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## Editorial



### Trees don't grow to the sky

This expression, used in the financial markets to mean that the rise in share prices will not go on forever, could be applied to many other areas such as:

- in planetary terms, demographic and economic growth;
- with regard to company management, diminishing profits, the learning curve and

technological impact;

- on a level of human performance, the breaking of sporting records;
- in nature, the height of trees, of course, but also radioactive disintegration (we will return to this example as a means for modelling).

These phenomena are all characterised by **strong initial growth followed by slower and more costly development**; this type of evolution is the expression of a well-known process<sup>1</sup> based on:

- the emergence of a limit set by the laws of physics and economics governing the phenomena under study;
- an asymptotic approaching of this limit, taking at each instant the most appropriate measurement of the cost efficiency criterion - easy measures in the early days with difficult and costly carrying over of measurements towards the end).

**Future planning is a difficult and demanding task**, but one that is crucial to decision making: it requires skill, imagination, hard work, honesty, humility and a healthy mistrust of armchair forecasters who, with the supreme confidence born of a single piece of information, are capable of building up an entire vision of the future. During the process of reflection, technological revolutions and empirical behaviour (both unpredictable by nature) must be differentiated from progressive advances (which can be used as models). Thereafter, the first stage consists of a circumstantial analysis of the past by means of adequate sampling of measurements (for the modellable part) and the choice of representative parameters; in a second stage, the model is built up from a representative structure of impacting physical phenomena and an estimation of the numerical coefficients extrapolated from existing data.

In the field of aerospace, such treatment has been applied to many phenomena; in the case of civil aeronautics, which we will examine more closely, these include:

- traffic growth;
- delivery numbers;

- price of kerosene;
- fuel consumption efficiency.

To illustrate this methodology, we will examine the fuel consumption of transport aircraft to determine if, and how, a model can be determined. The first thing to note is that the single major breakthrough in the course of the past 100 years was the jet engine and the subsequent entry into service in 1952 of the Comet, first subsonic jet transport aircraft; our analysis will therefore be limited to this type of aircraft. Considerable improvements have been made to it over time (double flow engines, new materials, digital systems ...) but they formed part of a progression that, whilst comprising major fluctuations, can still be qualified as continuous.

Using the customary way of measuring the efficiency of any mode of transport - unit consumption (expressed in kg/km/seat) - as an indicator, the following evolution can be noted from 1950 to 2000:

- **overall reduction in unit consumption of 80%** (or a factor of 5);
- **annual reduction dropping steadily** from 4% in 1960 to 2.5% in 1980 to 1% in 2000.

**In order to build up a representative model of this trend, we based ourselves on the phenomenon of radioactive disintegration** for which the flow of disintegrated matter at each moment evolves in proportion to the remaining quantity of non disintegrated matter. By transposing this to our analysis, and by applying the laws of rational mechanics, fluid mechanics, thermodynamics and materials resistance, we determined an optimal theoretical level of consumption with a speed of approach proportional to the distance from the limit, digitally matched to past evolutions.

The application of this model to new aircraft, either in service (A380) or under development (Boeing 787 and A350), gives fuel consumption values close to those announced by manufacturers, which would seem to confirm the quality of the model.

**On the other hand, the model forecasts an improvement in unit consumption of only 12% for aircraft to be put into operation in 2020 with respect to 2000 aircraft, very far from the 50% objective fixed in Europe by ACARE** (Advisory Council for Aeronautical Research in Europe). The model is possibly pessimistic, but on the other hand it would seem reasonable to fix ambitious goals; if this is the case, we must be aware that we might get close to them, but possibly not actually achieve them: **one more example of the old saying that trees don't grow to the sky!**

1. Moore's law relative to the doubling every two years of the number of transistors on a chip would at first sight seem to be a counter example; I am no expert in this field but a look at recent developments indicates that the growth rate might be slackening off.

