Walden University

College of Management and Technology

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Mike Marticek

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Walden University
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Abstract

Aviation Management Perception of Biofuel as an Alternative Fuel Source

by

Michael Marticek

M.B.A, Strayer University, 2008

B.S, Robert Morris University, 2006

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Business Administration

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Abstract

The purpose of this phenomenological study was to explore lived experiences and perceptions from a population of 75 aviation managers in various locations in Pennsylvania about the use of aviation biofuel and how it will impact the aviation industry. The primary research question for this study focused on the impact of biofuel on the airline industry and how management believes biofuel can contribute to the reduction of fossil fuel. Grounded in the conceptual framework of sustainability, interview data collected from 27 airline and fueling leaders were analyzed for like terms, coded, and reduced to 3 themes. Data were organized and prioritized based on frequency of mention. The findings represented themes of (a) flight planning tools, (b) production, and (c) costs that are associated with aviation fuel. The results confirmed findings addressed in the literature review, specifically that aviation biofuel will transform the airline industry through lower cost and production. These findings have broad applicability for all management personnel in the aviation industry. Implications for social change and improved business environments could be realized with a cleaner environment, reduced fuel emissions, and improved air quality.

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Dedication

This doctoral study is dedicated to my daughter Isabella and wife Gabrielle who endured many days and nights of schoolwork throughout this doctoral process. Their encouragement over my doctoral journey will forever be remembered. It it my hope that they will believe anything is possible when you work hard and have faith.

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To my family and friends who have assisted me with additional support and motivation during this three year process. Your support has allowed me to continue my study.

Finally, to my wife and daughter, I say thank you for your support, understanding, encouragement, and belief in me. The last three years have not be easy and we have faced many challenges along the way.

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Section 1: Foundation of the Study

The airline industry has been changing, and one of the major factors that has caused the change is fuel. The cost of fuel has created a crisis for the airline industry and its business model. In recent years, this crisis has been addressed through downsizing and other means of corporate restructuring in order to sustain business. One of the ways the airline business may be brought back to profitability is alternative fuel. The alternative fuel development should assist organizational leaders as they plan for the future and determine opportunities (Nyrgen, Aleklett, & Hook, 2009). The alternative fuel, which is generated from plant feedstocks, such as camelina and jatropha, has shown potential for substantial life-cycle and carbon dioxide ($C0^2$) reductions (Swickard, 2010). Company leaders are starting to test and analyze the effects of these biofuels, as the impact may be significant.

Background of the Problem

Airline industry leaders continually review and evaluate the impact of fuel costs. The production of fuel is expected to decrease by 2026, which will cause further problems for airline leaders (Nyrgen, Aleklett, & Hook, 2009). Airline leaders spend millions of dollars on fuel, which is needed to operate their fleets, and testing of alternative fuel may be a viable resolution. Aviation industry leaders continue to increase testing of sustainable alternative fuels to reduce impacts of current aviation fuel (Abeyratne, 2010). The fuel situation is creating awareness among the airlines, and leaders are starting to implement control mechanisms through their flight operations

departments. These control mechanisms consist of different flight altitudes and working with air traffic control. The airlines are having significant cost reductions through these flight operation procedures; however, these procedures alone may not sustain airline operations. Airline leaders have started to reduce capacity and continue to reduce the fleet, which could offset rapidly rising fuel costs. Since 2009, leaders in the aviation industry have actively addressed interest about alternative fuels and ways to control costs. From January 2004 through July 2006, jet fuel prices increased by $1.16 per gallon, according to the Air Transport Association (ATA), and the cost continues to rise. In 2007, oil prices reached a high of $92.22 dollars per barrel (Air Transport Association, 2010). The push for alternative fuel is the driving force to assist airline leaders, but many elements need to be examined and researched. The testing of alternative fuel can take years, but the testing phase is normally worth the wait (Abeyratne, 2010). The alternative fuel is just a starting point for the airline industry, which is experiencing cost and revenue shock from the cost of fuel. The airline industry is quickly assessing the issue and adapting to change (Bisignani, 2006).

Problem Statement

The aviation industry is changing with increased aviation traffic, which will continue to grow through the coming years. The industry is estimated to grow by 5% per year through 2026, and the fuel demand is estimated to grow by 3% per year (Nyrgen, Aleklett, & Hook, 2009). One fuel that may have the ability to alter the aviation industry is biofuel, which has many challenges and hurdles that need to be identified and overcome (Daggett, Hadaller, Hendricks, & Walther, 2006). The general business problem is that the increased cost of aviation fuel and environmental concerns have

created a crisis for the aviation industry. The specific business problem is that company managers do not perceive the potential benefits of using alternative fuel in the airline industry.

Purpose Statement

The purpose of this study was to describe the changes that biofuel has on the airline industry, through the perception of aviation management. I used a qualitative, phenomenological approach to collect lived experiences and perceptions from leaders in the aviation industry in Pennsylvania (Pandey & Sharma, 2009). The sample of 27 participants was representative of the population of 75 employees from various aviation and biofuel companies. The use of biofuel contributes to social change through environmental improvements that can reduce carbon dioxide (CO^2) omissions (Swickard, 2010). Airline industry leaders are challenged by fuel costs, and the production of fuel is expected to decrease by 2026, which may create additional problems for the airline industry (Nyrgen et al., 2009). The issue of fuel cost has aviation industry leaders researching alternative fuels. The findings from the study contribute to social change by providing information that may help reduce impacts of current aviation fuel costs, which may provide cost savings advantages for customers and reduce the social costs associated with environmental pollution (Abeyratne, 2010).

Nature of the Study

The qualitative, phenomenological approach was used to explore the lived experiences of participants (Moustakas, 1994). I conducted interviews with participants involved in aviation management. The interviews presented findings of how the alternative fuel process works and the benefits that the alternative fuel has on the aviation

industry. The study included interviews with management from one major airline, Airline for America Association (A4A), and the Federal Aviation Aministration (FAA). These interviews provided information on attitudes toward the use of alternative fuel and environmental concerns.

The research provided insight into the beliefs of managers and executives regarding the use of biofuels. The qualitative method was a suitable fit for this type of research because it involved interviews and assessments, which allowed for an understanding of how the industry group feels about the biofuel as an alternative fuel. The qualitative approach uses data to both present and resolve research questions within a study (Kaplan, 1988).

A qualitative method was chosen because numerical data were not available and would not provide understanding of lived experiences or address the perceptions of participants. The quantitative method applies statistical measurements without the opportunity for open-ended questions that would not be appropriate for exploring lived experiences from participants. Also, the qualitative method helps in providing a deeper understanding of the issue, which may not be possible through a quantitative method.

Research Question

I explored the impact that biofuel will have on the airline industry and how managers believe biofuel may contribute to a reduction in the use of fossil fuels. The study findings represented an understanding of acceptance of and participation in alternative fuel. A pilot study (Appendix A), administered to five participants within the airline industry, determined the interview questions represented a valid instrument that

met the purpose of the study. The interview questions provided to participants are listed below and in Appendix B.

Q1: What are some of the operational changes that the company has made with regards to aviation fuel? Please explain any change strategies.

Q2: Describe your thoughts on whether or not aviation biofuel might transform the aviation industry and what the expected outcome might be.

Q3: What are your biggest concerns with biofuel?

Q4: Describe your thoughts on whether or not aviation fuel, as an alternate fuel, can be profitable for the aviation industry.

Q5: What applications or tools are being used to reduce overall fuel costs within your company? Please explain.

Q6: What organizational interventions are being used to reduce fuel costs? Please explain.

Q7: What are some barriers for the organization with regards to aviation fuel? Please explain.

Q8: Describe if alternative fuel might represent a best strategy for controlling costs or not? Please explain.

Q9: What course of action, if any, have the company leaders made to relieve the burden of fuel costs?

Q10: Describe how biofuel might or might not reduce climate change and how can environmental concerns be addressed for current fuel specifications.

Conceptual Framework

Sustainability represented a theoretical basis for the focus on alternative fuel as a source for airline leaders addressing environmental and global climate concerns. Aviation leaders are searching for sustainable methods to reduce costs and maintain operations. Airline leaders are looking for a new alternative fuel to assist them in reducing a major operating cost. The aggressive approach toward alternative fuels presents an opportunity for major change within the aviation community (Bisignani, 2006). Global aviation leaders should collaborate with stakeholders to sustain a viable position among transportation. The government must continue to regulate safety, security, and environmental standards (Bisignani, 2006).

There are several manufacturers within the airline industry representing a strong interest in replacing aviation gas (avgas). As a result, there are many groups, such as the Environmental Protection Agency (EPA), that promote elimination of avgas. The cost of fuel has hindered operations of many airlines, and has caused reductions in airplanes and staff. The crisis may continue until the fuel costs are under control.

Biofuel researchers use algae, forestry, and other agricultural crops to show benefits of the next generation fuel. Several companies are looking to embrace the idea of alternative jet fuel. Boeing Corporation leaders are researching and designing algae testing, which the company leaders believe can yield 150 times more fuel. The most exciting new alternative fuel development is algae, which is pond scum and has rather unique properties. The algae substance consumes CO^2 to grow, and it can be grown practically anywhere. The growing of algae will not require any fields, such as the spy bean or crop farms (Cunningham, 2007). The alternative fuel that is currently being

tested does not require any fresh water. The Boeing Company is also looking to grow algae with the help of salt water, which can be obtained from the ocean (Cunningham, 2007). The biofuel process with algae could be a direct petroleum replacement from a production and manufacturing standpoint. The algae process is much simpler then the current refining process. The process is also less costly and could save money in the long run through production and manufacturing (Brushnell, 2009).

Many managers and executives involved from various airlines support the sustainability premise of the alternative fuel method. Various companies in the industry are willing to use alternative fuel. Their willingness will allow airline leaders to collaborate on new fuel sources. The collaboration should generate fresh ideas and creativity among members. Many organizational leaders support grants and other sources of money to help create the next generation of aviation fuel. These organizational leaders have generated interest among all airlines and will continue to push for new sources of fuel.

The fuel problem impacts the operations of all airlines. The cost of fuel is the highest airline expense and will continue to increase total cost. Fuel cost continues to be a problem (Coffin, 2008). In the past, employee salaries were always the highest expense, but fuel has become the highest expense with current operational budgeting (Jackson & Jackson, 2009). The problem has started a quest for every airline leader, who try to reduce the cost per passenger and improve the environment through cleaner skies (Mazraati & Alyousif, 2009). Several commercial aircraft manufacturers are seeking improvements by addressing the challenges of fuel consumption, such as lighter parts and enhanced engine efficiencies (Mazraati & Alyousif, 2009). These changes should help to

reduce fuel consumption and improve overall operations. The rise and fall of world economies has also affected the airline industry through multiple areas, such as passenger traffic, oil prices, and airport capacities (Mazraati & Alyousif, 2009). These various items listed above all have an impact on the airline business, but fuel is the major factor hindering the airline business model.

The industry has been highly resilient to short-term shocks and problems, but it is now unclear how the aviation sector will respond to persistent and significant issues (Bows, Anderson, & Mander, 2009). These fuel incentives created advocates among leaders of airlines, policitical groups and fueling companies. There seems to be heavy involvement within every airline to push for alternative fuels. This involvement has started collaboration among the government, fueling, airlines, and airplane manufacturers. This has been a great start to ensure a brighter future for the airline business and environment centered around the conceptual theory of sustainability.

Definition of Terms

Aircraft Engine: The aircraft engine is an engine used to propel an aircraft, including a part, appurtenance, and accessory of the engine (Conrad, 2009).

Algae: The use of algae has become one of the most important biofuel technologies of the 21st century. The algae fuel is a replacement for oil and is practical and cheap. The algae is found in abundant resources like saltwater and wasteland (Brushnell, 2009).

Biofuel: These fuel alternatives utilize biomas to produce fuel for the transportation sector (Adam, Galadima, & Muhammad, 2011).

Biomass: The biomas is a nonfossilized and biodegradable organic material, which originates from plants and animals. This also includes products, residues and waste from agriculture (Environmental Protection Agency, 2009).

Camelina: The camelina plant is an oil seed plant, which can be used as an alternative biofuel (Lu & Kang, 2008).

Cap-and-Trade: The cap-and-trade system allows a total maximum amount of emissions for a specific region and then allows the individual regions to trade among themselves (Conrad, 2009).

Carbon Dioxide (CO^2): Carbon dioxide is a process that enters the atmosphere through the burning of fossil fuels, such as oil, natural gas, tress and coal (Environmental Protection Agency, 2009).

Carbon Fibre: The carbon fibre is a composite material, which will help produce more efficient aircraft and reduce fuel costs (Ball, 2008).

Drag: The drag is a resistance by the air friction to the shape and size of the aircraft, which improves the field of aerodynamics (Mazraati & Alyousif, 2009).

Environmental Protection Agency (EPA): The EPA has been established to protect human health and the overall environment. The main purpose of the EPA is to ensure that all Americans are protected from significant risks, such as to human health and environment concerns (Environmental Protection Agency, 2013).

Federal Aviation Administration (FAA): The Federal Aviation Administration was established to provide the safest and most efficient aerospace system in the world. The FAA strives to reach the highest level of safety, efficiency and environmental responsibility (Federal Aviation Administration, 2010).

Fuel Hedging: The hedging of fuel allows an airline to lock in a price with the prediction that prices will continue to escalate to higher prices. The hedging of fuel may also be explained as a way to stabilize the cost of fuel (Shapiro, 2008).

GLARE (Glass-Reinforced Fibre Metal Laminate): The GLARE material is a composite material, which is laminated and consists of thin layers of aluminum sheets and unidirectional glass fibre layers, which help to reduce weight but yet enhance the overall material strength (Scelsi et al., 2011).

Greenhouse Gas: The greenhouse gas that has been trapped in the atmosphere is called greenhouse gases. The greenhouse gases usually occur naturally through CO^2 and then are emitted to the atmosphere (Environmental Protection Agency, 2010).

NO^sub x^: The NO^sub x^ is a process that also has the effects of greenhouse gases, which is through its interaction with the ozone. This effect is emitted at high altitudes and the effect is less studied than that of CO^2 (Keen & Strand, 2007).

Particulate matter (PM): The particulate matter is a complex mixture of solid particles and liquid droplets that are in the atmosphere. The particulate matter comes from sources, such as transportation, electricity generation and wind-blown dust and is measured in size of micrometers (Hileman et al., 2009).

Photobioreactors: The photobioreactors is a tubular system, which is closed for cultivating microalgae. The photobioreactors (PBR) are growth systems, which permit essentially single-species culture of algae for prolonged durations of time (Torrey, 2008).

Put & Call Options: The put option is security that an indivdual can sell at a given price. The call option is a security that an individual can purchase at a set amount or striking price on or before a stated day (Borak, Härdle, & Cabrera, 2010).

Winglets: A winglet is a small attachment or fin on the tip of the aircraft wing, which can help reduce the drag produced by the wing tip (Mazraati & Alyousif, 2009).

Assumptions, Limitations, and Delimitations

Airline leaders are seeking alternative fuel as a means to offset operating cost, which can help reduce fuel costs. Airline leaders may perceive the benefits of alternative fuel differently. This study included some assumptions, limitations, and delimitations.

