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Pace Flight Profile Optimizer
Research and Implementation of Advanced Fuel Burn Reduction Strategies

Jónas Einar Thorlacius

Leiðbeinandi: Eðvald Möller Aðjúnkt
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Foreword

This thesis is a final work towards a Bachelor’s degree specialising in Finance from the faculty of Business Administration at the University of Iceland. The thesis focuses on a software application used by airlines to achieve fuel savings, mainly during the cruise stage, and its implementation by an Icelandic flight operator, Icelandair.

The supervisor for this thesis was Óðvald Möller, adjunct at the Business department of the University of Iceland. I would like to thank him sincerely for his generous and valuable advice and for keeping me on track in finalising this thesis.

Also I want to thank my fiancée Eva and my two daughters for their emotional support and their patience in allowing me to immerse myself in work and soak in the academic atmosphere needed to be able to complete this work.
Abstract

The objective of the dissertation is to determine how the Pacelab Flight Profile Optimizer achieves its purpose of saving fuel for the airlines that use this software.

Also, during implementation, what course of action is followed regarding the training of flight crews in using this software and does it bring about the expected fuel savings?

The paper demonstrates how the software uses live weather data in order to achieve optimisation of vertical flight paths resulting in reduced fuel burn, by selecting both the most economical cruising altitude and speed schedule according to current atmospheric conditions, thus outperforming the original operational flight plan which may be outdated even prior to departure, due to changing flight conditions.

Qualitative research was performed in the form of several interviews with aviation specialists to give insight into the factors affecting fuel burn at altitude and the data collection process, implementation process and the goals at Icelandair.

The interviews all took place at Icelandair’s Headquarters from November through December 2017.

The goal of the thesis is to determine whether the Pacelab Flight Profile Optimizer software meets the expected claims for fuel savings and how the training of flight crews in using the software is a factor in achieving these results.
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1 Introduction

In the aviation industry, due to fierce competition for markets, resulting in ever decreasing air fares, heavy emphasis is laid on reducing costs, without jeopardising safety, to obtain acceptable operating results, mainly focusing on aircraft operating costs. A breakdown of direct operating costs indicates that, in recent years, fuel costs have constituted up to 20% of airlines direct operating costs. Due to surging oil prices from 2004, peaking in 2008, the proportion of fuel costs to direct operating costs was as high as 35%.

This became a wakeup call for airlines to seek better fuel saving techniques in operating their aircraft and many such have been introduced in recent years, perhaps most notably and visibly the introduction of retro fitted winglets to minimise induced drag created by the lift of the wing in order to reduce drag and thus reduce fuel burn and also incorporating fuel savings software into flight management systems.

Pace is a German based company that has developed Vertical Flight Profile Optimizer software to be used on board aircraft as a part of the aircraft´s Electronic Flight Bag. The developer claims that a 1–2% fuel savings can be achieved on a yearly basis by using their on-board software. Although not a high percentage, it would still mean substantial savings in terms of money and increased profitability for airlines.

Aviation uses terms and abbreviations that may be confusing to the layman. I have already explained some terms widely used in aviation. This is important, in order to understand how fuel can be saved in-flight.

These terms are: Optimum Altitude, Cost Index (CI), North Atlantic Organized Track System (NAT OTS), Operational Flight Plan (OFP), and Flight Management Computer (FMC).

Fuel prices and cost classifications are also explained briefly. This has relevance as to why it is important for the airline’s bottom line to achieve even a minor percentage of fuel savings. Finally, the software’s functionality and its implementation process at Icelandair are explained. This is a work in progress and it is expected to take full effect during 2018.
2 Airline costs structure

This chapter introduces the cost airlines and flight operations departments face and how it is categorised into direct operational cost and indirect operational cost. The chapter focuses on direct operational cost, that is, everything that is specific to directly operating the aircraft. It is normal practice to divide airline accounts into operating and non-operating categories. The aim is to separate and identify all costs and revenues not directly associated with the operation of an airline’s air services. Non-operating items would include items such as surplus of aircraft sales, income from investments, dividends received from subsidiaries etc.

Indirect operational costs would include items such as station and ground staff, buildings, passenger services cost, ticketing and promotion. (Doganis, 2002, Ch. 4).

