5-1994

Mandatory Certification of Aviation Line Service Technicians: A Question of Formal or Informal Training

Jeffrey S. Lewis
Embry-Riddle Aeronautical University - Daytona Beach

Follow this and additional works at: https://commons.erau.edu/db-theses

Part of the Aviation Commons

Scholarly Commons Citation
Lewis, Jeffrey S., "Mandatory Certification of Aviation Line Service Technicians: A Question of Formal or Informal Training" (1994). Theses - Daytona Beach. 263.
https://commons.erau.edu/db-theses/263

This thesis is brought to you for free and open access by Embry-Riddle Aeronautical University – Daytona Beach at ERAU Scholarly Commons. It has been accepted for inclusion in the Theses - Daytona Beach collection by an authorized administrator of ERAU Scholarly Commons. For more information, please contact commons@erau.edu.
MANDATORY CERTIFICATION OF AVIATION LINE SERVICE TECHNICIANS: A QUESTION OF FORMAL OR INFORMAL TRAINING

by
Jeffrey S. Lewis

A Thesis Submitted to the Office of Graduate Programs in Partial Fulfillment of the Requirements for the Degree of Master of Aeronautical Science

Embry-Riddle Aeronautical University
Daytona Beach, Florida
May 1994
INFORMATION TO USERS

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleed-through, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

UMI Microform EP31962
Copyright 2011 by ProQuest LLC
All rights reserved. This microform edition is protected against unauthorized copying under Title 17, United States Code.
MANDATORY CERTIFICATION OF AVIATION LINE SERVICE TECHNICIANS: A QUESTION OF FORMAL OR INFORMAL TRAINING

by

Jeffrey S. Lewis

This thesis was prepared under the direction of the candidate's thesis committee chairman, Dr. Charles Richardson, Department of Aeronautical Science, and has been approved by the members of his thesis committee. It was submitted to the Office of Graduate Programs and was accepted in partial fulfillment of the requirements for the degree of Master of Aeronautical Science.

THESIS COMMITTEE:

Dr. Charles Richardson
Chairman

Mr. Donald Hunt
Member

Mr. William Mason
Member

Department Chair, Aeronautical Science

Dean of Faculty, Daytona Beach Campus

Date
Acknowledgements

Appreciation must be acknowledged to Dr. Charles Richardson, who provided the researcher with positive motivation and guidance that went beyond the duty of a thesis chairman. Dr. Richardson's commitment to excellence has given this researcher the skills to expect and accept no substitute but for higher standards of performance. To the other committee members, gratitude is extended for the many recommendations that were provided to make this research more special. To David A. Voelker, a great amount of appreciation is acknowledged for his consistent encouragement and friendship. This thesis is dedicated to the researcher's parents, who without their consistent love, support, patience, and encouragement throughout his life, this level of achievement could not be obtained.
Abstract

Author: Jeffrey S. Lewis
Title: Mandatory Certification of Aviation Line Service Technicians: A Question of Formal or Informal Training
Institution: Embry-Riddle Aeronautical University
Degree: Master of Aeronautical Science
Year: 1994

Accidents and incidents are created by improperly trained aviation line service technicians. To reduce accidents and incidents associated with improperly trained line service personnel, a mandatory certification plan should be developed. This study utilized the procedures established for the descriptive research method. The researcher gathered data with a self constructed questionnaire, from 72 separate sources of the 120 solicited. All relevant data was analyzed to decide if the research hypothesis could be accepted. The researcher anticipated that statistical evidence would support the research hypothesis, that structured formal training procedures would reveal a significant reduction in the number of accidents and incidents associated with organizations which utilize pure informal line service training techniques. Conclusions supported various line service training techniques that should be incorporated into a mandatory line service technician certification plan.
# Table of Contents

Abstract.................................................................................. v
List of Tables........................................................................... viii
List of Figures.......................................................................... vix

Introduction................................................................. 1
  Statement of the Problem.................................................. 5
  Review of Related Literature........................................... 7
    Accidents/Incidents....................................................... 10
    Training Techniques..................................................... 16
    Summary....................................................................... 26
Statement of the Hypothesis................................................. 28

Method................................................................................. 29
  Samples......................................................................... 29
  Instrument................................................................. 30
  Design.......................................................................... 37
  Procedures..................................................................... 38

Analysis.............................................................................. 44

Conclusions........................................................................ 72

Recommendations.............................................................. 76

References......................................................................... 79
List of Tables

Table 1. Chi-Square Analysis for Significance Regarding Reported Accidents and Non-Accidents versus Training Methods........................................ 70

Table 2. Chi-Square Analysis for Significance Regarding Reported Incidents and Non-Incidents versus Training Methods........................................ 71
# List of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 1.</td>
<td>Average Number of Line Service Employees</td>
<td>45</td>
</tr>
<tr>
<td>Figure 2.</td>
<td>FBO Line Service Technician Average Age</td>
<td>47</td>
</tr>
<tr>
<td>Figure 3.</td>
<td>Average Line Service Technician Time of Service</td>
<td>48</td>
</tr>
<tr>
<td>Figure 4.</td>
<td>Confusion with Line Service Procedures</td>
<td>49</td>
</tr>
<tr>
<td>Figure 5.</td>
<td>Line Service Procedural Guessing</td>
<td>51</td>
</tr>
<tr>
<td>Figure 6.</td>
<td>Amount of Training on an Annual Basis</td>
<td>52</td>
</tr>
<tr>
<td>Figure 7.</td>
<td>Level of Agreement Regarding Classroom Training</td>
<td>54</td>
</tr>
<tr>
<td>Figure 8.</td>
<td>Most Widely Used Line Service Training Method</td>
<td>55</td>
</tr>
<tr>
<td>Figure 9.</td>
<td>Quantity of Recurrent Line Service Training</td>
<td>57</td>
</tr>
<tr>
<td>Figure 10.</td>
<td>Type of Recurrent Training</td>
<td>58</td>
</tr>
<tr>
<td>Figure 11.</td>
<td>Level of Agreement on Improper Line Service</td>
<td>60</td>
</tr>
<tr>
<td>Figure 12.</td>
<td>Number of Line Service Accidents</td>
<td>65</td>
</tr>
<tr>
<td>Figure 13.</td>
<td>Number of Line Service Incidents</td>
<td>67</td>
</tr>
</tbody>
</table>
Introduction

Throughout the aviation industry, improper training of aviation line service technicians continues to cost organizations both money and lives. Excessive damage to property and to human life is developing a concern among many aviation managers whether mandatory certification of line service technicians should occur to increase safety and reduce industry costs. For example, some airport managers believe, according to the National Transportation Safety Board (NTSB) (1984a):

... that fuelers should be licensed by the FAA [Federal Aviation Administration] as are pilots and mechanics. Since the responsibility for aviation safety is shared by pilots, mechanics, and fuelers, the FAA should ensure that a minimum level of competency for fuelers is required by instituting a certification program. (p. 18)

During a safety study conducted by the NTSB (1984a), the government agency concluded that airport personnel are not knowledgeable in the handling of aircraft fuel. In addition, the board claimed that the screening and training of prospective fuel service employees varies greatly in scope and thoroughness throughout most airports. Therefore,
"... the Federal Aviation Administration has the legal authority to establish training and proficiency standards for fueling personnel, and many airport managers believe that the FAA should license fueling personnel" (NTSB, 1984a, p. 47). Even more alarming, since 1967 up to 1984, the safety board issued seven safety recommendations regarding aircraft fueling operations, five of which were directed to the FAA. Not only did the recommendations cover fueling operations, they covered fuel handling procedures, ramp safety, color coding for aircraft fuel filler openings, and removal of water contamination from aircraft fuels (NTSB, 1984a). However, the approach to certification has been slow to develop, because of compromise and strong opposition from aviation trade organizations.

In what condition does this slow down and comprising effect on a certification plan for line service technicians leave the aviation industry? The condition is quite clear, an industry full of dangerous safety violations and improperly trained line service personnel. The physical and economic damages created by this condition impose preventable expenditures on fixed base operators (FBOs), oil companies, air carriers, and even causes the loss of human life. As far back as 1976, one major United States (U.S.) airline suffered over $185 thousand dollars worth of damage to aircraft and equipment as result of poor ground handling and servicing (Brunetti, 1977). More recently, Jobanek (1989) estimates that aviation ground mishaps worldwide cost
the industry up to $170 million U.S. dollars annually. Enders (1993) claims that one international airline reports annual costs per year, resulting from ground damage to aircraft, to be $20 million U.S. dollars. Unfortunately, accidents also occur to aviation facilities. One accident alone, involving a fuel farm fire at Denver's Stapleton International Airport, created damages costing between $15 and $20 million dollars (NTSB, 1991). Accidents with priceless cost estimates also occur. In 1984, a pilot lost his life when a DC-3 crashed because of improper fuel being loaded aboard the aircraft. These accidents/incidents may have been preventable with proper line service training. McGuire (1992a) conducted a study that reveals 88.38% of all ramp accidents/incidents are the result of line service practices and procedures. Jack K. Gartner, manager of the Aeronautical Services Division at John F. Kennedy International Airport in New York, claims that line service accident prevention is more than a simple truism, because common sense is not common enough (McGuire, 1992c). In addition, Betty Stansbury, assistant director of operations and maintenance for the Wichita Airport Authority in Kansas states that "no high-tech equipment or complicated procedure is needed, just some basic common sense and an awareness on the part of the people who operate vehicles and aircraft on the ramp" (McGuire, 1992b, p. 1). However, this common sense must come from training and experience. Therefore, a real solution to the problem of mandatory certification of
line service technicians appears to be the development and compliance of a mandatory standardized system of training.

In the aviation industry, most professions require some type of mandatory certification or training. Pilots, mechanics, and flight attendants all have undergone formal and informal training. For example, the aircraft dispatcher must complete formal classroom training in ground schools, then must pass a written and practical examination to test operational dispatch knowledge before certification. In addition, once certified, the dispatcher must complete many hours utilizing the hiring companies own equipment and facilities. Even a detailed familiarization of each aircraft in the company's fleet must become a workable part of the dispatcher's common knowledge. However, aviation line service technicians are not required, by federal law, to undergo formal line service training. Only facilities that deal with aviation fuels are required to administer formal fire training to one line service supervisor. The other line service agents are only required to undergo on-the-job training from the formally trained supervisor (Federal Aviation Administration, 1993).

Some aviation organizations utilize an extensive formal training program in the teaching of aviation line service technicians. The NTSB (1984a) claims that 60% of larger fueling facilities visited in the safety study, provided formal training. Extensive classroom curricula with audio visual presentations and written tests are examples of the
formal method of training. However, many aviation companies rely solely on informal line service training methods, such as on-the-job and self-study (NTSB, 1984a).