Assumptions

Airline leaders are looking for a new alternative fuel to assist them in reducing a major operating cost. These biofuels can assist with airline industry operating costs, but may not be a total solution to the problem. The aggressive approach that many airlines and fuel company leaders are taking has demonstrated the potential for major change within the aviation community (Bisignani, 2008). Leaders may or may not believe that there is a current crisis or that they need to collaborate to sustain a viable transportation posture. The cost of fuel has hindered airlines, which has caused reductions in airplanes and staff. The crisis may continue until the fuel costs are under control. The government must continue to regulate safety, security, and environmental standards (Bisignani, 2008). Airline leaders have started to reduce capacity and continue to reduce the fleet in an effort to offset rapidly rising fuel costs (Coffin, 2008). Airline leaders are interested in alternative fuel as a cost-cutting measure rather than canceling flights, slashing jobs, retiring older aircraft, and charging passengers for luggage (Coffin, 2008).

Limitations

One weakness in the study was the ability to have full participation among the sample population. The sample population included several airlines, fueling companies, Airlines for America (A4A), and the FAA. Full participation from the entire airline industry population was not feasible for the purpose and depth of this study.

Delimitations

The scope of the research was limited to one major U.S. airline and several aviation companies in order to allow reliable and viable collection of data. One company is a major aircraft manufacturer, which has begun the first step in delivering an alternative fuel source. The aircraft manufacturer has been around for years and is a major player in the aviation industry, so it made sense to help find an alternative source. This scope allowed interviewing of managers and other executives throughout the companies applicable to the purpose of the study.

Significance of the Study

The significance of the study relates to reduction of gaps and implications of social change. The gaps have been identified through current aviation fuel cost, which has not been an issue in the past, due to lower costs. The social change is through the environment, which can benefit from cleaner skies and improved air quality. The alternative fuel process offers possible solutions and researching the attitudes of aviation managers has generated data and areas of concern among the alternative biofuel industry. The aviation managers and fueling leaders can help justify the needs for alternative biofuel and how it can impact the aviation industry and enhance efforts for sustainable social change in regard to a cleaner environment.

Reduction of Gaps

Historically, airline industry leaders have not viewed fuel as a major problem. However, within the current business environment the cost of airline fuel has reduced profitability among carriers. This reduction has decreased profits and forced many airlines out of business or into merger situations, in order to survive.

Implications for Social Change

The change to use of alternative biofuels should assist leaders with challenges in the airline industry and environment. Infusion of alternative fuel can help create a better business model, which can help save industry jobs. The fuel cost has reduced thousands of jobs and may continue to do so until an alternative means of operation is in place. The alternative fuel development should assist organizational leaders as they plan for the future and envision sustainable possibilities (Nyrgen et al., 2009). The environment can also benefit from this development through cleaner skies and improved air quality. The alternative biofuel can help reduce fuel emissions, which plays an important part in atmospheric pollution.

A Review of the Professional and Academic Literature

There are many benefits associated with biofuels. The airline industry can reduce operation costs and streamline the airline business model, due to the cost of the biofuel. The environment may also benefit from these new types of fuels as they are safer and produce less pollution. The purpose of this literature review is to discuss the benefits of aviation biofuels and how they could create a win-win situation for both airline management and the environment. The literature review will include previous and

current studies, which will reflect biofuel, fuel hedging, manufacturers, airlines, and environmental aviation concerns. Appendix C provides the literature review search matrix specifics.

Aviation Industy

The aviation industry consists of several stakeholders, including airlines, air traffic control systems, manufacturers, airports, supplier companies and national and international regulators, such as the Federal Aviation Administration (Lawrence, 2009). These stakeholders play important roles in the overall aviation industry, and each have a chance to assist the industry. The aviation industry is under major pressure to deliver reductions in fuel costs and greenhouse gases. From 2003 to 2008, the rise in petroleum costs created several problems for the airline industry, including the higher price of jet fuel, which contributed to the bankruptcy of several airlines (Hileman, Ortiz, Bartis, Mong, Donohoo, Weiss, & Waitz, 2009). This issue has motivated many airlines to merge in order to sustain operations. The cost of jet fuel is significant among all airlines (Abeyratne, 2011). The aviation industry is also under growing pressure to reduce greenhouse gas (GHG) emissions (Hileman et al., 2009).

The alternative fuels are still in the research and development phase; however, sufficient approved quantities could reduce the world demand for petroleum and reduce the world price of oil. The biofuels of today have involved either ethanol or diesel, which account for 90% of the market (Fresco, 2009). This market includes Brazil, United States, and China, which are the biggest producers (Fresco, 2009). The bioethanol is developed from sugar cane and corn (Fresco, 2009). The aviation industry is researching

biofuels that come from such materials as grass, organic waste, wood, and algae. The supply of such materials is broad because half of all biomass on Earth can be processed into alternative fuel (Fresco, 2009). The aquatic biomass, which would include the use of algae, provides another option for the transportation industry. The expansion of testing will include growing grass and tree species in order to create a safe and environmental product (Fresco, 2009). The jet fuels derived from biomass or renewable oils can offer reduction to life-cycle GHG emissions and global climate change. These fuels can result in reduced particulate matter (PM) and improved air quality (Hileman et al., 2009). The particulate matter (PM) is a complex mixture of solid particles and liquid droplets that are in the atmosphere and caused by transportation, electricity generation, and wind-blown dust and is measured in size of micrometers (Hileman et al., 2009). The environmental pressure has derived from several groups, which have started capturing the political agenda and are driving change. The stakeholders in the political sector believe that aviation must make a fair contribution to the costs of mitigating climate change (Lawrence, 2009). The Federal Aviation Administration (FAA) has issued over $125 million dollars in contracts, which has helped develop commercial aviation technology and assist in fuel consumption (Boyd, 2010). The contract also assisted with emissions control, which is expected to save on nitrogen oxide emissions by 60%, which is significant to the environment (Boyd, 2010). This contract is a step in the right direction, as fuel has been steadily increasing over the years.

The FAA reported it is contracting with many aviation equipment suppliers such as Boeing, General Electric, Honeywell, Pratt and Whitney, and Rolls Royce, to speed up

green technologies, which will assist in the development of lower energy and emissions (Boyd, 2010). The engine manufacturers, such as Pratt and Whitney, have been reviewing and studying ways to improve fuel-savings. The review includes advanced technologies, which would decrease greenhouse gases (GHG) emissions. The Pratt and Whitney Corporation is testing the EcoPower Engine, which has been tested twice in 2009. This testing reflected a reduction in fuel burn by 1.2%, which represented a significant improvement in fuel efficiency (Conrad, 2009). The General Electric Corporation is also studying and exploring fuel efficiency, which will cut emissions. This is the primary focus of General Electric (GE) and it has redesigned new fans and composite materials to help in the ongoing fuel situation (Conrad, 2009). Additional companies, such as Airbus, are studying alternative fuels. The Boeing Corporation is supporting the development and commercialization of plant-based fuel sources, which will offer a lower lifecycle carbon footprint (Boeing Corporation, 2009b). This process does not compete with food and land resources. The plant-based fuel sources absorb carbon dioxide (CO^2) and have the potential to reduce the industry's dependence on fossil fuels (Boeing Coporation, 2009b). In 2008, Boeing, with the help of Virgin Atlantic and GE Aviation, provided the technical feasibility of using biofuels in commercial jetliners (Boeing Corporation, 2009b).

The Boeing Corporation is also researching hydrogen fuel cells, which will lower the weight of the aircraft and therefore lower fuel burn (Boeing Corporation, 2009b). This process will also lower emissions. Finally, other manufacturers, such as Volvo, are exploring biofuels (Conrad, 2009). The five aviation supplier companies will work on a

range of technology goals, which will include sustainable alternative aviation fuels and lighter and more efficient gas turbine engine components (Boyd, 2010). The FAA program will help develop environmentally friendly and energy efficient aircraft. This process has included design and engine technology that should enter the commercial market by 2015 (Boyd, 2010). During the past few years, aviation has become serious about alternative fuels and ways to control costs. During January 2004 through July 2006, jet fuel prices skyrocketed $1.16 per gallon, according to the Air Transport Association (ATA), and has continued in an upward trend. In 2007, oil prices hit an all time high of $92.22 dollars per barrel. Airlines for America (A4A) indicated that fuel costs will equal around 29% of the total airline revenue in 2007, which is significant and has raised concerns among aviation leaders (Jackson & Jackson, 2009).

The Air Force and government leaders are striving to introduce alternative energy systems, which encourages cost-effectiveness (Heppard & Green, 2009). The United States Air Force (USAF) has become one of the largest users of petroleum. The (USAF) is expected to use about 7 million gallons of aviation fuel per day and 2.5 billion gallons per year (Heppard & Green, 2009). The Air Force has started testing synthetics, and it has acquired approximately 300,000 gallons of fuel from the Shell Corporation. The Air Force has established a new policy of buying fuel from processing plants, which are equipped with the most advanced carbon capture and storage technology. The Air Force has started working with biofuel and diversifying its supply of aviation fuels. In late March of 2010, an Air Force jet made its first attempt to demonstrate flight burning process of 50/50 blend of a plant- based biofuel and conventional JP-8 in its engines,

which showed promise (Hutchinson, 2010). The Air Force tested on an A-IOC Thunderbolt II, which was based out of Eglin Air Force Base in Florida. The biofuel used a blend of hydrotreated renewable jet fuel, which was made from camelina. The camelina is nonfood plant (Hutchinson, 2010). The Navy Office of Research has also conducted alternative jet fuel testing and production with the help of the U.S Department of transportation (Perry, 2012).

Biofuel

The aviation industry has been changing due to fuel. The future of fuel is one of society's most daunting challenges, linked with global stability and quality of life. Fuel currently represents around 70% of the total global energy requirements, which includes transportation and manufacturing (Gouveia & Oliveira, 2009). There are rising concerns over climate change, rising fuel costs, and few renewable energy resources. The biofuels, such as bioethanol and biodiesel are becoming the most competitive alternative to petroleum. The superior environmental benefits can have a positive net energy gain, which include all factors that are critical to the substitution of fossil fuels (Preiss & Kowalski, 2010). The biofuels of today have involved either ethanol or diesel, which accounts for 90% of the market. This market includes Brazil, United States, and China, which are the biggest producers. The bioethanol is developed through sugar cane and corn (Fresco, 2009). The aviation industry is researching biofuels that come from such materials as grass, organic waste, wood, and algae. The supply of such materials is broad as about half of all biomass on Earth can be processed into alternative fuel (Fresco, 2009).

These alternative fuels are being tested within the aviation industry. The testing of these different fuels may take years. However, the overall savings can benefit the airlines' business models. The testing of biofuel is utilizing algae, sewage and other agricultural crops. The algae fuel alternative, which is pond scum and has rather unique properties can also produce an alternative fuel, which would not have been possible in years past. The algae substance consumes CO^2 to grow, and it can be grown practically anywhere. The growing of algae will not require any fields, such as the soy bean or crop farms (Cunningham, 2007). The algae alternative is becoming the fastest development of alternatives. The alternative fuel method has many managers and executives involved from various airlines. The alternative fuel has a willingness of participation from various companies in the industry. In the past, employee salaries were always the highest expense, but fuel has overturned the expense factor. This problem has started a quest for every airline, which is reducing the cost per passenger and improving the environment through cleaner skies and less emissions (Mazraati & Alyousif, 2009). The commercial aircraft emissions situation has become one of the fastest growing issues in the aviation sector. Aircraft emissions have become a major problem, involving greenhouse gases, which have significantly depleted the stratospheric ozone layer (Environmental Protection Agency, 2010). Climate change is becoming one of the most serious environmental issues and challenges that the world is facing. The aviation sector is in turbulent times and has taken steps to reduce further damage. The aviation industry is being faced with increased oil prices and the climate change debate.

The alternative biofuels can offer the potential to reduce the greenhouse gas (GHG) emissions within the aviation industry. This change is not due to a fuel composition or engine efficiency, but through the extraction, production and combustion of the biofuel fuel (Stratton, Wong, & Hileman, 2010). Several other issues need to be addressed when evaluating the alternative biofuel, which include the efficient usage of water and land resources. These issues address the ability to produce the feedstock for the alternative fuel, as water and land are the key components to a production facility (Stratton, Wong, & Hileman, 2010). The life cycle of alternative biofuels encompasses emissions from the complete fuel cycle, which includes the transportation of the feedstock from the field or production facility. The processing of these materials into fuel and the distribution of the fuel to the aircraft (Stratton, Wong, & Hileman, 2010).

There are a few strategies for using energy from biofuels in engines. One strategy is adapting engines to the existing fuels. Second, biofuel could be designed to exhibit all important features of the traditional fossil fuels. The last strategy is to use biofuels, which are blended with traditional fuels. This process often results in modification of the fuel's properties, such as an increased octane rating and without the environmentally harmful additives (Antoni, Zverlov, & Schwarz, 2007). The biotechnology of alternative fuel will include microbial, but also a chemical and technical production method (Antoni et al., 2007). The bioethanol blending to gasoline is just the starting point of these technologies. The biofuel production will include the biomass of plants, which help reach higher yields. This process also reduces competition with food production and

nature conservation. The microbial process has great development potential through the steps of pretreatment, fermentation, and others (Antoni et al., 2007).

The microalgal biomass production has several advantages over conventional biomass production. This includes higher productivities, recovery of waste nutrients and reuse of CO^2. The microalgal biomass production offers potential assistance for greenhouse gas (GHG), which provides biofuel as a replacement for fossil fuels (Brune, Lundquist, & Benemann, 2009). The biological research will need to contribute to an improved biofuel production through various breeding, such as enzymatic hydrolysis, energy plants, waste treatment, and specialized fermentation strains (Antoni et al., 2007). There are two concerns that are motivating alternative fuel to conventional petroleum. The first one is the price and the second one is the environmental effects (Hileman et al., 2009). During 2003 through 2008, the rise in the petroleum costs has created several problems for the airlines business, which the higher price of jet fuel has contributed to the bankruptcy of several airlines in the past few years (Hileman et al., 2009). This issue has motivated many airlines to merge in order to sustain operations.

The aviation business also has been under growing pressure to reduce their greenhouse-gas (GHG) emissions (Hileman et al., 2009). The alternative fuels in still in the research and development phase, however sufficient approved quantities, could reduce the world demand for petroleum and reduce the world price of oil. The jet fuels derived from biomass or renewable oils can offer reduction to life-cycle GHG emissions and global climate change. These fuels can result in reduced particulate matter and the impact on air quality (Hileman et al., 2009). The particulate matter is a complex mixture

of solid particles and liquid droplets that are in the atmosphere. The particulate matter comes from sources, such as transportation, electricity generation and wind-blown dust and is measured in size of micrometers (Hileman et al., 2009).

The prospects for alternative jet fuels are limited at the present time, however more opportunities may be available in the long term. There are several alternative jet fuels, such as biomass and hydro-processed renewable jet (HRJ) fuels from renewable oil sources, which can reduce aviation's impact on climate change and air quality (Hileman et al., 2009). In order for biofuel to have an impact on the aviation industry, there must be a few issues addressed in the next few decades. The compatibility with current systems and fuel delivery is the most important part, as existing aircraft may need to be modified in order for efficient aircraft operations (Hileman et al., 2009). The production is limited by resource constraints and fuel production technology, which will limit number of biofuel plants in the coming years (Hileman et al., 2009).

