



Flight path optimization makes Volotea eco-efficient

Luis Fernandes, Fuel Efficiency Manager, Volotea and **David Rytter**, CEO, AVTECH share the experience of leveraging a flight crew's profile optimizing solution for eco-efficient flying

“Volotea is an airline that connects mid- to small sized cities across Europe with an all-Airbus fleet of 41 aircraft operating from 19 bases.”

The plan for this case study is to give readers an overview of the flight path optimization tool adopted by Volotea and what it provides for pilots and the airline. But, before going into that, it’s always useful to know something about the subject of a case study, in this case, Volotea.

VOLOTEA

Volotea is an airline that connects mid- to small sized cities across Europe with an all-Airbus fleet of 41 aircraft operating from 19 bases. There are more than 1,600 people employed in the business and Volotea flies around 365 routes carrying 9.5 million passengers a year (figure 1).

Volotea: an airline created to connect mid-small sized cities in Europe

Volotea was founded in 2011 by Carlos Munoz and Lázaro Ros, is one of the fastest-growing independent airlines in Europe, increasing year-on-year its fleet, routes served, and seats offered.

Since its start, Volotea has carried 40 million passengers across Europe.

Volotea serves more than 100 cities in 16 countries, with novelties in 2022 such as Denmark, which will begin operating in May this year from Italy, and Algeria, which began last December with flights from France.

Volotea became a full Airbus carrier in 2021, by renewing part of its fleet with aircraft from the European manufacturer.

Since 2012, Volotea has carried out more than 50 sustainability actions, thanks to which it has reduced its carbon footprint per passenger and kilometer by more than 41%.

In 2021, the airline began to voluntarily offset 5 percent of its total CO2 emissions until it reaches 25 percent offset of its carbon footprint in 2025.

This year, the company has introduced sustainable fuels in aircraft and collaborates with manufacturers and industry so that these fuels can be developed and become widespread as soon as possible.

Volotea was elected "Europe's Leading Low-cost Airline" at the World Travel Awards 2021.

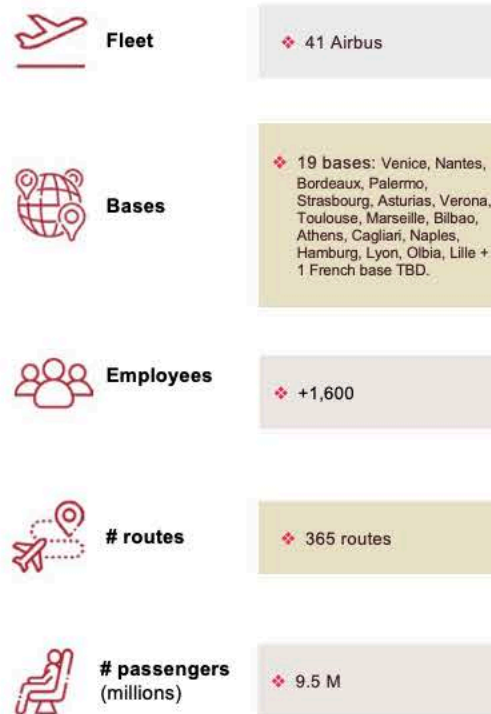


Figure 1

Looking at a history of Volotea’s growth (figure 2) we can see that from conception in 2009, the airline made its first flight in 2012.



We reached 40 million passengers in March 2022 and are celebrating 10 years of history this year!