2.1 Direct Operating Cost.

The way that an airline’s cost is broken down and categorised will depend on the purpose for which the accounts are being used. It is normal practice to divide airline accounts into operating and non-operating categories.

The breakdown is necessary to show cost trends over time and to measure the cost efficiency of a particular functional area such as flight operations or maintenance. Also, cost identification is crucial to any decisions an airline might make regarding its flight operations such as route or sector analysis, pricing policies, fuel efficiency and any evaluation of investments, whether for new aircraft or new routes or services. (Doganis, 2002, Chapter 4).

Cost of flight operations is a part of the direct operating cost at an airline and is “undoubtedly the largest single element of operating costs which is aircraft-dependent” (Doganis, 2002, p. 78)

Broadly speaking, direct cost should include all those costs associated with and dependent on the aircraft type being operated and which would change if the aircraft type were changed. Such costs should include all flying expenses such as flight crew salaries, fuel and oil, airport and en-route charges and insurance, all maintenance and overhaul costs and all aircraft depreciation costs. Costs associated with flight crew
include items such as salary, travelling and stopover expenses, pensions, insurance and any other social welfare payments.

The second major cost element of flight operations is fuel. During operations, actual fuel consumption varies considerably route to route in relation to the sector length, the aircraft weight, the wind conditions and the cruise altitude. (Doganis, 2002, p. 80)

In recent years, fuel cost accounts for up to 20% of the total direct operating cost (fact-sheet-fuel.pdf), but is also very aircraft specific because fuel consumption varies between aircraft types, the size and thrust of the engines and also the age of those engines.

Fuel costs and oil costs include any fuel throughput charges levied by airport authorities on the volume of fuel uplifted, the fuel handling charges to the supplier and any relevant taxes or duties levied by governments. (Doganis, 2002, Ch. 4)
3 Pacelab Flight Profile Optimizer (FPO)

In this chapter, terms widely used in aviation will be briefly explained and their effect in reducing fuel burn illustrated.

Pace Flight Profile Optimizer is also introduced and the software’s functionality and benefits and possible downsides are explained. The author gained access to a computer based training (CBT) program developed by Pace. The very same program is used to train flight crews in using the software. The information in this thesis regarding the software and its functionality is based on that CBT program and also on interviews conducted with aviation specialists at Icelandair.

3.1 Fuel Prices

In 2008, jet fuel prices had reached levels of more than three times those of 2004. The aviation industry responded in numerous ways to try control these spiralling costs. Some airlines flew slower at a lower cost index.

Fuel saving techniques, when operating the aircraft, were also introduced at some airlines.

Another method was single engine taxiing, meaning pilots would shut down one of the engines on a twin engine jet to reduce fuel burn if anticipated taxi time to airport gate was long.

The starting of the Auxiliary Power Unit (APU) after landing could also be delayed and careful selection of cruise and descent speeds, configuration management at take-off and landing and low power descent in order to minimise fuel consumption became accepted means of reducing fuel usage at airlines.

In 2009–2010 fuel prices fell from their 2008 highs and the spike demonstrated uncertainty regarding the future price of fuel. (Ryerson & Hansen, 2013).

The impact of the fuel price on direct costs and airline operational strategies is therefore of great practical importance for airlines.
Figure 1. Jet fuel and crude oil price
In the year 2018, it is forecast that airlines’ fuel bills will rise and represent 19.6% of average operating cost. Jet fuel prices have continued to rise and the slow rise in price is being driven by the realisation that inventories need to remain higher than before. Fuel efficiency, in terms of capacity use, will improve due to fuel prices starting to trend upwards slowly.

“Fuel is such a large cost that it focuses intense effort in the industry to improve fuel efficiency, through replacing fleet with new aircraft, better operations and efforts to persuade governments to remove the airspace and airport inefficiencies that waste around 5% of fuel burn each year.” (IATA, 2017)
3.2 Flight Management Computer (FMC)

The heart of the flight management system is the flight management computer. The FMC uses flight plan data entered by flight crew, airplane systems data and data from the navigation database to calculate the airplane’s present position and generate the pitch, roll and thrust commands necessary to fly an optimum flight profile. (Boeing Company, 2017)

3.3 Pacelab Flight Profile Optimizer Software

Pacelabs, a German company located in Berlin, is a subsidiary of the company TXT e-solutions, an international specialist in advanced aerospace software. (PACE, n.d.)