The biofuel process with algae could be a direct petroleum replacement from a production and manufacturing standpoint. The algae process is much simpler then the current refining process. This process is also less costly and could save money in the long run (Brushnell, 2009). The use of halophytic algae could lessen the world's food and water shortages, but also assist as an alternative fuel. Some 68% of the freshwater that is currently tied up in agriculture could now assist with thirsty populations and free up irrigating dependent crops (Brushnell, 2009). The use of halophytes and algae are only part of the solution. This utilization can also help combat global warming. Since the beginning of 2005, aviation fuel and biofuels, have received greater attention from the

aviation industry and community. This attention also includes the greenhouse gas emissions (Green, 2009). Airline leaders have started to reduce capacity and continue reducing the fleet in an effort to offset rapidly rising fuel costs (Coffin, 2008). The Air Force is also involved in the process, as it started doing some testing on synthetics, which it has acquired approximately 300,000 gallons of fuel from the Shell Corporation. The Air Force has established a new policy of buying the fuel from processing plants, which are equipped with the most advanced carbon capture and storage technology (Heppard & Green, 2009).

The additional cost of fuel has forced budget cuts in many areas and has started to disrupt the ability to replace the Air Forces aging fleet. A KLM Royal Dutch flight took off and landed in Amsterdam in 2009, with the hope of carrying the airline industry into a new environmental world (Edmonson, 2009). The KLM Group used a Boeing 747 with 40 passengers. This was one of their latest test flights by using biofuel. The KLM Group along with other airlines are in search for answers and several questions facing the aviation industry over greenhouse gas emissions and biofuel (Edmonson, 2009). The aviation industry has reviewed several ideas that include a cap-and-trade system to more fuel-efficient aircraft design and alternative biofuels, as a means to reduce greenhouse gas emissions (Edmonson, 2009).

The aviation industry has been hoping for rapid development of biofuels, which would help stave off environmental rules. The KLM flight was powered by a mix of 50% traditional kerosene jet fuel and 50% of biofuel, which was developed by Honeywell International Group (Edmonson, 2009). The aviation industry has been

slower, then most to take on alternative fuels. The Boeing Corporation plans to fly more airplanes on biofuel in the future, which will continue the testing phase. The Boeing Corporation claims that its aircraft will need absolutely no upgrade to run on a 50% blend within five years. The Boeing Corporation is researching and testing algae as their alternative fuel. The Boeing Corporation has estimated that algae could yield 150 times more fuel than soy beans, which is an additional biofuel in the testing phase. There have been many investors, including one notable oil company, which is putting their money into developing algae-based biofuel.

The ExxonMobil Corporation has joined the investors group to start testing and developing the algae-based biofuels. ExxonMobil will invest $300 million with Synthetic Genomics Inc, which is based out of San Diego, CA (Dittrick, 2009). The Synthetic Genomics Group has plans to build and develop a testing plant in San Diego, CA. The algae makes oil naturally, as much as 75% in some high-yielding species. The cells can be harvested and then processed to make biocrude. This biocrude can be more refined to make jet fuel and gasoline (Torrey, 2008). The algae strains can help produce more carbohydrates and less oil can be processed and fermented to produce ethanol. The residual proteins can then be used for animal feed, as an alternative (Torrey, 2008). The algae grown for biofuels have the potential for major environmental benefits, which are suboptimal land or near industrialized areas. The use of algae as a feedstock has led to accelerated development as a future fuel source. The algae process has lead to technologies, which include algae strains and genetic enhancement of algae strains and other biotechnological modifications (Preiss & Kowalski, 2010). The algae can be

produced in wastewater, which removes sewage effluents and carbon dioxide. The process requires less water and will not deplete the earth's water supply (Torrey, 2008). These testing plants will grow algae in several open ponds. The test plants will also research and study oil-extraction techniques (Dittrick, 2009).

The ExxonMobil Group has estimated that several billions of dollars are needed in order to achieve commercial production for an algae-based fuel. The ExxonMobil group has made an investment of $300 million dollars, which is intended to help develop a biochemical path to algae oil (Dittrick, 2009). The algae based fuel is the favored biofuel at this point in time, due to the oil yield promises and fuel pricing. One of the major challenges is developing a way to scale up production and minimizing the need for water or land. One company that is testing algae is PetroSun, which is producing algae farms. The oil product of the algae will be transported via rail or truck, then to the fuel refineries, which will produce the final product. The company is growing native microalgae strains. This type of strain should limit any impact on the local water supply. The PetroSun Corporation has estimated that the 1,100-acre saltwater-ponds algae farm will open in 2008 and will produce a minimum of 4.4 million gallons of algae oil (Torrey, 2008, p. 30).

Some problems that are associated with growing algae is ponds, which include open-air, temperature variations and risk of contamination from unwanted items. This includes various items such as flying and swimming creatures, which may be hard to control. To defeat these problems, many entrepreneurs are starting to use photobioreactors (Torrey, 2008). The photobioreactors are closed tubular systems, which

is for cultivating microalgae. These systems allow essentially single-species culture of algae for prolonged durations of time (Torrey, 2008). The typical photobioreactor operation uses about 40-50% of the costs, which is consumed by the mixing process, such as algae, water, CO^2 and other nutrients (Phelan, 2008). The algae process is about half of the Earth's photosynthetic activity and has about100,000 strains. The strains range from microscopic organisms to seaweed and holds almost unlimited potential for usage (Phelan, 2008).

One alternative fuel company is AltAir Fuels, which produces oil from camelina. The camelina is a plant that does not compete with food crops. The Camelina plant is a biofeedstock, which can be converted to make alternative jet fuel. The camelina plant is an oil seed plant, which can be used as an alternative biofuel (Lu & Kang, 2008). In 2009, a company named Sustainable Oils, which is in a joint venture with TGI and Green Earth Fuels, said jet fuel created from camelina seeds showed that it also reduced carbon emissions by 80%, which is compared to the traditional jet fuel. The AltAir Fuel Group is the first to license the Honeywell Company (UOP) process, which produces hydrotreated renewable jet fuel (HRJ).

The AltAir Fuel company has a few challenges of starting a biofuel production plant. The company is working with several farmers to grow camelina. The Japan Airline Group tested a flight with a Boeing 747 for 90 minutes using an alternative fuel made primarily from camelina. The camelina is a flowering stalk, which produces several amounts of plant oil (Biello, 2009). The production of camelina has already started in Africa and India. The camelina plant is improved as a rotation crop with wheat.

The camelina plant should bring in a price point of $80 dollars per barrel. This estimation is within the next three to five years (Biello, 2009).

Fuel Hedging

One of the tools that airlines are using is fuel hedging, which allows the company to lock in a price with the prediction that prices will continue to escalate to higher prices. The aviation industry offers an excellent setting for examining the effect of hedging fuel. The airline business is exposed to substantial risk exposures. One risk factor that is facing the airlines is the rising jet fuel prices. The airlines, like many industrial companies, are exposed to risks, due to adverse movements in interest rates, currency prices, and particularly aviation fuel prices. The fuel price is particularly transparent, due to oil, which is a widely traded commodity (Carter, Rogers, & Simkins, 2006). The investment patterns in the airline industry have suggested that hedging fuel will allow the airline business to fund during periods of high jet fuel prices (Carter et al., 2006). The aviation industry is unique because aviation fuel constitutes a large to higher percentage of airline operating costs, which is forcing airlines into consolidation and other means of reducing operating expenses (Carter et al., 2006). The jet fuel prices are highly volatile and many airlines are using hedging as a way to offset price risk. The hedging process allows airlines to purchase fuel during periods of high jet fuel prices, which protects them through contractual commitments (Carter et al., 2006). The hedging of fuel may also be explained as a way to stabilize the cost of fuel (Shapiro, 2008). As the cost of fuel increases many airlines are posting losses, however hedging the fuel can help offset additional losses and stabilize the airline industry (Shapiro, 2008).

In the airline business, hedging the cost of fuel has never been more important than it is now, a time of soaring prices. One of the most successful airline hedgers is Southwest Airlines. The airline has dealt with the fuel price increase by implementing one of the best hedging programs in the aviation industry. The program has allowed Southwest to stay profitable during fuel crisis. The company was able to negotiate fuel contracts for over 70% of its 2006 fuel needs at $36 dollars per barrel. This contract was able to save the company an estimated $675 million dollars during the course of the contract (Jackson & Jackson, 2009). Southwest was hedged through 2012, however its hedges have gradually decrease each year. One example is that they were locked in at 55% at $51 dollars per barrel in 2009 and around 15% at approximately $64 dollars in 2011 (Coffin, 2008). This hedging process has allowed Southwest to report its 60th consecutive profitable quarter in 2008 and a net income of $321 million, which is up from $278 million a year earlier (Coffin, 2008).

The hedging of fuel has been done by many airlines; however several experts agree that it is rarely the airline's operational risk manager who is involved in reducing the jet fuel cost and risk (Shapiro, 2008). The cost of fuel has turned the airline industry upside down and airline leaders are starting to use other methods to reduce costs. However, some methods are possibly compromising airline safety (Shapiro, 2008). In several airlines the awareness of fuel has become a major issue and concern. The airline business uses several tools and strategies to hedge costs.

The hedging of fuel has started to become less attractive for the time being, due to the cost of aviation fuel within the past two years. This is primarily due to the plunging

bargain prices and demand among travelers. The airline business is buying less fuel, which is pushing the overall fuel price down (Hannon, 2009). The Energy Information Administration has recently published that aviation fuel prices have plunged from a peak of more than $4.30/gallon to $1.38 within the past 2 years (Hannon, 2009). The aviation industry could not have dreamed of such low jet fuel prices in the past 2 years, buyers still are not sold on hedging contracts, since the prices could go lower. This is partly because of the amount of money many airlines have lost on hedges in 2008 (Hannon, 2009).

In 2010, many airlines and producers had very little or no reason to hedge against risk (Shari, 2011). The phenomenon is known as contango, which future delivery prices were actually higher than expected. This phenomenon gives airlines no reason to lock in current fuel prices (Shari, 2011).

Airline Manufacturers

There has been several years of airline manufacturers, such as Boeing and Airbus making technical tradeoffs. These tradeoffs have been given priority to factors such as potential profits and other non-technical characteristics of the airline industry and airplane technology (Lamb, Daim, & Anderson, 2010). The Airbus Corporation through its parent company EADS is backing algae. The company feels that it is the best source of sustainable jet fuel and asserting that other feedstocks will not meet the airline standards with regards to carbon-footprint reduction goals. The company does not believe second-generation, plant-derived biofuels will offer sufficient life-cycle, carbon-dioxide

reductions (Swickard, 2010). The ability to use bio-fuels can offer an alternative to traditional fossil fuels, which the aviation industry uses today.

The Airbus Corporation is developing a path to develop such energy sources, which will not compete with food resources. The company is now focusing on second-generation bio-fuels, which is known as biomass (Airbus Corporation, 2011a). The biomass plant thrives on CO^2, which can reduce carbon footprint throughout its growth cycle. These biomass plants, such as the 200,000 species of algae, can produce oil and do not require fresh water or land (Airbus Corporation, 2011a). The Airbus Corporation has a commitment to eco-awareness and innovation. The company believes that research and development of biofuel energy is one of the highest priorities on environmental performance, which can also reduce overall energy consumption (Airbus Corporation, 2011a). The Airbus Corporation has shown significant progress in eco-efficiency over the past ten years. The air quality "also has been improved with a 90% reduction in unburned hydrocarbon (HC) and smoke emissions, and a more than 50% reduction in carbon monoxide" (Airbus Corporation, 2011b, para. 2).

The Chief Technical Officer of EADS, James Botti feels that a half blend of conventional jet fuel, which is plant-derived biofuel and hydro-treated jet fuel will be expected to be approved for use in 2010, however research into algae fuels is less advanced for current production (Swickard, 2010). The aircraft manufacturers also have improved the airframe of the aircraft, which can help reduce the weight of an aircraft while maintaining the required strength. The use of aluminum alloys was the first material used by aircraft manufacturers, however newer advancements have allowed for

better properties and lighter aircraft weights. The airline manufacturers are starting to use advanced models to define the aircraft structure and utilization of composites (Hutchinson, 2007). The method has reduced fuel consumption through the lighter weights. The airline manufactures are starting to replace the metal in aircraft with lightweight composite materials. This process can reduce fuel consumption by 25%. The Boeing Corporation has started to utilize these materials in the 787 Dreamliner planes, which is made entirely of plastic and reinforced with carbon fibre. This innovation has cut half of the aircraft's weight through composite materials.

The Airbus Corporation also has started to utilize the lighter material, which the A380 has sections in the fuselage (Sanderson, 2008). The Airbus Corporation claims that the A380 will burn 17% less fuel per seat and produces only half the carbon dioxide emissions per passenger. The aviation business has also been tackling the issue of emissions for quite some time; however, there has been a bigger concern most recently. The starting points for emission reductions are through airframe, engine and operations, which includes air traffic management (Egelhofer, Marizy, & Cros, 2007). The reduction of fuel consumption can lead to fewer emissions and improved environmental conditions over time. The airframe, aerodynamics and lightweight structures, such as GLARE or carbon fibre can help reduce fuel consumption. The modification of wing tips can also improve and reduce fuel consumption, which produces fewer emissions (Egelhofer, Marizy, & Cros, 2007).

The history of the Boeing Corporation is one of vision, innovation and decision-making. The Boeing Corporation has risked the firm at least four times during their

beginnings to current. The risk was through development and innovative of new aircraft design (D'Intino, Boyles, Neck, & Hall, 2008). The designing and production of airplanes has been a part of Boeing for over 50 years and counting, however the business has been plagued with flat sales, due to the huge losses and mergers within the airline industry (Hoiness, 2006). The company has acquired several new engineers, which have been working on new aircraft designs. The main goal of the Boeing Corporation is to obtain talented engineers and scientists, which will assist them in building a more innovative company (Swain, 2007). The company is looking to create a revolutionary jet, which will set them apart from any other manufacturer. The company is betting on technology advancements as a means for market share. These advancements will produce a better product and more fuel efficient aircraft, than past models (Hoiness, 2006).

The Boeing Corporation has also started research and design on algae testing, which the company believes can yield 150 times more fuel. The most exciting new alternative fuel development is algae, which is pond scum and has rather unique properties. The Boeing Corporation has started a project to examine large-scale biofuel production through a corporate partnership ("Aviation Biofuel," 2009). The Boeing Corporation and China have also signed a biofuel agreement with the Chinese Academy of Sciences and Chinese universities. The agreement will help conduct research and development that could potentially support commercialization of jatropha, which is an alternative biofuel. China has been very proactive in the biofuel area for several years. Another process that the Boeing Corporation is doing is through engine modification,

which will allow for interchangeability. The engine interchangeability will allow commercial airlines to change from one manufacturer's engine to another. The process will reduce cost through fleet flexibility and lower maintenance costs, which is needed during a time of reduction and consolidation (Hoiness, 2006).

The airline industry and manufacturers have a strong interest in replacing aviation gas (avgas). In September 2008, the Boeing Corporation announced a biofuel demonstration flight designed to help accelerate the development of biofuel and the methods of sustaining alternative fuels for commercial aviation. The Boeing Corporation is exploring alternative methods through second-generation biofuel, which has the potential to reduce greenhouse gases (Boeing Corporation, 2007). This demonstration is vital to the alternative fuel and the future of commercial aviation. The test flight used Air New Zealand Boeing 747-400, which is equipped with Rolls-Royce engines.

