb-91	Los Angeles, CA	USAir (US Airways)

There were 50 accidents between 1991 and 2010 which met the criteria required for inclusion in this study. Thirty-one accidents (62%) occurred between 1991 and 2000 and nineteen accidents (38%) occurred between 2001 and 2010, representing a 39% decrease in the number of major U.S. air carrier accidents in the later period.

Figure 7



Research Question #1: What were the operational characteristics of major U.S. air carrier accidents between 1991 and 2010 based on select operational related variables?

Operational Characteristics

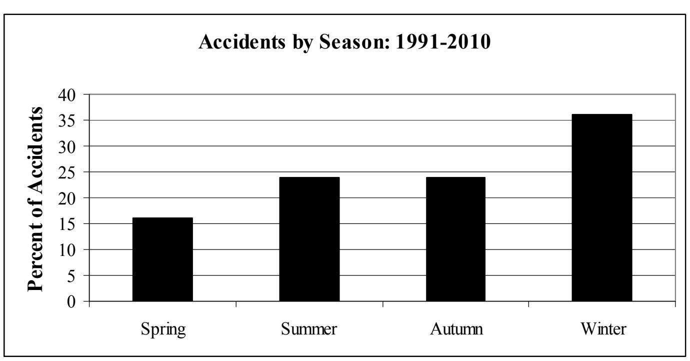
Variables related to the operational characteristics of major U.S. air carrier accidents included: phase of flight; period of day; annual season; light condition; meteorological condition; type of operation; equipment type; and involvement of environmental factors, mechanical factors, and other persons.

Environmental Information

Environmental related variables included season of year, period of day, light condition, and meteorological conditions.

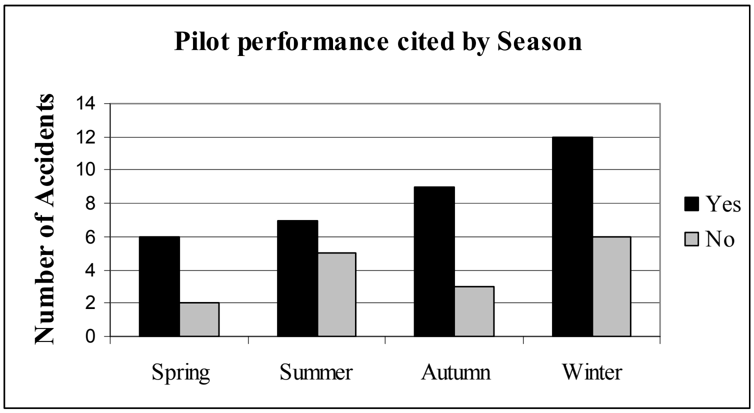
Season of year data was available for all of the accidents. Eight accidents (16%) occurred during the spring months (March 21 – June 20). Twelve accidents (24%) occurred during the summer months (June 21 – September 22). Twelve accidents (24%) occurred during the autumn months (September 23 – December 20). Eighteen accidents (36%) occurred during the winter months (December 21 – March 20).

Figure 8



There was not a significant difference between groups of pilots with regard to the season of the year in which the accidents occurred, $X^2(df = 3, N = 50) = 0.980, p = 0.806$.

Figure 9



Period of day data was available for all of the accidents. Eleven accidents (22%) occurred during the morning-midday hours (0600-1359). Twenty-six accidents (52%) occurred during the afternoon-evening hours (1400-2159). Thirteen accidents (26%) occurred during the overnight hours (2200-0559).

Figure 10

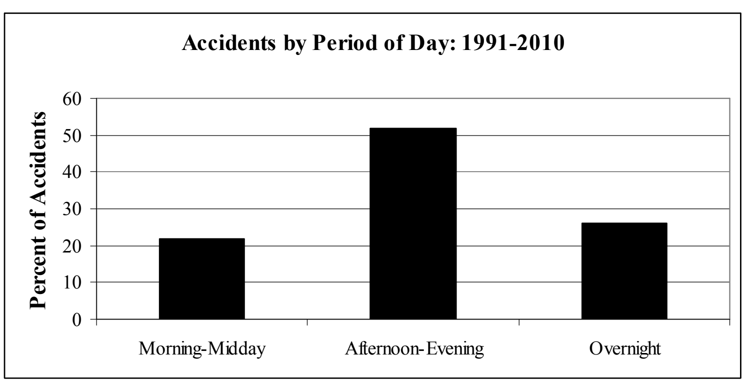
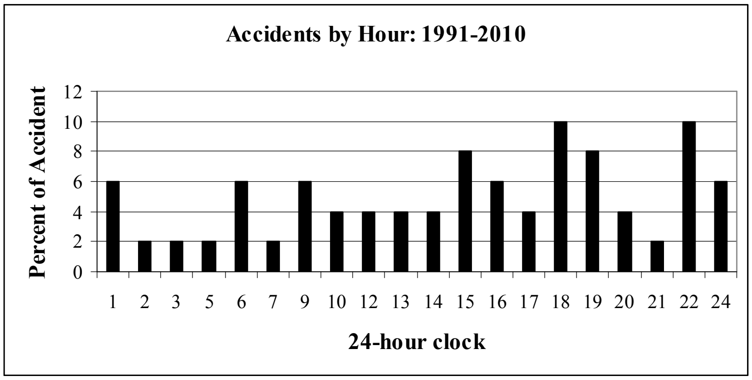
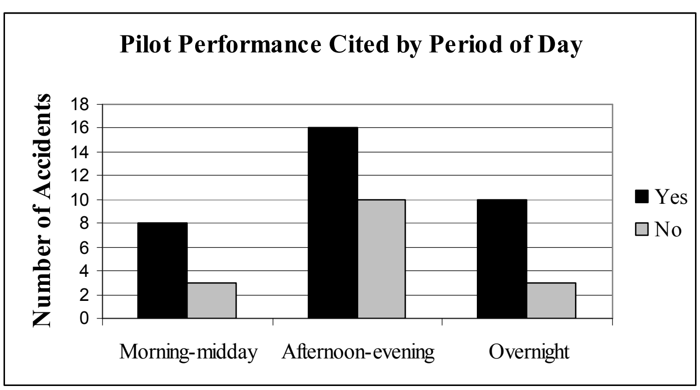


Figure 11



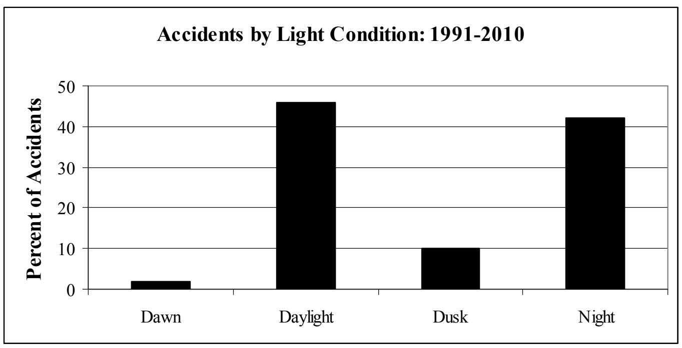
There was not a significant difference between groups of pilots with regard to the period of day in which the accidents occurred, $X^2(df = 2, N = 50) = 1.088$, $p = 0.581$. Nor was there a significant difference between groups of pilots with regard to the time of day in which the accidents occurred based upon the 24-hour clock, $X^2(df = 19, N = 50) = 15.456$, $p = 0.693$.

Figure 12



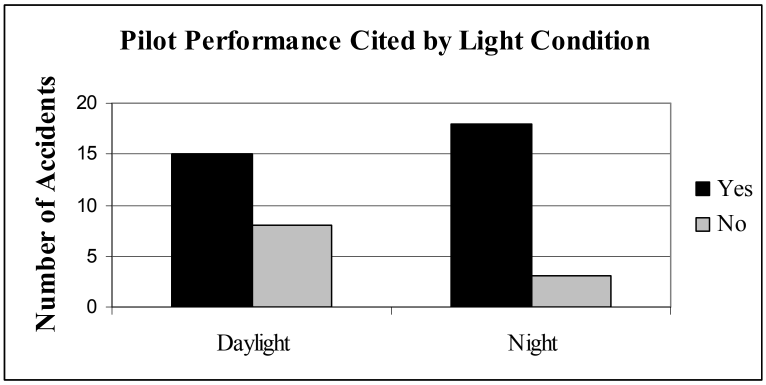
Light condition data was available for all of the accidents. One accident (2%) occurred during dawn. Twenty-three accidents (46%) occurred during daylight hours. Five accidents (10%) occurred during dusk. Twenty-one accidents (42%) occurred during night hours.

Figure 13



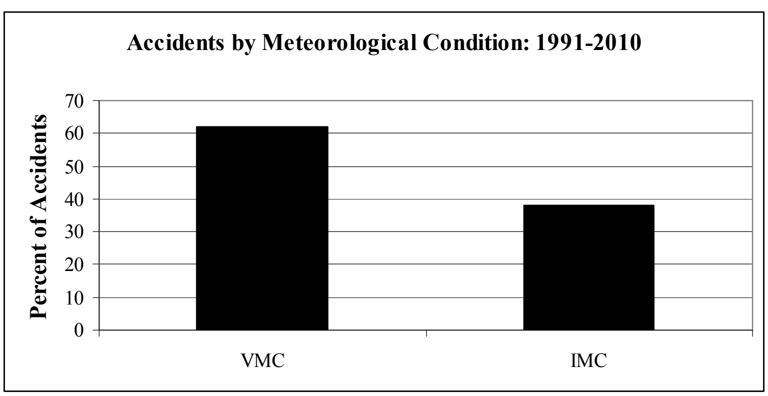
There was a significant difference between groups of pilots with regard to the light condition in which the accidents occurred, $X^2(df = 3, N = 50) = 10.529, p = 0.015$. However, this statistical difference only occurred when the periods of dawn and dusk were included in the analysis. These are relatively short periods of time and mark a transition from night to day and day to night. One accident, not involving pilot performance, occurred during the period of dawn and five accidents, one involving and four not involving pilot performance, occurred during the period of dusk. Therefore, a second chi-square test was performed to compare only “daylight" and "night" lighting conditions. This analysis revealed there was not a significant difference between groups of pilots with regard to daylight and night light conditions, $X^2(df = 1, N = 44) = 2.460, p = 0.117$.

Figure 14



Meteorological data was available for all accidents. Thirty-one (62%) of the accidents occurred during visual meteorological conditions (VMC) and nineteen accidents (38%) occurred during instrument meteorological conditions.

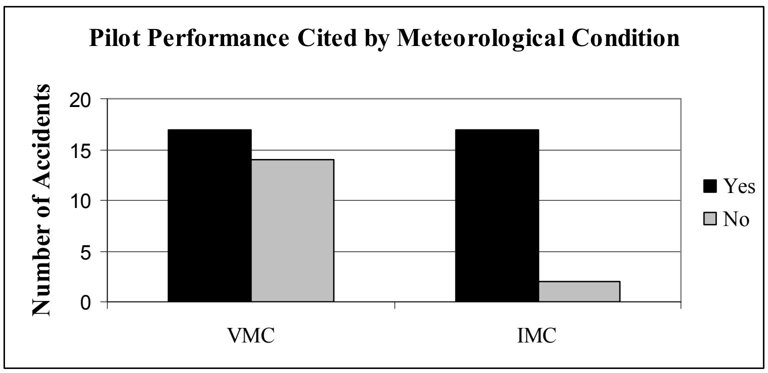
Figure 15



There was a significant difference between groups of pilots with regard to the meteorological conditions in which the accidents occurred, $X^2(df = 1, N = 50) = 6.494$, $p = 0.011$. Of the thirty-one accidents which occurred during VMC conditions, seventeen

(55%) involved pilot performance and fourteen (45%) did not involve pilot performance. However, of the nineteen accidents which occurred during IMC conditions, seventeen (89.5%) involved pilot performance while only two (10.5%) did not involve pilot performance.

Figure 16



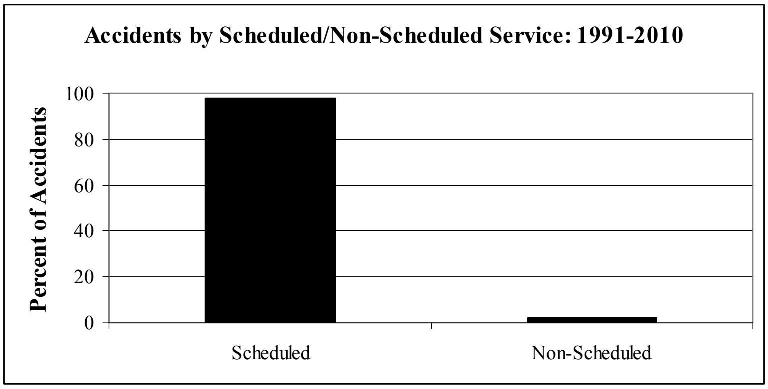
These findings suggest that pilot performance played a disproportionately greater role in the accidents which occurred during IMC conditions than they did during VMC conditions.

Type of Operation

Variables related to the type of operation included scheduled and non-scheduled operations, passenger and cargo flights, and whether an air carrier was operating under its own name or “doing business as” (DBA) another carrier.

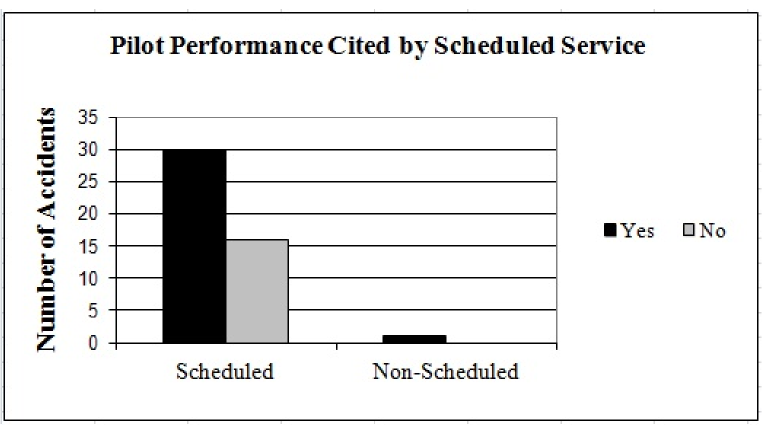
Scheduling data was available for 47 accidents. Forty-six accidents (98%) were scheduled and one accident (2%) was non-scheduled.

Figure 17



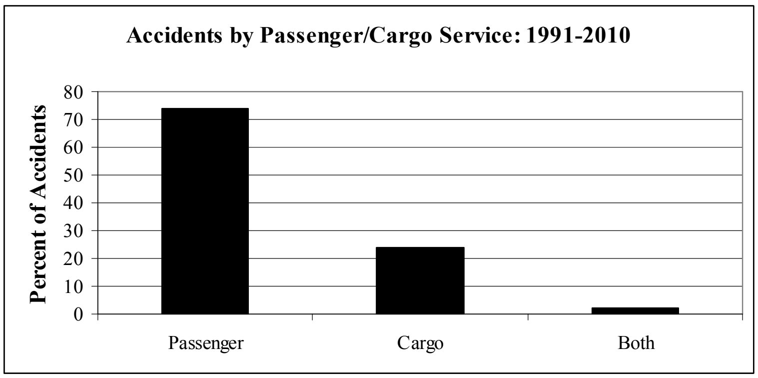
There was not a significant difference between groups of pilots with regard to whether the accident air carrier was scheduled or non-scheduled, $X^2(df = 1, N = 47) = 0.527$, $p = 0.468$.

Figure 18



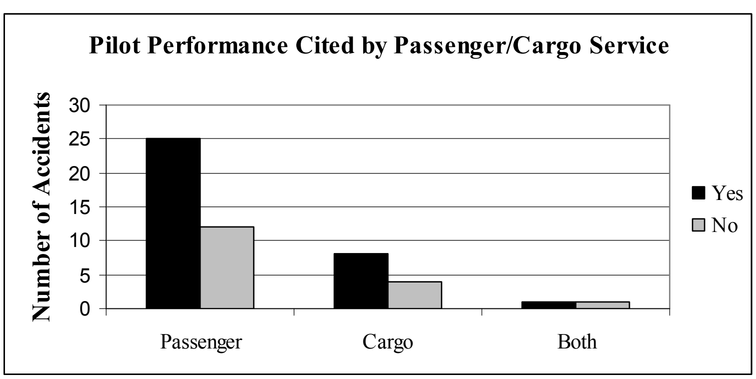
Passenger/cargo flight data was available for 49 accidents. Thirty-seven accidents (74%) were conducted as passenger flights and twelve accidents (24%) were conducted as cargo flights. One accident (2%) was stated to be both a passenger and cargo flight.

Figure 19



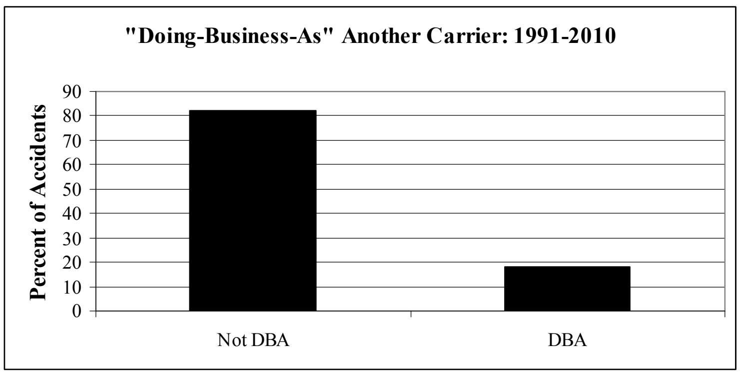
There was not a significant difference between groups with regard to whether the accident air carrier was operating as a passenger or cargo flight, $X^2(df = 2, N = 50) = 0.484$, $p = 0.785$.

Figure 20



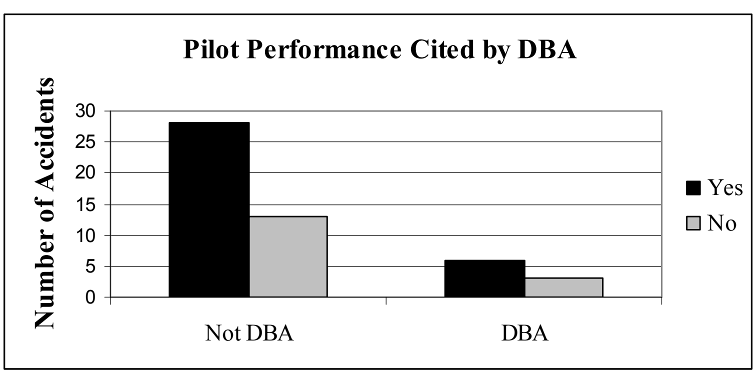
Data related to whether an air carrier was operating under its own name or "doing business as" another carrier was available for all 50 accidents. Forty-one accidents (82%) occurred while the accident air carrier was operating under its own name. Nine accidents (18%) occurred while the accident air carrier was "doing business as" another air carrier.

Figure 21



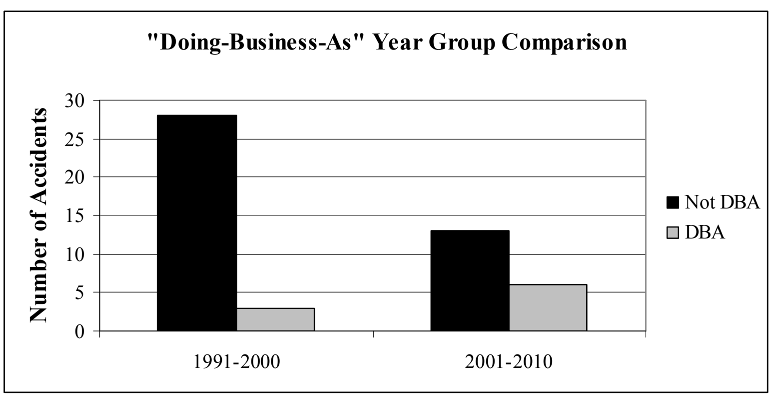
There was not a significant difference between groups of pilots with regard to whether the accident air carrier was operating under its own name or doing-business-as another air carrier, $X^2(df = 1, N = 50) = 0.009, p = 0.925$.

Figure 22



Further analysis was performed to determine whether there was a significant difference between year groups, irrespective to the citing of pilot performance. Of the thirty-one accidents between 1991 and 2000, twenty-eight carriers (90%) were not doing-business-as another carrier while three carriers (10%) were doing-business-as another carrier. Of the nineteen accidents between 2001 and 2010, thirteen carriers (68%) were not doing-business-as another carrier while six carriers (32%) were doing-business-as another carrier. There was a significant difference between year groups with regard to whether an accident air carrier was doing-business-as another carrier, $X^2(df = 1, N = 50) = 3.828$, $p = 0.050$. While the findings suggest a significant increase in the number of DBA accidents, it is highly likely there was also an overall increase in the number of partnerships between carriers during the later period.

Figure 23



Aircraft Information

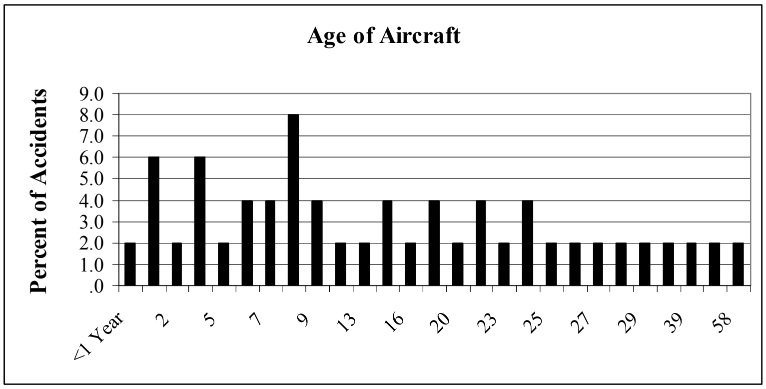
Aircraft related variables included aircraft age, required number of flight crew, number of engines, and engine type. Table 3 details the aircraft involved in the selected accidents.

Table 3

Make/Model of Accident Aircraft: 1991-2010		
Aircraft Type	Number	Percent
Airbus A300	1	2%
Airbus A320	1	2%
Avions de Transport Regional ATR 42	1	2%
Avions de Transport Regional ATR 72	2	4%
Raytheon Beechcraft 1900D	1	2%
Boeing 727	2	4%
Boeing 737	7	14%
Boeing 747	2	4%
British Aerospace BAE-J3201	1	2%
Bombardier Challenger CL-600	2	4%
Convair CV-580	1	2%
Douglas DC-8	5	10%
Douglas DC-9	7	14%
Douglas DC-10	2	4%
Bombardier DHC-8	1	2%
Embraer ERJ-170	1	2%
Fokker F-28	1	2%
Grumman Turbo Mallard G-73T	1	2%
Lockheed L-1011	1	2%
McDonnell Douglas DC-10	1	2%
McDonnell Douglas DC-11	1	2%
McDonnell Douglas MD-82	3	6%
McDonnell Douglas MD-83	2	4%
McDonnell Douglas MD-88	2	4%
Saab 340B	1	2%
Total	50	100%

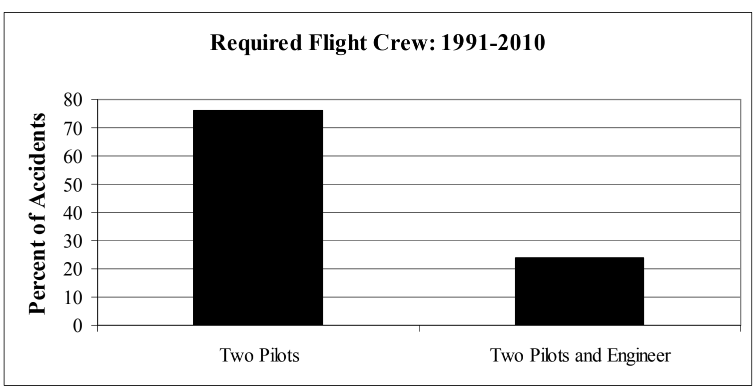
Age of aircraft data was available for 41 of the accidents. The mean aircraft age was 15.89 years old with a standard deviation of 13.307.

Figure 24



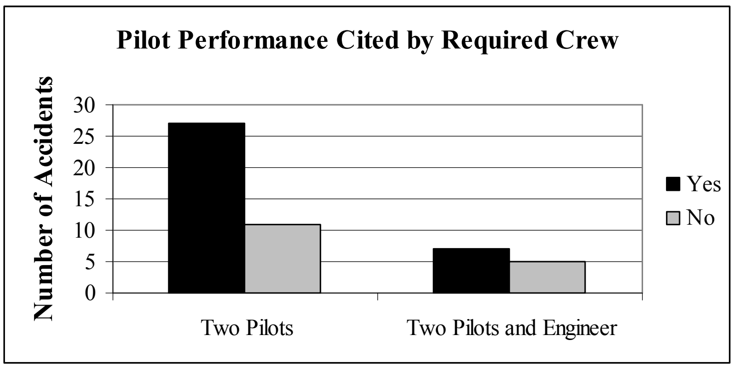
Required flight crew data was available for all of the accidents. Thirty-eight accidents (76%) involved aircraft requiring two pilots only. Twelve accidents (24%) involved aircraft which required two pilots and an engineer.

Figure 25



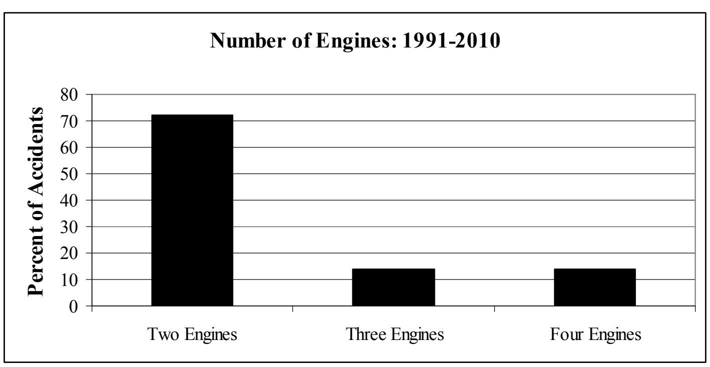
There was not a significant difference between groups of pilots with regard to the number of flight crew required to operate the aircraft, $X^2(df = 1, N = 50) = 0.678$, $p = 0.410$.

Figure 26



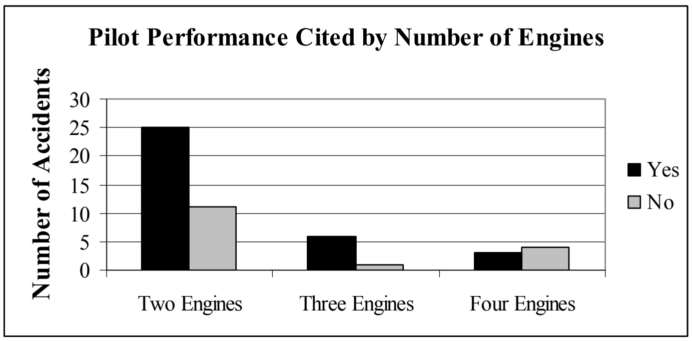
Number of engines data was available for all of the accidents. Thirty-six accidents (72%) involved two-engine aircraft. Seven accidents (14%) involved three-engine aircraft. Seven accidents (14%) involved four engine aircraft.

Figure 27



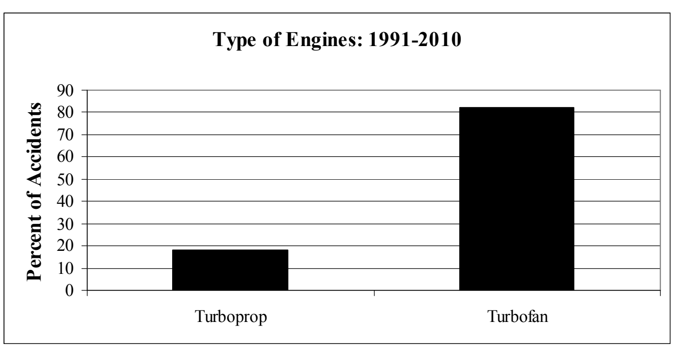
There was not a significant difference between groups of pilots with regard to the number of engines installed on the accident aircraft, $X^2(df = 2, N = 50) = 3.078$, $p = 0.215$.

Figure 28



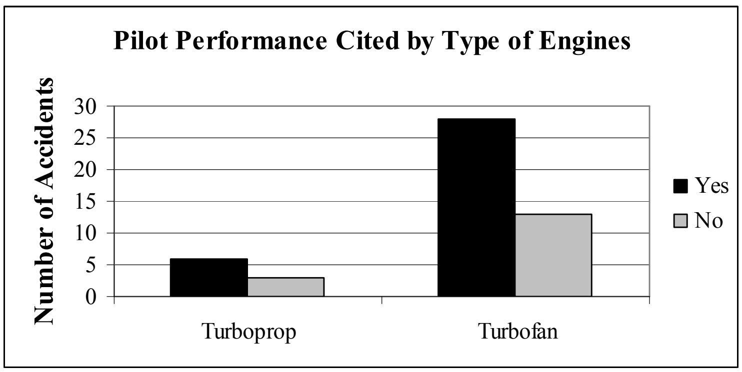
Type of engine data was available for all of the accidents. Nine accidents (18%) involved aircraft utilizing turboprop engines. Forty-one accidents (82%) involved aircraft utilizing turbofan engines. Zero accidents (0%) involved aircraft utilizing turbojet engines.

Figure 29



There was not a significant difference between groups of pilots with regard to the type of engines (turboprop, turbofan, turbojet) installed on the accident aircraft, $X^2(df = 1, N = 50) = 0.009$, $p = 0.925$.

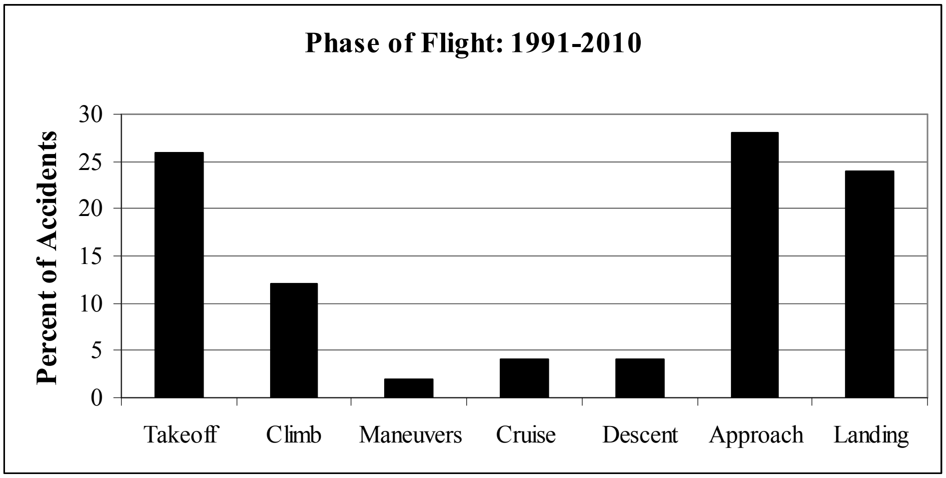
Figure 30



Phase of Flight

Phase of flight data was available for all accidents. Zero accidents (0%) occurred during taxi. Thirteen accidents (26%) occurred during takeoff. Six accidents (12%) occurred during climb. One accident (2%) occurred while maneuvering. Two accidents (4%) occurred during cruise. Two accidents (4%) occurred during descent. Fourteen accidents (28%) occurred during approach. Twelve accidents (24%) occurred during landing. Figure 31 depicts the distribution of accidents by phase of flight.

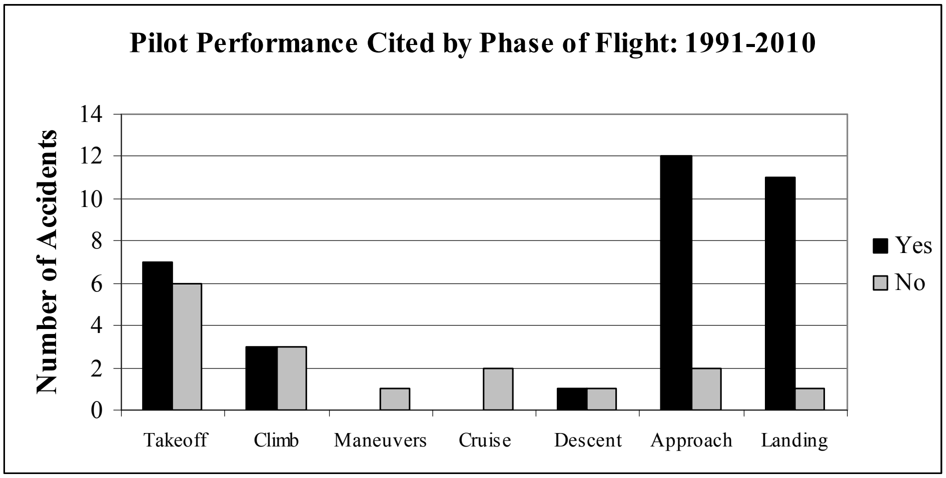
Figure 31



There was a significant difference with regard to the phases of flight in which the accidents occurred with regard to the citing of pilot performance, $X^2(df = 6, N = 50) = 13.871$, $p = 0.031$. Further analysis revealed that nineteen accidents (38%) occurred during the combined takeoff and climb phases of flight and twenty-six accidents (52%) occurred during the combined approach and landing phases of flight. There were only five accidents (10%) which occurred during the maneuvering, cruise, or descent phases of flight and only one of those accidents involved pilot performance.

The distribution for the citing/not citing of pilot performance for each phase of flight was nearly even for takeoff, climb, and descent. There were only three accidents which occurred during the maneuvering and descent phases and only one (2%) involved pilot performance. However, twelve (86%) of the fourteen accidents which occurred during the approach phase of flight involved pilot performance. Eleven (92%) of the twelve accidents which occurred during the landing phase of flight involved pilot performance.