**Statement of the Problem**

To begin the certification process for aviation line service technicians, an industry standard for mandatory line service training must occur. The purpose of this research was to develop a relationship between formal and informal training procedures for aviation line service personnel. An ideological familiarization to address all assumptions that a formal method of training, for initial and recurrent training, were established to reveal the overall reduction in the number of accidents and incidents associated with pure informal line service training techniques. The effects of mandatory training was compared to safety and economic concerns facing many aviation firms. In this study, line service technicians are individuals directly involved in the towing, fueling, and general servicing of aircraft. The term line service technician applies to FBO line service employees. Airline ramp agents, fleet service clerks, or any other airline employee classification that labels airline employees who tow, fuel, or conduct general servicing of airline aircraft, are considered under the same operational definition of line service technicians. The phrase, general servicing of aircraft, was referenced to all other line servicing items, such as checking tire pressure,
windshield cleanliness, oil quantity, baggage loading, and ground vehicle operation. In addition, the type of line service organization examined may vary in size and purpose, however, no military operations are considered, because military line service operations are developed for specialized aircraft and equipment. Formal methods of training are considered structured classroom environments, written examinations, and video-tape presentations that are conducted with informal types of training. Other types of training, such as on-the-job and self-instruction, are considered informal training procedures. Recurrent training was considered a type of training to review new or current line service procedures. Accidents/incidents were considered any damage that was caused by line service operations. However, incidents were considered minor damages to property or persons, whereas, accidents result in major damage or serious personal injury. Minor damages to aircraft and line service equipment are scratches, minor collisions, or other damage that results in a minimal out of service time for the equipment. Major damage was damage that renders aircraft or equipment from further utilization.

The actual certification process of line service technicians goes beyond the scope of this research. However, industry officials can use such information in developing mandatory line service training procedures to aid in the certification process.
Review of Related Literature

Mandatory certification of aviation line service technicians has been a widely discussed issue throughout the aviation community since the early 1980's. Unfortunately, formal research into the certification process is extremely limited. However, in a safety study conducted by the NTSB (1984a), airport managers were concerned about aviation line service technician training, when the FAA was considering airport authorities as responsible parties for aircraft fueler training. This responsibility consideration came after several safety recommendations were directed to the FAA regarding licensing of line service personnel. The FAA's position provided for strong disagreement among airport operators. Airport managers disagreed that:

... holding the certificated airport responsible for tenant fueling agent operations [was] unfair and that adequate surveillance of fueling operations would impose a severe financial burden on the airport. The airport managers further argued that they are not held responsible for the quality of airplane maintenance or flight training of their fixed base operations (FBO) or for certificating those individuals conducting such services and that they did not understand why one segment of an FBO's services (fueling) was being singled out. (NTSB, 1984a, p. 18)

After petition from the South Chapter of the American Association of Airport Executives (AAAE) in 1982, the FAA
ruled that airport authorities are responsible for meeting and complying with the Code of Regulations (CFR) Part 139. Therefore, airport authorities are responsible for verifying training of aircraft fuelers at fuel dispensing facilities (NTSB, 1984a). The FAA's final decision, with respect to certifying line service technicians, was adopted on January 1, 1988. After strong debate from the National Air Transportation Association (NATA), the "FAA adopted NATA's recommendation to not license line service technicians. Instead the final rule relies on industry self-regulation to ensure fueling safety" (NATA, 1987). NATA stated their position to the FAA, claiming that the fueling problem "... was exaggerated and that licensing fueling personnel would not improve an already admirable safety record" (NATA, 1987).

Unfortunately, the Code of Regulation Part 139 does not provide for adequate safety in terms of line service procedures. Part 139 only requires a supervisor at each fuel dispensing facility to undergo formal fire safety training. All other employees of these facilities are required to complete at least on-the-job training provided by the formally trained line service supervisor (FAA, 1993). Other line services, such as ground vehicle operation, have undergone strong deliberation regarding training responsibility. Again, NATA pushed for airport authorities to retain sole training responsibility, leaving the tremendous burden of training records with parties already
responsible for all airport operations. NATA (1989) was:

. . . extremely concerned with the continuing efforts by airport operators to avoid responsibility to the FAA for activities occurring on the airport. Since the airport operator is the owner of the airport property, landlord of the tenants and FAA certificate holder, NATA believes airport operators should not be allowed to abrogate all their responsibilities. (p. 1)

The FAA agreed with the proposed changes to Part 139, and gave airport authorities the overall responsibility for ground vehicle operation training (NATA, 1990). Although the airport authorities are responsible for line service training, as stated under Part 139 of the FAA code of regulation, not all line service facilities conduct a high level of training.

In the NTSB (1984a) survey of 30 fuel service facilities, the concerns included fuel storage facilities, condition of fuel service equipment, and the training, hiring, and turnover rate of aircraft refueling personnel. The NTSB concluded that only two of the thirty facilities surveyed conducted any type of pre-employment test for aptitude. Over 70% of the facilities hired line service technicians off the street, and the remaining percentage promoted personnel from within company ranks. The majority of the companies, 90%, preferred some aviation experience, however, this experience was not required. In terms of formal classroom or self-study line service training, only
20% of the surveyed FBOs required this type of training. However, the remaining 80% required testing on refueling procedures and audiovisual presentations. The audiovisual presentations, about 60%, were provided by contract airline companies, whereas, 40% of those surveyed developed training programs specifically designed for that operation. All of the surveyed organizations required on-the-job training, which was usually conducted by a senior company line service technician (NTSB, 1984a).

**Accidents/Incidents.** Improperly trained aviation line service technicians contribute strongly to the escalating expenses created by damage to aircraft, aircraft equipment, and human life. On May 30, 1970, a Lehigh Acres Development, Incorporated Martin 404 aircraft experienced engine failure on both engines shortly after departure. The flight originated at the DeKalb-Peachtree Airport, Chamblee, Georgia enroute under Instrument Flight Rules to Fort Myers, Florida. The flight manifest included two pilots, two cabin crew attendants, and 29 passengers (NTSB, 1970).

Seconds after lift-off the pilot contacted Atlanta Departure Control and established radar contact. Shortly after contact was established, the pilot reported a loss of engine power from the number 2 engine. The engine continued to loss power to the point that no useful power was being developed by the number 2 engine, therefore the flight crew decided to shut down the engine. As the crew began shut
down procedures, the number 1 engine began to suffer a substantial power loss. The flight crew declared an emergency and attempted an emergency landing on Interstate Highway 285. As the aircraft touched down, the plane began to skid for a distance of one-half mile before striking a bridge. During the skid the aircraft struck an automobile inflicting fatal injuries to all five occupants. All crew members and passengers received serious injuries and one passenger died as a result of sustained injuries (NTSB, 1970).

During the Federal investigation, authorities discovered that 200 gallons of improper fuel grade was delivered to the Martin 404. The fixed base operator verified that the captain had ordered 200 gallons of 100/130 octane aviation fuel. The aircraft, however, was fueled with Turbo Fuel also known as Jet-A. The investigation proved that the truck was properly marked with Jet-A and Turbo Fuel labels, but the error was not detected by the two aircraft refuelers or the pilot supervising the fuel operation. "The company had no formalized training program or checkout procedures for the linemen who perform fueling operations. The manager stated that new employees are on-the-job trained with experienced linemen" (NTSB, 1970, p. 7). The Martin 404 was refueled by two linemen. One lineman was a full-time agent and the other aircraft refueler was a part-time agent attending an aviation technical school. A company official claimed that both
linemen knew they were servicing the aircraft with Jet-A fuel, and that the misfueling was a result of aircraft and engine recognition. One lineman stated "I have seen planes similar that took Jet-A turbo fuel so I assumed this was the proper fuel" (NTSB, 1970, p. 7). No estimated damage costs were published.

January 9, 1984 proved to be another day for tragedy resulting from improper line service procedures. After landing in St. Louis, Missouri, the captain of a Douglas DC-3 placed a fuel order for 420 gallons of avgas. After a short stay at the FBO, the aircraft attempted two departures. Each departure was aborted due to slow aircraft performance. An engine run-up was conducted after each aborted takeoff, which proved normal engine operation. Not satisfied with the run-up results, the aircraft called back to the FBO to confirm the type of fuel delivered to the aircraft. The FBO's response was 100LL. On the third attempt, the aircraft struck a light pole and forced the aircraft through a fence. Investigation proved that the aircraft was fueled with Jet-A, a fuel not compatible with the aircraft's engines. Investigations claimed that the truck containing Jet-A fuel looked very similar to the 100LL avgas refueler. However, investigation proved that the fuel trucks were properly marked. The accident resulted in one fatality and one serious injury. No estimated damage costs were published. The aircraft sustained substantial fire damage (NTSB, 1986).
More recently, in February 1994, an air ambulance flight crashed shortly after departing San Antonio International Airport. Federal officials stated that the twin-engine Cessna 421 experienced engine trouble on takeoff and crashed into a grove of trees on an attempted return to the airport. Critical Air Medicine officials of San Diego, stated that the fueling company serviced the 100LL avgas aircraft with Jet-A fuel. The accident killed two persons and seriously injuring another. No estimated damage costs were published (Associated Press, 1994).

These misfueling accidents maybe misleading. The General Aviation Manufactures Association (GAMA) reveal that NTSB statistics claim that only 52 misfueling crashes have resulted in twelve years through the last quarter of 1981. However, many more incidents involving misfueling, both reported and unreported, occur contrary to NTSB statistics. "Hundreds of times each year, perhaps thousands of times, aircraft are loaded with wrong fuel. Results range from the lost time and the expense of defueling to massive overhaul bills for ruined engines" (Steketee, 1983b, p. 1). For example, NTSB (1984b) claimed the "... fuel was not the normal color, but the pre-flight run-up checked ok. Engine sputtered and lost power shortly after takeoff" (p. 6). Many of these reports exist in the NTSB contamination files. The GAMA claims that no one is immune from the misfuelings. Most misfuelings end as unreported incidents as the line personnel or FBO detect the error
before the aircraft departs (Steketee, 1983b). However, Gresham (1983) totals the estimated damages from misfuelings from 1979 through 1982 as totaling over two million dollars in a combination of aircraft and passenger claims. Measures have been taken to counteract this misfueling problem. The GAMA, in conjunction with other aviation organizations, launched an anti-misfueling campaign program in 1983. The program included the use of the GAMA designed wing decals along with federal required fuel markings mandated by aircraft type certificates (Steketee, 1983a). Also, many corporations are developing their own fueling services. These services are primarily for company owned aircraft, however, many Non-FBO facilities are dealing with the public. The motivation behind such a move is fostered by improper fueling of aircraft, carelessness, rude, or sloppy line services (NATA, 1984). Therefore, accidents often occur as a result of poor supervision and carelessness with line service procedures.

For example, on July 24, 1979, eight people lost their lives because of the inadequate supervision of cargo loaders. A Puerto Rico International Airlines, Incorporated Dehavilland Heron crashed on the airport while executing a takeoff from the Alexander Hamilton Airport, in Christiansted, St. Croix, U.S. Virgin Islands. The aircraft was destroyed because of the accident. The crash occurred "... because of the aircraft's grossly overweight and out-of-balance condition ..." (NTSB, 1980, p. 29). The
investigation showed that the Heron was improperly loaded in regard to company policy. During the Federal hearings "... testimony indicated that most of the training given to load control personnel was 'on the job' and that no training was given to the loaders. Many load control personnel did not know the critical safety aspects of proper loading" (NTSB, 1980, p. 18). This accident was the result of company officials inadequacy to supervise and to enforce its loading procedures (NTSB, 1980).

Accidents not only effect aircraft or persons, they also affect aviation ground equipment. On Sunday, November 25, 1990, a fire erupted at a fuel farm located at Stapleton International Airport, Denver, Colorado. From the time the fire began, until the fire was extinguished, took the efforts of 634 firefighters, 47 fire units, 56 million gallons of water, and 28,000 gallons of foam. The fire burned for 48 hours. The cause of the accident:

"... was the failure of AMR Combs to detect loose motor bolts that permitted the motor of motor pump unit number 3 to become misaligned resulting in damage to the pump and subsequent leakage and ignition of fuel. Contributing to the accident was the failure of AMR Combs to properly train its employees to inspect and maintain the fuel pump equipment ..." (p. 56)

Over 3 million gallons of fuel were either lost by fuel tank leakage or consumed by the fire. The NTSB estimated damages to the fuel farm to have been between 15 and 20 million
dollars. However, no fatalities or injuries resulted from the fire (NTSB, 1991).