The Boeing Corporation is also in discussions with several fuel-source providers, which can help identify potential biofuels. These biofuel may be available in suitable quantities for laboratory testing and in compliance with stringent aviation commercial requirements (Boeing Corporation, 2007). The alternative fuels could assist in the long term, which could significantly reduce environmental impacts. However, finding an alternative fuel could be very challenging, as further development and studies need to be completed (Parker, 2009). The Rolls-Royce Corporation has three requirements when assessing any candidate fuel. The three requirements are suitability, sustainability and production capability. The suitability requirement must include high energy content, low freezing point, good flow properties and compatibility with materials and components in

the fuel system. The sustainability must be an alternative fuel with real environmental benefits (Parker, 2009). The alternative fuel should be from a renewable source, which can produce less greenhouse gas emissions over its life cycle than conventional aviation fuel. Also the biomass must be able to be produced sustainably and it must not depend on energy intensive farming. The production capability must be capable of industrial levels of production and have the ability to replace 50% of today's aviation kerosene (Parker, 2009).

There are many alternative aviation fuels to be considered by research groups. The most viable alternatives currently being considered is hydrogenated plant or vegetable oils. The vegetable oils are in the early development stages. The biggest challenge associated with plant and vegetable oils is finding a feedstock. The feedstock must have the appropriate chemical structure and can be produced in a sustainable method and a cost effective way. There are two potential feedstocks, which may be able to be produced. These two are algae and jatropha, however these promising alternative fuels have significant development and validation efforts, which must be validated before an alternative aviation fuel can be implemented (Parker, 2009). There are other feedstocks that will be considered in the future, which testing will be determined. The aviation group as a whole may expect biofuels to include a wider range than have been tested to date.

Environmental Concerns

The climate change is becoming one of the most serious environmental issues and challenges that the world is facing. The airline industy is the fastest growing source of

greenhouse gases, which can cause climate change (Capoccitti, Khare, & Mildenberger, 2009). The aviation sector is in turbulent times and has taken steps to reduce further damage. The aviation industry is taking very aggressive steps to keep aviation emissions low, without losing sight of air quality or noise. In fact, industry leaders gathered in Geneva to sign a declaration of commitment, which will take action on climate change. This declaration includes identifying a pathway to carbon-neutral growth and toward a carbon-free future (Glover, 2008). In aviation each take-off and landing produces emissions, which include idle, taxi to and from terminal gates. The airline industry contributes to about 2% of CO^2 emissions. These phases of flight can cause concern when dealing with thousands of flights per day. The aircraft emissions contribute to ambient pollutant concentrations, which is through the additional fuel burn (Ratliff et al., 2009). The contribution of aircraft emissions to poor air quality has been influenced by air traffic management system and their inefficiencies as a government agency. These inefficiencies have resulted in increased fuel burn, as jet fuel is at an all-time high. The amount of time spent in each phase of aircraft operations can also add to the emissions problems and climate change (Ratliff et al., 2009). One aviation report suggests that over the next 20 years aviation biofuels can assist in cutting greenhouse gas emissions ("Flying Green," 2011).

There are several strategies available to aircraft operators to reduce emissions, which include aircraft and engine technology advancements; however the biggest component is the air traffic management system at U.S. airports (Ratliff et al., 2009). In airlines there are delays, which may be caused by an imbalance between demand and the

timely operation of flights. This can point to over-scheduling at the airport, maintenance and airline operating inefficiencies or air traffic management programs, which can hold airplanes in a location, due to congestion. Airlines deal with these issues daily and try to plan accordingly; however, such events can be difficult to assess. The amount of time an aircraft sits out on the ramp can cause further disruption and longer idle times, which increases fuel burn and ground level emissions (Ratliff et al., 2009).

The Boeing Corporation has made an environmental commitment with their airplane development, which begins with research and development. The environmental commitment has a clear and precise focus on their business model (Glover, 2008). On top of the aviation charts are the increased oil price rises and the climate change debate. The industry has been previously highly resilient to short-term shocks and problems, but now finds it unclear as to how the aviation sector will respond to persistent and significant issues (Bows, Anderson, & Mander, 2009). The airline industry has been gaining further knowledge into the threat of climate change, however the aviation industry continues to operate without any adaptation or plan for climate change (Conrad, 2009). The threats have placed public health in question, which is posed by climate change. The global transport growth has become a major concern for climate change. The recent advancements with technological developments, such as hydrogen fuel cells and biofuels has started to penetrate the markets of industrialized nations. The industrializing nations will continue to grow and become increasingly dependent on oil (Bows, Anderson, & Mander, 2009).

The aviation industry is one of the current threats as a major contributor of GHGs; however it receives relatively little attention in comparison to power plants and motor vehicles, which are the source of 19% and 32% of total U.S. emissions. The problem will continue to grow, as airlines continue to process more and more passengers yearly (Conrad, 2009). There have been many promising advancements through technology, which can help improve the aircraft engines and design, which will allow the aircraft to become more fuel efficient. This process will help reduce GHG emissions (Conrad, 2009). This climate change is brought on by global warming and aviation emissions. The Boeing Corporation has modified its 787 aircraft design, which uses carbon fibre and less fuel burn. This process makes the 787 lighter than comparably sized aircraft. The lighter aircraft means less weight and less drag. The modification will equate to an immediate reduction in CO^2 emissions. The Boeing Corporation has taken a lifecycle approach, which means that the climate impact of their airplanes will be lower than the airplanes they replace in the future (Glover, 2008). The second-generation biofuels, which are from plant feedstocks, such as camelina and jatropha have promised substantial life-cycle and carbon dioxide reductions. However, the process of CO^2 is still being produced during the process of creating the biofuel (Swickard, 2010).

The aviation industry has been expanding through the years, which has caused further damage, due to greenhouse emissions. The expansion has been through tourism, which has been increasing and causing additional climate change, especially through the use of air travel (Becken, 2007). The air transportation industry plays an important part in the tourism industry. The airline industry transports about 40% of international

tourists by air. The airline industry contributes to about 10% of the world's gross domestic product (GDP) and has about 80 million employees worldwide (Abeyratne, 2010). The aviation industry lost $56 billion dollars between 1999 and 2009. During this timeframe the airline industry also carried about 20 billion passengers by air. The industry loss was about $2.00 per passenger (Abeyratne, 2010). One fact is that 32,000 aircraft in future operation will have a much larger emission level of carbon dioxide (CO^2) and other greenhouse gases. This situation is causing concern among world leaders and nations, which must have a strategic action in place in order to control emission levels from aircraft (Aberyratne, 2010).

The concentrations of green house gases are rising, which have doubled in volume, since 1950 (Abeyratne, 2010). The main pollutants from aviation fuel are NO^sub x^, hydrocarbons, carbon monxide, sulphates and other soot aerosols (Keen & Strand, 2007). The major factor is that some of these pollutants, such as NO^sub x^, also affect the concentrations or substances, such as ozone and methane through the complex chemical process (Keen & Strand, 2007). The air pollution is more damaging in more populated areas, which aircraft have produced through its emissions. The aviation industry has noticed and took note that more international flights than domestic flights are over sea or deserted land areas. The process averages less air pollution than domestic flights (Keen & Stand, 2007).

The international aviation industry has been faced with overwhelming pressure to reduce growth in its greenhouse gas emissions. The international industry has been able to deflect several abatement measures through the cause of global warming, however the

industry has been aided by a lack of political and legal policy, which addresses the greenhouse emissions (Macintosh & Wallace, 2009). The fossil fuel has become one of the primarly reasons for global warming, which affects the climate change. The climate change is no longer a theory, but has become an unequivocal reality, which will continue to define our time (Abeyratne, 2010). The aviation industry and airline manufacturers continue to increase testing of sustainable alternative fuels. The process will be on-going and will help reduce impacts of current aviation fuel (Abeyratne, 2010). These alternative fuels may include feedstock resources; improving oil recovery and extraction; higher value co-products, and improving the efficiency of jet fuels through the converison of raw biofuels (Abeyratne, 2010).

The European Organization for the Safety of Air Navigation has established operational solutions that will contribute to noise reduction and improved air quality surrounding several airports (Watt, 2008). The aviation industry has become very focused over its contribution to climate change, which has several studies being conducted. Another way to control emission reduction is through reform and development. The remodeling of the aviation system through the flight management process can decrease emissions and help create a more efficient operation (Lawrence, 2009).

The air traffic management (ATM) system has been pushed to ensure that aircrafts are flying optimum flight levels, which reduces CO^2 emissions. The (ATM) process is set to deliver a 10% reduction in greenhouse emissions per flight by 2020 (Watt, 2008). The air traffic management system also complements the technological

push with aircraft manufacturers, which will deliver a 40% reduction in emissions from a new advanced aircraft by 2020 (Watt, 2008). The introduction of the air traffic management system process has allowed the department to create a central flow management unit, which improves the organization of the flow of traffic across the entire system. The central flow system works by holding aircrafts at the departure gate, until airspace is available for an entire flight, which helps reduce unnecessary generation of CO^2 emissions (Watt, 2008). The air traffic management system estimates that its new efficiency measures have started to reduce greenhouse gases by some 3.4 million tons per year (Watt, 2008). The air traffic management system is becoming one of the key tools to reducing environmental impact. The air traffic management system has several capabilities to meet the demand of the air transport industry through society demands for mobility and environmental reductions (Watt, 2008).

Federal Aviation Administration

The Federal Aviation Administration (FAA) plays a major role in regulating the aircraft industry. This role may be through fuel, transporting or through federal aviation regulations. The FAA plays a role in the transport of passengers or tourists, which comes to about 40% of international travel. The air transport of passengers contributes to about 10% of the world's gross domestic product and employs around 80 million people, which includes worldwide (Abeyratne, 2010). The tourism industry has become increasingly more and more dependent on the air transport industry, as a means to transport passengers back and forth; however the future depends on finding ways to reduce GHG

emissions. The problem has become bigger in recent years and many are searching for ways to reduce emissions, without reducing tourism's activities (Gössling et al., 2007).

The FAA also deals with many regulation organizations, such as the EPA, which controls or regulates aircraft emissions (Conrad, 2009). The FAA may consult with regulators, such as the Environmental Protection Agency (EPA). The consulting is needed to help approve procedures or processes, which may impact emissions or enforcement of emissions regulations (Conrad, 2009). The FAA has started advancing strategies and development for future airline transport innovation, which can help drive the next generation of transportation. This innovation can increase productivity and challenges the transportation sector, such as aging infrastructure, congestion and climate change (Merrifield, 2010). The Federal Aviation Administration (FAA) has recently issued over $125 million dollars in contracts, which will help develop commercial aviation technology and assist in fuel consumption (Boyd, 2010). The million dollar contracts will also assist with emissions control, which expects to save on nitrogen oxide emissions by 60%, which is significant to the environment (Boyd, 2010). The million dollar contract is a step in the right direction, as fuel has been steadily increasing over the years. As part of the biofuel process, the FAA, U.S. Air Force and NASA have funded research to measure the emissions from alternative jet fuels. The emission measurements are essential to accurately assessing the impact of alternative biofuel on both air quality and environmental change (Hileman et al., 2009).

The FAA contracted with many aviation equipment suppliers such as Boeing, General Electric, and Honeywell. Pratt & Whitney and Rolls Royce, to speed up green

technologies, which will assist in the development of lower energy and emissions (Boyd, 2010). The FAA program or contracts will help develop environmentally friendly and energy efficient aircraft. The process will include design and engine technology that should enter the commercial market by 2015 (Boyd, 2010). During the past few years aviation has become very serious about alternative fuels and ways to control costs. During January 2004 through July 2006, jet fuel prices increased $1.16 per gallon, which has continued in an upward trend (Air Transport Association, 2010).

The FAA has also started looking into an advanced air traffic control system, which is called NextGen. The NextGen system will replace the ground-based system with a satellite-based system. The NextGen system will improve several things, such as safety, lower fuel consumption, shortened flight times, reduced noise and pollution. The process will assist airlines and controllers. The NextGen system is the key to the future of aviation (Bliss, 2010). There is significant environmental benefits through a better managed global transportation system. The International Air Transport Association (IATA) has estimated that air traffic management enhancements could improve fuel efficiency and reduce carbon dioxide (CO^2) emissions by up to 12% (Boeing Corporation, 2009a).

Fuel Management

Airline leaders have started to apply programs, which have started to reduce the cost of aviation fuel. These programs include airplane modifications and other operational awareness factors. Some airlines are even applying cost-cutting measures, including canceling flights, slashing jobs, retiring older aircraft and even charging

passengers for luggage, which will help offest the costs (Coffin, 2008). When evaluating the airline business, the airline must consider the overall performance and the cost structure within that organization. Airline companies are dealing with more and more optimization problems during the planning phase. The major objective is to minimize operating costs, which is impacted by higher fuel costs (Afsar, Espinouse, & Penz, 2009). The airlines success will generally hinge on the ability to manage growth and costs. The airline industry has three primary areas of cost, which involve fuel, labor, and airframes. These three factors can sustain a business if properly managed (Jackson & Jackson, 2009). The labor costs have dropped to the second highest expense among airlines, due to increasing fuel costs and fuel costs have taken over the leading expense (Jackson & Jackson, 2009).

The airline association has already started to create strategies and awareness regarding the problem of aviation fuel. The fuel problem has forced many airlines into a restructure mode, in order to handle the higher cost of operation (Ryerson & Hensen, 2010). This seems to be a growing trend among all airlines and has continued to challenge their business model (Ryerson & Hensen, 2010).

The fuel costs in the past, was the second largest cost for airlines, however this cost has taken over as the primary cost factor, which has placed it into the number one expense. The fuel costs represented about 25.7 % of total revenues between 2006 and 2007. The factor has caused airlines to take action through programs and other cost cutting tools. The fuel efficiency factor has become the major factor among all airlines. The airline business must take into consideration the age and type of aircraft in order to

determine the cost of operation (Jackson & Jackson, 2009). There are many options to lower the costs associated with airframes. Airlines can adjust the percentage by leasing equipment rather than purchasing. This process can result in additional savings, which can save in the long run. The leasing of equipment can ensure a younger fleet with considerable lower maintenance costs (Jackson & Jackson, 2009). The entire aviation industry remains unsure of which way the pendulum will swing on any given day, which makes it clear that quarterly earnings will hinge on the price of a barrel of oil (Coffin, 2008).

One airline that has modified their fleet is Southwest Airlines. The airline has started to change out the winglets on the end of the airplane wings, which will help reduce drag and improve efficiency, which reduces the fuel burn (Box & Byus, 2009). The drag is the resistance induced by the air friction, which is based on shape and size of the aircraft. There has been several improvements in the field of aerodynamics, such as winglets (Mazraati & Alyousif, 2009). In addition, over 48% of the airlines fleet, which consists of 737-300 aircraft have added this winglet technology, which will save costs in the long run (Jackson & Jackson, 2009). The winglets can help reduce the fuel consumption in an aircraft by an estimated 3 cents per gallon, which has made the winglets a must on all new aircrafts. The ability to retrofit older aircraft can be very beneficial to an airline, as the cost reduction can add up (Mazraati & Alyousif, 2009). This is just one of the modifications airlines are starting to making. The aircraft manufacturers are starting to use innovative concepts, which contists of reducing fuel consumptions (Mazraati & Alyousif, 2009).