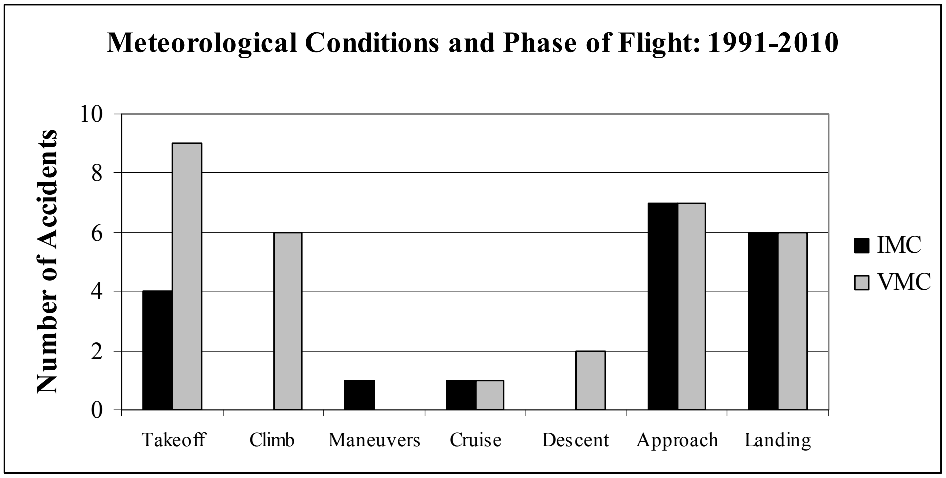
Figure 32



These findings suggest that pilot performance played a disproportionately greater role during the approach and landing phases than during any other phase of flight.

Analysis was also performed to see if there were any significant differences with regard to the phases of flight and environmental conditions, irrespective of the citing/not citing of pilot performance. There was not a significant difference with regard to the phase of flight in various meteorological conditions, $X^2(df = 6, N = 50) = 8.535$, $p = 0.201$. There was not a significant difference with regard to the phase of flight and season of year, $X^2(df = 18, N = 50) = 20.721$, $p = 0.294$. There was not a significant difference with regard to phase of flight and period of day, $X^2(df = 12, N = 50) = 8.074$, $p = 0.779$. Nor was there a significant difference with regard to phase of flight and daylight/night lighting conditions, $X^2(df = 5, N = 44) = 8.259$, $p = 0.143$.

Figure 33


Meteorological Conditions and Phase of Flight: 1991-2010
Number of Accidents
10
8
6
4
2
0
Takeoff
Climb
Maneuvers
Cruise
Descent
Approach
Landing
IMC
VMC

Research Question #2: What were the characteristics of the pilots involved in major U.S. air carrier accidents between 1991 and 2010 based on select pilot related variables?

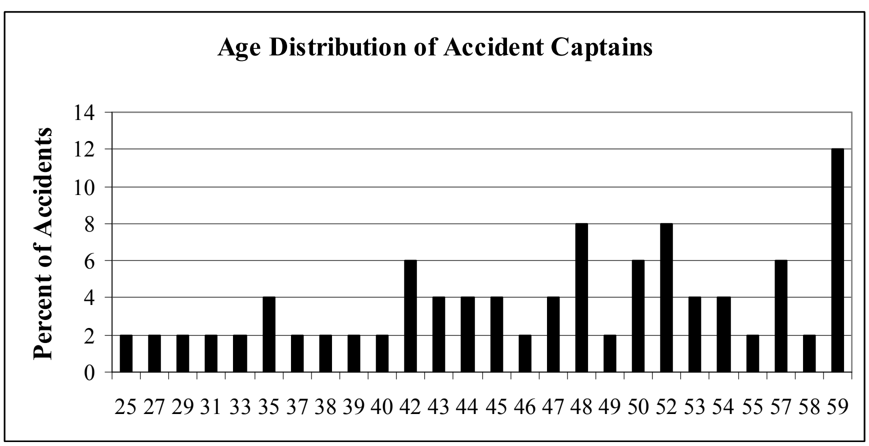
Characteristics of the Accident Pilots

Variables related to the characteristics of pilots included: age; gender; flight experience; level of certification; duration of employment with the accident air carrier; crew assignment; crew familiarity; the involvement of pilot performance; past unsatisfactory ratings; FAA accidents, incidents, and violations; and prior driver's license suspension and revocations.

Crewmember Age

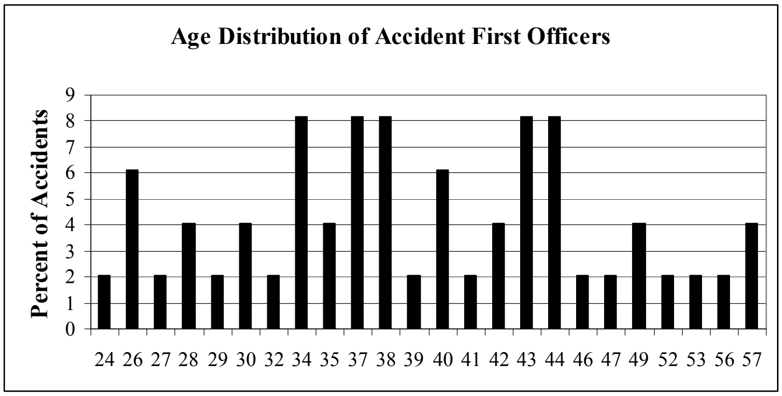
Crewmember age data was available for all of the captains. The age of captains ranged between 25 and 59 years old with a mean of 47 years of age.

Figure 34



Age data was available for 49 first officers. The age of first officers ranged between 24 and 57 years old with a mean of 39 years of age.

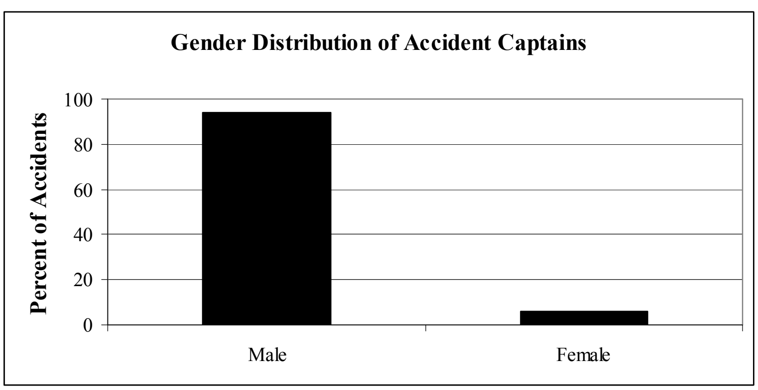
Figure 35



Gender of Crewmembers

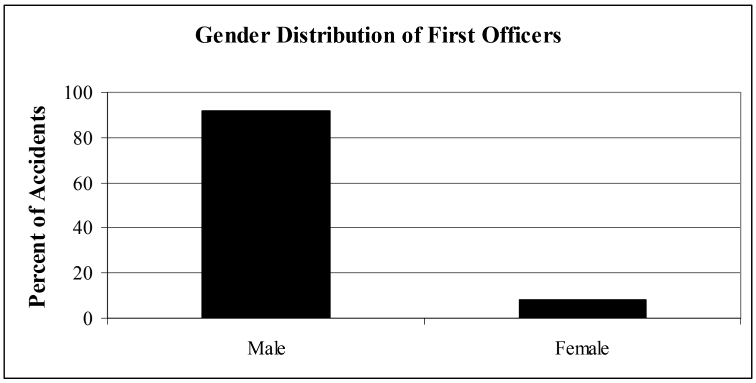
Gender data was available for all captains. Forty-seven captains (94%) were male and three (6%) were female. Figure 36 depicts the gender data for captains.

Figure 36



Gender data was available for all first officers. Forty-six first officers (92%) were male and four (8%) were female.

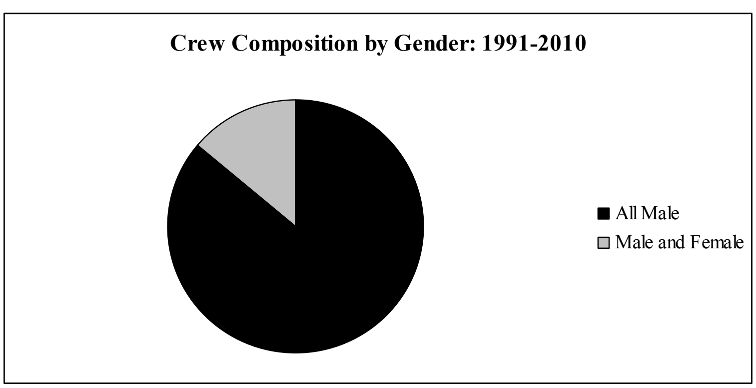
Figure 37



Gender Composition

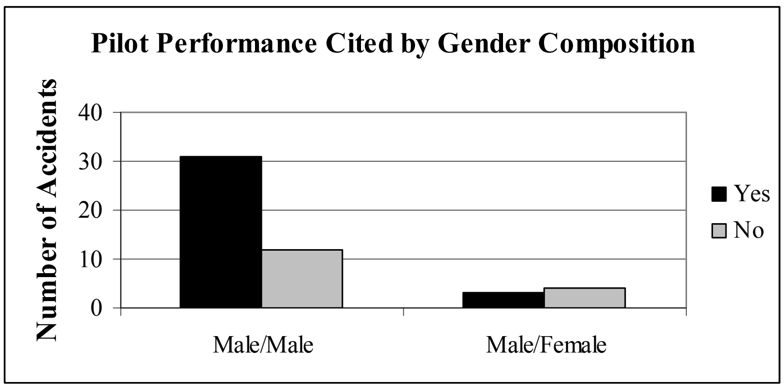
Forty-three accidents (86%) involved an all male crew of pilots. Seven accidents (14%) involved a male/female crew of pilots. Zero accidents (0%) involved an all female crew of pilots.

Figure 38



There was not a significant difference between groups with regard to the composition of crews by gender in which the accidents occurred, $X^2(df = 1, N = 50) = 2.365, p = 0.124$.

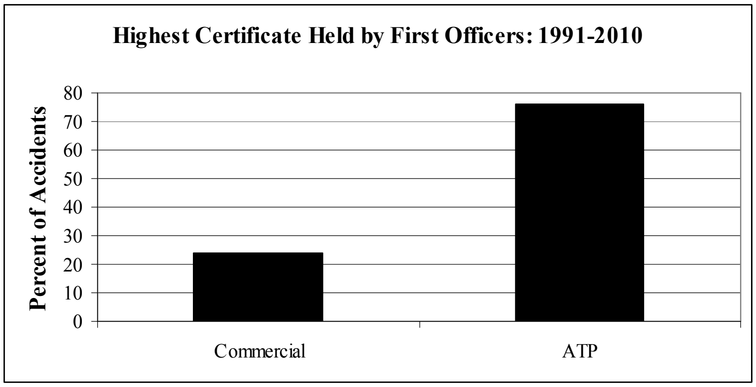
Figure 39



Certificates Held

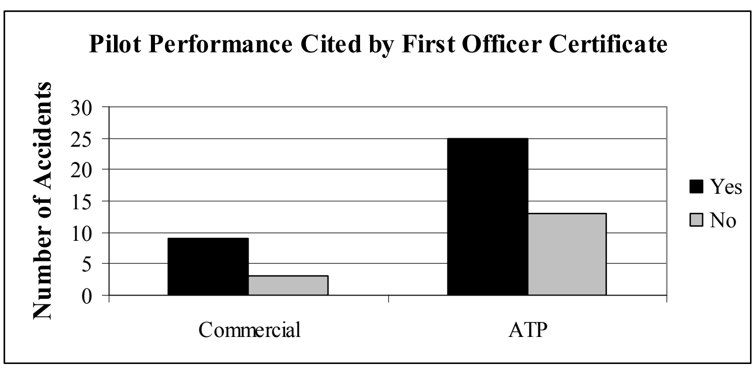
Certificate data was available for all captains and first officers. All captains (100%) held an ATP certificate. This was expected as possession of an ATP certificate is required in order to perform pilot-in-command duties under 14 CFR 121. Twelve first officers (24%) held a commercial certificate and thirty-eight (76%) held an ATP certificate.

Figure 40



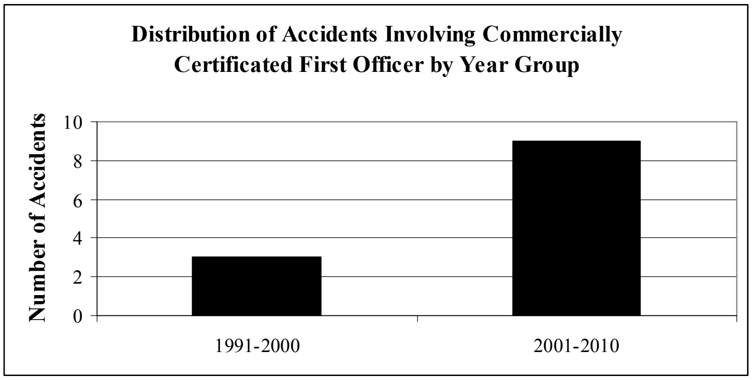
There was not a significant difference between groups of first officers with regard to the highest certificate held, $X^2(df = 1, N = 50) = 0.356, p = 0.551$.

Figure 41



Further analysis revealed that of the twelve accidents involving a first officer whose highest certificate was a commercial certificate, three (25%) occurred between 1991 and 2000 and nine (75%) occurred between 2001 and 2010.

Figure 42



Irrespective of the citing/not citing of pilot performance, there was a significant difference between 1991-2000 and 2001-2010 with regard to the distribution of accidents based upon the highest certificate held by first officers between periods, $X^2(df = 1, N = 50) = 9.175$, $p = 0.002$. Between 1991 and 2000, twenty-eight first officers (90%) held an ATP certificate while only three (10%) held a commercial certificate. Between 2001 and 2010, ten first officers (53%) held an ATP certificate and nine (47%) held a commercial certificate. Again, this analysis was irrespective of the citing/not citing of pilot performance.

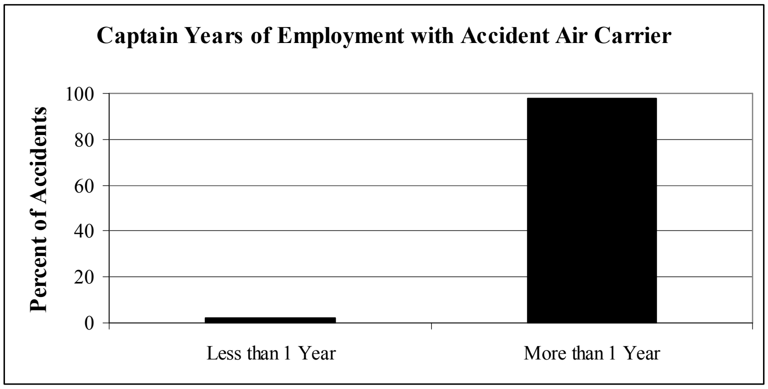
Figure 43

These findings suggest a significant shift in the distribution of major U.S. air carrier accidents involving commercially certificated first officers during the later period. It was unknown what the actual employment distribution was among ATP and commercially certificated first officers who were involved in 14 CFR 121 air carrier operations during either period.

Duration of Employment

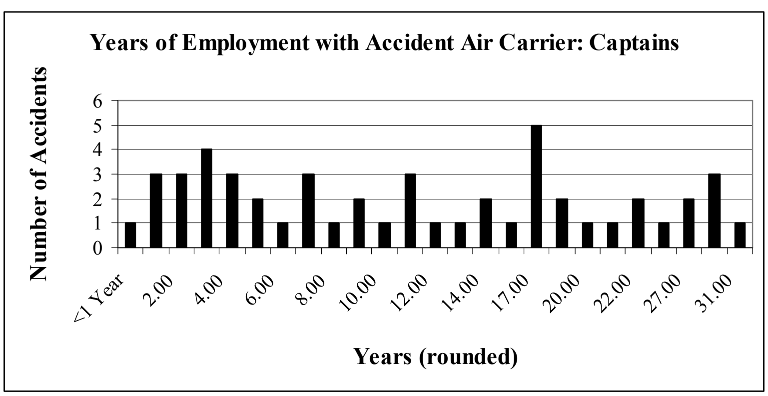
Employment data was available for all of the captains. The accident captains' duration of employment ranged from less than one month to over 30 years of employment with the accident air carrier, with a mean of 12.2 years. Only one captain (2%) had less than one year of employment with the accident air carrier. Forty-nine captains (98%) had more than one year of employment with the accident air carrier.

Figure 44



There was not a significant difference between groups with regard to whether the captain had more or less than one year of employment with the accident air carrier, $X^2(df = 1, N = 50) = 0.480, p = 0.488$.

Figure 45



Employment data was available for 49 first officers. The accident first officers' duration of employment ranged from less than one month to over 32 years of employment with the accident air carrier, with a mean of 5.4 years. Thirteen first officers

(26.5%) had less than one year of employment with the accident air carrier. Thirty-six first officers (73.5%) had more than one year of employment with the accident air carrier. There was not a significant difference between groups of first officers with regard to whether the first officer had more or less than one year of employment with the accident air carrier, $X^2(df = 1, N = 49) = 0.473$, $p = 0.492$.

Figure 46

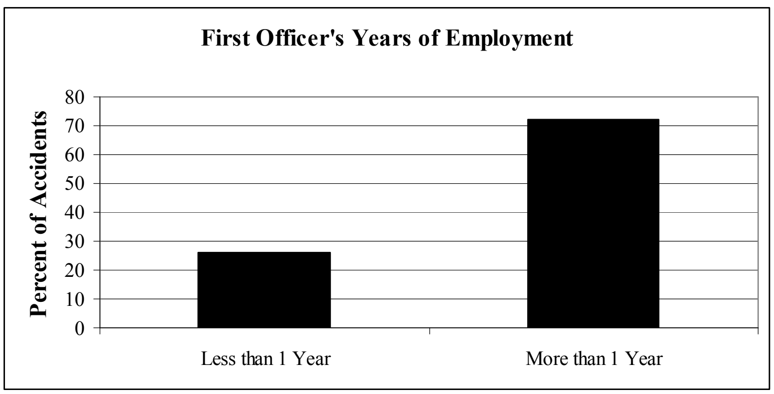


Figure 47

Nor was there a significant difference between the periods of 1991-2000 and 2001-2010 with regard to first officers' duration of employment, $X^2(df = 1, N = 49) = 0.406$, $p = 0.524$.

Total Flight Time

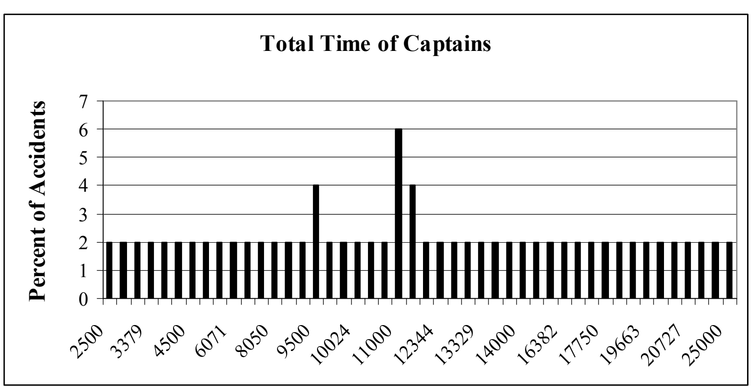
Total flight time data was available for all of the captains. The least experienced captain had 2,500 hours of total flight time and the most experienced captain had 25,000 hours of total flight time, with a mean of 11,994 hours.

Table 4

Total Time Captain

Mean	11993.62
Median	11500.00
Mode	11000
Std. Deviation	5741.178
Minimum	2500
Maximum	25000

Figure 48



There was not a significant difference between groups of pilots with regard to whether the captain had more or less than 1,500 hours of total flight time as 100% of captains had over 1,500 hours of total flight time.

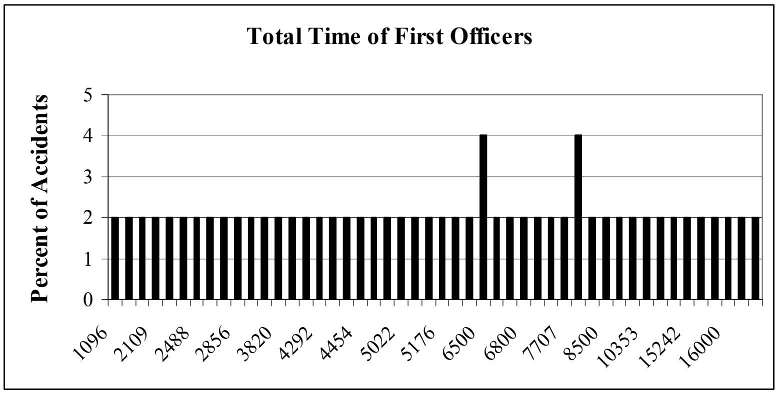
Total flight time data was available for all of the first officers. The least experienced first officer had 1,096 hours of total flight time and the most experienced first officer had 17,734 hours of total flight time, with a mean of 6,838 hours. Only two first officers (4%) had less than 1,500 hours of total flight time. Forty-eight first officers (96%) had more than 1,500 hours of total flight time. Of the two first officers with less than 1,500 hours, one possessed 1,096 hours and the other possessed 1,420 hours of total flight time.

Table 5

Total Time First Officer

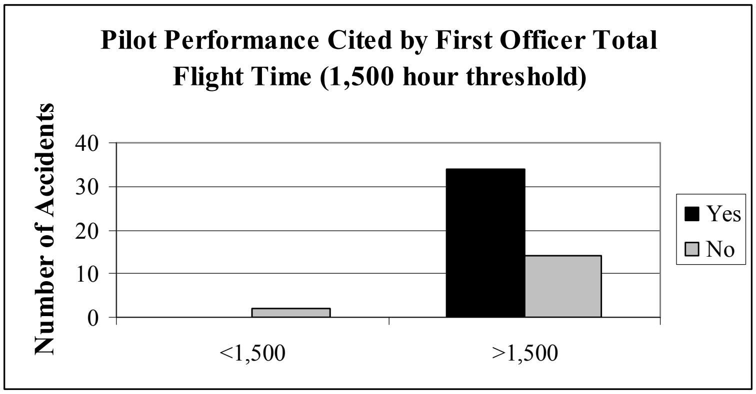
Mean	6837.92
Median	5407.00
Mode	6500[a]
Std. Deviation	4478.409
Minimum	1096
Maximum	17734

Figure 49



There was a significant difference between groups with regard to whether the first officer had more or less than 1,500 hours of flight time, $X^2(df = 1, N = 50) = 4.427$, $p = 0.035$. Of the first officers with more than 1,500 hours of total flight time, thirty-four (71%) were involved in an accident citing pilot performance as a causal or contributing factor and fourteen (29%) were involved in an accident not citing pilot performance as a causal or contributing factor. Of the two first officers with less than 1,500 hours of total time, neither (0%) were involved in an accident citing pilot performance as a causal or contributing factor.

Figure 50



The findings suggest that first officers with less than 1,500 hours of total flight time did not contribute to any major U.S. air carrier accidents between 1991 and 2010.

Flight Experience in Make/Model

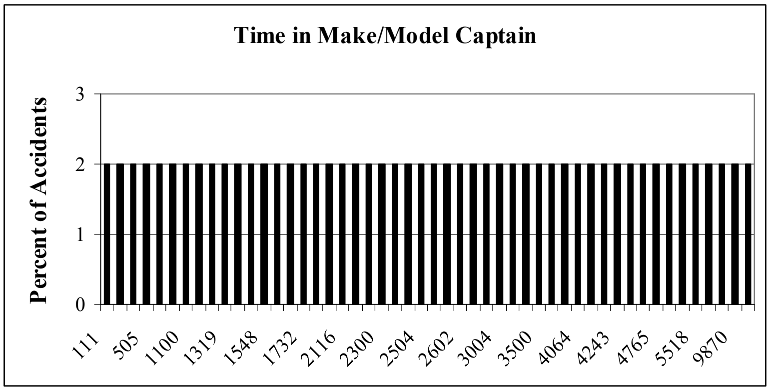
Hours of flight time in the accident make and model was available for all of the captains. The least experienced captain had 111 hours in make/model and the most experienced captain had 16,000 hours in make/model, with a mean of 3,113 hours.

Table 6

Make and Model Captain

Mean	3112.54
Median	2507.00
Mode	111[a]
Range	15889
Minimum	111
Maximum	16000

Figure 51



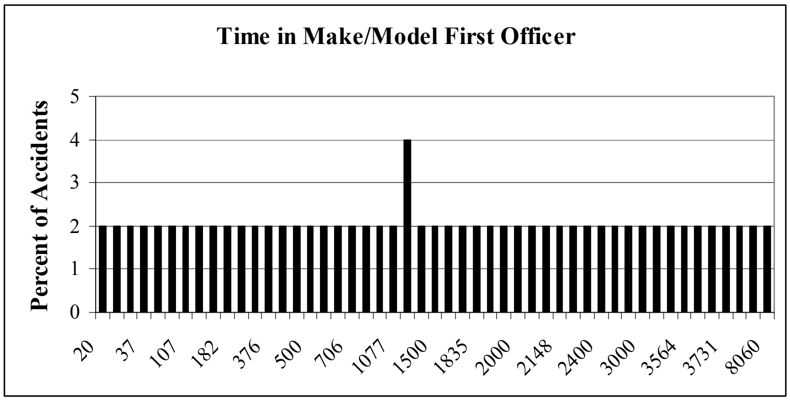
Hours of flight time in the accident make and model was available for all first officers. The least experienced first officer had 20 hours in make/model and the most experienced first officer had 8,060 hours in make/model, with a mean of 1,683 hours.

Table 7

Make and Model First Officer

Mean	1682.76
Median	1419.00
Mode	1200
Range	8040
Minimum	20
Maximum	8060

Figure 52



Flight Experience in Make/Model and Position (e.g. B737 Captain)

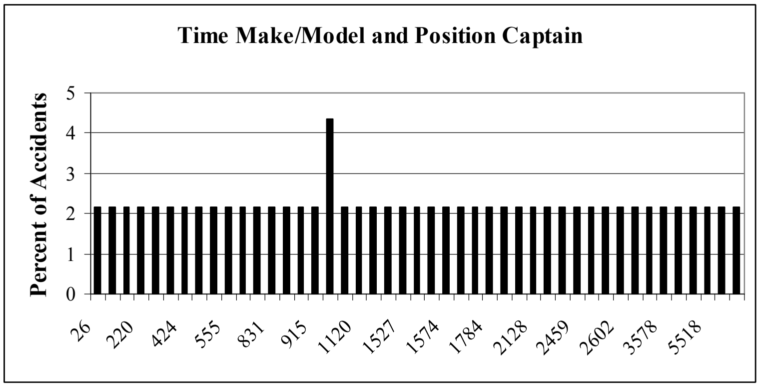
Hours of flight time in the accident make/model and position was available for 46 captains. The least experienced captain had 26 hours as a captain in the accident aircraft make/model and the most experienced captain had 16,000 hours as a captain in the accident aircraft make/model, with a mean of 2,048 hours.

Table 8

Type and Position Captain

Mean	2048.43
Median	1537.50
Mode	1100
Std. Deviation	2536.204
Range	15974
Minimum	26
Maximum	16000

Figure 53



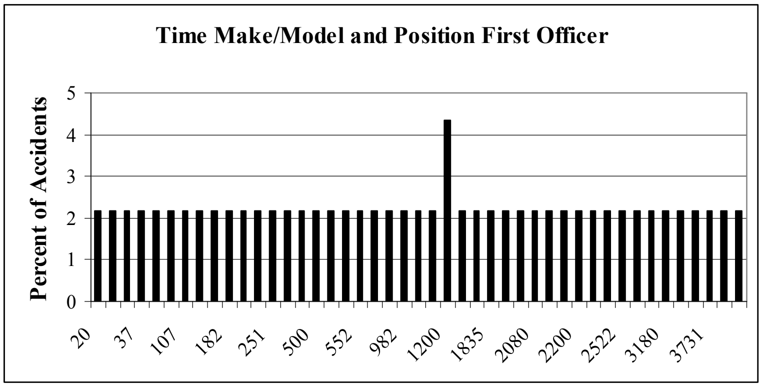
Hours of flight time in the accident make/model and position was available for 46 first officers. The least experienced first officer had 20 hours as a first officer in the accident aircraft make/model and the most experienced first officer had 8,060 hours as a first officer in the accident aircraft make/model, with a mean of 1,503 hours. Table 9 and Figure 54 present the distribution for first officers in make/model and position.

Table 9

Type and Position First Officer

Mean	1502.87
Median	1110.00
Mode	1200
Std. Deviation	1584.646
Range	8040
Minimum	20
Maximum	8060

Figure 54

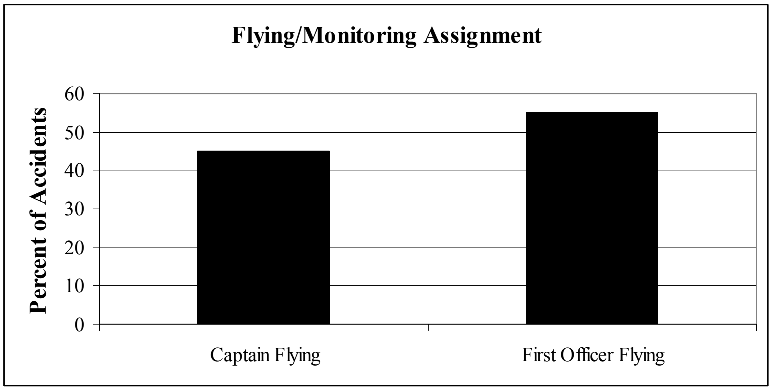


Flying Assignment

Flying assignment data was available for 49 accidents. Measurements were made in terms of "assigned" duties. In other words, if the first officer was assigned flying duties and the captain took control of the aircraft before, during, or after the accident occurred, the first officer was recorded as the flying pilot.

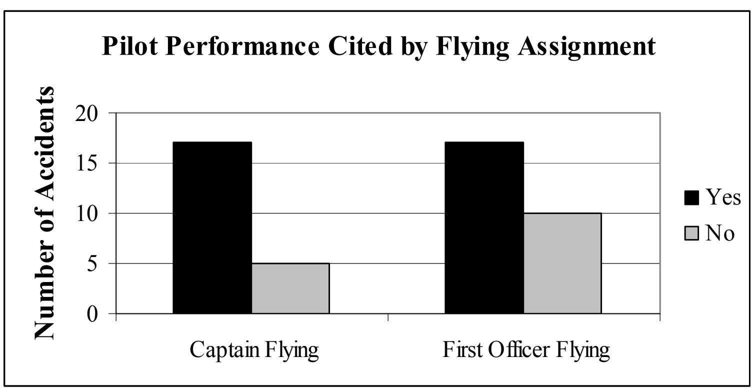
The captain was performing flying duties and the first officer was performing monitoring duties in twenty-two (45%) of the accidents. The first officer was performing flying duties and the captain was performing monitoring duties in twenty-seven (55%) of the accidents.

Figure 55



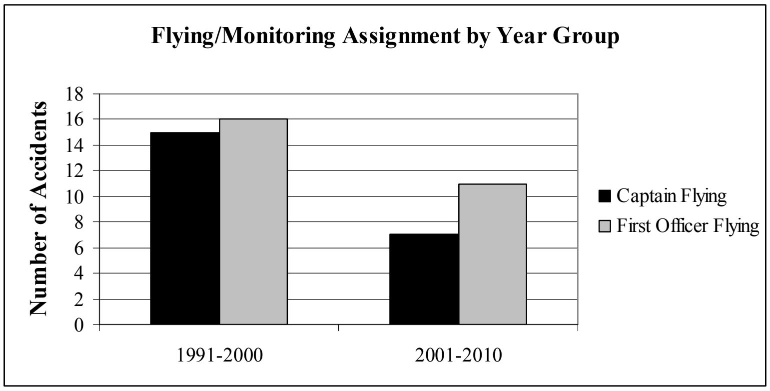
There was not a significant difference between groups of pilots with regard to which pilot was performing the flying duties and which pilot was performing the monitoring duties, $X^2(df = 1, N = 49) = 1.169, p = 0.280$.

Figure 56



Nor was there a significant difference between 1991-2000 and 2001-2010 with regard to crew assignment, irrespective of the citing/not citing of pilot performance $X^2(df = 1, N = 49) = 0.415, p = 0.519$.

Figure 57

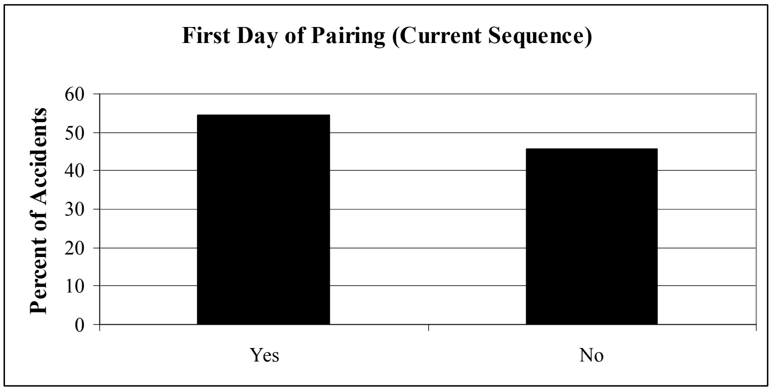


Crew Familiarity

Crew familiarity was measured in terms of (1) first day of pairing on the current sequence/pairing; (2) first leg of the day on the current pairing; and (3) whether the accident sequence pairing was the first pairing together.