"Preventable ground accidents continue to recur in the U.S. at the rate of over 10,000 each year" (Jerome, 1985, p. 6). One airline in 1977 reported a 50% increase in its ground accident costs. The airline claimed damage costs went from $4,913,427 in 1976, to $7,371,229 the following year (Staff, 1978). Although these figures have risen to current day dollars, accidents to equipment and aircraft from ground service personnel and equipment still contribute to over 88% of line service accidents (McGuire, 1992a). For example:

[a] parked B-727 was struck by another aircraft that was being towed. Rather than going around the ramp by a longer route, the tug driver believed he could get through a more-convenient area between parked aircraft. He took the gamble without the help of wing walkers. The collision crushed the parked aircraft's radar antenna and punched a small hole in the fuselage. Repairs cost almost $10,000, and the aircraft was out of service for 14 hours. (Jerome, 1985, p. 6)

**Training Techniques.** When safety must be considered a number one priority in aviation, the failed agreement on industry wide training for line service agents, has created doubt among aviation organizations whether the solution to the problem can be answered. Many organizations do not fail
to recognize the need for training, but fail to develop training plans or to devote time to training. "Training of the individual normally occurs only for new hires. Rarely does anyone receive "in service training" (Peters, 1989, p. 330). Most FBOs line service training is hit and miss, which results in the ignorance to the importance of line service training and its outcomes (Woodworth, 1990). FBOs do not usually find line personnel who are experienced both in line operations and customer service. Therefore, managers must realize that line service training:

... is usually technical, but service training is a must do or die situation. The problem then should be viewed as part 1: how to cost-effectively train employees to ensure quality service, and part 2: how to keep those employees interested enough in the business to stay around despite low pay, minimal benefits and little change for advancement. (p. 58)

Line service technicians can overcome the feelings of burnout by continuing a new approach to line service training. Once the agents are trained in the basic procedures, continue to train on a regular basis (Woodworth, 1990). "If training is recognized by senior managers as an important element in their business strategy, then the impact of the training is much more likely to succeed at the entry level ... " (Cresswell, 1989/1990, p. 278). According to Gilbert (1988e), there is an understanding that better line service training results
in fewer accidents. But, few line service organizations compare training to actual accident statistics.

There exists some disarray throughout the aviation community on the proper line service training devices. Larger corporations have developed and stressed formal classroom type training methods (Gilbert, 1988e). Some individuals believe that motivation provides for ground crew safety. Jerome (1988) states that motivation becomes an internal process that makes individuals complete items that satisfy individual needs. Therefore, a line service program utilizing motivation must include the following program policies:

1. Program makes every effort to achieve and maintain positive work attitudes in the work force.
2. Where positive work attitudes conflict with boredom, frustration or insecurity, positive attitudes are built by calling attention to quality workmanship.
3. Program should plan and implement specific systems and techniques to improve work performance, error reductions and accident prevention. (p. 1)

The author continues by stating "an aviation organization safety program is no better than its safety education and training" (Jerome, 1988, p. 4). In order for this motivational training to be effective, the supervisor
must take an active part during the training. The supervisor must follow these techniques:

1. Tell the employee.
2. Show the employee.
3. Let the employee tell you each step as you do it.
4. Let the employee "do and tell" each step.
5. Correct the employee until the task is performed correctly.
6. Supervise the employee while the task is performed correctly.
7. Spot-check frequently when the employee is left alone. (p. 4)

During a conference in 1979, the membership of the International Air Transportation Association (IATA) voiced concern regarding ramp safety and costs arising from damages to aircraft and equipment. The members of IATA developed a campaign to create safe working environments, awareness among ramp personnel regarding damage costs, developing positive attitudes, and to encourage training (Ferrari, 1990). Continually, IATA provides instruction manuals for the training of line service ramp coordinators. These training manuals provide useful information in the principles of aircraft departure coordination. IATA discusses the training and qualifications needed to presume the duties of ramp supervisor. Training recommendations include training in the theoretical analysis of the organization, knowledge of manpower and equipment needs, and
knowledge of the essential rules and regulations for passengers and cargo (IATA, 1985).

Other organizations provide updated standards for aircraft fuel servicing and training. The National Fire Protection Association's (NFPA) standard for aircraft refueling, states "... only authorized personnel trained in the safe operation of the equipment they use, in the operation of emergency controls, and in procedures to be followed in an emergency shall fuel or defuel aircraft" (NFPA, 1955-1985, p. 407-6). In addition, the NFPA provides step-by-step explanations for all aircraft refueling procedures and defines all technical terms used in aircraft refueling operations (NFPA, 1955-1985). Other aviation associations provide similar quality control procedures for aircraft refueling and aircraft support operations. One IATA manual provides an extensive quality control check list for supervisors and inspectors. This check list enables employees to complete a step-by-step inspection of all aircraft refueling equipment and fuel storage facilities. Some of the detailed check list categories include fuel truck inspections, fuel transfer hose inspections, filter/separator differential pressure checks, and other quality control inspections (IATA, 1988).

The National Air Transportation Association's (NATA) Energy Committee continues to research and combine refueling and quality control information into publications that will assist FBOs, oil companies, and major commercial airlines in
the training of aviation line service technicians and inspectors. The NATA submits revised manuals periodically to the following companies: American Airlines, Delta Airlines, United Airlines, Texaco, Exxon International, Mobil Oil Company, Shell Oil Company, Chevron Oil Company, and Phillips Petroleum Company. These organizations are encouraged to provide additional suggestions for the improvement of inspection and training procedures contained in the NATA quality control manual. Often, the recommendations made are incorporated into the published quality control manuals (NATA, in press).

Oil companies are providing some training devices to the FBOs for aviation line service training. Chevron provides a one day seminar on fueling procedures. Topic areas include fuel handling, filtering, testing, and procedures for quality control (Chevron, in press). The company's manager of general aviation, Ray Filippini, "... strongly [encourages] dealers to attend" training sessions (Gilbert, 1988j, p. 46). Chevron believes in supporting aviation dealer operations. The Exxon Corporation also provides a self-study course for line service technicians. Because of the high turn over rate among line service personnel, the program fills the gap for complicated training sessions year round. Manuals provide the basis for Exxon's training course. Topic areas include an introduction to aviation line service and advanced servicing. All of the courses are provided with a
supervisor manual and written examinations (Exxon, in press). Gene Raney of Exxon, claims the training program has been "... designed to help the FBO pick up the new employee and bring in all things pertinent to [the] particular business" (Gilbert, 1988f, p. 46). Texaco has developed a one tape video covering fueler training and quality control procedures. The tape provides guidelines for fuel storage and emergency operations (Texaco, in press). Texaco's manager of general aviation, Jim Covell, hopes "... that the FBOs are looking at it" (Gilbert, 1988i, p. 46).

The United States Federal Government has even developed criteria for aviation line service training. The FAA has published an Advisory Circular (AC) regarding aircraft fuel storage, handling, and dispensing on airports. The purpose of the AC was to provide "... information on aviation fuel deliveries to airport storage and the handling, cleaning, and dispensing of fuel into aircraft" (FAA, 1982, p. 1). The AC has been updated to include fuel fire safety training recommendations as amended by the FAA Code of Regulation Part 139 established in 1989 (FAA, 1986). Although fuel service only covers one area of line operations, the AC provides specific knowledge areas for aircraft line personnel. The FAA has also published a training manual for airport line personnel involved in ground vehicle operations. Guidelines regarding aircraft fuel bonding, vehicle speed, airport markings, air traffic
control procedures that apply to airport ground vehicle operators, and airport lighting are covered to provide the line service technician with generic procedures that can be expanded upon to develop a line service training program (FAA, 1990).

Although these trade and government publications provide general information regarding line service training methods, the 1980's provided the industry with a number of training aids. The most popular and effective training devices include classroom audio-visual-text training packages and hands-on line service seminars (Gilbert, 1988e). NATA's manager of industry affairs in 1988, claimed "there is no doubt there's been a renewed emphasis on [training] since the early 80's" (Gilbert, 1988a). Even the manager of the certification and compliance branch of the FAA believes the aviation industry has met the challenge in line service procedural training (Gilbert, 1988b).

Most of the training video produced provides line service technicians with a means of initial and recurrent training. The most known video series comes offered by Combs-Gates. Combs-Gates training program, Professional Line Service Training (PLST), consists of five core development curricula. The following topics are included in the five tape series: Introduction, Safety, Fueling Piston Aircraft, Fueling Turboprop Aircraft, and Fueling Jet Aircraft. Each tape provides the line agent with specific procedures to follow in the topic areas, and gives audio-
visual presentations of many aircraft in use today. Combs-Gates also offers optional tapes to cover towing and fuel farm management. The programs include texts, instructor manuals, written examinations, and aircraft checklists (Combs-Gates, 1980). The 1988 marketing support specialist for Combs-Gates claimed the tapes were offered "... in the interest of raising industry service and safety standards" (Gilbert, 1988c, p. 44).

Another company, Aviation Innotech and Aero Services International, created a version of line service training tapes titled under the same name as the Combs-Gates series, PLST. However, the developer affiliated the company as the International FBO Network (IFN). The tapes were developed to standardize service at all affiliated organizations (IFN, 1983). To recoup the company's investment, the tapes were offered to the industry. Five video tapes were created to cover these subject areas: Introduction and General Aircraft Handling, Deicing Techniques and Safety, Aircraft Refueling, Aircraft Towing, and Fuel Farm Procedures and Safety. The program comes with a series of examinations that are to be taken while viewing the video series. John Carlen, vice president of administration for the IFN, claimed a 30% to 40% reduction in the number of line service accidents after employee training (Gilbert, 1988g). The IFN developed a second series of tapes in 1985 to specifically cover line service procedures for the Falcon Jet. These tapes included procedures for towing, fueling, and passenger
and cargo door operations (IFN, 1985).

The Aircraft Owners and Pilots Association (AOPA) developed a company named the International Learning Systems (ILS). AOPA created a single video tape or 16mm film to cover most line service procedures (AOPA, 1988). The subsidiary company ILS, created videos containing illustrated presentations of refueling procedures and precautions (ILS, 1988). The ILS, Combs-Gates, and IFN video tapes are available through NATA (Gilbert, 1988e).

Supervisor seminars are also available to train line service personnel. NATA developed the training course for line service supervisors shortly after the NTSB recommendation to license line service agents. The trade organization offers two to three day seminars to cover technical fueling information and the art of delivering material to co-workers (NATA, 1985).

Other agencies also provide line service training seminars. These agencies not only include trade organizations, but state funded departments. In 1986, the Illinois Division of Aeronautics funded a fuel handling course throughout the state. Dean Stagers, of Peoria-based Byerly Aviation, believed that line service technicians needed training in fuel receipt, filtering, testing, and use of a fire extinguishers (Illinois Aviation Department, 1986).

Mr. Stagers "... worked and worked with [line service agents] until they got it. If we can save one life, it's
worth it" (Gilbert, 1988d, p. 46). After the Division of Aeronautics resigned from funding the training project, the Illinois Aviation Trades Association provided a training course, however, a fee was charged to participants. The course covered the same topic areas as the previously funded course (Illinois Aviation Trades Association, 1987).