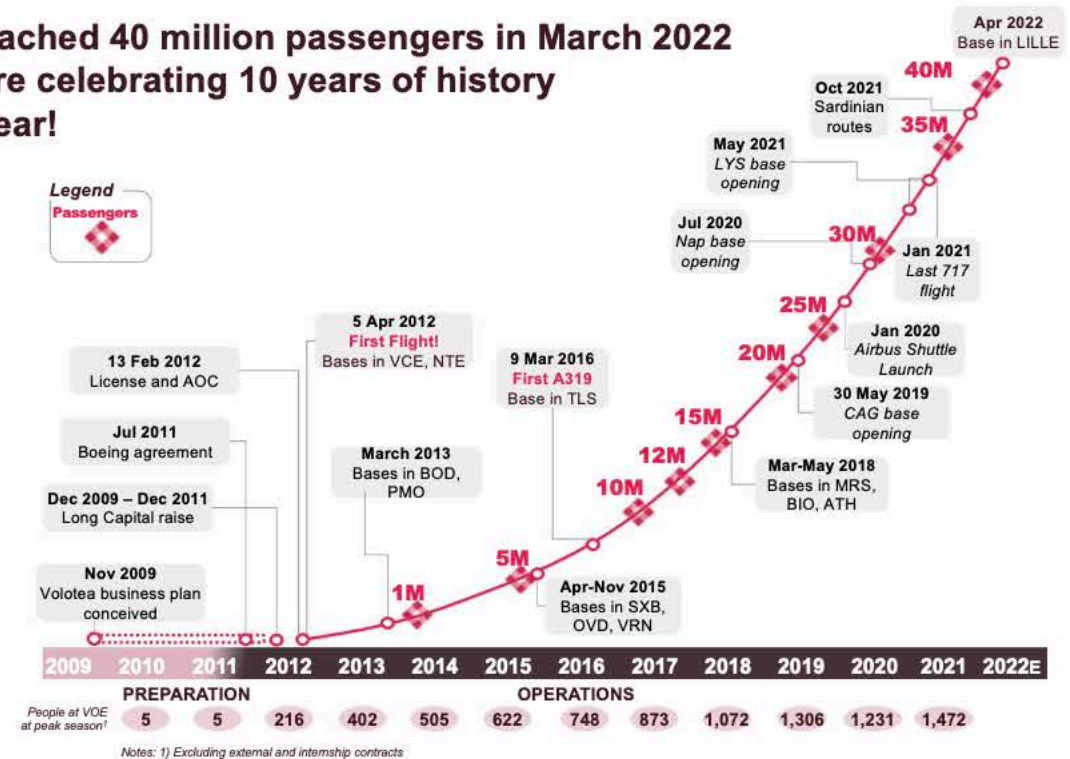


Figure 2

The initial fleet used Boeing 717 aircraft but in 2016, started to change to Airbus starting with A319s. Then in 2021, after the COVID pandemic period, the Boeing 717 fleet was replaced with Airbus A320s.

The airline has recently opened its latest base in Lille plus, in March 2022, Volotea passed 40 million passengers carried in the ten years since launch.

AVTECH CLEARPATH

AVTECH designed ClearPath to be an advanced in-flight optimization capability that integrates very smoothly into the user airline's existing operation (figure 3). The system operates as a ground-based service and utilizes already installed technology and therefore requires no investments.

CLEARPATH
FLIGHT PATH OPTIMIZATION

- **Real-time flight path optimization**
 - Uses already existing technology
 - Cost optimal flight path (base on CI)
- **Big data ground-based computations**
 - High-resolution AC performance data
 - Actual flight parameters
 - High-resolution weather
- **Automatic and manual**
 - Delivered directly to cockpit
 - EFB or Printer/Screen

**2.5%
FUEL & CO2
REDUCTION**

Figure 3

The solution

Airlines can utilize the equipment they already have, and pilots can continue to fly in the same way they currently do, interacting with the FMC (Flight Management Computer) as usual. ClearPath calculates a cost-optimal flight path based on the cost index, aircraft gross weight and route, as downloaded from the FMC in-flight.

As the service is ground based, it is able to perform its flight optimization calculations with unlimited computational resources and full access to the latest accurate high-resolution weather forecasts (figure 4).

“ClearPath calculates a cost-optimal flight path based on the cost index, aircraft gross weight and route, as downloaded from the FMC in-flight.”

