Southern AirFreight Corporation

INTEROFFICE COMMUNICATION
Date: April 22, 2007
To: Michael Fournier, Senior Manager of Operations
From: Andrew Biederman, Research Engineer
Sehar Mehmood, Research Engineer
Nic Reveles, Research Engineer
Daniel Tong, Research Engineer

Subject: Completion Report of the Research Project Regarding Continuous Descent Approach (CDA)

Attached to this document is the completion report of a research project regarding the feasibility of changing the landing procedure at Southern AirFreight to CDA. This report was completed according to the schedule outlined in the corresponding research proposal submitted March 30, 2007 and details the advantages and disadvantages of the proposed switch.

In order to obtain the information provided in the research report, we interviewed professionals in the fields of flight instruction, air traffic management, and CDA development. The information we obtained from the interviews suggested that a switch to CDA could be reasonably completed. We then went on to look for data regarding the costs and benefits of completing such a switch. Part of this data came from trial data conducted by the United Parcel Service (UPS), who previously conducted CDA research using Boeing 757s and 767s. Because our fleet also consists of Boeing 757s and Boeing 767s, this data was highly relevant to our research and we closely reviewed their research. Their data revealed that we would be saving an estimated average of $1,720 (476 lbs of fuel) per flight. Finding these savings to be significant, we then looked into the costs of implementing CDA, particularly the costs of the technology required. This information was found in various aviation and economic journals. We then went on to analyze the data in order to create a recommendation relevant to our company's interests.

From our results, we recommend that Southern AirFreight implement the continuous descent approach in our landings as soon as funding becomes available. The total cost of implementing CDA comes to almost $1 million, and the savings come out to $1.4 million. We would start profiting from the switch by August of 2008 if we make the switch by January of the same year.

If you have any questions or comments, please do not hesitate to contact our group at (404) 555-6062 ext. 1434.

Feasibility Study Continuous Decent Approach: A Completion Report

Prepared For: Michael Fournier, Senior Manager of Operations

Team: Andrew Biederman, Research Engineer
Sehar Mehmood, Research Engineer
Nic Reveles, Research Engineer
Daniel Tong, Research Engineer

Wednesday April 25, 2007

Abstract

"Feasibility Study for Continuous Decent Approach: A Completion Report"

Team: Andrew Biederman- Research Engineer
Sehar Mehmood – Research Engineer
Nic Reveles – Research Engineer
Daniel Tong – Research Engineer

Continuous Descent Approach (CDA) is a new procedure of landing aircraft that is currently being investigated for mainstream use. The procedure alters the landing path taken by aircraft as it arrives at the destination airport. CDA can reduce fuel and noise emissions by eliminating the fuel intensive portions of standard landings. Additionally, the overall duration of the landing procedure is shortened. Numerical results were obtained by examining data from CDA landings performed by UPS in 2004. From those results, extrapolated figures specific to Southern AirFreight were calculated and are presented. Estimated fuel savings per flight range from 175 to 450 pounds of jet fuel for an average per flight savings of $115. In addition, ground noise reduction is as high as 50%. Our conclusion and recommendation is to pursue implementation of the Continuous Descent Approach as the aircraft landing procedure.

Keywords: Continuous Descent Approach, landing procedure, fuel savings, noise reduction, emissions reduction

Table of Contents

Executive Summary……………………………………………………………………. 1

Introduction…………………………………………………………………………….. 2

Procedure……………………………………………………………………….. 2

Benefits………………………………………………………………………….2

Safety……………………………………………………………………………3

Methods………………………………………………………………………................ 4

Results………………………………………………………………………….…. 5

1. Preliminary Investigation…………………………………………….……. 5

2. Identifying Benefits………………………………………………….……. 5

3. Identifying Costs……………………………………………….………. 5

4. Data Analysis………………………………………………….……….. 6

Conclusions……………………………………………………………………….. 7

Recommendations………………………………………………………………….... 8

References ……………………………….………………………….............. 9

Glossary…………………………………………………………………………...... 10

Appendix A: Email Interview with Sathya Silva…………………………………………… 11

Appendix B: Interview with Jim Brooks ………………………………………………… 12

Appendix C: Cost Calculations………………………………………………………… 14

C-1: Fuel Savings…………………………………………………………… 14

C-2: Costs and Total Savings……………………………………………….... 15

C-3: Projected Savings through 2020…………………………………………... 16

Appendix D: Figures...………………………….……………………….…… 17

Executive Summary

Over the last few months, Southern Airfreight had been experiencing a downturn in market profits. We were commissioned to find and explore possible ideas that would help reverse that recent economic trend. The most promising idea that we encountered was that of the Continuous Descent Approach, or CDA. This is a new landing procedure that saves fuel, reduces noise, reduces landing approach time, and cuts back on fuel emissions. These benefits fall into two categories: monetary benefits, and public relations benefits.

Reducing fuel usage per flight reduces fuel costs per flight. Current estimates place annual savings at $1.2 to $1.3 million if we use CDA for all landings at our Atlanta airport.

Flight reduction time is important to Southern AirFreight because it will allow for a greater number of flights to land in a given period of time, which in turn will accommodate greater efficiencies than otherwise possible.

