A Pilot's Point-of-View

ATC is Not the Problem

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For the last 40 years, EUROCONTROL, FAA, NASA, and others have worked extremely hard and spent $100s of Billions to fix delays, congestion, and reduce CO^2 — but the benefits elude us.

DURING THE FOUR decades I have been involved with Air Traffic Control *(ATC)* and airline operational issues, the ATC-proposed solution always has been 10 years and $100 Billion into the future:

- This was the case in the 1980s with the Microwave Landing System *(MLS)*, curved approaches, Advanced Automation Systems *(AAS)*, Initial Sector Suite System *(ISSS)*, etc.;
- The case in the 1990s with the Future Air Navigation System *(FANS)*, Global Positioning System *(GPS)*, and FreeFlight Systems;
- The case in the 2000s with Controller Pilot Data Link Communications *(CPDLC)*, Standard Terminal Automation Replacement System *(STARS)*, Required Navigation Performance *(RNP)*, Automatic Dependent Surveillance — Broadcast *(ADS-B)*, and Automatic Dependent Surveillance — Contract *(ADS-C)*;
- The Case in the 2010s with NextGen, SESAR, ERAM, and enroute climb — and now,
- Still is the case in the 2020s with NextGen/SESAR.

Many argue we have not spent enough money. Yet ANSPs *(Air Navigation Service Providers)*, government aviation authorities, ATC systems, and airlines have spent $100s of Billions. Again, did I mention the benefits elude us?

Others argue that ASNPs, as mostly government agencies, are too bureaucratic to accomplish such a large task. Yet, in countries where the ANSP is *not* a direct government agency, delays and congestion still exist. Still others say ANSPS do not have the resources or talent to solve the problem.

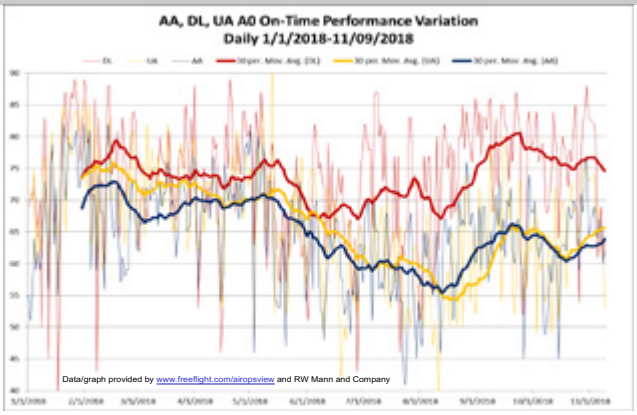
I find it difficult to believe expertise within the FAA, NASA, EUROCONTROL, Air Services Australia, etc., is less than needed if delays were actually an ATC problem. They are not.

Finally, others argue the problem is too large to fix, weather is too unpredictable, airline schedules cause the problem, we need more runways, or..., or..., or. But you get the picture — lots of reasons why it won't work, and still no solution.

Most focus on the most visible participant: ATC is the culprit, and ATC is in control around airports where most delays are visible and where most efforts and money are funneled.

Let me be clear: ATC is *NOT* the problem; nor is it the solution.

Airlines Desperately Need To Solve This



Customers Feel Variation, Not Averages

(*Making Six Sigma Last*, George Eckes, 2001)

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So, how can such a long-held belief not be true? The belief "only ATC can fix it" stems from the fact that 40 years ago when the above assumptions were made, we did not have reliable weather forecasts, good aircraft position data, necessary communication capabilities, or the computational power to look into the movement of the aircraft in real time — or the vital real time predictive analytics.

Further, ATC was the only entity with even close to a wide enough view of the problem to do anything — so everyone concluded ATC was the problem and only ATC could fix the problem.

Time moved on — technology got better, and since the 1990s, the forecasts, aircraft position data, communications, and computational power required are readily available to see what is happening in real time within the world's airspace — and more importantly, with predictive analytics, what will happen "day of" hours into the future.

So why can't we fix this? The answer is simple: for the past 40 years, we have been trying to solve the wrong problem.