CLEARPATH HOW DOES IT WORK

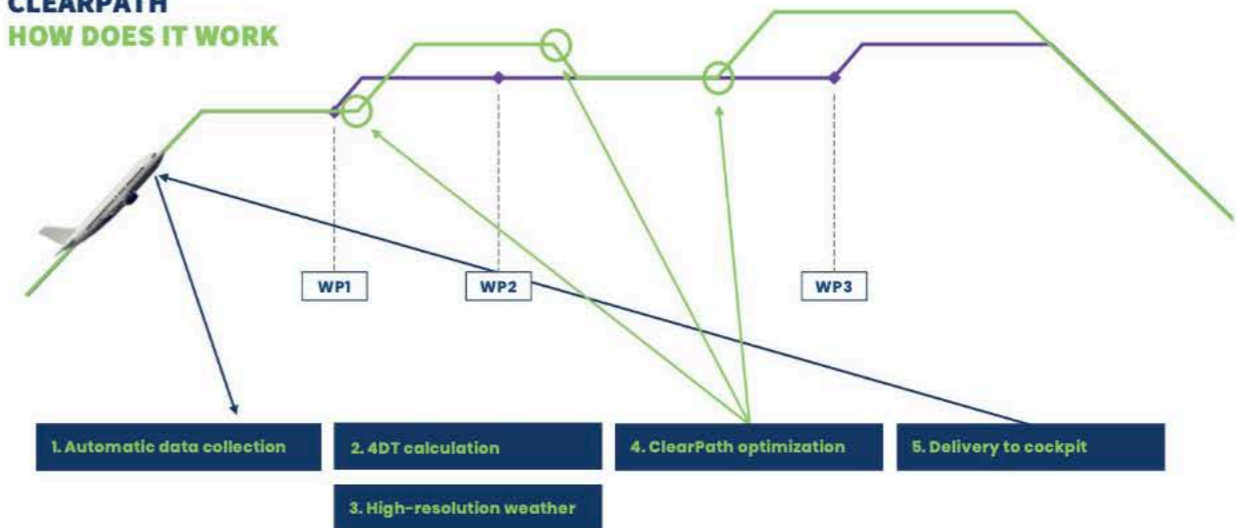


Figure 4

The service is fully automatic and starts by collecting data from the flight such as active route, Aircraft gross weight, the selected speed or cost index.

Using this data, a four-dimensional flight trajectory is calculated and used to retrieve the latest high-resolution weather forecast for the specific flight path. ClearPath then calculates the cost optimal flight profile by comparing all different flight level options to fly from point A to point B.

The resulting optimal flight path is uplinked to the cockpit in real time, together with information about estimated savings. This means that it's entirely hands-off for the pilots to get this information and then it's up to them to use it to optimize the flight.

For each flight, the service automatically looks at how the ClearPath optimized profile compares with the fuel burn time of flying the original flight plan (OFP) planned flight profile altitude steps. This fuel saving potential is typically around 2.5 percent, however this varies with airline and operation.

How the system works

After take-off, the system monitors the flight and automatically uplinks the information to the pilots. ClearPath requests certain parameters from the Flight Computer, such as the active route, the cost index and the weight of the aircraft. The solution does a 4DT (four-dimensional trajectory) calculation using the high-resolution weather forecast from the Met Office. This is a full 10k resolution weather forecast with hourly temporal resolution, compared to the standard 140km resolution weather forecast that you see in flight planning. The solution works with the full trajectory and does the ClearPath optimization, calculating the most cost optimal flight profile. The system then calculates what altitudes will give this flight, in this atmosphere with this weight, the most cost-optimal flight profile, then creating a short message uplink to the cockpit.

How ClearPath supports pilots

Figure 5 shows a typical ClearPath message, uplinked to the pilot. This message can be tailored to the airline's preference.

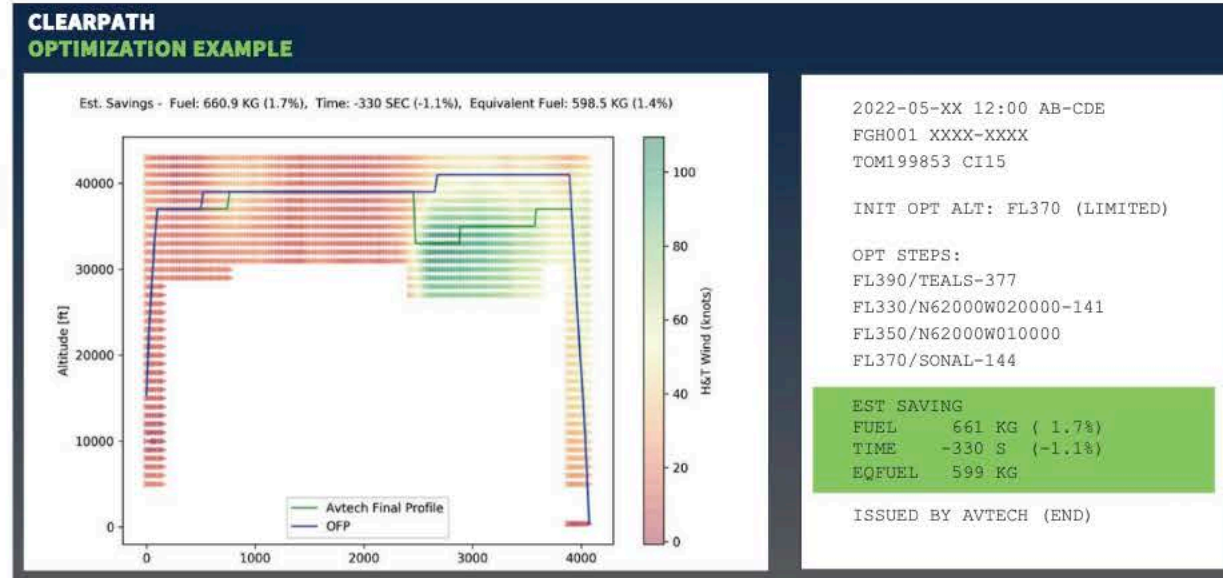


Figure 5

Here we see a great example of ClearPath in action on a Boeing 787 flight over the Atlantic.