Pacelabs develops innovative software products for the aviation and aerospace industries. However, this paper focuses on only one of their products, the Pace Flight Profile Optimizer. Other services provided by Pacelabs are preliminary aircraft and systems architecture design, aircraft and cabin configuration and aircraft economics and route analyses.

Pace is a new Electronic Flight Bag (EFB) software application located in the cockpit on board the aircraft. It calculates the most cost efficient speeds and altitudes and displays the resulting most economic flight profile in an easy way for the operating flight crews to follow.

Normally, optimum flight profiles are calculated from the Operational Flight Plan (OFP) issued by flight operations department of each airline for each flight, but the OFP may not accurately reflect the reality of that flight.

For many airlines, the operational flight plans are issued hours before the actual flight takes place. That can pose a problem as sometimes underlying assumptions need to be factored into the OFP such as weather en route, winds aloft, altitude flown and aircraft weight consisting of passengers booked and expected cargo and luggage. All of these factors can all change before the actual flight takes place. Also, unexpected delays can occur, delaying the standard departure time from an airport.
Pace FPO re-calculate the economical flight profile for the current existing flight conditions after the aircraft has taken off by using live weather and aircraft data coupled with the airplane’s avionics.

With a different level of accuracy than the on-board Flight Management System Computer (FMC), Pace FPO helps to find the least expensive way of completing the flight by taking into account any deviations from the original flight plan regarding weight, altitude, centre of gravity, delays and re-routes.

This greater level of accuracy stems from the fact that the software uses better or live data and thus it can deliver more accurate results than the current on-board technology.

The software uses the manufacturer’s aircraft performance data, live weather data uploaded to the FMC, real tropopause altitudes at all waypoints and real temperatures and winds for every flight level. Because of this different level of accuracy, the optimisation results can differ from the FMC’s recommendations. Furthermore, Pace’s optimisation is holistic, which means that it is always looking at the remaining route as a whole to find the least expensive way to complete the flight instead of just what is optimum for the current position as is the case for the FMC.

The software’s connection to the aircraft avionics enables access to data regarding the current position of the aircraft expressed in latitude and longitude, weights, wind, speed and temperature. Based on this data, the flight profile is continuously re-calculated in the background meaning that the flight crew does not have to make any manual changes to settings while in flight other than to accept or deny a new optimised flight profile.

All the flight crew is expected to do is to follow the vertical economy flight profile and to monitor the advice from the software and to enter the recommended values from the software into the FMC.

Basically, the total cost of a flight includes fuel cost, trip time and missed passenger connections cost. The trip time cost is related to the fuel cost via the cost index.

The cost index effectively expresses how much a trip costs the airline in terms of fuel per hour or per minute. For instance, an aircraft that uses cost index 10 for a particular flight would cost the airline 20 kilograms of fuel in the event of a 2 minute delay. If a
cost index of 200 is assumed, then a 2 minute delay would cost the airline 400 kilogrammes of fuel.

Within the Pace FPO software, one is able to use the cost index relation to express trip time cost in terms of fuel measured in kilograms.

However, flying a particular flight profile with a high cost index may get you to your destination earlier and you may not actually save fuel. Instead, you are burning more fuel to fly faster. That depends on the airline’s preferences, because getting to the destination earlier may save more money than burning less fuel on the trip.

One of the top priorities in the flight operations department of every airline is to improve operational efficiency whether it is improving time performance or reducing costs.

In today’s airline industry, every airline is committed to reducing fuel burn and to improving the operational efficiency of its fleet and, in so doing, improving profitability.

By utilising the availability of real time information and on-board technology in today’s jetliners, flight profile optimisation can be a significant contributor to achieving operational efficiency that can have an impact on the airline’s bottom line.

