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Looking beyond the economic crisis: mobilizing the aviation community to recruit, educate, train and retain the next generation of aviation professionals

KEYNOTE SPEECH

Monsieur le Président
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Madame la Directrice
Mesdames, Messieurs,

I am extremely honoured to open this important symposium, which clearly indicates your desire to engage in questions involving the changing professions of aeronautics.

As it happens, today is the 41st anniversary of Concorde's maiden flight. This now mythical aircraft provided the inspiration for countless innovations. Thanks to Concorde, a coherent aeronautics training system was established for the first time in Europe which, to this day, remains the basic model for all Airbus training programmes. I was lucky enough to have been both a player and observer during the last half century, in which air transport was truly born. I was witness to the profound mutations it went through, before attaining the vital global role it plays today. Based on this experience I would like to share some reflections with you on the subject.

One initial observation. The current crisis is clearly affecting the financial stability of the air transport system, which in turn has an impact on operational life. However its influence must not be overestimated. Today's evolutions have their roots firmly in the past; the present crisis is simply accelerating them. It is, though, accompanied by four, more serious phenomena that cannot be ignored:
- the growing awareness of the limited supply of fuel,

- the need to protect the environment,
- excessive media coverage of the slightest incident,
- and the precautionary principle, superimposed onto our aeronautics safety culture.

These factors will complicate your reflections, but you will need to keep them in mind at all times, with their side effects.

The main phenomenon is not directly linked to air transport but does affect it strongly: It is a whole set of factors influencing our daily life - biological, technical, commercial, financial, social and cultural – interacting on a global level, and air transport, by nature global, finds itself at the crossroads of these interactions. To simplify a complex issue, I will cite only two of the many consequences of this globalisation: heightened competition and the innovation that goes with it. Together, these two factors force air transport players - airlines, manufacturers and regulators - to react fast in order to survive. The regulating authorities are then faced with the following problem: what can they do, what *must* they do, when they are rushing to catch up with an evolution they are not in control of? Since their role is to ensure the admissible safety level, couldn't they at last take the initiative? I will come back to this.

This global system can easily get jammed, and a dynamic balance must be found using compromise and common sense. The word is out: **common sense**, a term which must be uppermost in your reflections. But what actually is it? To my knowledge no definition has yet succeeded in fully capturing this very human, very individual quality. It does exist though, indeed without it, little human construction would survive, and you have to make use of it.

Another observation, which first came to me 40 years ago: training is not meant to correct the design faults of aircraft and their systems, but trainers must collaborate with equipment designers so that human adaptation is as simple as possible. 15 years were needed to persuade design offices to introduce the innovative and difficult notions of cognitive as well as physiological ergonomics. What it comes down to, is that innovation – whether in terms of equipment, its operational use or specialised training - must be dealt with as a whole. Training cannot be looked on, as a separate entity, indeed in an ideal world it would not even be necessary. This is the notion of "affordance" in

systems design. In fact, it is maintenance that comes closest to this ideal for the moment.

In the 1980s, I was given a helping hand by the revolution in computer sciences. Looking at how things have evolved, since this highly innovative era, I can see unequal rates of progress in the different categories. In the beginning, flight and cabin crew benefited from the most significant innovations and Concorde was a crucial element in that. Automated systems and computer simulation played a key role. In 1985, the introduction of Crew Resource Management and the advent of behaviour goals as well as technical goals, gave type rating training the human quality it was lacking. Since then, technological developments in aircraft systems and simulators have allowed many fine updatings, but training programmes have not fundamentally changed.

On the other hand maintenance training, which was very tough at the time of analogue equipment, has gone through a veritable revolution in 15 years. Driven by economic necessity (and the financial model of low cost airlines in particular), this process was helped along, by the advent of highly reliable digital equipment and the widespread use of electronics and computers. Modern aircraft can be monitored individually in real time, anywhere in the world, and maintenance engineers have dispensed with printed manuals. In these aircraft, between 5,000 and 10,000 sensors – contained in the different instruments, the engines and even in the structure – provide information on the state and life evolution of each aircraft. This information is transmitted to assistance centres, which deal with problems when they arise, and anticipate them where possible. It is important to note that this processing is made possible by some very sophisticated software and, above all, by its intelligent interpretation by teams of specialists. Training is clearly facilitated, but recruitment and basic training have also evolved.

A further observation concerning recruitment and basic training. At the origin of this observation is a phenomenon observed in the past two decades: i.e. technical executives became scarce at the upper echelons of major high-tech industrial groups. Managers now have a commercial, financial or even administrative background. This seems logical at first sight because global competition calls for a perfect knowledge of financial and market issues, and their appropriate management. But in the case of a highly technical sector, this is not enough. Let me give you an example.