The state of Texas has also provided for safety training for fuel operators. Texas Aeronautics Commission (TAC) gives safety seminars to cover basics of safe aircraft refueling. The program utilizes the Combs-Gates PLST video series, however, the training is taught in a formal classroom environment (TAC, in press). John Eslinger, TAC Education Coordinator, provides the training and requires testing of "... everybody in class on each section. If a guy is taking a test, he's got to learn something" (Gilbert, 1988h, p. 46).

**Summary.** Mandatory certification of aviation line service technicians has been a highly debated topic throughout the aviation community. Government and trade organizations have been deliberating certification issues since the early 1980's. After compromising was accomplished between NATA and the FAA in 1987, a fueling fire safety regulation was adopted. However, the costs of this compromising action has left the industry full of unsafe practices and accidents. Since the early 1970's, improper fuel has been added to aircraft causing excessive damage to
aircraft and the loss of lives. Even high damage costs have been reported as a result of the improper use of ground support equipment and other line service procedures. There was an estimate that 88% of all line service accidents are the result of ground personnel or equipment. Annual damage estimates range in the millions of dollars.

To counteract the tremendous costs associated with these accidents and failed policies, many organizations have developed training devices to teach aviation line service technicians proper occupational procedures. FBO leaders, such as Combs-Gates, IFN, ILS, AOPA, and NATA have developed specialized video tape and hands-on seminar training packages for purchase by the line service community. The use of such training materials provides the line agent with updated manuals and audio-visual presentations for fuel dispensing, towing, and emergency operations. In addition, state agencies are providing funded training seminars through aeronautical departments. The seminars provide a formal classroom environment with the training provided by a state representative specialized in the teaching of line service procedures. Most state agencies utilize the trade organizations developed training tapes, however, the agencies require testing at the conclusion of the seminars. Oil companies have also created limited training material to FBO dealer companies. Although very limited in training information, each oil company provides an audio-visual presentations, written examinations, and manuals for use
Statement of the Hypothesis

The lack of proper training of aviation line service technicians is creating strong debate among many aviation organizations as to whether mandatory certification of line service personnel should occur. The damage to property and to human life is creating excessive expenditures for fixed base operators, major commercial airlines, and aviation consumers. Formal and informal training practices are used throughout the aviation industry to train line service technicians. Therefore, it is hypothesized that organizations that utilize formal methods of training, for the initial and recurrent training of aviation line service technicians, will reveal the overall reduction in the number of accidents and incidents associated with pure informal line service training techniques.
Method

Samples

To adequately test the stated hypothesis, samples containing airlines and fixed base operators (FBOs) who utilize a formal, informal, or a combination of the two line service training methods were selected. One sample for this study was selected from the population of United States fixed base operators. The National Air Transport Association (NATA), the trade group who represents fixed base operators, was contacted to obtain a current listing of all United States fixed base operators who are members of this trade organization (NATA, 1992). The second sample was selected from the United States major commercial airlines. However, only the top three major commercial airlines were selected in the sample, to avoid sampling bias of highly structured line service training programs.

To reduce the number of FBOs sampled, 120 FBOs from the population of United States fixed base operators listed in the NATA 1992 membership listing, were used as a sample. This FBO sample represented 10% of the stated population. Only FBO's who listed themselves as offering aviation line services were selected. A random sampling method, utilizing a random number, was used in all population sampling. The
random number was selected from a table of ten thousand random numbers listed in *Educational Research*, by Gay (1992). Each FBO was selected whose assigned number corresponded to the random number shown in the table, until the research total sample was obtained.

**Instrument**

To test adequately the stated hypothesis, the primary instrument used in the research study was a questionnaire (see Appendix G). Each questionnaire was self-constructed to gain the opinions of each member of the fixed base operator and major commercial airline sample populations. A sample questionnaire was developed and tested on MAS 605 Research Methods and Statistics students at Embry-Riddle Aeronautical University. Here, any improvements made to the questionnaire were implemented in preparation for a pilot study.

To determine the reliability and validity of each administered questionnaire, a pilot study was conducted on Dallas, Texas fixed base operators (FBOs). Three FBOs were selected for the pilot study. Each FBO varied in operational size and economic strength. Since the pilot study was to test the reliability and validity of each stated question listed on the questionnaire, no advance notification was given to the selected FBOs. However, a company management official was contacted at the time of the study, to receive permission to survey subjects. During the
pilot study, all participants were encouraged to critique each question.

A total of 39 questionnaires were administered. The overall percentage rate of completed questionnaires was 43.59%. The low rate of completion was the result of one company official not allowing employees the opportunity to complete the questionnaire. However, three employees of this organization elected to complete the questionnaire without company authorization. To provide the basis for this analysis, a detailed examination of each question occurred.

The first three questions stated on the questionnaire were to determine the size, age, and experience level at each line service organization. These three questions provided a wide distribution of answers throughout the pilot study. Therefore, the first three questions proved to be reliable and valid.

1. How many line service agents does your company or station employ? (Please place a check mark in the blank of your choice.)

   1-5  6-10  11-15  16-20  21-25  Over 25

   __  __  __  __  __  __

2. What is the average age in your line service department? (Please place a check mark in the blank of your choice.)

   18-25  26-32  33-39  Over 40

   __  __  __  __  __
3. How long have you been employed by your organization? (Please place a check mark in the blank of your choice.)

0-1 Year  2-6 Years  7-11 Years  Over 12 Years

Question four was the first question to show weakness in the administered instrument.

4. All line service technicians in your company have formal line service classroom training? (Please circle the number below your choice.)

Strongly Agree  Neither Agree  Strongly Disagree
Agree  or Disagree  Disagree

5  4  3  2  1

Over 82% of all subjects surveyed, agree in some manner, that their organization provides formal classroom training for line service employees. The results obtained on this question warranted a restructuring of the question, in order to provide subjects with a better understanding of formal classroom training.

The pilot study also determined that question five was an unreliable question. This was because over 64% of all line service technicians surveyed failed to understand the stated instructions.

5. Which three line service training methods do you feel are the most effective? (Use the number 1 for the most important, 2 for the second most important, and 3 for the least important of your three choices.)

Video-Tape  Classroom  On-the-Job  Self
Instruction  Instruction

___  ___  ___  ___
This question was restructured to provide each subject with a clear understanding of the stated objective. In addition, an open-ended response blank was added to enhance the opinion of each subject.

In contrast to other stated questions, question six was open-ended.

6. Which line service training method in question 5 is most widely used in your organization? (Please provide one method only.)

The results proved to be reliable, with only 5.88% of all subjects surveyed electing not to respond. However, this question was modified to give subjects a choice of line service training techniques.

Unfortunately, question seven proved to be another unreliable question.

7. Line service accidents sometimes go unreported. (Please circle the number below your choice.)

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neither Agree</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

Over 82% of surveyed subjects, disagree to some extent, to the contents of the question. However, this high percentage may reflect the employee's fear to answer the question truthfully, whereas, admitting accident fault. Question seven was restructured to develop a relationship between line service training and accident/incident rates, not to
imply fault to any line service agent.

This initial pilot study also concluded that questions eight, nine, and ten proved reliable and valid.

8. Are line service procedures sometimes confusing? (Please place a check mark in the blank of your choice.)

Yes No

If yes, how are line service procedures confusing?

9. Improper line service procedures are sometimes used to service aircraft. (Please circle the number below your choice.)

Strongly Agree Neither Agree Strongly Disagree
Agree or Disagree Agree

5 4 3 2 1

10. An educated guess is sometimes used in executing line service procedures. (Please circle the number below your choice.)

Strongly Agree Neither Agree Strongly Disagree
Agree or Disagree Agree

5 4 3 2 1

Each of these questions provided the anticipated results and displayed a wide answer selection.

However, question 11, proved to be an unreliable question, since 88.23% of all surveyed line service employees selected the same answer. These results reflect the employee's reluctance to admit accident or incident fault. The question was modified to suggest that improper training creates line service accidents, and by providing constructive suggestions, no personal admittance of fault occurs.
11. Are ramp accidents usually the result of improper line service training? (Please place a check mark in the blank of your choice.)

Yes
No

If yes, what improper training techniques resulted in the accident?

To provide the number of accidents or incidents associated with each line service training method, questions 12, 13, and 14 requested the subject to provide an approximation of the number of accidents or incidents, as defined in the operational definitions, they have witnessed. However, the percentage of answers did not provide a realistic value in the view of the researcher.

12. Approximately how many line service accidents have occurred in your organization caused by improper training of line service procedures, since you have been employed at your organization? (Please place the number in the blank provided.)

13. Approximately how many line service accidents resulted in the death of persons, on the ground or in the air, as a result of improper line service training at your organization? (Please place the number in the blank provided.)

14. Approximately how many line service incidents have occurred caused by the improper training of line service procedures, since you have been employed at your organization? Incidents are minor damages to aircraft, line service equipment, or facilities. (Please place a check mark in the blank of your choice.)
Therefore, these questions were restructured to provide each subject a pre-selected approximation of the number of accidents or incidents associated with line service training programs, whereas, providing appropriate values for the researcher. Also, these questions were changed to remove any blame that may have been misrepresented by the question.

Questions 15, 16, 17, and 18 all proved reliable and valid. A wide answer distribution was reflected on these four questions. However, question 18 was restructured to provide the researcher with proper data concerning initial and recurrent line service training.

15. Do you feel your company's training method may be the cause of certain line service accidents or incidents? (Please place a check mark in the blank of your choice.)

   Yes   No

16. How often does your organization conduct recurrent line service training? Recurrent training is the review of new or current line service procedures. (Please place a check mark in the blank or your choice.)

   Every 3 Months   Every 6 Months   Once a Year   Never

17. If your company provides recurrent line service training, what training method is utilized in the process? (Please place a check mark in any TWO blanks.)

   Video   Classroom   Open Book Exams   None
   Instruction
18. How much time is devoted to line service training in your organization? (Please place a check mark in the blank of your choice.)

None  1-4  5-10  1-2  3-5  Over 5
Hours  Hours  Days  Days  Days

In addition, question 18 was further modified to provide each subject with an annual limit on the term "time".

Moreover, question 19 was an open-ended question.

19. What would you like to see the aviation industry do regarding line service training? (Please be specific.)

This question provided excellent comments for possible study recommendations and improved industry wide line service training techniques. Some of the recommendations included updated video-tape material, mandatory certification for line service technicians, and monthly advisories providing new line service procedures. However, question 19 was restructured to create a more readable question.

Design

As outlined in the textbook, Educational Research, by Gay (1992), the descriptive research method was used in this study. To assess the attitudes, opinions, demographics, conditions, and procedures associated with line service training methods, and to develop a current ideological familiarization of proper line service training techniques, the descriptive research method utilized a self-constructed
questionnaire to collect the necessary research data. During data collection, the researcher had no control over the line service training methods used in each company, but could measure the organization's utilization of existing training methods. The population of United States fixed base operators and major commercial airlines provided the appropriate data for testing the stated hypothesis, and for answering questions concerning the current status of the research subject. The critical variable uncontrollable in using the descriptive method, was in the percentage of responses from the sample populations. To ensure that the data collected was reliable and valid, the questionnaire was subjected to a pilot study. At the conclusion of the pilot study, detailed analyses of the collected data was conducted and appropriate changes were implemented.

After the necessary research data was collected, the Chi-square statistical method was utilized, to describe in quantitative terms, the degree to which selected quantifiable variables related to the hypothesis. Selected variables used in the statistical analysis included various informal and formal line service training methods, and line service accidents or incidents associated with each training technique.