Continuous Descent Approach can reduce noise emissions at our primary airport up to an estimated 50%. Noise is one of the current major issues surrounding airports, and cutting back on noise would be quite a desirable move in the eyes of the public.

Fuel emissions are achieved by burning less fuel. Once again, assuming that one third of all Southern AirFreight flights use the CDA procedure, an estimated 41.7 million pounds of CO_2 emissions are eliminated.

In conclusion, CDA shows much potential for profitability and we strongly recommend that the procedure be implemented at Southern AirFreight.

Introduction

Our group investigated the use of a new landing procedure at Southern AirFreight's private airport in the Atlanta area. The procedure of interest, the Continuous Descent Approach (CDA), is capable of providing many important benefits. The purpose of this report is to explore the benefits of CDA, benefits that are capable of both putting Southern AirFreight back in the contested forefront of the freight shipping industry as well as ensuring that the company remain competitive even through higher fuel prices, stricter emission rules, and a myriad of other corporate constraints.

The Continuous Descent Approach is a technique that is currently being practiced and tested. It has proven to be successful before, the most immediate example being test runs that UPS performed in 2004 on their overnight flights from Los Angeles to Louisville. The most recent tests that are being done are those by Delta on arriving passenger flights into Atlanta from 13 cities in the western United States, including Denver, Los Angeles, Seattle and San Francisco.

Procedure

The CDA approach differs from the standard approach in a couple different ways. First, as the name implies, the descent from cruising altitude is a smooth and continuous. In the standard approach, airplanes are directed to descend to a certain altitude and then level off until they are instructed to drop to next lower level. This difference is clearly shown in Figure 1 (Appendix D). In the figure, the black path is the CDA path and the red path is the conventional procedure.

The standard approach uses a layered descent because it allows Air Traffic Control (ATC), which directs airplanes that are coming and going from an airport, to easily keep descending planes in a holding pattern until they are clear to land or descend further. With CDA, that layered holding pattern is removed, so ATC must now direct aircraft that are making a single descent down the ground.

This is harder to manage because much more planning is required to accommodate possible interruptions in landing activities. The main method for solving this problem is to line the aircraft up at a metering point much further from the airport than with the standard approach, and then let the aircraft follow the CDA flight path down to the runway. In doing so however, ATC must be mindful the spacing between aircraft.

Benefits

One of the primary benefits of CDA is fuel savings. These savings stem from not having to level out the aircraft after descending to a certain altitude as required in the standard approach. In the standard approach, aircraft cut their engines to less than half power to lose altitude, and then power them up again to level off as needed. This starting and restarting of the engines is a loud, fuel intensive process. With CDA, however, this process is largely eliminated, as the aircraft is not required to level off after dropping a certain amount of altitude (Brooks). Consequently, less fuel is burned during the landing approach.

Since the altitude drop is continuous, an aircraft performing a CDA procedure may maintain cruising altitude longer as it approaches the airport than it would with the normal landing pattern. This increase in average altitude during the final phases of the flight reduces noise heard on the ground (Brooks).

Burning less fuel during the landing approach also means that fewer emissions are released into the atmosphere. Cutting back on emissions does not immediately translate into monetary savings in it of itself; lower emissions do, however, generate positive public relations.

The final primary benefit of the CDA landing is that it is quicker than the normal approach. Research indicates only marginal savings are made per flight, but as Southern AirFreight expands and grows those savings may become crucial to maintaining a high airport efficiency while handling a high amount of traffic.

Safety

For safety reasons, airplanes cannot be allowed to get too close to each other. Currently, radar is not adequate to gather information about the locations of aircraft fast enough to make CDA a practical procedure when the air-traffic density is high. This problem has been resolved by a new technology called Automatic Dependent Surveillance-Broadcast, or ADS-B (Brooks).

ADS-B provides an accurate real-time picture of what is happening in the air. ADS-B operates in two parts. First, a transmitter, which emits a signal in all directions informing all listening parties where the aircraft is, what its altitude and heading are, what speed it’s traveling at, etc. Secondly, a receiver which receives signals from other ADS-B transmitter units and determines where other aircraft relative to itself. By putting both transmitters and receivers in aircraft as well as on the ground, both ATC on the ground and airplanes in the sky have a precise understanding of where everybody is and where they’re headed.

The FAA has noted that since switching to ADS-B in some of Alaska’s mountains, accidents have fallen by 50% (Doyles and Gillies, 57).

Research Methods

In order to be able to create a recommendation regarding the implementation of Continuous Descent Approach, we performed the following research:

1. In order to obtain basic information regarding CDA we conducted interviews with professionals in the fields of flight instruction, air traffic management, and CDA development. This method was chosen over others because of the option to ask specific questions and the value of professional experience. The first interviewee was Sathya Silva, a certified flight instructor, who we contacted through email. The second interviewee was Jim Brooks, a senior research engineer in air traffic management who is currently working on CDA research. That interview was conducted in person, in the Engineering Science and Mechanics building at the Georgia Institute of Technology campus.

2. To find data regarding costs or benefits, we looked into the research data conducted by others concerning CDA. We found the data from a recent United Parcel Service (UPS) research project to be particularly useful in evaluating the benefits of the CDA switch. Using the UPS data, we estimated the savings for our own company.