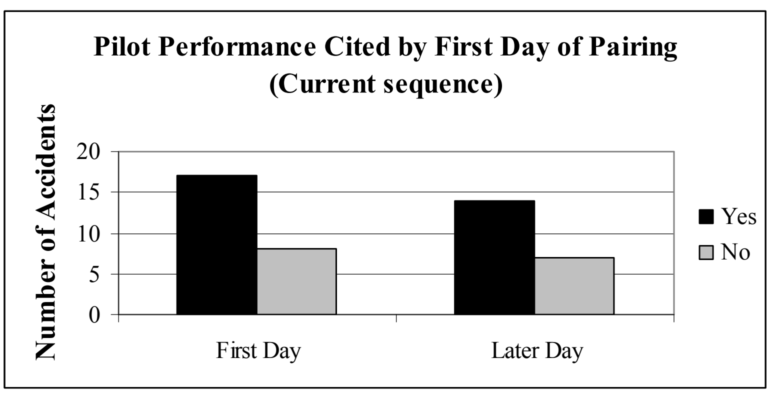
First day of pairing on the current/accident sequence/pairing was available for 46 accidents. Twenty-five accidents (54%) occurred during the first day of crew pairing. Twenty-one accidents (46%) occurred on a day following the crew's first day flying together.

Figure 58



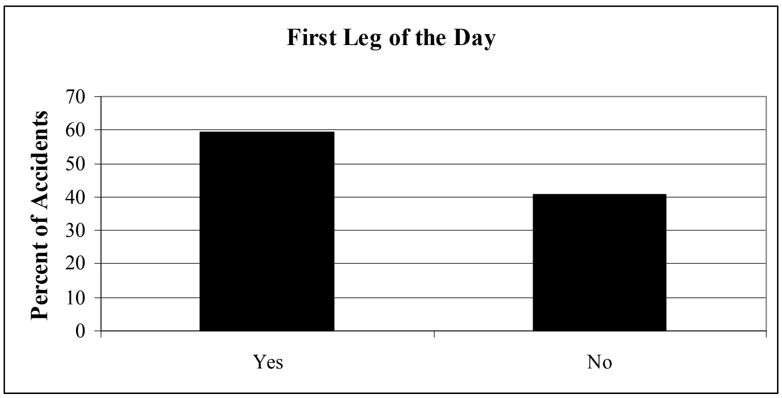
There was not a significant difference between groups with regard to whether the accident occurred on the crew's first day of pairing on the current sequence/pairing, $X^2(df = 1, N = 46) = 0.009$, $p = 0.923$.

Figure 59



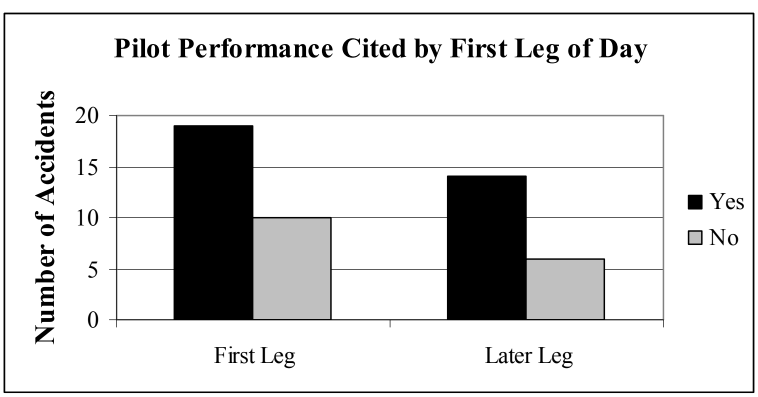
First leg of the day data was available for 49 accidents. Twenty-nine accidents (59%) occurred during the first leg of the day. Twenty accidents (41%) occurred after the crew had already completed at least one leg that day prior to the accident leg. It is important to note that not all trip sequences involve multiple legs per day. It is possible that a portion of the accidents which occurred during the first leg of the day involved a trip sequence with only one leg that particular day.

Figure 60



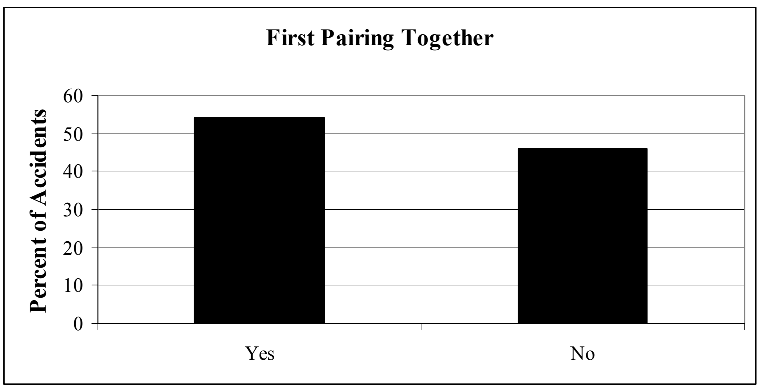
There was not a significant difference between groups of pilots with regard to whether the accident occurred on the first flight-leg of the day, $X^2(df = 1, N = 49) = 0.108, p = 0.742$.

Figure 61



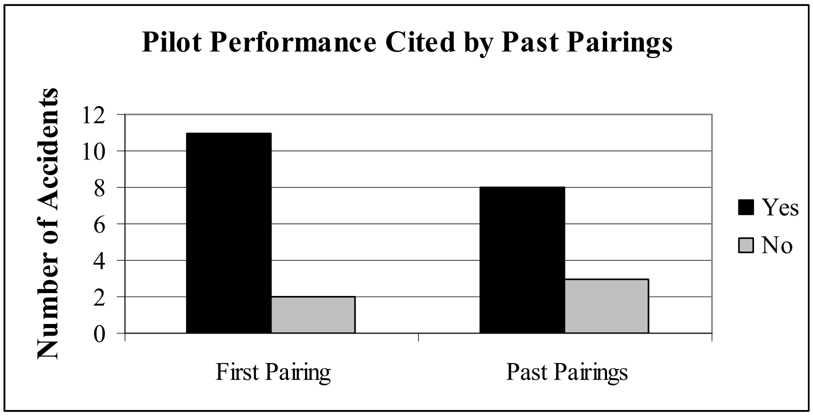
Data related to whether the accident crew had flown together in the past on another pairing sequence was available for 24 accidents. Thirteen flight crews (54%) had been paired together on at least one pairing, other than the accident pairing, in the past. For eleven flight crews (46%), the accident sequence pairing was the first time the crewmembers had been paired together.

Figure 62



There was not a significant difference between groups of pilots with regard to whether the accident occurred during the first pairing between pilots, $X^2(df = 1, N = 24) = 0.511$, $p = 0.475$.

Figure 63



Medical and Toxicological

Toxicological data for major drugs of abuse was available for 46 captains and 44 first officers. All forty-six captains (100%) tested negative for major drugs of abuse. All forty-four first officers (100%) tested negative for major drugs of abuse. Major drugs of abuse included: marijuana; cocaine, phencyclidine, amphetamines, and opiates. Appendix Q provides a list of prescription and over-the-counter substances detected through toxicological testing.

Toxicological data for ethanol (alcohol) was available for 36 captains and 32 first officers. Thirty-three captains (92%) tested negative for ethanol. While the toxicological tests of three captains (8%) tested positive for ethanol, the NTSB stated in each of these cases that the presence of ethanol was either consistent with or likely a result of postmortem ethanol production (decomposition). Thirty first officers (94%) tested negative for ethanol. While the toxicological tests of two first officers (6%) tested positive for ethanol, the NTSB stated in each of these cases that the presence of ethanol was either consistent with or likely a result of postmortem ethanol production (decomposition).

Trained and Qualified

Data related to whether each crewmember was properly trained and qualified in accordance with FAA regulations and company policy was available for all captains and first officers. Forty-nine captains (98%) were properly trained and qualified to perform their assigned duties. One captain (2%) was using the prescription drug Phenobarbital for a gastrointestinal problem. According to the NTSB, Phenobarbital was "contraindicated for use by airline pilots" (1991). While this case was recorded as not qualified for the purpose of this study, the NTSB stated "The flightcrews of both airplanes were properly trained and qualified for the flights except for the self-medication practices of two pilots…the postmortem presence of Phenobarbital in the captain of USA1493 and over-the-counter medication in the first officer of SKW5569 did not contribute to the accident" (1991). There was not a significant difference between groups of pilots with regard to whether the captain was qualified to perform the assigned duties, $X^2(df = 1, N = 50) = 2.168, p = 0.141$.

Forty-nine first officers (98%) were properly trained and qualified to perform their assigned duties. One first officer (2%) "…held a current Federal Aviation Administration airman medical certificate at the time of the accident; however, he failed to provide information about his medical condition (anxiety) or his use of the prescription drug alprazolam when he applied for the certificate" (NTSB, 1991). There was not a significant difference between groups of pilots with regard to whether the first officer was qualified to perform the assigned duties, $X^2(df = 1, N = 50) = 0.480, p = 0.488$.

Previous Accidents, Incidents, and Enforcements

Data related to previous aircraft accidents, incidents, and enforcements was available for 38 captains and 35 first officers. Four captains (10.5%) had been involved in a previous aviation accident, incident, or enforcement action. Thirty-four captains (89.5%) had not been involved in a previous aviation accident, incident, or enforcement action. None of the first officers (0%) had been involved in a previous aviation accident, incident, or enforcement action. There was not a significant difference between groups with regard to whether the captain had a previous aviation accident, incident, or enforcement action, $X^2(df = 1, N = 38) = 0.495$, $p = 0.482$, and there was not a significant difference between groups with regard to whether the first officer had a previous aviation accident, incident, or enforcement action as none of the first officers were involved in such occurrences.

Driver's License Suspension or Revocation

Data related to driver's license suspensions or revocations was available for 26 captains and 27 first officers. Twenty-six captains (100%) had no history of a driver's license suspension or revocation. One first officer (4%) had been subject to a driver's license suspension/revocation. The remaining 26 first officers (96%) had no history of driver's license suspension/revocation. There was not a significant difference between groups with regard to whether the captain had a previous driver's license suspension as none of the captains were involved in such actions. There was not a significant difference between groups with regard to whether the first officer had a previous driver's license suspension or revocation, $X^2(df = 1, N = 27) = 0.437$, $p = 0.508$.

Unsatisfactory Flight Evaluations

Captains and first officers were recorded as having a past unsatisfactory flight evaluation only if the NTSB reported so in the aircraft accident report or brief. Without access to actual FAA airman records, it was impossible to review the full evaluation history of all crewmembers to determine whether there were any unreported failures. Seven accidents (14%) involved a crewmember with one or more previous unsatisfactory flight evaluations. Five accidents (10%) involved a captain with one or more previous unsatisfactory flight evaluations. Four accidents (8%) involved a first officer with one or more previous unsatisfactory flight evaluations. Two out of fifty accidents (4%) involved a captain and first officer who both had one or more previous unsatisfactory flight evaluations. There was not a significant difference between groups with regard to whether the captain had one or more past unsatisfactory flight evaluations, $X^2(df = 1, N = 50) = 2.614$, $p = 0.106$. There was not a significant difference between groups with regard to whether the first officer had one or more past unsatisfactory flight evaluations, $X^2(df = 1, N = 50) = 2.046$, $p = 0.153$.

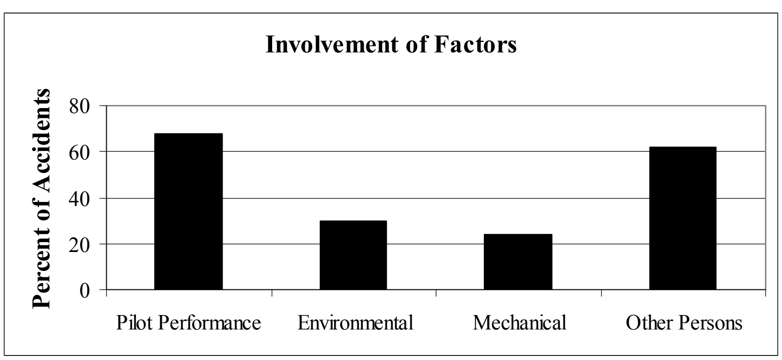
Content Analysis

Content Analysis #1: Causal and Contributing Factors

Content analysis was first performed on the cause and factor finding statements for each of the accidents. For the purpose of this particular analysis, causal and contributing factors were classified as: pilot performance; environmental; mechanical; and other persons. The "(C) = Cause, (F) = Factor" Findings Legend in the "Brief of Accident" reports were used as a means to accurately record each of the measurements.

Causal and contributing factor data was available for all of the accidents. Thirty-four accidents (68%) cited pilot performance as a causal or contributing factor. Fifteen accidents (30%) cited the environment as a causal or contributing factor. Twelve accidents (24%) cited mechanical factors as a causal or contributing factor. Thirty-one accidents (62%) cited other persons as a causal or contributing factor.

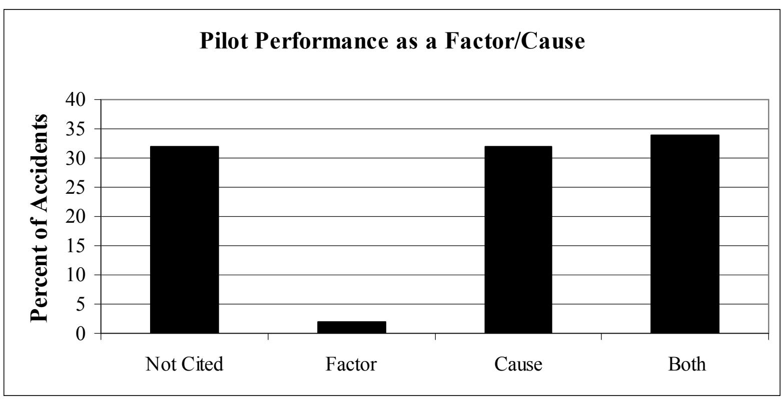
Figure 64



Pilot Performance

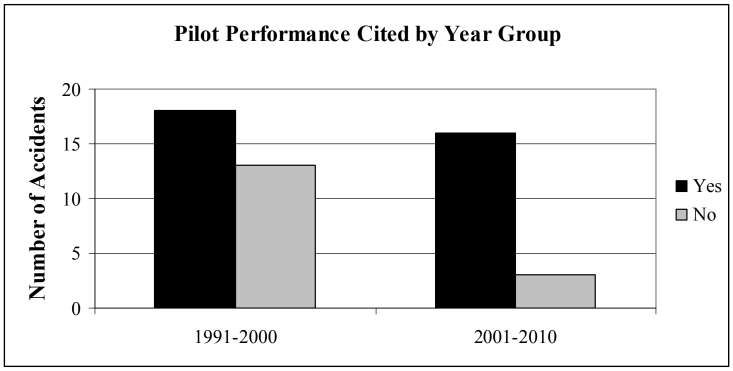
Thirty-four accidents (68%) cited pilot performance as a causal or contributing factor. One accident (2%) cited pilot performance as a contributing factor but not a cause. Sixteen accidents (32%) cited pilot performance as cause but not a contributing factor. Seventeen accidents (34%) cited pilot performance as both a causal and contributing factor. The remaining sixteen accidents (32%) did not cite pilot performance as either a causal or contributing factor.

Figure 65



Further analysis between year groups revealed there was not a significant difference between 1991-2000 and 2001-2010 with regard to the involvement of pilot performance as a causal or contributing factor, $X^2(df = 1, N = 50) = 3.701, p = 0.054$.

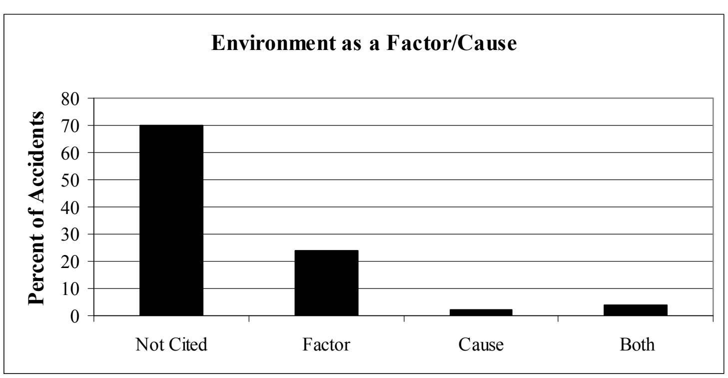
Figure 66



Environmental Factors

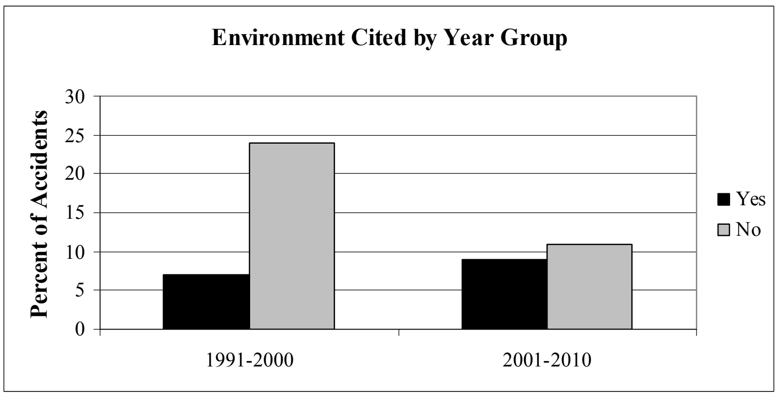
Fifteen accidents (30%) cited the environment as a causal or contributing factor. Twelve accidents (24%) cited the environment as a contributing factor but not a cause. One accident (2%) cited the environment as a cause but not a contributing factor. Two accidents (4%) cited the environment as both a causal and contributing factor. The remaining thirty-five accidents (70%) did not cite the environment as either a causal or contributing factor.

Figure 67



Further analysis between year groups revealed there was not a significant difference between 1991-2000 and 2001-2010 with regard to the involvement of the environment as a causal or contributing factor, $X^2(df = 1, N = 50) = 2.138, p = 0.144$.

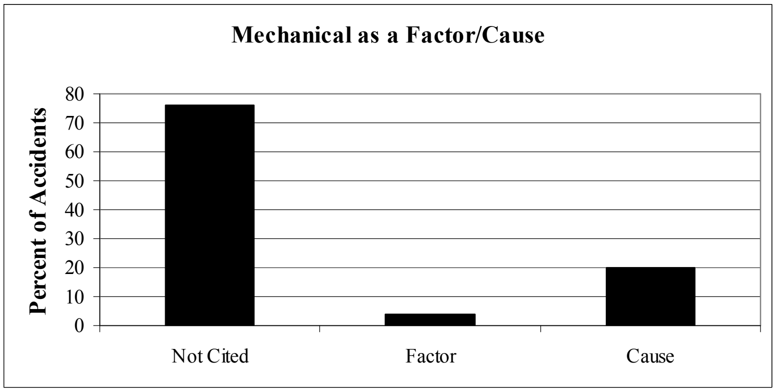
Figure 68



Mechanical Factors

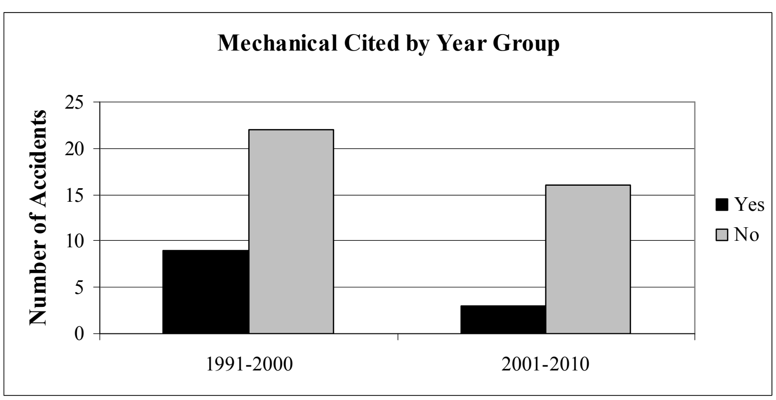
Twelve accidents (24%) cited mechanical factors as a causal or contributing factor. Two accidents (4%) cited mechanical factors as a contributing factor but not a cause. Ten accidents (20%) cited mechanical factors as a cause but not a contributing factor. Zero accidents (0%) cited mechanical factors as both a causal and contributing factor. The remaining thirty-eight accidents (76%) did not cite mechanical factors as either a causal or contributing factor.

Figure 69



Further analysis between year groups revealed there was not a significant difference between 1991-2000 and 2001-2010 with regard to the involvement of mechanical issues as a causal or contributing factor, $X^2(df = 1, N = 50) = 1.133, p = 0.287$.

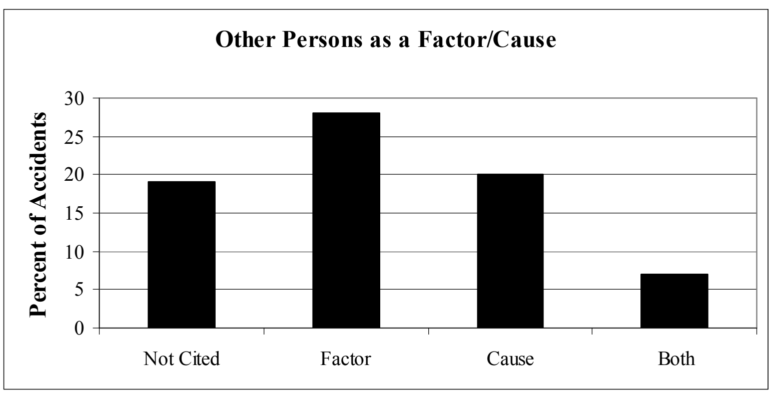
Figure 70



Other Persons

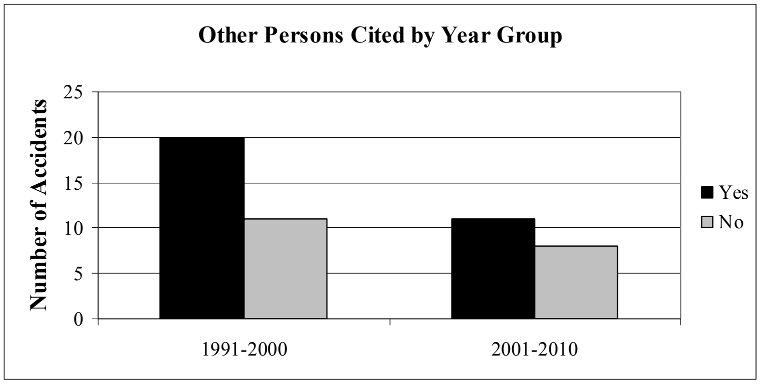
Thirty-one accidents (62%) cited other persons as a causal or contributing factor. Fourteen accidents (28%) cited other persons as a contributing factor but not a cause. Ten accidents (20%) cited other persons as a cause but not a contributing factor. Seven accidents (14%) cited other persons as both a cause and contributing factor. The remaining nineteen accidents (38%) did not cite other persons as either a causal or contributing factor.

Figure 71



Further analysis between year groups revealed there was not a significant difference between 1991-2000 and 2001-2010 with regard to the involvement of other persons as a causal or contributing factor, $X^2(df = 1, N = 50) = 0.219$, $p = 0.640$.

Figure 72



Other Persons Cited by Year Group
Number of Accidents
25
20
15
10
5
0
1991-2000
2001-2010
Yes
No

Content Analysis #2: Additional Sequence-of-Events Findings

A second analysis was performed on each of the findings listed in the sequence-of-events section of NTSB's "Brief of Accident" reports. For the purpose of this particular analysis, the researcher focused on: (1) primary non-person related findings (Aircraft/Environment); (2) primary person-related findings (Operations/Performance); (3) direct underlying events; and (4) indirect underlying events.

Each of the findings listed in the sequence-of-events section of the "Brief of Accident" reports were originally coded by NTSB investigators in accordance with the NTSB Coding Manual. While the briefs themselves were only available in narrative format, the researcher simply used the NTSB Coding Manual to recode and categorize each of the variables. Data for each of the variables was available for all 50 accidents.

Non-Person Related Findings

The NTSB reported one or more non-person related finding (environment or aircraft) in thirty-two (64%) of the accidents. Fifteen accidents (30%) cited the environment as a non-person related finding. This finding was consistent with the first content analysis. Nineteen accidents (38%) cited either an aircraft system or structure as a non-person related finding. Eighteen accidents (36%) did not involve any type of non-person related event. Snow and ice were the two most frequently reported non-person weather related events.

Person Related Findings

Forty-four accidents (88%) cited one or more person related finding as a causal or contributing factor. Thirty-four accidents (68%) cited the flight crew as a person related finding. This finding was consistent with findings of the first content analysis. The majority of primary person related findings were attributed to either: (1) aircraft handling; (2) planning and decision-making; (3) communication and information; or (4) maintenance.

Twenty-five accidents (50%) cited aircraft handling as a person related finding. Of those twenty-five accidents, four (16%) cited aircraft control as an element of aircraft handling, four (16%) cited directional control, and three accidents (12%) cited airspeed (8%, 8%, and 6% of all accidents selected in this study, respectively).

Twenty accidents (40%) cited planning and decision-making as a causal or contributing flight crew factor. Of those twenty accidents, five (25%) cited noncompliance with procedures and directives (10% of all accidents selected in this study). Noncompliance with procedures and directives was the most frequently cited element of planning and decision-making. Four accidents (20%) cited the lack of use or noncompliance with checklists as a planning and decision-making element (8% of all accidents selected in this study).

Thirteen accidents (26%) cited communication/information/ATC as a causal or contributing person related factor. Of those thirteen accidents, six (46%) were attributed to the flight crew and three (23%) were attributed to ATC personnel (12% and 6% of all accidents selected in this study, respectively). Crew/group coordination, which includes crew resource management (CRM), was reported in six (46%) of those accidents which cited communication/information/ATC (12% of all accidents selected in this study).

Eight accidents (16%) cited maintenance as a causal or contributing person related factor.

Direct Underlying Events

Direct underlying events were reported in thirty-two (64%) of the accidents selected in this study. Of those thirty-two accidents, ten (31%) cited inadequate procedures attributed to company management, the manufacturer, the FAA, or maintenance personnel (20% of all accidents selected in this study). Eight accidents (25%) cited a physiological condition (16% of all accidents selected in this study). Fatigue was the most frequently reported underlying physiological condition ($N = 7$, 22% of accidents reporting a direct underlying event and 14% of all accidents selected in this study). Inadequate flight crew training, lack of experience, or lack of familiarity with the aircraft was reported in four accidents (8% of all accidents selected in this study).

Indirect Underlying Events

Indirect underlying events were reported in twelve (24%) of the accidents selected in this study. Of those twelve accidents, five (42%) cited inadequate surveillance of operation (10% of all accidents selected in this study). Three accidents (25%) cited inadequate certification/approval, three accidents (25%) cited inadequate substantiation process, and three accidents (25%) cited insufficient standard/requirements as an indirect underlying event (6%, 6%, and 6% of all accidents selected in this study, respectively).

Due to the complexity and intricacy of the data gathered for the second content analysis, additional analysis was not performed. Additional analysis was also beyond the scope of this study.

Research Question #3: Based on the select variables, were the characteristics of pilots involved in major U.S. air carrier accidents in which pilot performance was cited as a causal or contributing factor significantly different than the characteristics of pilots involved in accidents in which pilot performance was not cited as a causal or contributing factor?

Research question #3 was addressed throughout this chapter as part of the narrative discussion as it pertained to each of the operational and pilot related variables. Table 10 and Table 11 present a summary of the findings already discussed.

Table 10 – Summary of Significant Differences (Operational Characteristics)

Variable	Significance
Season of year	.806
Period of day	.581
Time of day (24-hour clock)	.693
Light condition (dawn, daylight, dusk, night)	**.015
Light condition (daylight/night)	.117
Meteorological condition	**.011
Scheduled/non-scheduled	.468
Passenger/cargo	.785
Required flight crew	.410
Number of engines	.215
Type of engines	.925
Phase of flight (general)	**.031

** = denotes a significant difference between groups of pilots with regard to the citing/not citing of pilot performance

Table 11 – Summary of Significant Differences (Pilot Characteristics)

Variable	Significance
Crew composition (gender)	.124
Certificate held (first officer)	.551
Duration of employment (captain)	.488
Duration of employment (first officer)	.492
Total flight time (captain)	N/A
Total flight time (first officer)	**.035
Crew assignment	.280
First day of pairing (current sequence)	.923
First leg of the day	.742
First pairing together (past pairings considered)	.475
Properly qualified (captain)	.141
Properly qualified (first officer)	.488
Prior accidents/incidents/enforcements (captain)	.482
Prior accidents/incidents/enforcements (first officer)	N/A
Driver's license suspension/revocation (captain)	N/A
Driver's license suspension/revocation (first officer)	.508
Unsatisfactory flight evaluations (captain)	.106
Unsatisfactory flight evaluations (first officer)	.153

** = denotes a significant difference between groups of pilots with regard to the citing/not citing of pilot performance

CHAPTER V

CONCLUSIONS

The purpose of this study was to identify the characteristics of major U.S. air carrier accidents between 1991 and 2010 operated under 14 CFR 121. For the purpose of this study, an accident was included if the following criteria were met: the accident involved a U.S. air carrier operating under 14 CFR 121 between 1991 and 2010 and the NTSB conducted a major investigation. Major investigations were defined as investigations in which the NTSB adopted an aircraft accident report (AAR) or aircraft accident brief (AAB). Variables related to the operational characteristics of major U.S. air carrier accidents included: phase of flight; period of day; annual season; light condition; meteorological condition; type of operation; equipment type; and involvement of environmental factors, mechanical factors, and other persons. Variables related to the characteristics of pilots included: age; gender; flight experience; level of certification; duration of employment with the accident air carrier; crew assignment; crew familiarity; the involvement of pilot performance; past unsatisfactory ratings; FAA accidents, incidents, and violations; and prior driver's license suspension and revocations.

Major U.S. air carrier accidents citing pilot performance as a causal or contributing factor were the group of “cases”. Accidents not citing pilot performance as a causal or contributing factor were the group of “controls”. The two groups represented the entire population of major U.S. air carrier accidents between 1991 and 2010 operating under 14 CFR 121 and were compared with one another to determine whether any statistical differences existed between select variables. The researcher was particularly interested in determining whether a statistical difference existed between groups with regard to flight experience and level of certification, as Public Law 111-216 will require all first officers to obtain an ATP certificate and possess at least 1,500 hours of total flight time.

Conclusions

Research Question #1: What were the operational characteristics of major U.S. air carrier accidents between 1991 and 2010 based on select operational related variables?

There were 50 accidents between 1991 and 2010 which met the criteria required for inclusion in this study. Of those, thirty-one accidents (62%) occurred between 1991 and 2000 and nineteen (38%) occurred between 2001 and 2010, representing a 39% decrease in the number of major U.S. air carrier accidents in the later period. This finding supports the notion that the U.S. air carrier industry has continued on its path towards an ever safer industry.

With regard to the environment, the findings of this study indicate there was not a significant difference between those accidents involving pilot performance and those accidents not involving pilot performance with regard to season of year, period of day, and daytime/night light conditions. There was, however, a significant difference between meteorological conditions with regard to the involvement of pilot performance as a causal or contributing factor. Pilots were cited in seventeen (55%) of the thirty-one accidents which occurred during flight in VMC conditions but were cited in thirteen (89.5%) of the nineteen accidents which occurred during flight in IMC conditions. These findings suggest that pilot performance played a disproportionately greater role in the accidents which occurred during IMC conditions than they did during VMC conditions.

With regard to the different types of aircraft operations, the findings of this study indicate there was not a significant difference between those accidents involving pilot performance and those accidents not involving pilot performance with regard to scheduled, non-scheduled, passenger, or cargo services. While there was not a significant difference with regard to whether a carrier was doing-business-as another carrier during the cumulative period between1991 and 2010, there was a significant different between the 1991-2000 and 2001-2010 year groups (irrespective of the citing/not citing of pilot performance). The findings indicate there was a significant increase in the number of accidents involving air carriers who were doing business under another carrier's name during the later period. However, it is highly likely there was also an overall increase in the number of partnerships between carriers during the later period.

With regard to the types of aircraft involved in those accidents, the mean age of accident aircraft was 15.89 years old, with a standard deviation of 13.307. There was not a significant difference between those accidents citing pilot performance as a causal or contributing factor and those not citing pilot performance as a causal or contributing factor with regard to the number of flight crew required to operate the aircraft, the number of engines installed, or the type of engines.

With regard to the phases of flight in which the accidents occurred, there was a significant difference. Nineteen (38%) of the fifty accidents occurred during the takeoff and climb phases of flight. Twenty-six (52%) of the fifty accidents occurred during the approach and landing phases of flight. These four phases consume a relatively short amount of flight time, but account for a disproportionately significant percentage of accidents. Meanwhile, only five (10%) of the fifty accidents occurred during the maneuvering, cruise, and descent phases of flight. Even more interesting was that the distribution of accidents either attributed to or not attributed to pilot performance was nearly identical for the takeoff and climb phases while twelve (86%) of the fourteen accidents during approach and eleven (92%) of the twelve accidents during landing cited pilot performance as either a causal or contributing factor. These findings suggest that pilot performance played a disproportionately greater role during the approach and landing phases than during any other phase, to include the takeoff and climb phases of flight. With regard to the environmental conditions present during the various phases of flight, irrespective of the citing/not citing of pilot performance, neither meteorological conditions, season of year, period of day, nor daylight/night light conditions were found to be of significant difference.

Research Question #2: What were the characteristics of the pilots involved in major U.S. air carrier accidents between 1991 and 2010 based on select pilot related variables?

The age of captains ranged between 25 and 59 years old with a mean of 47 years and the age of first officers ranged between 24 and 57 years old with a mean of 39 years. Forty-seven (94%) of the fifty captains were male and three (6%) were female. Forty-six (92%) of the fifty first officers were male and four (8%) were female. The disproportionate number of males was most likely the result of an underrepresentation of women in aviation. As a result, forty-three (86%) of the fifty flight crews were comprised of an all male crew of pilots. Seven (14%) of the fifty crews were comprised of both a male and female pilot and none of the accidents (0%) involved an all female crew of pilots. There was not a significant difference between groups with regard to the composition of crews by gender.