The whole idea of the software is to enable the flight crew to respond quickly to any unforeseen changes along the route which in turn reduces the cost penalties of sub-optimum operations by operating as closely to the optimum flight path as possible. As written above, the FMC provides only a very basic means of re-optimising vertical flight profiles making decisions on the most economical and efficient way to continue the flight more difficult to interpret by the flight crew. Also, the OFP in which the FMC is fed data to can recommend step climb altitude changes based on the relevant data. However, waypoints on the OFP can be far apart from each other and the OFP does not specify where exactly between two waypoints it is recommended to climb to a more preferable altitude. Pace FPO indicates exactly where, between those waypoints, changes should be made to a vertical flight path. In effect, substantial potential savings are left untapped unless there is continuous decision support for the flight crews.
The obvious benefits of Pace FPO include improvements in operational efficiency which include both reduced fuel burn, up to 2% according to the manufacturer, and better on-time performance.

An additional feature of the software also includes a turbulence forecast model based on the weather updates received by Pace which will enhance flight safety and allow flight crews to have a visual representation of a forecasted turbulence vertical profile chart en route.

"Pace is a great tool for the flight crew to adjust to current conditions after the OFP has been issued and in outperforming that same flight plan which can be based on outdated forecasts and atmospheric conditions." (Capt. Steinarr Bragson interview, Dec 13, 2017) Pace FPO complements on-board equipment and the functional scope of the flight management system which is the heart of the modern aircraft.

Other benefits include that the potential savings are automatically provided and any additional saving potential with real time data of winds aloft and temperature fluctuations are displayed as an alternate economy flight profile and the flight crew can decide whether to accept this or not.
The software can be used on all types of flights whether it be long haul, medium or short haul flights.

However, despite the many benefits, Pace FPO is not without faults.

The software relies on pilot input regarding air traffic control constraints in the form of closed off airspaces and military airspaces and altitude constraints.

The operating flight crew must define any constraint and enter this manually into the software and specify starting point and end points of that constraint. Also, the software only provides recommendations on savings on the vertical flight profile. That means that any direct clearances, meaning changes in lateral navigation will have to be entered manually in the software and then re-calculated because if flying a different route, then the corresponding winds and temperatures have to be considered for that new route.

The vertical flight profile optimisation is based on forecasts for the planned route and, in the case of in-flight re-routing, flight crew workload and attention in the form of inputting current route waypoints have to be considered.

Figure 4. Temperature layer
3.4 Optimum altitude / Altitude selection

The optimum cruising altitude of a jetliner is that at which a given thrust setting results in the corresponding maximum range speed.

The optimum altitude is not a constant and it changes over the period of a flight as atmospheric conditions vary en route and the weight of the airplane changes as fuel is burnt off. A decrease in temperature at a given flight level will alter the optimum altitude to a higher one. The same effect occurs as the airplane weight decreases. Then, the optimum altitude increases.

At the optimum altitude, operating costs will be minimised when operating at a cost index or Mach Speed setting which gives the most economical means of operating that flight. (SKYbrary Aviation Safety, n.d.)

In selecting suitable cruise levels, the flight crew must make a decision based upon prevailing conditions at a particular altitude. Although one would choose a flight level as close to the FMC recommended altitude as possible, other factors also come into play, such as passenger comfort. Even though the airplane can handle turbulence through the duration of flight, it is not very sensible or comfortable to sit through a turbulent flight for many hours, even though that would be the optimum and most economical flight level for that flight.

Therefore, normally, flight crews must determine whether the optimum altitude will be acceptable with regard to expected or reported turbulence conditions ahead.

Optimum altitude increases by about 800 feet per hour as fuel is burned off and cruise penalties, when wind is not a factor, include a 1–2% increase in trip fuel when operating at 2,000 feet above or below the optimum altitude. When operating at 4,000 feet below the optimum altitude a 3–5% increase in trip fuel occurs. Therefore, it is important to operate close to the optimum altitude as it conserves fuel. (Icelandair, 2017, p. 6-3)
3.5 North Atlantic Organized Track System (NAT OTS)

“A significant portion of the NAT traffic operates on tracks, which vary from day to day depending on meteorological conditions. The variability of the wind patterns would make a fixed track system unnecessarily penalising in terms of flight time and consequent fuel usage” (ISAVIA, n.d.)