In the illustration we see the operational flight plan profile as a blue line with a typical planned step climb towards the end of the flight as it's coming in over Europe. In the same picture we can also see a jet stream core over Europe with beneficial winds on lower altitudes.

On the right side of the screen, we are presented with a ClearPath text message that was received by the pilots during the climb phase, around FL150. This message provides the optimal initial altitude and step climb recommendations for the specific flight, calculated by ClearPath based on the actual weight of the aircraft and a cost index of 15. In the illustration, the ClearPath advice is depicted as a green line, visually representing the recommended altitude profile.

Since this flight is operating at a low cost index of 15, where fuel efficiency is prioritized over time, the optimal flight path is to descend into more favorable wind layers. The pilots can observe that, by following this optimal path, they can achieve a fuel saving of 661 kg and experience a time delay of only five minutes, as compared to flying the originally planned profile. This translates to a fuel saving of 1.7 percent of the total cruise fuel consumption, with the trade-off being a slight delay in arrival time on an eight or nine-hour flight.

It is worth noting that on this specific flight, the pilots successfully adhered to the optimal path and, upon landing, a report was received confirming the achieved savings.

AVTECH PROFLIGHT

Avoid Thunderstorms Like A Pro With Real-Time CB Satellite Data

Powered by **Met Office**

TRY FOR FREE!

WxFUSION

By initiating the service automatically (figure 6) after take-off, several benefits are achieved. Firstly, it guarantees that every flight undergoes optimization. Additionally, this automated process ensures that the optimization takes into account the precise aircraft parameters, which are extracted by the service directly from the flight computer. This guarantees that the optimization is tailored to the specific characteristics of the aircraft being flown.

**CLEARPATH
AUTOMATIC SETUP**

WHY AUTOMATIC?

- Ensures optimization using actual performance data
- No pilot workload compared to other solutions
- Ensures every flight is optimized
- High compliance rate
- Maximizes service value



Figure 6

ClearPath distinguishes itself from other services in the market by minimizing the workload on pilots through its hands-off and fully automated nature. With ClearPath, pilots receive automatic optimization, leaving them with the primary tasks of coordinating with air traffic control and following the recommended flight profile. Extensive airline case studies have demonstrated that this approach fosters a high level of pilot compliance, thereby maximizing the value delivered to the airline.

We just launched a brand-new feature in ClearPath that we think pilots, crew and passengers will like (figure 7).

**BRAND NEW CLEARPATH FEATURE
DETECTION AND AVOIDANCE OF INFLIGHT HAZARDS**



Figure 7

ClearPath has recently incorporated a groundbreaking feature (refer to figure 8) that integrates the detection, notification, and avoidance of hazardous turbulence directly into its optimization process. Going forward, ClearPath will proactively inform pilots about the presence of hazardous turbulence along their route and provide suggestions on the most cost-optimal methods to avoid it. Importantly, this entire process is fully automated, further reducing pilots' workload. The foundation of this feature lies in the utilization of a highly detailed and accurate

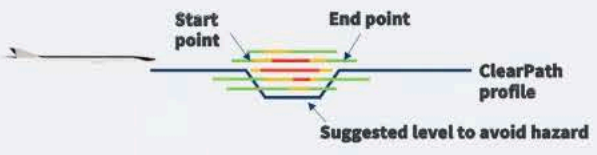
high-resolution EDR turbulence forecast provided by the UK Met Office. Leveraging this advanced weather information, ClearPath aims to revolutionize the way turbulence is managed during flights. With this innovative capability, we anticipate that this new feature will have a significant impact on the industry.

