Clean Sky 2
Information Day dedicated to the 10th Call for Proposal (CfP10)

AIFRAME ITD

Topics related to AIR WP B.4-2 – Next Generation Civil TiltRotor Project

Leonardo Helicopters

Innovation Takes Off

www.cleansky.eu

Clean Sky 2

FRC Overview
Filling the Mobility Gap

MISSIONS

EMS, SAR,
Coast guard
Disaster relief
Oil & Gas offshore

Corporate Transport
Air Taxi

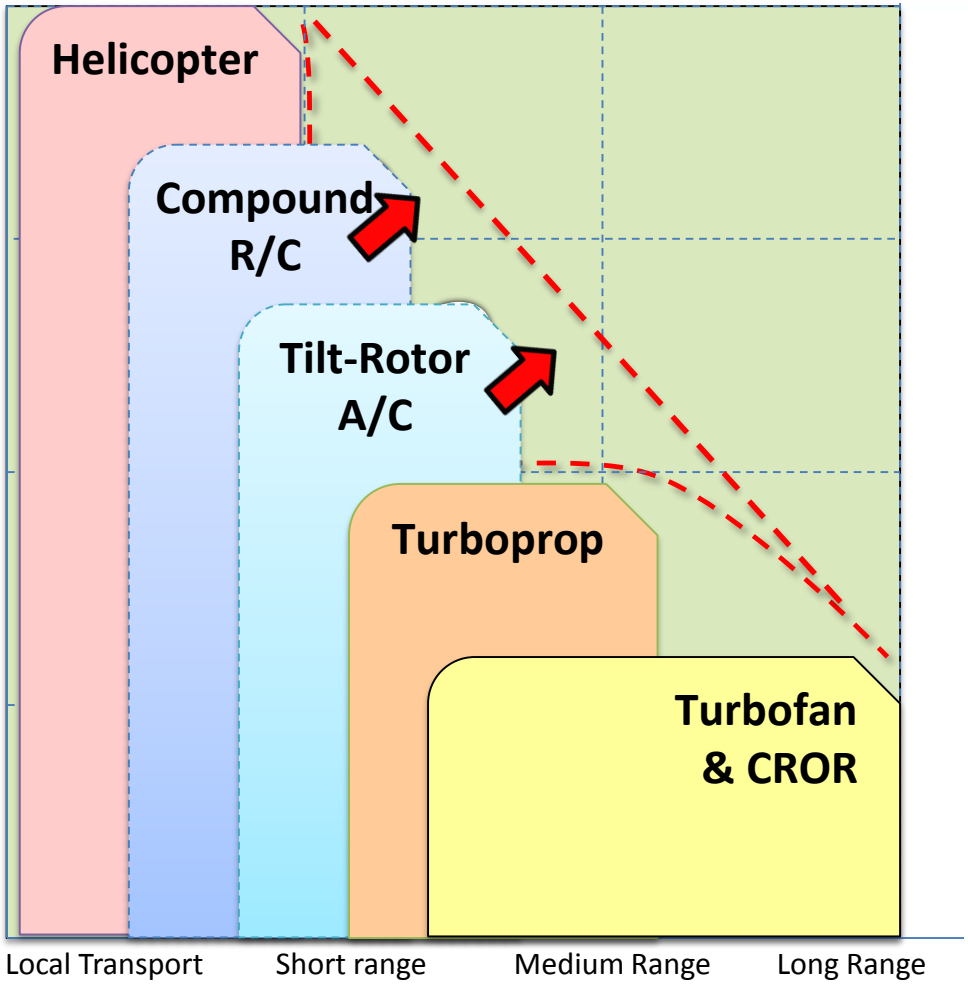
AIRFIELD

Unprepared Area
Helideck
Door-to-Door

Heliport
Local airfield

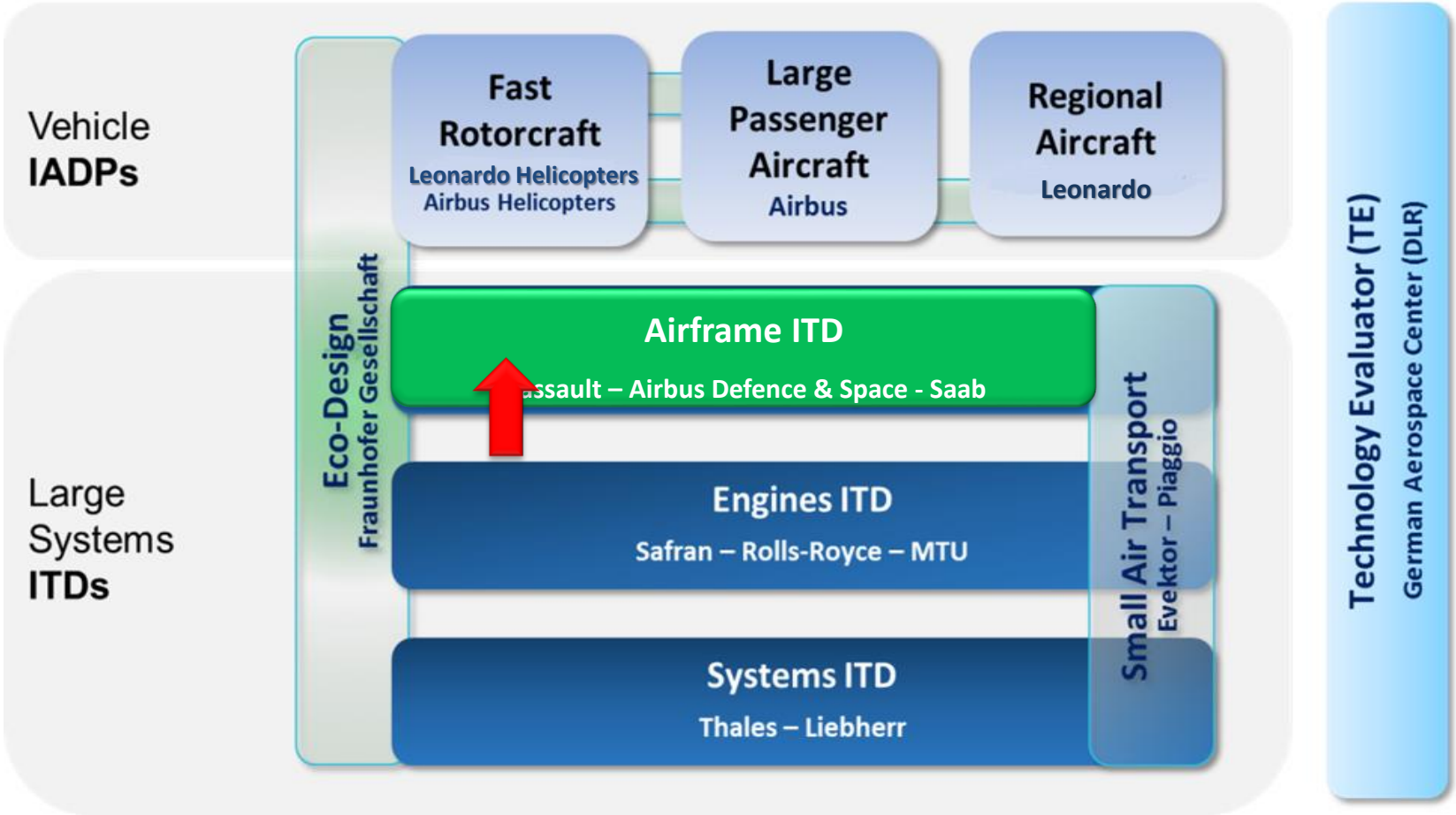