  
**Georges VILLE**

Academy President, Former Deputy Director of  
the Aircraft Division, Aerospatiale

# RISK-TAKING: A HUMAN ACTIVITY THAT MU

## Guy BOY

President of the European Institute of Cognitive  
Engineering and Sciences  
Member of the Air and Space Academy



**Aeronautics research centres and the aviation industry have made steady progress on aircraft reliability, resulting in air transport forging ahead of other modes of transport in terms of safety. Human fallibility, however, still remains the main cause (75%) of aviation accidents and incidents. It is therefore the human-machine duo, and more generally the interactions between humans, machines and the environment, that must be considered.**

Human beings have always sought to extend the resources of their hands and brains by building devices of all kinds, ceaselessly developing, innovating and pushing back limits to improve safety, performance and comfort. In doing so, they were forced to take risks and these risks had to be managed. The purpose of this article is to take a closer look at the question of risk-taking.

### **A conference to start the ball rolling**

For two years, many questions were thrown up in the numerous meetings organised by the Academy's Section 3 to put together the conference structure. These questions were grouped into six major headings (see box below).

The outcome of these reflections was a conference, organised in February 2008 (an account of which is given in Letter No.57). This article attempts to give an overview of the conference and some initial conclusions drawing from the different presentations. By pooling operational and scientific experiences and reflections we attempted to put human beings back at the heart

of the issue of risk-taking. Quite simply because the moment always comes when someone is called on to take a decision and act!

### **No such thing as "zero risk"**

As Bernard Ziegler, former Technical Director at Airbus, confirms, "*routine represents more of a risk than a first test flight*". This was the reasoning behind the development of procedures and automated systems. We have made considerable progress in the area of assisted operations. On the other hand we have also observed that a proliferation of regulations stifles critical spirit, common sense and the possibility to stand back from a situation. Unfortunately, in pursuing the idea of zero fault, syntax has progressively undermined semantics! We have lost sight of the fact that not everything is foreseeable and that managing the

unforeseeable requires talent, skill and humility, not to mention luck, a spirit of adventure and an open mind. It is high time we moved beyond the current quest for "zero risk", which systematically obstructs intuition and creativity. We have developed an aversion to individual risk, playing on false fears whilst at the same time collectively incurring huge risks to our society and environment.

Likewise we only appear to be interested in risk-taking that involves benefit and gain, based on a very cognitive, economic approach. This throws up a fundamental contradiction: by focussing on short term gains, we are setting

**The moment always comes when someone is called on to take a decision and act!**

up long term risks. Our firms are now controlled by Excel spreadsheets displaying short-term requirements and performances whilst neglecting any long-term vision. We are in a world of insurance and materialism in which everything must be regulated, conditioned, standardised ... Despite the sway exerted by the economic and socio-technical system, human beings and their instinct still manage to surface. Some seem surprised to discover that human beings make mistakes, but didn't we discover centuries ago that "*errare humanum est*"? Human beings have changed very little over the centuries, but the repercussions of their acts, whether

### **Topics of the conference**

- Topic 1: Consistency and inconsistency of psychological and legal aspects
- Topic 2: Preparation of high risk operations
- Topic 3: Risk and responsibility
- Topic 4: Individual and collective risk
- Topic 5: Risk and organisation
- Topic 6: Industrial risk-taking

### **Can there be action without risk?**



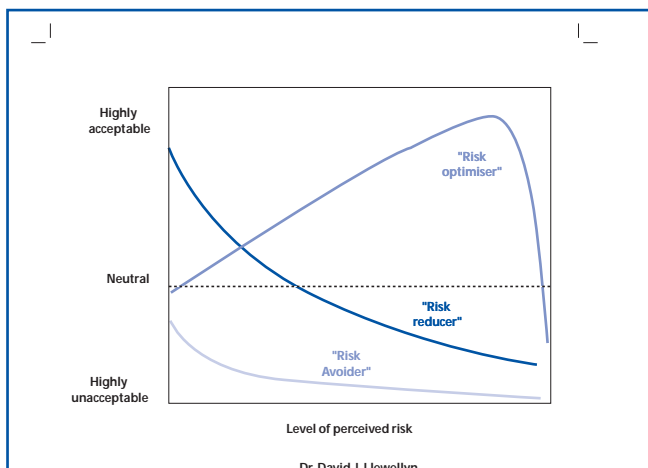


Fig. 2:  
model by Dr  
David  
Lewellyn,  
University of  
Leeds, UK

erroneous or not, have radically changed.