**NEW CLEARPATH FEATURE
DETECTION AND AVOIDANCE OF INFLIGHT HAZARDS**

Enhanced Flight Safety and Comfort

- Avoidance of **temperature** outside limits
- Avoidance of **turbulence** above limits

ClearPath now provides Turbulence/Temperature exceedances along flight path



ClearPath Pilot Advice

OPT STEPS:

- FL370/BUDAR-116
- FL350/5440N-141 (TEMP LIM) ← FL limited by temperature
- FL370/5730N-59
- FL330/6020N-56 (TURB LIM) ← FL limited by turbulence
- FL390/6210N-143

OFF PROFILE EXCEEDANCES:

- TEMP -72C ← Low temperature warning on planned FL
- FROM FL370/5440N-141NM
- TO FL370/5730N-59NM
- SUGGEST FL350
- TURB SEV39 ← Turbulence warning on planned FL
- FROM FL370/6020N-56NM
- TO FL370/6210N-143NM
- SUGGEST FL330

**NEW
FEATURE**

Figure 8

The ClearPath report now lists in a separate section any turbulence and temperature exceedances along the planned flight profile, complete with start point, end-point and intensity, and the ClearPath optimization will now clearly state when optimal flight levels are limited by temperature or turbulence. ClearPath always shows the most cost-optimal altitudes and step positions to avoid these hazards.

The accuracy of this weather information now truly makes this new feature a game changer for pilots and airlines. The text-based version of ClearPath (figure 9) really makes it easy to get started and get it into the cockpit and used by the pilots while the pilots continue to interact with the FMC.

**CLEARPATH
UPLINK DISPLAY FORMAT**

Flight data

Optimum initial flight level

Optimal flight path

Fuel / time saving vs OFF

OPTIMAL CRZ PROFILE

```

2019-09-03 12:28Z XX-XXX
XX0123 LEAL-ENGM
CI:15, GWT:64375 KG

INIT OPT FL: FL340

OPT STEPS
FL380/ARGOR-5
FL400/VANAD-40
FL390/TOLEN

EST SAVING
FUEL 392.4 KG (4.6%)
TIME 380 S (2.8%)
FUEL_EQ 464.2 KG (4.1%)
                
```

Figure 9

ClearPath eliminates the need for additional apps or the introduction of numerous new elements. Pilots can continue their operations as usual but now benefit from enhanced guidance and support.

The ClearPath service can also be integrated into AVTECH's ProFlight EFB app (figure 10) where the pilot will be able to interact a bit more, put constraints on the optimization and more. However, the optimization remains the same advanced optimization in the background.

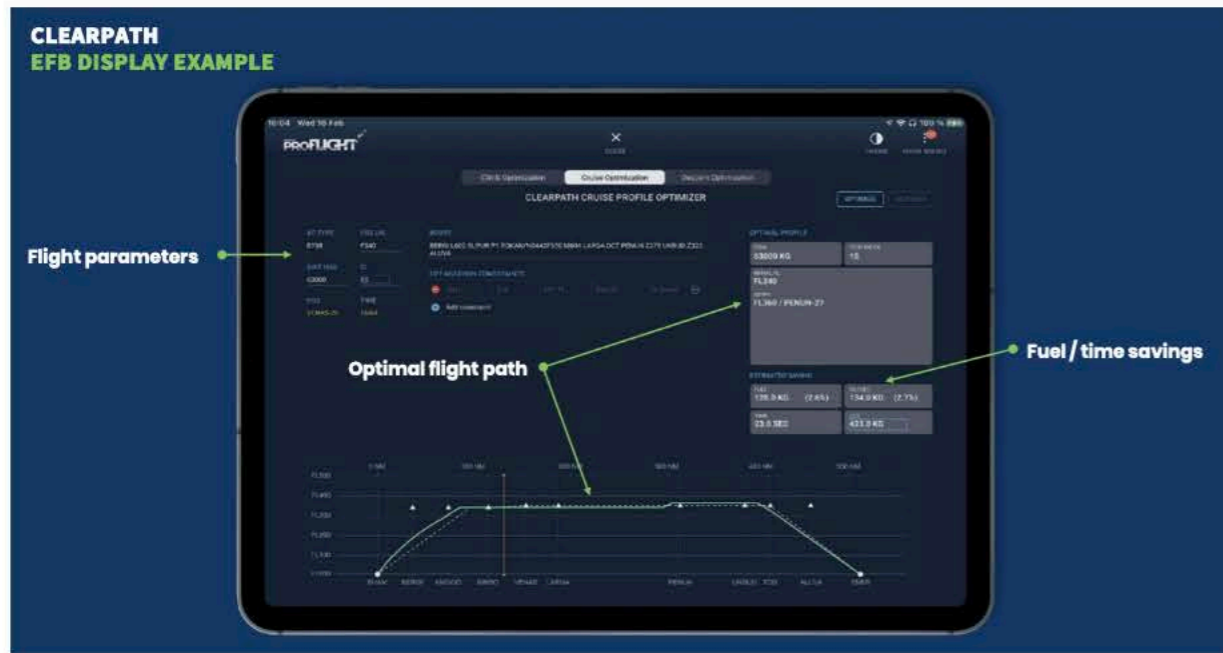


Figure 10

AVTECH'S CLEARPATH IN VOLOTEA

AVTECH's ClearPath service implementation timeline with Volotea. Can be seen in figure 11.