Variance

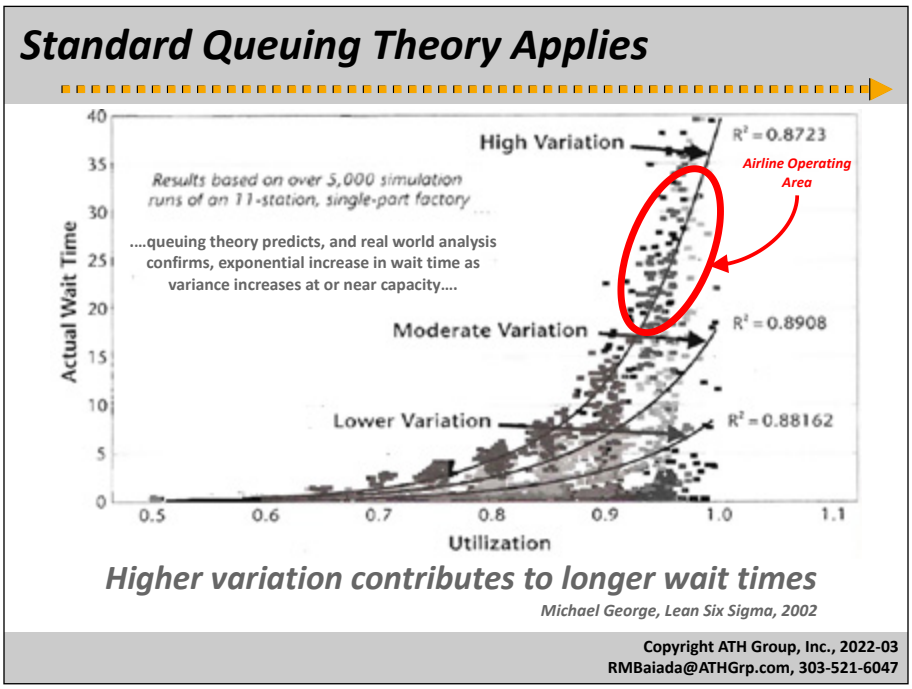
So, if ATC is not the problem, what is? The answer is variance.

Variance in the movement and flow of aircraft has never been fully considered. But, as the chart, *"Airlines Desperately Need to Solve This,"* shows, the variance in the movement of an airline's aircraft is huge. But instead of removing this completely unnecessary variance, all of the energy, money and focus has been on ATC and technology. No one went back to do the basic engineering, i.e., determine the root cause of the problem before you work on the solution.

Also, let's look at what we now call ATC delays. I believe that actual ATC delays are close to zero. Of course, an ATC equipment failure would be classified as an ATC delay, but these are very rare.

Next, consider that ATC is a reactive process. If the airlines throw 150 aircraft at Chicago in an hour, when Chicago can handle 120 aircraft an hour, or more realistically, 60 aircraft in half an hour, only one thing can happen — delays.

ATC must vector the extra aircraft farther out over Lake Michigan into an extended downwind and final, and ATC takes the blame for the delay. In manufacturing, this is called work-in-process inventory, which all industries, including airlines, recognize as expensive.



Therefore, is the fault of delays and congestion attributable to ATC who can't handle the bunching in the last 30 to 40 minutes *(i.e., overload)*, and are forced to space out the arrivals safely? Or are the delays the fault the airlines who allowed bunching to manifest in the first place? I choose the latter.

Further, as the graphic shows, Time in Queue grows exponentially as a process approaches capacity. During the overloads, we are at or near capacity. As shown repeatedly, in numerous other industries, actual wait times *(i.e., delays)* grow exponentially as the variation increases. This is fact, not theory.

The question then becomes — what is the easiest way to resolve this bunching. ATC could try to safely pack them in tighter, a solution they have been working on for the last 40 years with little success, i.e., Defect Correction, waiting until after the problem has developed to correct it. Or airlines can choose the simpler, quicker, and much less expensive solution of not sending 150 aircraft into Chicago airspace in an hour *(i.e., Defect Prevention)*.