The North Atlantic Ocean is a huge airspace and it is largely without radar surveillance. As a result, an organised track system is set up twice a day for each of the westbound and eastbound flight flows, westbound flow departing Europe in the morning and an eastbound flow of traffic departing North America in the evening. “Each core OTS is comprised of a set, typically 4 to 7, of parallel or nearly parallel tracks, positioned in the light of the prevailing winds to suit the traffic flying between Europe and North America” (ISAVIA, n.d.)

The airspace links Europe and North America and is the busiest oceanic airspace in the world. Aircraft separation and safety are ensured by demanding the highest standards of horizontal and vertical navigation performance and accuracy. (SKYbrary Aviation Safety, n.d.)

The constraints for operators within the NAT OTS offer a limited economical height band because of congestion and heavy traffic flow, resulting in flights not being able to operate at the most economical altitude for the flight. When crossing the Atlantic, the use of OTS is not mandatory, operators can choose to plan a flight on a random route, that is, a route that is not part of the pre-defined OTS. However, if that flight is to cross a NAT track or operate within the OTS published altitude levels, a common occurrence is that a different flight level from that planned on the OFP is very likely to occur even though air traffic control would try to facilitate the flight as planned.

When flying within the OTS with the mindset of conserving fuel, a few things must also be accepted. Your clearance within the NAT region might not reflect the altitude profile which gives the most economical way of completing the flight. You might be restricted to a flight level which is sub-optimal for the duration of the Atlantic crossing. Also, when flying westbound, a flight level with an even number is given, for example FL 320, FL 340, FL360 etc. Odd flight level numbers are reserved for eastbound flights. This
semi-circular rule ensures vertical separation between flights operating on different tracks. RVSM, or reduced vertical separation minima, reduces the vertical separation above FL290. This allows an aircraft to fly more optimum routes and compensates for increased fuel burn when not flying at the optimum altitude by adding new flight levels. Normally, minimum separation is 2,000 feet. Only aircraft that have been certified to meet RVSM standards are allowed to fly in RVSM airspace as the NAT OTS. In RVSM the general rule is when flying track 000-179 degrees there are odd thousands (FL 290, 310, 330 etc.) and for magnetic track 180–359 degrees there are even thousands (FL 300, 320, 340 etc.). By adding these restrictions into the Pacelab FPO, the software compensates in its calculations of the most economical flight profile.

3.6 Operational flight plan (OFP)

An operational flight plan (OFP) is completed before each company operated flight based on considerations of aircraft performance, operating limitations and expected conditions on the route to be followed and at the airport concerned. However, the OFP does have its limitations and is exactly what it says it is, a plan.

Normally, with airlines, a computerised flight plan is created for each flight prepared by the flight operations department at the airline. The OFP presented to the flight crew is the master document and is signed by the captain of each flight as he/she is responsible for the conduct of the flight. Items such as the airplane type and registration, take-off weight, trip fuel required, wind and weather forecast at altitude and at airports, altitude and speed comparison and significant weather charts are normally provided in the OFP. The aviation industry is highly regulated and a copy of the flight plan must be stored in the company’s database. (Icelandair, 2017)

3.7 Cost index

“Used appropriately, the cost index (CI) feature of the flight management computer (FMC) can help airlines significantly reduce operating costs” (Aeromagazine, n.d.)

By definition, the cost index is the ratio of the time related cost of an airplane operation and the cost of fuel. The FMC uses the cost index number and calculates the economical climb, cruise and descent speeds. When entering a cost index 0, the resulting output of the FMC will be maximum range airspeed and minimum trip fuel
cost. This speed schedule would ignore the cost of time. Conversely, if the maximum number of cost index 9999 is entered into the FMC, the speed schedule would call for maximum flight envelope speeds and minimum flight time and would ignore the cost of fuel altogether. In practice, neither of the extreme values is used. Instead, operators use values based on their specific cost structure modified for individual route requirements on a daily basis. When fuel costs are high compared to other operating costs, a low cost index in the region of 25–50 is generally used to minimise cost on the routes flown. In equation form, cost index is expressed as: CI = time related cost divided by fuel cost.

\[
\text{In equation form: } \text{CI} = \frac{\text{Time cost} \sim \$/hr}{\text{Fuel cost} \sim \text{cents/lb}}
\]
4 Implementation process of Pace FPO at Icelandair.

