Aircraft are evolving, how much should pilots?

By John Morris

On a recent commercial flight seated next to me was an airline Captain, (younger than me by 20years) deadheading home. We began talking “shop”, what I flew and what he was currently driving, which was the Airbus A-320. He made an interesting comment that stuck with me enough to generate this article. The comment was that he would much rather fly the A-320 than the B-737 (aircraft we were seated in) “because it was easier to fly, less work”.

A very short differences example of the A-320 versus the B-737: The B-737 first flight was 1967 and the A-320 1984. Even the current flying B-737 is *NOT* digital fly-by-wire aka cables and hydraulic assist flight controls but has evolved with Primary Flight Displays (glass) whereas the A-320 *began* with (almost) all glass and fly-by-wire systems. A part of this then very new fly-by-wire system was computer control “Laws”. Meaning engineered to limit the pilot’s flight control inputs to maintain the aircraft within normal performance parameters [overbank-pitch prevention] when using the side-stick “yoke” with no tactile feed-back. Another relevant feature to both aircraft but different is Auto Throttle versus Auto Thrust. Once set, in the B-737 the Auto throttles will move, in the A-320 Auto Thrust they don’t move.

From Webster’s: Evolution (Non Biological) Definition: “a process of change in a certain direction; *especially*: a process of constant change from a lower or simple state to a higher or complex” state.

When I was first introduced to the PC12 in 1999 I thought this plane was so advanced compared to the aircraft I was teaching/flying at the time, which were twin-pistons and turbines built from the late 60’s to 1984. For a single-engine aircraft the systems development and redundancy built into it reminded me of the twin-engine aircraft, meaning dual everything with the minor exception of a second engine.

The traditional “six pack” had partially evolved to the EFIS displays. Gone were the analogue Attitude, Heading and Turn & Bank Indicators. What remained from the “six”, Airspeed, Vertical Speed indicators and the Inclinometer. Included required redundancy of the EFIS was an Electric Standby Attitude Indicator.

The even cooler part was the Attitude Heading Reference System [AHRS]! To me this system was so advanced by comparison since it was using non-moving, laser like gyros. At the time Ring-Laser Gyro Systems, the much more precise AHRS like version, were only in use by the military and the airlines flying long range, over water flights. These systems took hours to align and were *very* expensive.

Currently the Legacy PC12s are in the process of upgrades from the partial evolution of EFIS and some "six" to complete removal of the traditional "six" to all digital Flight Instrumentation with a redundant digital "three" Attitude, Airspeed, Altitude all-in-one Emergency Standby Instrument [ESI]. Remember the Compass? Used for heading back up. Has been approved to NOT be installed with the Global Navigation Satellite System (GNSS) installed in the NG.

And coming soon is the PC12 NGX, with the new PT6E-67XP engine/propeller. The 67XP will have dual-channel integrated electronic propeller and engine control with full digital envelope protection. In the cockpit will be the Advanced Cockpit Environment (ACE) avionics which will have touch-screen controls and a new emergency descent mode. Envelope protection against excessive bank angles is also included as standard equipment.

Everything I have written about so far is about the evolution of the aircraft. They are becoming much safer, more reliable, more efficient and easier for the pilot to manage.

What about the Pilot evolution? Remember when enroute navigation was Radio Navigation, "RNAV", which was cool using VOR's for great circle routing instead of point-to-point, flying actual airways plus VOR or NDB holds/approaches. We had to carry lots of charts. Weather information was only via FSS and Flightwatch. The ongoing pilot's evolution - iPads, GPS/WAAS, Vertical Navigation, High and Low Airways digitally available, Moving Map Displays with traffic alerts/weather information continuously available, etc. All Great!

Back to the A-320 Captain's comment. Easier is always better since workload is reduced. Is "flying" a digital aircraft better than an analogue, wired, aircraft? Manual flying, occasionally with feedback, or auto all the way? Have pilots evolved into tech "drivers"?

