Modern aircraft performance is not alone!

by Maciej Szczukowski

Aviation is great – from shiny airplanes in 70-year-old black and white pictures, with smiling pilots and their white scarves and impeccably trimmed moustaches, to today's complex cockpits and hundreds of flashing lights, with smiling pilots and their white shirts and impeccably tailored uniforms. The huge changes in aviation fashion have been mirrored by the evolution of aircraft performance. What once used to be only a trial in Kitty Hawk is now a huge industry and business with millions of people involved. What used to be a simple "refuel – clear prop – depart – land" scheme is now one of the most complex fields not only in engineering science but also in IT, management, psychology and medicine.

I think that we have also reached a time when modern aircraft performance and present-day ATC performance are not always in step. When did they divide? It is a topic for a whole book, I guess, but let's follow up one or two clues.

I admire the variety of airplanes flying on our skies nowadays. I like to learn about them, see new aircraft types or new airlines landing on the runway of the airport I work at. I like to know that, although still limited by the laws of nature, engineers are able to set new records for maximum altitude, speed, minimum fuel consumption.

These new high-performance aircraft are real pieces of engineering art, but the airspace is one and they share it with others. These same aircraft often fly in the same airspace, are served by one and the same air traffic management system and use the same airports as all the others that are able to "cheat" the law of gravity. Vintage aircraft, business aviation, military, recreational aviation, gliders, paragliders, UAVs, rockets, birds, Santa Claus and occasional witches…

Do you know the expression "the chain is only as strong as its weakest link"? This implies that any chain, system, organisation, or ATC, performance is going to be determined by the least reliable element in it, i.e. by the least reliable airspace user.

This expression may be an interesting proverb, but mathematically speaking it is not true. Systems and organisations are designed to have redundancies, back-ups and protections for their less reliable elements. The chain becomes more like a network and a failure of one element makes a hole in the network but does not break it completely.

The ATC system is a very well protected system, layer after layer…but sometimes, for some situations, it is more like the chain made by the varying performance of the aircraft this system serves. The links in this chain range from very sophisticated modern aircraft, like the Airbus 380 and the Boeing 787, to "war birds" from WWII. And like the proverb above, the reliability of the most sophisticated elements in the chain can be compromised by the less reliable ones.

Let me give you some examples.

Some advanced Air Navigation Service Providers have recently been introducing functionalities in their systems based on Mode S technology. Mode S is a surveillance technology that, together with the usual surveillance position, provides much more information that can be used for all sorts of not only cool but also useful applications. These include aircraft identity, altitude, speed, heading, vertical rates and downlinked TCAS resolution advisories. The benefits may be enormous – take a look on SKYbrary at the video[1] for Mode S implementation in Maastricht UAC. Likely level busts can be captured by the Air Traffic Controllers as soon as the pilot selects the wrong altitude and the same is true for identifying mis-set radar headings and mis-set speeds. Cool!

However, these Mode S equipped aircraft sometimes share the same airspace with aircraft with no transponder at all! Or an inoperative one, or one transmitting incorrect information. Such an aircraft can be invisible or appear with the wrong position for an ACC using only secondary surveillance. STCA systems cannot capture the conflict affected by these problems and TCAS too will be totally ineffective in preventing collisions. You may say that this will not happen or that it is "extremely improbable". Well, it has happened more than once, as you can see from the article that has been already published in HindSight[2].

1- http://www.skybrary.aero/index.php/Mode_S
2- http://www.skybrary.aero/bookshelf/books/1418.pdf

???? and controllers are sometimes confronted with rapid-onset, dynamically developing situation

In this case the single transponder fitted was faulty but still operating and the altitude information was incorrect. SSR Mode C indicated FL 270 but the aircraft was actually flying at FL 290. Surveillance was misled, neither STCA nor TCAS was triggered and the collision was averted only by a 'last-minute' see and avoid. You can see more on this in SKYbrary, which also has a copy of the Investigation carried out by the French BEA (Bureau d'Enquêtes et d'Analyses pour la sécurité de l'aviation civile).[3]

What we have now is a chain aircraft with sophisticated surveillance performances potentially in the same airspace with an aircraft with critically affected surveillance performance or no surveillance performance at all (at least secondary surveillance). Think about our proverb now!

My second example highlights the opportunity for teamwork and cross-monitoring on a multi crew flight deck. You may have in one and the same airspace aircraft with two or more flight crew and also small single-pilot aircraft. I know it is simplistic to look only at the number alone, as there should be procedures and other means to ensure an equivalent level of safety no matter how many pilots you have. But do not tell me that the challenges facing two aircraft flying the same non-precision approach are necessarily the same. One aircraft may be operated by a highly trained, professional crew with regular exposure to non-precision approaches. The other could also be legally acceptable in the same airspace, but flown by a private pilot who has not flown such a non-precision approach anywhere for several years.

The story of the Qantas A380 uncontained engine failure on 4 November 2010 is a great example of teamwork in which the Captain had the good fortune to share the flight deck not only with the usual extra co-pilot for the planned long flight but also two more pilots – a Check Captain and a Supervisor Check Captain. This team of five made this story a success with a careful division of tasks[4].

Take another story[5] – the incident on 12 January 2011, when the single pilot of privately operated Socata TBM850, with some 12 hours of flight experience in the 28 days before the incident, lost radio contact on a non-precision approach, continued the approach without landing clearance and landed over the top of DHC8-400, which had lined up ready for take off. The PPL-licensed Socata pilot had a heavy workload in trying to perform an NDB DME approach for the first time in four years and failed to stabilise the approach, mistuned the radio, carried on without landing clearance and finally failed to see an aircraft on the landing runway threshold, missing it by pure chance.

And in general how do you think a single pilot, flying manually copes with copying complex ATC clearances?

So our ATC network system is highly protected, and we have these sophisticated modern jets with high performance, but sometimes it takes very little for this airspace user community to look more like a chain than a network. This makes it more vulnerable to failure, which is why I would argue that modern aircraft performance and present-day ATC performance are not always in step.

Isn't it about time they werereunited?

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3- http://www.skybrary.aero/index.php/PC12_/A318,_en- route_north_east_of_Toulouse_France,_2010_(LOS_AW_HF)
4- You can see more about this and access the official investigation report at http://www.skybrary.aero/index.php/A388,_en-route_Batam_Island_Indonesia,_2010_(AW)
5- http://www.skybrary.aero/index.php/TBM8,_Birmingham_UK,_2011_(AGC_LOS_HF)