In 2017, Icelandair’s fleet consisted of 25 Boeing 757-200 aircraft, 1 Boeing 757-300 and 4 Boeing 767-300 wide body jets serving Europe and North America from Iceland’s unique location. (Icelandair, n.d.)

Icelandair’s business strategy is based on the geographical position of Iceland which is midway between Northern Europe and the Eastern coast of the USA.

Icelandair plans to implement Pace FPO in three phases beginning first tests on December 15, 2017.

The first two phases are planned to be completed before summer schedule 2018 and include an IP broadband connection to the aircrafts avionics and installation of Spectralux Envoy ACARS equipment which replaces the existing ACARS (Aircraft Communications Addressing and Reporting System)

With the new Spectralux Envoy ACARS installation, the possibility of receiving weather updates before each flight becomes available to flight crews with data loading on ground. The forecasted weather is uploaded to the FMC via the Spectralux Envoy ACARS box. Pace receives a separate upload, but with a greater magnitude of information at every altitude.

Initially, four weather forecast updates will be available for upload per day because of the sheer magnitude of information and a lack of current computing power. However, in the third and final phase, Icelandair plans to be able to call for weather data packages on demand.

This third and final implementation phase is planned to take effect by the end of the year 2018. (Einar Ingvi Andrésson interview, Nov. 17, 2017)

The benefits of the on-demand weather upload are useful in the case of in-flight re-route or direct routings being issued to flight crews while in flight. This means that flight crews will be able to call for live weather data via ACARS and the Pace FPO will be able to calculate the most economical way of completing the flight.

During the implementation phases, aircrews will be trained in using the software and computer based training software will be the main source for pilots using the Pace FPO. Icelandair looks to the implementation of the software in regards to training aircrew by
Lufthansa in Germany. Lufthansa trained their pilots with the computer based training program provided by Pace and also received a specialist for further training. (Einar Ingvi Andrésson interview, Nov. 17. 2017)

“I think that a high usage rate of our tool is a prerequisite to achieve expected fuel savings. This requires that the pilots understand how and why the tool helps them to improve operational efficiency and how best to use it without increasing their daily workload. Given the cost of crew training, I am convinced that the CBT is a good means of equipping pilots with the necessary knowledge. In addition, we usually recommend that our customers to do some class training as well. For this purpose, we offer optional one-day train-the-trainer workshops, e.g. for check pilots. This enables them to spread the knowledge among their colleagues.” (Oliver Kranz, Dec 8. 2017)

Icelandair’s training will consist of the CBT program for pilots and, in addition, the airline plans to give their instructor pilots special training in order to train other pilots in the use of the software in flight.

The advantages of using CBT training are that the content is standardised and consistent regardless of where crews are situated and large numbers of flight crews can be trained within a short time period and each individual being trained has full flexibility over the learning experience. On the drawing board, further training in the form of publishing guidance and support material for pilots in various forms is planned. Icelandair realises that good training is crucial for the implementation process in order to achieve the desired fuel savings. For that reason, video guidance material for pilots is also planned, to introduce the mutual benefits to the airline and the pilots with regards to fuel saving. (Capt. Steinarr Bragason interview, Dec. 17. 2017)

The incentive is further fuel and cost saving for the airline by promoting cost-efficiency awareness of their flight crews and creating an incentive for the flight crew in the form of fuel bonuses and periodical performance achievements.
5 Research Method

This chapter explores the methods used to gain knowledge of the Pace FPO software from interviews and published information on websites and computer based training program now accessible to all Icelandair flight crews.

Fundamental terms in aviation are briefly explained and set in context as to how they function in fuel savings within the software.

A qualitative method is used and specialists in aviation industry are interviewed to gain insight into the implementation process and the functionality of the software. The author sets out to explore the functionality of the software and how it is presented to the flight crew that use the software.

The author also investigates whether the proposed implementation of the software would bring about the anticipated fuel savings.