**Procedures**

Before the actual research study could begin, NATA was contacted to obtain a current listing of all United States
fixed base operators. From this listing, a population of FBOs that offered aviation line services was selected. To reduce the number of FBOs sampled, 120 FBOs from the population of United States fix based operators listed in the NATA Membership Guide (1992) was used as a sample. A random sampling method was used to select the FBO sample population. United States major commercial airlines designated the second population. However, to avoid sampling bias of highly structured line service training programs, only the top three United States major commercial airlines were selected. The three commercial airlines used in the study were American, Delta, and United.

To test the stated hypothesis, the primary instrument to collect data was developed. Since the descriptive research method was the design characteristic for the study, the primary instrument selected for data gathering was a self-constructed questionnaire. The line service questionnaire was developed for the population of FBOs and major commercial airlines. The questions were constructed to gather the appropriate information concerning line service training methods, accident/incident statistics, demographic information, and possible recommendations for line service training. The term line service technician applied to FBO line service employees. Airline ramp agents, fleet service clerks, or any other airline employee classification that labels airline employees who tow, fuel, or conduct general servicing of airline aircraft, were also
considered under the same line service technician operational definition.

To test the quality of each administered questionnaire, a pretest was conducted on Embry-Riddle Aeronautical University MAS 605 Research Methods and Statistics students. Here, any improvements made to the questionnaire was implemented in preparation for a pilot study. With management permission, the reliability and validity of each administered questionnaire was established through a pilot study conducted on Dallas, Texas fixed base operators. The appropriate company representative was contacted at the time each pilot study would be administered. During the pilot study, individuals were encouraged to critique each question. The sample group was verbally assured that strict confidentiality of all questionnaire responses would be adhered to at all times. At the conclusion of the pilot study, detailed analysis of the questionnaire was conducted and appropriate changes implemented. Each questionnaire was reviewed, and the assurance of a wide answer selection distribution was determined. All questions on the instrument were scored using a percentage scoring technique. Each answer was counted, however, the scoring method used for each questionnaire remained consistent throughout the scoring process. However, all tentative scoring procedures were tested after the pilot study, and no corrections to the scoring method was implemented.

The data collection process was proven reliable and
valid. Each questionnaire was professionally duplicated and prepared for administration. In June, 1993, using a random sampling method, a questionnaire was mailed to 50% of the sample populations. In addition to the questionnaire, a personalized cover letter was addressed to an upper level management official, to ensure proper administration of the instrument (see Appendix A). A time limit of one month applied to the administering of the questionnaire. After the time limit expired, a follow up letter was planned for implementation (see Appendix C). However, controversy over the questionnaire developed among NATA members. Mr. Burian, President of NATA, contacted the researcher by letter condemning the research hypothesis and instrument (see Appendix D). The researcher quickly followed up the criticism with a letter addressed to Mr. Burian, with a analysis of NATA's accusations (see Appendix F). The researcher found no misrepresented facts with the initial cover letter, however, the author decided to omit one statement in anticipation to increase the instrument response rate (see Appendix B). A final response was received by Mr. Burian stating NATA's efforts regarding the research subject (see Appendix E). These final comments were taken as positive motivation, and the final administration of the instrument occurred in December, 1993. After the one month time limit expired, a follow up letter was addressed to all sample companies in the randomly selected populations. Only the current number of instrument
responses were used in the study. However, the lack of response to the originally administrated questionnaire mailing was addressed in the analysis section of the study. After follow up attempts were completed, only the current number of instrument responses was used in the study.

When all research data was collected, each instrument was scored. A percentage scoring method was conducted on each question stated on the instrument. However, the scoring method remained consistent throughout the scoring process. A percentage value was assigned to each question response. The instrument percentages were totaled, coded, and tabulated in preparation for statistical analysis. The coding process assigned an alphanumeric value to each group and subgroup. The planned analysis called for subgroup comparisons. Therefore, the percentages of each subgroup was tabulated separately. All data collected was placed on data sheets for ease in analyzing. Each data card was coded utilizing an alphanumeric symbol. The data cards were coded to represent two line service training categories: formal and informal.

To test the stated hypothesis, the totaled scores of each administered instrument were calculated and prepared for statistical analysis. The primary variables for this study were the two types of line service training methods and the number of accidents or incidents that are associated with each training technique. The Chi-square method, as outlined by Elzy (1971), was used to determine significance,
P = 0.05, against the selected variables. The results obtained through these statistical computations were compared to the following null hypothesis: there is no significant difference (P = .05) in the number of accidents and incidents associated with the use of formal line service training versus the use of informal line service training, among organizations that reported accident and incident information. This null hypothesis provided the basis for analyses and conclusions regarding the research hypothesis.
Analysis

In order to collect the necessary data to support analyses regarding the hypothesis, 120 line service questionnaires were mailed to the stated samples. The number of responses used for analysis was reduced to 110. This reduction resulted from 5 questionnaires being returned to the researcher with no forwarding address, and 5 questionnaires returned as a result of no line services offered at those organizations. However, the original mailings produced 43 completed questionnaires. The original response rate equaled 39.1%. At the conclusion of the time limit specified in the cover letter addressed to the administer of the instrument, a follow-up letter and questionnaire were sent to those companies that failed to return a completed survey. The follow-up attempts yielded 29 completed questionnaires. The follow-up response rate equaled 26.4%. Therefore, the overall response rate to the line service questionnaire was 65.5%. The remaining 34.5% lack of response was the result of lost mail, lack of interest, or controversy over the research topic.

To establish a background of the sample populations, demographic questions were asked to identify size, age, and experience levels of each organization. This background
information was to develop generalizations of the FBO industry's diversity in the line service training environment. To claim an average size of an FBO operation, question one on the line service questionnaire provided the researcher with the percentages in terms of the number of employees at each line service organization. Figure 1 displays these percentages as provided by the administered instrument.

![Bar Chart: Average Number of Line Service Employees](image)

**Figure 1.** Average Number of Line Service Employees.

Question 1 revealed that 38% of the surveyed organizations employ between 1 and 5 line service agents. The 6 to 10 selection choice represented 25% of the sample. Line service operations that employed between 11 and 25 workers represented only 24% of the surveyed organizations. A 13% response rate was obtained from companies which utilize over
25 line service technicians. These statistics indicate that the majority of line service operations employ between 1 to 5 or over 25 line service agents. The small number of line service agents employed at each FBO, implies that many companies find the task of training line service employees much more demanding than larger organizations. Developing time, programs, and supervisors for the actual training, would be difficult when each line service shift only utilizes two line service agents. In addition, most organizations are open for business 24 hours a day. This indicates that those organizations that employ 1 to 5 workers, only provide one agent during the late night hours. Trying to implement a formal program of training and cover shifts would be impossible.

Question 2 on the line service questionnaire developed the generalization of the line service agents average age. The data was to provide information regarding the turnover rates at most FBOs. An average age between 26-32 years, would indicate that most line service technicians move on to different occupations after 4-5 years of service. In addition, a lower average age would indicate that most line service technicians are below the age of 26. This information was to help the researcher develop an idea that high turnover rates show the difficulties in finding the manpower and time to implement and development a formal system of training. Figure 2 shows the line service industry's average employee age.
As anticipated, question 2 showed that at 49% of the surveyed organizations, there existed an average age between 26 and 32 years. The number of workers between the ages of 18 and 25 years represented the second highest percentage at 28%. Only 23% had an average age over 33 years. These percentages indicate, that turnover rates at line service operations do exist, and the ability to implement and develop a formal training program would not be feasible.

For further clarification of turnover rates, question 3 of the line service questionnaire was to provide the average time of service of each FBO line service employee. Question 3 proved that 43% of the subjects have over 11 years of experience. The category representing 2 to 6 years of experience received a 36% rate of response. Only 11% of
the subjects claimed 7 to 11 years of line service employment. Even the least experienced worker only represented 8% of the sample. A 2% non-response was received, however, these subjects failed to answer page 1 of the questionnaire. These results would indicate that there exists a very experienced line service force in the industry. However, there appeared to be some bias to the question as stated. This bias was concluded by the high number of workers which claimed a lengthy time of employment. The bias appeared to show that a manager at each FBO sampled elected to answer the questionnaire. Figure 3 shows the average experience level of line service technicians.

![Graph showing average line service technician time of service](image)

**Figure 3.** Average Line Service Technician Time of Service.

The research hypothesis calls for statistical analysis
of accident/incident statistics versus training methods. However, before this analysis could begin, an evaluation of industry opinion on training methods, accidents, and incidents occurred. In addition, opinions on whether line service procedures were completed in relation to proper servicing techniques, would provide a generalization of the causes of line service accidents/incidents.

To develop an industry view on whether improper line service procedures result in accidents/incidents, question 8, 9, and 10 of the line service questionnaire provided data concerning the quality of implementing line service procedures. Question 8 was concerned that line service workers may find procedures confusing. Figure 4 displays the agreement versus disagreement regarding the working knowledge of line service procedures.

![Figure 4](image)

Figure 4. Confusion with Line Service Procedures.
A strong agreement would indicate a lack of adequate training. However, a large number of disagreeing responses would indicate the industry's view of performing servicing techniques as learned in training sessions. Question 8 showed that 72% disagreed that line service procedures are confusing. The remaining percentage, 26%, agreed with the statement. Only 2% of the technicians surveyed elected not to respond, however, these individuals failed to complete an entire page of the line service questionnaire. Although there was strong disagreement with the statement, the disagreement only shows that procedures learned are not confusing. This would not indicate that all line service procedures are clear. Certain workers are only qualified to perform specific procedures, therefore, other procedures which are performed would be confusing. Also, with the low number of employed line workers in the average organization, agents may have to perform procedures not qualified to conduct.

Those line workers that felt procedures were confusing, were asked to explain reasons for the confusion. The majority of subjects that agreed with the statement, claimed that there are too many different types of aircraft in the industry to have a working knowledge of each type. In addition, the procedures for servicing each type of aircraft are different, which develops confusion regarding the proper procedure to follow while servicing.

Some line service agents even believe that educated
guessing takes place to service aircraft. When asked whether an educated guess was used to provide line service to aircraft, a wide distribution of answers occurred among sample groups. Figure 5 shows the diversity among sample groups on line service procedural guessing.

Figure 5. Line Service Procedural Guessing.

Examining the results of question 10, over 50% of the subjects disagree that an educated guess takes place during line service operations. However, 22% of the subjects believe guessing does take place on the ramp. These percentages begin to show the apparent lack of training at 22% of the surveyed organizations. When considering the 22% that neither agreed or disagreed with the statement, more of these individuals could be reluctant to agree not sure if
other organizations guess on procedures.

In comparing accident/incident statistics to training methods, an understanding of the aviation line service industry opinion of training methods was needed. Questions 4, 5, and 6 provided a familiarization of the industry view on which training methods were most important, and which method was utilized at each facility. This information was needed to define the variables for statistical analysis.

To develop an understanding of industry opinion on the training issue, subjects were asked how much time was devoted for line service training. Figure 6 shows the amount of time, in both hours and days, that organizations devote to line service training on an annual basis, as reported on question 18 of the line service questionnaire.

![Figure 6. Amount of Training on an Annual Basis.](image)
A 74% response rate was determined for organizations which spend less than one week on line service training during a one year period. A small 24% spend over 5 days on training aviation line service workers. The remaining 2% of the sample population elected not to respond to the question. The researcher concludes that the failure to respond would indicate no selection choice applied to those training criteria set by the organization. The percentages show that very little time was set aside for line service training on an annual basis. The lack of training time was related to the average number of workers employed by line service organizations. These organizations find the task of developing and implementing training programs difficult with so few line service technicians covering work shifts. The researcher began to estimate that training only occurs during new hire procedures.

