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**THE
WORLD OF
HONDAJET**
MICHIMASA FUJINO'S
CONTRIBUTION TO
AVIATION HISTORY



FUJINO'S FORM

AN IN DEPTH LOOK INTO HONDAJET AND ITS VISIONARY LEADER
BY JEFF MATTOON



The young aeronautical engineering major sat respectfully and patiently as he was questioned. Through numerous sessions with numerous interviewers, he calmly and professionally replied, and apparently, he answered and behaved satisfactorily because he got the job.

Michimasa Fujino began his professional career not designing airplanes, instead as an automotive research and development engineer. His designs of auto components and electronic systems found their way into a new breed of Japanese supercar.





Over the past two-and-a-half decades, the hallmark trait of Michimasa Fujino is pragmatism. That trait started professionally in 1984 when seeking his first job out of school. He knew that his dream of building airplanes would be delayed for a while – if not forever.

"I wanted to design my own new concepts and since that wasn't practical in aerospace, I decided to use my skills in the automobile industry, the only industry that would allow me to accomplish that goal," says Fujino.

The only industry because in Japan, now, and certainly in the early eighties, there is really no pervasive general aviation community, and certainly no aircraft manufacturing. Post World War II, the proud Japanese aviation manufacturing industrial machine had been gutted, and the only aeronautical jobs left were with aviation parts manufacturers. Not exactly what a young design wunderkind-to-be aspired to do, so he humbly took the position with Honda Motor Company to make his mark within the automobile industry.

At the time, Honda designed and built a slew of tiny, sub-compact cars, some motorcycles, the Prelude and the Civic – a solid line of automobiles, but nothing tremendously noticeable. The only companies designing and manufacturing impressive, powerful and technologically advanced sports cars were names like Ferrari, Lamborghini and Porsche, and this small Japanese auto manufacturer wanted in on that game. So, Honda assembled a team of talented and forward-thinking engineers and technicians to do just that.

Fujino was assigned to a research project where he designed breakthrough systems and components.

"I engaged in extensive research and development of a steer-by-wire system, control software and hardware, and a reduction gear system," he remembers. "It was very good experience for me to design practical control systems – it exposed me to the proper way of doing things within the company. It also taught me how to operate a project."

Years later, these innovative research

projects were collectively utilized in a revolutionary, first-of-its-kind Japanese sports car. At the time, Ferraris were great, but unreliable, and a bit squirrely to drive. If you weren't careful, they could kill you, and quickly. Honda's vision was to create a supercar that was a dream to drive, offered excellent handling, top quality, with power and efficiency. In 1990, that car was revealed to the world in the form of the Honda NSX, or as it is known in the U.S., the Acura NSX.

Four years prior to the unveiling of the NSX, and only two years into the job, Fujino had worked his way into the position of chief engineer of Honda R&D. During a lunch break one day, he was interrupted by his boss who informed him that he was being transferred to a different project. "What project?" Fujino asked. "Airplane design," he was told.

"Initially I declined the offer because I only wanted to work on the future technologies' auto projects such as the NSX. It didn't matter that I declined. Because I worked for the company, I had to do whatever I was ordered, so I was transferred anyway."

"It made me think back to my interview, where one of the managers asked me about my aeronautical engineering degree and if I wanted to build airplanes. I thought nothing of the question, until I received my new job. It's been rumored that they knew then I would be assigned to aircraft design, and that my time working on the auto project was preparation for my new assignment."

Since Japan had no robust aeronautical manufacturing at the time, all Fujino's aeronautical engineering was theoretical, with no practical experience.

"I wasn't sure if I could design an aircraft, but I quickly looked at this as a once-in-a-lifetime opportunity."

In the United States in 1986, the Honda Civic was making its mark as a small, efficient, good value, compact car. American cars were huge and heavy and drank a lot of gasoline, so the timing was right for the introduction of a smaller car.

"I wanted to do the same thing with





aircraft," Fujino remembers. "Current business jets were not very fuel efficient, and they didn't have the best ergonomics, so I wanted to solve these problems and establish a new aircraft value in the market.

Honda not only assigned Fujino to a new division within the company, they made him the head of that division and gave him a significant amount of resources and support. Also, since certifying an aircraft in Japan would prove very difficult and costly, primarily because there were too many restrictions on operating experimental aircraft, it was decided the new Honda Aircraft division would be established in the United States. This

decision was also in following a corporate philosophy of manufacturing the product in the region that contained the market, and the U.S. was no doubt the largest potential consumer of business aircraft.

"My intention with the HondaJet design wasn't just to capture a certain market share, but to create and expand the market. In order to create the market, I had to create new technology."

