A TREMENDOUS GAME CHANGER: WHERE IT ALL BEGAN - NICK GUIDA TAMARACK AEROSPACE

News / Business aviation, Manufacturer

I do my best to talk about solutions we have today for the decarbonization of aviation. Technologies already proven by hundreds of aircraft flying and using it with more than reassuring results. For me, it's more than important to understand the road made between the idea, the realization and the use of technological improvements. So the best place to start is where it all began. In case of Tamarack Aerospace Group - I had the pleasure to discuss with Founder, Chairman, CEO & CTO - Nick Guida. Take a seat and immerse yourself in this surprising and interesting journey.

T.O. So, as the Founder of Tamarack Aerospace, tell me how it started? How the idea of technology came up? What was the point 0? How many years it took you to fight for the technology and prove it? Was it easy?

N.G. Yeah, very funny. So, I am an aerospace engineer and one of my consulting clients had asked me to help them with the King Air winglet project, years and years ago. Back in middle of the 2000s when I built my consulting business. I was a DER – Designated Engineering Representative for the FAA for fatigue, loads, structures, and damage tolerance. A broad area of

capabilities. So, I did these winglets, old fashioned passive winglets. I put these winglets on an aircraft for the client, did the certification, static testing, analysis, helped with flight testing and it took a couple years.

And then I just kept doing more and more winglet projects. And every time I did a winglet project I realized; how much compromise was required. Because the aerodynamicist and the structures guy are two different silos of information.So, the aerodynamicist wants big winglets, but that increases the stresses on an existing wing. So, the stress guy gets angry and has to put more metal on the airplane. This continual battle between reinforcing the wing and aerodynamics just kind of was in my brain of trying to figure out how could we get around this. The 737 has 500 to 600 pounds of additional aluminum and steel to accommodate the added old-fashioned winglets. The 767 has 2000 lbs. In order to take an existing wing from the seventies and put a winglet on them. That's how much more stress is imposed.

Winglets are great for aerodynamics, but not good for structural side. It was just bothering me for about three years before I had this idea because I knew everything about all the nuances, the loads, damage tolerance, the fatigue, all these things just fight each other when you are trying to make high aspect ratio wings, because that's really where the drag reduction magic comes from. The high aspect ratio reduces the induced drag, which, overall reduces the total drag, which increases the efficiency of the aircraft, reduces the need for as much fuel and allows the plane to fly higher and many other benefits that are part of the Tamarack Active Winglet Smartwing technology now.

I was constantly thinking about how to solve these problems and I finally had that epiphany on the way back from a Steely Dan concert in the summer of 2009, getting ready to board a flight at SeaTac and I had the big idea: why not build a load alleviation system just inboard of the winglet so we could do a wing extension, put the alleviation system there, and then add the winglet and you end up with very high efficiency wings. And then during the higher g gusts and maneuvers, when the winglet is loading up the wing too much, use the active winglet technology to turn off the wing stresses that the winglets cause,

Then I went back to my aerospace consulting team, and we did the test on a small personal plane I had, and it worked perfectly. I could alleviate gusts and maneuvers with a prototype system that we built out of assembly line servos and technology using PLCs and we threw it together and it worked. We also realized then there would be many other benefits from the invention like taking off with a larger payload, the ability to take off and land on shorter runways, getting to altitude faster without step-climbs, reducing noise pollution around airports and reducing the effects of turbulence. My invention would let the upgraded aircraft take off when other aircraft couldn't under high/hot conditions. The pilot would experience more stability and control. The revolutionary Active Winglets would dramatically increase fuel savings, range and increase safety preventing runway excursions and incursions along with having more fuel reserves so you'd have time to make safer flight decisions … a really efficient, sustainable and economically efficient outcome. The new invention would be and is a tremendous game changer and the costs are offset by benefits in only a few years.

Then I started raising money. I approached Textron because I was going to first do Citation Jets on the way to upgrading and changing other airframes, narrow body commercial aircraft and military transports --- a whole range of aircraft.

The business plan was written for narrow bodies back in 2009. Narrow bodies are where 70% of all aviation emissions come from and we wanted to have this wonderful invention that would save money and also be sustainable. Huge. I started the business with Cirrus SR-22, then Citation Jets.