Question 5 asked subjects to list the three training methods believed to be the most effective in line service training. The three training methods selected by 69% of the subjects to be most effective, were video-tape, classroom, and on-the-job. A 4% response rate selected video-tape, on-the-job, and self-instruction. Also, 7% of the surveyed subjects felt that just video-tape and on-the-job training was needed to properly train line service personnel. Just 8% of the sampled subjects agreed that only on-the-job training was needed to train workers. The remaining 12% were evenly divided as using only one of the following
training methods: self-instruction, video-tape, and training manuals.

Question 4 of the instrument asked line service personnel what level of agreement or disagreement was felt regarding whether formal classroom training was utilized by the organization. The results showed that 28% strongly agreed that formal classroom training was provided. A 35% response rate agreed with the statement. This indicated that a majority, 63%, displayed agreement with the statement. However, there were 19% that showed a level of disagreement. The high disagreement rate led the researcher to believe that the subjects had a misconception of the question and the procedures involved in formal classroom training. Figure 7 displays the percentage of companies that agree or disagree that formal classroom training was provided by the organization.

![Figure 7. Level of Agreement Regarding Classroom Training.](image-url)
These percentages would also conclude that some companies are forced to train line service personnel using informal methods reducing safety and increasing the probability of accident/incident statistics.

When the subjects were asked which training method was most widely used throughout the organization, the percentages supported the researchers primary belief that most line service organizations do not provide a combination of formal and informal training. Figure 8 displays the percentage of line service agents that estimate which training method was most widely utilized.

![Figure 8. Most Widely Used Line Service Training Method.](image)

As operationally defined, these methods were grouped into the following two categories: formal and informal. The values shown in figure 8 show that 60% of the surveyed
companies utilize informal training devices. Only 40% of those questioned use formal training as a primary training method. This rate of response on the training methods used at organizations, supported the researchers belief that most organizations only provide informal training and do not spend the time to train effectively over the entire spectrum of line service operations.

Another type of training that was considered a valuable part of any line service training program was recurrent training. The use of recurrent training provides line workers with training to improve, review, and introduce new and old line servicing procedures. Line service personnel were asked whether recurrent training was offered, and how much time was devoted for this training. In addition, the training method used for recurrent training was established to give perceptions into the class of training utilized. Questions 16 and 17 of the instrument were to gather the recurrent training data. Question 16 addressed whether the line service organization provided recurrent training. Considering the results, the majority of subjects, 51%, claim recurrent training was provided annually. Those operations which conducted recurrent training every six months, represented 19% of the sample. There was a percentage of companies, 8%, that implemented a recurrent training program every three months. However, 17% of the sample stated that no recurrent training was provided to line service technicians. An overall 78% of the
organizations surveyed do utilize recurrent training programs. Figure 9 shows the percentage of those companies which use recurrent training in the development of the line service worker.

Figure 9. Quantity of Recurrent Line Service Training.

The percentage of companies that do not offer this type of training show that the training occurs only during the initial hiring process. The researcher anticipated an even distribution of responses on those which offer and do not offer recurrent training. The failure of providing this type of training supports literary works that most companies do not continue to train line service agents throughout service. The remaining 5% that selected not to respond to the question, stated that recurrent training was provided only as needed. This indicates, in the researcher's
opinion, that these organizations provide recurrent training only after an accident/incident has occurred.

For those companies which provide recurrent training, the quality of training was established through question 17 of the line service questionnaire. The same criteria applied to training categories, however, an open book exam selection was added to the choices. Open book exams for recurrent training are used at many organizations. Figure 10 displays the type of recurrent training used at surveyed organizations.

![Figure 10. Type of Recurrent Training.](image)

Considering these percentages, 51% of the subject companies utilize a formal or the combination of formal and informal recurrent training methods as operationally defined. But, 43% of the sample population neither conduct recurrent
training or utilize an informal training method. This high percentage supports the researcher's findings that line service training was limited to new hires and employees which have mishaps. Therefore, the lack of recurrent training would led to the conclusion that turnover rates hinder the delivery of recurrent line service training. The 6% non-response resulted from the on-the-job category being removed from question 17. Since surveyed organizations utilized formal and informal training methods for initial training and recurrent training, the criteria for statistical analysis was met. Therefore, the accident/incident statistics associated with the formal and informal training methods was needed for analysis. However, the accident/incident data had to be accurate.

To prepare for statistical analysis, the line service industry opinion on accident/incident statistics in relation to training methods was established. Questions 7, 11, and 15 of the instrument provided a working knowledge on the reporting of accidents/incidents, the misuse of line service procedures, and the utilization of improper line servicing training techniques. Question 7 was to provide data to show industry opinion regarding accidents/incidents caused by improper training methods. Examining the statistics, 26% of the subject responses implied that improper training techniques create a number of line service accidents/incidents. These subject responses indicate that 26% of the facilities in which subjects work, only use
informal line service training. These individuals were asked to comment on which training method was a major contributor to the accident/incident rate. The majority of comments stated that not following proper aircraft servicing procedures, standard operating practices, and aircraft towing techniques, created the most damage to aircraft, line equipment, and personnel. Figure 11 shows the generalization of industry opinion regarding accidents and incidents caused by improper training of line personnel.

![Figure 11. Level of Agreement On Improper Line Service.](image)

To support the findings of question 11, question 15 restated, in different phraseology, the same ideals as question 11. The original 26% response rate to question 11 rose to a 51% agreement rate that improper line service training methods create line service accidents/incidents.
The researcher believes that the 51% rate was more realistic to actual estimates regarding accidents/incidents and training methods. Question 15, however, was positioned after accident statistic questions were asked on the questionnaire. The placing of the question on the instrument created sampling bias. Subjects felt compelled to answer in agreement after listing the accident/incident data. However, the researcher believes question 15 provides a more accurate description regarding the accident/incident rate, while utilizing improper training methods. The reasoning behind such an evaluation, was that after the subject concluded the number of accidents/incidents associated with training methods used at the subject's company, the accident/incident rate showed personnel that the existing training method would support such a conclusion.

Another consideration, was the line service industry's opinion on line service training. Question 19 of the line service questionnaire was constructed as an open-ended question. The industry now had the opportunity to state possible recommendations to improve training devices. The following comments were provided to the researcher on question 19:

"Insist upon FAA Line Technician Certification, like A&P/Pilot Certification. Leaving the training for individual companies has not [been effective]"

"Standardized audio/visual aids would be welcome"
"... some type of recurrent training required besides [Part] 139 training"

"Should be regulated by FARs-It's time to recognize the line technician as more than a temporary job-it's a profession"

"Sponsor a line service training and certification course based on current industry standards and procedures. Offer smaller FBOs a training outline and/or syllabus containing industry standards and procedures for line service technicians"

"Do not allow federal agencies into training or certification activity"

Although comments ranged from requesting increased pay to new training videos, the majority of comments focused around the need for industry to recognize there was a problem regarding training and training devices. The industry was asking for updated training devices to address the advanced aircraft and procedures of today's aviation industry. In addition, more standardization and affordable training aids would need to be developed so all organizations could implement training programs.

Accidents and incidents occur for many reasons in line service operations. The purpose of this research and analysis was to determine whether training methods contributed to the accident/incident rates. To accomplish the task, a test to determine if line personnel would report accurate accident and incident information was conducted with question 7 of the line service questionnaire. The majority of subjects, 86%, agree that minor line service accidents were reported after occurrence. Only 4% of the
sample population believed that minor line service accidents are not reported to management. A small percentage, 8%, elected not to agree or disagree with the statement. One individual did not respond to the question, however, the non-response was the failure to complete an entire page of the questionnaire. These statistics showed the researcher that accident/incident data provided by the subjects could be considered accurate.

To add significance for the research, and for gathering accident/incident data, question 13 was to determine whether improper line service training resulted in the death of line workers. With 100% of the subjects responding to the question, 1% reported a death. The death of this worker, as a result of improper line service training, shows the need for mandated changes to standardize line service training. Therefore, the accident/incident data was ready for statistical analysis to help aid industry in developing a relationship for accidents and incidents associated with improper line service training.

To complete a statistical analysis to accept or reject the null hypothesis, variables had to be selected. Therefore, subgroups were established for the various line service training techniques. Formal and informal training methods were established as the subgroups for the analysis. The informal method represented the first subgroup, and was utilized at 60% of the subject companies. Formal training was utilized at only 40% of the surveyed organizations, and
represented the second subgroup.

To implement a statistical analysis, these subgroups were compared to accident and incident data. Questions 12 and 14 of the line service questionnaire provided the accident and incident data for the analysis. These questions asked subjects to estimate the number of accidents and incidents associated with improper line service training techniques. However, the subjects did not know which training method was being considered. The primary method of training at each organization was grouped with the related accident and incident numbers that were reported on the questionnaire.

Question 12 was to gather statistics on accident occurrences. To determine the percentage of companies which reported line service accidents, the number of accident responses were added and divided by the total number of subject responses. Those organizations which reported accidents utilizing an informal method of training represented 34% of the sample. The number of companies that used informal training that claimed no line service accidents reflected 26% of the sample. The organizations which utilized a formal training method and claimed accidents represented only 14% of the sample. Those organizations that used formal training and reported no accidents reflected 26% of the subject companies.

Incident statistics were also needed before the test for significance against the null hypothesis could take
place. The same procedure was used to calculate the percentage of companies claiming incidents associated with each training method. The companies which claimed line service incidents and used a formal training method represented 26% of the sample. The companies utilizing formal training, which claimed to be incident free, reflected 14% of the sample. In terms of the informally trained organizations, those which claimed incident occurrences reflected 39% of the sample. The companies that claimed no incidents was only 21%.

However, question 12 provided more information in regards to accident/incident statistics. Figure 12 shows the number of accidents that occurred at the airport for which subjects were employed.

![Figure 12. Number of Line Service Accidents.](image-url)
Although the statistical analysis required determining the number of organizations that report accidents and incidents, specific ranges to the number of accidents and incidents for each organization were provided. Since each organization was given the opportunity to claim over 16 accidents or incidents, only 1 accident or incident was used in the test for significance, since the null hypothesis called for the number of organizations which report accidents or incidents. However, the average mean to each range was developed to gain insight into the total number of accidents and incidents that were witnessed by sample organizations. Over half of the subjects, 53%, reported that no line service accidents occurred as a result of improper line service training. The remaining percentage, 49%, claimed that line service accidents do occur because of the improper training of line personnel. These statistics show that using an average mean of 3, for the 1 to 5 selection choice, that 84 line service accidents occurred at 39% of the sample organizations. The 6 to 10 selection, using an average mean of 8, only 8 accidents representing 1% of the sample occurred. The 11 to 15 selection, using an average mean of 13, showed that 26 accidents occurred to 3% of the sample companies. Only 4% of the organizations, using an average mean of 19, claimed over 16 accident occurrences. This 4% resulted in 57 accidents. Overall, 175 line service accidents were created by the sampled companies.

Question 14 was to show the number of incidents that
are associated with improper line service training methods. Incidents were considered minor damages to aircraft, line service equipment, or facilities. The procedure for determining the total number of incident occurrences for the sampled companies, remained consistent with the procedure established for accident occurrence.

Figure 13 displays the number of occurrences of line service incidents.

