Innovation Takes Off

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Clean Sky 2

Clean Sky 2
Information Day dedicated to the
4th Call for Proposal (CfP04)

ENGINE ITD

François Mirville : SAFRAN/Snecma
Kevin Phuah : Rolls-Royce
Peter Taferner : MTU Aero Engines

Brussels, 22 June 2016

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Clean Sky 2

From Clean Sky towards Clean Sky 2

- Clean Sky, through SAGE (Sustainable And Green Engines), is delivering significant step changes in key engine technologies along the following themes:
  - Open Rotor, Composites, Lean Burn combustors, high power gearboxes, enhanced turbines and compressors, advanced materials and improved structures
- *Clean Sky 2 is about providing and demonstrating new engine technology for the whole of the civil market*
- *The Clean Sky 2 engines ITD will build on Clean Sky and demonstrate technology at a whole engine level*

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Overview of the ITD/IADP

High-Level Objectives

- Environmental objectives for the engines ITD are to demonstrate at TRL6 the following:
  - *20-30% reduction in CO_2**
  - *Significant contribution to ACARE 2020 NO_x reduction target (-80%*)*
  - *Upto -11EPNdB per operation reduction in noise**

relative to year 2000 baseline

- Industrial objectives are to ensure future competitiveness of European Aero Engine industry, securing trade, employment and high technology knowledge and skills

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SPD Work Breakdown Structure

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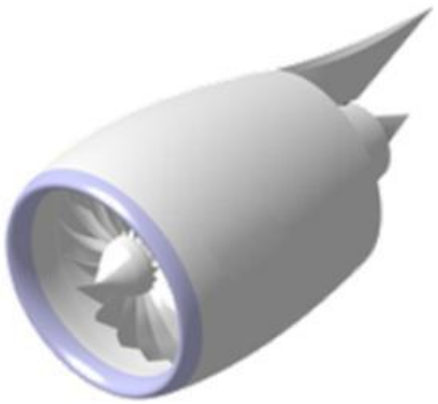
CfP#4 – Topics from Safran Aircraft Engines and its Core Partners

WP2 Safran Aircraft Engines *Clean Sky 2* activities: Ultra High Propulsive Efficiency for SMR aircraft



UHBR turbofan for SMR aircraft

Main Technology Objectives

- from design to ground test of an engine demo to validate LP modules & nacelle technologies

Key Technologies

- Low pressure ratio fan / variable area fan nozzle
- Low weight / low drag fixed or rotating structures and nacelle.
- High power gear box
- High efficiency LP turbine & LP compressor
- Engine / aircraft specific integration

Potential Partner participation:

- Fixed structures in propulsive system, low pressure turbine components, controls and systems components, shafts, bearings

SAFRAN

CfP#4 – Topics from Safran Helicopter Engines and its Core Partners

- Main Technology Objectives
  - From design to ground test of a new turboprop engine demo for business aviation and short range regional.
  - Improvement of advanced core engine ARDIDEN3

From ARDIDEN 3 existing turboshaft engine to full Integrated Turboprop System

- Key Technologies
  - HP core small size
  - Advanced propeller / air inlet / gear box
  - Controls, lub & actuation systems