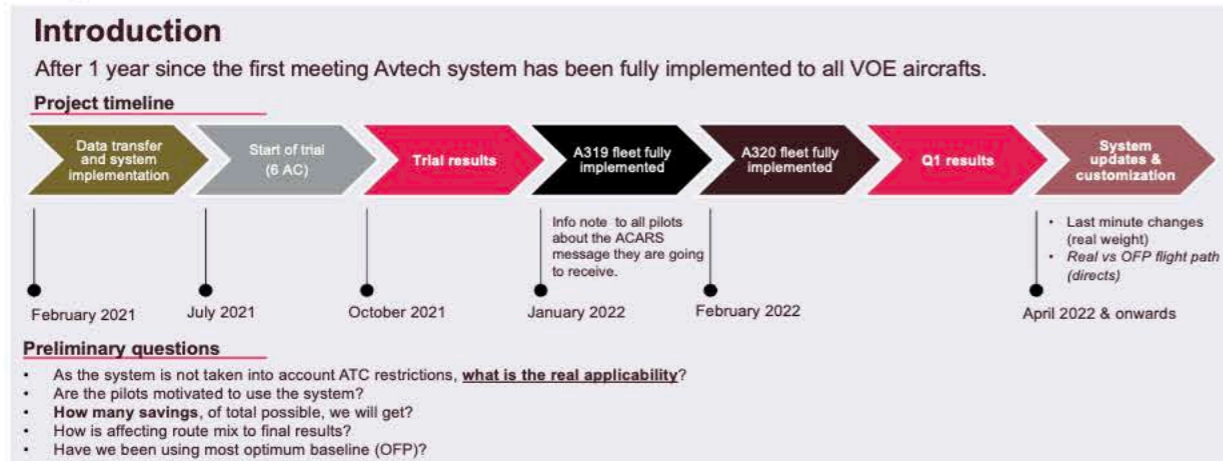


Figure 11

AVTECH and Volotea first met in 2019 at an Aircraft Commerce, Aircraft IT conference. However, because of COVID, any progress on the project stopped but was re-activated in February 2021. The trial started July 2021 and was commenced using six A319 aircraft. The application was tested over four months until October 2021, and was afterwards fully implemented to the entire fleet.

Based on pilot feedback the system has been customized slightly. ClearPath now uses Volotea's actual takeoff weight including last-minute changes, making the optimization much more accurate.

AFTER IMPLEMENTATION

Volotea chose to do a survey amongst their pilots in order to verify the service utilization and how much of the potential savings actually could be achieved. Since Volotea has a lot of shorter routes, it was never going to be possible to realize the full saving potential.

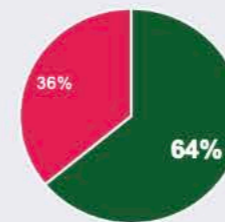
In the survey the pilots were able to offer feedback during around 6,200 flights and pilot responses were obtained in respect of 64 percent of those flights (figure 12).

Applicability during Q1 2022

Good feedback from our pilots (64% of flights answer the survey) with a 49% of total savings achieved.

Feedback reliability

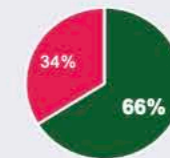
■ Answered ■ Not answered



Total flights = 6209

Feedback per fleet

A319
■ Answered ■ Not answered



A319 flights = 4736

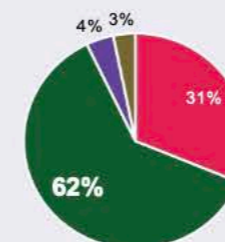
A320
■ Answered ■ Not answered



A320 flights = 1473

Answered surveys feedback

■ ATC denied ■ CP used
■ Other reasons ■ Performance limitations



CP used comments (62% of the flights)

■ No savings vs OFP ■ Only partially approved
■ No comments

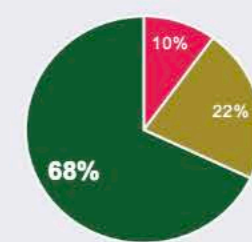


Figure 12

The answers told the airline that 62 percent were able to fully operate the route according to the recommendations from ClearPath optimization. In 31 percent of the cases, ATC were unable to grant the pilots' requests, and for the remaining seven percent of the flights there were performance limitations or other unspecified reasons why the pilots did not use the optimized flightpath.