New technology indeed. In 1986, there was no very light jet. Most importantly, there was no very light jet engine, so one of the first tasks at hand was to develop a new, powerful, lightweight turbofan engine, and, as many have learned, this is no small task. While Fujino

to work creating prototype aircraft, the engine team toiled on a huge design problem.

Under the strictest secrecy, the new Honda Aviation team worked methodically, creating numerous designs and proof-of-concept aircraft. Fujino was making incredible technological advancements, but only in his own thoughts could he bask in the excitement.

"It was so secret that not even my family knew I was working on an aviation project," he says. "Keeping the project secret was frustrating to me, especially when I discovered or developed something that advanced the current technology, I couldn't share it with anyone, and those within the company who knew about the project could not appreciate the value of the discovery - that was very disappointing to me. Because of this I almost quit many times. I had invitations to join national research labs or universities and I contemplated joining them so



A HondaJet fuselage mounted to one of many in-house load test rigs. This assembly is being readied for rigorous structural pressurization testing.



Michimasa Fujino inspects a stiffened carbon fiber panel, just one type of composite technology used in the HondaJet.

that I could publish my research, but I stayed at Honda because I felt they would eventually have the ability to turn my research into reality and actually build the jet."

The new Honda aviation team first built a single-engine turboprop — an aircraft that was never intended for commercialization. Then in 1992, with the assembly help of Mississippi State University, the first all carbon fiber twin-turbofan six-place business jet, rolled into successful flight-testing, powered by two Pratt JT15D engines.

Six years and many millions of dollars down the road and the "new" Honda Aviation team still hadn't developed the product that the division was created for. To American manufacturers, this was an odd way of doing things, but the Japanese have a different way — Ringi. Ringi is the formal decision making process used by

Japanese business. It is deliberate, methodical, and to Americans, slow. Considering the glut of American VJL failures, maybe slow is the way to go.

The Honda version of ringi involves a significant commitment of resources over the early years, allowing for the discovery of high-tech solutions to design problems always present with new product concepts. To the foreign eye, it appears not much is happening, but quite the contrary. As the design of the HondaJet began to coagulate, Fujino created state-of-the-art solutions to many form and functionality issues.

In one arena, his desire was to offer HondaJet customers the finest in state-of-the-art avionics. Honda and Garmin secretly partnered in the

creation of a computer-powered, flat-panel, multi-screen avionics suite for the HondaJet, revolutionizing aviation. The product was created, and because of ringi, and the desire of the company to keep the project secret, Garmin had no choice but to roll out the new product with no mention of Honda whatsoever. That product is the now venerable Garmin G1000.

"I would have liked to publicly speak about my concepts, but I wasn't allowed to. There were many design innovations we developed for the HondaJet, where, much later, other manufacturers were stating as innovations they initiated, but we knew that was not the case. For example, the G1000 was developed for and came from the original HondaJet I designed,



but it was eventually released for other OEM aircraft because we were not ready to reveal our aircraft at that time.

"The category of aircraft was also something we developed in 80's, the very light and light jet concept but at that time Honda had not formally decided to enter the aviation market, so we could not speak publicly."

This is why numerous times Fujino was brought to the point of quitting, but to his credit, he showed great tenacity, which accompanied the design brilliance.

"Almost every month I tried to convince the management. Since there were many layers, it took a long time to go through those layers. First was the Honda Research and Development management. Then I had to go to the Board of Directors of Honda Motors, and finally I was able to speak to the Honda CEO. It took years and years to reach the CEO and every time I spoke with him I took the opportunity to raise the subject."

The year was 1996 and the HondaJet program we know today was born. A mountain of knowledge was learned from the prototype and proof of concept aircraft Fujino and his team had built, and within a year what amounted to a paper napkin

sketch grew into the real thing.

This exasperating secret period was intensified by others who were entering the market of developing very light jets. A case-in-point was all the adoration Vern Raburn received for being the "father" of the VLJ. The innovator. The genius. Accolades ad nauseam. Michimasa Fujino is a patient, humble man; even still, it was painful to watch as others received praise for innovations he had developed years earlier.

Quietly, in 2004, Honda finally gave Fujino the nod that this product would be developed into the next official Honda mode of transportation. The next year, with great fanfare and industry acceptance, the HondaJet flew to Oshkosh, respectfully shouting to the world it was in this game to stay.

The HondaJet is a carbon fiber fuselage, aluminum wing and empennage, six -



"THERE IS NO CURVE
ON THE AIRFRAME THAT
I CANNOT EXPLAIN."
MICHIMASA FUJINO



place, twin turbofan, around 10,000-pound business jet. As with a number of other, now non-existent former competitive VLJ aircraft, the HondaJet is distinctive in design.