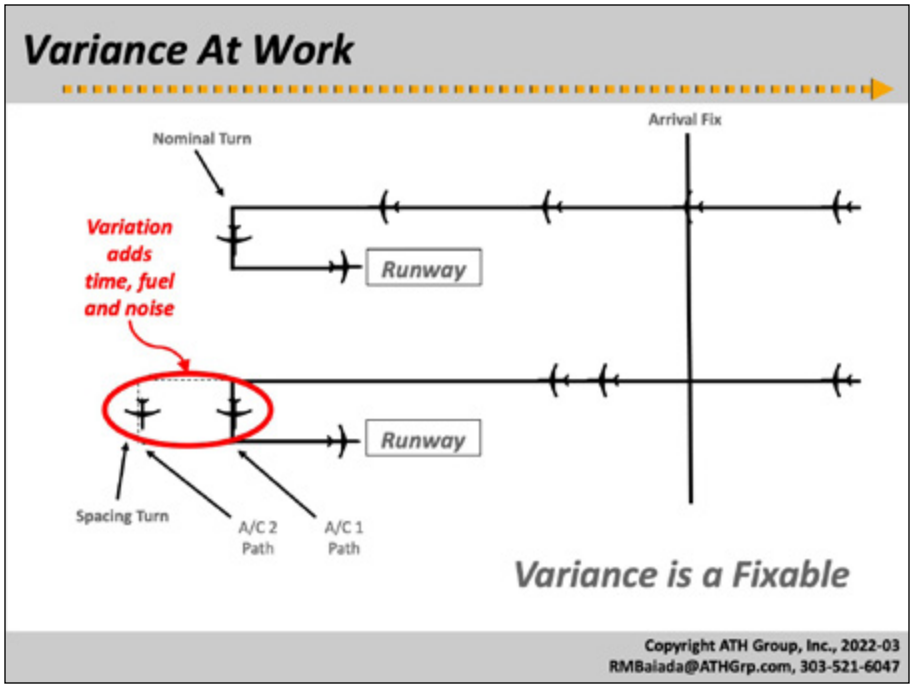
Here, you probably think schedule changes, but, unless schedule changes are draconian, they make little difference. Think 2002 after Sep 11th, when we still had delays.

No, the solution is much simpler and less costly — manage the aircraft arrival flow to remove the variance.

Airlines can quickly do this now by applying business-based time flows to speed manage the enroute aircraft to not overload Chicago. By speeding up late aircraft or ones with available gates, and slowing down early aircraft or those without gates, airlines could spread out the arrival flow, both forward and backward in time from a business perspective, so the "right" 120 aircraft enter Chicago airspace in an hour, and more importantly, with two aircraft per minute time-sequenced to the end of the runway.

Instead of randomly overloading ATC, and bunching the flow so ATC is forced to act, and increase time-in-queue, airlines could manage the arrival flow to provide ATC the right number of aircraft, at the right time and right place. *Right part, right time, right place.*

As proof of how this can be accomplished, consider that in 1995, by adjusting enroute speed, United calculated my on-time performance was over five percent better than the average B737 Captain, while using 100 pounds less fuel per flight. Add in coordination across all flights and, as Embry-Riddle Aeronautical University concluded, *"benefits improve with more flights*



optimized and complied."

Further, nothing I propose prevents ATC from safely packing the aircraft in tighter. When and *if* this happens, time-based flows will automatically adapt to the new spacing and capacity. In other words, airlines can achieve the best of both worlds.

Now for another contrarian perspective — airports are NOT full. Point overloads — absolutely, full no. Every airport we analyzed shows available capacity, but it is mostly forward in time, and therefore these available landing slots are wasted in today's operation.

To prove this, take a good weather day aircraft arrival flow for a full day in the actual order of their arrival and then tighten the flow on paper *(well, actually in a computer)* to current minimum spacing. Next do the same on a bad weather day. If every slot is not filled — which it is not — the airport is not full.

The prime cause of delays, congestion, and overloads is variance, not ATC, and something airlines or ANSPs *(FAA, EUROCONTROL, etc.)* have yet to fully consider. For example, while analyzing Frankfurt, we noticed delays continued after the demand dropped below capacity.

As the graphic shows, a variant flow — even at the same demand — will cause delays and congestion to add in spacing turns. Now instead of two aircraft and one downwind, add in eight aircraft coming from different corner posts, two down winds, and a few straight-ins — and delays explode.

Next, consider an analysis of JFK, which showed all delays could be eliminated by simply changing the arrival time of the aircraft an average of two minutes, with the maximum required arrival time change of less than seven minutes. These types of coordinated arrival time changes are all well within the capabilities of any aircraft, on all but the shortest flights.

And the shortest flights could be managed with a coordinated departure time. Not a GDP *(FAA)* or CFMU *(EUROCONTROL)* time, but a real time, fully coordinated departure time into a fully coordinated arrival slot.

The benefit of this approach is that it does not require airlines to change their schedules, easily crosses flight information region *(FIR)*/sector boundaries *(a hugely important factor)*, uses navigation and communication equipment already paid for and in place, is easily coordinated with ATC, and can rapidly be implemented within three years across the entire US or Europe.

Also, consider what a NextGen/SESAR solution would look like. With full NextGen/SESAR, ATC will take full control of the movement of the aircraft. ATC will tell aircraft what time to depart, what time to be at different fixes, and what time to land. These times would be decided with little to no business input by the airline.