These CitationJets were certified to 41,000 ft,but were often flying in mid 30s. They can’t climb to their certified ceiling, because of physics. They don’t have enough wing, don’t have enough thrust. When you add a lot of wing and increase the aspect ratio and you reduce the induced drag, you can get straight up to 41 thousand ft and that's where the magic happens. Between 35 and 41K you can get over 15% of fuel savings because it's 3% per thousand feet increase in specific range. But people, especially OEMs, they don’t really know that their planes have these limitations. Because many OEM engineers aren’t also pilots, they don’t fly. They think that their jets can go to 41K when heavy, but they really can't. Operationally, they're just not going to 41. It was a key factor to pick the perfect plane, which is an amazing CitationJet, and allow that to have these benefits. We built one. Textron heard about us, but they were skeptical and weren't that interested. Then our team built a prototype and flew an unofficial world record from Sandpoint, Idaho to White Plains, New York, 6 hours and 16 minutes. 1853 nm with only a 26 kt tailwind. Which is impossible in a flat wing CitationJet. No extra fuel. It was just a normal flight (we’ve flown other official NAA world records since then). The next day I flew that plane to Wichita, KS and started our deal with Textron. Textron was the first major OEM that understood what we could do, and that’s where it started. We started to work on an STC together. It took us about 4 years to develop the system, to the high standards for certification, flight testing. We went to Europe first and used EASA for certification, because at the time, the FAA was in sequestration and using project sequencing, and they couldn’t work on our project in a reasonable timeframe. We were first certified in Europe in December of 2015 and started selling in the EU. Then we did a yearlong validation into the US and then started selling here.

T.O. How easy it is to explain to potential customers the main benefits? Do you think it is easy? Do you think they understand? Or is more and more education and explanation about what exactly your technology can do needed? How would you explain to potential a customer why they need to reach out to you tomorrow if not today?

N.G. Yeah, it's interesting. It really depends on the customer and what their needs are. Airlines need to reach out to us because they have to figure something out. We can save them 10% of their fuel bill and possibly more. Lufthansa spends $9 billion dollars a year on fuel. So, 10% of that is a big deal. That's just bottom line, not even talking about emissions. Delta spends $5 billion a year on fuel, so they have reached out because it’s real. Now customers demand it. We have a fleet of 187 aircraft, Citation Jets, flying around now. Our fleet is growing and we have gotten some attention. We will have some news about military aircraft contracts and regional jet contracts along with upgrading new sustainable hybrid aircraft very soon.

But everybody is different. One of the problems, Tatiana, with our system, the challenge for selling, is that it does so many things. It saves you fuel; it allows you to climb higher, faster. We have a client in Europe that needs that to get over the traffic and the Alps, so he can actually make longer trips instead of being stuck lower and then having to be rerouted. Max zero fuel weight is increased. Takeoff and landing distances are shorter. Single engine climb is much better, much safer. The stability Is much higher. We actually remove the OEM yaw damper inoperative limitations above flight level 280 on the M2, it is that much safer. So, there's so many things that it does that people think you're a snake oil salesman because they think that winglets, they were trained by Joe Clark of APB in the 1980s, that winglets just save 2% or 3%. That's all they think about because they don’t understand the physics, but things are changing fast now, and our technology is finally being accepted much more widely.

Potential customers don't think about being able to take off with lower power settings and keeping the temps on their engines lower so that they can have longer time between overhauls and still maintain the same climb gradients. There are so many things that comes into play. So, when

you’re talking to a skeptical customer, they think your claims are too good to be true and they think it's just a sales pitch when it really is a major improvement that can be proved.

Our customers are seeing these benefits all the time. You must build trust with prospects. My goal is to have them talk to another customer, so that Tamarack gets out of the loop. Prospects could have direct information about how it changed our customers flying life. They bought a CJ and now it flies like a CJ2 or they bought a CJ2 and it flies like a CJ3. Basically, for a quarter of a million dollars, they got a new plane that is worth 3 million more. Our claims can be proved.