3. From our interview with Jim Brooks, we knew which items were required in the implementation of CDA. Using this information, we investigated into the total costs of implementing CDA. This data was found in the aviation journal *Avionics Magazine* and the economic journal *Forbes*.

4. We went on to estimate costs and benefits as they would apply to our own company. We used information from our own flight records, savings data from the UPS research, and cost data from *Avionics Magazine* and *Forbes* to conduct this estimation. From this extrapolated data, we drew conclusions and created a recommendation to present.

Results

In this section, we present the results of our research obtained through the methods outlined in the "Research Methods" section.

1. ***Preliminary Investigation***
   First, to find out whether a switch to CDA was at least possible, we interviewed a certified flight instructor, Sathya Silva, and a senior research engineer, Jim Brooks. From Sathya Silva, we learned that switching to CDA would not be too difficult, in regards to any trouble the pilots and air traffic control would have to go through. There would be a small amount of extra work required from the both of them, but it would definitely be within reason. From Jim Brooks, we learned that how the procedure works and the equipment necessary (ADS-B and transponder) to implement CDA.

2. ***Identifying Benefits***
   After deciding that a switch to CDA was possible, we decided to look into costs and benefits to see if it would be beneficial to our company. To find this data, we looked into research previously conducted by others interested in CDA. The United Parcel Service (UPS) was one such company, and from that UPS trial data, we found information regarding fuel savings, emissions reductions, time savings, and noise reductions. For fuel, the saving figure averaged to about 476 lbs of fuel per flight. Emissions were reduced by about 880 and 1790 lbs of CO_2 per flight for the Boeing 757 and the Boeing 767, respectively. The time savings averaged to about 100 seconds per flight and the noise was reduced by up to 33%. Using this savings data, we estimated savings for our own company. To perform this estimation, we assumed that each aircraft would conduct two CDA landings every three days. We then multiplied the savings from these landings by the number of CDA landings, and then multiplied that figure by the number of days a year we predicted that we would be operating. Assuming that the price of fuel remained relatively constant, we estimated an annual savings of $1.2 to $1.3 million in fuel costs and a reduction of 41.7 million lbs of CO_2 in emissions. We estimated that noise would be reduced up to 50%, depending on flight conditions. Finding the savings to be significant, we went on to find data regarding costs in order to continue our research.

3. ***Identifying Costs***
   Because of our interview with Jim Brooks, we knew which items would be required in the implementation of CDA. These items were the ADS-B unit and transponders for the planes. Knowing this, we set out to estimate the costs of purchasing this equipment. This information was found in the aviation journal *Aviation Magazine* and the economic journal, *Forbes*. The cost of the ADS-B unit including installation was $200,000, and the transponders were approximately $16,500 per plane with installation, totaling about $950,000 for our airport. In addition, it was determined that the upkeep for this technology would total about $40,000 per year.

4. ***Data Analysis***
With our data regarding costs and benefits, we set out to estimate costs and benefits as they related specifically to our company. We used flight data from the UPS research, cost data from *Avionics Magazine* and *Forbes*, and information regarding our current fleet composition to conduct this estimation. From this extrapolated data, we drew conclusions and created a recommendation to present.

See Appendix C for cost calculations.

Conclusions

The estimated savings in dollars per landing was $628 for the Boeing 757s and $2,816 for the Boeing 767s (Appendix C). Current radar maintenance costs us approximately $200,000 every year. Using ADS-B in place of radar will cost us only $40,000 per year while providing much more up to date information to our tower controllers. ADS-B alerts the ATC to our aircraft positions every second rather than the every fourteen seconds that we are currently limited to by radar, thus improving safety (Doyles and Gillies, 56).

By 2020, when ADS-B transponders will become required by the FAA (Doyles and Gillies, 56), the company will have netted $15.9 million in lower maintenance costs and lower fuel requirements even after taking into account the costs of setting up the system. This is assuming that we do not acquire any additional aircraft, fuel prices do not rise, and that our business remains stagnant, yielding a very conservative estimate on our savings. As our business grows and we acquire more aircraft while fuel prices continue to rise, these savings will compound.

We can also use our switch as a chance to strengthen public relations with environmentally concerned citizens as well as our customers who ship with us. We will burn less fuel and emit fewer emissions while delivering our packages faster. This could easily be a great selling point for consumers currently using our competitor's services.

There is also talk about the U.S. moving to a carbon credit system. If such a switch were to occur, from a financial aspect, it could greatly behoove us to cut our emissions. A switch to CDA would lower our emissions by 16.2 millions pounds of CO_2 yearly.

Recommendations

Our team recommends that the Continuous Descent Approach procedure be implemented by Southern AirFreight. The procedure shows no major drawbacks and improves performance in most categories associated with landing approaches. By switching to CDA, Southern Airfreight can save $15.9 million between 2008 and 2020, the year that ADB-S will become required by the FAA.

References

1. "AAR Corp. (AIR)." Online image. 11 Apr 2007. Yahoo Finance. Commodity Systems Inc. 11 Apr 2007. <http://finance.yahoo.com/q?s=AAR>.