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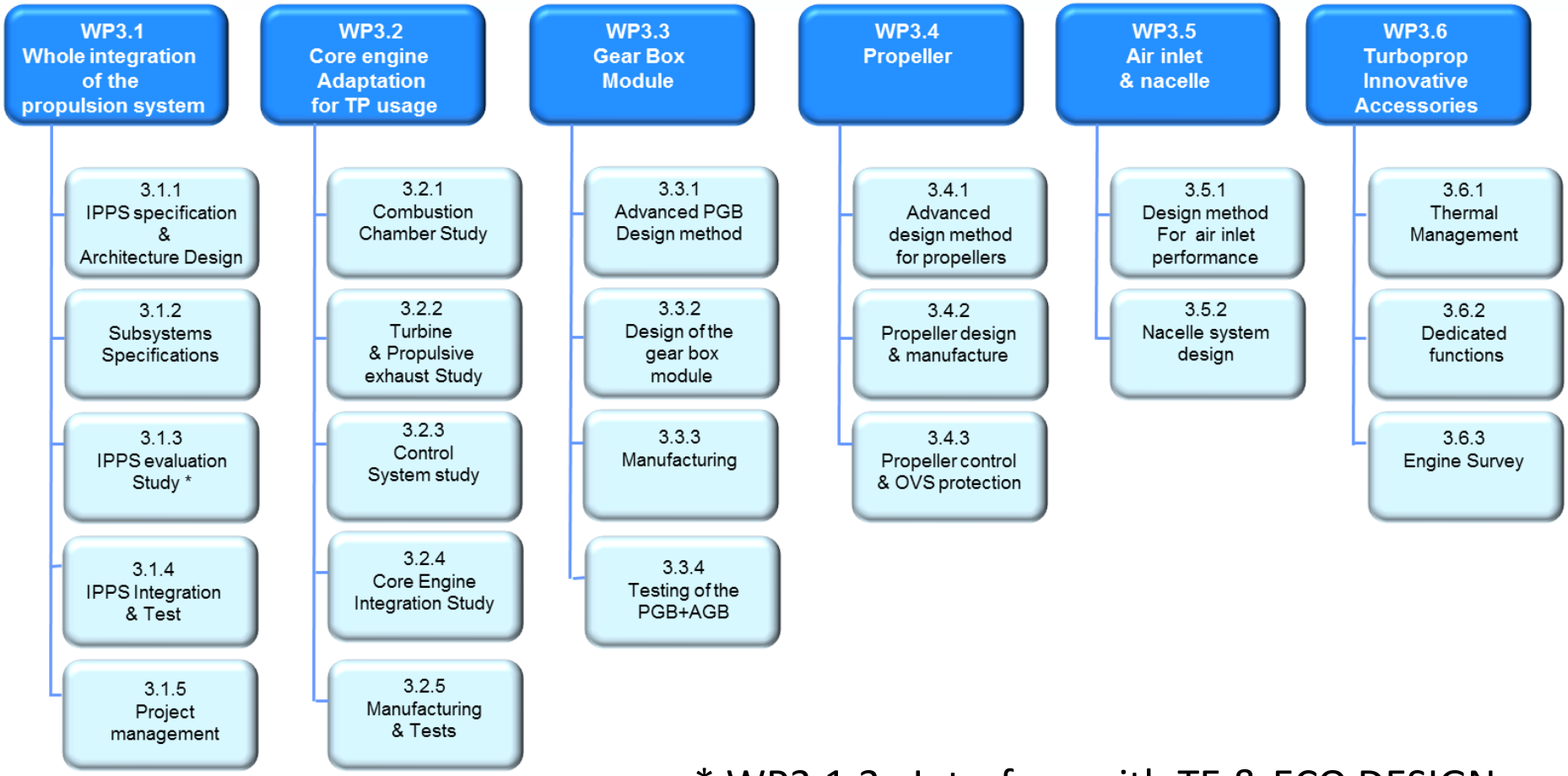
WP3 – Work Breakdown Structure



- * WP3.1.3 : Interface with TE & ECO DESIGN
- WP3.3 & WP3.4 open to core partner
- WP3.6 open to partners

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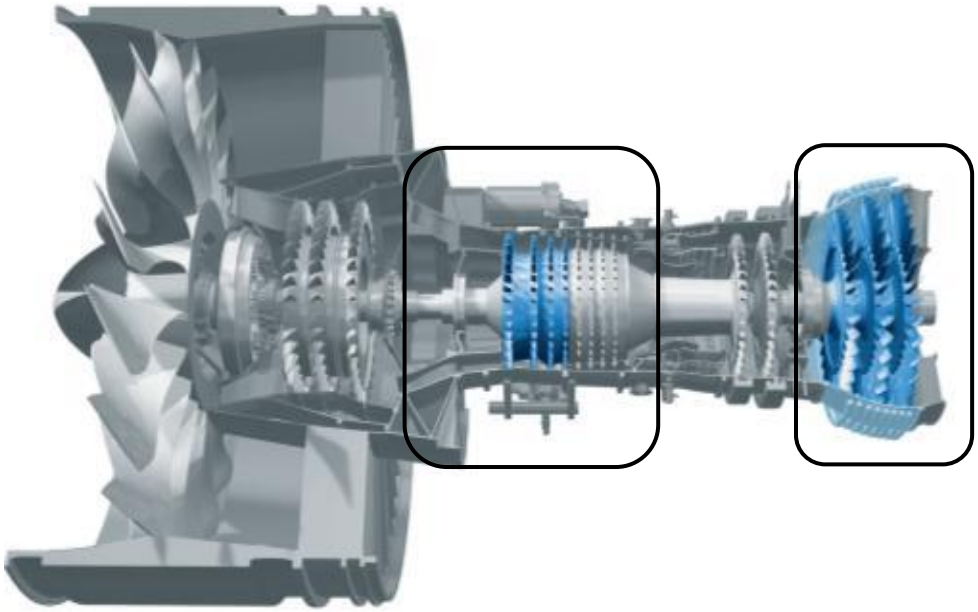
Overview of the ITD/IADP