People are asking when it will pay off. Immediately, because you just got a new plane, right? Some people are saying: I just have these short flights; I don’t need fuel savings because my flight is one hour; I never get to go above 25,000ft so I can’t save fuel. Yes, but you can put three more people on the plane, how’s that? Your max zero fuel weights increase, and you can take off and land at shorter runways. Now, because your stability is so much higher, you're going to come in at your approach speed and your VREF speed that's published. And you're going to use a lot less runway, a lot less brake pads that you're going to be needing. You're saving money these ways. Whenever I hear someone, I just listen to what their needs are and then our sales team is awesome, and we just try to meet them where they need to be. But it is a hard sell to some people. Some people immediately get it and they just buy them. They don't even think twice. And some people have to be brought along and help them understand that what we're saying is not just fluff. The real savings and real operational benefits are there.

T.O. Would you agree that we need to talk more about operational benefits, even more than just savings, fuel savings or emission reductions? Because as much as I know there are many operational benefits, what your technology is capable to give to a customer. Not everyone is aware of that. Where would you start? What is the number one operational benefit?

N.G. Well, that's interesting. It comes down to stage length, as for operational benefits. Like I flew a Citation CJ3 from Paris, Texas, near Dallas to Paris, France, with one stop at St. John's, Newfoundland. So operationally, I landed one time in between. No one's ever done that. And then I flew back from Shannon, Ireland to Gander, Canada, against the wind. Think about that. You're burning less fuel because you only have one stop. And you don't need to go up and down, up and down, up and down. You don't have to spend the night overnight as many times you can make that trip shorter and less landing fees. Operationally that's just an example of benefits for someone that wants to do long hauls. It's perfect. I have customers flying from Dallas, Texas, to Long Beach in a CJ1 all the time, back and forth, nonstop. Every time you stop, you're burning up time. How much is your time worth? if you look at just stage length and the airplane you have, there's so many ways to show benefits.

If you asked four people how to talk about this, you get five answers. Because everybody has their own way of looking at the world. For some people it is all about savings. They want every penny, and they look at that relating to fuel. However, by having two more passengers onboard, like I mentioned, max zero fuel weight goes up. So, for short flights they are not going to save fuel, but they are getting two or three extra seats on the CJ2. It's 800 pound more max zero fuel weight. So even on a 20-minute flight, you can put four more people legally in the plane. Now figure what does that do to your cost per seat? Landing at an airport, that's closer to your facility, instead of having to drive a car or a taxi. Then consider all of the other benefits and capabilities I’ve already mentioned.

I have so many stories to share about happy customer experiences. I had one of our customers that has a CJ3. He didn't need the range because he was flying from Portland, Oregon to Santa

Monica, California. You can do that in any CJ. For him, it was landing in Santa Monica with a CJ3, because they kept making the runway shorter. Used to be 5000ft, now it's 3400ft. The first time he landed that CJ3 at SMO, he took a little bit more than half the runway to land with light brakes. For him, it was the safety aspect of landing on a 3400-foot runway with the ability to also take off from that runway. Consider, what if you lose an engine on takeoff? Our technology addresses so many different problems and everybody has different needs and concerns. Everybody's different.

For airlines, operational benefits are also very important, of course.: max zero fuel weight, shorter take-off and landing distances are all figured into their business equation. But a real big thing for the airlines is taking off with lower power settings. So, if you're going to maintain the same climb rate and the same distance takeoff, runway lengths, the stop go and all those type of balanced field lengths, the single engine climb comes into play. If you're able to keep your temperatures low and still maintain the same climb gradients, you're increasing your operational benefits by not having to have the hot sections replaced or the hot section interval can be increased. Our technology’s benefits begin at take-off all the way to landing. You can put more people on board, you can take off with lower power settings,maintaining the same regulatory safety. You can climb to higher level altitudes to get over the traffic much quicker. You can fly longer, even at reduced power settings, even at max altitude. And then during your descent, you can use less fuel and you can land at shorter distances. It's not just about 3% fuel saving during cruise with the traditional winglets that people parrot. That's the old story our story is a story about now and the future.

T.O. Nick, I will do my best and that is why you are here, to use 50skyshades platform. Let’s tell more. Because even general public now understands that it's not that easy. It's not only those numbers were repeatedly written in all the advertising and people need to know the real story. That's why you're here. To.

08 OCTOBER 2023

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