All of the captains (100%) held an ATP certificate. This was expected as possession of an ATP certificate is required in order to perform pilot-in-command duties under 14 CFR 121. Twelve (24%) of the fifty first officers were commercially certificated and thirty-eight (76%) were ATP certificated. While there was not a significant difference between those accidents citing pilot performance as a causal or contributing factor and those not citing pilot performance during the cumulative period between 1991 and 2010, there was a significant difference between the 1991-2000 and 2001-2010 year groups irrespective of the citing/not citing of pilot performance. Between 1991 and 2000, only three (10%) of the thirty-one accidents involved a commercially certificated first officer. However, nine (47%) of the nineteen accidents which occurred between 2001 and 2010 involved a commercially certificated first officer. This finding suggests a significant shift in the distribution of major U.S. air carrier accidents involving commercially certificated first officers during the later period. It was unknown what the actual employment distribution was among ATP and commercially certificated first officers who were involved in 14 CFR 121 air carrier operations during either period. However, this finding may be of particular interest with regard to the certification requirements imposed by Public Law 111-216.

The accident captains' duration of employment ranged from less than one month to over 30 years of employment with the accident air carrier, with a mean of 12.2 years and the accident first officers' duration of employment ranged from less than one month to over 32 years of employment with the accident air carrier, with a mean of 5.4 years. Only one (2%) of captains had less than one year of employment with the accident air carrier. However, thirteen (26.5%) of the fifty first officers had less than one year of employment with the accident air carrier. There was not a significant difference between groups with regard to duration of employment and citing/not citing of pilot performance.

The least experienced captain had 2,500 hours of total flight time and the most experienced captain had 25,000 hours of total flight time, with a mean of 11,994 hours. The least experienced first officer had 1,096 hours of total flight time and the most experienced first officer had 17,734 hours of total flight time, with a mean of 6,838 hours. Only two first officers (4%) had less than 1,500 hours of total flight time and neither were involved in an accident citing pilot performance as a causal or contributing factor. The findings suggest that first officers with less than 1,500 hours of total flight time did not contribute to any major U.S. air carrier accidents between 1991 and 2010. This finding may be of particular interest with regard to the total flight time requirements imposed by Public Law 111-216. It is, however, important to point out that it is highly likely there were proportionately very few first officers with less than 1,500 hours of total time who were employed by U.S. air carriers operating under 14 CFR 121 during this period.

The least experienced captain had 111 hours in make/model and the most experienced captain had 16,000 hours in make/model, with a mean of 3,113 hours. The least experienced first officer had 20 hours in make/model and the most experienced first officer had 8,060 hours in make/model, with a mean of 1,683 hours. The least experienced captain had 26 hours as a captain in the accident aircraft make/model and the most experienced captain had 16,000 hours as a captain in the accident aircraft make/model, with a mean of 2,048 hours. The least experienced first officer had 20 hours as a first officer in the accident aircraft make/model and the most experienced first officer had 8,060 hours as a first officer in the accident aircraft make/model, with a mean of 1,503 hours.

With regard to flying assignment, the captain was performing flying duties and the first officer was performing monitoring duties in twenty-two (45%) of the accidents. Twenty-five (54%) of the forty-six accidents for which data was available occurred during the first day of crew pairing on the current pairing/sequence and twenty-nine (59%) of the forty-nine accidents for which data was available occurred during the first leg of the day. Of the twenty-four accidents for which data was available, thirteen (54%) of the accident crews had been paired together in the past on at least one other pairing/sequence other than the accident pairing/sequence.

With regard to causal and contributing factors, thirty-four (68%) of the fifty accidents included in this study cited pilot performance as a causal or contributing factor. Fifteen (30%) of the accidents cited the environment as a causal or contributing factor. Twelve (24%) of the accidents cited mechanical factors as a causal or contributing factor and thirty-one (62%) cited other persons as a causal or contributing factor. A comparison between the 1991-2000 and 2001-2010 year groups indicated there was not a significant difference between groups with regard to the involvement of pilot performance, environmental factors, mechanical factors, or other persons.

Conclusions Relevant to Public Law 111-216

The Airline Safety and Federal Aviation Extension Act of 2010 will require all flight crewmembers, to include first officers, serving in 14 CFR 121 U.S. air carrier operations to hold an ATP certificate and possess at least 1,500 hours of total flight experience. There is, however, a provision within the Act which authorizes the FAA to grant credit for specific academic training courses toward the 1,500 total flight hour requirement if a determination is made "…that allowing a pilot to take specific academic training courses will enhance safety more than requiring the pilot to fully comply with the flight hours requirement" (Government Printing Office, 2010). The FAA previously sought comment on whether to permit "...academic credit in lieu of required flight hours or experience" (FAA, 2010).

Of the 50 accidents investigated in this study, all fifty captains (100%) had at least 2,500 hours of total flight time and forty-eight first officers (96%) had at least 2,000 hours of total flight time at the time of the accident. There were only two first officers (4%) with less than 1,500 hours of total time, having 1,096 and 1,420 hours respectively, and neither were involved in an accident citing pilot performance as a causal or contributing factor. These findings do not support the notion that a 1,500 hour total flight time requirement will contribute to the safety of 14 CFR 121 air carrier operations, as neither (0%) of the first officers with less than 1,500 hours of total flight time were involved in a major U.S. air carrier accident which cited pilot performance as a causal or contributing factor.

There was, however, a disproportionate increase between 1991-2000 and 2001-2010 in the distribution of major U.S. air carrier accidents involving commercially certificated first officers, irrespective of the citing/not citing of pilot performance, $X^2(df = 1, N = 50) = 9.175$, $p = 0.002$. Between 1991 and 2000, twenty-eight (90%) of the thirty-one first officers held an ATP certificate while only three (10%) held a commercial certificate. Between 2001 and 2010, ten (53%) of the nineteen first officers held an ATP certificate and nine (47%) held a commercial certificate. Of the nine commercially certificated first officers involved in an accident between 2001 and 2010, seven (78%) were involved in an accident citing pilot performance as a causal or contributing factor. While an ATP certification requirement for first officers will certainly eliminate the possibility of any future air carrier accidents involving commercially certified first officers, it is not possible to predict whether such a change will contribute to the enhancement of safety for 14 CFR 121 air carrier operations. It is possible there will simply be a redistribution of the number of accidents involving ATP certificated first officers.

CHAPTER VI

RECOMMENDATIONS

Recommendation #1:

Administrators and regulators need to proceed cautiously with the way in which changes to the existing regulations are written into the new regulations. Current regulations allow a commercially certificated first officer involved in 14 CFR 121 operations to perform second-in-command duties but require the captain, or pilot-in-command, to possess at least an ATP certificate with 1,500 hours of total flight time. If the decision is made to grant academic credit in lieu of required flight hours or experience for the issuance of an ATP certificate, there needs to be some type of mechanism in place to ensure it does not create an unintended automatic reduction to the current pilot-in-command requirements.

Recommendation #2:

The FAA also sought comment as to whether there should still be a prescribed minimum number of flight hours "...for a commercial pilot to serve as SIC in Part 121 operations...If the FAA were to credit academic study" (FAA, 2010). This study was limited to only those accidents which occurred while operating under 14 CFR 121 and all but two of the pilots had over 2,000 hours of total flight time. As a result, this study does not provide the quantitative data necessary to make a recommendation with regard to what constitutes an appropriate reduction in flight hours. What can be stated is that 100% of the captains and 96% of the first officers included in this study had well over 1,500 hours of total flight time at the time of their accident. However, there are a significant number of aircraft accident reports (AAR) and aircraft accident briefs (AAB) for accidents involving operations conducted under 14 CFR 91 and 14 CFR 135. Part 91 and Part 135 operations are often a bridge between the employment opportunities which are available early in one's career and the air carrier operations available to the seasoned pilot. Perhaps the data contained within those accident reports would shed additional light on the distribution of accidents with regard to total flight time at the lower and intermediate flight levels. Such a study might help to identify the levels of exposed risk for pilots with less than 1,500 hours of total flight time and aid in recommendations as to what constitutes an appropriate or acceptable reduction in flight time without a compromise to safety.

Recommendation #3:

There is little to no quantitative or qualitative data to support the notion that graduates of a collegiate aviation program or other academic course of study are any more or any less safe than those pilots who have not been exposed to such an academic course of study. It might be of benefit to better understand the academic and experiential backgrounds of those pilots involved and those not involved in one or more aircraft accidents. Perhaps data such as this would help to identify whether exposure to certain academic courses, training, or other such preparation correlates to a reduction in the likelihood of being involved in an accident.

Recommendation #4:

It is unclear what impact the regulations which stem from Public Law 111-216 will have on the pilot supply pipeline, collegiate aviation institutions, regional air carriers, major air carriers, and/or other sectors of the aviation industry. However, there have been concerns that such changes might have one or more unintended negative consequences. Therefore, it is recommended that such data be tracked and monitored to ensure the cost of safety does not come at too great an economic cost, costs which might otherwise degrade other efficiencies already present in the current system.

Recommendation #5:

Finally, administrators, regulators, and researchers need to ensure there is a way to track and monitor the outcomes of any new regulations which alter the existing certification and flight time requirements. It is important that such regulations, which will likely impact a number of pilots and other parties, actually yield a benefit to safety. Otherwise, they come only at a cost. This will ensure any such regulatory changes are justified and meaningful.

REFERENCES

AABI. (2007). *Pilot supply pipeline panel discussion.* Retrieved from http://www.aabi.aero/News&Calendar/Pilot%20Pipeline%20Discussion%20Notes.pdf

AABI. (2012). *What is the Aviation Accreditation Board International?* Retrieved from http://www.aabi.aero/faq1.html

AvScholars. (n.d.). *Careers in aviation.* Retrieved from http://www.avscholars.com/Aviation_Careers/pilots-airline-pilots-commuter-pilots.htm

Bureau of Air Safety Investigation. (1996). *Human factors in fatal aircraft accidents.* Retrieved from http://www.narcap.org/articles/HumanFactorsinFatalAircraft accidents.pdf

Bureau of Labor Statistics. (2011). *Career guide to industries, 2010-11 Edition: Air transportation.* Retrieved from http://www.bls.gov/oco/cg/cgs016.htm

Bureau of Labor Statistics. (2011). *Occupational outlook handbook, 2010-11 Edition: Aircraft pilots and flight engineers.* Retrieved from http://www.bls.gov/oco/ocos107.htm#outlook

Bureau of Transportation Statistics. (2012). *Introduction.* Retrieved from http://www.bts.gov/publications/significant_accomplishments/2009/html/introduction.html

Bureau of Transportation Statistics. (2011). *Table 2-9: U.S. air carrier safety data.* Retrieved from http://www.bts.gov/publications/national_transportation _statistics/html/table_02_09.html

Bureau of Transportation Statistics. (2011). *Table 2-10: U.S. commuter air carrier safety data.* Retrieved from http://www.bts.gov/publications/national_transportation_ statistics/html/table_02_10.html

Bureau of Transportation Statistics. (n.d.). *The dynamics of aircraft degradation and mechanical failure.* Retrieved from http://www.bts.gov/publications/journal_ of_transportation_and_statistics/volume_08_number_01/html/paper_01/ index.html

Bureau of Transportation Statistics. (2011). *U.S. air carrier traffic statistics: Domestic passenger – revenue passenger enplanements (Jan 2010 – Dec 2010).* Retrieved from http://www.bts.gov/xml/air_traffic/src/datadisp.xml

Bureau of Transportation Statistics. (2011). *U.S. air carrier traffic statistics through March 2011.* Retrieved from http://www.bts.gov/xml/air_traffic/src/index. xml#CustomizeTable

CBS News. (2009). *Flight 1549: A routine takeoff turns ugly.* Retrieved from http://www.cbsnews.com/stories/2009/02/08/60minutes/main4783580.shtml

Chesterfield, B. (2002). *James Reason's model.* Unpublished manuscript. Oklahoma City, OK: Southeastern Oklahoma State University.

Code of Federal Regulations. (2011). *Part 121 – operating requirements: Domestic, flag, and supplemental operations.* Retrieved from http://ecfr.gpoaccess.gov/cgi/t/text/ text-idx?c=ecfr&tpl=/ecfrbrowse/Title14/14cfr121_main_02.tpl

Code of Federal Regulations. (2011). *Part 135 – operating requirements: Commuter and on demand operations and rules governing persons on board such aircraft.* Retrieved from http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&tpl=/ecfrbrowse/Title14/14cfr135_main_02.tpl

Colgan Air. (2008). *Our company: History of Colgan Air.* Retrieved from http://www.colganair.com/site/our_company/index.php

Colorado State University. (2011). *Reliability.* Retrieved from http://writing.colostate.edu/guides/research/relval/pop2a.cfm

Creswell, J. (2008). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research.* Upper Saddle Creek, NJ: Pearson Education.

Dismukes, R., Berman, B., & Loukopoulos, L. (2007). *The limits of expertise: Rethinking pilot error and the causes of airline accidents.* Burlington, VT: Ashgate Publishing Company.

FAA. (2011). *2001 estimated airmen certificates held.* Retrieved from http://www.faa.gov/data_research/aviation_data_statistics/civil_airmen_statistics/2001/media/air1-01.xls

FAA. (2011). *2010 estimated airmen certificates held.* Retrieved from http://www.faa.gov/data_research/aviation_data_statistics/civil_airmen_statistics/2010/media/Air01-2010.xls

FAA. (1998). *Appendix G: FAA order 8040.4*. Retrieved from http://www.faa.gov/library/library/manuals/aviation/risk_management/ss_handbook/media/app_g_1200.pdf

FAA. (2012). *Aviation accident/incident database.* Retrieved from http://www.asias .faa.gov/portal/page/portal/ASIAS_PAGES/LEARN_ABOUT/AIDS_LA.html

FAA. (2000). *Chapter 15: Operational risk management (ORM).* Retrieved from http:// www.faa.gov/library/manuals/aviation/risk_management/ss_handbook/media/ chap15_1200.pdf

FAA. (2007). *FAA statement on pilot age retirement.* Retrieved from http://www.faa. gov/news/press_releases/news_story.cfm?newsId=10072

FAA. (2011). *Lessons learned from transport airplane accidents.* Retrieved from http://accidents-ll.faa.gov/

FAA. (2004). *Mechanical systems: FAA's aging mechanical systems research program.* Retrieved from http://airportaircraftsafetyrd.tc.faa.gov/Programs/AgingAircraft/ agingsystems/mechanicalsystems/index.htm

FAA. (2010). *Mission.* Retrieved from http://www.faa.gov/about/mission/

FAA. (2010). *New pilot certification requirements for air carrier operations.* Retrieved from http://www.faa.gov/regulations_policies/rulemaking/recently_published/ media/2010-02643_PI.pdf

FAA. (2010). *New pilot certification requirements for air carrier operations.* Retrieved from http://edocket.access.gpo.gov/2010/pdf/2010-2677.pdf

FAA. (n.d.). *NTSB weather related accident study: 1994 – 2003.* Retrieved from http://www.asias.faa.gov/aviation_studies/weather_study/summary.html

FAA. (2000). *FAA system safety handbook.* Retrieved from http://www.faa.gov/library/ manuals/aviation/risk_management/ss_handbook/

FAA. (2011). *Title 14: Aeronautics and space: Part 61 – Certification: Pilots, flight instructors, and ground instructors.* Retrieved from http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=167b2b3414e46c7e4380c24fd156afaf&rgn=div6&view=text&node=14:2.0.1.1.2.6&idno=14

FAA. (2011). *Wildlife strikes to civil aircraft in the United States: 1990 – 2009.* Retrieved from http://wildlife-mitigation.tc.faa.gov/wildlife/downloads/BASH90-09.pdf

Flight Safety Foundation. (1996). *Military Boeing 707 strikes birds after liftoff; Damage to engines no. 1 and no. 2 result in loss of power and impact with terrain.* Retrieved from http://flightsafety.org/ap/ap_nov96.pdf

Food and Drug Administration. (1997). *Hazard analysis and critical control point principles and application guidelines.* Retrieved from http://www.fda.gov/food/foodsafety/HazardAnalysisCriticalControlPointsHAACP/ucm114868.htm

Government of Canada. (2005). *Risk management - policies and publications.* Retrieved from http://www.tbs-sct.gc.ca/pubs_pol/dcgpubs/riskmanagement/siglist-eng.asp

Government Printing Office. (2010). *H.R. 5900: Airline safety and federal aviation administration extension act of 2010.* Retrieved from http://www.gpo.gov/fdsys/pkg/BILLS-111hr5900enr/pdf/BILLS-111hr5900enr.pdf

Government Printing Office. (2010). *New pilot certification requirements for air carrier operations.* Retrieved from http://frwebgate3.access.gpo.gov/cgi-bin/PDFgate.cgi?WAISdocID=uqp5Ug/1/2/0&WAISaction=retrieve

GPO Access. (2012). *Code of federal regulations (CFR): Main page.* Retrieved from http://www.gpoaccess.gov/cfr/

Graziano, A., & Raulin, M. (2007). *Research methods: A process of inquiry.* Boston, MA: Pearson.

Haiss, T., Chapman, Y., & Wells, S. (2010). *A grey system study of air accidents from the perspective of human factors.* Retrieved from http://icma-web.org.uk/download/5.3.format.pdf

IATA. (2012). *About us.* Retrieved from http://www.iata.org/about/Pages/index.aspx

ICAO. (2011). *Phase of flight definitions and usage notes.* Retrieved from http:www.mexico.icao.int/icaoaspa2010/ECCAIRS/Miscellaneous/CICTT/PhaseofFlightDefinitions.pdf

Kaur, K. (2007). *IATA warns of severe pilot shortage.* Retrieved from http://www.asiaone.com/Travel/News/Story/A1Story20071130-39122.html

Kirby, M. (2007). *IATA calls for pilot training re-think to address shortage.* Retrieved from http://www.flightglobal.com/articles/2007/11/30/219962/iata-calls-for-pilot-training-re-think-to-address-shortage.html

McBurney, D., & White, T. (2007). *Research methods.* Belmont, CA: Thompson Higher Education.

NTSB. (1994). *A review of flightcrew-involved, major accidents of U.S. air carriers, 1978 through 1990.* Retrieved from http://libraryonline.erau.edu/online-full-text/ntsb/safety-studies/SS94-01.pdf

NTSB. (2006). *AAB-06/02*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (2002). *AAB-02/04*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (2001). *AAB-01/01*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (2011). *AAR-11/01*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (2010). *AAR-10/04*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (2010). *AAR-10/03*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (2010). *AAR-10/01*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (2009). *AAR-09/03*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (2008). *AAR-08/02*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (2008). *AAR-08/01*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (2007). *AAR-07/06*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (2007). *AAR-07/05*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (2007). *AAR-07/04*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (2006). *AAR-06/03*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (2006). *AAR-06/01*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (2005). *AAR-05/02*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (2005). *AAR-05/01*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (2004). *AAR-04/04*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (2004). *AAR-04/02*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (2004). *AAR-04/01*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (2003). *AAR-03/02*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (2002). *AAR-02/01*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (2001). *AAR-01/02*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (2001). *AAR-01/01*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (2000). *AAR-00/03*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (2000). *AAR-00/02*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (1999). *AAR-99/01*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (1998). *AAR-98/03*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (1998). *AAR-98/02*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (1998). *AAR-98/01*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (1997). *AAR-97/06*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (1997). *AAR-97/03*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (1997). *AAR-97/01*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (1996). *AAR-96/07*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (1996). *AAR-96/05*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (1996). *AAR-96/04*. Retrieved from http://library.erau.edu/worldwide/find/online -fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (1996). *AAR-96/03*. Retrieved from http://library.erau.edu/worldwide/find/online -fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (1996). *AAR-96/01*. Retrieved from http://library.erau.edu/worldwide/find/online -fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (1995). *AAR-95/05*. Retrieved from http://library.erau.edu/worldwide/find/online -fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (1995). *AAR-95/03*. Retrieved from http://library.erau.edu/worldwide/find/online -fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (1995). *AAR-95/01*. Retrieved from http://library.erau.edu/worldwide/find/online -fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (1994). *AAR-94/06*. Retrieved from http://library.erau.edu/worldwide/find/online -fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (1994). *AAR-94/04*. Retrieved from http://library.erau.edu/worldwide/find/online -fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (1994). *AAR-94/01*. Retrieved from http://library.erau.edu/worldwide/find/online -fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (1993). *AAR-93/04*. Retrieved from http://library.erau.edu/worldwide/find/online -fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (1993). *AAR-93/02*. Retrieved from http://library.erau.edu/worldwide/find/online -fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (1992). *AAR-92/05*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (1991). *AAR-91/09*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (1991). *AAR-91/08*. Retrieved from http://library.erau.edu/worldwide/find/online-fulltext/ntsb/aircraft-accident-reports.htm

NTSB. (2012). *About the national transportation safety board.* Retrieve from http://www.ntsb.gov/about/index.html

NTSB. (1990). *Aircraft accident report: United Airlines flight 232.* Retrieved from http://www.airdisaster.com/reports/ntsb/AAR90-06.pdf

NTSB. (2012). *Aviation accident database & synopses.* (Access to all 50 factual and probable cause reports) Retrieved from http://www.ntsb.gov/aviationquery/index.aspx

NTSB. (2011). *History of the National Transportation Safety Board.* Retrieved from http://www.ntsb.gov/about/history.html

NTSB. (2010). *Loss of control on approach: Colgan Air, Inc. operating as Continental Connection Flight 3407.* Retrieved from http://libraryonline.erau.edu/online-full-text/ntsb/aircraft-accident-reports/AAR10-01.pdf

NTSB. (2005). *Risk factors associated with weather-related general aviation accidents.* Retrieved from http://libraryonline.erau.edu/online-full-text/ntsb/safety-studies/SS05-01.pdf

NTSB. (2011). *The investigative process at NTSB.* Retrieved from http://www.ntsb.gov/investigations/process.html

OSU. (2008). *Handbook for the protection of human subject research.* Retrieved from http://compliance.vpr.okstate.edu/irb/documents/IRB_Guide.pdf

Price, H. (2007). *FAA forecasts steady growth in air travel demand.* Retrieved from http://www.faa.gov/news/press_releases/news_story.cfm?newsId=8358

Parental Drug Administration (PDA). (n.d.). *An incomplete history of risk management.* Retrieved from http://www.quantil.com.co/qt/images/docs/Risk_Assessment_Ch01.pdf

Phillips, W. (n.d.). *Ab initio training.* Retrieved from http://www.aopa.org/asf/publications/inst_reports2.cfm?article=132

Reason, J. (2008). *The human contribution.* Farnham, England: Ashgate Publishing Company.

Reason, J. (1990). *Human error.* New York, NY: Cambridge University Press.

Siegle, D. (2011). *ANOVA, regression, and chi-square.* Retrieved from http://www.gifted.uconn.edu/siegle/research/OtherStats/SampleStats.htm

Spector, P. (1981). *Research designs: Quantitative applications in the social sciences.* Newbury Park, CA: SAGE Publications, Inc.

The White House. (2010). *Statement by the Press Secretary on H.R. 5900.* Retrieved July from http://www.whitehouse.gov/the-press-office/statement-press-secretary-hr-5900

Trochim, W. (2006). *Descriptive statistics.* Retrieved from http://www.socialresearchmethods.net/kb/statdesc.php

Trochim, W. (2006). *Inferential statistics.* Retrieved from http://www.socialresearchmethods.net/kb/statinf.php

Transport Canada. (2011). *Sustainable development strategy 2001-03.* Retrieved from http://www.tc.gc.ca/eng/policy/acs-sd-strategy0103-glossary-675.htm

Travel Blackboard. (2008). *IATA partners with Flight Safety Foundation to tackle pilot shortage..* Retrieved from http://www.etravelblackboard.com/showarticle.asp?id=74962

Wiegmann, D., & Shappell, S. (2003). *A human error approach to aviation accident analysis: The human factors analysis and classification system.* Burlington, VT: Ashgate Publishing Company.

APPENDICES

APPENDIX A

CONSENT TO REPRODUCE FIGURE

Cambridge University Press - Reprint Permission - Kevin Boss (dissertation)

Marc Anderson manderson@cambridge.org
to me

Cambridge University Press
Publication Permission

March 25, 2012

Kevin Boss
Oklahoma State University
765-430-1166
kevinkb@ostatemail.okstate.edu

Reference

Human Error
James Reason
Hardback ISBN 9780521306690
Paperback ISBN 9780521314190
Selection: Figure 7.5, p. 202

Reprint Description

Title: Characteristics of Major U.S. Air Carrier Accidents Between 1991 and 2010, by Kevin Boss
Format: dissertation
Institution: Oklahoma State University

Rights/Acknowledgement

Permission is granted for nonexclusive rights in the English language to reprint one figure as described above. This permission requires full acknowledgement:

Human Error, by James Reason
Copyright © 1990 Cambridge University Press. Reprinted with permission.

This permission is also subject to the following:

-- You must must forward to Cambridge University Press all inquiries and reprint/reproduction requests that you may receive involving the material published by Cambridge University Press.

Sincerely,

____

Marc P. Anderson
Rights and Permissions Manager
Cambridge University Press
32 Avenue of the Americas
New York, N.Y. 10013-2473

tel.: 212-924-3900; 212-337-5048 (direct)
email: manderson@cambridge.org

APPENDIX B

ACCIDENT SELECTION DATA

NTSB Report/Brief	NTSB ID	Event Date	Public Use	Part 91	Part 135	Part 129	Part 121	Domestic	International	Selected Case
AAR-11/05	WPR09MA159	22 Mar 09		X						
AAR-11/04	CEN09PA348	9 Jun 09	X							
AAR-11/03	ANC10MA068	9 Aug 10		X				X		
AAR-11/02	CEN09MA142	27 Jan 09					X	X		X
AAR-11/01	DCA08MA085	31 Jul 08			X			X		
AAR-10/06	LAX08PA259	5 Aug 08	X							
AAR-10/05	ERA09MA447B	8 Aug 09			X			X		
AAR-10/04	DCA09MA021	20 Dec 08					X	X		X
AAR-10/03	DCA09MA026	15 Jan 09					X	X		X
AAR-10/02	DCA08MA098	19 Sep 08			X			X		
AAR-10/01	DCA09MA027	12 Feb 09					X	X		X
AAR-09/07	MIA08MA203	27 Sep 08	X							
AAR-09/06	CHI07MA160	4 Jun 07			X			X		
AAR-09/05	DFW08MA076	4 Mar 08		X						
AAR-09/04	DCA08MA076	28 Jun 08	Ground fire prior to engine start				X	X		
AAR-09/03	DCA07MA310	28 Sep 07					X	X		X
AAR-09/02	LAX07MA231	27 Jul 07		X						
AAR-09/01	NYC07MA162	10 Jul 07		X						
AAR-08/03	CHI06FA210	29 Jul 06		X						
AAR-08/02	DCA07FA037	12 Apr 07					X	X		X
AAR-08/01	DCA07MA072	18 Feb 07					X	X		X
AAR-07/07	DCA06MA022	7 Feb 06					X	X		X
AAR-07/06	DCA06MA009	8 Dec 05					X	X		X
AAR-07/05	DCA06MA064	27 Aug 06					X	X		X
AAR-07/04	DCA06MA010	19 Dec 05					X		X	X
AAR-07/03	LAX04FA329	24 Sep 04		X						
AAR-07/02	DCA05MA037	16 Feb 05		X						
AAR-07/01	DCA05MA003	14 Oct 04		X						
AAB-07/04	NYC05MA039	10 Jan 05		X						
AAB-07/03	LAX03MA292	20 Sep 03			X					
AAB-07/02	DCA07MA003	11 Oct 06		X						
AAB-07/01	SEA05MA199	23 Sep 05			X					
AAR-06/04	DCA05MA031	2 Feb 05			X			X		
AAR-06/03	DCA04MA068	13 Aug 04					X	X		X

NTSB Report/Brief	NTSB ID	Event Date	Public Use	Part 91	Part 135	Part 129	Part 121	Domestic	International	Selected Case
AAR-06/02	DCA04MA030	23 Mar 04			X				X	
AAR-06/01	DCA05MA004	19 Oct 04					X	X		X
AAB-06/07	IAD05FA023	27 Nov 04			X					
AAB-06/06	DCA05MA011	22 Nov 04		X						
AAB-06/05	LAX05FA015	24 Oct 04		X						
AAB-06/04	LAX04FA075	23 Dec 03		X						
AAB-06/03	DEN05MA029	28 Nov 04			X					
AAB-06/02	FTW03MA160	24 May 03					X	X		X
AAB-06/01	IAD05MA006	24 Oct 04		X						
AAR-05/02	DCA04MA045	9 May 04					X	X		X
AAR-05/01	DCA04MA011	18 Dec 03					X	X		X
AAR-04/04	DCA02MA001	12 Nov 01					X		X	X
AAR-04/03	MIA03FA141	13 Jul 03			X				X	
AAR-04/02	DCA02MA054	26 Jul 02					X	X		X
AAR-04/01	DCA03MA022	8 Jan 03					X	X		X
AAB-04/02	LAX01MA272	10 Aug 01			X					
AAB-04/01	CHI01MA006	10 Oct 00		X						
AAR-03/03	DCA03MA008	25 Oct 02			X			X		
AAR-03/02	DCA00MA026	16 Feb 00					X	X		X
AAR-03/01	DCA01MA017	27 Jan 01		X						
AAR-02/01	DCA00MA023	31 Jan 00					X		X	X
AAB-02/06	LAX99MA251	13 Jul 99		X						
AAB-02/05	DCA00MA052	21 May 00			X					
AAB-02/04	DCA00MA030	5 Mar 00					X	X		X
AAB-02/03	DCA01MA034	29 Mar 01			X					
AAB-02/02	CHI01MA011	16 Oct 00		X						
AAB-02/01	DCA00MA006	31 Oct 99				X			X	
AAR-01/02	DCA99MA060	1 Jun 99					X	X		X
AAR-01/01	DCA91MA023	3 Mar 91					X	X		X
AAB-01/02	DCA99MA088	25 Sep 99			X					
AAB-01/01	DCA98MA023	9 Feb 98					X	X		X
AAR-00/03	DCA96MA070	17 Jul 96					X		X	X
AAR-00/02	DCA97MA055	31 Jul 97					X	X		X
AAR-00/01	DCA97MA058	6 Aug 97				X			X	

NTSB Report/Brief	NTSB ID	Event Date	Public Use	Part 91	Part 135	Part 129	Part 121	Domestic	International	Selected Case
AAB-00/01	DCA00MA005	25 Oct 99			X					
AAR-99/01	DCA94MA076	8 Sep 94					X	X		X
AAR-98/04	DCA97MA017	9 Jan 97			X			X		
AAR-98/03	DCA96MA079	5 Sep 96					X	X		X
AAR-98/02	DCA97MA059	7 Aug 97					X		X	X
AAR-98/01	DCA96MA068	6 Jul 96					X	X		X
AAR-97/06	DCA96MA054	11 May 96					X	X		X
AAR-97/05	DCA97MA016	22 Dec 96		X				X		
AAR-97/04	DCA97MA009A	19 Nov 96			X			X		
AAR-97/04	DCA97MA009B	19 Nov 96		X						
AAR-97/03	NYC97MA005	19 Oct 96					X	X		X
AAR-97/02	SEA96MA079	11 Apr 96		X						
AAR-97/01	FTW96FA118	19 Feb 96					X	X		X
AAR-96/07	MIA96FA059	7 Jan 96					X	X		X
AAR-96/06	DCA95MA054	21 Aug 95			X			X		
AAR-96/05	DCA96MA008	12 Nov 95					X	X		X
AAR-96/04	DCA96MA029	20 Dec 95					X	X		X
AAR-96/03	ATL95MA106	8 Jun 95					X	X		X
AAR-96/02	Volume II of AAR-96/01: Bureau Enquetes-Accidents response									
AAR-96/01	DCA95MA001	31 Oct 94					X	X		X
AAR-95/07	DCA95MA006	13 Dec 94			X			X		
AAR-95/06	DCA95MA020	16 Feb 95		X				X		
AAR-95/05	CHI95MA044A	22 Nov 94					X	X		X
AAR-95/04	DCA95MA007	14 Dec 94	X							
AAR-95/03	DCA94MA065	2 Jul 94					X	X		X
AAR-95/02	DCA94MA061	18 Jun 94				X			X	
AAR-95/01	DCA94MA038	2 Mar 94					X	X		X
AAR-94/08	DCA94MA053	27 Apr 94			X			X		
AAR-94/07	DCA94MA027	7 Jan 94			X			X		
AAR-94/06	DCA94MA033	1 Feb 94					X	X		X
AAR-94/05	DCA94MA022	1 Dec 93			X			X		
AAR-94/04	DCA93RA060	18 Aug 93					X		X	X
AAR-94/03	DCA94GA010	26 Oct 93		X						
AAR-94/02	PB94-910403	7 Dec 92				X			X	

NTSB Report/Brief	NTSB ID	Event Date	Public Use	Part 91	Part 135	Part 129	Part 121	Domestic	International	Selected Case
AAR-94/01	DCA93MA040	14 Apr 93					X	X		X
AAR-93/08	DCA93GA042	19 Apr 93	X							
AAR-93/07	DCA93MA037	6 Apr 93				X			X	
AAR-93/06	DCA93MA033	31 Mar 93				X		X		
AAR-93/05	DCA92MA049B	11 Sep 92		X						
AAR-93/05	DCA92MA049A	11 Sep 92		X						
AAR-93/04	DCA92MA044	30 Jul 92					X	X		X
AAR-93/03	ATL92MA118	8 Jun 92			X			X		
AAR-93/02	DCA92MA025	22 Mar 92					X	X		X
AAR-93/01	LAX92MA184	22 Apr 92			X			X		
AAR-92/06	Revised by AAR-01/01									
AAR-92/05	DCA92MA022	15 Feb 92					X	X		X
AAR-92/04	DCA91MA052	11 Sep 91			X			X		
AAR-92/03	DCA91MA033	5 Apr 91			X			X		
AAR-92/02	Supersedes AAR-90/01 (Accident occurred 24 Feb 89)									
AAR-92/01	DCA91MA042	10 Jul 91			X			X		
AAR-91/09	DCA91MA021	17 Feb 91					X	X		X
AAR-91/08	DCA91MA018A	1 Feb 91					X	X		X
AAR-91/07	Fuel farm fire (occurred 25 Nov 90)									
AAR-91/06	DCA90MA011	26 Dec 89			X			X		
AAR-91/05	DCA91MA010B	3 Dec 90					X	X		
AAR-91/05	DCA91MA010A	3 Dec 90					X	X		
AAR-91/04	DCA90MA019	25 Jan 90				X			X	
AAR-91/03	DCA90MA017B	18 Jan 90					X	X		
AAR-91/03	DCA90MA017A	18 Jan 90		X						
AAR-91/02	DCA90MA030	2 Jun 90					X	X		
AAR-91/01	DCA89MA076	27 Sep 89			X			X		