In a major technical group, whose name I will not mention, the management committee comprised administrative, financial and commercial vice-presidents, but no technical manager. When a serious technical glitch came up, it proved impossible to pinpoint responsibility. Was this due to the lack of a technical manager? Who knows… But a technical manager is now back in the management committee!

This new supremacy of non-technical professions is affecting young people's career choices, with important repercussions for high tech businesses in the highly competitive sector of air transport. Are top managers aware of the growing difficulty recruiting maintenance personnel, technicians and engineers? It is high time they were. High tech sectors obviously require sound business management and a good knowledge of the target market. But above all they call for a firm grip of technological developments and their uses, which is vital to the company's operation. Is that common sense? The USA and China seem starting to move in the right direction.

For a long time, operational players were recruited mainly on technical and physiological criteria. This emphasis shifted gradually to embrace a more psychological perspective. In 2000 for instance, the Icarus Committee, the Flight Safety Foundation's "think tank", recommended qualities other than technical for pilots:
"Assuming appropriate pre-selection, the pilot's education starts with his basic training. Several important characteristics must be learned:
- Ability to be conscious of his or her actual position in a three-dimensional environment at all times and in all circumstances
- Ability to recover from unexpected situations
- Efficient time management under stress
- Good risk assessment
- Thoroughness and exactness in task execution
- Decision-taking in unexpected difficult and/or dangerous situations."

Leaving aside the first recommendation, which is specific to pilots (although usually insufficiently dealt with, in their initial training), the five other recommendations apply equally well to all aeronautics operators: cabin crew, air traffic controllers and maintenance personnel. Indeed behaviour is often placed

ahead of technical knowledge for maintenance staff. As proof, here are the 5 values chosen by a major airline as recruitment criteria:
- *Safety:* Priority no.1
- *Integrity:* Towards passengers and colleagues
- *Fun:* Work with good humour in a pleasant atmosphere
- *Caring:* Take care of passengers but also colleagues.
- *Passion:* Enjoy and be proud of what you do.

And this is what I'm leading up to, the key to all aeronautics operations: i.e. **education.** We cannot duck the issue of education if we are operating 500+ seater aircraft. Current training cannot take into account infinite combinations of failures and unforeseen flight events; crews must therefore be prepared to deal with these, by some other means.

Let us think back to the A320 accident of US Airways Flight 1549 taking off from La Guardia on 15 January 2009. It is by no means to detract from their utter professionalism, if I say that in their misfortune, they benefited from favourable conditions: good visibility, high altitude freeing up decision time, possibility of obstacle avoidance, manageable aircraft. But the crucial ingredient here is that the crew *made the most* of all these advantages: it is this key aspect that I wish to focus on. Was it simply due to training, or was there something else involved? Luck does not hold up, as an explanation: It is clear that the crew had received the necessary education to deal with a situation in which certain procedures were necessary but not in themselves sufficient. Had they received this education in their airline, during initial training, during their working life, or elsewhere? Could the happy outcome be reproduced with all air transport crews? I doubt it. All top air transport managers, including the certification authorities, should ask themselves these questions and recognise that training, without the education that contains and supports it, is not enough to produce a safety level appropriate to current challenges. Relying totally on a theoretical calculation of failure occurrence probabilities is more and more risky, to simplify with respect to the media and general public acceptance.

Another observation concerning pilots. For the passengers, they are the last bastion against catastrophe. Being a pilot myself, I will focus specifically on education and training problems directly affecting pilots, and I hope that those

of you from other professions will bear with me, but my observations can easily be transposed to other areas.

In the 1970s, the concept of specific behavioural objectives was introduced into aircraft type rating training, with technico-operational analyses defining the skills, knowledge and behaviour that needed to be taught. Since then, the basics of this training have been refined with the help of intensive use of simulation. This training has become very much more efficient. But it has become clear that 4 or 5 weeks of type rating are not nearly enough to lastingly educate behaviour, in cases where the basic level is deficient – as it often is, not only on a technical level but also in terms of behaviour education. During the 1980s and 90s, we endeavoured to convince aeronautics stakeholders that the beginnings of a solution could be found in basic training. Without any real success, because the economic constraints of ab initio training were too high. I am afraid, this may still be true.