In respect of the 62 percent that were able to use the optimized flightpath, only ten percent achieved no savings with ClearPath versus the OFP. With a further 22 percent only being partially approved (perhaps not all steps in the cruise were approved) while 68 percent were able to fully use ClearPath.

Out of the 62 percent of flights that used ClearPath, 68 percent of those were able to take full advantage of the service. Another 22 percent were able to take partial savings from the service. It all adds up to an actual saving of 49 percent of the savings potential (figure 13).

RESULTS January to March 2022

Taking into account direct kg and time savings the theoretical total savings achieved during first quarter of 2022 have been around 1%.

Hypothesis

- ❖ Outlayers (more than 100 kg/FH) savings per flight have been discarded as it is a consequence of "hard" ATC restrictions in flight plan that, in 92% of the flights, have been followed.
- ❖ Based on pilot's feedback 49% of the theoretical savings (fuel and/or time savings) will be finally applied.



*Savings over the total number of flights (not only when the system was applied)

Figure 13

ClearPath gives direct fuel and time savings.

In Q1 2022 we could see an increased fuel saving as the months progressed. In January 2022, the A319 fleet had an average saving of 4.1 kilos per flight. When the system was implemented for A320 in February, the average flight hours per flight increased. In March, savings were even higher with the longer cruise times of the A320 fleet giving them a saving of 7.5kg per flight and the A319s returning savings of 6.1kg per flight. Volotea was able to realize more value from the system as the year progressed.

When it comes to time saving, we could see 14 seconds time saving per flight

in January, increasing in the following months to around 25 seconds per flight on the A319 fleet and around 11-16 seconds per flight for the A320s.

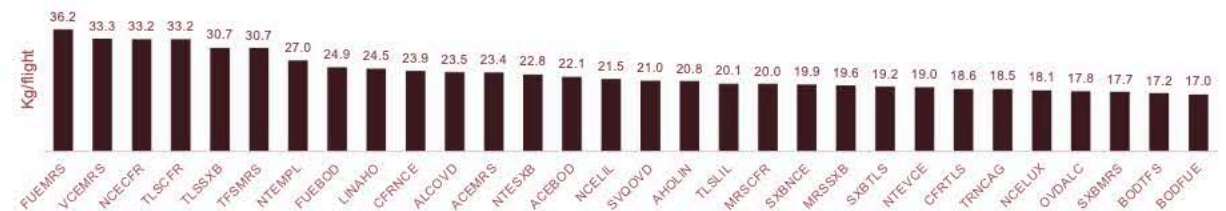
When adding both time and fuel savings, summarizing the total direct fuel savings and seconds per flight shown in the table on the right, you can see the overall value of 18kg per flight obtained from using the AVTECH ClearPath system.

Looking at the savings per route, figure 14 shows what Volotea expects to be the most optimal routes using ClearPath.

RESULTS January to March 2022

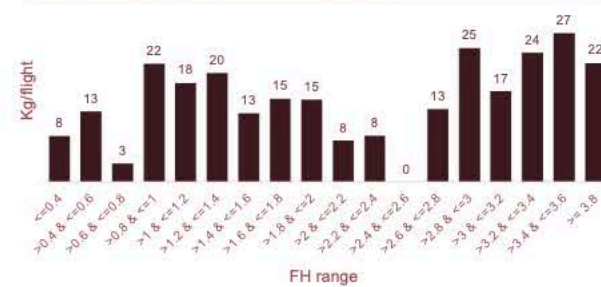
Final savings are not directly related with cruise duration but also in OFP optimization and theoretical ATC restrictions.

Top 30 routes with more savings obtained per flight [kg/flight]*



*Routes with more than 10 flights during the analyzed period (January to March 2022)

Total savings per flown hours [kg/flight]



Total savings per cruise duration [kg/flight]

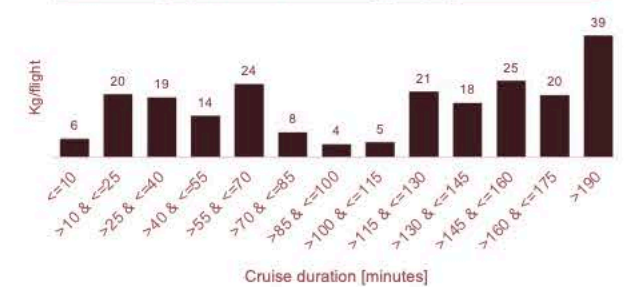


Figure 14

An interesting fact that you can see in the graph above is the flights with quite short cruise phases where verified savings could be achieved. For instance, the flight from Nantes (NTE) to Strasbourg (SXB), a short French domestic flight, achieved an average savings of 22.8kg. While our expectation was to have high savings on flights with longer cruise phases, the analysis revealed valuable savings on the shorter routes as well.