The first thing noticed are the high-perched, wing-mounted engines. To the casual eye, this appears to be a design gimmick – that is, until you dig a little deeper.

Fujino initiated his concept with a certain comfort target, interior cabin volume target and a certain baggage capacity target. By not mounting the engines to the fuselage, like nearly everyone else in the business jet market, all design objectives are met. The problem now was where exactly was the best spot on the wing to mount the engines? What Fujino needed to find was the "sweet spot," and that's exactly what he

did. Engine placement vertically and laterally, with respect to the wing and fuselage was a critical consideration. Too low, and a drag-inducing, stability-stealing shock wave was created. Too high, and an unacceptable nose-pitch-down moment arm was created. Too close to the fuselage, and high interference drag between the fuselage and nacelle is induced and the engine sound into the cabin would be unacceptable. Too far away from the fuselage, and too high the asymmetric thrust under an OEI (One Engine Inoperative) condition.

The HondaJet has a very slight nose-down pitch; and impressively, with no assist from FADEC, rudder pedal force with single-engine operation is easily managed.

Another design notable are the larger-than-normal



for this size aircraft winglets. When asked, Fujino is proud that this “small” design feature is noticed.

“Many business jets store fuel in the wing. If you use a high aspect ratio to reduce induced drag, then relative volume for fuel in the wing is consequently reduced. So we use a large winglet to keep the aspect ratio to secure fuel volume in the wing, which we need for the desired fuel capacity. The design constraints I placed on the airplane was that I wanted a specific fuel capacity and I wanted to keep the wingspan under 45 feet so it could fit into a standard hangar. Winglets help meet this design requirement I set.”

The empennage is aluminum. Why not carbon?

“Carbon is a very good material regarding strength and weight, but it is very expensive. With this size aircraft there is a narrow margin with respect to cost. Aluminum components cost less to manufacture, but they are more susceptible to fatigue. Considering this, due to the high number of pressurization cycles with the fuselage, I chose to use carbon fiber. Since the empennage is not subjected to this same repeated fatigue, I chose aluminum for cost savings,” says Fujino.

If there is a temporary Achilles heal with the HondaJet, it’s the same pain many, if not most manufacturers feel, and that is the pesky problem of small engine design. Fujino is convinced that the engine is a solid performer, but it’s had a recent setback in certification.

Late in 2011, during certification testing, the HF120 had what Honda refers to as a minor failure under certain extreme icing conditions.

“In one respect, this is a very large disappointment for me, but this is a Honda product so we cannot compromise quality. That being said, engine performance is good and it’s extremely easy to operate. The team is always working hard to find the best solution for the success of the HondaJet. As with all Honda products, I want to

gain long-term trust with our customers - our purpose is to not simply build an aircraft that can obtain certification, but to obtain a high degree of satisfaction with the customer.”

As turbofan design shrinks, tolerances in manufacturing and quality control of materials become more and more difficult to manage. This is why it’s only been relatively recently that these small, stout, power-packed engines have come into the fore.

The HF120 turbofan is the result of a design alliance between Honda and General Electric, with their joint venture company GE Honda Aero. The companies decided to join braintrusts, bringing their separate designs together to create a product that would prove better than either could develop on their own in a short time; and it appears it’s a well-formed match.

When you walk around the HondaJet, the obvious gives way to the subtle. The nose has a distinctive shape. There is an almost imperceptible lateral bulge to the cockpit as well as a slight bubble top.

“I wanted to reduce drag by creating a laminar flow design with the nose. The canopy has a slight bulge out for good landing visibility. The bump in the airframe over the cockpit is designed to give the pilot more headroom. Other curves are designed for either aerodynamics or to create additional space - there is no curve on

the airframe that I cannot explain,” says Fujino subtly.

Of course the father of this invention knows his creation well. In the spirit of Honda Motors, the HondaJet offers the size and economy of a Civic and the verve, nimbleness and ease of handling of the NSX. Yes, Michimasa Fujino, the aeronautical engineer, learned quite well the lessons of his early days as an automobile design engineer.

Fujino has indeed learned how to manage projects successfully. In Japanese business culture, the practice of Kaizen establishes a deliberate and continual stride toward quality improvement. This involves all levels of employees, top to bottom.

In the impressive, state-of-the-art manufacturing headquarters in Greensboro, North Carolina, the President and CEO of the Honda Aircraft Company employs Kaizen. In fact, Michimasa Fujino doesn’t hide away from his employees in a cavernous corner office overlooking his domain. He sits in what amounts to a cubicle with short walls, in a room full of other short-walled cubicles. When someone is excited, the whole room knows. When someone is frustrated, the whole room knows. Fujino has built an airplane, to be sure, but more importantly Fujino has built a living organism of people who intend to make design history over and over and over again. ④



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