INTRODUCTION TO AIRCRAFT ENGINE STRUCTURAL DESIGN

E. SEINTURIER
Turbomeca - France

1. introduction

Environmental considerations and oil prices are raising significant challenges to aircraft engine manufacturers. The constant improvement of engine performance since decades must be accelerated by exploring new architectures and new technologies.

Figure 1 shows the evolution of fuel burn (liter/km/passenger) from 1955 to 2015 on large commercial aircrafts. Most of the reduction is due to engine improvements, mainly based on the bypass ratio increase. It can be seen that an asymptote is currently reached and that only cutting edge technologies will allow significant improvements.

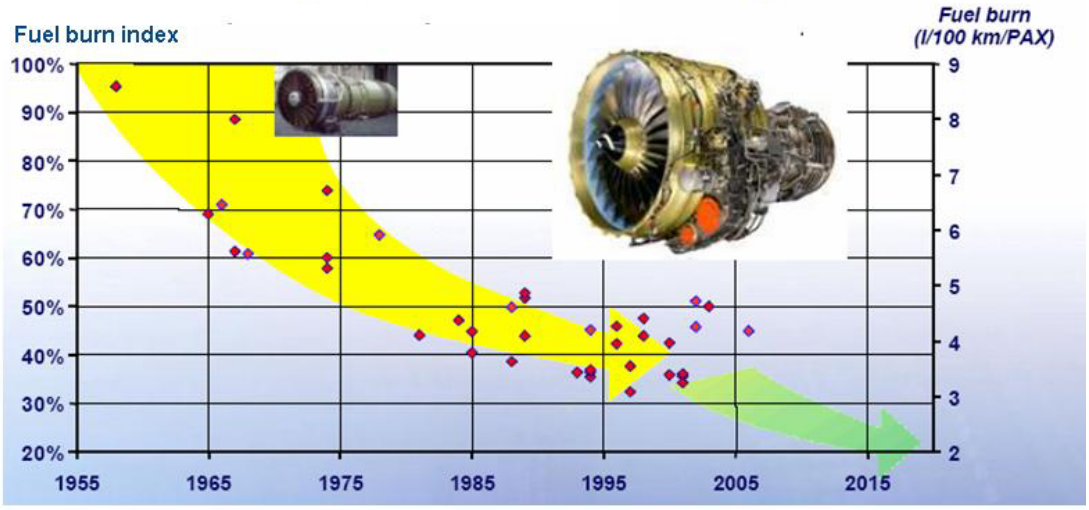

Figure 1 - Fuel consumption evolution

As an illustration, Figure 2 shows the evolution of thrust to mass ratio for military engine, which is a pertinent indicator of the performance for such applications. This ratio has been multiplied by 3 in 50 years to reach currently ratio higher than 10. These progresses are achieved thanks to significant improvements in the efficiency of thermodynamic cycles, implying a turbine inlet temperature increase as shown on Figure 3.

Many solutions are explored, from the preliminary design to technology demonstrations. But to make these solutions credible for the future, stress engineers must demonstrate it will be possible to meet the certification requirements. Indeed, whatever the performance evolution is, air transport never makes compromise on security and safety aspects.

It is also important to note that it is crucial for the operators to have highly reliable engines. Globally a 40% spacing of the shop visit has been achieved since 10 years thanks to a better understanding of the ageing process and optimised on condition maintenance.

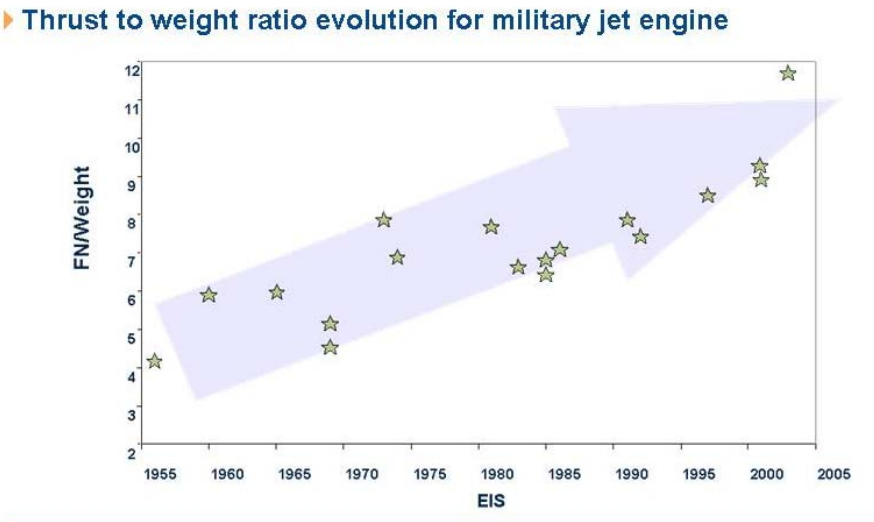

Figure 2 -Military jet engine performance evolution

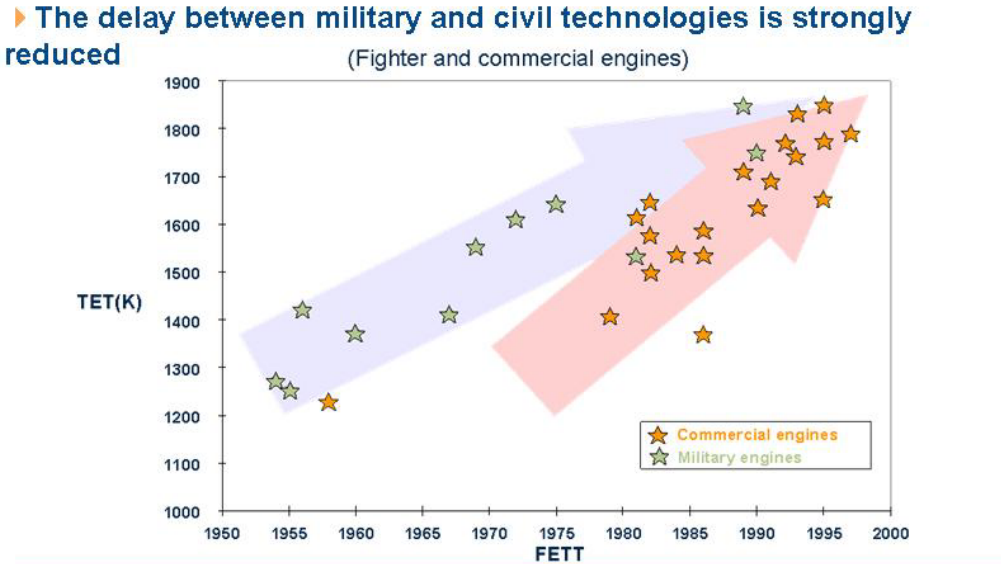

Figure 3 - Turbine inlet temperature evolution

As a consequence, the exciting challenge of aero engine structural design is to find the best compromise to allow major performance improvements (higher temperature, higher loads, and lower masses) while:

- guarantying a high level of reliability
- assuring the safety of the new designs for the security of air transport
- prospecting new architecture and new components technologies
- in a highly constrained development time (to reduce the lead time to market)

The objective of this introduction lecture is to give a global overview and to introduce each speaker of this lecture series within the structural design field all along the development process.