If a gate is occupied and ATC says to land early, you land early and wait for a gate. If the ramp becomes overloaded with aircraft waiting for gates, ATC will slow arrivals. Plus, if the aircraft has a maintenance problem and wants to land early to provide more time for maintenance; or if the aircraft has a 35 minute turn time and a full aircraft in and out, the airline might want to land early to improve the chances the next flight would depart on time; or if the airline wants to land early because of crew legality issues — there is no effective way to easily communicate these scenarios with full implementation of NextGen/SEASAR solutions.

In what business is having an outside entity, with no interest in the business needs of the users, a viable operational model?

Of course, airlines do not consider these business decisions in real time today and are happy with their 1950s, fire-and-forget, wing-and-a-prayer day of operation where airlines send a Billion dollars of aircraft out on the wing and hope it comes out OK. As history and reams of data show, it rarely does.

And of course, there is CO_2. Today, we look to very expensive, yet-to-be commercially viable sustainable fuels, which are at least 10 years into the future. Conversely:

Above and beyond any current airline sustainability or ATC program, airlines can inexpensively and internally cut their Carbon Footprint an additional five percent by 2025, while also improving profits and reducing delays/congestion.

Nothing I propose prevents airlines from using sustainable fuels. When and if *(a big if)* this happens, the time-based flows would still lower the amount of sustainable fuels burned. Since I introduced FreeFlight in 1995, airline-managed, time-based flows are the only solution that rapidly reduces CO_2, delays, congestion, and costs — solving each of the problems described.

We can continue to choose the 10-year, $100 Billion ATC plan, which has yet to provide the desired results. Or we can choose the three-year, $25 million airline self-help plan which

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reduces CO_2, delays, congestion, and costs that FAA and Embry-Riddle jointly proved *(FAA Task J Report — Steve Bradford, Dr. Vitaly Guzhva, and Dr. Ahmed Abdelghany)*; Delta Airlines proved (*Delta Checklist Publication*); Georgia Tech proved *(Dr. John-Paul Clark)*; and GE Aviation proved (*Dubai FLOW Report*) in actual operations.

Your choice!

Finally, let's recap the benefits of "day of," real time, business-based, cloud-driven, aircraft time flow management:

- More passengers where promised, when promised — check.
- Higher product quality — check.
- Happier, more satisfied customers — check.
- Low-cost, less CO_2, rapid implementation — check.
- Easily crosses FIR/sector boundaries — check.
- Less CO_2 generated — check.
- Less noise around airports — check.
- Less low altitude maneuvering — check.
- Less fuel wasted — check.
- Less flight time per leg — check.
- Higher airline productivity — check.
- Less dissatisfied passengers yelling at agents — check.
- Less disruptions and schedule deviations — check.
- Less flight crew deviations — check.
- Less costs, higher profits — check.
- Happier shareholders — check.
- Less ATC complexity — check.
- Less government spending — check.

What's not to love?

Real World Business Managed Flow Examples

Often, I asked my copilots what time they want to land, something they never really consider, which is amazing since airlines sell time. After a short pause, they would answer on time, which is a good first answer.

But what if the inbound and outbound are full with a minimum turn time? The airline might want to speed up the aircraft to land 10 minutes early to assure the next departure is on time.

Or what if the gate is occupied for 10 minutes after scheduled arrival? The airline might want to slow the aircraft enroute, save fuel, release the earlier landing slot, not congest the ramp, or anger the pax who see empty gates, just not theirs.

Or what if the aircraft requires a one-hour maintenance action with only a 40-minute turn time? The airline might want to speed up the aircraft to land 20 minutes early, to allow the next departure to be on time. So, the correct answer to what time should the aircraft land is "*it depends*," something only the airline can decide from a business/system perspective since most changes will impact another flight *(not ATC or the individual pilot)*.

Next, let's look at a flight which lands into San Francisco 30 minutes late because of fog. This is one of those times when weather is the first-tier cause of the delay. But because of airline crew scheduling practices, they schedule the aircraft, pilots, and flight attendants separately, so when the aircraft lands into San Francisco, the pilots go one way, the flight attendants go another, while the aircraft sits and waits for pilots and flight attendants from two other flights.

Since the crews have to switch aircraft, which means that by the time the new crew arrives at the aircraft, does the aircraft preflight, and is ready to depart — they end up off the gate 45 minutes late. The flight to Los Angeles is planned at normal speed and altitude since each flight is treated separately. But given the pressure to reduce fuel cost *(yet another cost center)*, the crew slows down to save fuel, so they land 49 minutes late.