It is important to note that no real progress is possible without accident, error, failure or natural catastrophe. It is crucial to rehabilitate the right to commit errors and to consider error in a more positive light. Xavier Guilhou, of the French Institute for national defence studies (IHEDN), asks whether we are capable of dealing with the famous question: “Houston, we have a problem!” of the Apollo 13 astronauts, a team who did everything in their power to pull through. Following Hurricane Katrina in New Orleans, for instance, those who attempted to resist, who succeeded in turning the situation round, were those who had the moral fibre of the Apollo 13 team.

### Precautionary principle

In practice, the precautionary principle is often interpreted as a principle for inaction. No-one nowadays wishes to assume responsibility, at the risk of being judged... and found guilty! The crucial question is that of how authority is apportioned in Western societies. Taking risks means exercising authority, and that in turn means management and accountability. We are always answerable to another authority. The paradox of current society is that it establishes circular relations of accountability so that no-one considers themselves responsible. States are more and more ineffectual, and a new world order has emerged with new boundaries, new interrelationships, in which we spend our time negotia-

ting. Responsibility is watered down, a tendency only amplified by the media.

The younger (and not so younger) generations must rediscover a taste for action, responsibilities and cooperation, values that are

**Fear of risk strangles our creativity, kills off our projects and jeopardises our successes**

essential to decision-making in any high-risk situation. Obviously the precautionary principle as it is formulated today has to be much more explicit, with clearly laid out rules and conditions for use. **Why not rename it “action principle”?**

### Ignorance, fear, trust and daring

A study of risk-taking cannot neglect the effects on human relationships of new communication and information technologies. With the Internet, anyone can become an editor or an authority. It worries us because it is all happening very quickly, and we tend to forget that it takes a while for new practices to find their own balance. Certainly no man is an island nowadays and obsessive media attention weaves interrelations that range from the highly virtual to the very real: you are the only judge! We are undergoing a real crisis of faith. On top of that the media’s objective is to generate audience, not information.

Television gives the impression that the planet’s fate can be settled in 45 minutes, but bureaucracy slows everything down so that we seem to be walking through treacle, with no landmarks to help us find our way. Every day we spend 4 to 5 hours on average in front of a screen (8 hours in the US). This image-based society reinforces individualism at the expense of the group, when what is needed is to generate feedback from experience, encourage cross fertilisations, learn to be less afraid of transgressing rules and invest in meaning. We are in highly individualistic cultures, but we must be collectively daring.

Our society does not accept that we might be in the realm of ignorance. To paraphrase Xavier Guilhou, we are in the realm of defiance and not of trust. Fear of risk strangles our creativity, kills off our projects and jeopardises our successes and advances. It is high time that we moved on to the realm of daring, by considering the reality of ignorance and the possibility of trust. We often hear the words: “everything is under control; there is no cause for alarm!” But in fact, everything is complex! Responsibility is no longer clearly identified from the start, and even less so when things start turning sour. This dilution of responsibility makes us prey to “last-minuteness”. We must establish responsibility on the basis of experience and expertise, and put questions of leadership, courage and non-conformism back on the agenda. This is not what gets taught in schools.

### Life is an enterprise

As Claude Terrazoni, President of the Toulouse Chamber of Commerce and Industry, reminds us, life is an enterprise in itself, and in any enterprise there is an element of risk. The whole history of our civilisation, the evolution and progress of our world, is based on initiative and risk-taking. Without these, we would still be in the Stone Age. What would have happened if the Wright brothers, Clément Ader, Louis Blériot or Jean Mermoz had not taken risks in



This tiny SIPA two-seater aircraft landed in the countryside during an aerial tour of France in 1953





**Jean-Claude CHAUSSONNET**  
*Secretary General of the Academy,  
former General Manager Airbus France*

The Academy's recent activities have included the international meeting Entretiens de Toulouse (Toulouse encounters, c.f. opposite) and the latest lectures from the "Of Air and Space" lecture cycle organised at the Toulouse Médiathèque: "Automation of air traffic control", by Jacques Villiers, and "Who does the Moon belong to?" by Armel Kerrest. Our thanks are extended to all speakers in this cycle for the very high quality of their lectures which attract a number of regular followers.