![Figure 13. Number of Line Service Incidents.](image)

In the case of incidents, 47% of the subjects stated that incidents do not occur because of improper training methods. The remaining percentage, 53%, claimed that line service incidents occurred as a result of improper line service training. Along with accidents, most of the incidents have resulted in 1 to 5 incidents at each facility. These
statistics show that using an average mean of 3, for the 1 to 5 selection range, that 90 line service incidents occurred at 42% of the sampled organizations. In the 6 to 10 category, using an average mean of 8, over a 50% increase in the total number of incidents versus the same category of accidents was noticed. A total of 32 incidents occurred at 6% of the subject organizations. The 11 to 15 range, using an average mean of 13, showed that only 13 incidents occurred at 1% of the sampled companies. Only 4% of the organizations, using an average mean of 19, claimed over 16 line service incident occurrences. This 4% resulted in 57 incidents. Overall, 192 incidents were created by the sampled companies utilizing existing training methods.

All of the accident and incident data was evenly distributed and was accurate in the opinion of the researcher.

The accepting or rejecting of the research hypothesis requires a test to determine the level of significance against a null hypothesis. The accepting or rejecting of the null hypothesis determines the validity of the research hypothesis. Therefore, the following statement was established as the null hypothesis: there was no significant difference in the number of accidents and incidents associated with the use of formal line service training versus the use of informal line service training, among organizations that reported accident and incident information.

To find the level of significance regarding the number
of accidents and incidents associated with these training methods, a relationship between the two variables had to be completed. To express a relationship between the two variables statistically, in terms of the line service organizations that reported accidents and incidents both occurring and non-occurring, and the training method utilized, the Chi-Square statistical method was selected.

The level of significance to accept or reject the null hypothesis was selected to be $P = .05$. In statistical analysis utilizing few variables, a higher level of significance would prove difficult to obtain and was not required for the study. Even at the $P = .05$ level of significance, the required Chi-Square value would be extremely hard to obtain. Beginning the test for significance, the Chi-Square statistical technique, as outlined by Elzy (1971), required the selection of four variables. Two variables were considered the line service training methods and the remaining two variables were considered the number of accidents and incidents, both occurring and non-occurring, associated with the each training method. Two separate statistical analyses were run to determine the Chi-Square value for the number of accidents and incidents associated with the methods.

Using a computerized statistical program, the variables were inputed into the Chi-Square formula. In the first analysis, accident and non-accident rates were compared against each training method. The data produced a
Chi-Square value of 3.80. The required Chi-Square value to show significance at \( P = .05 \) was 3.84. This analysis proved that the number of accidents associated with organizations which use formal training versus informal training, were not significant. Therefore, accidents are not associated with the type of training method utilized. The accident half of the null hypothesis was accepted. However, since the difference between the required Chi-Square value for significance \( P = .05 \) and the calculated Chi-Square value was only four one-hundredths of a point (.04), the possibility of a Type II error may have occurred. If the error occurred, the possible cause may have been sampling error. Table 1 shows the observed and expected frequencies, degrees of freedom, and Chi-Square value.

Table 1

<table>
<thead>
<tr>
<th>Observed Frequency</th>
<th>Expected Frequency</th>
<th>Cell Chi-Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.00</td>
<td>13.69</td>
<td>1.00</td>
</tr>
<tr>
<td>24.00</td>
<td>30.31</td>
<td>1.31</td>
</tr>
<tr>
<td>19.00</td>
<td>15.31</td>
<td>0.89</td>
</tr>
<tr>
<td>19.00</td>
<td>22.69</td>
<td>0.60</td>
</tr>
</tbody>
</table>

Chi-Square

Total of Observations

Degrees of Freedom

(Number of rows - 1) (Number of columns - 1)
To test the remaining half of the null hypothesis for significance, a computerized statistical program was used to input incident and non-incident information into the Chi-Square formula. This analysis produced a Chi-Square value of 6.52. The required value for significance at \( P = .05 \) was 3.84. This analysis proved that the number of incidents associated with organizations which use formal training versus informal training were significant. Incidents were associated with the type of line service training method utilized. The incident half of the null hypothesis was rejected. Therefore, the research hypothesis was accepted as a result of the rejection to part of the null hypothesis. Table 2 shows the observed and expected frequencies, degrees of freedom, and Chi-Square value.

Table 2
Chi-Square Analysis for Significance Regarding Reported Incidents and Non-incidents versus Training Methods

<table>
<thead>
<tr>
<th>Observed Frequency</th>
<th>Expected Frequency</th>
<th>Cell Chi-Square</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.00</td>
<td>15.31</td>
<td>1.84</td>
</tr>
<tr>
<td>28.00</td>
<td>22.69</td>
<td>1.24</td>
</tr>
<tr>
<td>19.00</td>
<td>13.69</td>
<td>2.06</td>
</tr>
<tr>
<td>15.00</td>
<td>20.31</td>
<td>1.39</td>
</tr>
</tbody>
</table>

Chi-Square 6.52
Total of Observations 72
Degrees of Freedom
(Number of rows - 1) (Number of columns - 1) 1
Conclusions

The development of a thesis takes extreme planning to implement an idea and carry the task to the final product. Each researcher conducting a thesis study anticipates accepting the research hypothesis. However, in many cases the research hypotheses are rejected. Therefore, such an action would not be considered a failure. In regard to this research study, part of the null hypothesis was rejected after the Chi-Square statistical method was conducted and significance was determined. The statistical analysis showed significance ($P = .05$), that the use of formal versus informal line service training, would show the overall reduction in the number of incidents associated with pure informal training methods. However, the statistical analysis showed no significance ($P = .05$), that the use of formal versus informal line service training, would show the overall reduction in the number of accidents associated with pure informal line service training methods. This analysis developed a Chi-Square value that did not meet the required value to show significance ($P = .05$), to reject the null hypothesis, that there was no significant difference in the number of accidents and incidents associated with the use of formal line service training versus the use of informal line
service training among organizations that reported accident and incident information. Therefore, the research hypothesis was accepted, that organizations that utilize formal methods of training, for initial and recurrent training of aviation line service technicians, would reveal the overall reduction in the number of accidents and incidents associated with pure informal line service training techniques.

The study provided excellent descriptive data for analysis, through the use of a self-constructed line service questionnaire. The questionnaire provided outstanding statistical data regarding the improper utilization of training programs, and the effects improper training creates on the number of accidents and incidents involved with each training method. There existed a high level of evenly distributed data that was anticipated from the beginning of the research study. The normal distribution of responses showed strong support for literary sources concerning the training provided line service technicians during initial and recurrent phases.

Although many subjects agreed that line service training was offered at member companies, there existed a wide variety of methods to develop line service agents. Unfortunately, this variety of training programs has no clear objective or standard of purpose. Many organizations provided only initial training for newly hired employees. With the increased turnover rates at most facilities,
recurrent training programs are seldom utilized.

In what condition does this lack of focus on an industry standard for line service training programs leave the aviation industry? The condition was clearly stated in the number of accidents and incidents associated with each line service training method. The statistical analyses shows the need for industry standardization regarding training methods, programs, videos, manuals, seminars, and even on-the-job training. The failure to standardize line service training was evident in the severity of literary works describing aircraft accidents and facilities. The loss of life, equipment, and facilities dictate mandated changes to reduce these costly expenses.

However, to standardize training methods and consider mandatory certification programs for line service technicians, the line workers must be consulted for possible recommendations on such actions. The line professionals stress the need for updated materials to service newer more advanced aircraft, maintain line service equipment, and affordable training programs offered through trade organizations and oil companies. Current programs are too expensive for all line service facilities. Therefore, affordable training programs must be provided and implemented before more damages or deaths occur. This study and the conclusions presented must mark the beginning to address the major safety problem concerning the mandatory certification of line service technicians, in
terms of formal and informal training practices. The time to stop ignoring this safety issue must begin today.
Recommendations

With all research studies, a great amount of skills are obtained through the development of hypotheses, research, questionnaire construction, and statistics. The entire study provided this researcher with a new opinion of extensive research and how to develop literary knowledge to complete the thesis project. During the course of this project, there was a sense of pleasure as the topic began to show validity. The need for a standardized training system or mandatory certification for line service technicians, was clearly evident by the number of accidents and incidents that were associated with each training method. But, what significantly made the study important was the many deaths that have occurred over the years as a result of improper supervision and training of line service personnel. Fortunately, the thesis yielded the results anticipated from the beginning of data collection. There was an outstanding feeling of accomplishment knowing that this research identified a safety problem throughout the aviation community and provided insights to possible solutions for improper line service training. However, more research into other areas of this safety issue must be accomplished. In this regard, the following recommendations are made:
1. With the strong criticism displayed by NATA, a joint effort to develop a study to examine each training tool, and ways to update, improve, and reduce cost of training material.

2. Require the FAA or designated organization to conduct research into possible evaluation programs to inspect organizations, and determine compliance.

3. Update research on mandatory certification of line service technicians. This study should consider all line service operations, and should not be limited to aircraft refuelers. The study could be an update to the 1984 NTSB Safety Study.

4. A reporting system should be developed to calculate the number of accidents/incidents that are created by aviation line service operations. This reporting system could be an extension to NASA's Aviation Safety Reporting System.

5. A follow-up study should be conducted to examine the number of accidents/incidents that are associated with each training tool.

6. Conduct research into a possible course of training offered by colleges and universities to train line
service personnel. This study should consider cost estimates on organizations and line workers.

7. Implement a mandatory recurrent training program to meet industry request. Develop research to find the adequate training method and pretest the program. Studies should be implemented at the conclusion of the pretest to determine an increase or decrease in accident/incident rates.

This research study identified many areas that need improvement throughout the aviation line service industry. A clear understanding of the safety violations that take place as a result of improper training was shown by the responses to the questionnaire. The line service industry must develop additional knowledge into possible solutions to improve current misdirected objectives regarding line service training.
References


Illinois Aviation Department. (1986). [Fuel-handling
course]. *Airport Services Management*, pp. 45-46.

[Fuel-handling course]. *Airport Services Management*,
p. 46.

Principles of aircraft departure coordination.
Montreal: Author.

Fuel quality control and fueling service guidance

service training program. *Airport Services Management*,
p. 44.

service training program-falcon jet series]. *Airport
Services Management*, p. 44.

[Aviation line service training video]. *Airport Services
Management*, pp. 44-45.


National Transportation Safety Board (1984b, September).

National Transportation Safety Board (1986, July 15).

National Transportation Safety Board (1991, October 1).


APPENDIX A

Sample Cover Letter
July 1, 1993

Mr. David Myers  
Chief Executive Officer  
Jet Fleet/Daljet Incorporated  
8605 Lemmon Ave.  
Dallas, TX 75209

Dear Mr. Myers:

I need your help!

The quality of line services offered by Jet Fleet/Daljet employees, shows the great concern that went into the training of your employees. However, there exists great concern among aviation organizations that mandatory certification of line service technicians should be implemented.

To complete my thesis for the degree of Master of Aeronautical Science at Embry-Riddle Aeronautical University, I need your assistance. Please take a few minutes to have your line service personnel complete the enclosed questionnaires. The data collected will be totally confidential. The opinions expressed on the questionnaires will be used to develop a clear understanding of the FBO and airline industry's position on line service training. With your help, the information collected may help reduce accidents, incidents, and associated industry costs created by improper line service training.

In order for your company to provide excellent opinions in this controversial issue, please complete and return the questionnaires by July 31, 1993. For your convenience, a self-addressed, postage paid envelope is enclosed.

I would like to thank you for taking time out of your busy schedule to address this industry wide safety issue.

