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Fly-By-Wire – Risk or Reward?

Phil Stevens, business development director, BAE Systems Commercial Aircraft Solutions reviews the state of play...

Fly-by-wire flight control electronics provide safe, controlled handling of aircraft while reducing weight and lowering maintenance costs relative to traditional flight control systems. Fly-by-wire replaces the heavy mechanical control cables with electrical signals generated by a computer and then transmitted through wires to the surface control actuators. BAE Systems' fly-by-wire system controls the aircraft ailerons, elevators, rudder, flaperons, spoilers, and horizontal stabilizers in commercial aircraft.

In the early days of flight, aircraft were operated with mechanical and manual flight controls, complex wire and cable

systems to connect the pilot's commands to the control surfaces. Technological advances introduced auto stabilizers and autopilot functions to reduce pilot fatigue and improve flight efficiency; subsequently adding analogue flight control computers to further reduce the pilot work load. This led to the advent of digital fly-by-wire flight control systems aboard military aircraft, allowing significant improvements in aircraft performance. BAE Systems was the first company to introduce digital microprocessors aboard civil aircraft, with slat and flap computers on the Airbus A310, and in 1994, the company provided Boeing's first commercial fly-by-wire system for the 777. BAE Systems developed and certified advanced, highly fault-tolerant flight control computer architecture and actuator control electronics for the 777, and continues to expand fly-by-wire technology encompassing Embraer and Bombardier platforms today.

Fly-by-wire flight controls offer weight savings, reduced and simplified maintenance, and greater flying precision

for commercial and military aircraft. The replacement of the heavier mechanical system with lightweight electrical wires and electronic controllers reduces fuel costs, and provides the opportunity of increasing passenger or payload capacity and therefore, revenue. In a fly-by-wire system, the mechanical control cables are replaced with electrical signals generated by the flight control computer and transmitted through wires to the control actuators. The use of fly-by-wire control systems improves control signal response time, facilitating more precise aircraft handling and improved safety. An additional advantage of the fly-by-wire flight control system is its automatic monitoring of pilot commands, which ensures the aircraft is operated within the flight protection envelope, allowing the pilot to extract maximum performance from the plane without running the risk of exceeding safety margins and improving pilot situational awareness.

The next step in the evolution of commercial flight controls technology is the introduction of active pilot controls. These systems are

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already used in military aircraft, replacing traditional, passive pilot controls, which use position sensors to send electrical signals to the fly-by-wire system; the aircraft uses mechanical devices to generate the feedback forces felt by the pilot. These mechanical inceptors cannot change the feel of the stick in real time, so changes to the flight envelope of the aircraft cannot be used to feed back to the pilot as force feedback cues, meaning there is no situational awareness through the inceptor feel, such as excessive bank angle. However, active inceptors provide force feedback directly into the pilot's hand, in real time. This force feedback, or tactile feedback, may take the form

concerns over dual pilot inputs in passive inceptor-equipped aircraft. BAE Systems is the world's only provider of flight-worthy active inceptors, with more than 25 years of design experience in active stick technology.

As flight control products continue to evolve and expand, BAE Systems offers today's first application of electronics that are truly "stick-to-surface." From fly-by-wire flight control electronics, to actuation electronics, active inceptors, and high lift electronics, BAE Systems is the provider of the first stick-to-surface solution, for Embraer's KC-390 platform, that will be civil certified. This is the culmination of more than four decades of



of various pilot cues, such as variable gradients, force breakouts, detents, ramps, gates and soft stops, to warn of mode engagements or impending flight envelope limits. It provides an intuitive means of giving immediate feedback to the pilot, and links the controls across the cockpit, so each pilot can feel the forces and see the displacements generated by the other pilot. This is done electrically by the system, is highly redundant, and replaces all the mechanical complexity, weight and volume of passive inceptor mechanical linkages without the significant capability loss resulting from the use of passive electrical inceptors. The result is increased safety and crew coordination in dual pilot aircraft, which may eliminate industry

flight control innovation, beginning with the development and certification of fly-by-wire flight control computer architecture for the Boeing 777 in 1994, and exemplifies why BAE Systems is regarded as the leader in commercial flight controls.

Fly-By-Wire is the future for all commercial platforms. After more than four decades of experience with flight control technology, BAE Systems can count more than 20,000 commercial and military systems in service on aircraft around the world today. Every second, a plane takes off somewhere in the world enabled by BAE Systems' flight-critical products, and the fly-by-wire technology that started it all is the foundation of this legacy.

Player Profile

Ryan Campbell – A Young Man With Serious Intent...

In July 2013, Ryan Campbell, a nineteen year old from Merimbula on the far South Coast of New South Wales, hopes to achieve a dream – a dream to fly solo around the world. If successful he will also become the youngest aviator to do so by breaking the record currently held by Swiss pilot Carlos Schmidt who completed his flight in 2012 at age 22.

The journey will take two and a half months and fly through fifteen countries, a distance of over 23,000 nautical miles. Ryan's plan will not only create history - he also hopes it will raise awareness of the opportunities within the aviation industry for young people. 'Throughout my journey from a wide eyed young boy to commercial pilot, I have not only seen and experienced what aviation has to offer young people, but noticed the lack of young people within aviation. I often wonder why is it that there are so few young people learning to fly?' he says, 'I'm hoping that what I plan to do will demonstrate to other young aviators that there are real opportunities for them to engage and become involved'.

Ryan Campbell's love of Aviation started from a very early age. He recalls his first flight vividly. 'The first time I set foot in an airliner was on a flight to Vanuatu when I was only six years old. After being pushed back in the seat on take-off, shown around the flight deck at 35,000 feet and sitting in awe of smartly dressed commercial pilots towing their small wheelie bags through the airport, I knew what I wanted to do for the rest of my life. Growing up with two older brothers meant that life's hardest decision, 'What do I want to be when I grow up?' was not just left to them. As a seven year old I would sternly and seriously tell anyone who would listen that I would grow up to be a 'Jumbo Jet' Pilot, own a Subaru WRX and live in Canberra!'

Whilst the seeds of an aviator were sown early in Ryan's childhood it was perhaps the family's original connection with flight that allowed them to take root and begin



to dominate his thinking. But there may never have been a connection had there not been a timely invitation from Charles Kingsford Smith. 'My Great Grandfather was one of those "if it was meant to fly it would have feathers and a beak" kind of people', recalls Ryan, 'so it was after much grumbling that he was convinced to join his wife and two sons on a barnstorming flight with Charles Kingsford-Smith. Only a young boy at the time, this flight sparked the love of aviation within my Granddad. After returning from World War Two he learnt to fly and, joining the ranks of fellow private pilots, he went on to build a total time of 222 hours and 22 minutes. Various factors including his time in the infantry on the Kokoda Track, a busy farming life and ill health meant that his flying was limited, yet he still managed to pass his love of aviation onto the next generation'.

This most fortunate encounter with Kingsford-Smith certainly embedded aviation in the family fabric and when Ryan Campbell's Dad began to take flying lessons, pursuing his dream to become a private pilot, it seemed logical for his son to follow suit. But how would it unfold? Where would it start? Just like his Great Grandfather before him, it was a single event that provided the catalyst. But this time things were different. There was no reluctance, no hesitation. 'It seemed common sense to think you would need to get your driver's licence before learning to fly' recalls Campbell, 'it was under this assumption that I decided to complete Year 12 and then pursue my career in aviation. But the plan changed for me at age 14 when I stumbled across an article in the local newspaper about a boy who had just flown an Ekvator Sportstar solo on his

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Ryan Campbell with the Cessna 182T that he plans to fly around the world.