Since they were later than Los Angeles ramp people expected, no one was there to park the aircraft, so they get to the gate 52 minutes late. The same process repeats itself on the flight back to San Francisco, and the aircraft is now one hour and four minutes late — and, again, on the next flight to Denver. Now the aircraft is one hour and 19 minutes late, and on, and on, throughout the day.

Conversely, if the airline kept crews together with the aircraft and developed a 'fast turn' process to service the aircraft at the gate, such that the 30-minute late arrival for fog departs SFO only 25 minutes late. Also, the flight plan could be calculated to give the pilots extra fuel to allow flying low and fast *(best groundspeed)*, so that it arrives at Los Angeles only 21 minutes late.

The ramp could always, yes always, park the aircraft when it arrives, the agent would always, yes always, immediately put the jetway up to the aircraft and open the door, do the 'fast turn,' and depart only 18 minutes late. Low and fast again, and now it is 14 minutes late into San Francisco. Repeat, and the flight is on time into Denver.

So, instead of three legs with the aircraft over an hour late, it could be three legs and the aircraft back on time. But this takes a system and defect prevention view, something airlines do not understand.

Another scenario: Consider two aircraft at the front of a tightly packed arrival queue of 30 aircraft. By identifying/speeding up the first two aircraft, moving them forward two minutes, the entire arrival queue moves forward. In other words, moving two aircraft forward at the front end of a large arrival queue doesn't just save two minutes, but saves two minutes for every aircraft in the queue behind the first two flights, as the entire queue moves forward. This creates what Dr. Clark of Georgia Tech labeled the "draft effect," thus dropping 60 minutes of flight time and delay from this one arrival queue alone.

Another example is my flight from Portland, OR *(PDX)* to Chicago *(ORD)*. That day, the tailwinds were in excess of 180 knots, which would put me into ORD 30 to 40 minutes early. Of course, the PDX agents wanted to shut the door 10 minutes early and "push" the aircraft to ORD, since everyone was on board the aircraft *(local goal of "shutting the door" early to meet an "on time departure" or D0)*, which I prevented, and we left on time. Next, I taxied very slowly, and cruised at a low speed for better fuel mileage, to the point ATC asked why I was flying so slowly. When I arrived at ORD, I landed 16 minutes prior to schedule, instead of 30 to 40 minutes like all the other arriving aircraft which were "pushed" off their departure gates to meet D0 and

wasted fuel going normal speed.

Of course, when so many aircraft land 30 to 40 minutes early at a hub airport, the gates are still full from the previous arrival bank. This forces ATC to temporarily park and manage aircraft anywhere they can, to the point that — as I exited the runway — I couldn't talk with ATC as they were completely overwhelmed with D0 "pushed" aircraft everywhere waiting for their gate. After a few minutes, I was able to break in on the radio, and received clearance to my gate, which was open. As I entered the alley, yes, my gate was open, but it was blocked by five other aircraft that had just left their gates, which were awaiting taxi clearance to depart.

The end result was that ORD devolved into a classic gridlock situation between the departures and D0 forced early arrivals, as the ATC system and airport were completely overwhelmed. I sat for 20 minutes looking at my empty gate 200 yards ahead but couldn't get to it. Of course, like everyone else who landed 30 to 40 minutes early, I was late to the gate *(20 minutes)*, even though I landed 16 minutes early.

Could ATC and the airport have handled this better? Of course! But the real solution was for the airlines to manage their departures by "pulling" the right aircraft from their departure gates in order to not overload the ORD ATC system or the airport. Clearly, if a simple line pilot recognized the problem hours prior *(accurate ETA information hours in advance)*, an airline should have done the same, and prevented the problem from developing in the first place *(ala W. Edwards Deming)*.

Also, we often hear the airline delay and congestion problem expressed in terms of the printed schedule, i.e., "*You can't schedule 10 aircraft to land at 8 AM and expect everyone to be on time*". Of course, if all 10 aircraft showed up at exactly 8 AM, this would be true. The answer to this riddle is twofold.

First, airlines deliver upwards of 80 percent of their aircraft off schedule *(early/late)*, so the potential of actually having all 10 aircraft arrive at 8 AM is very low.