WP4 MTU *Clean Sky 2* activities:

Advanced Geared Engine Configurations



Main Technology Objectives

- Rig and Engine Testing and Validation of Compressor and Turbine Technology to further reduce Emissions

Key Technologies

- Aerodynamic Integration
- Material Technologies
- Manufacturing Technologies

Timeframe: 2015 - 2021

MTU Aero Engines

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Overview of the ITD/IADP

Rolls-Royce *Clean Sky 2* activities are split into two work packages:

WP5: underlying technologies for VHBR engines with focus on the "Middle-of-Market" short range aircraft

WP6: VHBR technologies for the long range airliner market with Engine Demonstrator

Composites

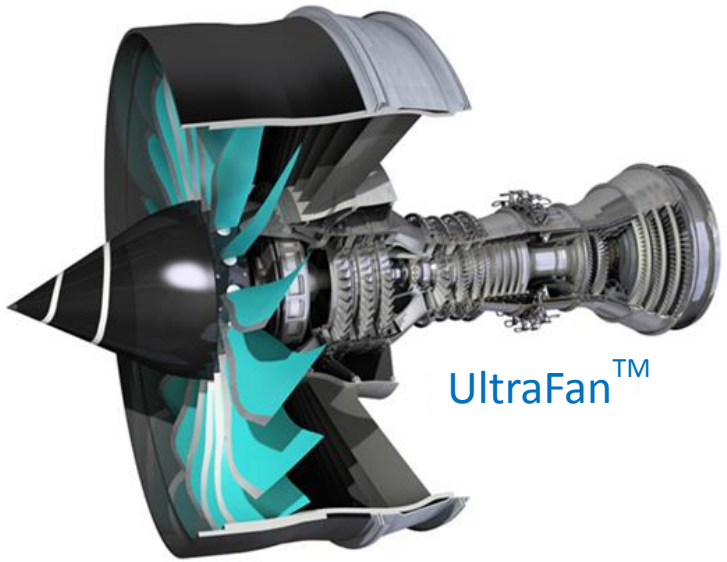
Integration

Turbines

Transmissions

Externals & Structures

Control & Power Systems

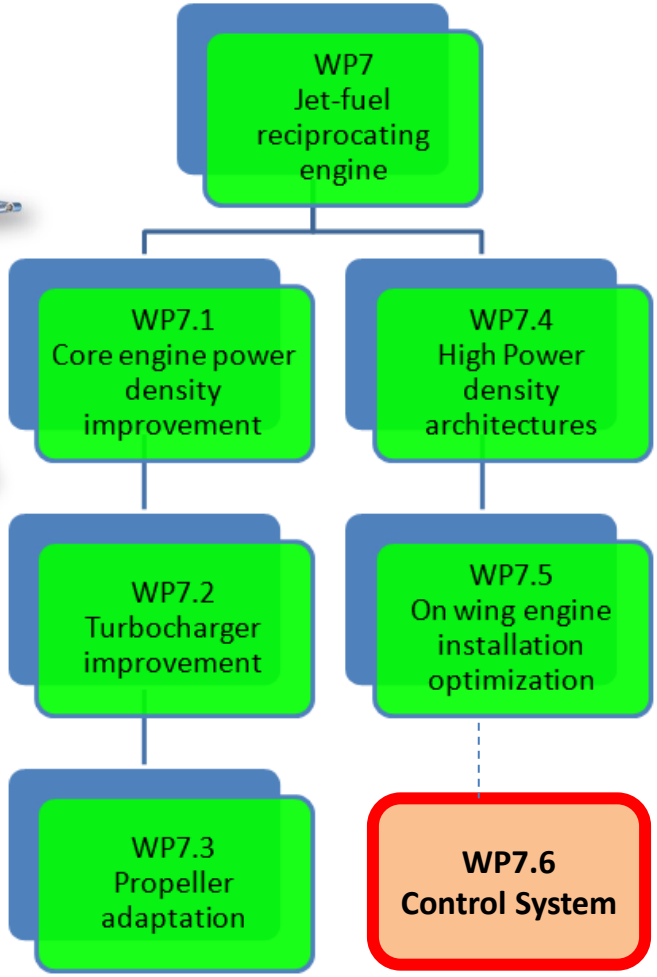


UltraFan™

Rolls-Royce

WP7 CfP#04: Engine Control System

WP7 Light weight & Efficient Jet-fuel reciprocating engine



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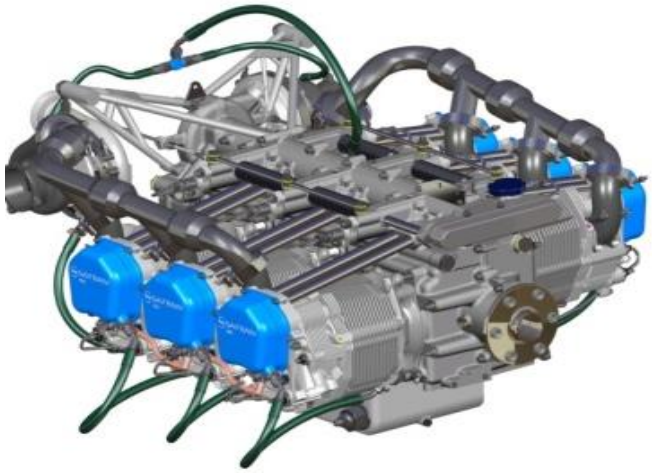

The ECS WP is the last topic to be launched for the SR460.

SAFRAN
SMA

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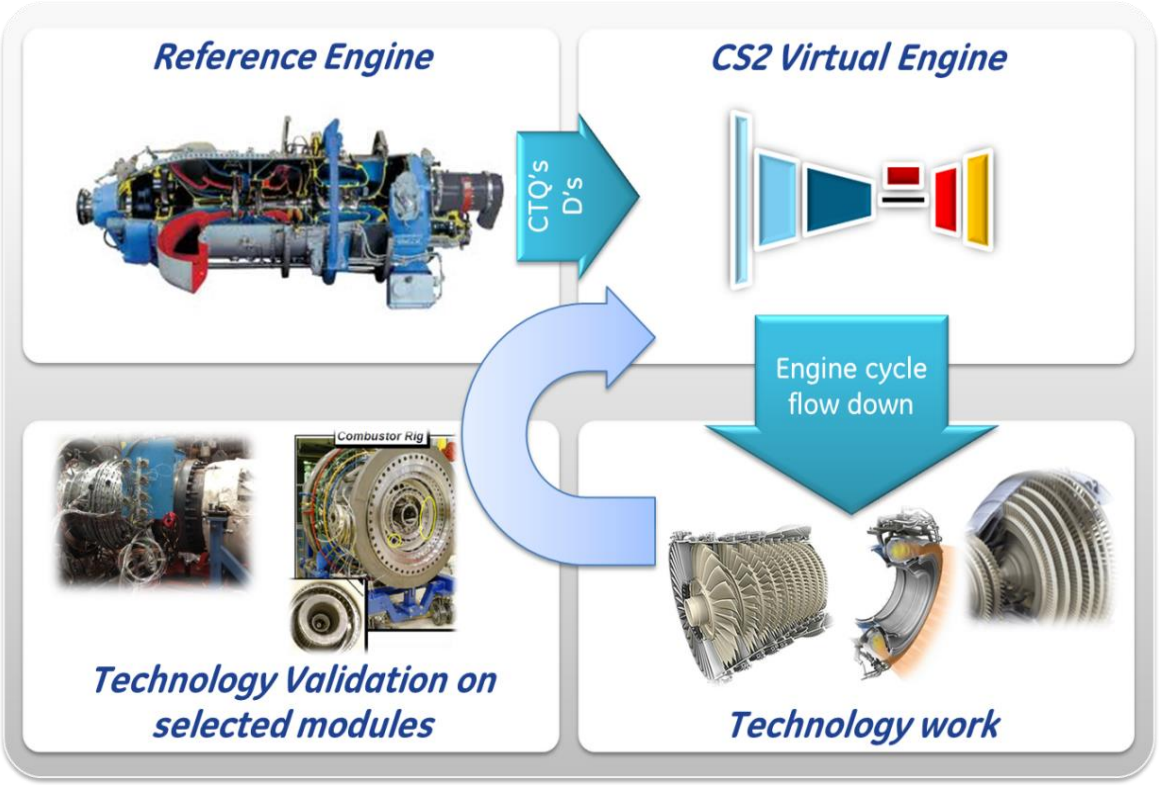
Overview of the ITD/IADP