APPENDIX C

ENVIRONMENTAL DATA

NTSB Report	NTSB ID	City	State	Event Date	Season	Time	Period of Day	Light Condition	IMC/VMC
AAR-11/02	CEN09MA142	Lubbock	TX	27 Jan 09	Winter	0437 CST	Overnight	Night/Dark	IMC
AAR-10/04	DCA09MA021	Denver	CO	20 Dec 08	Autumn	1818 MST	Afternoon-Evening	Night/Dark	VMC
AAR-10/03	DCA09MA026	Weehawken	NJ	15 Jan 09	Winter	1527 EST	Afternoon-Evening	Daylight	VMC
AAR-10/01	DCA09MA027	Clarence Center	NY	12 Feb 09	Winter	2217 EST	Overnight	Night	VMC
AAR-09/03	DCA07MA310	St Louis	MO	28 Sep 07	Autumn	1313 CDT	Morning-Midday	Daylight	VMC
AAR-08/02	DCA07FA037	Traverse City	MI	12 Apr 07	Spring	0043 EDT	Overnight	Night	IMC
AAR-08/01	DCA07MA072	Cleveland	OH	18 Feb 07	Winter	1506 EST	Afternoon-Evening	Daylight	IMC
AAR-07/07	DCA06MA022	Philadelphia	PA	7 Feb 06	Winter	2359 EST	Overnight	Night	VMC
AAR-07/06	DCA06MA009	Chicago	IL	8 Dec 05	Autumn	1914 CST	Afternoon-Evening	Night	IMC
AAR-07/05	DCA06MA064	Lexington	KY	27 Aug 06	Summer	0607 EDT	Morning-Midday	Night/Dark	VMC
AAR-07/04	DCA06MA010	Miami	FL	19 Dec 05	Autumn	1439 EST	Afternoon-Evening	Daylight	VMC
AAR-06/03	DCA04MA068	Florence	KY	13 Aug 04	Summer	0049 EDT	Overnight	Night	VMC
AAR-06/01	DCA05MA004	Kirksville	MO	19 Oct 04	Autumn	1937 CDT	Afternoon-Evening	Night/Dark	IMC
AAB-06/02	FTW03MA160	Amarillo	TX	24 May 03	Spring	2136 CDT	Afternoon-Evening	Night/Dark	IMC
AAR-05/02	DCA04MA045	San Juan	PR	9 May 04	Spring	1450 AST	Afternoon-Evening	Daylight	VMC
AAR-05/01	DCA04MA011	Memphis	TN	18 Dec 03	Autumn	1226 CST	Morning-Midday	Daylight	VMC
AAR-04/04	DCA02MA001	Belle Harbor	NY	12 Nov 01	Autumn	0916 EST	Morning-Midday	Daylight	VMC
AAR-04/02	DCA02MA054	Tallahassee	FL	26 Jul 02	Summer	0537 EDT	Overnight	Night/Dark	VMC
AAR-04/01	DCA03MA022	Charlotte	NC	8 Jan 03	Winter	0847 EST	Morning-Midday	Daylight	VMC
AAR-03/02	DCA00MA026	Rancho Cordova	CA	16 Feb 00	Winter	1951 PST	Afternoon-Evening	Night	VMC
AAB-02/04	DCA00MA030	Burbank	CA	5 Mar 00	Winter	1811 PST	Afternoon-Evening	Dusk	VMC
AAR-02/01	DCA00MA023	Port Hueneme	CA	31 Jan 00	Winter	1621 PST	Afternoon-Evening	Daylight	VMC
AAR-01/02	DCA99MA060	Little Rock	AR	1 Jun 99	Spring	2351 CDT	Overnight	Night	IMC
AAR-01/01	DCA91MA023	Colorado Springs	CO	3 Mar 91	Winter	0944 MST	Morning-Midday	Daylight	VMC
AAB-01/01	DCA98MA023	Chicago	IL	9 Feb 98	Winter	0954 CST	Morning-Midday	Daylight	IMC
AAR-00/03	DCA96MA070	East Moriches	NY	17 Jul 96	Summer	2031 EDT	Afternoon-Evening	Dusk	VMC
AAR-00/02	DCA97MA055	Newark	NJ	31 Jul 97	Summer	0132 EDT	Overnight	Night/Dark	VMC
AAR-99/01	DCA94MA076	Aliquippa	PA	8 Sep 94	Summer	1903 EDT	Afternoon-Evening	Daylight	VMC
AAR-98/03	DCA96MA079	Newburgh	NY	5 Sep 96	Summer	0554 EDT	Overnight	Dawn	IMC
AAR-98/02	DCA97MA059	Miami	FL	7 Aug 97	Summer	1236 EDT	Morning-Midday	Daylight	VMC
AAR-98/01	DCA96MA068	Pensacola	FL	6 Jul 96	Summer	1424 CDT	Afternoon-Evening	Daylight	VMC
AAR-97/06	DCA96MA054	Miami	FL	11 May 96	Spring	1414 EDT	Afternoon-Evening	Daylight	VMC
AAR-97/03	NYC97MA005	Flushing	NY	19 Oct 96	Autumn	1638 EDT	Afternoon-Evening	Daylight	IMC
AAR-97/01	FTW96FA118	Houston	TX	19 Feb 96	Winter	0902 CST	Morning-Midday	Daylight	VMC

NTSB Report	NTSB ID	City	State	Event Date	Season	Time	Period of Day	Light Condition	IMC/VMC
AAR-96/07	MIA96FA059	Nashville	TN	7 Jan 96	Winter	1620 CST	Afternoon-Evening	Daylight	VMC
AAR-96/05	DCA96MA008	East Granby	CT	12 Nov 95	Autumn	0055 EST	Overnight	Night/Dark	IMC
AAR-96/04	DCA96MA029	Jamaica	NY	20 Dec 95	Autumn	1136 EST	Morning-Midday	Daylight	IMC
AAR-96/03	ATL95MA106	Atlanta	GA	8 Jun 95	Spring	1908 EST	Afternoon-Evening	Dusk	VMC
AAR-96/01	DCA95MA001	Roselawn	IN	31 Oct 94	Autumn	1559 CST	Afternoon-Evening	Dusk	IMC
AAR-95/05	CHI95MA044A	Bridgetown	MO	22 Nov 94	Autumn	2203 CST	Overnight	Night/Dark	VMC
AAR-95/03	DCA94MA065	Charlotte	NC	2 Jul 94	Summer	1843 EDT	Afternoon-Evening	Daylight	IMC
AAR-95/01	DCA94MA038	Flushing	NY	2 Mar 94	Winter	1800 EST	Afternoon-Evening	Night/Dark	IMC
AAR-94/06	DCA94MA033	New Roads	LA	1 Feb 94	Winter	2140 CST	Afternoon-Evening	Night/Dark	VMC
AAR-94/04	DCA93RA060	Guantanamo Bay	Cuba	18 Aug 93	Summer	1656 EDT	Afternoon-Evening	Daylight	VMC
AAR-94/01	DCA93MA040	Dallas Ft Worth	TX	14 Apr 93	Spring	0700 CDT	Morning-Midday	Daylight	IMC
AAR-93/04	DCA92MA044	Jamaica	NY	30 Jul 92	Summer	1741 EDT	Afternoon-Evening	Daylight	VMC
AAR-93/02	DCA92MA025	Flushing	NY	22 Mar 92	Spring	2135 EST	Afternoon-Evening	Night/Dark	IMC
AAR-92/05	DCA92MA022	Swanton	OH	15 Feb 92	Winter	0326 EST	Overnight	Night/Dark	IMC
AAR-91/09	DCA91MA021	Cleveland	OH	17 Feb 91	Winter	0019 EST	Overnight	Night/Dark	IMC
AAR-91/08	DCA91MA018A	Los Angeles	CA	1 Feb 91	Winter	1807 PST	Afternoon-Evening	Dusk	VMC

APPENDIX D

AIR CARRIER DATA

NTSB Report	NTSB ID	DBA	Scheduled	Non-Scheduled	Passenger	Cargo
AAR-11/02	CEN09MA142		N/A			X
AAR-10/04	DCA09MA021		X		X	
AAR-10/03	DCA09MA026		X		X	
AAR-10/01	DCA09MA027	X	X		X	
AAR-09/03	DCA07MA310		X		X	
AAR-08/02	DCA07FA037		X		X	
AAR-08/01	DCA07MA072	X	X		X	
AAR-07/07	DCA06MA022		X			X
AAR-07/06	DCA06MA009		X		X	
AAR-07/05	DCA06MA064		X		X	
AAR-07/04	DCA06MA010	X	X		X	
AAR-06/03	DCA04MA068		X			X
AAR-06/01	DCA05MA004	X	X		X	
AAB-06/02	FTW03MA160		X		X	
AAR-05/02	DCA04MA045	X	X		X	
AAR-05/01	DCA04MA011		N/A			X
AAR-04/04	DCA02MA001		X		X	
AAR-04/02	DCA02MA054		X			X
AAR-04/01	DCA03MA022	X	X		X	
AAR-03/02	DCA00MA026		X			X
AAB-02/04	DCA00MA030		X		X	
AAR-02/01	DCA00MA023		X		X	
AAR-01/02	DCA99MA060		X		X	
AAR-01/01	DCA91MA023		X		X	
AAB-01/01	DCA98MA023		X		X	
AAR-00/03	DCA96MA070		X		X	
AAR-00/02	DCA97MA055		X			X
AAR-99/01	DCA94MA076		X		X	
AAR-98/03	DCA96MA079		X			X
AAR-98/02	DCA97MA059		X			X
AAR-98/01	DCA96MA068		X		X	
AAR-97/06	DCA96MA054		X		X	
AAR-97/03	NYC97MA005		X		X	
AAR-97/01	FTW96FA118		X		X	
AAR-96/07	MIA96FA059		X		X	
AAR-96/05	DCA96MA008		X		X	
AAR-96/04	DCA96MA029		X		X	X
AAR-96/03	ATL95MA106		X		X	
AAR-96/01	DCA95MA001	X	X		X	
AAR-95/05	CHI95MA044A		X		X	
AAR-95/03	DCA94MA065		X		X	
AAR-95/01	DCA94MA038		X		X	
AAR-94/06	DCA94MA033	X	X		X	
AAR-94/04	DCA93RA060	X		X		X
AAR-94/01	DCA93MA040		X		X	
AAR-93/04	DCA92MA044		X		X	
AAR-93/02	DCA92MA025		X		X	
AAR-92/05	DCA92MA022		X			X
AAR-91/09	DCA91MA021		N/A			X
AAR-91/08	DCA91MA018A		X		X	

APPENDIX E

AIRCRAFT DATA

NTSB Report	NTSB ID	Aircraft Type	Manufactured	Flight Crew	Number of Engines	Engine Model	Engine Type
AAR-11/02	CEN09MA142	ATR 42-320	1990	2	2	PW 121	Turboprop
AAR-10/04	DCA09MA021	B737-524	1994	2	2	CFM56-3B1	Turbofan
AAR-10/03	DCA09MA026	A320-214	1999	2	2	CFM56-5B4/P	Turbofan
AAR-10/01	DCA09MA027	DHC-8-402	2008	2	2	PW 150A	Turboprop
AAR-09/03	DCA07MA310	DC-9-82	1988	2	2	JT8D-219	Turbofan
AAR-08/02	DCA07FA037	CL-600-2B19	2003	2	2	CF34-3B1	Turbofan
AAR-08/01	DCA07MA072	ERJ-170	2005	2	2	CF34-8E5	Turbofan
AAR-07/07	DCA06MA022	DC-8-71F	1967	3	4	CFM56-2C1	Turbofan
AAR-07/06	DCA06MA009	B737-700	2004	2	2	CFM56-7B24	Turbofan
AAR-07/05	DCA06MA064	CL-600-2B19	2001	2	2	CF34-3A1	Turbofan
AAR-07/04	DCA06MA010	G-73T	1947	2	2	PT6A-34	Turboprop
AAR-06/03	DCA04MA068	CV-580	1953	2	2	RR 501-D13D	Turboprop
AAR-06/01	DCA05MA004	BAE-J3201	1990	2	2	TPE331	Turboprop
AAB-06/02	FTW03MA160	B737-300	N/A	2	2	CFM56	Turbofan
AAR-05/02	DCA04MA045	ATR 72-212	1995	2	2	PW 127	Turboprop
AAR-05/01	DCA04MA011	MD-10-10F	N/A	2	3	CF6-6D	Turbofan
AAR-04/04	DCA02MA001	A300B4-605R	1988	2	2	CF6	Turbofan
AAR-04/02	DCA02MA054	B727-232F	1974	3	3	JT8D-15	Turbofan
AAR-04/01	DCA03MA022	B-1900D	1996	2	2	PT6A-67D	Turboprop
AAR-03/02	DCA00MA026	DC-8-71F	1968	3	4	CFM56-2-C1	Turbofan
AAB-02/04	DCA00MA030	B-737-300	1996	2	2	CFM56-3	Turbofan
AAR-02/01	DCA00MA023	MD-83	1992	2	2	JT8D-217C	Turbofan
AAR-01/02	DCA99MA060	MD-82	1983	2	2	JT8D-217C	Turbofan
AAR-01/01	DCA91MA023	B737-291	1982	2	2	JT8D-17	Turbofan
AAB-01/01	DCA98MA023	B727-223	1975	3	3	JT8D-9A	Turbofan
AAR-00/03	DCA96MA070	B747-131	1971	3	4	JT9D-7AH	Turbofan
AAR-00/02	DCA97MA055	MD-11	1993	2	3	CF6-80C2	Turbofan
AAR-99/01	DCA94MA076	B737-300	1987	2	2	CFM56-3B-2	Turbofan
AAR-98/03	DCA96MA079	DC-10-10CF	1975	3	3	CF6-6D	Turbofan
AAR-98/02	DCA97MA059	DC-8-61	1968	3	4	JT3D-3B	Turbofan
AAR-98/01	DCA96MA068	MD-88	1988	2	2	JT8D-219	Turbofan
AAR-97/06	DCA96MA054	DC-9-32	1969	2	2	JT8D-9A	Turbofan
AAR-97/03	NYC97MA005	MD-88	1988	2	2	JT8D-219	Turbofan
AAR-97/01	FTW96FA118	DC-9-32	1970	2	2	JT8D-9A	Turbofan

NTSB Report	NTSB ID	Aircraft Type	Manufactured	Flight Crew	Number of Engines	Engine Model	Engine Type
AAR-96/07	MIA96FA059	DC-9-32	N/A	2	2	JT8D-9A	Turbofan
AAR-96/05	DCA96MA008	MD-83	N/A	2	2	JT8D-219	Turbofan
AAR-96/04	DCA96MA029	B747-136	1971	3	4	JT9D-7A	Turbofan
AAR-96/03	ATL95MA106	DC-9-32	N/A	2	2	JT8D-9A	Turbofan
AAR-96/01	DCA95MA001	ATR 72-212	1994	2	2	PW 127	Turboprop
AAR-95/05	CHI95MA044A	MD-82	1988	2	2	JT8D-200	Turbofan
AAR-95/03	DCA94MA065	DC-9-31	1973	2	2	JT8D-7	Turbofan
AAR-95/01	DCA94MA038	MD-82	1986	2	2	JT8D-217A	Turbofan
AAR-94/06	DCA94MA033	Saab 340B	1993	2	2	CT7-9B	Turboprop
AAR-94/04	DCA93RA060	DC-8-61	1969	3	4	JT3D-3B	Turbofan
AAR-94/01	DCA93MA040	DC-10-30	1973	3	3	CF6-50C2	Turbofan
AAR-93/04	DCA92MA044	L-1011-385-1	N/A	3	3	RB211-22B-02	Turbofan
AAR-93/02	DCA92MA025	Fokker F-28	N/A	2	2	M555-15P	Turbofan
AAR-92/05	DCA92MA022	DC-8-63	N/A	3	4	JT3D-7	Turbofan
AAR-91/09	DCA91MA021	DC-9-15	N/A	2	2	JT8D-7B	Turbofan
AAR-91/08	DCA91MA018A	B737-300	1985	2	2	CFM56-3B1	Turbofan

APPENDIX F

INJURY AND FATALITY DATA

		Crew			Passengers			Other		
NTSB Report	NTSB ID	Fatal	Serious	Minor/None	Fatal	Serious	Minor/None	Fatal	Serious	Minor/None
AAR-11/02	CEN09MA142	0	1	1	0	0	0	0	0	0
AAR-10/04	DCA09MA021	0	1	4	0	5	105	0	0	0
AAR-10/03	DCA09MA026	0	1	4	0	4	146	0	0	0
AAR-10/01	DCA09MA027	4	0	0	45	0	0	1	0	0
AAR-09/03	DCA07MA310	0	0	5	0	0	138	0	0	0
AAR-08/02	DCA07FA037	0	0	3	0	0	49	0	0	0
AAR-08/01	DCA07MA072	0	0	4	0	0	70	0	0	0
AAR-07/07	DCA06MA022	0	0	3	0	0	0	0	0	0
AAR-07/06	DCA06MA009	0	0	5	0	0	98	1	1	3
AAR-07/05	DCA06MA064	2	1	0	47	0	0	0	0	0
AAR-07/04	DCA06MA010	2	0	0	18	0	0	0	0	0
AAR-06/03	DCA04MA068	1	0	1	0	0	0	0	0	0
AAR-06/01	DCA05MA004	2	0	0	11	2	0	0	0	0
AAB-06/02	FTW03MA160	0	0	5	0	0	63	0	0	0
AAR-05/02	DCA04MA045	0	1	3	0	0	22	0	0	0
AAR-05/01	DCA04MA011	0	0	2	0	0	5	0	0	0
AAR-04/04	DCA02MA001	9	0	0	251	0	0	5	0	0
AAR-04/02	DCA02MA054	0	3	0	0	0	0	0	0	0
AAR-04/01	DCA03MA022	2	0	0	19	0	0	0	0	1
AAR-03/02	DCA00MA026	3	0	0	0	0	0	0	0	0
AAB-02/04	DCA00MA030	0	0	5	0	2	135	0	0	0
AAR-02/01	DCA00MA023	5	0	0	83	0	0	0	0	0
AAR-01/02	DCA99MA060	1	4	1	10	41	88	0	0	0
AAR-01/01	DCA91MA023	5	0	0	20	0	0	0	0	0
AAB-01/01	DCA98MA023	0	0	6	0	0	116	0	0	0
AAR-00/03	DCA96MA070	18	0	0	212	0	0	0	0	0
AAR-00/02	DCA97MA055	0	0	5	0	0	0	0	0	0
AAR-99/01	DCA94MA076	5	0	0	127	0	0	0	0	0
AAR-98/03	DCA96MA079	0	0	5	0	0	0	0	0	0
AAR-98/02	DCA97MA059	4	0	0	0	0	0	1	0	0
AAR-98/01	DCA96MA068	0	0	5	2	2	133	0	0	0
AAR-97/06	DCA96MA054	5	0	0	105	0	0	0	0	0
AAR-97/03	NYC97MA005	0	0	5	0	0	58	0	0	0

		Crew			Passengers			Other		
NTSB Report	NTSB ID	Fatal	Serious	Minor/None	Fatal	Serious	Minor/None	Fatal	Serious	Minor/None
AAR-97/01	FTW96FA118	0	0	5	0	0	82	0	0	0
AAR-96/07	MIA96FA059	0	0	5	0	0	88	0	0	0
AAR-96/05	DCA96MA008	0	0	5	0	0	73	0	0	0
AAR-96/04	DCA96MA029	0	1	16	0	0	451	0	0	0
AAR-96/03	ATL95MA106	0	1	4	0	0	57	0	0	0
AAR-96/01	DCA95MA001	4	0	0	64	0	0	0	0	0
AAR-95/05	CHI95MA044A	0	0	8	0	0	132	0	0	0
AAR-95/03	DCA94MA065	0	2	3	37	14	1	0	0	0
AAR-95/01	DCA94MA038	0	0	6	0	0	110	0	0	0
AAR-94/06	DCA94MA033	0	0	3	0	0	23	0	0	0
AAR-94/04	DCA93RA060	0	3	0	0	0	0	0	0	0
AAR-94/01	DCA93MA040	0	0	13	0	2	187	0	0	0
AAR-93/04	DCA92MA044	0	0	12	0	1	279	0	0	0
AAR-93/02	DCA92MA025	2	1	1	25	8	14	0	0	0
AAR-92/05	DCA92MA022	3	0	0	1	0	0	0	0	0
AAR-91/09	DCA91MA021	2	0	0	0	0	0	0	0	0
AAR-91/08	DCA91MA018A	2	2	2	20	11	52	0	0	0

APPENDIX G

PHASE OF FLIGHT DATA

NTSB Report	NTSB ID	Phase of Flight
AAR-11/02	CEN09MA142	Approach
AAR-10/04	DCA09MA021	Takeoff
AAR-10/03	DCA09MA026	Climb
AAR-10/01	DCA09MA027	Approach
AAR-09/03	DCA07MA310	Climb
AAR-08/02	DCA07FA037	Landing
AAR-08/01	DCA07MA072	Landing
AAR-07/07	DCA06MA022	Descent
AAR-07/06	DCA06MA009	Landing
AAR-07/05	DCA06MA064	Takeoff
AAR-07/04	DCA06MA010	Climb
AAR-06/03	DCA04MA068	Approach
AAR-06/01	DCA05MA004	Approach
AAB-06/02	FTW03MA160	Landing
AAR-05/02	DCA04MA045	Landing
AAR-05/01	DCA04MA011	Landing
AAR-04/04	DCA02MA001	Climb
AAR-04/02	DCA02MA054	Approach
AAR-04/01	DCA03MA022	Takeoff
AAR-03/02	DCA00MA026	Takeoff
AAB-02/04	DCA00MA030	Landing
AAR-02/01	DCA00MA023	Cruise
AAR-01/02	DCA99MA060	Landing
AAR-01/01	DCA91MA023	Approach
AAB-01/01	DCA98MA023	Approach
AAR-00/03	DCA96MA070	Climb
AAR-00/02	DCA97MA055	Landing
AAR-99/01	DCA94MA076	Approach
AAR-98/03	DCA96MA079	Cruise
AAR-98/02	DCA97MA059	Takeoff
AAR-98/01	DCA96MA068	Takeoff
AAR-97/06	DCA96MA054	Climb
AAR-97/03	NYC97MA005	Approach
AAR-97/01	FTW96FA118	Landing
AAR-96/07	MIA96FA059	Approach
AAR-96/05	DCA96MA008	Approach
AAR-96/04	DCA96MA029	Takeoff
AAR-96/03	ATL95MA106	Takeoff
AAR-96/01	DCA95MA001	Maneuvering
AAR-95/05	CHI95MA044A	Takeoff
AAR-95/03	DCA94MA065	Approach
AAR-95/01	DCA94MA038	Takeoff
AAR-94/06	DCA94MA033	Descent
AAR-94/04	DCA93RA060	Approach
AAR-94/01	DCA93MA040	Landing
AAR-93/04	DCA92MA044	Takeoff
AAR-93/02	DCA92MA025	Takeoff
AAR-92/05	DCA92MA022	Approach
AAR-91/09	DCA91MA021	Takeoff
AAR-91/08	DCA91MA018A	Landing

APPENDIX H

AGE DATA

NTSB Report	NTSB ID	Captain	First Officer
AAR-11/02	CEN09MA142	52	26
AAR-10/04	DCA09MA021	50	34
AAR-10/03	DCA09MA026	57	49
AAR-10/01	DCA09MA027	47	24
AAR-09/03	DCA07MA310	59	43
AAR-08/02	DCA07FA037	27	28
AAR-08/01	DCA07MA072	31	46
AAR-07/07	DCA06MA022	59	40
AAR-07/06	DCA06MA009	59	34
AAR-07/05	DCA06MA064	35	44
AAR-07/04	DCA06MA010	37	34
AAR-06/03	DCA04MA068	49	37
AAR-06/01	DCA05MA004	48	29
AAB-06/02	FTW03MA160	50	44
AAR-05/02	DCA04MA045	33	26
AAR-05/01	DCA04MA011	59	44
AAR-04/04	DCA02MA001	42	34
AAR-04/02	DCA02MA054	55	44
AAR-04/01	DCA03MA022	25	27
AAR-03/02	DCA00MA026	43	35
AAB-02/04	DCA00MA030	52	43
AAR-02/01	DCA00MA023	53	57
AAR-01/02	DCA99MA060	48	35
AAR-01/01	DCA91MA023	52	42
AAB-01/01	DCA98MA023	42	40
AAR-00/03	DCA96MA070	58	57
AAR-00/02	DCA97MA055	46	39
AAR-99/01	DCA94MA076	45	38
AAR-98/03	DCA96MA079	47	41
AAR-98/02	DCA97MA059	42	26
AAR-98/01	DCA96MA068	40	37
AAR-97/06	DCA96MA054	35	52
AAR-97/03	NYC97MA005	48	38
AAR-97/01	FTW96FA118	50	37
AAR-96/07	MIA96FA059	43	42
AAR-96/05	DCA96MA008	39	38
AAR-96/04	DCA96MA029	53	56
AAR-96/03	ATL95MA106	45	43
AAR-96/01	DCA95MA001	29	30
AAR-95/05	CHI95MA044A	57	38
AAR-95/03	DCA94MA065	38	Unknown
AAR-95/01	DCA94MA038	57	47
AAR-94/06	DCA94MA033	52	43
AAR-94/04	DCA93RA060	54	49
AAR-94/01	DCA93MA040	59	40
AAR-93/04	DCA92MA044	54	53
AAR-93/02	DCA92MA025	44	30
AAR-92/05	DCA92MA022	59	37
AAR-91/09	DCA91MA021	44	28
AAR-91/08	DCA91MA018A	48	32

APPENDIX I

GENDER DATA

NTSB Report	NTSB ID	Captain	First Officer
AAR-11/02	CEN09MA142	M	F
AAR-10/04	DCA09MA021	M	M
AAR-10/03	DCA09MA026	M	M
AAR-10/01	DCA09MA027	M	F
AAR-09/03	DCA07MA310	M	M
AAR-08/02	DCA07FA037	M	M
AAR-08/01	DCA07MA072	M	M
AAR-07/07	DCA06MA022	M	M
AAR-07/06	DCA06MA009	M	M
AAR-07/05	DCA06MA064	M	M
AAR-07/04	DCA06MA010	F	M
AAR-06/03	DCA04MA068	M	M
AAR-06/01	DCA05MA004	M	M
AAB-06/02	FTW03MA160	M	M
AAR-05/02	DCA04MA045	M	M
AAR-05/01	DCA04MA011	M	F
AAR-04/04	DCA02MA001	M	M
AAR-04/02	DCA02MA054	M	M
AAR-04/01	DCA03MA022	F	M
AAR-03/02	DCA00MA026	M	M
AAB-02/04	DCA00MA030	M	M
AAR-02/01	DCA00MA023	M	M
AAR-01/02	DCA99MA060	M	M
AAR-01/01	DCA91MA023	M	F
AAB-01/01	DCA98MA023	M	M
AAR-00/03	DCA96MA070	M	M
AAR-00/02	DCA97MA055	M	M
AAR-99/01	DCA94MA076	M	M
AAR-98/03	DCA96MA079	M	M
AAR-98/02	DCA97MA059	M	M
AAR-98/01	DCA96MA068	M	M
AAR-97/06	DCA96MA054	F	M
AAR-97/03	NYC97MA005	M	M
AAR-97/01	FTW96FA118	M	M
AAR-96/07	MIA96FA059	M	M
AAR-96/05	DCA96MA008	M	M
AAR-96/04	DCA96MA029	M	M
AAR-96/03	ATL95MA106	M	M
AAR-96/01	DCA95MA001	M	M
AAR-95/05	CHI95MA044A	M	M
AAR-95/03	DCA94MA065	M	M
AAR-95/01	DCA94MA038	M	M
AAR-94/06	DCA94MA033	M	M
AAR-94/04	DCA93RA060	M	M
AAR-94/01	DCA93MA040	M	M
AAR-93/04	DCA92MA044	M	M
AAR-93/02	DCA92MA025	M	M
AAR-92/05	DCA92MA022	M	M
AAR-91/09	DCA91MA021	M	M
AAR-91/08	DCA91MA018A	M	M

APPENDIX J

CERTIFICATE DATA

NTSB Report	NTSB ID	Captain	First Officer
AAR-11/02	CEN09MA142	ATP	Commercial
AAR-10/04	DCA09MA021	ATP	ATP
AAR-10/03	DCA09MA026	ATP	ATP
AAR-10/01	DCA09MA027	ATP	Commercial
AAR-09/03	DCA07MA310	ATP	Commercial
AAR-08/02	DCA07FA037	ATP	Commercial
AAR-08/01	DCA07MA072	ATP	ATP
AAR-07/07	DCA06MA022	ATP	ATP
AAR-07/06	DCA06MA009	ATP	ATP
AAR-07/05	DCA06MA064	ATP	ATP
AAR-07/04	DCA06MA010	ATP	Commercial
AAR-06/03	DCA04MA068	ATP	Commercial
AAR-06/01	DCA05MA004	ATP	Commercial
AAB-06/02	FTW03MA160	ATP	ATP
AAR-05/02	DCA04MA045	ATP	Commercial
AAR-05/01	DCA04MA011	ATP	ATP
AAR-04/04	DCA02MA001	ATP	ATP
AAR-04/02	DCA02MA054	ATP	ATP
AAR-04/01	DCA03MA022	ATP	Commercial
AAR-03/02	DCA00MA026	ATP	ATP
AAB-02/04	DCA00MA030	ATP	ATP
AAR-02/01	DCA00MA023	ATP	ATP
AAR-01/02	DCA99MA060	ATP	ATP
AAR-01/01	DCA91MA023	ATP	ATP
AAB-01/01	DCA98MA023	ATP	ATP
AAR-00/03	DCA96MA070	ATP	ATP
AAR-00/02	DCA97MA055	ATP	ATP
AAR-99/01	DCA94MA076	ATP	ATP
AAR-98/03	DCA96MA079	ATP	ATP
AAR-98/02	DCA97MA059	ATP	ATP
AAR-98/01	DCA96MA068	ATP	ATP
AAR-97/06	DCA96MA054	ATP	ATP
AAR-97/03	NYC97MA005	ATP	ATP
AAR-97/01	FTW96FA118	ATP	ATP
AAR-96/07	MIA96FA059	ATP	ATP
AAR-96/05	DCA96MA008	ATP	ATP
AAR-96/04	DCA96MA029	ATP	ATP
AAR-96/03	ATL95MA106	ATP	ATP
AAR-96/01	DCA95MA001	ATP	Commercial
AAR-95/05	CHI95MA044A	ATP	ATP
AAR-95/03	DCA94MA065	ATP	ATP
AAR-95/01	DCA94MA038	ATP	ATP
AAR-94/06	DCA94MA033	ATP	ATP
AAR-94/04	DCA93RA060	ATP	ATP
AAR-94/01	DCA93MA040	ATP	Commercial
AAR-93/04	DCA92MA044	ATP	ATP
AAR-93/02	DCA92MA025	ATP	ATP
AAR-92/05	DCA92MA022	ATP	Commercial
AAR-91/09	DCA91MA021	ATP	ATP
AAR-91/08	DCA91MA018A	ATP	ATP

APPENDIX K

EMPLOYMENT DATA

			Captain			First Officer		
NTSB Report	NTSB ID	Event Date	Date Hired	Mths Employed	Yrs Employed	Date Hired	Mths Employed	Yrs Employed
AAR-11/02	CEN09MA142	27 Jan 09	9 May 88	248	20.7	25 Jul 08	6	0.5
AAR-10/04	DCA09MA021	20 Dec 08	5 Nov 97	133	11.1	Mar 07	21	1.8
AAR-10/03	DCA09MA026	15 Jan 09	25 Feb 80	346	28.8	7 Apr 86	273	22.8
AAR-10/01	DCA09MA027	12 Feb 09	Sep 05	40	3.3	Jan 08	12	1.0
AAR-09/03	DCA07MA310	28 Sep 07	6 Aug 90	205	17.1	Jan 99	104	8.7
AAR-08/02	DCA07FA037	12 Apr 07	11 May 01	71	5.9	3 Jan 07	3	0.3
AAR-08/01	DCA07MA072	18 Feb 07	May 05	21	1.8	Jun 05	20	1.7
AAR-07/07	DCA06MA022	7 Feb 06	19 Sep 88	208	17.3	19 Feb 96	119	9.9
AAR-07/06	DCA06MA009	8 Dec 05	3 Aug 95	124	10.3	17 Feb 03	33	2.8
AAR-07/05	DCA06MA064	27 Aug 06	Nov 99	81	6.8	Mar 02	53	4.4
AAR-07/04	DCA06MA010	19 Dec 05	Mar 03	33	2.8	Apr 05	8	0.7
AAR-06/03	DCA04MA068	13 Aug 04	19 Jul 04	0	0.0	5 May 04	3	0.3
AAR-06/01	DCA05MA004	19 Oct 04	20 Mar 01	42	3.5	19 Jul 04	3	0.3
AAB-06/02	FTW03MA160	24 May 03	3 Mar 94	110	9.2	30 Aug 01	20	1.7
AAR-05/02	DCA04MA045	9 May 04	11 Jan 99	63	5.3	15 Mar 04	1	0.1
AAR-05/01	DCA04MA011	18 Dec 03	10 Jul 78	305	25.4	21 Feb 96	93	7.8
AAR-04/04	DCA02MA001	12 Nov 01	Jul 85	196	16.3	Mar 91	128	10.7
AAR-04/02	DCA02MA054	26 Jul 02	10 Apr 89	159	13.3	29 Oct 97	56	4.7
AAR-04/01	DCA03MA022	8 Jan 03	Mar 00	33	2.8	May 01	19	1.6
AAR-03/02	DCA00MA026	16 Feb 00	19 Oct 94	63	5.3	15 Sep 96	41	3.4
AAB-02/04	DCA00MA030	5 Mar 00	7 Jul 88	139	11.6	14 Nov 96	39	3.3
AAR-02/01	DCA00MA023	31 Jan 00	16 Aug 82	209	17.4	17 Jul 85	174	14.5
AAR-01/02	DCA99MA060	1 Jun 99	Jul 79	238	19.8	Jan 99	4	0.3
AAR-01/01	DCA91MA023	3 Mar 91	15 May 69	261	21.8	21 Nov 88	27	2.3
AAB-01/01	DCA98MA023	9 Feb 98	29 Jun 84	163	13.6	19 Aug 88	113	9.4
AAR-00/03	DCA96MA070	17 Jul 96	20 May 65	373	31.1	13 Apr 64	387	32.3
AAR-00/02	DCA97MA055	31 Jul 97	1979	216	18.0	6 Sep 94	34	2.8
AAR-99/01	DCA94MA076	8 Sep 94	4 Feb 81	163	13.6	Feb 87	90	7.5
AAR-98/03	DCA96MA079	5 Sep 96	8 Oct 79	202	16.8	27 Dec 89	80	6.7
AAR-98/02	DCA97MA059	7 Aug 97	11 Oct 93	45	3.8	15 Aug 94	35	2.9
AAR-98/01	DCA96MA068	6 Jul 96	1979	204	17.0	1990	72	6.0
AAR-97/06	DCA96MA054	11 May 96	25 Nov 93	29	2.4	13 Nov 95	5	0.4
AAR-97/03	NYC97MA005	19 Oct 96	5 Sep 78	217	18.1	30 May 88	100	8.3