But the real answer of how to schedule 10 aircraft to land at 8 AM and assure that all 10 are on schedule is for the airline to tactically manage the aircraft so the first one lands at 7:51 AM *(assuming a 60/hr. arrival rate)*, the second at 7:52, the third at 7:53, etc. To do this requires a level of tactical, real-time control — currently, airlines have the data necessary to accomplish this, but choose not to do so.

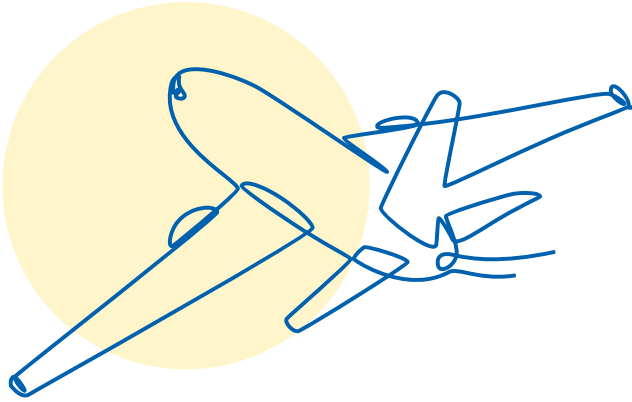
Next, look at airport capacity. No airport I have ever landed at is "*full*," as plenty of capacity is available, even at Chicago before their multi-Billion-dollar runway revamp — but it is mostly forward in time. Of course, airports are over capacity at certain times of the day *(even Boise is overcapacity when two aircraft want to land at the same time)*, but this doesn't preclude reducing delays, congestion and realizing a much improved on time arrival performance.

We simplify the arrival flow problem by looking at the airport as a single entity, i.e., a box. If the box can hold 100 aircraft per hour, allowing a rate of 130 aircraft per hour *(or 65 in 30 minutes)* to enter the "box" assures a very expensive 30 NM final. Control entry to the "box" and you mitigate much of the current arrival inefficiency and costs *(block time, fuel, crew time, noise pollution, etc.)*.

To make this a reality, the solution is that instead of waiting for ATC to de-peak the actual arrival flow backward in time — at around 200 nautical miles *(NM)* from landing — an airline could proactively pull the "*right*" aircraft off the front end of the actual arrival queue *(at 500 to 1,000 NM from landing, or more)*.

By speeding the "*right*" aircraft at the front of the arrival queue, moving the aircraft forward a couple of minutes, the entire arrival queue moves forward, thus providing a consistent, manageable flow, which would increase airport throughput and improve reliability. Further, an airline could speed up late aircraft, deal with aircraft maintenance issues or crew legality issues, and slow early aircraft or aircraft without a gate.

Finally, why fly fast enroute if your gate is not available? Not only does this waste fuel enroute, but it also congests the arrival fix and delays other aircraft, takes up a valuable landing slot which should be used by a late aircraft, congests the ramp, and — as proven by ATH Group — leads to increased taxi times while early flights wait for their gate. Further, the airline has ramp workers, fuelers, and other secondary processes "standing by," wasting time,



and costing money. One action produces lower quality with numerous highly variant and costly effects.

Nothing academic here — just well-understood supply chain and defect prevention tools from a system perspective.

Given the facts, one would think airlines would jump at the chance to internally implement an *FAA-proven, independently validated, inexpensive solution* that, within months, can improve on time performance, product quality, profits, and ATC — while cutting costs, fuel, CO_2, noise, and daily defects, all with a return on investment measured in months, if not weeks.

Here are additional articles outlining why a Defect Prevention, Operational Excellence solution *(>%5 CO2 reduction, >85% A0, <3% day to day A0 Standard Deviation, >8 minute scheduled block/gate time reduction per flight)*, driven by GreenLandings™, is the path forward to make airlines dramatically better and more profitable. Like Toyota did for the automotive industry in the 1980s, all it takes is one airline and/or an ANSP to lead the way.

GreenLandings™ Heathrow Interview by Harold Goodwin - Responsible Tourism *(video - 46:46, 2020-12-30)*

Aviation Needs a New Direction - Driven by Vision and Leadership *(Managing the Skies, Nov/Dec 2019)*

Fastest Airlines in the U.S. *(Forbes.com, 2019-06-17)*

Checklist publication - Confessions of an GreenLandings™ Doubter *(Delta Checklist, 2007-09-01)*

Air Traffic Control Is Not the Real Cause of Airline Delays *(Forbes.com, 2017-03-23)*

Not Working! *(ATCA Tech Symposium, Atlantic City, 2018-05-16)*

Parked Planes Cost Airlines Billions *(Forbes.com, 2017-08-15)*