WP8 – Piaggio Aero/ Avio Aero Clean Sky 2 activities

Reliable and more efficient small Gas Turbine engine for SAT market



Main Technology Objectives

- Virtual Engine Integration
- Component Maturation
- Component Validation

Key Technologies

- Material Technologies
- Manufacturing Technologies
- Compressor
- Combustor
- Turbine

Timeframe: 2015 - 2019

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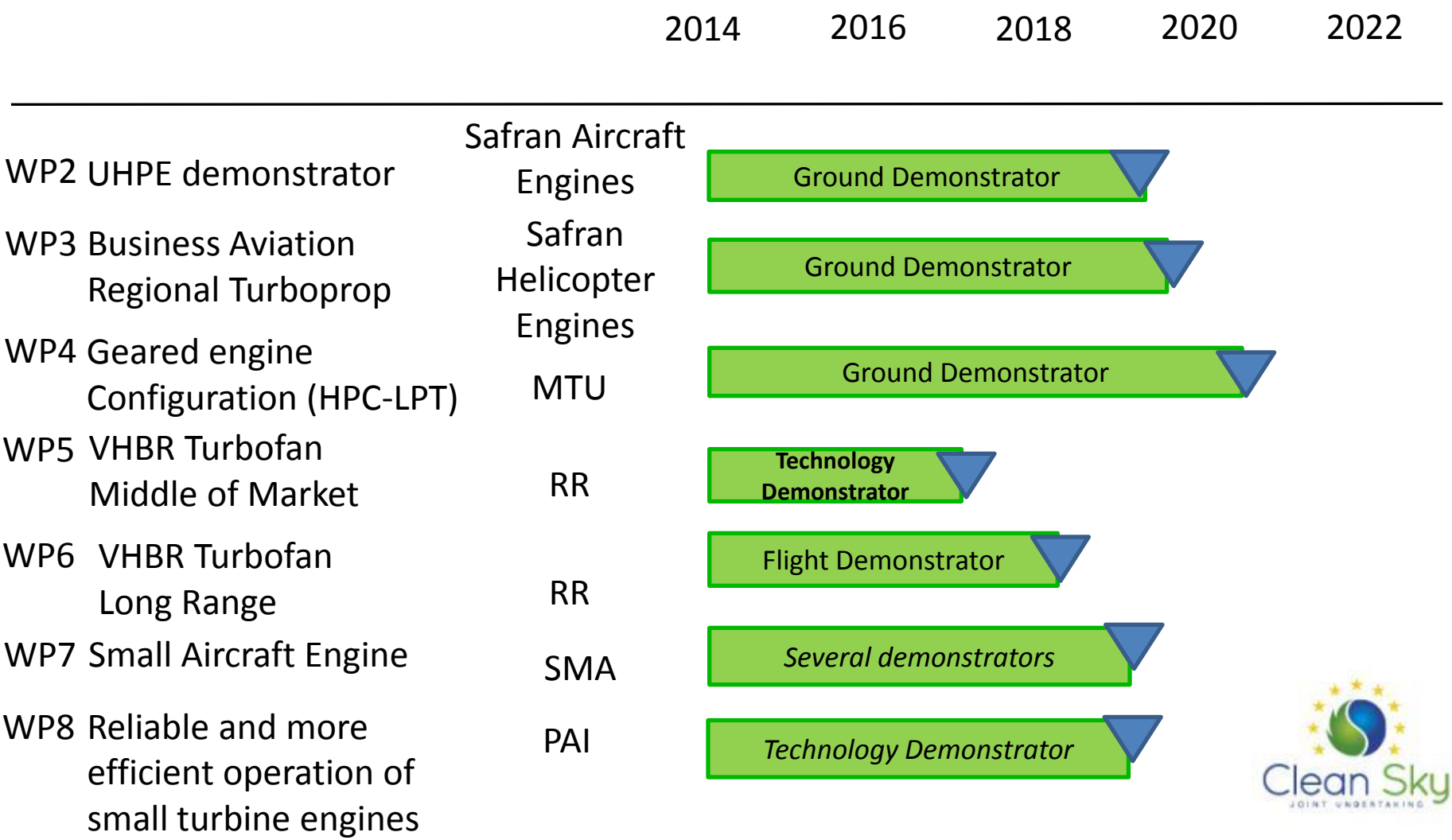
Overview of the ITD/IADP