2. Adams, Charlotte. “Input/Output: Cost of ADS-B: A First Take.” Avionics Magazine. Dec. 1, 2005. April 22, 2007. <http://www.aviationtoday.com/av/categories/commercial/1225.html>.

3. “Airport Aerial.” Online Image. 11 Apr 2007. Norwood, Massachusetts. Town of Norwood, Massachusetts. <http://www.ci.norwood.ma.us/Airport/Images/Photos/Airport%20Aerial.jpg>.

4. Brooks, Jim. Personal interview. March 5, 2007.

5. Doyles, Tim and Gillies, Andrew. “Smarter Skies”. Forbes. 26 Feb. 2007: 55-59.

6. Georgia Institute of Technology: Air Transportation Laboratory (March 30, 2007).

7. Liu, Sandy. “Continuous Descent Arrivals (CDA) Workshops #2.” 18 Apr 2006. FAA Office of Environment & Energy. 11 Apr 2007. <http://www.ae.gatech.edu/people/jpclarke/cda/workshop2/presentations/Liu.pdf>.

8. Silva, Sathya. Email. 11 Apr 2007.

9. Walton, Jim. "RNAV/CDA Arrival Design 2004 Flight Test Trials." 19 Jan 2006. United Parcel Service. 11 Apr 2007. <http://www.ae.gatech.edu/people/jpclarke/cda/workshop1/Presentations/Day1-Thu19Jan2006/3a.Walton.pdf>.

Glossary

ADS-B: Automatic **D**ependent **S**urveillance-**B**roadcast; a detection system that provides a real time picture of the aircraft while it is in the air.

Air Traffic Control: A group of people who direct aircraft into and out of air space surrounding the airport.

Approach: A term used to describe the final descent of an airplane into the airport.

Boeing: A manufacturer of commercial aircraft.

Boeing 757: A passenger aircraft that has a narrow body and small carrying capacity. One type of the aircrafts used by UPS in their test runs in 2004.

Boeing 767: A passenger aircraft that is a larger version of B757; The other type of aircraft used by UPS in their test runs in 2004.

CDA: Continuous **D**escent **A**pproach; a landing procedure, in which the airplane descends in a smoother manner than in the standard approach.

CO_2: Carbon Dioxide, a gas that is released during combustion. It is also one of the principal greenhouse gases that people are concerned about.

Delta: A commercial airline that will be performing CDA test runs on commercial flights into Atlanta during summer 2007.

Federal Aviation Administration: the United States government agency that regulates civil and commercial aviation. It is part of the U.S. Department of Transportation.

Radar: Radio **d**etection **a**nd **r**anging; the current system of identifying and locating aircraft.

UPS: United Parcel Service

Appendix A: Email Interview with Sathya Silva

Q: As a CFI, how much harder (or easier) do you think this would be?

A: From a pilot point of view- Power-off approaches are generally more challenging, however they build good skill, judgment, and situational awareness. From ATC point of view- once the system is in place to handle these approaches, it should make life easier for them. It's much more organized than the current approach system.

Q: Do you believe this would require a lot of practice? If so, how many hours or landings would you estimate?

A: As a pilot, one should be capable of these approaches. It may have to be incorporated into the training program for the airlines, just so that pilots get a feel for the approaches in the simulator before they actually carry passengers and do it. I do not believe it will take much additional training however. I can't give you a definite number.

Q: Would you have safety concerns?

A: Not especially. These "power off" approaches will have to be done with at least some power as to not shock cool the engines and make sure that it's still capable of a go-around if needed.

Q: If you were a pilot for a small freight company, would you demand a raise if your operations suddenly switched to this CDA landing method?

A: No, it saves time, fuel, and money. I personally think they are more fun as well as more challenging. A pilot should be capable of these approaches. It is not outside of their job descriptions to be able to make a power-off approach. It is nothing compared to the operations freight pilots are sometimes expected to do.

Appendix B: Interview with Jim Brooks

The following transcript is of the interview which took place on March 5, 2007.

A: Andrew Biederman, Southern AirFreight Research Engineer
J: Jim Brooks, Georgia Tech Senior Research Engineer

A: How does CDA actually work?
J: Aircraft approach in a continuous manner without entering any holding patterns. In this procedure, aircrafts make one gradual drop down to the runway as opposed to the standard procedure which has them descend in distinct increments of altitude. This puts pressure on ATC to line them up at a point much farther away from the airport than they currently do, and as of now, this is difficult to do. The main reason for this has to do with aircraft spacing; in other words, getting the proper distance between the aircrafts as they come in for the approach.

A: When will this procedure actually be realized (i.e. when will it be implemented in a wide-spread fashion)?
J: We believe that with the current technology that we have in place that approximately 60% of current flights can perform a CDA landing. We are conducting simulator tests with different airports to show that indeed that these landings can be done with most of the current aircraft during low-density period. The problem is that ATC cannot line up the aircrafts properly during high-traffic hours because there are simply too many airplanes in the air. UPS performed test runs into Louisville, KY in 2004, and this summer Delta will be conducting very similar tests into Atlanta.