			Captain			First Officer		
NTSB Report	NTSB ID	Event Date	Date Hired	Mths Employed	Yrs Employed	Date Hired	Mths Employed	Yrs Employed
AAR-97/01	FTW96FA118	19 Feb 96	1984	139	11.6	1988	91	7.6
AAR-96/07	MIA96FA059	7 Jan 96	Nov 94	13	1.1	Oct 95	2	0.2
AAR-96/05	DCA96MA008	12 Nov 95	11 Apr 85	127	10.6	24 May 89	77	6.4
AAR-96/04	DCA96MA029	20 Dec 95	23 May 92	42	3.5	16 Jan 95	11	0.9
AAR-96/03	ATL95MA106	8 Jun 95	25 Nov 93	18	1.5	28 Oct 94	7	0.6
AAR-96/01	DCA95MA001	31 Oct 94	1 Jul 87	87	7.3	14 Aug 89	62	5.2
AAR-95/05	CHI95MA044A	22 Nov 94	Oct 65	349	29.1	Unknown	Unknown	Unknown
AAR-95/03	DCA94MA065	2 Jul 94	24 Apr 85	110	9.2	12 Oct 87	80	6.7
AAR-95/01	DCA94MA038	2 Mar 94	1965	344	28.7	1985	104	8.7
AAR-94/06	DCA94MA033	1 Feb 94	6 Jan 86	96	8.0	13 Jul 87	78	6.5
AAR-94/04	DCA93RA060	18 Aug 93	11 Feb 91	30	2.5	3 Nov 92	9	0.8
AAR-94/01	DCA93MA040	14 Apr 93	1 Aug 66	320	26.7	Sep 86	78	6.5
AAR-93/04	DCA92MA044	30 Jul 92	24 May 65	326	27.2	17 Feb 67	305	25.4
AAR-93/02	DCA92MA025	22 Mar 92	20 May 85	82	6.8	19 Jul 89	32	2.7
AAR-92/05	DCA92MA022	15 Feb 92	31 Oct 90	15	1.3	25 Jul 89	30	2.5
AAR-91/09	DCA91MA021	17 Feb 91	Aug 89	18	1.5	Jan 91	1	0.1
AAR-91/08	DCA91MA018A	1 Feb 91	Aug 68	269	22.4	Oct 88	27	2.3

APPENDIX L

TOTAL FLIGHT TIME DATA

NTSB Report	NTSB ID	Captain	First Officer
AAR-11/02	CEN09MA142	13,935	2,109
AAR-10/04	DCA09MA021	13,100	8,000
AAR-10/03	DCA09MA026	19,663	15,643
AAR-10/01	DCA09MA027	3,379	2,244
AAR-09/03	DCA07MA310	14,000	7,000
AAR-08/02	DCA07FA037	5,600	2,600
AAR-08/01	DCA07MA072	4,500	3,900
AAR-07/07	DCA06MA022	25,000	7,500
AAR-07/06	DCA06MA009	15,000	8,500
AAR-07/05	DCA06MA064	4,710	6,564
AAR-07/04	DCA06MA010	2,820	1,420
AAR-06/03	DCA04MA068	2,500	2,488
AAR-06/01	DCA05MA004	4,234	2,856
AAB-06/02	FTW03MA160	9,500	10,000
AAR-05/02	DCA04MA045	6,071	2,000
AAR-05/01	DCA04MA011	21,000	15,000
AAR-04/04	DCA02MA001	8,050	4,403
AAR-04/02	DCA02MA054	13,500	8,000
AAR-04/01	DCA03MA022	2,790	1,096
AAR-03/02	DCA00MA026	13,329	4,511
AAB-02/04	DCA00MA030	11,000	5,022
AAR-02/01	DCA00MA023	17,750	8,140
AAR-01/02	DCA99MA060	10,234	4,292
AAR-01/01	DCA91MA023	9,902	3,903
AAB-01/01	DCA98MA023	11,000	5,638
AAR-00/03	DCA96MA070	18,800	17,000
AAR-00/02	DCA97MA055	11,000	3,703
AAR-99/01	DCA94MA076	12,000	9,119
AAR-98/03	DCA96MA079	12,344	6,535
AAR-98/02	DCA97MA059	12,154	2,641
AAR-98/01	DCA96MA068	12,000	6,500
AAR-97/06	DCA96MA054	8,928	6,448
AAR-97/03	NYC97MA005	10,024	6,800
AAR-97/01	FTW96FA118	17,500	2,200
AAR-96/07	MIA96FA059	4,381	7,707
AAR-96/05	DCA96MA008	8,000	5,100
AAR-96/04	DCA96MA029	16,455	17,734
AAR-96/03	ATL95MA106	9,500	3,800
AAR-96/01	DCA95MA001	7,867	5,176
AAR-95/05	CHI95MA044A	18,651	10,353
AAR-95/03	DCA94MA065	8,065	12,980
AAR-95/01	DCA94MA038	23,000	16,000
AAR-94/06	DCA94MA033	20,000	6,500
AAR-94/04	DCA94RA060	20,727	15,350
AAR-94/01	DCA93MA040	12,562	4,454
AAR-93/04	DCA92MA044	20,149	15,242
AAR-93/02	DCA92MA025	9,820	4,507
AAR-92/05	DCA92MA022	16,382	5,082
AAR-91/09	DCA91MA021	10,505	3,820
AAR-91/08	DCA91MA018A	16,300	4,316

APPENDIX M

MAKE/MODEL FLIGHT TIME DATA

NTSB Report	NTSB ID	Captain	First Officer
AAR-11/02	CEN09MA142	2,052	130
AAR-10/04	DCA09MA021	6,300	1,500
AAR-10/03	DCA09MA026	4,765	37
AAR-10/01	DCA09MA027	111	774
AAR-09/03	DCA07MA310	3,004	3,000
AAR-08/02	DCA07FA037	4,243	22
AAR-08/01	DCA07MA072	1,200	1,200
AAR-07/07	DCA06MA022	16,000	2,100
AAR-07/06	DCA06MA009	4,500	2,000
AAR-07/05	DCA06MA064	3,082	3,564
AAR-07/04	DCA06MA010	1,630	71
AAR-06/03	DCA04MA068	1,337	145
AAR-06/01	DCA05MA004	2,510	107
AAB-06/02	FTW03MA160	5,400	1,200
AAR-05/02	DCA04MA045	3,814	20
AAR-05/01	DCA04MA011	2,602	1,918
AAR-04/04	DCA02MA001	1,723	1,835
AAR-04/02	DCA02MA054	2,754	1,983
AAR-04/01	DCA03MA022	1,100	706
AAR-03/02	DCA00MA026	2,128	2,080
AAB-02/04	DCA00MA030	9,870	2,522
AAR-02/01	DCA00MA023	4,150	8,060
AAR-01/02	DCA99MA060	5,518	182
AAR-01/01	DCA91MA023	1,732	1,077
AAB-01/01	DCA98MA023	1,319	3,731
AAR-00/03	DCA96MA070	5,490	4,700
AAR-00/02	DCA97MA055	1,253	95
AAR-99/01	DCA94MA076	4,064	3,644
AAR-98/03	DCA96MA079	2,504	1,338
AAR-98/02	DCA97MA059	2,522	1,592
AAR-98/01	DCA96MA068	2,300	500
AAR-97/06	DCA96MA054	2,116	2,148
AAR-97/03	NYC97MA005	3,756	2,200
AAR-97/01	FTW96FA118	220	450
AAR-96/07	MIA96FA059	1,061	205
AAR-96/05	DCA96MA008	4,230	2,281
AAR-96/04	DCA96MA029	2,905	4,804
AAR-96/03	ATL95MA106	3,500	552
AAR-96/01	DCA95MA001	1,548	3,657
AAR-95/05	CHI95MA044A	3,178	251
AAR-95/03	DCA94MA065	1,970	3,180
AAR-95/01	DCA94MA038	6,000	2,400
AAR-94/06	DCA94MA033	300	1,700
AAR-94/04	DCA93RA060	1,527	492
AAR-94/01	DCA93MA040	555	376
AAR-93/04	DCA92MA044	2,397	2,953
AAR-93/02	DCA92MA025	2,200	29
AAR-92/05	DCA92MA022	2,382	3,135
AAR-91/09	DCA91MA021	505	510
AAR-91/08	DCA91MA018A	4,300	982

APPENDIX N

FLIGHT TIME IN TYPE AND POSITION DATA

NTSB Report	NTSB ID	Captain	First Officer
AAR-11/02	CEN09MA142	1,896	130
AAR-10/04	DCA09MA021	915	1,500
AAR-10/03	DCA09MA026	Unknown	37
AAR-10/01	DCA09MA027	111	774
AAR-09/03	DCA07MA310	831	3,000
AAR-08/02	DCA07FA037	2,459	22
AAR-08/01	DCA07MA072	1,100	1,200
AAR-07/07	DCA06MA022	16,000	2,100
AAR-07/06	DCA06MA009	Unknown	2,000
AAR-07/05	DCA06MA064	1,567	Unknown
AAR-07/04	DCA06MA010	430	71
AAR-06/03	DCA04MA068	88	145
AAR-06/01	DCA05MA004	719	107
AAB-06/02	FTW03MA160	600	1,200
AAR-05/02	DCA04MA045	1,120	20
AAR-05/01	DCA04MA011	2,602	1,918
AAR-04/04	DCA02MA001	1,723	1,835
AAR-04/02	DCA02MA054	861	526
AAR-04/01	DCA03MA022	1,100	706
AAR-03/02	DCA00MA026	2,128	2,080
AAB-02/04	DCA00MA030	5,302	2,522
AAR-02/01	DCA00MA023	4,150	8,060
AAR-01/02	DCA99MA060	5,518	182
AAR-01/01	DCA91MA023	891	1,077
AAB-01/01	DCA98MA023	424	3,731
AAR-00/03	DCA96MA070	Unknown	Unknown
AAR-00/02	DCA97MA055	318	95
AAR-99/01	DCA94MA076	3,269	3,644
AAR-98/03	DCA96MA079	1,621	237
AAR-98/02	DCA97MA059	2,522	1,592
AAR-98/01	DCA96MA068	2,300	500
AAR-97/06	DCA96MA054	1,784	2,148
AAR-97/03	NYC97MA005	3,578	2,200
AAR-97/01	FTW96FA118	220	450
AAR-96/07	MIA96FA059	26	205
AAR-96/05	DCA96MA008	1,514	2,281
AAR-96/04	DCA96MA029	1,102	4,804
AAR-96/03	ATL95MA106	2,500	552
AAR-96/01	DCA95MA001	1,548	3,657
AAR-95/05	CHI95MA044A	3,178	251
AAR-95/03	DCA94MA065	1,970	3,180
AAR-95/01	DCA94MA038	6,000	2,400
AAR-94/06	DCA94MA033	300	Unknown
AAR-94/04	DCA93RA060	1,527	Unknown
AAR-94/01	DCA93MA040	555	376
AAR-93/04	DCA92MA044	1,574	2,953
AAR-93/02	DCA92MA025	1,400	29
AAR-92/05	DCA92MA022	2,382	1,143
AAR-91/09	DCA91MA021	505	510
AAR-91/08	DCA91MA018A	Unknown	982

APPENDIX O

CREW ASSIGNMENT DATA

NTSB Report	NTSB ID	Captain	First Officer
AAR-11/02	CEN09MA142	Monitoring	Flying
AAR-10/04	DCA09MA021	Flying	Monitoring
AAR-10/03	DCA09MA026	Monitoring	Flying
AAR-10/01	DCA09MA027	Flying	Monitoring
AAR-09/03	DCA07MA310	Flying	Monitoring
AAR-08/02	DCA07FA037	Flying	Monitoring
AAR-08/01	DCA07MA072	Monitoring	Flying
AAR-07/07	DCA06MA022	Monitoring	Flying
AAR-07/06	DCA06MA009	Flying	Monitoring
AAR-07/05	DCA06MA064	Monitoring	Flying
AAR-07/04	DCA06MA010	Unknown	Unknown
AAR-06/03	DCA04MA068	Monitoring	Flying
AAR-06/01	DCA05MA004	Flying	Monitoring
AAB-06/02	FTW03MA160	Monitoring	Flying
AAR-05/02	DCA04MA045	Monitoring	Flying
AAR-05/01	DCA04MA011	Monitoring	Flying
AAR-04/04	DCA02MA001	Monitoring	Flying
AAR-04/02	DCA02MA054	Monitoring	Flying
AAR-04/01	DCA03MA022	Flying	Monitoring
AAR-03/02	DCA00MA026	Monitoring	Flying
AAB-02/04	DCA00MA030	Flying	Monitoring
AAR-02/01	DCA00MA023	Monitoring	Flying
AAR-01/02	DCA99MA060	Flying	Monitoring
AAR-01/01	DCA91MA023	Flying	Monitoring
AAB-01/01	DCA98MA023	Flying	Monitoring
AAR-00/03	DCA96MA070	Flying	Monitoring
AAR-00/02	DCA97MA055	Flying	Monitoring
AAR-99/01	DCA94MA076	Monitoring	Flying
AAR-98/03	DCA96MA079	Monitoring	Flying
AAR-98/02	DCA97MA059	Monitoring	Flying
AAR-98/01	DCA96MA068	Monitoring	Flying
AAR-97/06	DCA96MA054	Flying	Monitoring
AAR-97/03	NYC97MA005	Flying	Monitoring
AAR-97/01	FTW96FA118	Monitoring	Flying
AAR-96/07	MIA96FA059	Monitoring	Flying
AAR-96/05	DCA96MA008	Flying	Monitoring
AAR-96/04	DCA96MA029	Flying	Monitoring
AAR-96/03	ATL95MA106	Flying	Monitoring
AAR-96/01	DCA95MA001	Monitoring	Flying
AAR-95/05	CHI95MA044A	Monitoring	Flying
AAR-95/03	DCA94MA065	Monitoring	Flying
AAR-95/01	DCA94MA038	Flying	Monitoring
AAR-94/06	DCA94MA033	Flying	Monitoring
AAR-94/04	DCA93RA060	Flying	Monitoring
AAR-94/01	DCA93MA040	Monitoring	Flying
AAR-93/04	DCA92MA044	Monitoring	Flying
AAR-93/02	DCA92MA025	Flying	Monitoring
AAR-92/05	DCA92MA022	Monitoring	Flying
AAR-91/09	DCA91MA021	Monitoring	Flying
AAR-91/08	DCA91MA018A	Monitoring	Flying

APPENDIX P

CREW FAMILIARITY DATA

		This Trip Sequence		
NTSB Report	NTSB ID	First Day of Pairing	First Leg of Day	First Paring Together
AAR-11/02	CEN09MA142	Yes	Yes	Unknown
AAR-10/04	DCA09MA021	No	Yes	No
AAR-10/03	DCA09MA026	No	No	Yes
AAR-10/01	DCA09MA027	Yes	Yes	Unknown
AAR-09/03	DCA07MA310	Yes	Yes	Unknown
AAR-08/02	DCA07FA037	Yes	No	No
AAR-08/01	DCA07MA072	Yes	Yes	Yes
AAR-07/07	DCA06MA022	No	Yes	Unknown
AAR-07/06	DCA06MA009	Yes	Yes	Unknown
AAR-07/05	DCA06MA064	No	Yes	Yes
AAR-07/04	DCA06MA010	Yes	No	Yes
AAR-06/03	DCA04MA068	Unknown	Yes	Unknown
AAR-06/01	DCA05MA004	No	No	No
AAB-06/02	FTW03MA160	No	No	Unknown
AAR-05/02	DCA04MA045	Yes	Yes	Yes
AAR-05/01	DCA04MA011	No	No	Unknown
AAR-04/04	DCA02MA001	Yes	Yes	No
AAR-04/02	DCA02MA054	Yes	Yes	Yes
AAR-04/01	DCA03MA022	Yes	Yes	No
AAR-03/02	DCA00MA026	Yes	Yes	No
AAB-02/04	DCA00MA030	Yes	Yes	Unknown
AAR-02/01	DCA00MA023	Yes	Yes	Unknown
AAR-01/02	DCA99MA060	Yes	No	Yes
AAR-01/01	DCA91MA023	No	Yes	No
AAB-01/01	DCA98MA023	No	Yes	Unknown
AAR-00/03	DCA96MA070	Yes	Yes	Unknown
AAR-00/02	DCA97MA055	Unknown	Yes	Unknown
AAR-99/01	DCA94MA076	No	No	Yes
AAR-98/03	DCA96MA079	No	Yes	Unknown
AAR-98/02	DCA97MA059	Unknown	Yes	Unknown
AAR-98/01	DCA96MA068	No	Yes	Unknown
AAR-97/06	DCA96MA054	No	No	Unknown
AAR-97/03	NYC97MA005	Yes	Yes	No
AAR-97/01	FTW96FA118	No	No	Yes
AAR-96/07	MIA96FA059	Yes	No	Yes
AAR-96/05	DCA96MA008	No	No	Unknown
AAR-96/04	DCA96MA029	Yes	Yes	Yes
AAR-96/03	ATL95MA106	Yes	Yes	Unknown
AAR-96/01	DCA95MA001	Yes	No	Unknown
AAR-95/05	CHI95MA044A	No	No	Unknown
AAR-95/03	DCA94MA065	Yes	No	Unknown
AAR-95/01	DCA94MA038	Yes	No	No
AAR-94/06	DCA94MA033	Yes	Yes	Unknown
AAR-94/04	DCA93RA060	No	No	Yes
AAR-94/01	DCA93MA040	No	Yes	Yes
AAR-93/04	DCA92MA044	Unknown	Unknown	Unknown
AAR-93/02	DCA92MA025	No	No	Unknown
AAR-92/05	DCA92MA022	No	Yes	No
AAR-91/09	DCA91MA021	No	No	No
AAR-91/08	DCA91MA018A	Yes	No	Unknown

APPENDIX Q

DRUGS AND ALCOHOL DATA

		Captain		First Officer	
NTSB Report	NTSB ID	Drugs	Alcohol	Drugs	Alcohol
AAR-11/02	CEN09MA142	Negative	Negative	Negative	Negative
AAR-10/04	DCA09MA021	Negative	Negative	Negative	Not Conducted
AAR-10/03	DCA09MA026	Negative	Negative	Negative	Negative
AAR-10/01	DCA09MA027	Negative [1]	Negative	Negative	Negative
AAR-09/03	DCA07MA310	Not Conducted	Not Conducted	Not Conducted	Not Conducted
AAR-08/02	DCA07FA037	No	Not Conducted	No	Not Conducted
AAR-08/01	DCA07MA072	Negative	Negative	Negative	Negative
AAR-07/07	DCA06MA022	Negative	Negative	Negative	Negative
AAR-07/06	DCA06MA009	Negative	Negative	Negative	Negative
AAR-07/05	DCA06MA064	Negative	Negative	Negative [2]	Negative
AAR-07/04	DCA06MA010	Negative [3]	Negative	Negative [3]	Negative
AAR-06/03	DCA04MA068	Negative	Negative	Negative	Negative
AAR-06/01	DCA05MA004	Negative [4]	Negative	Negative [5]	Negative
AAB-06/02	FTW03MA160	Unknown	Unknown	Unknown	Unknown
AAR-05/02	DCA04MA045	Negative	Negative	Negative	Negative
AAR-05/01	DCA04MA011	Negative	Negative	Negative	Negative
AAR-04/04	DCA02MA001	Negative	Positive [6]	Negative [7]	Negative
AAR-04/02	DCA02MA054	Negative [8]	Negative	Negative	Negative
AAR-04/01	DCA03MA022	Negative	Negative	Negative	Negative
AAR-03/02	DCA00MA026	Negative	Not Conducted	Negative	Not Conducted
AAB-02/04	DCA00MA030	Negative	Negative	Negative	Negative
AAR-02/01	DCA00MA023	Negative	Negative [9]	Negative	Negative [9]
AAR-01/02	DCA99MA060	Negative	Negative	Not Conducted	Not Conducted
AAR-01/01	DCA91MA023	Negative	Negative	Negative	Negative
AAB-01/01	DCA98MA023	Unknown	Unknown	Unknown	Unknown
AAR-00/03	DCA96MA070	Negative	Negative [10]	Unknown	Unknown
AAR-00/02	DCA97MA055	Negative	Unknown	Negative	Unknown
AAR-99/01	DCA94MA076	Negative	Negative [11]	Negative	Negative [11]
AAR-98/03	DCA96MA079	Negative	Unknown	Negative	Unknown
AAR-98/02	DCA97MA059	Negative	Unknown	Negative	Unknown
AAR-98/01	DCA96MA068	Negative	Not Conducted	Negative	Not Conducted
AAR-97/06	DCA96MA054	Unknown	Unknown	Unknown	Unknown
AAR-97/03	NYC97MA005	Negative	Negative	Negative	Negative
AAR-97/01	FTW96FA118	Negative	Negative	Negative	Negative
AAR-96/07	MIA96FA059	Negative	Negative	Negative	Negative
AAR-96/05	DCA96MA008	Negative	Not Conducted	Negative	Not Conducted
AAR-96/04	DCA96MA029	Negative	Negative	Negative	Negative
AAR-96/03	ATL95MA106	Negative	Negative	Negative	Negative
AAR-96/01	DCA95MA001	Negative	Negative	Negative	Negative
AAR-95/05	CHI95MA044A	Negative	Negative	Negative	Negative
AAR-95/03	DCA94MA065	Negative	Negative	Negative	Negative
AAR-95/01	DCA94MA038	Negative	Negative	Negative	Negative
AAR-94/06	DCA94MA033	Negative	Not Conducted	Negative	Not Conducted
AAR-94/04	DCA93RA060	Negative	Negative	Negative [12]	Negative
AAR-94/01	DCA93MA040	Negative	Not Conducted	Negative	Not Conducted
AAR-93/04	DCA92MA044	Negative	Not Conducted	Negative	Not Conducted
AAR-93/02	DCA92MA025	Negative	Negative	Negative	Not Conducted [13]
AAR-92/05	DCA92MA022	Negative	Negative	Negative	Negative
AAR-91/09	DCA91MA021	Negative	Negative	Negative	Negative
AAR-91/08	DCA91MA018A	Negative [14]	Negative	Negative	Negative

1. The captain tested positive for Diltiazem, "FAA medical records indicated that he was taking this medicine to control hypertension" (NTSB, 2010).

2. "A low amount of pseudoephedrine was detected...Pseudoephedrine is a decongestant that is available without a prescription in various preparations that are marketed for the treatment of cold or allergy symptoms" (NTSB, 2007).

3. The captain's toxicological test revealed diphenhydramine, "commonly known by the trade name Benadryl" and the first officer's test revealed quinine, which "is found in tonic water" (NTSB, 2006).

4. "A urine specimen collected from the captain tested positive for acetaminophen" (NTSB, 2006).

5. "Blood and liver specimens obtained from the first officer revealed an unspecified quantity of quinine...Quinine is found in tonic water" (NTSB, 2006).

6. The NTSB stated "ethanol in specimens can be the result of the postmortem production of ethanol" (NTSB, 2002).

7. The first officer's specimen tested "positive for ephedrine and pseudoephedrine" which are "…present in many over-the-counter medications" (NTSB, 2002).

8. "The urine specimen collected from the captain tested positive for morphine and acetaminophen. A review of emergency room hospital records indicated that the captain was administered morphine intravenously" (NTSB, 2004).

9. "Although the analysis detected ethanol in the tissue specimens of both pilots, the analysis report noted that the ethanol found was consistent with postmortem ethanol production" (NTSB, 2002).

10. "…the presence of small amounts of alcohol in some of the specimens was most likely 'from postmortem ethanol production' caused by decomposition" (NTSB, 2000).

11. "Although ethanol was detected in muscle tissue samples from both the captain and first officer, the toxicological reports stated that 'the delay in the collection and the analysis of specimens may have resulted in postmortem ethanol production'" (NTSB, 1999).

12. “The first officer tested positive for codeine, which is a pain suppressant. According to personnel in the hospital trauma center, this drug was most probably administered after the accident” (NTSB, 1994).

13. "Voluntary blood and urine samples from the first officer were requested by the Safety Board, and this request was denied" (NTSB, 1993).

14. "CAMI reported that the captain of USA1493 had 1.6 ug/ml of Phenobarbital in his urine" (NTSB, 1991). However, the NTSB stated in its analysis that this medication did not contribute to the accident.

APPENDIX R

PROPERLY TRAINED AND CERTIFIED DATA

		Properly Certificated and Qualified	
NTSB Report	NTSB ID	Captain	First Officer
AAR-11/02	CEN09MA142	Yes	Yes
AAR-10/04	DCA09MA021	Yes	Yes
AAR-10/03	DCA09MA026	Yes	Yes
AAR-10/01	DCA09MA027	Yes	Yes
AAR-09/03	DCA07MA310	Yes	Yes
AAR-08/02	DCA07FA037	Yes	Yes
AAR-08/01	DCA07MA072	Yes	Yes
AAR-07/07	DCA06MA022	Yes	Yes
AAR-07/06	DCA06MA009	Yes	Yes
AAR-07/05	DCA06MA064	Yes	Yes
AAR-07/04	DCA06MA010	Yes	Yes
AAR-06/03	DCA04MA068	Yes	Yes
AAR-06/01	DCA05MA004	Yes	Yes
AAB-06/02	FTW03MA160	Yes	Yes
AAR-05/02	DCA04MA045	Yes	No
AAR-05/01	DCA04MA011	Yes	Yes
AAR-04/04	DCA02MA001	Yes	Yes
AAR-04/02	DCA02MA054	Yes	Yes
AAR-04/01	DCA03MA022	Yes	Yes
AAR-03/02	DCA00MA026	Yes	Yes
AAB-02/04	DCA00MA030	Yes	Yes
AAR-02/01	DCA00MA023	Yes	Yes
AAR-01/02	DCA99MA060	Yes	Yes
AAR-01/01	DCA91MA023	Yes	Yes
AAB-01/01	DCA98MA023	Yes	Yes
AAR-00/03	DCA96MA070	Yes	Yes
AAR-00/02	DCA97MA055	Yes	Yes
AAR-99/01	DCA94MA076	Yes	Yes
AAR-98/03	DCA96MA079	Yes	Yes
AAR-98/02	DCA97MA059	Yes	Yes
AAR-98/01	DCA96MA068	Yes	Yes
AAR-97/06	DCA96MA054	Yes	Yes
AAR-97/03	NYC97MA005	Yes	Yes
AAR-97/01	FTW96FA118	Yes	Yes
AAR-96/07	MIA96FA059	Yes	Yes
AAR-96/05	DCA96MA008	Yes	Yes
AAR-96/04	DCA96MA029	Yes	Yes
AAR-96/03	ATL95MA106	Yes	Yes
AAR-96/01	DCA95MA001	Yes	Yes
AAR-95/05	CHI95MA044A	Yes	Yes
AAR-95/03	DCA94MA065	Yes	Yes
AAR-95/01	DCA94MA038	Yes	Yes
AAR-94/06	DCA94MA033	Yes	Yes
AAR-94/04	DCA93RA060	Yes	Yes
AAR-94/01	DCA93MA040	Yes	Yes
AAR-93/04	DCA92MA044	Yes	Yes
AAR-93/02	DCA92MA025	Yes	Yes
AAR-92/05	DCA92MA022	Yes	Yes
AAR-91/09	DCA91MA021	Yes	Yes
AAR-91/08	DCA91MA018A	No	Yes

APPENDIX S

ACCIDENT, INCIDENT, FAA ENFORCEMENT DATA

		Accidents, Incidents, Violations	
NTSB Report	NTSB ID	Captain	First Officer
AAR-11/02	CEN09MA142	No	No
AAR-10/04	DCA09MA021	No	No
AAR-10/03	DCA09MA026	No	No
AAR-10/01	DCA09MA027	No	No
AAR-09/03	DCA07MA310	No	No
AAR-08/02	DCA07FA037	No	No
AAR-08/01	DCA07MA072	No	No
AAR-07/07	DCA06MA022	No	No
AAR-07/06	DCA06MA009	No	No
AAR-07/05	DCA06MA064	No	No
AAR-07/04	DCA06MA010	No	No
AAR-06/03	DCA04MA068	No	No
AAR-06/01	DCA05MA004	No	No
AAB-06/02	FTW03MA160	No	No
AAR-05/02	DCA04MA045	Unknown	Unknown
AAR-05/01	DCA04MA011	No	No
AAR-04/04	DCA02MA001	No	No
AAR-04/02	DCA02MA054	Unknown	Unknown
AAR-04/01	DCA03MA022	No	No
AAR-03/02	DCA00MA026	Unknown	Unknown
AAB-02/04	DCA00MA030	No	No
AAR-02/01	DCA00MA023	No	No
AAR-01/02	DCA99MA060	No	No
AAR-01/01	DCA91MA023	No	No
AAB-01/01	DCA98MA023	Unknown	Unknown
AAR-00/03	DCA96MA070	Unknown	Unknown
AAR-00/02	DCA97MA055	No	No
AAR-99/01	DCA94MA076	No	No
AAR-98/03	DCA96MA079	No	No
AAR-98/02	DCA97MA059	Yes	No
AAR-98/01	DCA96MA068	No	No
AAR-97/06	DCA96MA054	Yes	Unknown
AAR-97/03	NYC97MA005	Unknown	Unknown
AAR-97/01	FTW96FA118	No	No
AAR-96/07	MIA96FA059	Yes	Unknown
AAR-96/05	DCA96MA008	No	No
AAR-96/04	DCA96MA029	Unknown	Unknown
AAR-96/03	ATL95MA106	Unknown	Unknown
AAR-96/01	DCA95MA001	No	No
AAR-95/05	CHI95MA044A	No	No
AAR-95/03	DCA94MA065	Unknown	Unknown
AAR-95/01	DCA94MA038	No	No
AAR-94/06	DCA94MA033	Unknown	Unknown
AAR-94/04	DCA93RA060	No	No
AAR-94/01	DCA93MA040	No	No
AAR-93/04	DCA92MA044	Unknown	Unknown
AAR-93/02	DCA92MA025	No	No
AAR-92/05	DCA92MA022	Unknown	Unknown
AAR-91/09	DCA91MA021	Yes	Unknown
AAR-91/08	DCA91MA018A	No	No

APPENDIX T

DRIVER'S LICENSE SUSPENSION/REVOCATION DATA

		Driver's License Suspensions/ Revocations	
NTSB Report	NTSB ID	Captain	First Officer
AAR-11/02	CEN09MA142	Unknown	Unknown
AAR-10/04	DCA09MA021	No	No
AAR-10/03	DCA09MA026	No	No
AAR-10/01	DCA09MA027	No	No
AAR-09/03	DCA07MA310	No	No
AAR-08/02	DCA07FA037	No	No
AAR-08/01	DCA07MA072	No	No
AAR-07/07	DCA06MA022	No	No
AAR-07/06	DCA06MA009	No	No
AAR-07/05	DCA06MA064	No	No
AAR-07/04	DCA06MA010	No	No
AAR-06/03	DCA04MA068	No	No
AAR-06/01	DCA05MA004	No	No
AAB-06/02	FTW03MA160	No	No
AAR-05/02	DCA04MA045	Unknown	Unknown
AAR-05/01	DCA04MA011	No	Yes
AAR-04/04	DCA02MA001	No	No
AAR-04/02	DCA02MA054	Unknown	Unknown
AAR-04/01	DCA03MA022	No	No
AAR-03/02	DCA00MA026	Unknown	Unknown
AAB-02/04	DCA00MA030	No	No
AAR-02/01	DCA00MA023	No	No
AAR-01/02	DCA99MA060	No	No
AAR-01/01	DCA91MA023	Unknown	Unknown
AAB-01/01	DCA98MA023	Unknown	Unknown
AAR-00/03	DCA96MA070	Unknown	Unknown
AAR-00/02	DCA97MA055	No	No
AAR-99/01	DCA94MA076	Unknown	Unknown
AAR-98/03	DCA96MA079	No	No
AAR-98/02	DCA97MA059	Unknown	No
AAR-98/01	DCA96MA068	No	No
AAR-97/06	DCA96MA054	Unknown	Unknown
AAR-97/03	NYC97MA005	Unknown	Unknown
AAR-97/01	FTW96FA118	No	No
AAR-96/07	MIA96FA059	Unknown	Unknown
AAR-96/05	DCA96MA008	Unknown	Unknown
AAR-96/04	DCA96MA029	Unknown	Unknown
AAR-96/03	ATL95MA106	Unknown	Unknown
AAR-96/01	DCA95MA001	No	No
AAR-95/05	CHI95MA044A	Unknown	Unknown
AAR-95/03	DCA94MA065	Unknown	Unknown
AAR-95/01	DCA94MA038	No	No
AAR-94/06	DCA94MA033	Unknown	Unknown
AAR-94/04	DCA93RA060	Unknown	Unknown
AAR-94/01	DCA93MA040	Unknown	Unknown
AAR-93/04	DCA92MA044	Unknown	Unknown
AAR-93/02	DCA92MA025	Unknown	Unknown
AAR-92/05	DCA92MA022	Unknown	Unknown
AAR-91/09	DCA91MA021	No	No
AAR-91/08	DCA91MA018A	Unknown	Unknown