Looking at savings by flight hours per flight between 0.8 and less than one hour, there was an average saving of 22kg per flight. Regarding the longer cruises, between 3.4 and 3.5 hours per flight, there was an average saving of 27kg per flight; the difference is not as big as had been initially expected.

CONCLUSIONS

Taking into account that savings gained will vary according to the airline's route mix, for Volotea there has been an overall saving of 1 percent of the total fuel burn (figure 15).

CONCLUSIONS

1. **Savings are not directly related with cruise (flight) duration**, however the greatest results have been obtained in longest routes.



- ❖ What is your flight planning system, is accurate enough?
- ❖ Is the baseline (OFP) the best one? -> Test against FMS results.

2. **Real savings** computed have been at least **0.81%** of total fuel consumption during Q1.

3. Will the **savings ratio (%)** remain constant during **summer season**?



- ❖ More crowded airspace during summer season
- ❖ Will ATC be less open for OFP changes?

Figure 15

The conclusions that can be extracted from all of the above data from Volotea were that, while savings are not directly related to the cruise length of a flight, the greatest savings have been gained on longer routes. That does give rise to some questions. Is the flight planning system sufficiently accurate, is it optimizing the flight? Also, is the baseline of the OFP enough? Volotea tested ClearPath against the FMS to obtain more accurate results and to check whether the system is working, as well as to isolate individual initiatives. The ClearPath initiative's savings can then be calculated. From that, it was revealed that 0.81 percent of the total fuel consumption had been saved in Q1 2022. This means the real result that Volotea has obtained with the system (1 percent against the OFP base line) turned out to be 0.81 percent of total fuel consumption, which is regarded as a very good result during that first quarter.

During Q2 and the busy summer season, the skies are more crowded and, as a consequence, ATCs are less flexible about allowing pilots to change flight levels. Despite this, it is likely that AVTECH ClearPath will save Volotea around €3 million of fuel costs per year.

The busier the airline industry becomes, and as fuel prices increase, more airlines will implement fuel saving services. Which in turn will add to the workloads of ATCs as more pilots request re-routes and level changes. Will that reduce the benefit airlines can gain from these systems? AVTECH's ClearPath service is constantly communicating with the pilots and knows where the airplane is and where it is going. This is a great opportunity to improve information sharing, and for pilots to start planning ahead and to notify ATC well in advance when requesting new altitudes. Despite busy airspaces, AVTECH has already seen that airlines using ClearPath have been able to utilize a big part of the potential savings.

LUIS FERNANDES



Luis is an aeronautical engineer who started working at Volotea in 2016 as Safety Data Manager managing and analyzing flight data to maintain safety performance targets and reducing the risk within operations. During the case study in 2022 he was the Fuel Efficiency Manager developing Volotea's fuel efficiency and sustainability program and applying new data technologies to improve the detection of inefficiencies and drive Volotea to fuel consumption excellence.

DAVID RYTTER



David is a pilot and aerospace engineer who has been working in Aviation and IT since 2010 when he started at AVTECH. Over the years he has engaged in software and product development projects through various roles as product owner, project manager, solution architect and deployment manager. David enjoys working in close cooperation with customers. From 2015 to 2019 he was AVTECH's CTO and since 2020 he manages the company as CEO. David is the holder of a commercial pilot's license from Scandinavian Aviation Academy and an MSc in Aerospace Engineering from KTH Royal Institute of technology, Stockholm.

VOLOTEA



Volotea is one of the fastest-growing independent airlines in Europe serving more than 100 airports from 19 European capitals with its fleet of 41 Airbus A319 and A320. To date, Volotea has launched over 50 sustainability initiatives that have driven a reduction in carbon footprint per passenger and kilometre, and has been working on developing emission-free alternative technologies, operating Airbus' internal shuttle service with 34% of sustainable aviation fuel.

AVTECH



AVTECH, specializes in tailored information to the cockpit with easy, automated and inexpensive improvements in FMS optimization. The result is a reduced fuel burn and CO₂ footprint, while improving safety and comfort by avoiding turbulence. AVTECH's ClearPath service provides an automated optimization and decision support to each flight based on real-time flight parameters, and the latest high resolution weather modelling. ClearPath now also has detection, notification and avoidance of hazardous weather built right into its optimization. The service informs pilots about hazardous turbulence enroute and suggest how to avoid it in the most cost optimal way.

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