A: Who are the driving forces in Research and Development?
J: Well, the real driving force is the development of NexGen, which is a federally mandated restructuring of the airspace around airports. Current growth in the airline industries indicate that airport are going to max out their efficiencies within a few decades, and so the FAA is looking into methods that will increase those efficiencies. CDA is one of those avenues of research. Other big ones are NGATS and ADS-B.

A: What are some of the obstacles from implementing CDA now?
J: For CDA to be used, ATC has to restructure their method of bringing planes into the airports. ATC is primarily concerned with safety, and their current set of procedures has a very, very good track record. Right now, it's difficult to convince ATC to change those procedures because radar isn't really sufficient to give them the information they need to feel confident in landing CDAs. That's where ADS-B and Data-Link will come into play.

A: When is the time scale for the development of NexGen?
J: The FAA's goal is to have this restructuring done by 2025. However, we don't really see why we should wait in developing CDA until then.

A: What are the potential savings from using CDA?

J: Fuel, first and foremost. Because aircrafts don't perform the drop-and-drive procedure, they save fuel because they don't have to restart their engines and level-off. Not restarting their engines means less in terms of fuel emissions. Also, because the aircrafts have a higher altitude for longer, the intensity of noise on the ground is diminished. Additionally, drop-and-drive is noise intensive and this part of the flight is replaced with idle descent.

Appendix C: Cost Calculations

C-1: Fuel Savings

Table 1. Shown below is fuel saved with respect to specific aircrafts as well as average savings

Jet Fuel Information	
Jet-A fuel cost ($/gallon)	2.05
Density (lb/gallon)	8.5
fuel cost ($/lb)	0.241176471
Aircraft CDA Landings/day	0.666666667
Operating Days/Year	360

Aircraft Savings	aircraft owned	lb/flight	$/flight	Total $/day	CO2 Savings/flight (lbs)	C02 million lb/year
Boeing 757	14	279	67.28824	628.0235	881.64	2.96231
Boeing 767	31	565	136.2647	2816.137	1785.4	13.28338
Weighted Average Savings:		476.0222	114.8054	1722.08	1504.23	
Total Annual Fuel Savings	**1,239,897.88**				Total Savings:	16.24569

Appendix C: Cost Calculations

C-2: Costs and Total Savings

Table 2. Overview of costs estimation

Initial Costs (USD)	
ADS-B installation:	200000
Transmitter (per aircraft)	16,500
number of aircraft	*45*
Transmitters (total cost)	742500
Total Initial Costs:	942500
Yearly Costs	
ADS-B maintenance	40000
Yearly Savings	
Fuel	1,239,897.88
RADAR maintenance savings	200000
Yearly Total:	1,399,897.88

Appendix C: Cost Calculations

C-3: Projected Savings through 2020

Table 3. Shown below is an end of year balance if we switch to CDA in 2008

Year	EOY Balance
2009	$457,397.88
2010	$1,857,295.76
2011	$3,257,193.65
2012	$4,657,091.53
2013	$6,056,989.41
2014	$7,456,887.29
2015	$8,856,785.18
2016	$10,256,683.06
2017	$11,656,580.94
2018	$13,056,478.82
2019	$14,456,376.71
2020	$15,856,274.59

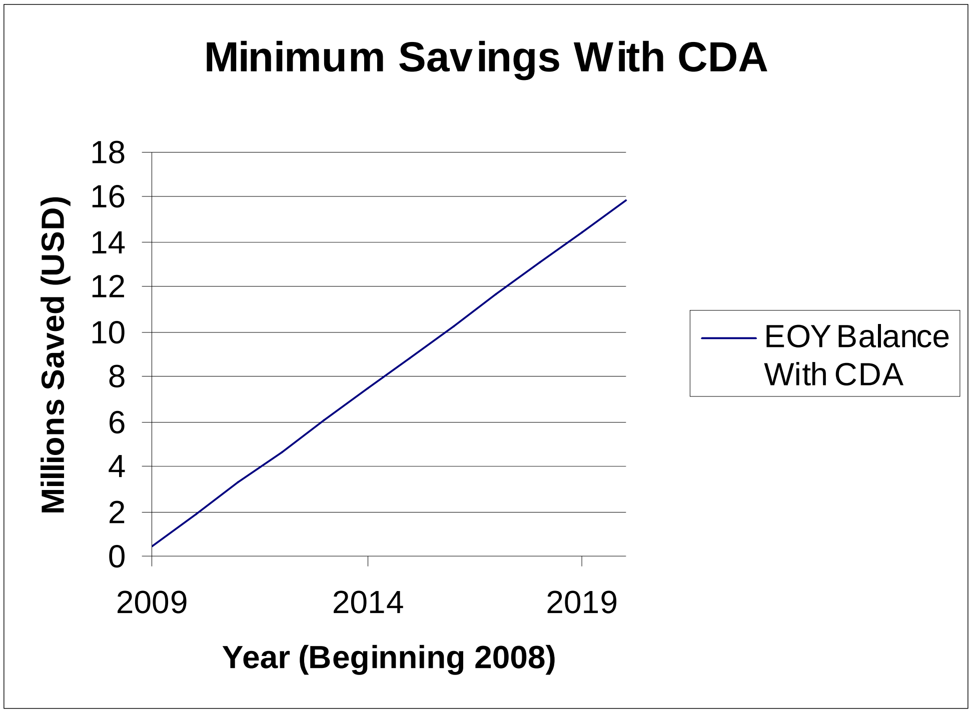

Chart 1. A graph of table 3.