## Session 31 March and 1 April

This session, held in Italy, enabled Academy members to:

- meet important figures of the Italian aerospace world;
- be invited to Thales Alenia Space Italia and see the integration room Globalstar;
- be shown round the ESRIN centre of the European Space Agency;
- visit the Avio group's plant, where both Vega and the propulsive units for Ariane V are built.

This meeting, organised by fellow members Marius Le Fèvre and Massimo Rizzo, was a great success.

## Documentation and information centre

The Academy's documentation centre can now be consulted on line, on our website [www.anae.fr](http://www.anae.fr). A number of the Academy's resources (including more than 800 works, magazines, newsletters, and audiovisual documents) are now available for consultation.

*For further information:*  
[patricia.arquellada@anae.fr](mailto:patricia.arquellada@anae.fr)  
05.34.25.03.84

*Opening times:*  
Monday to Friday, by appointment only: 9am-1pm; 2pm-5pm.

## Homage to Jacques PLENIER

*Former President of the Academy*

It is with great sadness that we have just learnt of the passing away of our fellow member Jacques Plenier, former Director of the Aircraft division of Aerospatiale and past President of the Academy. Jacques Plenier devoted a great deal of energy to the Academy in recent years, impressing all who knew him with his openness of spirit, his great simplicity and his charisma, which made him a man appreciated and admired by all.

The Academy will pay a special tribute to Jacques Plenier during one of its forthcoming public sessions.

## LES ENTRETIENS DE TOULOUSE (TOULOUSE ENCOUNTERS)

*April 2008 at ISAE Toulouse SupAéro site*

The Toulouse encounters, organised jointly by the Air and Space Academy and Collège de Polytechnique, attracted 200 participants on 15-16 April 2008 in the Toulouse ISAE SupAéro site. This event, which had been in preparation for more than 2 years, succeeded in its goals, viz:

- to bring together players from all fields of the aerospace sector for active exchanges;
- to facilitate mutual understanding and to spread scientific and technological knowledge to all players;
- to contribute to exchanges between small, medium-sized and large companies, contractors, and research and training centres.

32 encounters, lasting three hours each, tackled technological subjects chosen by the programme committee after consultation with the industrial committee. All participants received a printed booklet containing preparatory documents. The authors were asked to make a special effort to make their documents accessible to all persons in the aerospace world.

Thanks to this preparation, and to the high quality of speakers and moderators, the discussions

were lively and constructive, as witness the very positive feedback we have received.

Participants indicated that they would be interested in a Toulouse Encounters 2009 and suggested matters that might be included. They also put forward ideas on how to improve the event. The organisation committee will reconvene immediately so as to attain these new goals.

All involved were invited to a cocktail by the Toulouse Municipality on the evening of 15 April.

The Toulouse Encounters were a great success and we would like to thank all those who made them possible: participants, speakers and moderators as well as the staff from Collège de Polytechnique and the Air and Space Academy who took care of practical aspects before and during the event. Our thanks also to our partners who helped in raising the profile of the project and to ISAE for making its premises available.

**Jacques BOUTTES**

*President of the Education-Training Commission,  
Air and Space Academy*



## Homage to Dr Jiri BENES, *Honorary member of the Academy*

Dr Jiri Benès passed away in Prague on 3 May last at the age of 87.

After attending the French Lycée in Prague, he went on to study electrical engineering, obtaining his doctorate in Prague in 1950.

He kept up a regular contact with France, particularly with the Henri Poincaré Institute.

His career was oriented towards computer studies and automation. I made his acquaintance at the

creation of IFAC (International Federation of Automatic Control), which he presided between 1969 and 1972 before going on to play an advisory role in which he remained very active in the area of automated control. Very fond of France, he made frequent visits and even published in French on occasion.

Let us pay homage to Jiri Benès, Emeritus member of our Academy.

**Marc PÉLEGRIN**, *Emeritus member of the Academy*

## 23<sup>rd</sup> forum: VISION, A VIEW OF THE SPIRIT

Tuesday 21 October 2008, at the DGAC, Paris

## programme

Most of the information necessary for pilots, astronauts or air traffic controllers to carry out their tasks passes through the eye before being processed by the brain.