APPENDIX U

UNSATISFACTORY FLIGHT EVALUATION DATA

		Past Unsatisfactory Flight Examinations	
NTSB Report	NTSB ID	Captain	First Officer
AAR-11/02	CEN09MA142	No	No
AAR-10/04	DCA09MA021	No	No
AAR-10/03	DCA09MA026	No	No
AAR-10/01	DCA09MA027	Yes	Yes
AAR-09/03	DCA07MA310	No	No
AAR-08/02	DCA07FA037	No	No
AAR-08/01	DCA07MA072	No	No
AAR-07/07	DCA06MA022	No	No
AAR-07/06	DCA06MA009	No	No
AAR-07/05	DCA06MA064	No	No
AAR-07/04	DCA06MA010	No	No
AAR-06/03	DCA04MA068	Yes	Yes
AAR-06/01	DCA05MA004	No	No
AAB-06/02	FTW03MA160	No	No
AAR-05/02	DCA04MA045	Yes	No
AAR-05/01	DCA04MA011	No	Yes
AAR-04/04	DCA02MA001	No	No
AAR-04/02	DCA02MA054	No	No
AAR-04/01	DCA03MA022	No	No
AAR-03/02	DCA00MA026	No	No
AAB-02/04	DCA00MA030	No	No
AAR-02/01	DCA00MA023	No	No
AAR-01/02	DCA99MA060	No	No
AAR-01/01	DCA91MA023	No	No
AAB-01/01	DCA98MA023	No	No
AAR-00/03	DCA96MA070	No	No
AAR-00/02	DCA97MA055	Yes	No
AAR-99/01	DCA94MA076	No	No
AAR-98/03	DCA96MA079	No	No
AAR-98/02	DCA97MA059	No	No
AAR-98/01	DCA96MA068	No	No
AAR-97/06	DCA96MA054	No	No
AAR-97/03	NYC97MA005	No	No
AAR-97/01	FTW96FA118	No	Yes
AAR-96/07	MIA96FA059	No	No
AAR-96/05	DCA96MA008	No	No
AAR-96/04	DCA96MA029	No	No
AAR-96/03	ATL95MA106	No	No
AAR-96/01	DCA95MA001	No	No
AAR-95/05	CHI95MA044A	No	No
AAR-95/03	DCA94MA065	No	No
AAR-95/01	DCA94MA038	No	No
AAR-94/06	DCA94MA033	No	No
AAR-94/04	DCA93RA060	No	No
AAR-94/01	DCA93MA040	No	No
AAR-93/04	DCA92MA044	No	No
AAR-93/02	DCA92MA025	No	No
AAR-92/05	DCA92MA022	Yes	No
AAR-91/09	DCA91MA021	No	No
AAR-91/08	DCA91MA018A	No	No

APPENDIX V

CONTENT ANALYSIS #1: SEQUENCE OF EVENTS DATA

NTSB Report: AAR-11/02

Findings
1. Personnel issues-Task performance-Use of equip/info-Aircraft control-Flight crew - C
2. Aircraft-Aircraft oper/perf/capability-Performance/control parameters-Airspeed-Not attained/maintained - C
3. Environmental issues-Conditions/weather/phenomena-Ceiling/visibility/precip-Freezing rain/sleet-Effect on equipment
4. Personnel issues-Action/decision-Action-Incorrect action performance-Pilot - F
5. Personnel issues-Action/decision-Info processing/decision-(general)-Flight crew - F
6. Personnel issues-Physical-Alertness/Fatigue-Lack of sleep-Pilot - F
7. Personnel issues-Physical-Alertness/Fatigue-Circadian rhythms or jetlag-Pilot - F
8. Personnel issues-Task performance-Communication (personnel)-CRM/MRM techniques-Flight crew - F

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2011).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-11/02	CEN09MA142	Factor/Cause	Not Cited	Not Cited	Not Cited
	Associated Findings	1, 2, 4, 5, 6, 7, 8			

NTSB Report: AAR-10/04

Findings
1. Aircraft-Aircraft oper/perf/capability-Performance/control parameters-Directional control-Not attained/maintained-C
2. Aircraft-Aircraft oper/perf/capability-Performance/control parameters-Crosswind correction-Not attained/maintained - C
3. Environmental issues-Conditions/weather/phenomena-Wind-Crosswind-Response/compensation - C
4. Personnel issues-Action/decision-Action-Incomplete action-Pilot - C
5. Personnel issues-Task performance-Use of equip/info-Aircraft control-Pilot
6. Environmental issues-Conditions/weather/phenomena-Wind-Crosswind-Availability of related info - F
7. Organizational issues-Management-Communication (organizational)-Between groups/organizations-ATC - F
8. Organizational issues-Support/oversight/monitoring-Training-(general)-Not specified - F

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2010).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-10/04	DCA09MA021	Cause	Factor	Not Cited	Factor
	Associated Findings	1, 2, 3, 4, 5	6		7, 8

NTSB Report: AAR-10/03

Findings
1. Environmental issues-Physical environment-Object/animal/substance-Animal(s)/bird(s)-Effect on equipment - C
2. Organizational issues-Development-Selection/certification/testing-Equip certification/testing-FAA/Regulator - F
3. Aircraft-Aircraft oper/perf/capability-Performance/control parameters-(general)-Related operating info - F
4. Aircraft-Aircraft oper/perf/capability-Performance/control parameters-Airspeed-Not attained/maintained - F
5. Environmental issues-Task environment-Pressures/demands-Other pressure/demand-Effect on personnel - F

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2010).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-10/03	DCA09MA026	Factor	Factor/Cause	Not Cited	Factor
	Associated Findings	4	1, 5		2, 3

NTSB Report: AAR-10/01

Findings

1. Aircraft-Aircraft systems-Navigation system-Stall warning system-Incorrect use/operation - C
2. Personnel issues-Action/decision-Action-Incorrect action selection-Pilot - C
3. Personnel issues-Psychological-Attention/monitoring-Monitoring equip/instruments-Flight crew - F
4. Personnel issues-Task performance-Communication (personnel)-CRM/MRM techniques-Flight crew - F
5. Personnel issues-Task performance-Workload management-(general)-Pilot - F
6. Organizational issues-Management-Policy/procedure-Adequacy of policy/proc-Operator - F
7. Environmental issues-Conditions/weather/phenomena-Temp/humidity/pressure-Conducive to structural icing-Not specified

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2010).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-10/01	DCA09MA027	Factor/Cause	Not Cited	Not Cited	Factor
Associated Findings		1, 2, 3, 4, 5			6

NTSB Report: AAR-09/03

Findings

1. TURBINE ASSEMBLY
2. (C) CHECKLIST - FLIGHTCREW
3. (C) PROCEDURE INADEQUATE - COMPANY MAINTENANCE PERSONNEL
4. (C) INADEQUATE SURVEILLANCE OF OPERATION - COMPANY/OPERATOR MGMT

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2009).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-09/03	DCA07MA310	Cause	Not Cited	Not Cited	Cause
Associated Findings		1			2, 3

NTSB Report: AAR-08/02

Findings

1. (F) WEATHER CONDITION - SNOW
2. (C) IN-FLIGHT PLANNING/DECISION - IMPROPER - PILOT IN COMMAND
3. (F) FATIGUE - FLIGHTCREW

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2008).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-08/02	DCA07FA037	Factor/Cause	Factor	Not Cited	Not Cited
Associated Findings		2, 3	1		

NTSB Report: AAR-08/01

Findings
1. (C) MISSED APPROACH - NOT PERFORMED - FLIGHTCREW
2. (F) FATIGUE - PILOT IN COMMAND
3. (F) AIRPORT FACILITIES,RUNWAY/LANDING AREA CONDITION - OTHER
4. (F) PROCEDURE INADEQUATE - COMPANY/OPERATOR MANAGEMENT
5. OBJECT - ANTENNA

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2008).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-08/01	DCA07MA072	Factor/Cause	Factor	Not Cited	Factor
Associated Findings		1, 2	3		4

NTSB Report: AAR-07/07

Findings
1. (C) CARGO/BAGGAGE - FIRE
2. (F) FIRE EXTINGUISHER,CARGO - LACK OF
3. FIRE WARNING SYSTEM,CARGO - INADEQUATE
4. SMOKE DETECTOR(S) - INADEQUATE
5. (F) ACFT/EQUIP,INADEQUATE STANDARD/REQUIREMENT
6. (F) INADEQUATE CERTIFICATION/APPROVAL

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2007).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-07/07	DCA06MA022	Not Cited	Not Cited	Not Cited	Factor
Associated Findings					2, 5, 6

NTSB Report: AAR-07/06

Findings
1. (C) THRUST REVERSER - INADEQUATE
2. (C) PROCEDURES/DIRECTIVES - NOT FOLLOWED - FLIGHTCREW
3. (C) LACK OF FAMILIARITY WITH AIRCRAFT - FLIGHTCREW
4. (F) PROCEDURE INADEQUATE
5. (F) CONDITION(S)/STEP(S) INSUFFICIENTLY DEFINED - COMPANY/OPERATOR MANAGEMENT
6. OBJECT - FENCE
7. OBJECT - VEHICLE

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2007).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-07/06	DCA06MA009	Cause	Not Cited	Not Cited	Factor
Associated Findings		1, 2, 3			4, 5

NTSB Report: AAR-07/05

Findings
1. LIGHT CONDITION - DARK NIGHT
2. (F) PROCEDURES/DIRECTIVES - NOT FOLLOWED - FLIGHTCREW
3. (C) BECAME LOST/DISORIENTED - INATTENTIVE - FLIGHTCREW
4. (C) WRONG TAXI ROUTE - NOT DETECTED - FLIGHTCREW
5. (F) INSTRUCTIONS,WRITTEN/VERBAL - NOT REQUIRED - FAA(OTHER/ORGANIZATION)
6. (F) PROCEDURE INADEQUATE - FAA(OTHER/ORGANIZATION)
7. (C) WRONG RUNWAY - INATTENTIVE - FLIGHTCREW
8. (C) WRONG RUNWAY - NOT DETECTED - FLIGHTCREW

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2007).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-07/05	DCA06MA064	Factor/Cause	Not Cited	Not Cited	Factor
Associated Findings		2, 3, 4, 7, 8			5, 6

NTSB Report: AAR-07/04

Findings
1. (C) WING - FAILURE,TOTAL
2. (C) MAINTENANCE - INADEQUATE - COMPANY MAINTENANCE PERSONNEL
3. (C) PROCEDURE INADEQUATE - COMPANY/OPERATOR MANAGEMENT
4. (C) INADEQUATE SURVEILLANCE OF OPERATION - FAA(ORGANIZATION)
5. TERRAIN CONDITION – GROUND

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2007).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-07/04	DCA06MA010	Not Cited	Not Cited	Cause	Cause
Associated Findings				1	2, 3, 4

NTSB Report: AAR-06/03

Findings
1. (C) FLUID,FUEL - STARVATION
2. (C) CHECKLIST - NOT FOLLOWED - PILOT IN COMMAND
3. (F) PREFLIGHT PLANNING/PREPARATION - INADEQUATE - PILOT IN COMMAND
4. (F) INATTENTIVE - PILOT IN COMMAND
5. (F) CHECKLIST - DELAYED - PILOT IN COMMAND
6. (F) ENGINE INSTRUMENTS,FUEL QUANTITY GAGE - STARVATION
7. (F) IN-FLIGHT PLANNING/DECISION - INADEQUATE - FLIGHTCREW
8. (F) INATTENTIVE - FLIGHTCREW
9. (F) AIRCRAFT HANDLING - NOT RECOGNIZED - FLIGHTCREW
10. TERRAIN CONDITION - GROUND

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2006).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-06/03	DCA04MA068	Factor/Cause	Not Cited	Not Cited	Not Cited
Associated Findings		1, 2, 3, 4, 5, 6, 7, 8, 9			

NTSB Report: AAR-06/01

Findings
1. (F) LIGHT CONDITION - NIGHT
2. (C) MINIMUM DESCENT ALTITUDE - CONTINUED BELOW - FLIGHTCREW
3. OBJECT - TREE(S)
4. (C) CREW/GROUP COORDINATION - INADEQUATE - FLIGHTCREW
5. (F) FATIGUE - FLIGHTCREW

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2006).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-06/01	DCA05MA004	Factor/Cause	Factor	Not Cited	Not Cited
Associated Findings		2, 4, 5	1		

NTSB Report: AAB-06/02

Findings
1. (F) WEATHER CONDITION - THUNDERSTORM
2. (F) WEATHER CONDITION - GUSTS
3. (F) WEATHER CONDITION - VARIABLE WIND
4. (F) WEATHER CONDITION - RAIN
5. (F) FLIGHT INTO KNOWN ADVERSE WEATHER - CONTINUED - FLIGHTCREW
6. (F) VISUAL LOOKOUT - REDUCED - FLIGHTCREW
7. (C) PROPER ALIGNMENT - NOT MAINTAINED - FLIGHTCREW
8. (C) DIRECTIONAL CONTROL - NOT MAINTAINED - FLIGHTCREW
9. OBJECT - RUNWAY LIGHT

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2006).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAB-06/02	FTW03MA160	Factor/Cause	Factor	Not Cited	Not Cited
Associated Findings		5, 6, 7, 8	1, 2, 3, 4		

NTSB Report: AAR-05/02

Findings
1. FLARE - IMPROPER
2. (C) RECOVERY FROM BOUNCED LANDING - ATTEMPTED - PILOT IN COMMAND
3. (C) GO-AROUND - NOT PERFORMED - PILOT IN COMMAND
4. LANDING GEAR,MAIN GEAR - OVERLOAD
5. LANDING GEAR,MAIN GEAR - FAILURE

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2005).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-05/02	DCA04MA045	Cause	Not Cited	Not Cited	Not Cited
Associated Findings		2, 3			

NTSB Report: AAR-05/01

Findings
1. (C) PROPER ALIGNMENT - IMPROPER - COPILOT/SECOND PILOT
2. (C) FLARE - IMPROPER - COPILOT/SECOND PILOT
3. (C) SUPERVISION - INADEQUATE - CHECK PILOT
4. (C) LANDING GEAR,MAIN GEAR - OVERLOAD

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2005).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-05/01	DCA04MA011	Cause	Not Cited	Not Cited	Not Cited
Associated Findings		1, 2, 3, 4			

NTSB Report: AAR-04/04

Findings
1. COMPENSATION FOR WIND CONDITIONS - PERFORMED
2. (F) WEATHER CONDITION - GUSTS
3. (C) RUDDER - EXCESSIVE
4. (F) INADEQUATE TRAINING - COMPANY/OPERATOR MANAGEMENT
5. VERTICAL STABILIZER - OVERLOAD
6. VERTICAL STABILIZER - FAILURE
7. (C) VERTICAL STABILIZER - SEPARATION
8. AIRCRAFT CONTROL - NOT POSSIBLE
9. TERRAIN CONDITION – GROUND

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2004).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-04/04	DCA02MA001	Cause	Factor	Cause	Factor
Associated Findings		3	2	7	4

NTSB Report: AAR-04/02

Findings
1. (F) LIGHT CONDITION - DARK NIGHT
2. (C) PROPER GLIDEPATH - NOT ATTAINED - FLIGHTCREW
3. (F) FATIGUE - FLIGHTCREW
4. (C) CREW/GROUP COORDINATION - INADEQUATE
5. TERRAIN CONDITION - RUNWAY

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2004).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-04/02	DCA02MA054	Factor/Cause	Factor	Not Cited	Not Cited
Associated Findings		2, 3, 4	1		

NTSB Report: AAR-04/01

Findings
1. (C) FLT CONTROL SYST,ELEVATOR CONTROL - MOVEMENT RESTRICTED
2. (C) MAINTENANCE,ADJUSTMENT - IMPROPER - OTHER MAINTENANCE PERSONNEL
3. (C) IMPROPER USE OF PROCEDURE - COMPANY MAINTENANCE PERSONNEL
4. (F) INADEQUATE SURVEILLANCE OF OPERATION - COMPANY/OPERATOR MGMT
5. (C) AIRCRAFT PERFORMANCE,TAKEOFF CAPABILITY - DETERIORATED
6. MAINTENANCE,ADJUSTMENT
7. (F) INADEQUATE SURVEILLANCE OF OPERATION - FAA(ORGANIZATION)
8. (C) AIRCRAFT WEIGHT AND BALANCE
9. (C) MATERIAL INADEQUATE - COMPANY/OPERATOR MANAGEMENT
10. (F) INADEQUATE SURVEILLANCE OF OPERATION - FAA(ORGANIZATION)
11. AIRCRAFT WEIGHT AND BALANCE
12. (F) INADEQUATE SURVEILLANCE,INADEQUATE PROCEDURE - FAA(ORGANIZATION)
13. AIRCRAFT WEIGHT AND BALANCE
14. (F) INADEQUATE SURVEILLANCE,INADEQUATE PROCEDURE - COMPANY/OPERATOR MGMT
15. TERRAIN CONDITION - GROUND

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2004).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-04/01	DCA03MA022	Not Cited	Not Cited	Cause	Factor/Cause
Associated Findings				1, 5	2, 3, 4, 7, 8, 9, 10, 12, 14

NTSB Report: AAR-03/02

Findings
1. (C) MISCELLANEOUS,BOLT/NUT/FASTENER/CLAMP/SPRING - NOT SECURED
2. (C) MAINTENANCE,INSTALLATION - INADEQUATE
3. (C) MAINTENANCE,INSPECTION - INADEQUATE
4. (C) FLT CONTROL SYST,ELEVATOR TRIM/TAB CONTROL - DISCONNECTED
5. (C) FLT CONTROL SYST,ELEVATOR TRIM/TAB CONTROL - MOVEMENT RESTRICTED
6. (C) AIRCRAFT CONTROL - RESTRICTED
7. TERRAIN CONDITION - GROUND

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2003).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-03/02	DCA00MA026	Not Cited	Not Cited	Cause	Cause
Associated Findings				4, 5, 6	1, 2, 3

NTSB Report: AAB-02/04

Findings
1. (C) AIRSPEED - EXCESSIVE - FLIGHTCREW
2. (C) FLIGHTCREW
3. (C) IMPROPER DECISION - FLIGHTCREW
4. (C) GO-AROUND - NOT PERFORMED - FLIGHTCREW
5. (F) IMPROPER DECISION - ATC PERSONNEL(DEP/APCH)
6. OBJECT - FENCE

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2002).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAB-02/04	DCA00MA030	Cause	Not Cited	Not Cited	Factor
Associated Findings		1, 2, 3, 4			5

NTSB Report: AAR-02/01

Findings

1. (C) LUBRICANT,GREASE - INADEQUATE
2. (C) MAINTENANCE,LUBRICATION - INADEQUATE - COMPANY MAINTENANCE PERSONNEL
3. PROCEDURE INADEQUATE
4. (F) INSUFFICIENT STANDARDS/REQUIREMENTS - COMPANY/OPERATOR MGMT
5. (F) INADEQUATE CERTIFICATION/APPROVAL - FAA(ORGANIZATION)
6. (C) FLT CONTROL SYST,HORIZ STAB DRIVE - WORN
7. (C) MAINTENANCE,INSPECTION - INADEQUATE - COMPANY MAINTENANCE PERSONNEL
8. PROCEDURE INADEQUATE
9. (F) INSUFFICIENT STANDARDS/REQUIREMENTS - COMPANY/OPERATOR MGMT
10. (F) INADEQUATE CERTIFICATION/APPROVAL - FAA(ORGANIZATION)
11. FLT CONTROL SYST,HORIZ STAB DRIVE - STRIPPED THREAD
12. (F) INADEQUATE CERTIFICATION/APPROVAL - MANUFACTURER
13. (C) AIRCRAFT CONTROL - NOT POSSIBLE
14. TERRAIN CONDITION – WATER

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2002).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-02/01	DCA00MA023	Not Cited	Not Cited	Cause	Factor/Cause
	Associated Findings			6, 13	1, 2, 4, 5, 7, 9, 10, 12

NTSB Report: AAR-01/02

Findings

1. (C) FLIGHT INTO KNOWN ADVERSE WEATHER - CONTINUED - FLIGHTCREW
2. (F) FATIGUE - FLIGHTCREW
3. (C) IMPROPER DECISION - FLIGHTCREW
4. (F) PROCEDURES/DIRECTIVES - NOT COMPLIED WITH - FLIGHTCREW
5. (F) IMPROPER USE OF PROCEDURE - FLIGHTCREW
6. (C) SPOILER EXTENSION - NOT VERIFIED - FLIGHTCREW
7. (F) REVERSERS - EXCESSIVE - FLIGHTCREW
8. (F) IMPROPER USE OF EQUIPMENT/AIRCRAFT - FLIGHTCREW
9. (F) OBJECT - APPROACH LIGHT/NAVAID

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2001).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-01/02	DCA99MA060	Factor/Cause	Factor	Not Cited	Not Cited
	Associated Findings	1, 2, 3, 4, 5, 6, 7, 8	9		

NTSB Report: AAR-01/01

Findings

1. (C) FLIGHT CONTROL,RUDDER SURFACE - UNCOMMANDED
2. (C) FLIGHT CONTROL,RUDDER - JAMMED
3. AIRCRAFT CONTROL - NOT POSSIBLE
4. TERRAIN CONDITION - GROUND

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2001).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-01/01	DCA91MA023	Not Cited	Not Cited	Cause	Not Cited
	Associated Findings			1, 2	

NTSB Report: AAB-01/01

Findings
1. WEATHER CONDITION - LOW CEILING
2. (F) AUTOPILOT - IMPROPER
3. VISUAL/AURAL DETECTION - PILOT IN COMMAND
4. (C) AIRCRAFT CONTROL - NOT MAINTAINED - FLIGHTCREW
5. COMMUNICATIONS/INFORMATION/ATC - NOT COMPLIED WITH - ATC PERSONNEL(LCL/GND/CLNC)
6. AIR/GROUND COMMUNICATIONS - NOT USED - ATC PERSONNEL(LCL/GND/CLNC)

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2001).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAB-01/01	DCA98MA023	Cause	Not Cited	Factor	Not Cited
Associated Findings		4		2	

NTSB Report: AAR-00/03

Findings
1. ELECTRICAL SYSTEM - UNDETERMINED
2. FUEL SYSTEM,TANK - EXPLODED

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2000).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-00/03	DCA96MA070	Not Cited	Not Cited	Not Cited	Not Cited
Associated Findings					

NTSB Report: AAR-00/02

Findings
1. (C) AIRCRAFT CONTROL - INADEQUATE - PILOT IN COMMAND
2. LANDING GEAR,MAIN GEAR ATTACHMENT - SEPARATION
3. LANDING GEAR,MAIN GEAR ATTACHMENT - OVERLOAD
4. WING - SEPARATION
5. WING - OVERLOAD

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 2000).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-00/02	DCA97MA055	Cause	Not Cited	Not Cited	Not Cited
Associated Findings		1			

NTSB Report: AAR-99/01

Findings
1. (C) FLIGHT CONTROL,RUDDER SURFACE - UNCOMMANDED
2. (C) FLIGHT CONTROL,RUDDER - JAMMED
3. AIRCRAFT CONTROL - NOT POSSIBLE
4. TERRAIN CONDITION - GROUND

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 1999).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-99/01	DCA94MA076	Not Cited	Not Cited	Cause	Not Cited
Associated Findings				1, 2	

NTSB Report: AAR-98/03

Findings
1. (C) CARGO/BAGGAGE - SMOKE
2. (C) CARGO/BAGGAGE - FIRE
3. (C) CARGO/BAGGAGE - UNDETERMINED
4. SUPERVISION - INADEQUATE - PILOT IN COMMAND
5. HAZARDOUS MATERIAL
6. INFORMATION INSUFFICIENT - OTHER GOVERNMENT PERSONNEL

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 1998).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-98/03	DCA96MA079	Not Cited	Not Cited	Not Cited	Not Cited
Associated Findings					

NTSB Report: AAR-98/02

Findings
1. (C) AIRCRAFT WEIGHT AND BALANCE - INADEQUATE
2. (C) IMPROPER USE OF PROCEDURE - OTHER PERSON
3. (C) INADEQUATE SURVEILLANCE OF OPERATION - COMPANY/OPERATOR MGMT
4. (C) INADEQUATE SURVEILLANCE OF OPERATION - FAA(ORGANIZATION)
5. (C) TRIM SETTING - IMPROPER
6. (C) AIRCRAFT CONTROL - NOT POSSIBLE - PILOT IN COMMAND
7. (C) AIRSPEED - NOT MAINTAINED
8. STALL
9. TERRAIN CONDITION - GROUND
10. OBJECT – VEHICLE

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 1998).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-98/02	DCA97MA059	Not Cited	Not Cited	Not Cited	Cause
Associated Findings					1, 2, 3, 4, 5

Note: Finding 5, 6, and 7 were the result of inadequate weight and balance (control was not possible for the pilots)

NTSB Report: AAR-98/01

Findings
1. 1 ENGINE
2. (C) COMPRESSOR ASSEMBLY,ROTOR DISC - FATIGUE
3. (C) MAINTENANCE,INSPECTION - INADEQUATE - COMPANY MAINTENANCE PERSONNEL
4. (C) COMPRESSOR ASSEMBLY,ROTOR DISC - FRACTURED
5. COMPRESSOR ASSEMBLY,ROTOR DISC - SEPARATION
6. MISC,ENGINE UNCONTAINED FAILURE
7. FUSELAGE,CABIN - FOREIGN OBJECT DAMAGE

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 1998).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-98/01	DCA96MA068	Not Cited	Not Cited	Cause	Cause
Associated Findings				2, 4	3

NTSB Report: AAR-97/06

Findings
1. (C) HAZARDOUS MATERIAL - IMPROPER
2. (C) PROCEDURE INADEQUATE - OTHER PERSON
3. (C) CARGO/BAGGAGE - IMPROPER
4. (C) MAINTENANCE - INADEQUATE - COMPANY/OPERATOR MANAGEMENT
5. (C) SMOKE DETECTOR(S) - NOT INSTALLED
6. (C) FIRE EXTINGUISHER,CARGO - NOT INSTALLED
7. (C) INSUFFICIENT STANDARDS/REQUIREMENTS - FAA(ORGANIZATION)
8. FUSELAGE,CARGO COMPARTMENT - FIRE

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 1997).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-97/06	DCA96MA054	Not Cited	Not Cited	Not Cited	Cause
Associated Findings					1, 2, 3, 4, 5, 6, 7

NTSB Report: AAR-97/03

Findings
1. (F) WEATHER CONDITION - RAIN
2. (F) WEATHER CONDITION - FOG
3. (C) DISTANCE/ALTITUDE - MISJUDGED - PILOT IN COMMAND
4. (C) VISUAL ILLUSION - PILOT IN COMMAND

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 1997).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-97/03	NYC97MA005	Cause	Factor	Not Cited	Not Cited
Associated Findings		3, 4	1, 2		

NTSB Report: AAR-97/01

Findings
1. (F) CHECKLIST - NOT COMPLIED WITH - FLIGHTCREW
2. HYDRAULIC SYSTEM - NOT SELECTED - FLIGHTCREW
3. (F) CHECKLIST - NOT USED - FLIGHTCREW
4. (F) GEAR DOWN AND LOCKED - NOT VERIFIED - FLIGHTCREW
5. (C) GO-AROUND - NOT PERFORMED - PILOT IN COMMAND
6. (F) INADEQUATE SUBSTANTIATION PROCESS - COMPANY/OPERATOR MGMT
7. (F) INADEQUATE SURVEILLANCE OF OPERATION - FAA(ORGANIZATION)
8. WHEELS UP LANDING - INADVERTENT

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 1997).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-97/01	FTW96FA118	Factor/Cause	Not Cited	Not Cited	Factor
Associated Findings		1, 3, 4, 5			6, 7

NTSB Report: AAR-96/07

Findings
1. WEATHER CONDITION - TEMPERATURE,LOW
2. LANDING GEAR,NOSE GEAR STRUT - IMPROPER
3. LANDING GEAR,GEAR SWITCH - MOVEMENT RESTRICTED
4. EMERGENCY PROCEDURE - PERFORMED - FLIGHTCREW
5. ELECTRICAL SYSTEM,CIRCUIT BREAKER - OPEN
6. (F) CHECKLIST - INACCURATE - COMPANY/OPERATOR MANAGEMENT
7. (C) PLANNING/DECISION - IMPROPER - FLIGHTCREW
8. (C) CIRCUIT BREAKER - SELECTED - FLIGHTCREW
9. (F) LACK OF FAMILIARITY WITH AIRCRAFT - FLIGHTCREW
10. (C) SPOILER EXTENSION - INADVERTENT ACTIVATION - FLIGHTCREW

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 1996).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-96/07	MIA96FA059	Factor/Cause	Not Cited	Not Cited	Factor
Associated Findings		7, 8, 9, 10			6

NTSB Report: AAR-96/05

Findings
1. LIGHT CONDITION - DARK NIGHT
2. WEATHER CONDITION - RAIN
3. WEATHER CONDITION - HIGH WIND
4. WEATHER CONDITION - GUSTS
5. (F) APPROACH/DEPARTURE CONTROL SERVICE - INADEQUATE - ATC PERSONNEL(DEP/APCH)
6. (F) ALTIMETER SETTING - NOT OBTAINED - FLIGHTCREW
7. (C) MINIMUM DESCENT ALTITUDE - BELOW - FLIGHTCREW
8. OBJECT - TREE(S)
9. OBJECT - ANTENNA

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 1996).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-96/05	DCA96MA008	Factor/Cause	Not Cited	Not Cited	Factor
Associated Findings		6, 7			5

NTSB Report: AAR-96/04

Findings
1. (F) AIRPORT FACILITIES,RUNWAY/LANDING AREA CONDITION - SNOW COVERED
2. (F) AIRPORT FACILITIES,RUNWAY/LANDING AREA CONDITION - ICY
3. (F) NOSEWHEEL STEERING - EXCESSIVE - PILOT IN COMMAND
4. (F) DIRECTIONAL CONTROL - NOT MAINTAINED - PILOT IN COMMAND
5. (F) PROCEDURE INADEQUATE - COMPANY/OPERATOR MANAGEMENT
6. (F) PROCEDURE INADEQUATE - MANUFACTURER
7. (F) FACILITY INADEQUATE
8. (C) ABORTED TAKEOFF - DELAYED - PILOT IN COMMAND
9. (F) THROTTLE/POWER CONTROL - IMPROPER USE OF - PILOT IN COMMAND
10. OBJECT - AIRPORT SIGN/MARKER
11. OBJECT - OTHER

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 1996).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-96/04	DCA96MA029	Factor/Cause	Factor	Not Cited	Factor
Associated Findings		3, 4, 8, 9	1, 2, 7		5, 6

NTSB Report: AAR-96/03

Findings
1. (C) COMPRESSOR ASSEMBLY,ROTOR DISC - FATIGUE
2. (C) MAINTENANCE,INSPECTION - IMPROPER - OTHER MAINTENANCE PERSONNEL
3. (F) MAINTENANCE,RECORDKEEPING - INADEQUATE - OTHER MAINTENANCE PERSONNEL
4. (F) PROCEDURE INADEQUATE - OTHER MAINTENANCE PERSONNEL
5. (C) COMPRESSOR ASSEMBLY,ROTOR DISC - FAILURE
6. ABORTED TAKEOFF - PERFORMED
7. FUSELAGE - FIRE

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 1996).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-96/03	ATL95MA106	Not Cited	Not Cited	Cause	Factor/Cause
Associated Findings				1, 5	2, 3, 4

NTSB Report: AAR-96/01

Findings
1. WEATHER CONDITION - ICING CONDITIONS
2. (C) AIRFRAME - ICE
3. (C) ACFT/EQUIP,INADEQUATE AIRCRAFT MANUALS - MANUFACTURER
4. (C) AIRCRAFT/EQUIPMENT INADEQUATE - MANUFACTURER
5. (C) INADEQUATE SUBSTANTIATION PROCESS - OTHER GOVT ORGANIZATION
6. (F) INADEQUATE SUBSTANTIATION PROCESS - FAA(ORGANIZATION)
7. (F) INFORMATION INSUFFICIENT - FAA(OTHER/ORGANIZATION)

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 1996).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-96/01	DCA95MA001	Not Cited	Cause	Not Cited	Factor/Cause
Associated Findings			2		3, 4, 5, 6, 7

NTSB Report: AAR-95/05

Findings
1. (C) WRONG RUNWAY - SELECTED - PILOT OF OTHER AIRCRAFT
2. EXPECTANCY - PILOT OF OTHER AIRCRAFT
3. (F) COMMUNICATIONS/INFORMATION/ATC - INADEQUATE
4. (F) RADAR,ASDE - UNAVAILABLE

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 1995).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-95/05	CHI95MA044A	Not Cited	Not Cited	Not Cited	Factor/Cause
Associated Findings					1, 3, 4