Pilots are becoming more systems watchers and data managers. Is that making workload easier? The advancements in redundancy are impressive in reducing pilot workload. Current examples of more evolution coming up for the PC12 world: The NGX

should eliminate the “worry” about the fuel control unit failure with the dual-Fadec system in the 67E engine.

The Auto Throttles’ main use is to extend the usable life of the engine since the control system is monitoring the engine performance so it will also control its output for optimum results.

Since an Auto throttle will be standard with the NGX, the Emergency Descent Mode can be incorporated (Electric Landing Gear deployment assumed to be part of this mode).

Bank angle envelope protection is again the evolution of digital flight performance information from the Primary Flight Display and most likely the electronic engine control system to determine when excessive loads are likely to occur. This system is of course to help deter the most common cause of fatal accidents, Loss of Control – Infight.

All the evolutionary advancements are wonderful assuming the systems function correctly. As rare as the system malfunctions are they do still occur. Recently a PC12 made an emergency landing due to “loss of power”. It has yet to be determined what “loss of power” means but newer engine designs cannot guarantee elimination of events like this. One former event justification for the new Emergency Descent mode would be the TBM 900 accident in 2014 – a Husband and Wife, both experienced pilots but while on an enroute, high altitude cross-country flight they apparently encountered hypoxia. The final investigation indicates the pilots were informed by the Crew Alerting System of multiple system malfunctions but for unknown reasons did not react to the emergencies in a timely manner. The NGX - With the CAS alerts and no near-immediate action by the pilot should cause the Emergency Descent Mode to activate. I wrote an article relating to the TBM accident about a year after the event but before the final report was released. I felt that there may have been a system, or two, that failed to alert the pilot’s in a timely manner. The final report has stated otherwise.

The premise I have suggested however is still valid. What I mean is that protective Warning and Caution systems have glitches or have failed for various reasons, sometimes due to unforeseen electrical or mechanical issues and sometimes due to the pilot or pilots not “catching” an indication or simply missing a checklist item.

These same systems can be in good working order but not understood as to their functionality. As a case in point, the last article I wrote addressed the Stick Pusher/Shaker system operations. As I have taught/talked and written about the system

in the past. I have drivers (still) who believe that the Stick Shaker will ALWAYS precede a Pusher activation. Negative. If a rapid change in angle of attack occurs the logic of the system is to protect by artificially pushing to prevent a possible natural stall occurrence.

Another very important point which is still not understood by some pilots is the definition of, and the cause/indications of, a Trim Runaway. The ONLY announced-audible Trim Runaway event is manual use of the Stabilizer Trim. The Legacy Autopilot has a Master Warning CAWS/"tone". The Series 10's have an accompanied voice callout but it is not considered a trim runaway but trim faulting. The NG's Autopilot is newer but still maintains the same basic monitoring functions as the Legacy version. The system will similarly fault OFF with a Master Warning and PFD indication for certain system events but will otherwise only be initially indicating out of trim conditions via a CAS caution message. ANY problem with the Autopilot requires the pilot to immediately take manual control of the aircraft and completely disengage the Autopilot!

In the PC12 world at least, pilots should never evolve out of being able to hand fly, feel the airplane, and pay attention to the basics of flying. The Inclinometer is as basic as it gets but it is now being replaced with a slip/skid rectangular bar below the sky pointer on the Primary Flight Display. Do you look at that bar while in flight? Really! When do you actually know if you are in a skidding turn? This is THE [unfortunate] primary reason for the Envelope Protection of the NGX.

Of course for a single pilot, the greatest system for workload reduction is the Autopilot. Then we can devote our time to managing all of the continuously evolving electronic "tools".

Manual flying is fun, rewarding and necessary for takeoff and landing! Using the Autopilot from 400 agl after takeoff to 400 agl before landing is NOT maintaining proficiency.

And the only redundancy for the Autopilot is the pilot! The second greatest redundancy, or maybe really the first, is decision-making.

"A Safe Pilot is always learning"

John Morris

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