One innovation is the reduction in engine running time, which will have indirect improvements in reducing the extra amounts of fuel needed. These improvements will alter such things as aircraft engines, aerodynamics and structural materials (Mazraati & Alyousif, 2009). The future of engines will utilize ultra-high bypass ratio engines, which will add further fuel consumption savings, which will help reduce fuel costs (Mazraati & Alyousif, 2009). The Boeing Corporation is modifying their engines, which will allow for interchangeability. The engine interchangeability will allow commercial airlines to change from one manufacturer's engine to another. The process will reduce cost through fleet flexibility and lower maintenance costs, which is needed during a time of reduction and consolidation (Hoiness, 2006). The airframe improvements can help reduce the weight of an aircraft while maintaining the required strength. The use of aluminum alloys was the first material used by aircraft manufacturers however, newer advancements have allowed for better properties and lighter aircraft weights. The method has reduced fuel consumption through the lighter weights.

The airline manufacturers are starting to replace the metal in aircraft with lightweight composite materials. The process can reduce fuel consumption by 25%. The Boeing Corporation has started to utilize these materials in the 787 Dreamliner planes, which is made entirely of plastic and reinforced with carbon fibre. This innovation has cut half of the aircraft's weight through composite materials.

The Airbus Corporation also has started to utilize the lighter material, which the A380 has sections in the fuselage (Sanderson, 2008). The Airbus claims that the A380 will burn 17% less fuel per seat and produces only half the carbon dioxide emissions per

passenger. The material that is used in the A380 will make up a quarter of the A380's weight. The aircrafts upper fuselage will utilize aluminum–glass fibre laminate, which is called GLARE. The material was developed and studied in the Netherlands. The material also showed improved corrosion and impact-resistance during the studies (Ball, 2008). The A380 also contains a honeycomb composite of high strength Kevlar, which helps reduce aircraft weight. This material will help produce more efficient aircraft and reduce fuel costs (Ball, 2008). In civil aviation, the implementation of Glare and carbon fibre has been driven largely by the high cost of aviation fuel. There also has been strong legislation, which is setting limits on the emission of greenhouse gases. These two composite materials have created a more efficient industry and will continue to do so in the coming years (Scelsi et al., 2011).

There has been New Product Development (NPD) within the commercial aerospace industry, which focuses on reducing operating emissions and weights, while increasing operating performance parameters. The development was also focused on cost-effective and lightweight composite parts, which will provide a fuel savings. There has been an increasing use of composite materials in the aerospace industry, which has been shown to achieve through increased strength and reduced weight (McAdam, O'Hare, & Moffett, 2008). The General Electric Corporation (GE) has used carbon fibres through their aviation division. The Genreal Electric (GE) division used carbon fibers and resins in the development of their turbines on the aero GE engines. The carbon fibre material will allow for the production without the penalty of extra weight, which can save airlines annual costs (Gwynne, 2010).

The new composites offer several advantages over older material production, says John Tomblin who is the executive director of Wichita State University's Aviation Research Institute. The composites, such as carbon fibre have higher strength ratios, which gives the airlines better fuel economy (Brown, 2007). The carbon fibre has been proven to have excellent fatigue and corrosion resistance, which can also reduce maintenance costs in the long run. The newer resin system, which uses carbon fibers to form composites are much more damage tolerant and stronger than compared to older material (Brown, 2007). The newer composites also allow for combining parts, such as panels and framing. The process allows for fewer parts and cheaper production (Brown, 2007). The aerospace aluminum suppliers have researched and mainly concentrated their efforts for further development of high strength patented alloys, which is currently losing market share to other composite parts, such as carbon fibre and GLARE. The aircraft manufacturers are shifting to the composite material in order to meet the airline demand. This process will allow airlines to achieve significant weight reductions and greater fuel efficiency (Lewis & Loebbaka, 2008).

The airline operation has been transformed over the past few years, which additional changes are being made due to the cost of fuel. The U.S. airline industry has been transformed and changed by the filing of several bankruptcies over the past few years, including major airlines like Delta, Northwest, and United Airlines. The U.S airlines have estimated a loss well in excess of $8 billion (Bisignani, 2006). The European airlines have been breaking even and some turning a profit. One Asian carrier has been turning a profit for the last 5 years with $1 billion in profits in 2005. The airline

business is very competitive with tight profit margins, which is causing many to merge in order to meet the challenges, such as fuel costs and labor issues (Bisignani, 2006). The main message that upper management is sending the frontline employee group, such as pilots and aircraft dispatchers is to do something, as doing nothing is needlessly losing the airline money. The areas of fuel cost has been a quick remedy for fastest results (Rose, 2007). The proper utilization of many aircraft can reduce fuel consumption through seating capacities and optimizing the best flight routes (Mazraati & Alyousif, 2009). The ability to replace older aircraft can also improve the impact on the fuel and emission problems, which is produced by the commercial airline fleet.

Airline leaders are starting to use optimized flight profiles or routes, which can calculate the best optimal cruise altitude. This process can burn less fuel and can be a major cost savings for the airline. Some newer aircraft have advanced technologies, which can improve climb performances than older generations (Egelhofer et al., 2007). Several airlines have announced capacity cuts, which started during the first half of 2008. This method was due to the fluctuation of fuel prices and uncertiainites of the future (Ryerson & Hensen, 2010). The flight routes are being improved through navigation, which is providing better and faster routes. The Alaska Airlines group is deploying a new navigation system to yield more direct routings, which can reduce fuel costs (Mazraati & Alyousif, 2009). Another tool that many airlines are using is the ability to taxi in and out from the gate with one engine operating, which can reduce fuel costs by an estimated $10 to 12 million per year (Mazraati & Alyousif, 2009). The fuel efficiency in the aircraft has improved over the recent decades. This improvement is more than 25%

in 2006 when comparing to the data in 1990. The airlines are planning to gain another 25% by 2020 (Mazraati & Alyousif, 2009). The Lufthansa Airline group has also signed an agreement with Algae Tec in order to build an alternative fuel plant ("Airline eye full-scale," 2012).

Transition and Summary

Overall the airline industry has been changing and one of the major factors that have caused the change is aviation fuel. The aviation fuel problem has been impacting all airlines and how they operate. The fuel cost is currently the highest cost of an airline expense and will continue to drive costs upward. One of the tools that many airlines use is fuel hedging, which allows the company to lock in a price with the prediction that prices will continue to escalate to higher prices. The hedging of fuel may also be explained as a way to stabilize the cost of fuel (Shapiro, 2008). The airline industry and manufacturers have a strong interest in replacing aviation gas (avgas). The alternative fuel method has many managers and executives involved from various airlines. The alternative fuel has a willingness of participation from various companies in the industry.

The FAA has started advancing strategies and development for future airline transport innovation, which can help drive the next generation of transportation. The innovation can increase productivity and challenges the transportation sector, such as aging infrastructure, congestion and climate change (Merrifield, 2010). The Federal Aviation Administration (FAA) has recently issued over $125 million in contracts, which will help develop commercial aviation technology and assist in fuel consumption (Boyd, 2010). This willingness is a very important part of the program and will allow each

airline to collaborate thoughts and ideas. The million dollar contracts will also assist with emissions control, which expects to save on nitrogen oxide emissions by 60%, which is significant to the environment (Boyd, 2010). The million dollar contract is a step in the right direction, as fuel has been steadily increasing over the years. The FAA said it is contracting with many aviation equipment suppliers such as Boeing, General Electric, and Honeywell. Pratt & Whitney and Rolls Royce, to speed up green technologies, which will assist in the development of lower energy and emissions (Boyd, 2010). In section 2, I have identified the project, researcher role, purpose statement, and methodology.

Section 2: The Project

This section is an overview of the qualitative study. The section provides a description of the research method, design, data collection, participants, and population. The reliability and validity of the research are also discussed.

Purpose Statement

The purpose of the study was to address the perception of aviation managers and fueling company leaders pertaining to the benefits of usage of alternative fuel. The contribution of aircraft emissions to poor air quality has become a major issue with global climate. These inefficiencies have resulted in increased fuel burn, jet fuel use is at an all-time high (Ratliff et al., 2009). The airline industry has been struggling with fuel cost in recent years and will continue to do so through the coming years. The production of fuel will also decrease by 2026, which will cause further problems for the struggling airline business (Nyrgen et al., 2009). The fuel cost problem has developed into an extreme situation and several airlines have declared bankruptcy, due to the increased financial pressure that fuel has caused among their total operating costs (Assaf, 2009). The fluctuation in oil price is expected to affect the structure of the airline industry and also increase competition between airlines (Assaf, 2009). The testing of alternative fuels has been the starting point. Fuel consumption is a major fixed cost and is being researched and studied by airlines leaders (Stolzer, 2002). The fuel situation is creating awareness among the airline leaders, and many airline leaders are starting to control mechanisms through their flight operations departments. The control mechanisms consist of optimal flight altitudes and working with air traffic control. The airlines are experiencing significant cost reduction through these flight operation procedures;

however, these procedures alone may not save the airlines. Airline leaders have started to reduce capacity and continue to reduce the fleet, which may help offset rapidly rising fuel bills. The fuel bill has become one of the most significant expenses for all airlines (Abdelghany, Abdelghany, & Raina, 2005). In June 2011, U.S air carriers spent an average of $2.94 per gallon, which is 5% more than June 2010 (Firestine & Guarino, 2012). The cost of fuel has nearly doubled the cost of labor, since 2000 and continues to have an upward trend (Firestine & Guarino, 2012).

Role of the Researcher

I explored and identified the impact that biofuel has on the airline business. The data collected through interviews or face-to-face meetings with aviation managers identified the role that biofuel plays. Though I work within flight operations and do not have a direct relationship with aviation managers or the fueling industry, studying the use of alternative fueling options was of interest and indirectly could impact future airline operations. Since I live and work in Pennsylvania, I chose this geographical area because of convenience in data collection and the availability of qualified participants to meet the purpose of the study.

Participants

The participants were selected from at least one major U.S airline and several aviation companies. The participants included a Chief Operating Officer (COO), executives, pilots, and frontline managers. The random sample of 27 participants provided an indepth understanding on the alternative biofuel and how management views the testing for future use. The selection process was identified through each participant's role in the use or testing of alternative fuel. The methods used to ensure ethical

protection were not naming individuals and securing the data. The data were secured through the use of a laptop computer, which is password and username protected. The random sampling ranged from executives to frontline managers and the results presented a realistic perception of the benefits of alternative fuel. The study included a confidentiality/consent form for the participating interviewees, which is located in Appendix B.

Research Method and Design

The qualitative method and phenomenological research design were used to identify the lived experiences of participants regarding the impact that aviation biofuel has on the aviation industry (Bryman, 2008). The phenomenological design allowed the participants to share their lived experiences of the forced distribution method (Moustakas, 1994). The process involved open-ended, semistructured questions that resulted in thematic analysis. I conducted interviews with several management members within the airline business and fueling companies, such as CEOs and frontline managers.

Method

The qualitative method involved phone conferencing, as a means to capture follow-up interviews with the participant (France, 2010). The study used open-ended interviews as the instrument to collect data. The qualitative method explores perceptions and lived experiences, whereas the quantitative method examines data based on statistical analysis with closed-ended questions. The interviews were conducted with several fueling company leaders who have started to create and explore new alternative biofuels. The interviews were conducted with management from one major airline, which provided

an operational perspective. The qualitative method provided an opportunity to collect responses from participants' lived experiences and perceptions associated with the use of biofuel (Kirkwood, 2009). The qualitative method is critical and interpretive, which can create change that is powerful, ethical, and communitarian (Denzin, Lincoln, & Giardina, 2006). The qualitative method utilized a collection of interviews concerning biofuels and how they may impact the airline industry. The data outlined alternative biofuel and environmental concerns within the airline industry. Some of the questions were related to how the participants felt about alternative fuel and its overall impact. Another question was whether or not aviation fuel, as an alternate fuel, can be profitable for the aviation industry. These questions were just a starting point, but tried to capture the reasoning of each participant. The one airline association, Airlines for America (A4A), represented the organization where the sample was identified. This access allowed further insight into how the problem is impacting the airline industry.

Research Design

The research design was a phenomenological approach, which is a useful method for researchers looking to explore lived experiences about a phenomenon. The design allowed questioning to explore impacts and processes through the knowledge base within the aviation industry (Pandey & Sharma, 2009). The phenomenological design also allowed for reasoning and explanation from organizational leaders in decision-making roles (Harrington & Ottenbacher, 2009). Case study design was not appropriate for the purpose of this study as it was not meant to evaluate perceptions from leaders of a single organization, but various industry leaders' perceptions (Yin, 2012). Ethnographic design

was not appropriate because shared patterns within an organizational culture was not the intent of the study (Marshall & Rossman, 2011).

Population and Sampling

The research population included 27 airline management and aviation fueling leaders. The qualitative study provided a better understanding of what each participant believes about the future of aviation fuel. The qualitative study provided more in-depth information than a quantitative study. The population of 75 employees consisted of various airline leaders, fueling leaders, and the Airline for America (A4A) who would have knowledge of aviation fuel because of their managerial position in the aviation industry. The sample size was projected to be 30 participating employees from these three groups; however, 27 participated, which was enough to satisfy the purpose of the study and met the requirements of at least 20 participants for a Walden University phenomenological doctoral study.

Ethical Research

I distributed consent forms that described the nature of the study and risks (Appendix C). The participants were able to withdraw from the study at any point, without recourse. There was no incentives provided for participation. The data collected was kept secure and confidential in a safe that only I had access. The findings did not include names or anything that could identify participants. All electronic media were secured in log files, which were locked and secured in a encrypted safe that only I had access to during the duration of the study. Shredding of all documents and erasing of all electronic media will occur 5 years after completion and publishing of the doctoral study.

Data Collection

In this section I have identified the instruments, data collection, and data organization techniques. The instruments were validated through a pilot study. The data collection was conducted using interviews. The data were maintained in secure log files, which were locked and secured in a encrypted safe that only I had access to during the duration of the study.

Instruments

The instrument consisted of semistructured, open-ended interview questions validated through a pilot study, and provided in Appendix A. The pilot study was conducted with five participants, within the airline industry, who were not participants in the actual study, to determine the validity of the interview questions (Yin, 2012). The pilot study participants determined the interview questions met the purpose of the study, so no changes were made to the instrument (Appendix B). The interviews were established through e-mail or face-to-face meetings, which provided a powerful, but efficient method of data analysis. This form of data collection provided analysis, which was geared toward the participant, the aviation industry, and purpose of the study. The findings were coded, analyzed, and organized to determine core themes. The use of semistructured, open-ended questions allowed participants to provide responses they felt were honest and through (Clark, 2010).

Data Collection Technique

The technique used to collect data was through interviews and assisted in generating information (Englander, 2012). The software that was used to analyze the

data was Excel, which allowed inputting of interview data into a spreadsheet. The coding process occurred twice, once for the pilot study participants and once for the actual study participants. The first type was the pilot study, which was coded as PS1 through PS5, which meant pilot study participant one through five. This has ensured privacy and confidentiality for the pilot study participants. The second type was SP1 through SP27, which identified study participant one through 27. The data were classified using inductive analysis in order to identify emerging individual patterns (Moustakas, 1994).

