DREAM – PROJECT DESCRIPTION

The project will integrate and validate engine technologies, components and structures in an engine architecture aimed at minimising the operating costs of propulsion systems in a new carbon trading world. Where applicable, these technologies will be developed through to component and system level and verified by the use of rig component and/or system demonstrators. This study will include, where necessary, the latest advances in whole engine integration, validation and modelling.

The project technology themes includes advanced technologies mainly devoted to fuel consumption / CO_2 reduction (through propulsive efficiency, weight and alternative fuels), pollution reduction, with noise level acceptability. The considered technologies are listed below. Is to be noted that the final selection will be adjusted according the available budget:

. **Test of alternative fuels like synthetic kerosene from Fischer-Tropsch process or other giving fuels with thermo-chemical characteristics acceptable for aeronautics:**

The test is foreseen on an helicopter turboshaft engine.

Objective: expensive oil world, carbon trading world, pollution reduction (combustor emission)

. Control technologies, passive and active for aerodynamics and vibrations

Nowadays control technologies can be considered to improve the engine thermal efficiencies. Best candidates seems to be:

Aspiration / blowing combined effects on blade profiles, ducts, etc…in the all the turbomachinery modules (fan, turbine, …)

Minimization and control of leakages and clearance effects

Cooling modulation

Adaptive LP turbine

Objective: fuel burn reduction through efficiencies, operability

On the structural side there exist also promising technologies such as active damping of blades or integrated blade/disks (blisks) or blade/rings (blings):

friction devices

hybrid elastomer / metal devices

active piezo-electric devices

Objective: weight reduction (reduces fuel burn), operability, safety, reliability

. Contra-rotary open rotors with variable pitch (i.e. contra propfans)

This architecture is known to provide 10 to 15% fuel burn reduction but to have acoustics levels higher than those of the high by-pass turbofans. Since earlier 1990's important progress in aero-acoustic modelling and design allow to reconsider the question for the short / medium haul aircraft. A preliminary list of technologies and actions could be:

Aero-acoustic design and optimisation, particularly on blade tip new concepts

Less complex variable pitch system adapted to the selected architecture (contra-rotary power turbine or gear system)
Mechanical optimisation of the contra-rotary power turbine
Models aero-acoustic tests in wind tunnel

Objective: fuel burn and weight reduction with acceptable cost and acceptable noise (better than ICAO Stage 4 is aimed)

. Others novel turbomachinery

Improvements on weight and aero efficiency can be obtained by taking in account complex aerodynamic effects in the design like unsteady effects, by combining composite / metallic materials and by considering new compressor architectures. The consider technologies is summarized below:

unsteady optimised LP turbomachinery (compressor and turbine)
low weight LP compression with mixed use of OMC composite / light weight metals
low weight LP turbine mechanical designs for any engine architecture
compact compressors using mixed flow / centrifugal concepts

Objective: fuel burn (through weight and efficiencies)

. Innovative and integrated engine structures with added functionality

These chapter is aimed to strongly integrate the engine structures and some devices needed by the new engine concept or needed to provide new functionalities. The considered technologies are:

Ultra-light weight fan frame concept
Structures including Integrated intercooler
Efficient “wall heat exchanger” for thermal management of high power electrical systems demanded by the “more electrical aircrafts”
Integration of new functions (aerodynamics, noise absorption, power generation & transmission, embedded sensors, thermal management in engine & aircraft,…)

. Whole engine architecture

Integration of the above technologies that show benefit within a complete new novel engine architecture. This will form a major aspect of the project, with virtual models and rig demonstrators and will ensure that the final paper engine design is optimised with the novel technologies.