Appendix D: Figures

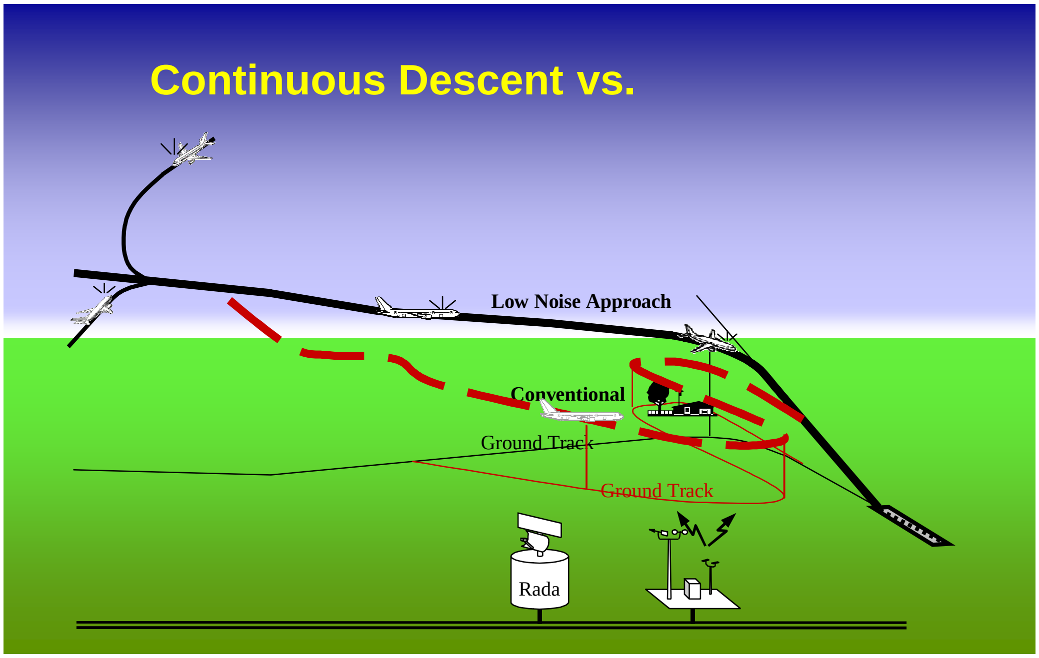

Figure 1: CDA and standard approach paths [6]

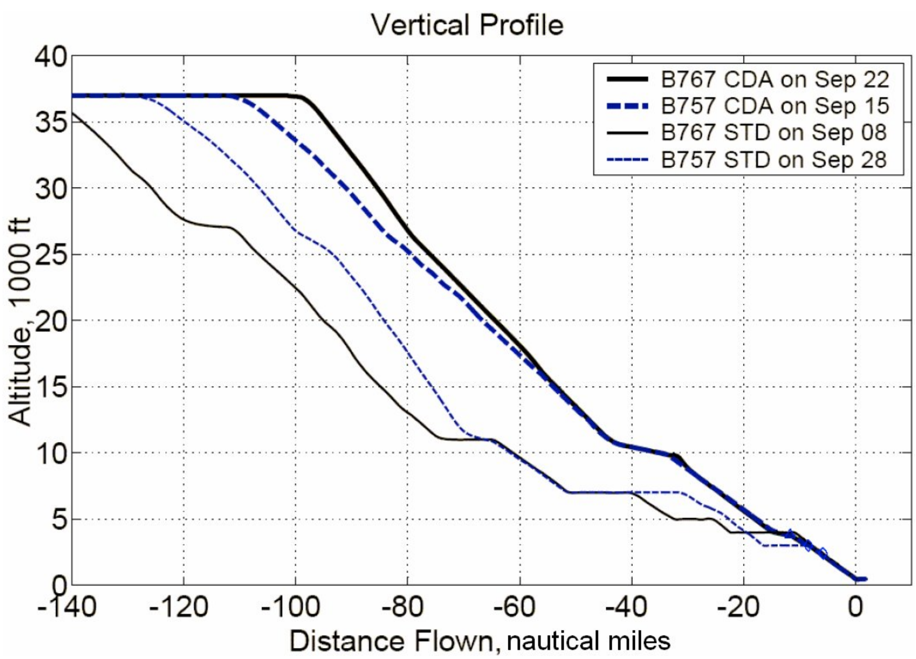

Figure 2: A vertical profile comparing CDA and non-CDA flights into Louisville, KY. Results are from UPS 2004 Flight Test Trials [9].