Engine ITD timelines



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Overview of SPD topics

Identification Code	Title	Type of Action	Value (Funding in M€)	Topic Leader
JTI-CS2-2016-CFP04-ENG-01-10	High speed turbine performance improvement through cascade tests	RIA	1,500	Safran Aircraft Engines
JTI-CS2-2016-CFP04-ENG-01-11	2 VBV actuators (LHS & RHS) for Ground Test Demo 2 VSV booster actuators (LHS & RHS) for Ground Test Demo	IA	1,800	Safran Aircraft Engines
JTI-CS2-2016-CFP04-ENG-01-12	Development of the investment casting process and weldability for high temperature capable superalloys	IA	0,700	GKN
JTI-CS2-2016-CFP04-ENG-01-13	High load gear and bearings materials	IA	0,450	AA
JTI-CS2-2016-CFP04-ENG-01-14	Experimental & Numerical analysis dedicated to FOD Management for Turboprop Air intake	RIA	0,950	Safran Helicopter Engines
JTI-CS2-2016-CFP04-ENG-02-05	Substitution of Chromium(VI)-based substances for corrosion protection of Aluminum-and Magnesium alloys	RIA	1,000	MTU
JTI-CS2-2016-CFP04-ENG-03-13	Small-Scale Spin Test for Hoop-Burst Overspeed Assessment	RIA	0,663	RR
JTI-CS2-2016-CFP04-ENG-03-14	Fuel injector coking	IA	1,000	RR
JTI-CS2-2016-CFP04-ENG-04-06	Engine Control System	IA	0,500	Safran SMA
JTI-CS2-2016-CFP04-ENG			**8,563**	

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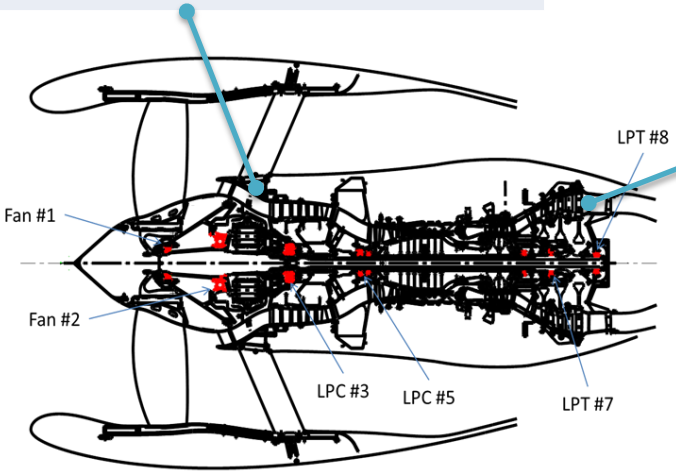
CS2- CPW02- ITD ENGINE TOPICS

- 9 topics :
  - WP2 (Safran Aircraft Engines & its Core Partners) : 4 topics
  - WP3 (Safran Helicopter Engines) : 1 topics
  - WP4 (MTU) : 1 topic
  - WP5 & 6 (Rolls Royce and its Core Partners) : 2 topics
  - WP7 (Safran SMA) : 1 topic