Einar Ingvi Andrésson, Fuel Efficiency Manager at Icelandair, was interviewed and an Icelandair Flight Crew Captain, Steinarr Bragason was also interviewed.

Both pilots gave the author a good insight into the functionality of the software, its implementation process and the anticipated fuel savings for Icelandair.

Unfortunately, Icelandair was not able to release full details of their anticipated yearly savings, but the developer Pace suggests, in their introduction material, that it could be up to 1–2% on a yearly basis.

A managing partner at PACE, who was contacted via e-mail correspondence, provided an answer as to which training procedure of flight crews the manufacturer of the software recommends.

Aviation specialists in Iceland are few and that became somewhat of an obstacle in collecting certain facts. The author was fortunate enough to have gained access to specialists at Icelandair who were willing to be interviewed and to give an insight into their environment in the aviation industry and the functionality of the software.

The interviews were not recorded because of the airline’s definition of sensitive information regarding actual fuel saving calculations.
6 Conclusion

Airlines operate on a very thin margin which means that cost pressures are considerable and ever present and thus there are only two ways for the airlines to increase profitability, either increase fares or reduce costs, or both.

However, in today’s environment, the first option would seem difficult, if not impossible, so cost reduction through innovation and continuous programs would seem to be the only solution. Fuel savings management is a priority of the highest order among airlines.

Even though the benefits of using Pace FPO are still in the future, feasibility calculations seem to indicate obvious advantages of implementation to obtain the desired goals and savings for the airline. In order to achieve the full benefits of the software, it is crucial that implementation is successful both in regards to technological aspects but also in regards to the training of flight crews. Flight crews have to be aware of the negative aspects in using the software and, also, it is important that flight crews be made aware that their efforts in reducing fuel burn are rewarded. Classroom workshops and video guidance material should be produced to maintain cost efficient ways of thinking in the long term.

Icelandair Group’s Consolidated Financial statement for year 2016 states that aircraft fuel in operating expenses was US $213,418,000. (Icelandairgroup, 2016)

Based on information from that financial statement and Pace’s claim of up to 1-2% reduced fuel burn, a total savings of 2.1 million USD up to 4.2 million USD is possible on a yearly basis.

Of all the methods possible, this paper has mainly described vertical profile optimisation. It is also worth mentioning briefly the other methods that airlines are constantly evaluating to push down fuel costs, such as replacing APU’s and other Ground Service Equipment with electronic or alternatively powered units and Winglets and Schimitar Blended Winglets installation to minimise induced drag created by the lift of the air foil.

Based on the author’s experience as an airline pilot with 12 years’ experience, a few factors would be interesting to explore and analyse further. Firstly, after full
implementation, whether the software meets expectations in regards to reduced fuel burn and yearly savings and whether time performances, passenger connections and airport bottlenecks override the possibility of an airline issuing OFP’s at an optimum Cost Index. That remains a topic for future academic research.
Bibliography

http://www.boeing.com/commercial/aeromagazine/articles/qtr_02_10/pdfs/AERO_Fue
lConsSeries.pdf

copy]

Doganis, R. (2002). Flying off course: the economics of international airlines (3rd ed.).

December 12, 2017, from
http://www.iata.org/publications/economics/Reports/Industry-Econ-

https://www.iata.org/pressroom/facts_figures/fact_sheets/Documents/fact-sheet-
fuel.pdf

http://www.icelandair.us/information/about
icelandair/our-fleet/


from https://www.icelandairgroup.is/servlet/file/store653/item976535/item.pdf

ISAVIA (n.d.) North Atlantic Organized Track System (NAT OTS). Retrieved December 18,
2017, from https://www.isavia.is/english/air-navigation/reykjavik-area-control-
centre/north-atlantic-organized-track-system-(nat-ots)/


2018, from, https://www.skybrary.aero/index.php/High_Altitude_Flight_Operations-
Optimum_Cruise_Altitude

Retrieved December 18, 2017, from
https://www.skybrary.aero/index.php/North_Atlantic_Operations_-_Organised_Track_System

Ryerson, M. S., & Hansen, M. (2013). Capturing the impact of fuel price on jet aircraft
operating costs with Leontief technology and econometric models. Transportation