Some interviews were electronically e-mailed to the participants. The other method was through face-to-face meetings. The interview questions were validated through a pilot study (see Appendix A). The pilot study was conducted with five participants within the aviation industry to determine if the interview questions represented the purpose of the study.

Data Organization Techniques

The system used to collect and track the interviews was through research logs. These logs were secured through a password protected laptop and were locked in a secure safe that only I had access. This helped secure the information, as further data collection occurred. Destruction of all hard copy by shredding and electronic documents by erasure will occur 5 years after completion of doctoral study.

Data Analysis Technique

Participants responded to the following interview questions (see Appendix B).

Q1: What are some of the operational changes that the company has made with regards to aviation fuel? Please explain any change strategies.

Q2: Describe your thoughts on whether or not aviation biofuel might transform the aviation industry and what the expected outcome might be.

Q3: What are your biggest concerns with biofuel?

Q4: Describe your thoughts on whether or not aviation fuel, as an alternate fuel, can be profitable for the aviation industry.

Q5: What applications or tools are being used to reduce overall fuel costs within your company? Please explain.

Q6: What organizational interventions are being used to reduce fuel costs? Please explain.

Q7: What are some barriers for the organization with regards to aviation fuel? Please explain.

Q8: Describe if alternative fuel might represent a best strategy for controlling costs or not? Please explain.

Q9: What course of action, if any, have the company leaders made to relieve the burden of fuel costs?

Q10: Describe how biofuel might or might not reduce climate change and how can environmental concerns be addressed for current fuel specifications.

The data or information was handled through interviews. The comparison of data can be identified through a few steps, such as (a) grouping core themes from the participants, (b) checking for consistent components with the participants knowledge, (c) providing detailed information about each participant and their expertise in the subject matter, and (d) providing detailed accounts of each participants overall experience in the field and their differences (Moustakas, 1994). Another process for collecting information

was through face-to-face meetings. Once information was obtained, the information was placed in the secure research log, which was locked in an encrypted file that only I had access to during the study. The data relates to the conceptual framework of sustainability theory through the exploration from a variety of stakeholders that understand alternative fuel and environmental concerns.

Reliability and Validity

This section discusses reliability and validity within the study. The reliability was ensured through instruments and collections. The validity was maintained through the controlling process.

Reliability

The most reliable information comes from those within the research field and professionals who are impacted by the research (Marshall & Rossman, 2011). A consistent collection of the data, from professionals within the field of aviation and fueling, using open-ended questions and semistructured interview techniques ensured that the data collection and analysis were credible and applicable to the purpose of the study (Rubin & Rubin, 2012). The data was secured in research logs that were secured to ensure reliability of collections.

Validity

The qualitative approach was checked for validity through double checking interview sessions and ensuring that qualified participants participated in the study. Moustakas (1994) stated that the internal validity happens when the researcher is able to demonstrate consistency in collecting the data. Collecting data from professionals in the

aviation industry provided credibility of the data to ensure that the findings were transferable to all organizations in the aviation industry (Guba & Lincoln, 1994). The internal validity was addressed through open-ended questions, which encouraged in-depth responses from participants' experiences and perceptions and supported the design concept to reduce researcher bias (Rubin & Rubin, 2012). Because the study was directly related to the aviation industry, an external threat to validity resulted as the findings were not considered directly transferable to organizations that were not associated with aviation.

Transition and Summary

Overall this specific problem was chosen due to the cost of aviation fuel and the shortage of fuel expected in future years. The airline industry has been struggling with fuel cost in recent years and will continue to do so through the coming years. The research method chosen for the study was a qualitative method. The qualitative method utilized a collection of interviews in regards to biofuel and how it is going to impact the airline industry. The qualitative method provided an opportunity to collect responses from participants' lived experiences and perceptions about the use of biofuel (Kirkwood, 2009). The use of a qualitative method allowed insight into participants' thoughts and attitudes about alternative type of biofuel. The validation was checked for validity through double checking interview sessions and ensuring that qualified participants are participating within the study. This also assisted in the validation process (Moustakas, 1994). The research design was a phenomenological strategy. The process allowed for questioning in regards to aviation biofuel and how it will impact the airline industry. The participants included a CEO, executives, and aviation management.

The results of the qualitative study provided a better understanding of how each participant views the future of aviation fuel and the alternative fuel options. The reliability of the study was processed through professionals within the field of aviation and fueling, which provided interviews. The most reliable information comes from those within the research field and professionals who are impacted by the research (Marshall & Rossman, 2011). Section 3, presents the findings and analysis from the data collection.

Section 3: Application to Professional Practice and Implications for Change

The following is a presentation of findings, applications for professional practice, implications for social change, and recommendations for action. In addition, suggestions for future study are offered for the purpose of further exploration of this subject matter.

Overview of Study

The purpose of this qualitative phenomenological study was to explore aviation biofuel and how it may impact the aviation industry. The findings identified several areas in which biofuel can assist the airline industry. An email invitation to participate was sent to 75 airline and fueling leaders, with 27 responding. The specific business problem explored was the perception of aviation managers and fueling leaders in regards to the benefits of using alternative fuel. The central research question was to explore the impact that biofuel will have on the airline industry and how management believes biofuel can contribute to a reduction in the use of fossil fuels.

To gather pertinent information that would be useful in identifying areas that biofuel can assist, the participants were asked questions regarding their knowledge on aviation biofuel. These questions included:

Q1: What are some of the operational changes that the company has made with regards to aviation fuel? Please explain any change strategies.

Q2: Describe your thoughts on whether or not aviation biofuel might transform the aviation industry and what the expected outcome might be.

Q3: What are your biggest concerns with biofuel?

Q4: Describe your thoughts on whether or not aviation fuel, as an alternate fuel,

can be profitable for the aviation industry.

Q5: What applications or tools are being used to reduce overall fuel costs within your company? Please explain.

Q6: What organizational interventions are being used to reduce fuel costs? Please explain.

Q7: What are some barriers for the organization with regards to aviation fuel? Please explain.

Q8: Describe if alternative fuel might represent a best strategy for controlling costs or not? Please explain.

Q9: What course of action, if any, have the company leaders made to relieve the burden of fuel costs?

Q10: Describe how biofuel might or might not reduce climate change and how can environmental concerns be addressed for current fuel specifications.

The managers and biofuel producers generated several different perceptions on the usage of biofuel and the impact that it will have on the airline industry. Thematic patterns such as operational changes, fuel barriers, aletnative fuel, cost control, and environmental concerns were identified through the collection of data.

Presentation of the Findings

A pilot study, consisting of five participants, not participants of the formal study, was undertaken. The pilot study participants were asked three additional questions to verify and validate the questionnaire instrument (Appendix A). All pilot study participants determined the questions represented the purpose of the study. No adjustments were made to the instrument.

The study participants included airline management and fuel team leaders. The selection of participants was random to reduce bias within the study. The study participants applied their knowledge in order to generate the following analysis.

Of the 27 study participants' responses to the 10 study questions, the following information was complied for each question. This data was able to generate several themes, such as increased efficiency, flight routes, supply chain, production, and affordability from within the information provided. The presentation of findings follow by question.

Operational Changes

When addressing Question 1 regarding operational changes, two (7%) respondents felt that air traffic and flight routes was an operational change with regards to fuel cost. SP18 commented that since the fuel price shock of 2008, the airline industry as a whole has taken some aggressive steps (SP18). Airline leaders are starting to use optimized flight profiles or routes, which can calculate the best optimal cruise altitude. This process can burn less fuel and can be a major cost savings for the airline. Some newer aircraft have advanced technologies, which can improve climb performances than older generation aircraft (Egelhofer et al., 2007).

Eleven (41%) respondents felt that less fuel usage to lower costs was an operational change with regards to fuel cost. SP23 commented that flight dispatchers are encouraged to file the optimal route for efficiency and less fuel usage. Fuel is now viewed as a time value instead of a gallon value (SP23). The aircraft manufacturers are

starting to use innovative concepts, which consists of reducing fuel consumptions (Mazraati & Alyousif, 2009).

Eight (30%) respondents felt that increased efficiency was an operational change with regards to fuel cost. SP3 commented that our company has been systematically implementing several initiatives to reduce fuel consumption. Among them we have some operational (examples: partial flap landing, idle reverse, APU use reduction on ground) and some in the maintenance area (examples: engine wash, fleet monitoring, weight reduction) (SP3). The fuel efficiency in the aircraft has improved over the recent decades. This improvement is more than 25% in 2006 when comparing to the data in 1990. The airlines are planning to gain another 25% by 2020 (Mazraati & Alyousif, 2009).

Seven (26%) respondents felt that the introduction of alternative fuel systems was an operational change with regards to fuel cost. SP10 commented that the FAA has made development and deployment of sustainable alternative jet fuels as a key component of the U.S. NextGen system modernization. The FAA has also started looking into an advanced air traffic control system, which is called NextGen (SP10). The NextGen system will replace the ground-based system with a satellite-based system. The NextGen system will improve several things, such as safety, lower fuel consumption, shortened flight times, reduced noise and pollution. This process will assist airline leaders and controllers with fuel efficiency. The NextGen system is the key to the future of aviation (Bliss, 2010).

Table 1 identifies the various themes, which were collected during the interview phase of the study. These themes listed below were based on the operational changes that the company has made in order to reduce fuel costs.

Table 1

Operational Changes That the Company has Made

Themes	No. of participants who shared this experience	Percentage of participants who shared this experience	Participants who shared this experience
Air traffic and flight routes	2	7%	10,11
Less Fuel Usage to lower costs	11	41%	2,3,6,9,14,16,17,20,21,23,25
Increased Efficiency	8	30%	2,17,18,19,20,21,22,23
Introduce alternative fuel system	7	26%	6,8,13,16,18,19,26

Biofuel Transformation of Aviation

When addressing Question 2 regarding aviation biofuel transformation, 17 (63%) respondents felt that aviation biofuel will transform the aviation industry. The majority of participants felt that biofuel holds some promise for the future; however, supply and demand plays an important role in the progression of the alternative fuel. SP25 commented that biofuels are an important part of commercial aviation's long-term fuel diversification strategy, enabling sustainable growth, providing an additional lever to

manage costs, and improving overall environmental performance (SP25). In order for biofuel to have an impact on the aviation industry, there must be a few issues addressed in the next few decades. The compatibility with current systems and fuel delivery is the most important part, as existing aircraft may need to be modified in order for efficient aircraft operations (Hileman et al., 2009).

Twelve (44%) respondents felt that supply and demand will be a factor with transforming aviation biofuel within the aviation industry. SP2 commented that the aviation industry and what the expected outcome might be. A sufficient distribution system is created, and if there is no increase in maintenance issues and reliability is maintained then an environmentally favorable biofuel could become the industry standard (SP2). The life cycle of alternative biofuels encompasses emissions from the complete fuel cycle, which includes the efficient usage of water and land resources. These issues address the ability to produce the feedstock for the alternative fuel, as water and land are the key components to a production facility (Stratton, Wong, & Hileman, 2010).

Five (18%) respondents felt that improved performance will be a factor with transforming aviation biofuel within the aviation industry. SP16 commented that the aviation industry will not be fundamentally transformed because it will remain reliant upon liquid fuels and for the foreseeable future, petroleum fuels will be at least 50% of the fuel used in each flight. The real transformation will be a diversified source of supply, enhanced operational reliability and improved environmental performance (SP16). The FAA said it is contracting with many aviation equipment suppliers such as Boeing, General Electric, and Honeywell. Pratt & Whitney and Rolls Royce, to speed up green technologies, which will assist in the development of lower energy and emissions

(Boyd, 2010).

Table 2 identifies the various themes, which were collected during the interview phase of the study. These themes listed below were based on aviation biofuel and how they might transfrom the aviation industry.

Table 2

Aviation Biofuel Might Transform the Aviation Industry

Themes	No. of participants who shared this experience	Percentage of participants who shared this experience	Participants who shared this experience
Biofuel might transform	17	63%	1,3,5,6,7,8,9,10,12,13,18,19,20,21 22,23,25
Supply and demand	12	44%	2,6,8,9,10,11,13,14,16,22,23,26
Improved performance	5	18%	3,7,11,14,16

Biggest Concerns With Biofuel

When addressing Question 3 regarding biofuel concerns, four (15%) respondents felt that the lack of reliable biofuel sources will be the biggest concern for aviation biofuel. SP24 commented that he was concerned that there has not been enough emphasis being placed upon sourcing and using sustainable biofuels (SP24). There are several other issues that need to be addressed when evaluating the alternative biofuel, which include the efficient usage of water and land resources. These issues address the

ability to produce the feedstock for the alternative fuel, as water and land are the key components to a production facility (Stratton, Wong, & Hileman, 2010).

Eleven (41%) respondents felt that affordability will be the biggest concern for aviation biofuel. SP12 commented that there is one big concern for us and that is the price. Of course the sustainability of the biomass and supply chain create issues as well, but the only thing hindering use of more biofuel at this point is the price (SP12). There are two concerns that are motivating alternative fuel use to conventional petroleum use. The first one is the price and the second one is the environmental effects (Hileman et al., 2009).

Seven (26%) respondents felt that the supply chain will be the biggest concern for aviation biofuel. SP6 commented that there are two major issues with biofuels. The first is production and supply and the second is an understanding of the difference between biofuel and alternative-fuel (SP6). The production is limited by resource constraints and fuel production technology, which will limit number of biofuel plants in the coming years (Hileman et al., 2009).

Six (22%) respondents felt that inconsistent regulatory policies will be the biggest concern for aviation biofuel. SP12 commented that the concern would be that EU/US/other continents legislation will differ and hence benefits from emission trading would not be realized in all cases (SP12). The international aviation industry has been faced with overwhelming pressure to reduce growth in its greenhouse gas emissions. The international industry has been able to deflect several abatement measures through the cause of global warming, however the industry has been aided by a lack of political and legal policy, which addresses the greenhouse emissions (Macintosh & Wallace, 2009).

Table 3 identifies the various themes, which were collected during the interview phase of the study. These themes listed below were based on the biggest concerns with biofuel.

Table 3

Biggest Concerns With Biofuel

Themes	No. of participants who shared this experience	Percentage of participants who shared this experience	Participants who shared this experience
Lack of reliable biofuel sources	4	15%	2,3,14,26
Affordability	11	41%	1,2,7,8,10,12,15,16,20,25,26
Supply chain	7	26%	1,6,9,10,18,25,26
Inconsistent regulatory policies	6	22%	4,9,14,22,25,26

Alternate Fuel Being Profitable

When addressing Question 4 regarding profitability of alternative fuel, 10 (37%) respondents felt that production will be an issue on alternative fuel and profitability. SP12 commented that when the production costs come down (economies of scale) and when there is more local production of biomasses the price should be heading towards the conventional jet fuel (SP12). The Japan Airline Group tested a flight with a Boeing 747 for 90 minutes using an alternative fuel made primarily from camelina (Biello, 2009). The camelina is a flowering stalk, which produces several amounts of plant oil (Biello,

2009). The production of camelina has already started in Africa and India. The camelina plant is improved as a rotation crop with wheat. The camelina plant should bring in a price point of $80 dollars per barrel. This estimation is within the next 3 to 5 years (Biello, 2009).