CfP#4 – Topics from SAFRAN Snecma and its Core Partners

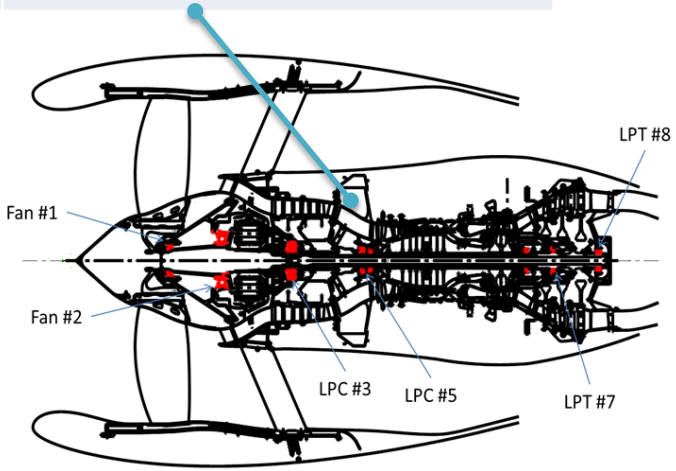
2 VBV actuators (LHS & RHS) for Ground Test Demo 2 VSV booster actuators (LHS & RHS) for Ground Test Demo	
Funding:	1,8M€
Objectives:	Supply two variable bleed valve actuators and two variable stator vanes actuators for UHPE Ground Test Demo including current definition products and specific products that will be necessary due to the characteristics of UHPE Ground Test Demo. Innovative design is required in order to meet demo specification and to provide significant weight savings and room benefit versus existing standards

High speed turbine performance improvement through cascade tests	
Funding:	1,5M€
Objectives:	Cascade tests for subsonic and transonic airfoil profiles consistent with high-speed LP turbine design. The aim of the tests is to validate and improve performance of turbine blades by testing various configurations. 'State of the art' instrumentations & facilities are required to capture unsteady phenomena that were not taken into account in the past



CfP#4 – Topics from SAFRAN Snecma and its Core Partners – Cont'd

Development of the investment casting process and weldability for high temperature capable superalloys	
Funding:	700k€
Objectives:	Develop the investment casting process and weldability for high temperature superalloys for example by tailoring the casting solidification structure, adapting the thermal processing or by minor alloy chemistry adjustments, in order to improve weldability of a number of commercially available alloys



High load gear and bearings materials	
Funding:	450k€
Objectives:	• Down-selection of candidate materials and surface treatments for high power density gearboxes. • Procurement of bearing and gear test articles. • Perform testing activities on bearings also in contaminated conditions, and on gears through high load and high temperature testing, reproducing conditions similar to the ones of next generation very high bypass engines.

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Experimental & Numerical analysis dedicated to FOD Management for Turboprop Air intake

Identification	Title
JTI-CS2_2015-CFP03-ENG-TM-4	Experimental & Numerical analysis dedicated to FOD Management for Turboprop Air intake