NTSB Report: AAR-95/03

Findings
1. WEATHER CONDITION - MICROBURST/WET
2. (C) IN-FLIGHT PLANNING/DECISION - IMPROPER - FLIGHTCREW
3. WEATHER CONDITION - WINDSHEAR
4. (C) WEATHER EVALUATION - INADEQUATE - FLIGHTCREW
5. (C) AIRCRAFT HANDLING - IMPROPER - FLIGHTCREW
6. (C) UNSAFE/HAZARDOUS CONDITION WARNING - INADEQUATE - ATC PERSONNEL(LCL/GND/CLNC)
7. (F) PROCEDURE INADEQUATE - FAA(OTHER/ORGANIZATION)
8. (F) SUPERVISION - INADEQUATE - ATC PERSONNEL(SUPERVISOR)
9. (F) PROCEDURE INADEQUATE - COMPANY/OPERATOR MANAGEMENT
10. (F) WARNING SYSTEM(OTHER) - INADEQUATE
11. (F) ACFT/EQUIP,INADEQUATE DESIGN - MANUFACTURER

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 1995).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-95/03	DCA94MA065	Cause	Not Cited	Not Cited	Factor/Cause
Associated Findings		2, 4, 5			6, 7, 8, 9, 10, 11

NTSB Report: AAR-95/01

Findings
1. (C) CHECKLIST - NOT COMPLIED WITH - FLIGHTCREW
2. (C) ANTI-ICE/DEICE SYSTEM - NOT USED - FLIGHTCREW
3. (F) WEATHER CONDITION - SNOW
4. (F) WEATHER CONDITION - TEMPERATURE,LOW
5. (F) PITOT/STATIC SYSTEM - OBSTRUCTED
6. (C) ABORTED TAKEOFF - DELAYED - FLIGHTCREW
7. ABORT ABOVE V1 - PERFORMED - FLIGHTCREW

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 1995).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-95/01	DCA94MA038	Cause	Factor	Not Cited	Not Cited
Associated Findings		1, 2, 6	3, 4, 5		

NTSB Report: AAR-94/06

Findings
1. ALL ENGINES
2. (C) THROTTLE/POWER CONTROL - IMPROPER USE OF - PILOT IN COMMAND
3. (C) ACFT/EQUIP,INADEQUATE DESIGN - MANUFACTURER
4. (C) INSUFFICIENT STANDARDS/REQUIREMENTS,AIRCRAFT - MANUFACTURER
5. (C) INSUFFICIENT STANDARDS/REQUIREMENTS,AIRCRAFT - FAA(ORGANIZATION)
6. (C) INSUFFICIENT STANDARDS/REQUIREMENTS,AIRCRAFT - OTHER GOVT ORGANIZATION

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 1994).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-94/06	DCA94MA033	Cause	Not Cited	Not Cited	Cause
	Associated Findings	2			3, 4, 5, 6

NTSB Report: AAR-94/04

Findings
1. (C) JUDGMENT - POOR - PILOT IN COMMAND
2. (C) IN-FLIGHT PLANNING/DECISION - IMPROPER - PILOT IN COMMAND
3. (C) FATIGUE - PILOT IN COMMAND
4. (C) AIRCRAFT HANDLING - INADEQUATE - PILOT IN COMMAND
5. (F) FATIGUE(FLIGHT AND GROUND SCHEDULE) - FLIGHTCREW
6. (C) PROCEDURES/DIRECTIVES - NOT FOLLOWED - PILOT IN COMMAND
7. (F) FATIGUE(LACK OF SLEEP) - FLIGHTCREW
8. (C) REMEDIAL ACTION - NOT PERFORMED - PILOT IN COMMAND
9. (F) FATIGUE(CIRCADIAN RHYTHM) - FLIGHTCREW
10. STALL/MUSH - INADVERTENT - PILOT IN COMMAND
11. (F) INADEQUATE TRAINING - FLIGHTCREW
12. AIRPORT/FACILITIES - INOPERATIVE
13. (F) COMMUNICATIONS/INFORMATION/ATC - INADEQUATE - OTHER GOVERNMENT PERSONNEL

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 1994).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-94/04	DCA93RA060	Factor/Cause	Not Cited	Not Cited	Factor
	Associated Findings	1, 2, 3, 4, 5, 6, 7, 8, 9, 11			13

NTSB Report: AAR-94/01

Findings
1. (C) DIRECTIONAL CONTROL - NOT MAINTAINED - PILOT IN COMMAND
2. LANDING GEAR,NOSE GEAR - OVERLOAD

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 1994).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-94/01	DCA93MA040	Cause	Not Cited	Not Cited	Not Cited
	Associated Findings	1			

NTSB Report: AAR-93/04

Findings
1. (C) STALL WARNING SYSTEM - FAILURE,PARTIAL
2. (C) MAINTENANCE,AAIP/PROGRESSIVE PROGRAM - INADEQUATE - COMPANY/OPERATOR MANAGEMENT
3. (C) ACFT/EQUIP,INADEQUATE DESIGN - MANUFACTURER
4. STALL WARNING SYSTEM - FALSE INDICATION
5. (C) CREW/GROUP COORDINATION - INADEQUATE - PILOT IN COMMAND
6. (C) CREW/GROUP COORDINATION - INADEQUATE - COPILOT/SECOND PILOT
7. GROUND LOOP/SWERVE - INTENTIONAL - PILOT IN COMMAND
8. LANDING GEAR,NOSE GEAR - OVERLOAD

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 1993).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-93/04	DCA92MA044	Cause	Not Cited	Cause	Cause
Associated Findings		5, 6		1	2, 3

NTSB Report: AAR-93/02

Findings
1. (F) WEATHER CONDITION - ICING CONDITIONS
2. (F) WING - ICE
3. (C) ICE/FROST REMOVAL FROM AIRCRAFT - NOT IDENTIFIED - PILOT IN COMMAND
4. (C) INFORMATION INSUFFICIENT - COMPANY/OPERATOR MANAGEMENT
5. (C) INFORMATION INSUFFICIENT - FAA(OTHER/ORGANIZATION)
6. (F) PROCEDURES/DIRECTIVES - NOT FOLLOWED - PILOT IN COMMAND
7. (F) PROCEDURES/DIRECTIVES - NOT FOLLOWED - COPILOT/SECOND PILOT
8. (F) CREW/GROUP COORDINATION - INADEQUATE - PILOT IN COMMAND
9. (F) CREW/GROUP COORDINATION - INADEQUATE - COPILOT/SECOND PILOT

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 1993).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-93/02	DCA92MA025	Factor/Cause	Factor	Not Cited	Cause
Associated Findings		3, 6, 7, 7, 9	1, 2		4, 5

NTSB Report: AAR-92/05

Findings
1. LIGHT CONDITION - DARK NIGHT
2. WEATHER CONDITION - LOW CEILING
3. WEATHER CONDITION - RAIN
4. WEATHER CONDITION - FOG
5. (F) FLIGHT/NAV INSTRUMENTS,ATTITUDE DIRECTOR IND(ADI) - UNDETERMINED
6. (C) AIRCRAFT CONTROL - NOT MAINTAINED - PILOT IN COMMAND
7. (F) SPATIAL DISORIENTATION - PILOT IN COMMAND

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 1992).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-92/05	DCA92MA022	Factor/Cause	Not Cited	Factor	Not Cited
Associated Findings		6, 7		5	

NTSB Report: AAR-91/09

Findings
1. (F) WEATHER CONDITION - SNOW
2. (C) WING - ICE
3. (C) AIRCRAFT PREFLIGHT - NOT PERFORMED - PILOT IN COMMAND
4. (C) ICE/FROST REMOVAL FROM AIRCRAFT - NOT PERFORMED - PILOT IN COMMAND
5. (C) INADEQUATE TRAINING - COMPANY/OPERATOR MANAGEMENT
6. (C) ACFT/EQUIP,INADEQUATE AIRCRAFT MANUALS - MANUFACTURER
7. (C) ACFT/EQUIP,INADEQUATE AIRCRAFT MANUALS - FAA(OTHER/ORGANIZATION)
8. STALL - INADVERTENT - PILOT IN COMMAND

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 1991).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-91/09	DCA91MA021	Cause	Factor/Cause	Not Cited	Cause
Associated Findings		3, 4	1, 2		5, 6, 7

NTSB Report: AAR-91/08

Findings
1. (C) SUPERVISION - INADEQUATE - ATC PERSONNEL(SUPERVISOR)
2. (F) INADEQUATE SUBSTANTIATION PROCESS - FAA(ORGANIZATION)
3. (C) ATC CLEARANCE - IMPROPER - ATC PERSONNEL(LCL/GND/CLNC)
4. OBJECT - AIRCRAFT PARKED/STANDING

Findings Legend: (C) = Cause, (F) = Factor (NTSB, 1991).

NTSB Report	NTSB ID	Pilot Performance	Environmental	Mechanical	Other Persons
AAR-91/08	DCA91MA018A	Not Cited	Not Cited	Not Cited	Factor/Cause
Associated Findings					1, 2, 3

APPENDIX W

PRIMARY NON-PERSON RELATED EVENT DATA

Report	Primary Non-Person Related Event	Measurement
AAR-10/03	Animals/birds	Environment
AAR-08/02	Weather Condition - snow	Environment
AAR-08/01	Airport facilities, Runway/Landing area condition - other	Environment
AAR-07/07	Cargo/Baggage - fire	Aircraft
AAR-07/07	Fire Extinguisher, cargo - lack of	Aircraft
AAR-07/06	Thrust Reverser - inadequate	Aircraft
AAR-07/04	Wing - failure, total	Aircraft
AAR-06/03	Fluid, fuel - starvation	Aircraft
AAR-06/03	Engine instruments, fuel quantity gage - starvation	Aircraft
AAR-06/01	Light condition - night	Environment
AAB-06/02	Weather condition - thunderstorm	Environment
AAB-06/02	Weather condition - gusts	Environment
AAB-06/02	Weather condition - variable wind	Environment
AAB-06/02	Weather condition - rain	Environment
AAR-05/01	Landing gear, main gear - overload	Aircraft
AAR-04/04	Weather condition - gusts	Environment
AAR-04/04	Vertical stabilizer - separation	Aircraft
AAR-04/02	Light condition - dark night	Environment
AAR-04/01	Flt control system, elevator control - movement restricted	Aircraft
AAR-04/01	Aircraft performance, takeoff capability - deteriorated	Aircraft
AAR-03/02	Flt control syst, elevator trim/tab control - disconnected	Aircraft
AAR-03/02	Flt control syst, elevator trim/tab control - movement restricted	Aircraft
AAR-03/02	Aircraft control - restricted	Aircraft
AAR-03/02	Miscellaneous, bolt/nut/fastener/clamp/spring - not secured	Aircraft
AAR-02/01	Flt control syst, horiz stab drive - worn	Aircraft
AAR-02/01	Aircraft control - not possible	Aircraft
AAR-02/01	Lubricant, grease - inadequate	Aircraft
AAR-01/02	Object - approach light/navaid	Environment
AAR-01/01	Flight control, rudder surface - uncommanded	Aircraft
AAR-01/01	Flight control, rudder - jammed	Aircraft
AAB-01/01	Autopilot - improper	Aircraft
AAR-99/01	Flight control, rudder surface - uncommanded	Aircraft
AAR-99/01	Flight control, rudder - jammed	Aircraft
AAR-98/03	Cargo/baggage - smoke	Aircraft
AAR-98/03	Cargo/baggage - fire	Aircraft
AAR-98/03	Cargo/baggage - undetermined	Aircraft
AAR-98/01	Compressor assembly, rotor disc - fatigue	Aircraft
AAR-98/01	Compressor assembly, rotor disc - fractured	Aircraft
AAR-97/06	Smoke detector(s) - not installed	Aircraft
AAR-97/06	Hazardous material - improper	Aircraft
AAR-97/06	Cargo/baggage - improper	Aircraft

Report	Primary Non-Person Related Event	Measurement
AAR-97/06	Fire extinguisher, cargo - not installed	Aircraft
AAR-97/03	Weather condition - rain	Environment
AAR-97/03	Weather condition - fog	Environment
AAR-96/04	Airport facilities, runway/landing area condition - snow covered	Environment
AAR-96/04	Airport facilities, runway/landing area condition - icy	Environment
AAR-96/03	Compressor assembly, rotor disc - fatigue	Aircraft
AAR-96/03	Compressor assembly, rotor disc - failure	Aircraft
AAR-96/01	Airframe - ice	Environment
AAR-95/05	Radar, ASDE - unavailable	Environment
AAR-95/03	Warning system (other) - inadequate	Aircraft
AAR-95/01	Weather condition - snow	Environment
AAR-95/01	Weather condition - temperature, low	Environment
AAR-95/01	Pitot/static system - obstructed	Environment
AAR-93/04	Stall warning system - failure, partial	Aircraft
AAR-93/02	Weather condition - icing conditions	Environment
AAR-93/02	Wing - ice	Environment
AAR-92/05	Flight/Nav instruments, attitude director ind (ADI) - undetermined	Aircraft
AAR-91/09	Weather condition - snow	Environment
AAR-91/09	Wing - ice	Environment

APPENDIX X

PRIMARY PERSON RELATED EVENT DATA

Report	Primary Person Related Event	Modifier	Measurement
AAR-11/02	Aircraft control	Flight crew	Aircraft Handling
AAR-11/02	Airspeed - not attained/maintained	Flight crew	Aircraft Handling
AAR-11/02	Action/decision - action - incorrect	Flight crew	Planning/Decision
AAR-11/02	Info processing/decision	Flight crew	Planning/Decision
AAR-11/02	Communication - CRM/MRM techniques	Flight crew	Communication/Information/ATC
AAR-10/04	Directional control - not attained/maintained	Flight crew	Aircraft Handling
AAR-10/04	Crosswind correction - not attained/maintained	Flight crew	Aircraft Handling
AAR-10/04	Crosswind - response/compensation	Flight crew	Aircraft Handling
AAR-10/04	Action/decision - incomplete	Flight crew	Planning/Decision
AAR-10/03	Airspeed - not attained/maintained	Flight crew	Aircraft Handling
AAR-10/03	Communication - between groups - ATC	Unknown	Communication/Information/ATC
AAR-10/01	Stall warning system - incorrect use/operation	Flight crew	Planning/Decision
AAR-10/01	Action/decision - incorrect	Flight crew	Planning/Decision
AAR-10/01	CRM/MRM techniques	Flight crew	Communication/Information/ATC
AAR-09/03	Checklist	Flight crew	Planning/Decision
AAR-08/02	In-flight planning/decision - improper	Flight crew	Planning/Decision
AAR-08/01	Missed approach - not performed	Flight crew	Aircraft Handling
AAR-07/06	Procedures/directives - not followed	Flight crew	Planning/Decision
AAR-07/05	Procedures/directives - not followed	Flight crew	Planning/Decision
AAR-07/05	Became lost/disoriented - inattentive	Flight crew	Planning/Decision
AAR-07/05	Wrong taxi route - not detected	Flight crew	Planning/Decision
AAR-07/05	Instructions, written/verbal - not required	FAA (Other/Organization)	Communication/Information/ATC
AAR-07/05	Wrong runway - inattentive	Flight crew	Planning/Decision
AAR-07/05	Wrong runway - not detected	Flight crew	Planning/Decision
AAR-07/04	Maintenance - inadequate	Company Maintenance Personnel	Maintenance
AAR-06/03	Checklist - not followed	Flight crew	Planning/Decision
AAR-06/03	Preflight planning/preparation - inadequate	Flight crew	Planning/Decision

Report	Primary Person Related Event	Modifier	Measurement
AAR-06/03	Checklist - delayed	Flight crew	Planning/Decision
AAR-06/03	In-flight planning/decision - inadequate	Flight crew	Planning/Decision
AAR-06/03	Aircraft handling - not recognized	Flight crew	Aircraft Handling
AAR-06/01	Minimum descent altitude - continued below	Flight crew	Aircraft Handling
AAR-06/01	Crew/group coordination - inadequate	Flight crew	Communication/Information/ATC
AAB-06/02	Flight into known adverse weather - continued	Flight crew	Planning/Decision
AAB-06/02	Visual lookout - reduced	Flight crew	Planning/Decision
AAB-06/02	Proper alignment - not maintained	Flight crew	Aircraft Handling
AAB-06/02	Directional control - not maintained	Flight crew	Aircraft Handling
AAR-05/02	Recovery from bounced landing - attempted	Flight crew	Aircraft Handling
AAR-05/02	Go-around - not performed	Flight crew	Aircraft Handling
AAR-05/01	Proper alignment - improper	Flight crew	Aircraft Handling
AAR-05/01	Flare - improper	Flight crew	Aircraft Handling
AAR-05/01	Supervision - inadequate	Flight crew	Planning/Decision
AAR-04/04	Rudder - excessive	Flight crew	Aircraft Handling
AAR-04/02	Proper glidepath - not attained	Flight crew	Aircraft Handling
AAR-04/02	Crew/group coordination - inadequate	Flight crew	Communication/Information/ATC
AAR-04/01	Maintenance adjustment - improper	Other Maintenance Personnel	Maintenance
AAR-04/01	Aircraft weight and balance	Unknown	Planning/Decision
AAR-03/02	Maintenance, installation - inadequate	Company Maintenance Personnel	Maintenance
AAR-03/02	Maintenance, inspection - inadequate	Company Maintenance Personnel	Maintenance
AAB-02/04	Airspeed - excessive	Flight crew	Aircraft Handling
AAB-02/04	Improper decision	Flight crew	Planning/Decision
AAB-02/04	Go-around - not performed	Flight crew	Aircraft Handling
AAR-02/01	Maintenance, lubrication - inadequate	Company Maintenance Personnel	Maintenance
AAR-02/01	Maintenance, inspection - inadequate	Company Maintenance Personnel	Maintenance
AAR-01/02	Flight into known adverse weather - continued	Flight crew	Planning/Decision

Report	Primary Person Related Event	Modifier	Measurement
AAR-01/02	Procedures/directives - not complied with	Flight crew	Planning/Decision
AAR-01/02	Spoiler extension - not verified	Flight crew	Planning/Decision
AAR-01/02	Reversers - excessive	Flight crew	Aircraft Handling
AAB-01/01	Aircraft control - not maintained	Flight crew	Aircraft Handling
AAR-00/02	Aircraft control - inadequate	Flight crew	Aircraft Handling
AAR-98/02	Aircraft weight and balance - inadequate	Unknown	Unknown
AAR-98/02	Trim setting - improper	Unknown	Unknown
AAR-08/01	Maintenance inspection - inadequate	Company Maintenance Personnel	Maintenance
AAR-97/06	Maintenance - inadequate	Company/Operator Management	Maintenance
AAR-97/03	Distance/altitude - misjudged	Flight crew	Aircraft Handling
AAR-97/01	Checklist - not complied with	Flight crew	Planning/Decision
AAR-97/01	Checklist - not used	Flight crew	Planning/Decision
AAR-97/01	Gear down and locked - not verified	Flight crew	Planning/Decision
AAR-97/01	Go-around - not performed	Flight crew	Aircraft Handling
AAR-96/07	Checklist - inaccurate	Company/Operator Management	Unknown
AAR-96/07	Planning/decision - improper	Flight crew	Planning/Decision
AAR-96/07	Circuit breaker - selected	Flight crew	Planning/Decision
AAR-96/07	Spoiler extension - inadvertent activation	Flight crew	Planning/Decision
AAR-96/05	Approach/departure control service - inadequate	ATC Personnel	Communication/Information/ATC
AAR-96/05	Altimeter setting - not obtained	Flight crew	Planning/Decision
AAR-96/05	Minimum descent altitude - below	Flight crew	Aircraft Handling
AAR-96/04	Nose wheel steering - excessive	Flight crew	Aircraft Handling
AAR-96/04	Directional control - not maintained	Flight crew	Aircraft Handling
AAR-96/04	Aborted takeoff - delayed	Flight crew	Aircraft Handling
AAR-96/04	Throttle power control - improper use of	Flight crew	Aircraft Handling
AAR-96/03	Maintenance inspection - improper	Other Maintenance Personnel	Maintenance
AAR-96/03	Maintenance recordkeeping - inadequate	Other Maintenance Personnel	Maintenance

Report	Primary Person Related Event	Modifier	Measurement
AAR-95/05	Wrong runway - selected	Other Persons	Planning/Decision
AAR-95/05	Communication/Information/ATC - inadequate	Unknown	Communication/Information/ATC
AAR-95/03	In-flight planning/decision - improper	Flight crew	Planning/Decision
AAR-95/03	Weather evaluation - inadequate	Flight crew	Planning/Decision
AAR-95/03	Aircraft handling - improper	Flight crew	Aircraft Handling
AAR-95/03	Unsafe/hazardous condition warning - inadequate	ATC Personnel	Communication/Information/ATC
AAR-95/03	Supervision - inadequate	ATC Personnel	Communication/Information/ATC
AAR-95/01	Checklist - not complied with	Flight crew	Planning/Decision
AAR-95/01	Anti-ice/deice system - not used	Flight crew	Planning/Decision
AAR-95/01	Aborted takeoff - delayed	Flight crew	Aircraft Handling
AAR-94/06	Throttle/power control - improper use of	Flight crew	Aircraft Handling
AAR-94/04	Judgment - poor	Flight crew	Planning/Decision
AAR-94/04	In-flight planning/decision - improper	Flight crew	Planning/Decision
AAR-94/04	Aircraft handling - inadequate	Flight crew	Aircraft Handling
AAR-94/04	Procedures/directives - not followed	Flight crew	Planning/Decision
AAR-94/04	Remedial action - not performed	Flight crew	Aircraft Handling
AAR-94/04	Communications/information/ATC - inadequate	Other government person	Communication/Information/ATC
AAR-94/01	Directional control - not maintained	Flight crew	Aircraft Handling
AAR-93/04	Maintenance AAIP/progressive program - inadequate	Company/Operator Management	Maintenance
AAR-93/04	Crew/group coordination - inadequate	Flight crew	Communication/Information/ATC
AAR-93/04	Crew/group coordination - inadequate	Flight crew	Communication/Information/ATC
AAR-93/02	Ice/frost removal from aircraft - not identified	Flight crew	Planning/Decision
AAR-93/02	Procedures/directives - not followed	Flight crew	Planning/Decision
AAR-93/02	Procedures/directives - not followed	Flight crew	Planning/Decision
AAR-93/02	Crew/group coordination - inadequate	Flight crew	Communication/Information/ATC
AAR-93/02	Crew/group coordination - inadequate	Flight crew	Communication/Information/ATC
AAR-92/05	Aircraft control - not maintained	Flight crew	Aircraft Handling

Report	Primary Person Related Event	Modifier	Measurement
AAR-91/09	Aircraft preflight - not performed	Flight crew	Planning/Decision
AAR-91/09	Ice/frost removal from aircraft - not performed	Flight crew	Planning/Decision
AAR-91/08	Supervision - inadequate	ATC Personnel	Communication/Information/ATC
AAR-91/08	ATC clearance - improper	ATC Personnel	Communication/Information/ATC

APPENDIX Y

DIRECT UNDERLYING EVENT DATA

Report	Direct Underlying Event	Modifier	Measurement
AAR-11/02	Fatigue - lack of sleep	Flight crew	Physiological Condition
AAR-11/02	Fatigue - circadian rhythms or jetlag	Flight crew	Physiological Condition
AAR-10/04	Wind-crosswind - availablity of related info	FAA (other/organization)	Information Insufficient
AAR-10/04	Support/oversight/monitoring - training	Unknown	Qualification
AAR-10/03	Pressure/demand - effect on personnel	Flight crew	Excessive workload
AAR-10/01	Attention/monitoring - equip/instruments	Flight crew	Psychological Condition
AAR-10/01	Workload management	Pilot	Excessive workload
AAR-10/01	Policy/procedure - adequacy of policy	Company/Operator Management	Procedure Inadequate
AAR-09/03	Procedure inadequate	Company/Maintenance Personnel	Procedure Inadequate
AAR-08/02	Fatigue	Flight crew	Physiological Condition
AAR-08/01	Fatigue	Pilot in Command	Physiological Condition
AAR-08/01	Procedure inadequate	Company/Operator Management	Procedure Inadequate
AAR-07/07	Acft/equip, inadequate standard/requirement	Unknown	Acft/equip, inadequate design
AAR-07/06	Lack of familiarity with aircraft	Flight crew	Qualification
AAR-07/06	Procedure inadequate	Unknown	Procedure Inadequate
AAR-07/06	Condition(s)/Step(s) insufficiently defined	Company/Operator Management	Procedure Inadequate
AAR-07/05	Procedure inadequate	FAA (other/organization)	Procedure Inadequate
AAR-07/04	Procedure inadequate	Company/Operator Management	Procedure Inadequate
AAR-06/03	Inattentive	Pilot in Command	Psychological Condition
AAR-06/03	Inattentive	Flight crew	Psychological Condition
AAR-06/01	Fatigue	Flight crew	Physiological Condition
AAR-04/04	Inadequate training	Company/Operator Management	Qualification
AAR-04/02	Fatigue	Flight crew	Physiological Condition
AAR-04/01	Improper use of procedure	Company/Maintenance Personnel	Improper use of Procedure
AAR-04/01	Material inadequate	Company/Operator Management	Material Inadequate
AAB-02/04	Improper decision	ATC Personnel	Improper decision
AAR-01/02	Fatigue	Flight crew	Physiological Condition

Report	Direct Underlying Event	Modifier	Measurement
AAR-01/02	Improper decision	Flight crew	Improper decision
AAR-01/02	Improper use of procedure	Flight crew	Improper use of Procedure
AAR-01/02	Improper use of equipment/aircraft	Flight crew	Improper use of equipment/aircraft
AAR-98/02	Improper use of procedure	Other person	Improper use of Procedure
AAR-97/06	Procedure inadequate	Other person	Procedure Inadequate
AAR-97/03	Visual illusion	Pilot in Command	Psychological Condition
AAR-96/07	Lack of familiarity with aircraft	Flight crew	Qualification
AAR-96/04	Procedure inadequate	Company/Operator Management	Procedure Inadequate
AAR-96/04	Procedure inadequate	Manufacturer	Procedure Inadequate
AAR-96/04	Facility inadequate	Unknown	Facility Inadequate
AAR-96/03	Procedure inadequate	Other Maintenance Personnel	Procedure Inadequate
AAR-96/01	Acft/equip, inadequate aircraft manuals	Manufacturer	Aircraft/Equipment Inadequate
AAR-96/01	Aircraft/equipment inadequate	Manufacturer	Aircraft/Equipment Inadequate
AAR-96/01	Information insufficient	FAA (other/organization)	Information Insufficient
AAR-95/03	Procedure inadequate	FAA (other/organization)	Procedure Inadequate
AAR-95/03	Procedure inadequate	Company/Operator Management	Procedure Inadequate
AAR-95/03	Acft/equip, inadequate design	Manufacturer	Acft/equip, inadequate design
AAR-94/06	Acft/equip, inadequate design	Manufacturer	Acft/equip, inadequate design
AAR-94/04	Fatigue	Pilot in Command	Physiological Condition
AAR-94/04	Fatigue (flight and ground schedule)	Flight crew	Physiological Condition
AAR-94/04	Fatigue (lack of sleep)	Flight crew	Physiological Condition
AAR-94/04	Fatigue (circadian rhythm)	Flight crew	Physiological Condition
AAR-94/04	Inadequate training	Flight crew	Qualification
AAR-93/04	Acft/equip, inadequate design	Manufacturer	Acft/equip, inadequate design
AAR-93/02	Information insufficient	Company/Operator Management	Information Insufficient
AAR-93/02	Information insufficient	FAA (other/organization)	Information Insufficient
AAR-92/05	Spatial disorientation	Pilot in Command	Physiological Condition

Report	Direct Underlying Event	Modifier	Measurement
AAR-91/09	Inadequate training	Company/Operator Management	Qualification
AAR-91/09	Acft/equip, inadequate aircraft manuals	Manufacturer	Aircraft/Equipment Inadequate
AAR-91/09	Acft/equip, inadequate aircraft manuals	FAA (other/organization)	Aircraft/Equipment Inadequate

APPENDIX Z

INDIRECT UNDERLYING EVENT DATA

Report	Indirect Underlying Event	Modifier	Measurement
AAR-10/03	Selection/certification/testing - equip	FAA (organization)	Inadequate Certification/Approval
AAR-09/03	Inadequate surveillance of operation	Company/Operator Mgmt	Inadequate Surveillance of Operation
AAR-07/07	Inadequate certification/approval	Unknown	Inadequate Certification/Approval
AAR-07/04	Inadequate surveillance of operation	FAA (organization)	Inadequate Surveillance of Operation
AAR-04/01	Inadequate surveillance of operation	Company/Operator Mgmt	Inadequate Surveillance of Operation
AAR-04/01	Inadequate surveillance of operation	FAA (organization)	Inadequate Surveillance of Operation
AAR-04/01	Inadequate surveillance of operation	FAA (organization)	Inadequate Surveillance of Operation
AAR-04/01	Inadequate surveillance, inadequate procedure	FAA (organization)	Inadequate Surveillance of Operation
AAR-04/01	Inadequate surveillance, inadequate procedure	Company/Operator Mgmt	Inadequate Surveillance of Operation
AAR-02/01	Insufficient standards/requirements	Company/Operator Mgmt	Insufficient Standards/Requirements
AAR-02/01	Inadequate certification/approval	FAA (organization)	Inadequate Certification/Approval
AAR-02/01	Insufficient standards/requirements	Company/Operator Mgmt	Insufficient Standards/Requirements
AAR-02/01	Inadequate certification/approval	FAA (organization)	Inadequate Certification/Approval
AAR-02/01	Inadequate certification/approval	Manufacturer	Inadequate Certification/Approval
AAR-98/02	Inadequate surveillance of operation	Company/Operator Mgmt	Inadequate Surveillance of Operation
AAR-98/02	Inadequate surveillance of operation	FAA (organization)	Inadequate Surveillance of Operation
AAR-97/06	Insufficient standards/requirements	FAA (organization)	Insufficient Standards/Requirements
AAR-97/01	Inadequate substantiation process	Company/Operator Mgmt	Inadequate Substantiation Process
AAR-97/01	Inadequate surveillance of operation	FAA (organization)	Inadequate Surveillance of Operation
AAR-96/01	Inadequate substantiation process	Other govt organization	Inadequate Substantiation Process
AAR-96/01	Inadequate substantiation process	FAA (organization)	Inadequate Substantiation Process
AAR-94/06	Insufficient standards/requirements	Manufacturer	Insufficient Standards/Requirements
AAR-94/06	Insufficient standards/requirements	FAA (organization)	Insufficient Standards/Requirements
AAR-94/06	Insufficient standards/requirements	Other govt organization	Insufficient Standards/Requirements
AAR-91/08	Inadequate substantiation process	FAA (organization)	Inadequate Substantiation Process

VITA

Kevin Korey Boss

Candidate for the Degree of

Doctor of Education

Thesis: CHARACTERISTICS AND ANALYSIS OF MAJOR U.S. AIR CARRIER ACCIDENTS BETWEEN 1991 AND 2010

Major Field: Applied Educational Studies (Aviation & Space Science)

Biographical:

Education: Completed the requirements for the Doctor of Education in Applied Educational Studies at Oklahoma State University, Stillwater, Oklahoma in July, 2012

Completed the requirements for the Master of Science in Aerospace Administration and Logistics at Southeastern Oklahoma State University, Durant, Oklahoma, 2007

Completed the requirements for the Master of Aeronautical Science in Aerospace Management at Embry-Riddle Aeronautical University, Daytona Beach, Florida, 2006

Completed the requirements for the Bachelor of Science in Professional Flight Technology at Purdue University, West Lafayette, Indiana, 2002

Completed the requirements for the Associate in Applied Science in Aviation Flight Technology at Vincennes University, Vincennes, Indiana, 2001

Experience: United States Air Force, 2004 to Present; FAA Certified Flight Instructor: Airplane Single Engine; FAA Commercial Pilot: Airplane Single & Multi-Engine Land; Instrument Airplane

Professional Memberships: Phi Kappa Phi, Golden Key, Pi Lambda Theta, and Kappa Delta Pi Honor Societies; National Association of Flight Instructors; The American Legion; Veterans of Foreign Wars; and Military Officers Association

Name: Kevin K. Boss Date of Degree: July, 2012

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: CHARACTERISTICS AND ANALYSIS OF MAJOR U.S. AIR CARRIER ACCIDENTS BETWEEN 1991 AND 2010

Pages in Study: 228 Candidate for the Degree of Doctor of Education

Major Field: Applied Educational Studies (Aviation & Space Science)

Scope and Method of Study: This study described the characteristics of major U.S. air carrier accidents between 1991 and 2010. A case control methodology was used to compare the characteristics of air carrier accidents citing pilot performance as a causal or contributing factor with air carrier accidents not citing pilot performance as a causal or contributing factor in order to determine whether any significant differences existed between groups. The researcher was particularly interested in determining whether a statistical difference existed between groups with regard to flight experience and level of certification.

Findings and Conclusions: The major findings of this study indicate that between 1991 and 2010, 96% of the first officers involved in a major U.S. air carrier accident possessed at least 2,000 hours of total flight time. Of the two first officers (4%) with less than 1,500 hours of total flight time, neither were involved in an accident which cited pilot performance as a causal or contributing factor. This finding did not support the notion that a 1,500 hour total flight time requirement will contribute to the safety of air carrier operations conducted under 14 CFR 121. However, the findings of this study also indicate there was a significant increase between 1991-2000 and 2001-2010 with regard to the distribution of accidents involving a first officer who's highest certificate was a commercial pilot certificate, irrespective of the citing/not citing of pilot performance. While an ATP certification requirement for first officers will certainly eliminate the possibility of any future accidents involving commercially certificated first officers, it was not possible to predict whether such a change will contribute to the enhancement of safety for 14 CFR 121 air carrier operations. It is possible there will simply be a redistribution of the number of accidents involving ATP certificated first officers.

ADVISER'S APPROVAL: Dr. Timm Bliss