AUTOMATED AIRCRAFT SYSTEMS
TO CREW OR NOT TO CREW: THAT IS THE QUESTION

The Art of Flying is but newly invented, ‘twill improve by degrees, and in time grow perfect…
— Bernard Le Bovier de Fontenelle, ‘A week’s conversation on the plurality of worlds,’ 1686. (English translation by William Gardiner, 1728.)

At a time when a driverless car has made a journey across the continental United States, a natural progression is to wonder when, and if, the aviation industry will introduce a similar model which eliminates the pilot from the cockpit in favour of fully automated aircraft. While the employment of an automated aircraft is easy to speculate it is far from reality—at least for the time being.

On 22 February 1987, the Airbus A320-100, an aircraft that went on to become one of the most successful commercial aircraft, flew for the first time with a digital fly-by-wire flight control system. At that time, the automated control system seemed to spell the end of crewed commercial and cargo transportation aircraft—the technological marvel of a completely automated aircraft appeared to be within reach. However, when an A320 crashed at an air show in 1988, the aviation industry was forced to take a more detailed look at automated systems. The lessons of the crash resonated across the full spectrum of transport aircraft operations, including in military aviation. Although the computer is a technological marvel, it can and does fail, which in turn could create critical situations for aircraft in flight.

It is interesting that as aviation technology evolves, many people view the elimination of the pilot as the logical and inevitable end point. The same is not the case with any other human activity—like maintenance or air traffic control—that is equally associated with the employment of air power for benign purposes. There are a number of myths regarding cockpit automation, a pervasive notion being that modern commercial aircraft are flown by computers and that pilots are there only to monitor their functioning. This germinates the idea that in some not-so-distant future, pilots will be taken out of the picture altogether. This attitude is intriguing, to say the least.

Automation can be defined as the science of applying automatic control through the use of various control systems to industrial processes, steering and stabilising ships and aircraft, as well as other applications with minimal or reduced human intervention. While the biggest benefit of automation is that it saves on labour costs, it is also used to improve quality, accuracy and precision, achieved through an optimised combination of electronic and computer technologies. It is in the sphere of accuracy and precision that automation is involved in the operation of aircraft systems.

What was the impetus for automation to take such a central role in aviation? Essentially it stemmed from the growing concern regarding pilot error as a primary cause for accidents. Automation was intended to assist the pilot and also to diminish pilot-fatigue, which was identified as one of the major issues that caused accidents due to pilot error. There is no doubt that automation has increased the safety and efficiency of air operations. However, while automated systems enhance pilots’ situational awareness, they have never been alternatives to pilot initiated actions that ensure the safety of the aircraft. The principal task of the pilot is to ‘fly’ the aircraft and the automated systems assist during extraordinary events, such as emergencies, to free his/her attentional resources to this fundamental task.

In many ways high-tech, automated cockpit equipment that assists the pilot is no different to the high-tech equipment that assists a surgeon or a physician. They vastly improve the capabilities of the human being but are by no means a substitute for the experience and skills required to perform at the level required to ensure safety of the passengers or patients. These systems have not even come remotely close to rendering the pilot (or the surgeon) redundant.
Auto-pilot is a term that is very commonly used to indicate the aircraft being flown in an autonomous mode. What is lost in ‘translation’ is that automation is only a tool that still needs a pilot to tell it what, how, and when to carry out a function. A combination of several systems that control speed, thrust, navigation, and height require regular inputs from the crew regarding contextual requirements. In order to fly an aircraft in an ‘automated mode’ the pilot has to make several inputs and then monitor and update the inputs constantly, it is not as simple as just pressing a button and letting the automated system take over.

A flight—from start of engines, to switching off at the destination—is a dynamic endeavour, complex, fluid and ever changing; in which decision-making is continuous, constant and critical. During this period the crew make hundreds, if not thousands, of subjective inputs and decisions, to ensure a safe flight undertaken within the requirements of standard procedures. Even with the aid of automation, the standard aircraft cockpit can very rapidly reach the point of task saturation for the crew. The situation becomes exacerbated especially if an in-flight emergency occurs, when the assistance from automated systems may be considerably reduced.

There are two fundamental disadvantages that automation brings to aviation, which have not yet been mitigated. First, unexpected automation behaviour or uncommanded behaviour caused by system failure has the potential to create adverse consequences and flight manoeuvres. If this happens at night or when flying in bad weather, the situation could develop beyond the ability of the pilots to control, leading to disastrous consequences. Second, the failure of the automated system may not be apparent to the pilots and the subsequent warnings that are provided are only indicative of the flight conditions being met at that particular time and not indicative of the remedial measures. Delay in assuming manual control can once again lead to crashes and loss of life.

It is often said that modern automated aircraft are ‘easier’ to fly than older aircraft. In fact the opposite is true. The operational aspects of modern flying requires a prerequisite volume of erudite knowledge—from an understanding of the on-board systems, navigation equipment, weather information and communications, to name a few—in addition to the skills required to fly an extremely sophisticated aircraft safely. In a holistic manner, no automated system has yet been made that can completely carry out the full spectrum tasks that a modern pilot undertakes. However, technology does exist to create such a system, fairly quickly if necessary. Indeed, some experimental systems have already proven that this is possible.

So what prevents the development and use of automation to the complete exclusion of the pilot from the equation? The answer is simple; a combination of human risk perception, trust or the lack of it, and the proclivity towards emotive responses to personal danger. It is a fact that in situations of danger, human decision-making becomes increasingly emotive as the danger moves closer to the individual. Individually and collectively human beings are not yet ready to accept the perceived dangers involved in an aircraft being flown in a fully automated state while they are passengers onboard. The built-in ‘safety system’ in the human brain will take generations to accept such a situation.

Today, what exists in the modern cockpit is the finest example of what modern technology can provide to improve flying, making it faster, safer and more reliable than ever before. However, aviation is still a long way from taking the pilot out of the loop in both military and civil transport aircraft operations.

Key Points

- The Airbus A320-100 was the first transport aircraft to fly with fully digitised fly-by-wire control system.
- A number of false ideas regarding the capabilities of automated aircraft systems have been perpetuated through less than optimum understanding of the role of the pilot in modern commercial transport aircraft.
- The biggest impediment to achieving complete automation in aviation, to the exclusion of the pilot from the loop, is the ingrained human perception regarding personal risk, lack of trust in automation and emotive responses to danger.

Note: This Pathfinder has only considered the automation of transport aircraft that are NOT employed in any kind of combat operations. The challenges to automating combat air power systems will be considered in a forthcoming Pathfinder.