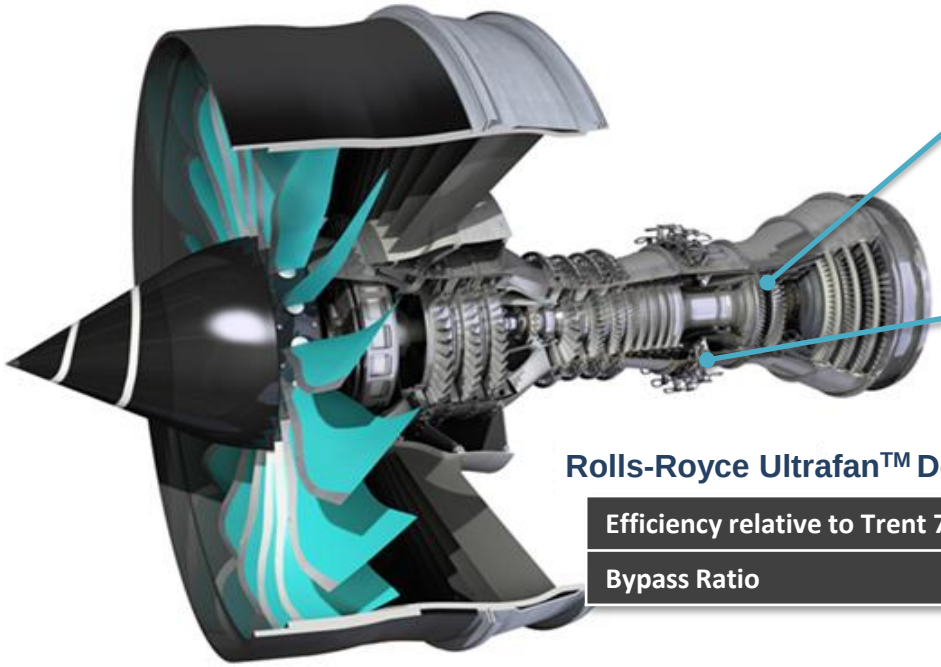
Short description

The purpose of the study is to verify the efficiency of the Inlet Particle Separator (IPS) of the Turboprop air intake. Numerical & experimental investigations will be conducted to assess the air intake and IPS geometry for FOD management (water, sand).

Type of action (RIA or IA)	RIA		
Programme Area	ENG		
Joint Technical Programme (JTP) Ref.	JTP version 4, Chapter 10		
Indicative Funding Topic Value (in k€)	950 k€		
Duration of the action (in Months)	48 months	**Start Date***	Q4/2017

CfP #4 – Topics from Rolls-Royce and its Core Partners

Nickel disc over-speed capability testing	
Funding:	€650K
Objectives:	The aim of the project is to develop capability and understanding of the overspeed performance of a new nickel disc alloy, RR1073. This would consist of 3 main work-streams: 1.Design of a small spin test for hoop burst overspeed testing, 2.Manufacture and test of 6 small spin tests and 3.Analysis of rig tests and development of the overspeed correlation.



Rolls-Royce Ultrafan™ Demonstrator

Efficiency relative to Trent 700	25%+
Bypass Ratio	15+

Fuel Injector Coking	
Funding:	€900K
Objectives:	The programme aims to characterise the fuel injector coking phenomenon in a representative environment experimentally and numerically. Both stagnant and flowing fuel flow conditions will be investigated. The research is meant to de-risk the lean burn programme, but results will be exploited by rich burn as well.

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MTU CfP#4 – Substitution Cr 6

Substitution of Chromium(VI)-based substances for corrosion protection of Aluminum- and Magnesium alloys

Substances based on Chromium(VI) are used for passivation / chromating of aluminium and magnesium alloys as a corrosion protection of the surface.

These substances (chromium trioxide and dichromates) are subject to the REACH regulation and use will be forbidden from September 2017 on.

The goal is to develop suitable substitutes.

MTU CfP#4 – Substitution Cr 6

Substitution of Chromium(VI)-based substances for corrosion protection of Aluminum- and Magnesium alloys

Type of action:	RIA
Programme Aerea:	ENG
JTP Ref.:	WP4 Geared Engine Configuration
Ref. No.:	JTI-CS2-2016-CFP04-ENG-02-05
Indicative Funding Topic Value:	900 k€
Duration:	18 month
Start Date:	Q2 - 2017

CfP #4 – Topics from Safran SMA

Type of action (RIA or IA)	IA		
Programme Area	ENG – WP7.6 [Light weight and efficient Jet-fuel reciprocating engine]		
Joint Technical Programme (JTP) Ref.	JTP V5		
Indicative Funding Topic Value (in k€)	500 k€	**Type of agreement**	Implementation Agreement
Duration of the action (in Months)	18 months	**Indicative Start Date**[53]	Q2 2017

Identification	Title
JTI-CS2-2016-CFP04-ENG-04-06	**Engine Control System**
Short description (3 lines)	
Design and manufacture an engine control system prototype to mainly drive a mechanical injection system.	

Questions ?

Any questions on the Call and topics can be addressed to the following mailbox:

Info-Call-CFP-2016-01@Cleansky.eu

Deadline to submit your questions:

15th April 2016, 17:00 (local time)

Thank You

AIRBUS

AIRBUS HELICOPTERS

FINMECCANICA HELICOPTER DIVISION

FINMECCANICA AIRCRAFT DIVISION

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