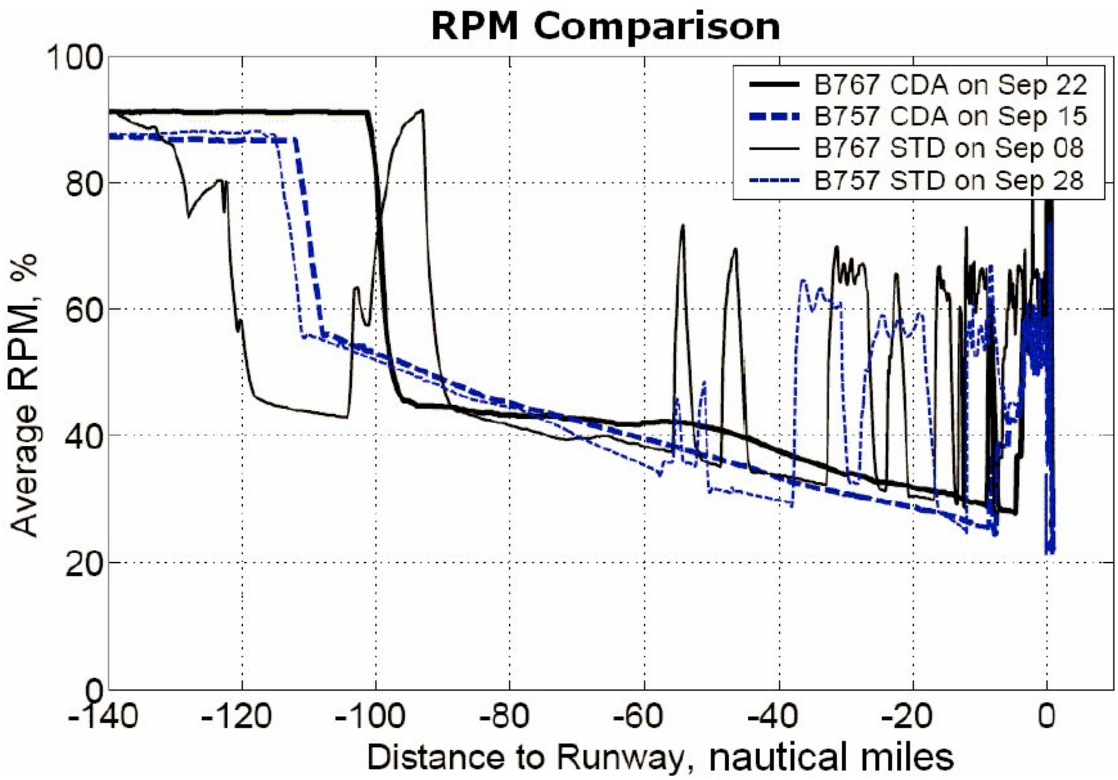

Figure 3: RPM usage for CDA and non-CDA flights. Results are from UPS 2004 Flight Test Trials [9].

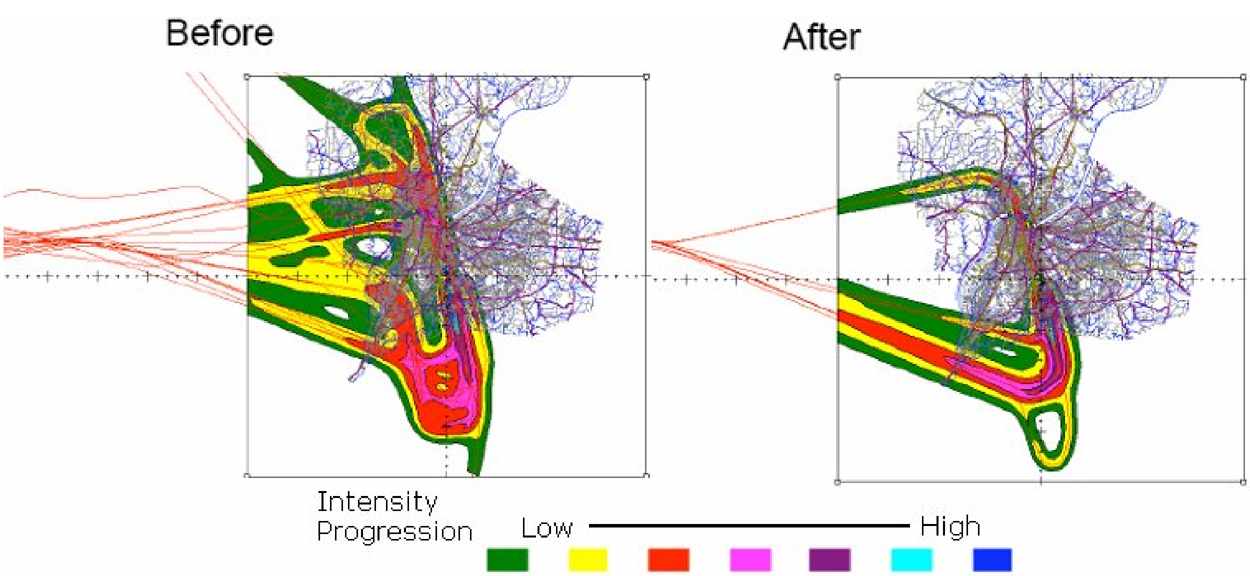

Figure 4: Noise emission comparison illustrations for non-CDA and CDA test runs in Louisville, KY. Results are from UPS 2004 Flight Test Trials [7,9].