Four (15%) respondents felt that alternative fuel would not be profitable for the airline industry. SP11 commented that he can't envision a situation where that could happen – unless we see an airline owning and/or investing in primary biofuel production a sort of return to the kind of vertical integration business model that is now so unfashionable, where it can control everything and have exclusive use rights (SP11). There are two concerns that are motivating alternative fuel to conventional petroleum. The first one is the price and the second one is the environmental effects (Hileman et al., 2009).

Sixteen (59%) respondents felt that alternative fuel can be profitable for the airline industry. SP9 commented that he felt it could, but only if advancements in feedstock production, distribution, and processing occur to allow the scale-up of production to economically viable levels. This will allow biofuel supply to increase, thereby putting price pressure on petroleum-derived jet fuel. Government funding will be required to make these technological advancements (SP9). The Air Force and government leaders are striving to introduce alternative energy systems, which encourages cost-effectiveness (Heppard & Green, 2009). The United States Air Force (USAF) has become one of the largest users of petroleum. The United States Air Force (USAF) is expected to use about 7 million gallons of aviation fuel per day and 2.5 billion gallons per year (Heppard & Green, 2009).

Table 4 identifies the various themes, which were collected during the interview phase of the study. These themes listed below were based on aviation fuel as an alternate fuel can be profitable in the industry.

Table 4

Aviation Fuel as an Alternate Fuel can be Profitable

Themes	No. of participants who shared this experience	Percentage of participants who shared this experience	Participants who shared this experience
Production	10	37%	6,8,9,11,12,20,21,23,24,27
Not profitable	4	15%	10,11,12,16
Profitable	16	59%	1,3,6,7,8,9,13,14,15,19,20,22,24,25,26, 27

Reducing Overall Fuel Costs

When addressing Question 5 regarding reduction of overall fuel costs, 15 (55%) respondents felt that advanced flight planning systems are helping to reduce fuel costs. SP16 commented that the flight planning system is set up so that fuel prices will be continually updated with what the company is paying at each station, it will then tell the flight dispatcher which leg should be a tanker (SP16). The main message that upper management is sending the frontline employee group, such as pilots and aircraft dispatchers is to do something, as doing nothing is needlessly losing the airline money. The areas of fuel cost has been a quick remedy for fastest results (Rose, 2007).

Four (15%) respondents felt that integration of new aircraft would assist in reducing fuel costs. SP16 commented that each airline has adopted fuel conservation strategies consistent with its policies. Most fleets have been updated with more efficient engines and aircraft (SP16). The aircraft manufacturers are shifting to the composite material in order to meet the airline demand. This process will allow airlines to achieve significant weight reductions and greater fuel efficiency (Lewis & Loebbaka, 2008).

Five (18%) respondents felt that integration of new avionics would assist in reducing fuel costs. SP26 commented that integration of new avionics and operational procedures would reduce fuel usage (SP26). The FAA has also started looking into an advanced air traffic control system, which is called NextGen. The NextGen system will replace the ground-based system with a satellite-based system. This system will also replace the avionics within airplanes. The NextGen system will improve several things, such as safety, lower fuel consumption, shortened flight times, reduced noise and pollution. This process will assist airlines and controllers. The NextGen system is the key to the future of aviation (Bliss, 2010). Some newer aircraft have advanced technologies, which can improve climb performances over older generation aircraft (Egelhofer et al., 2007).

Nine (33%) respondents felt that the reduction of ground support would assist in reducing fuel costs. SP25 commented that the reduction of ground support, such as APU and taxiing usage would reduce fuel usage (SP25). Another tool that many airlines are using is the ability to taxi in and out from the gate with one engine operating, which can reduce fuel costs by an estimated $10 to 12 million dollars per year (Mazraati & Alyousif, 2009).

Table 5 identifies the various themes, which were collected during the interview phase of the study. These themes listed below were based on tools used to reduce overall fuel costs.

Table 5

Tools Used to Reduce Overall Fuel Costs

Themes	No. of participants who shared this experience	Percentage of participants who shared this experience	Participants who shared this experience
Advanced flight planning systems to reduce fuel usage	15	55%	2,11,12,13,15,16,17,18,19,20,21, 22,23,25,26
Integration of high-efficiency new aircraft	4	15%	2,16,25,26
Integration of new avionics	5	18%	16,18,20,25,26
Reduction of ground support fuel usage	9	33%	11,13,15,16,18,19,20,25,26

Organizational Interventions

When addressing Question 6 regarding organizational interventions, 10 (37%) respondents felt that the replacement of older aircraft was an organizational intervention for the reduction of fuel costs. SP22 commented that our organization is replacing older aircraft with newer ones and more efficent aircraft. Its also encouraging employees to use less fuel (SP22). The aircraft manufacturers are shifting to the composite material in

order to meet the airline demand. This process will allow airlines to achieve significant weight reductions and greater fuel efficiency (Lewis & Loebbaka, 2008).

Nine (33%) respondents felt that flight routes and planning was an organizational intervention for the reduction of fuel costs. SP26 commented that active programs to monitor fuel usage on specific routes with feedback loop into the system to correct operational inefficiencies was becoming a standard (SP26). The flight routes are being improved through navigation, which is providing better and faster routes. The Alaska Airlines group is deploying a new navigation system to yield more direct routings, which can reduce fuel costs (Mazraati & Alyousif, 2009).

Five (18%) respondents felt that optimization software was an organizational intervention for the reduction of fuel costs. SP16 commented that the use of flight planning optimization software, more efficient taxi patterns at airports and adding seats to the airplane can help reduce fuel cost per passenger (SP16). Airline companies are dealing with more and more optimization problems during the planning phase. The major objective is to minimize operating costs, which is impacted by higher fuel costs (Afsar, Espinouse, & Penz, 2009).

Eight (30%) respondents felt that taxiing of aircraft was an organization intervention for the reduction of fuel costs. SP13 commented that we have an internal program named "Fuel Sense" that educates crew members on the most efficient methods for single engine taxi, using ground power whenever possible, reduced APU usage (SP13). One tool that many airlines are using is the ability to taxi in and out from the gate with one engine operating, which can reduce fuel costs by an estimated $10 to 12

million dollars per year (Mazraati & Alyousif, 2009).

Table 6 identifies the various themes, which were collected during the interview phase of the study. These themes listed below were based on organizational interventions to reduce fuel costs.

Table 6

Organizational Interventions to Reduce Fuel Costs

Themes	No. of participants who shared this experience	Percentage of participants who shared this experience	Participants who shared this experience
Replacing older aircraft	10	37%	11,13,16,18,19,20,21,22,25,26
Specific routes and planning	9	33%	11,13,16,18,19,20,22,25,26
Optimization software	5	18%	3,11,16,25,26
Taxiing of aircraft usage	8	30%	11,13,16,18,19,21,25,26

Barriers With Aviation Fuel

When addressing Question 7 regarding barriers with usage of aviation fuel, 12 (44%) respondents felt that operational cost was the main barrier to aviation fuel. SP12 commented that for the biofuels it is the cost and the current profit margins for the sector. Company leaders have every incentive to reduce fuel burn and hence the role of the fleet

renewal is important (SP12). There are two concerns that are motivating alternative fuel to conventional petroleum. The first one is the price and the second one is the environmental effects (Hileman et al., 2009). During 2003 through 2008, the rise in the petroleum costs has created several problems for the airlines business, which is that the higher price of jet fuel has contributed to the bankruptcy of several airlines in the past few years (Hileman et al., 2009).

Nine (33%) respondents felt that quality of fuel was the main barrier to use of aviation fuel. SP13 commented that the quality of the fuel, meeting the specifications and location was a barrier (SP13). The aviation industry and airline manufacturers continue to increase testing of sustainable alternative fuels. This process will be on-going and will help reduce impacts of current aviation fuel (Abeyratne, 2010). These alternative fuels may include feedstock resources; improving oil recovery and extraction; higher value co-products, and improving the efficiency of jet fuels through the converison of raw biofuels (Abeyratne, 2010).

Seven (26%) respondents felt that financing was the main barrier to aviation fuel. SP6 commented that the availability of capital or financing to build fuel manufacturing plants. The aviation industry must also decide what is most paramount in the immediate future, a fuel that functions the same as current fuels at a controlled price, or ultra clean fuels. These are both goals that are not yet achievable in one product (SP6). The ExxonMobil Corporation has joined the investors group to start testing and developing the algae-based biofuels. ExxonMobil will invest $300 million with Synthetic Genomics Inc, which is based out of San Diego, CA. (Dittrick, 2009). As part of the biofuel process, the FAA, U.S. Air Force and NASA have funded research to

measure the emissions from alternative jet fuels. The emission measurements are essential to accurately assessing the impact of alternative biofuel on both air quality and environmental change (Hileman et al., 2009).

Table 7 identifies the various themes, which were collected during the interview phase of the study. These themes listed below were based on the barriers with regards to aviation fuel.

Table 7

Barriers With Regards to Aviation Fuel

Themes	No. of participants who shared this experience	Percentage of participants who shared this experience	Participants who shared this experience
Operational costs	12	44%	2,6,8,10,11,12,15,19,20,22,25,26
Quality of fuel	9	33%	2,6,8,9,10,13,15,25,26
Financing available	7	26%	2,3,6,16,19,25,26

Alternative Fuel Strategies

When addressing Question 8 regarding strategies for alternative fuel usage, 16 (63%) respondents felt that alternative biofuel as a whole should assist in controlling costs. SP6 commented that as explained before, alternate fuels are the best strategy now and moving forward in cost control. However, it must be viewed as in investment not

only in dollars but in how the industry does business (SP6). The fuel costs in the past, was the second largest cost for airlines, however this cost has taken over as the primary cost factor, which has placed it into the number one expense. The fuel costs represented about 25.7 % of total revenues between 2006 and 2007. This factor has caused airlines to take action through alternative biofuel testing and other cost cutting tools. The fuel efficiency factor has become the major factor among all airlines (Jackson & Jackson, 2009).

Sixteen (59%) respondents felt that biofuel produced and distributed would assist in controlling fuel costs. SP6 commented that as explained before, alternate fuels are the best strategy now and moving forward in cost controlled. However, it must be viewed as in investment not only in dollars but in how the industry does business. It is not the intent to put the aviation industry into the fuel production business but rather have them team with and invest in the alternative fuel industry (SP6). The biofuel process with algae could be a direct petroleum replacement from a production and manufacturing standpoint. The algae process is much simpler than the current refining process. This process is also less costly and could save money in the long run (Brushnell, 2009). The Boeing Corporation has also started research and design on algae testing, which the company believes can yield 150 times more fuel. The most exciting new alternative fuel development is algae, which is pond scum and has rather unique properties. The Boeing Corporation has started a project to examine large-scale biofuel production through a corporate partnership ("Aviation Biofuel," 2009).

Table 8 identifies the various themes, which were collected during the interview phase of the study. These themes listed below were based on alternative fuel for controlling costs.

Table 8

Alternative Fuel for Controlling Costs

Themes	No. of participants who shared this experience	Percentage of participants who shared this experience	Participants who shared this experience
Alternate biofuels should control costs	17	63%	2,6,7,8,9,10,12,13,14,15,16, 19,20,22,24,25,26
Biofuel produced and distributed	16	59%	1,2,6,7,9,11,13,14,17,20,21, 22,24,25,26,27

Company Leaders and Fuel Costs

When addressing Question 9 regarding company leaders' control over fuel costs, 15 (55%) respondents felt that control over efficiency has been made by company leaders in order to reduce fuel costs. SP6 commented that the company leaders have become open minded to alternative fuels. Delta as an example has gone to the extent that it has purchased their own refinery. This is only a baby step and can help one company. To have a real impact on the industry it will have to be an industry effort with all companies coming together as one to team with the fuel production companies to insure the effort happens at levels that meet the needs of the industry and the fuel is available at the sites as needed (SP6). Airline leaders have started to apply programs, which have started to

reduce the cost of aviation fuel. These programs include airplane modifications and other operational awareness factors. Some airlines are even applying cost-cutting measures, including canceling flights, slashing jobs, retiring older aircraft and even charging passengers for luggage, which will help offest the costs (Coffin, 2008).

Nine (33%) respondents felt that fuel hedging has been made by company leaders in order to reduce fuel costs. SP19 commented that fuel hedging is being used by most airlines to offset price increases. Minimum fuel polices are in place at United Airlines when possible. The phasing out of older less efficient aircraft and replacing with new fuel efficient models will help companies cut fuel cost (SP19). One of the tools that many airlines use is fuel hedging, which allows the company to lock in a price with the prediction that prices will continue to escalate to higher prices. The aviation industry offers an excellent setting for examining the effect of hedging fuel. The airline business is exposed to substantial risk exposures. One risk factor that is facing the airlines is the rising jet fuel prices (Carter, Rogers, & Simkins, 2006).

Table 9 identifies the various themes, which were collected during the interview phase of the study. These themes listed below were based on the action that company leaders have made to reduce fuel costs.

Table 9

Action That Company Leaders Have Made

Themes	No. of participants who shared this experience	Percentage of participants who shared this experience	Participants who shared this experience
Control over efficiency	15	55%	1,3,6,11,12,13,15,16,18,19,20, 21,22,25,26
Fuel hedging	9	33%	2,6,11,12,15,16,19,25,26

Biofuel and Climate Change

When addressing Question 10 regarding biofuel and climate change, 21 (78%) respondents felt that alternative biofuel can assist in reducing climate change through C02 emissions. SP10 commented that some biofuels offer great potential to improve the life-cycle greenhouse gas emissions in comparison with petroleum. Some analyses suggest that greater than 80% reduction is possible (SP10). The second-generation biofuels, which are from plant feedstocks, such as camelina and jatropha have promised substantial life-cycle and carbon dioxide reductions. However, the process of CO^2 is still being produced during the process of creating the biofuel (Swickard, 2010).

Seventeen (63%) respondents felt that current jet fuel is polluting the environment. SP1 commented that biofuel goes along with all the "green" movement that is currently rampant in the aviation industry. If biofuel manages to take off, it certainly has the potential to reduce CO^2 emissions then current aircraft jet fuel (SP1). The air pollution is more damaging in more populated areas, which aircraft have

produced through its emissions. The aviation industry leaders have noticed that more international flights than domestic flights are over sea or deserted land areas. This process averages less air pollution than domestic flights (Keen & Stand, 2007).

The international aviation industry is faced with overwhelming pressure to reduce growth in its greenhouse gas emissions. The international industry has been able to deflect several abatement measures through the cause of global warming, however the industry has been aided by a lack of political and legal policy, which addresses the greenhouse emissions (Macintosh & Wallace, 2009).

Table 10 identifies the various themes, which were collected during the interview phase of the study. These themes listed below were based on the climate change and environmental concerns with aviation fuel.

Table 10

Climate Change and Environmental Concerns

Themes	No. of participants who shared this experience	Percentage of participants who shared this experience	Participants who shared this experience
Careful control of CO^2 lifecyle emissions	21	78%	1,2,3,4,5,6,8,9,10,11,12,14,15, 16,17,19,20,22,24,25,26
Current jet fuel is polluting the environment	17	63%	3,4,5,6,8,9,10,11,12,14,15,16, 17,19,20,25,26

Applications to Professional Practice

This study is relevant to aviation as a whole, as the cost of doing business has become a major issue for airlines. The fuel cost situation has become a major issue and needs to be resolved. This cost has the aviation industry researching alternative fuels. The FAA has also created incentives for airlines, which has issued over $125 million in contracts, which will help develop commercial aviation technology and assist in fuel consumption (Boyd, 2010). These programs and incentives have also reached out to the airplane manufacturers such as, the Airbus Corporation, which has made a commitment to eco-awareness and innovation. The company believes that research and development of biofuel energy is one of the highest priorities on environmental performance, which can also reduce overall energy consumption (Airbus Corporation, 2011a).