Recent progress in medicine has shed light on the mechanisms of vision and provided humans with the means to maintain and improve it. This will be the theme of this forum organised by the Academy with the support of the DGAC and the patronage of the Académie nationale de Médecine.



*"The eye, which is the window of the soul, is the chief organ whereby the understanding can have the most complete and magnificent view of the infinite works of nature."*

Leonardo da Vinci

- 8.30 Registration
- 9.00 Opening speech by Mr Patrick Gandil, General Director for Civil Aviation
- 9.15 Presentation

### 1- VISION IN THE LIGHT OF RECENT DISCOVERIES

- 9.30 Prof. Christian Corbé, Director of the Institut national des Invalides, member of the Academy, Ophthalmological Expert for the Conseil médical de l'Aviation civile

### 2- VISION OF COLOURS

- 10.00 Prof. Philippe Lanthony, Director of the Laboratory for colour vision, Hôpital des Quinze-Vingts
- 10.30 Mr Alain Léger, Thales
- 11.00 Coffee break

### 3- HYGIENE

- 11.15 Prof. Michel Maille, Professor at Val de Grâce, Head of Ophthalmology, Hôpital d'instruction des armées Percy and Centre principal d'expertises médicales du personnel navigant

### 4- IMPORTANCE OF VISION FOR PILOTS, Evolution of medical standards with European regulations

- 11.45 Dr René Germa, Director of Medical Bureau of the Control and Safety Directorate DGAC

### 5- DEROGATIONS POLICY

- 12.15 Prof. Michel Cupa, President of the Conseil médical de l'Aviation civile
- 12.45 Lunch

### 6- IMPROVING VISION

- 14.15 Glasses: Ms Pascale Godin, Head of Technical Support ESSILOR
- 14.45 Contact lenses: Dr Catherine Peyre, Head of Department, Hospital of Nanterre
- 15.15 Surgery: Dr Jean Jacques Saragoussi, President of the Société de l'Association française d'implantologie intra-oculaire et de chirurgie réfractive (SAFIR)

### 7- EVOLUTION OF VISION WITH AGE

- 15.45 Dr Martine Crochet, ophthalmologist, President of the Société d'exploration visuelle et d'electrophysiologie (SEVE)

To register or for more information:

[www.anae.fr](http://www.anae.fr) - 05 34 25 03 80 - [anae@anae.fr](mailto:anae@anae.fr)

## In Toulouse

Lecture cycle "d'Air et d'Espace" at the Toulouse Médiathèque J. Cabanis : 6 p.m.

All lectures are given in French

Tuesday 24 June

**Is General Aviation at risk?**

Claude Lelaie, test pilot, Airbus

Tuesday 30 September

**Scientific aspects of the Galileo programme**

Felix Perosanz, CNES, GRGS

Tuesday 28 October

**Medical check ups of pilots**

Dr Jean-Georges Mouchard, correspondent of the Academy, Director of the Toulouse CEMPN

Tuesday 25 November

**Flight testing of the A380**

Jacques Rosay, Head Flight test Pilot, Airbus

For more information: [www.anae.fr](http://www.anae.fr)

## In Paris

Afternoon of lectures on the theme of:

**Evolution of air transport; latest issues**

Palais de la Découverte, Thursday 19 June 2008

14.00-18.00

In French

Programme:

- **Flight testing of the A380**, Jacques Rosay, Head Flight test Pilot, Airbus
- **How will we fly tomorrow?** Philippe Jarry, Senior Vice-President Aircraft Strategy, Airbus
- **Air transport and the energy challenge**, Georges Ville, former Deputy Director Aircraft division Aerospatiale, President of the Academy

Booking is obligatory for this event

email: [aerien@palais-decouverte.fr](mailto:aerien@palais-decouverte.fr)

fax: 01 40 74 86 00

For more information: [www.palais-decouverte.fr](http://www.palais-decouverte.fr)

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- No.53 *Airbus: the Future*, August 2007

The full list of previous issues and other publications can be found on our website: [www.anae.fr](http://www.anae.fr)

## ERRATUM

In Letter number 57 an error found its way into the first paragraph of the editorial; there were of course 2,761 orders of airliners in 2007, and not 27,612 as indicated! We would like to apologise for this typing error.