THE ERICA TILTROTOR CONCEPT

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1 INTRODUCTION

The European advanced tiltrotor configuration ERICA will be presented in details describing the driving requirements that inspired the design, goals and the subsequent issues raised by this project that is a relevant step forward in the V/STOL aircraft landscape. Performance, vehicle general architecture and sizing, rotor aerodynamic and dynamic design, aircraft structural dynamics and flight control system will be presented together with a review of the Critical Technology Programs established by the major European Industries under the aegis of European Community [EU] to minimise the risks associated to the development of this challenging aircraft.

2 TILTROTORS ISSUES

The tiltrotor must use the same propulsive system (rotor) both in hover and in forward flight; but the required thrust is completely different in the two regimes (equal to half the weight in hover and half the aircraft drag in forward flight with a ratio of, more or less, 10 / 1). For this reason the rotor optimisation task, for this class of machine, is a very demanding job and despite of aerodynamic and architectural choices (high twist, variable RPM) the disk loading still remains too different in the two regimes to allow to reach optimal performance both in hover and in cruise and eventually this would lead to a low-speed performance worse than helicopters (consider for instance the wing download caused by the rotor wake in H/C).

At low speed the combination of the low forward velocity with the rotor strong flow imposes high negative angle of attack to this aerodynamic surface forcing it to stall with the consequent high drag, buffeting, oscillatory loads, loss of control, high pilot workload, noise and worsening of comfort for passenger. The wing stall affects the width of the conversion corridor too and limits the flight path management during climb and transition. The autorotation in helicopter mode is another outstanding condition: because of the high rates of descent and the relatively low induced velocity on the rotor disc, great positive angles of attack are generated on the wing (i.e. high lift); this reduces the thrust required by the rotors to balance the vehicle and makes problematic to reach a stable autorotative condition. Furthermore, the conversion from aircraft to helicopter mode in power-off condition could result very difficult to manage without compromising the autorotation status of the rotors (RPM droop).
3 THE ERICA CONCEPT

The tiltrotor technology, at least as today conceived, represent a compromise to merge the hover and near to hover flight capacities of the helicopters and the characteristics of speed, comfort and range of the present turboprop in cruise, and like always happen for compromises, its performance are far from the ones attainable by an helicopter or an aeroplane in the same class of weight.

Nevertheless, considering the present rate of growth of the transportation demand, it is a mean to improve the efficiency of actual airport areas thanks to its ability to use confined and narrow areas, flying simultaneous non interfering procedures with conventional aeroplanes and, practically, distinguishing the local traffic from the long range one.

![Artist impression of the ERICA concept](image)

**Figure 1: Artist impression of the ERICA concept**

In the framework of the EU technical committee, a draft specification for an advanced tiltrotor of 10 tons, able to range 600 NM was issued, the ERICA (ENHANCED ROTORCRAFT INNOVATIVE CONCEPT AGUSTA) concept was proposed by Agusta and selected by all the other European helicopter Industries to meet the EU requirement.

It will, so, represent the base for a number of research projects devoted to the comprehension of this advanced tiltrotor basic phenomena (Aerodynamics, Dynamics and Noise) and to the development of the technologies necessary to design and to manufacture a flying demonstrator in the next years.

The advanced features of ERICA are:

- Small rotor diameter (performance in cruise, delay of instability problems, weight reduction, safety: landing in aircraft mode is possible)
- Tiltable wing (performance, efficiency, handling qualities)
- Structural continuity of tilting mechanisms (safety, system simplification, weight reduction)

Thanks to these new features this aircraft becomes a competitive aircraft in the new scenario of the future ATM, as it is evident from the following figure in which the flight envelope of the helicopters and of the present T/R are compared with the ERICA one.