Also one can note certain aspects:
- Piloting an aircraft is based on carrying out procedures. This is sound practice, since it ensures a level of operational safety which is satisfactory to date. But not all situations, especially the most critical combinations of situations, can be resolved by the use of procedures alone (compare Flight 1549), although the latter can give good basic support.
- The generalised use of procedures, in flight management, equipment operation, navigation, automated systems and communications, and also in relations between the crew and with ATC, can lead to confusions in priorities and conflicting instructions. To the extent that during type rating training, basic principles have to be taught to students who have become lost in the multitude of procedures and need to return to simple, commonsensical actions. A good example are the Airbus's golden rules:
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  o The aircraft can be flown like any other aircraft.
  o Fly, navigate, communicate -in that order.
  o One head up at all times.
  o Cross check the accuracy of the FMS.
  o Know your FMA at all times.
  o When things don't go as expected – TAKE- OVER.
  o Use the proper level of automation for the task.

- o　　Practice task sharing, and back-up each other.

- Moreover, this operational use is oriented towards evolved dynamic, but bureaucratic management of the mission, in which the flight is the materialisation. The number of parameters at the pilot's disposal is impressive. For instance, with 3 different screens, the Primary Flight Display, Navigation Display and Vertical Display, pilots are presented around 80 parameters, of which they must use 30 to 35 at any one time. They therefore have at their disposal all parameters needed to apprehend accurately their real situation. This is what happens in the vast majority of circumstances. But there are cases in which oversights can lead to accidents. Are they due to undisciplined or intellectually deficient pilots? Are there too many different parameters, or are they not properly processed? Are we sure that such oversights cannot occur in 300 or 500 seater aircraft?

- Competition between manufacturers and airlines has certain advantages in terms of training. This was borne out, 30 years ago by the obligation to find effective methods. But the principles used for this training are only a transposition of knowledge and teaching methods used for centuries, adapted to our technological evolution. This evolution has become complex and the stakes have been raised, and yet the human brain does not change. In fact, the main parameter to have improved aircraft type rating is the extensive use of technology, mainly in simulation and in order to respect the admitted standard training duration. The many deficiencies in level are corrected by additional training modules, adapted to the defect in question. But fundamental aspects of this training haven't changed since the 1980s.

  In fact we rely on new technologies to solve operational and training problems, and yet technology can do nothing about the workings of the brain. It can make the interface between pilot and aircraft more ergonomic, and as a tool, it does provide many services. But it cannot solve problems such as the multiplicity of simultaneous tasks, diagnostic errors or bad choices, the time needed for complex, rapid tasks, stress, combinations of unforeseen factors, in other words all that can cause mental disturbance and therefore detract from safety.

- A bad, although common mistake, is to forget that pilots are not simply flight managers. They must remain aviators, despite the comfort of automated flight, in aircraft with highly reliable equipment. The Flight 1549 accident is there to remind us that this need exists, even if the circumstances are presumed to be rare. One can note also, that many pilots have severe problems mastering the third dimension in difficult situations, in which they dispose of only a few seconds to make their diagnosis and choose the correct solution. An aircraft cannot stop in mid-flight.

These differing observations have one common factor running through them. Training, with the unique backup of technology, has reached its limits, limits which will not be accepted by the public, in the inevitable case of an accident of a very large aircraft. Behaviour education on the basis of simple principles described here, and applied to unexpected, complex, dangerous situations is undoubtedly an appropriate response, but must go with something else. Training paradigms must be modified in order to move forward.

Two complementary, linked avenues are feasible and can be envisaged.

- To be effective, studies must look into the workings of the brain – improving memory retention, situation awareness, diagnosis of complex, unexpected situations, resistance to error and swift, reliable decision-making. The current pragmatic cooperation between technology and ergonomics – both physiological and cognitive – must give way to properly oriented scientific research. This is obviously valid for all professions.
- In order to do this, technology must offer effective support but cannot by itself come up, with the right solutions. It must be adapted to fundamental neurological knowledge.

I think that this opens up possibilities for regulatory organisations to take the initiative in terms of research orientations and the definition of fundamental rules. The current method of combining multiple procedures, each designed to simplify air operations and make them safer, is becoming too complicated for the human brain.

Aside from the industrial adjustments required, one of the main issues to be resolved, will be the reluctance of today's pilots to abandon elements acquired

through hard-won experience which they rightly think are the basis of their operational safety, in favour of new methods which, although more effective and relevant, will make it necessary to forget some learned habits. I am thinking for instance of a possible total reworking of flight parameters, since present technology makes it possible to display simplified synthetic presentations of the flight evolution.

As a general rule, the clear shift of justice in accidents inquiries towards "finding the guilty party" will make the position of industrial and regulatory leaders more and more difficult, while there are still some undeveloped areas of safety improvement.

I will bring this speech to a close, although I'm aware I have tackled only a fraction of the issues. It remains for me, to wish you "Bon courage" and good luck, and to thank you for your attention.