Sincerely,

Jeffrey S. Lewis

Enclosures
APPENDIX B

Up Dated Cover Letter
December 1, 1993

Mr. David Myers
Chief Executive Officer
Jet Fleet/Daljet Incorporated
8605 Lemmon Ave.
Dallas, TX 75209

Dear Mr. Myers:

I need your help!

The quality of line services offered by Jet Fleet/Daljet employees, shows the great concern that went into the training of your employees. However, there seems to be some concern throughout the industry on the many different approaches to aviation line service training. The lack of standardization in these methods has prompted this research study.

To complete my thesis for the degree of Master of Aeronautical Science at Embry-Riddle Aeronautical University, I need your assistance. Please take a few minutes to have your line service personnel complete the enclosed questionnaires. The data collected will be strictly confidential. The information being sought is for research purposes only, and will in no way reflect the view or opinions of your company. However, the opinions expressed on the questionnaires will be used to develop a clear understanding of the FBO and airline industry's position on line service training. With your help, the information collected may help reduce accidents, incidents, and associated industry costs created by improper line service training.

In order for your company to provide excellent opinions in this controversial issue, please complete and return the questionnaires by December 31, 1993. For your convenience, a self-addressed, postage paid envelope is enclosed.

I would like to thank you for taking time out of your busy schedule to address this industry wide safety issue.

Sincerely,

Jeffrey S. Lewis

Enclosures
APPENDIX C

Follow-up Cover Letter
January 18, 1994

Mr. Ray M. Jackson, II
Manager
Southwest Air Center
P.O. Box 3864
San Angelo, TX 76902

Dear Mr. Jackson:

Please I need your help!

Recently, I sent your company a line service questionnaire regarding line service training methods. The quality of line services offered by Southwest Air Center employees, shows the great concern that went into the training of your employees. However, there seems some concern throughout the industry on the many different approaches to aviation line service training. The lack of standardization in these methods has prompted this research study.

To complete my thesis for the degree of Master of Aeronautical Science at Embry-Riddle Aeronautical University, I need your assistance. Please take a few minutes to have one of your line service personnel complete the enclosed questionnaire. The data collected will be strictly confidential. The information being sought is for research purposes only. With your help, the information collected may help reduce accidents, incidents, and associated industry costs created by improper line service training.

In order for your company to provide excellent opinions in this controversial issue, please complete and return the questionnaire by January 31, 1994. For your convenience, a self-addressed, postage paid envelope is enclosed. Please, your opinion is very important in this issue. Increase the 50% response rate to the questionnaire by other line service organizations, so this research study may provide you and other aviation organizations with valuable safety information.

I would like to thank you for taking time out of your busy schedule to address this industry wide safety issue.

Sincerely,

Jeffrey S. Lewis
Enclosures
APPENDIX D

NATA Response To Thesis Project
June 25, 1993

Dear Mr. Lewis:

Several of our Members have called my office to discuss the Line Service Questionnaire you have forwarded to them to assist you in completing your thesis for a degree of Master Aeronautical Science at Embry-Riddle Aeronautical University. I was unaware of your effort; accordingly, I obtained a copy of your questionnaire and cover letter in order to review them personally.

In the opening paragraph of your letter you stated, "...there exists great concern among aviation organizations that mandatory certification of line service technicians should be implemented." With that "opening shot across the bow," you have, I am sure, damaged your credibility among NATA Members. Yes, the subject you selected for your thesis is occasionally discussed among the leading aviation organizations, but I can assure you there is no expression of a compelling urge or need for "mandatory certification." In fact, not too long ago, there was an industry coalition (led by NATA) to thwart such an inane proposal in Congress. Fortunately, we were successful in keeping the idea of licensed line service technicians from seeing the light of day.

After reading through your questionnaire, I have reached the conclusion that: (i) because of the apparent lack of input from the General Aviation service industry, including NATA, it was developed in an intellectual vacuum; (ii) your hypothesis was seriously flawed; and (iii) most of the questions were presumptuous, subjective, and some even irresponsible.

On many occasions over the years, NATA has cooperated with authors, consultants, and people like you seeking assistance on academic projects. It's unfortunate that you didn't give us the opportunity to work with you during the development stage of your questionnaire.

If more queries on your questionnaire come to us, we will continue to discourage our Members' cooperation.

Sincefely,

[Signature]

Lawrence L. Bunun
President

cc: Dr. Steven Sliwa
APPENDIX E

Researcher Response Letter To NATA
July 1, 1993

Mr. Lawrence L. Burian  
President  
National Air Transportation Association  
4226 King Street  
Alexandria, VA 22302

Dear Mr. Burian:

I am honored that a gentleman of your caliber took the time to address a graduate student on an innocent thesis project. However, with the response I received from NATA, I have concluded that the Mandatory Certification of Line Service Technicians is a very sensitive subject among NATA and its members. Let me assure you that the opening statement in the cover letter no way represents any promotion for Mandatory Certification. The statement is merely to attract attention to stimulate individuals in responding to the questionnaire. To date, over 48% of the NATA members mailed questionnaires responded. All but one organization had very helpful insights and perceptions to aid in my thesis completion.

Regarding your statements of the hypothesis, I think your conclusions are a bit overstated. First, the thesis hypothesis is not about Mandatory Certification of Line Service Technicians, however the hypothesis is stated, "... it is hypothesized that a combination of the two training methods, for initial and recurrent training, will reveal the overall reduction in the number of accident and incidents associated with pure informal line service training methods." The two training methods are informal and formal. My project is geared toward looking at the accident and incident statistics of each training method and using descriptive statistics to determine if there is any significant difference between the two methods. In fact, to date most NATA members have been more than willing to provide such information. At the end of the study, I hope to recommend a program of instruction that may help smaller companies with their line service training. I would seriously hope this is in line with the safety ideals established at NATA.

I would really enjoy talking with you or a representative of NATA to discuss this topic. I have encountered significant trouble locating NATA information regarding the subject from Embry-Riddle Aeronautical University resources. Your help would be greatly appreciated. As you are aware, obtaining a Master's degree is a learning process, and sometimes there are barriers to cross. I would like to thank you for sending a strong, but very motivating letter regarding my subject. And, be assured that the opening statement in my cover letter will be removed from future mailings.

If you have any questions regarding the study or pilot study process each questionnaire undertook, please contact me at (904) 257-4918. I would be honored to acquire your assistance in this learning process.

Sincerely,

Jeffrey S. Lewis
APPENDIX F

NATA Final Response Letter
August 20, 1993

Dear Mr. Lewis,

Thank you for responding to my recent letter to you concerning your thesis project. Your conclusion is right on target: Mandatory Certification of Line Service Technicians is, indeed, a very sensitive subject among our Membership.

I'm impressed with the questionnaire response rate you've achieved. Perhaps you will, after all, gather the information you need to successfully complete your thesis.

I would be interested in learning more as your project progresses. If it is what you hope it to be, then we may be interested in pursuing the end product, probably to the point of incorporating it into safety programs for our Member companies.

It comes as no surprise when you told me of the difficulty you encountered in locating information on NATA from E-RAU resources. Unfortunately over the years, E-RAU has chosen to work very closely with the National Business Aircraft Association and the General Aviation Manufacturers Association, but not with NATA.

Thanks again for getting back to me with a very thorough and thoughtful response. I'll look forward to learning more about your thesis project.

Sincerely,

Lawrence L. Burian
President
APPENDIX G

Aviation Line Service Questionnaire
LINE SERVICE QUESTIONNAIRE

The following questionnaire is provided to seek your impressions regarding industry wide line service training methods. For practical purposes, a line service technician is considered any person who tows, fuels, or conducts general servicing of airline or general aviation aircraft. General servicing of aircraft refers to windshield cleaning, catering, or oil servicing. With your help, the answers will provide the necessary data to help industry officials develop new training techniques. These new training methods will help reduce the number of line service accidents/incidents, resulting in reduced industry costs. Please take a few minutes to complete the following questionnaire. Your opinion is very important in challenging this safety issue.

ALL RESPONSES WILL BE KEPT STRICTLY CONFIDENTIAL!

1. How many line service agents does your company or station employ? (Please place a check mark in the box of your choice.)
   1-5  6-10  11-15  16-20  21-25  Over 25
   □  □  □  □  □  □

2. What is the average age in your line service department? (Please place a check mark in the box of your choice.)
   18-25  26-32  33-39  Over 40
   □  □  □  □

3. How long have you worked for your organization? (Please place a check mark in the box of your choice.)
   0-1 Year  2-6 Years  7-11 Years  Over 11 Years
   □  □  □  □

4. All line service technicians in your company are provided formal line service training, in a classroom with a qualified line service instructor. (Please circle the number below your choice.)
   Strongly Agree  Agree  Neither Agree  Strongly Disagree  Disagree or Disagree
   5  4  3  2  1

5. Which three line service training methods do you feel are the most effective? (Please place a check mark in three boxes.)
   Video-Tape Instruction  □
   Classroom Instruction  □
   On-the-Job Training  □
   Self Instruction  □
   Other (Please Specify) ____________________________
6. Which line service training method is most widely used in your organization?  
(Please place a check mark in the box of your choice.)

- Video-Tape Instruction
- Classroom Instruction
- On-the-Job Training
- Self Instruction
- Other (Please Specify)  

7. Minor line service accidents, hangar rash for example, are always reported when they occur.  
(Please circle the number below your choice.)

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neither Agree or Disagree</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

8. Are line service procedures sometimes confusing?  
(Please place a check mark in the box of your choice.)

- Yes
- No

If yes, how are line service procedures confusing?

9. Improper line service procedures are sometimes used to service aircraft.  
(Please circle the number below your choice.)

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neither Agree or Disagree</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

10. An educated guess is sometimes used in executing line service procedures.  
(Please circle the number below your choice.)

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neither Agree or Disagree</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

11. Ramp accidents usually result from some type of improper line service training.  
(Please circle the number below your choice.)

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neither Agree or Disagree</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

If you agree with this statement, what improper training technique(s) contributed to the accidents?
12. Approximately how many line service accidents have occurred on the airport that you work, caused by improper training of line service procedures? 
(Please place a check mark in the box of your choice.)

None  □
1-5  □
6-10  □
11-15  □
16 and over  □

13. Approximately how many line service accidents have occurred on the airport that you work, that resulted in the death of persons, on the ground or in the air, as a result of improper line service training? (Please place a check mark in the box of your choice.)

None  □
1-5  □
6-10  □
11-15  □
16 and over  □

14. Approximately how many line service incidents have occurred on the airport that you work, caused by the improper training of line service procedures? Incidents are minor damages to aircraft, line service equipment, or facilities. (Please place a check mark in the box of your choice.)

None  □
1-5  □
6-10  □
11-15  □
16 and over  □

15. Do you feel line service training methods may be the cause of certain line service accidents or incidents? (Please place a check mark in the box of your choice.)

Yes  □
No  □

16. How often does your organization conduct recurrent line service training? Recurrent training is the review of new or current line service procedures. (Please place a check mark in the box of your choice.)

Every 3 Months  □
Every 6 Months  □
Once a Year  □
Never  □

17. If your company provides recurrent line service training, what training method is utilized in the process? (Please place a check mark in any TWO boxes.)

Video-Instruction  □
Classroom  □
Open Book Exams  □
None  □

18. How much time is devoted to line service training, in your organization, on an annual basis? (Please place a check mark in the box of your choice.)

None  □
1-4 Hours  □
5-10 Hours  □
1-2 Days  □
3-5 Days  □
Over 5 Days  □
19. What should the aviation industry do regarding line service training? (Please be specific.)

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________