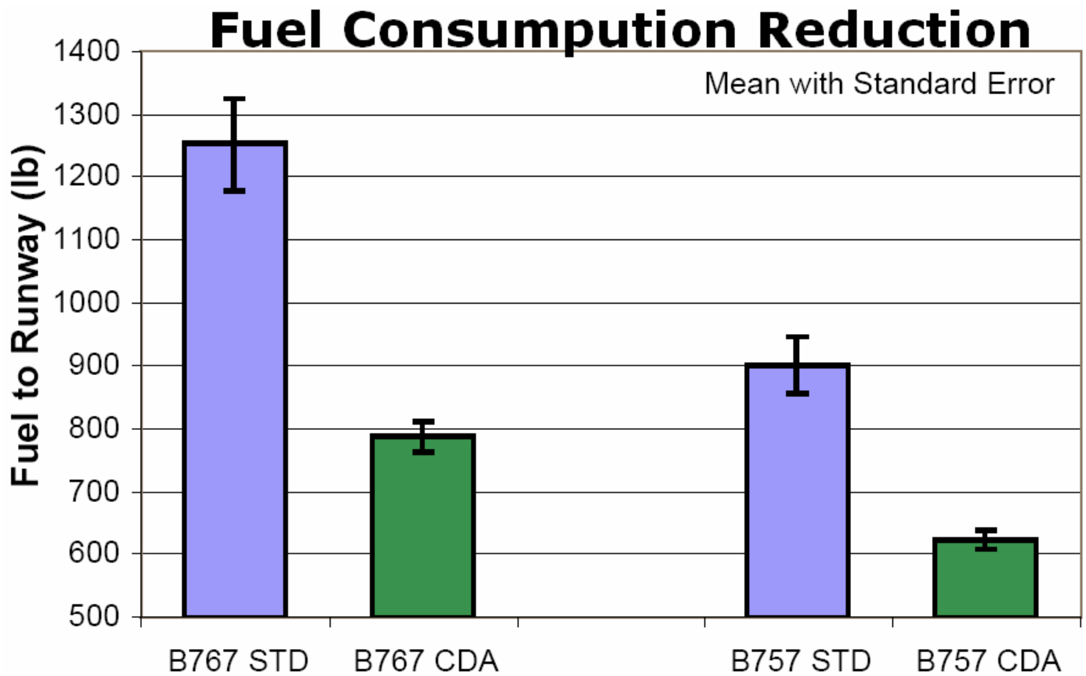

Figure 5: Fuel Consumption comparison for Boeing 757 and 767 for CDA and non-CDA test runs. Results are from UPS 2004 Flight Test Trials [9].

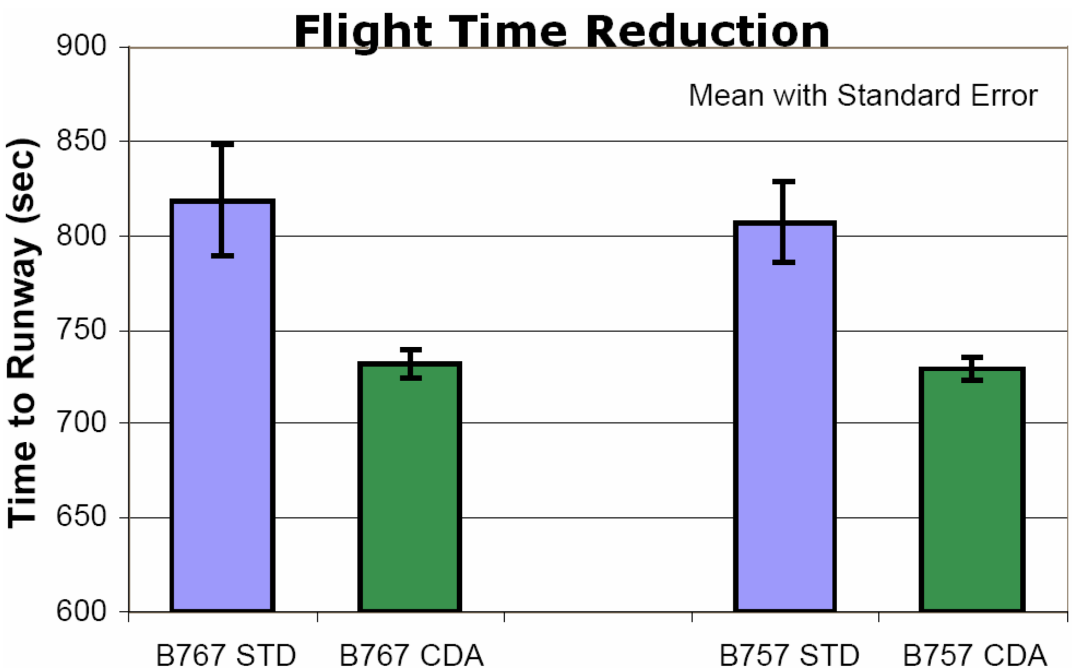

Figure 6: Flight Time Reduction comparison for Boeing 757 and 767 for CDA and non-CDA test runs. Results are from UPS 2004 Flight Test Trials [9].