The airline industry and manufacturers have a strong interest in replacing aviation gas (avgas). The Boeing Corporation has also announced biofuel testing, which will help accelerate the development of biofuel and the methods of sustaining alternative fuels for commercial aviation (Boeing Corporation, 2007). This process will be on-going and will help reduce impacts of current aviation fuel (Abeyratne, 2010). For that reason, the field of aviation could benefit from this study, as the generated data has created an overall perception of alternative biofuel among airline management and fueling leaders.

In summary, the themes such as quality, production, and cost have been identified through the perception of aviation and fueling company leaders. The overall perception is that aviation biofuel will transform the aviation industry; however, further studies will need to be conducted, as biofuel is still in its infancy phase.

Implications for Social Change

The change to use of the alternative biofuels should help alter a struggling airline industry and environment. The struggling airline business has been forced to reduce costs at every point. The findings of the study indicated several areas that will help reduce overall costs. The alternative fuel development will assist organizational leaders plan for the future and envision sustainable possibilities (Nyrgen et al., 2009). The environment can also benefit from this development through cleaner skies and improved air quality. The alternative biofuel can help reduce fuel emissions, which plays an important part in atmospheric pollution.

Recommendations for Action

The findings of this study indicated opportunites for improvement in the areas of cost, production, and environmental concerns. The literature review and study both point to these opportunites, as areas for the airline, government agencies, and fueling leaders to further study. The results can be disseminated through training programs, which will assist in further studies within the field of biofuel.

Cost

The findings indicated a need to further understand the cost of alternative biofuel, as research and development is a continuing phase. One respondent suggested government investment in research and development (R&D) as well as loan guarantees for companies looking to produce biojet fuel. The more progress is made in these fields, the lower the price becomes in the long run.

Production

The findings indicated a need to further understand the production process, as research and development is still in its infancy phase. One respondent suggested the availability of capital to build fuel manufacturing plants. The aviation industry must also decide what is most paramount for the immediate future, a fuel that functions the same as current fuels at a controlled price, or ultra clean fuels.

Environmental concerns

The information gathered indicated a need to further understand the impact of alternative fuel on the environment, however the majority participants felt that biofuel will reduce gas emissions. SP10 commented that some biofuels offer great potential to improve the life-cycle greenhouse gas emissions in comparison with petroleum. Some analyses suggest that greater than 80% reduction is possible. That said, life-cycle emissions can also be worse than petroleum depending on how the fuel is made (SP10).

Recommendations for Further Study

Future and continued study of alternative biofuel is necessary. The need for a better understanding of the cost, production, and environment concerns will continue until further data is provided, however research and development is still in its infancy phase. The airline industy will continue to struggle with fuel costs and other means of reduction, such as APU usage, single taxi, winglets, and flight planning software will be an essential tool until an alternative biofuel can be approved for daily usage. The recommendation of future studies should include the examination of each alternative fuel, which includes cost and production. The data will help continue the research that is needed to generate additional information on the usage of alternative fuel within the

airline industry. Overall the testing and usage of alternative fuel is still in its research and development phase and further studies would help generate further supporting data, as the process continues.

Reflections

Preconceived ideas of the resulting information gathered could have been easily applied in this study. Predictions that alternative fuel will be a significant cost saver in the operation of an airline has been confirmed, however further research and development is needed.

There was no contact in some cases other than via e-mail with potential participants. Although a necessary requirement, the inability to explain the study and importance of participation was hindered. Many participants failed to respond after agreeing to participate, which caused further delay and hindered data gathering. One thought process was that several participants lacked the additional knowledge on the field of study, as alternative fuel is still in its infancy stage. The study was important as it showed the perception of management and their view on the alternative fuel. The information can conclude that alternative fuel can transform the aviation industry, however further research and development is needed.

Summary and Study Conclusions

In this phenomenological study that was used to explore aviation management perception of biofuel, the majority of respondents were within the airline industry, however there were a few within aviation fueling. Overall seventeen (63%) respondents felt that aviation biofuel will transform the aviation industry. The majority felt that biofuel holds some promise for the future, however supply and demand plays an

important role in the progression of alternative fuel.

Recommendations included the need for a better understanding of the fuel cost, production, and environment concerns, however research and development is still in its infancy phase. The literature review and study both point to this area, as an area for the airline, government agencies, and fueling leaders to further study. The fuel cost is an area that needs further understanding. One respondent suggested government investment in R&D as well as loan guarantees for companies looking to produce aviation biofuel. The more progress is made in these fields, the lower the price becomes in the long run. The production process is another area of study. One respondent suggested the availability of capital to build fuel manufacturing plants. The aviation industry must also decide what is most paramount to them in the immediate future, a fuel that functions the same as current fuels at a controlled price, or ultra clean fuels. The third area of action is environmental concerns. One respondent suggested that some biofuels offer great potential to improve the life-cycle greenhouse gas emissions in comparison with petroleum. Some analyses suggest that greater than 80% reduction is possible. That said, life-cycle emissions can also be worse than petroleum depending on how the fuel is made. Overall the findings of the study indicated that many respondents felt that alternative biofuel will assist in reducing costs in the future, however further research and development is needed.

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Appendix A: Pilot Study

My name is Michael Marticek a doctoral student at Walden University. The purpose of the pilot study is to determine if the questions are relevant to the proposed study on alternative biofuel and environmental concerns within the aviation industry. This information will help me conduct my research, which will determine how management and others feel about alternative biofuel. The pilot study should take no more then one hour to complete. The pilot study will be either through face-to-face meetings or e-mail. I am a doctoral candidate with Walden University, and I will be applying this study to the completion of my doctoral degree in business administration (DBA). Please review and sign the attached informed consent form. I will make time for any additional questions or concerns; however, this will be documented through observation notes or audio tape.

Interview

Q1: What are some of the operational changes that the company has made with regards to aviation fuel? Please explain any change strategies.

Q2: Describe your thoughts on whether or not aviation biofuel might transform the aviation industry and what the expected outcome might be.

Q3: What are your biggest concerns with biofuel? Please explain your overall concerns.

Q4: Describe your thoughts on whether or not aviation fuel, as an alternate fuel, can be profitable for the aviation industry.

Q5: What applications or tools are being used to reduce overall fuel costs within your company? Please explain.

Q6: What organizational interventions are being used to reduce fuel costs? Please

explain.

Q7: What are some barriers for the organization with regards to aviation fuel? Please explain.

Q8: Describe if alternative fuel might represent a best strategy for controlling costs or not? Please explain.

Q9: What course of action, if any, have the company leaders made to relieve the burden of fuel costs?

Q10: Describe how biofuel might or might not reduce climate change and how can environmental concerns be addressed for current fuel specifications.

Three additional questions for the 5 (pilot study) participants

PSQ1: Do you feel these 10 questions above will provide applicable information for the following purpose of the study: To study the changes that biofuel will have on the airline industry, which will be through the perception of aviation management?

PSQ2: Do you feel any questions should be deleted or added to achieve the purpose of the study? If so, please explain in as much detail as necessary for the interviewer to adjust the interview document accordingly.

PSQ3: Do you feel the study purpose is clear and you understand what the questions are trying to achieve?

Appendix B: Interview

My name is Michael Marticek a doctoral student at Walden University. This information will help me conduct my research, which will determine how airline management and others feel about alternative biofuel. The study should take no more than one hour to complete. The study will be either face-to face meetings or e-mail. I am a doctoral candidate with Walden University, and I will be applying this study to the completion of my doctoral degree in business administration (DBA). I will make time for any additional questions or concerns; however, this will be documented through observation notes or audio tape.

Interview

Q1: What are some of the operational changes that the company has made with regards to aviation fuel? Please explain any change strategies.

Q2: Describe your thoughts on whether or not aviation biofuel might transform the aviation industry and what the expected outcome might be.

Q3: What are your biggest concerns with biofuel?

Q4: Describe your thoughts on whether or not aviation fuel, as an alternate fuel, can be profitable for the aviation industry.

Q5: What applications or tools are being used to reduce overall fuel costs within your company? Please explain.

Q6: What organizational interventions are being used to reduce fuel costs? Please explain.

Q7: What are some barriers for the organization with regards to aviation fuel? Please

explain.

Q8: Describe if alternative fuel might represent a best strategy for controlling costs or not? Please explain.

Q9: What course of action, if any, have the company leaders made to relieve the burden of fuel costs?

Q10: Describe how biofuel might or might not reduce climate change and how can environmental concerns be addressed for current fuel specifications.

Appendix C: Consent Form

You are invited to take part in a research study of alternative biofuel within the airline industry. The researcher is inviting any airline or biofuel professional with knowledge in the field of alternative biofuel to be in the study. This form is part of a process called "informed consent" to allow you to understand this study before deciding whether to take part.

This study is being conducted by researcher Michael Marticek, who is a doctoral student at Walden University. You may already know the researcher as a flight dispatcher, but this study is separate from that role.

Background Information:
The purpose of this study is to understand management perception toward alternative biofuel.

Data Collection:
The data will be collected through e-mail, phone, or in person.

Procedures:
If you agree to be in this study, you will be asked to:

- Review and answer the interview questions, which should take about 1 hour.

Here are some sample questions:

What are some of the operational changes that the company has made with regards to aviation fuel? Please explain any change strategies.

Describe your thoughts on whether or not aviation biofuel might transform the aviation industry and what the expected outcome might be.

Voluntary Nature of the Study:
Your participation in this study is voluntary. This means that everyone will respect your decision of whether or not you want to be in the study. If you decide to join the study now, you can still change your mind during the study. If you feel stressed during the study you may stop at any time. You may skip any questions that you feel are too personal. There is no penalty for withdrawing from this study or not participating in the study.

Risks and Benefits of Being in the Study:
The time commitment related to this study is that you will be required to complete the interview and the questionnaire outside of your normal work hours. You will be given a 1-2 page summary of the study results, if requested. There are no other risks related with this study, as the information will remain confidential. The benefit to society is a greater understanding of alternative biofuel and how it can assist airlines and emissions.

Confidentiality:
Any information you provide will be kept confidential. The researcher will not use your information for any purposes outside of this research project. Also, the researcher will not include your name or anything else that could identify you in any reports of the study. All electronic media will be encrypted on a flash drive and documents related to this study will be
kept in a locked safe in which only the researcher has access. After 5 years all collected data will be shredded.

Payment:
There are no payment or gifts for participation.

Contacts and Questions:
You may ask any questions you have now. Or if you have questions later, you may contact the researcher via email at mike.marticek@waldenu.edu or 412-855-8370. If you want to talk privately about your rights as a participant, you can call Dr. Leilani Endicott. She is the Walden University representative who can discuss this with you. Her phone number is 1-800-925-3368, extension 1210. Walden University's approval number for this study is **06-28-12-0153251** and it expires on **June 27, 2013.**

The researcher will give you a copy of this form to keep.

Statement of Consent:

I have read the above information and I feel I understand the study well enough to make a decision about my involvement. By signing below, I am agreeing to the terms described above and will receive a copy of the signed consent. If you are agreeing to participate by e-mail, then reply to the e-mail with the words "I consent" to indicate your agreement.

Printed Name of Participant _____

Date of consent _____

Participant's Written or Electronic* Signature _____

Researcher's Written or Electronic* Signature _____

Appendix D: Literature Review Search

Key Word Search	*Number*
Peer-reviewed journal articles	76
Books	7
National, State, and Local Governmental References	5
Studies	3
Seminal Professional Website	7
Total resources within past five years	74 Percentage 76%
Total resources greater than five years	23 Percentage 24%
Total Reviewed	97

Michael Marticek, M.B.A.

EDUCATION AND TRAINING

Doctor of Business Administration – Information Systems Management 2013
Walden University, Minneapolis, Minnesota

Master of Business Administration – Finance 2008
Strayer University, Pittsburgh, Pennsylvania

Bachelor of Science – Organizational Studies 2006
Robert Morris University, Pittsburgh, Pennsylvania

Associate of Science – Aerospace Management 2004
Community College of Beaver County, Monaca, Pennsylvania

RELEVANT EXPERIENCE

Associate Professor 2012-Present
Ashford University, Clinton, IA
Teach the bachelors degree program. Facilitate classroom of about 35 students. Experience with course design and e-college learning management system. Classroom instruction on Principles of management, Management of organizations, Prinicples of finance, Group behavior in organizations, Organizational Change, Finance Seminar, Finance for managers, Introduction to service management. Provide qualitative and quantitative assessment of students

Associate Professor 2010-Present
University of Phoenix, Phoenix, AZ
Teach the MBA program. Facilitate a classroom of about 22 MBA students. Experience with course design. Classroom instruction on Six Sigma, strategic practices, supply chain management and operations management. Provide qualitative and quantitative assessment of students.

Operational Manager / Designated Instructor 2003-2009
USA 3000 Airlines, Pittsburgh, PA
Provided training to 25 customer service employees. Created and implemented an online training portal. Managed 110 employees, which included pilots, flight attendants, agents and ramp personnel. Managed payroll and monthly budget. Established counseling and coaching among workgroups. Developed and taught orientation course to all new customer service agents. Awarded the 2006 marketing campaign award for USA 3000 Airlines. Provided PowerPoint presentations as an airport committee leader.

Operational Supervisor 2001-2003
United Parcel Service, Rochester, PA
Provided training to 35 employees. Managed employee training and oversee OSHA regulations. Oversaw production and efficiency of operation. Coordinated delivery and pickups. Operated as a call center support member.

OTHER PROFESSIONAL EXPERIENCE

Flight Dispatcher / Crew Coordinator 2008-Present
Us Airways Group, Pittsburgh, PA
Manage flight operations and irregular operations. Provide flight planning using applicable FAA tools and government regulations. Oversee meteorological conditions, aircraft discrepancies and performance limitations. Create flight routes and manage mechanical issues. Update flight statuses, aircraft substitutions, delays, unscheduled landings, diversions or cancellations.

Owner / President 2000-2003
Beyond Web Designs, Pittsburgh, PA
Manage day-to-day operations. Manage marketing, sales and web design. Contract work for business-to-business. Develop marketing campaigns. Manage accounting functions

LICENSES AND CERTIFICATIONS

Six Sigma Green Belt Certified
Six Sigma Lean Certified

HONORS AND AWARDS

Dean's Scholar Award 2007, Robert Morris University, Moon Twp, PA

Dean's List Spring 2007, Robert Morris University, Moon Twp, PA

Dean's List Spring 2005, Robert Morris University, Moon Twp, PA

Dean's List Fall 2005, Robert Morris University, Moon Twp, PA

Dean's List Spring 2004, Robert Morris University, Moon Twp, PA

PROFESSIONAL AFFILIATIONS

Member, Project Management (PMI Group)

TECHNICAL SKILLS

Blackboard portal, E-College, Lotus notes, Minitab statistics, Quicken, Word, Access, PowerPoint, Front Page, Outlook, PASW statistics, Web Design, Excel, Articulate, Camtasia