Regional
Airport

Large Airport

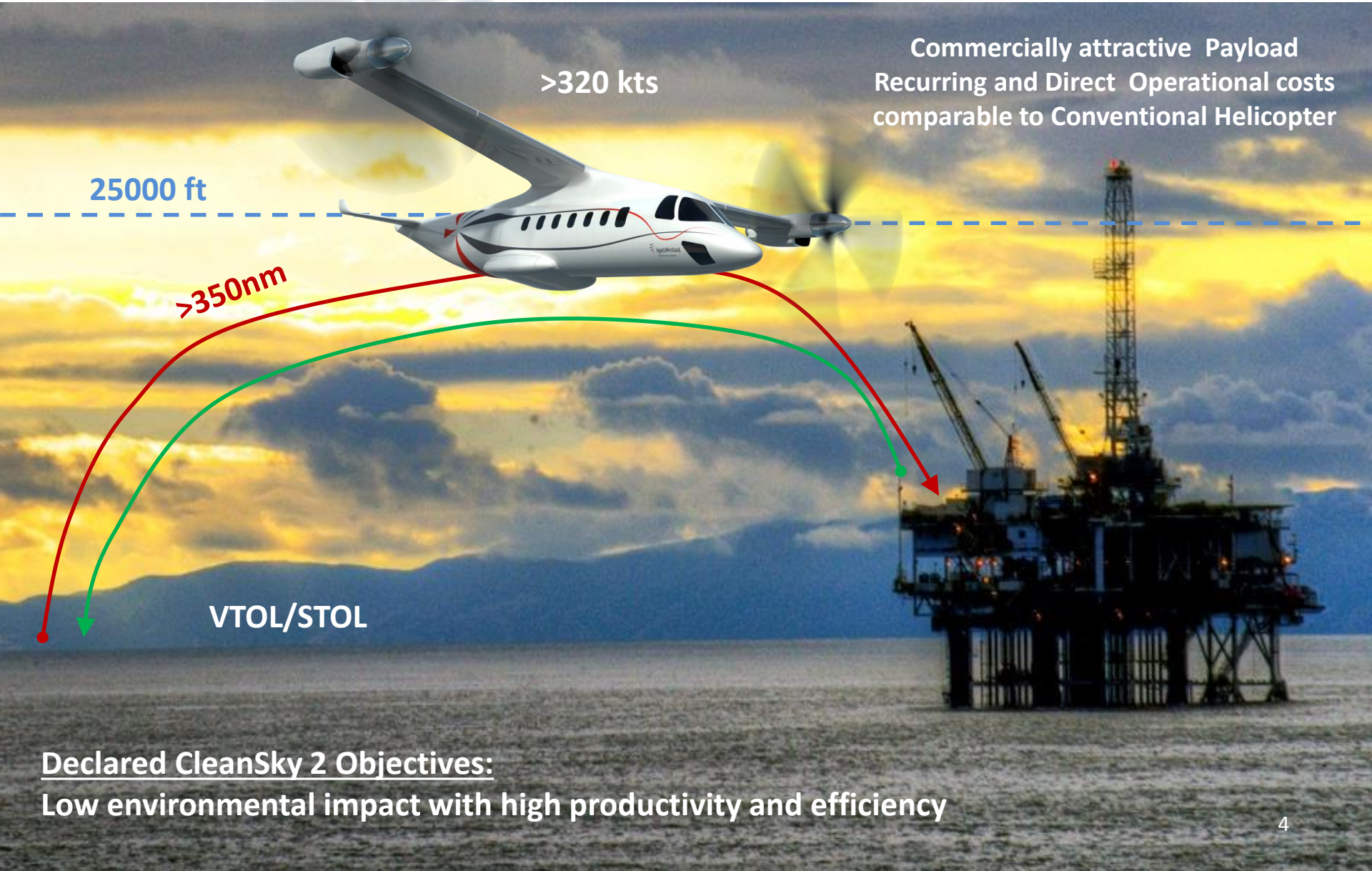


TRANSPORT RANGE & PRODUCTIVITY

Airframe ITD Overview
Clean Sky 2 Context



FRC Overview
NextGenCTR Objectives and Challenges



Declared CleanSky 2 Objectives:

Low environmental impact with high productivity and efficiency

Approach for NextGenCTR Program: 2 Phases

NextGenCTR

A 2-Phase Program

Phase 1

Design, Build, Fly a

Technology Demonstrator under CS2

NextGenCTR TD

- **De-risk program, expand current TR capability**
- Prove Architecture, Technologies, Operations
- Supported by external funding
- Develop collaborations and partnerships
- Sow the seeds for future technologies & products
- Technology exploitation and dissemination

if the market is ripe
on-going business case development

Phase 2

Develop & Certify a Product

NextGenCTR

- Tailored for diverse missions
- State-of-the-art Technologies embedded
- Competitive RC & DOCs vs. Helicopters
- No Legacy with AW609 technologies

Clean Sky
JOINT UNDERTAKING

NGCTR-TD Objectives

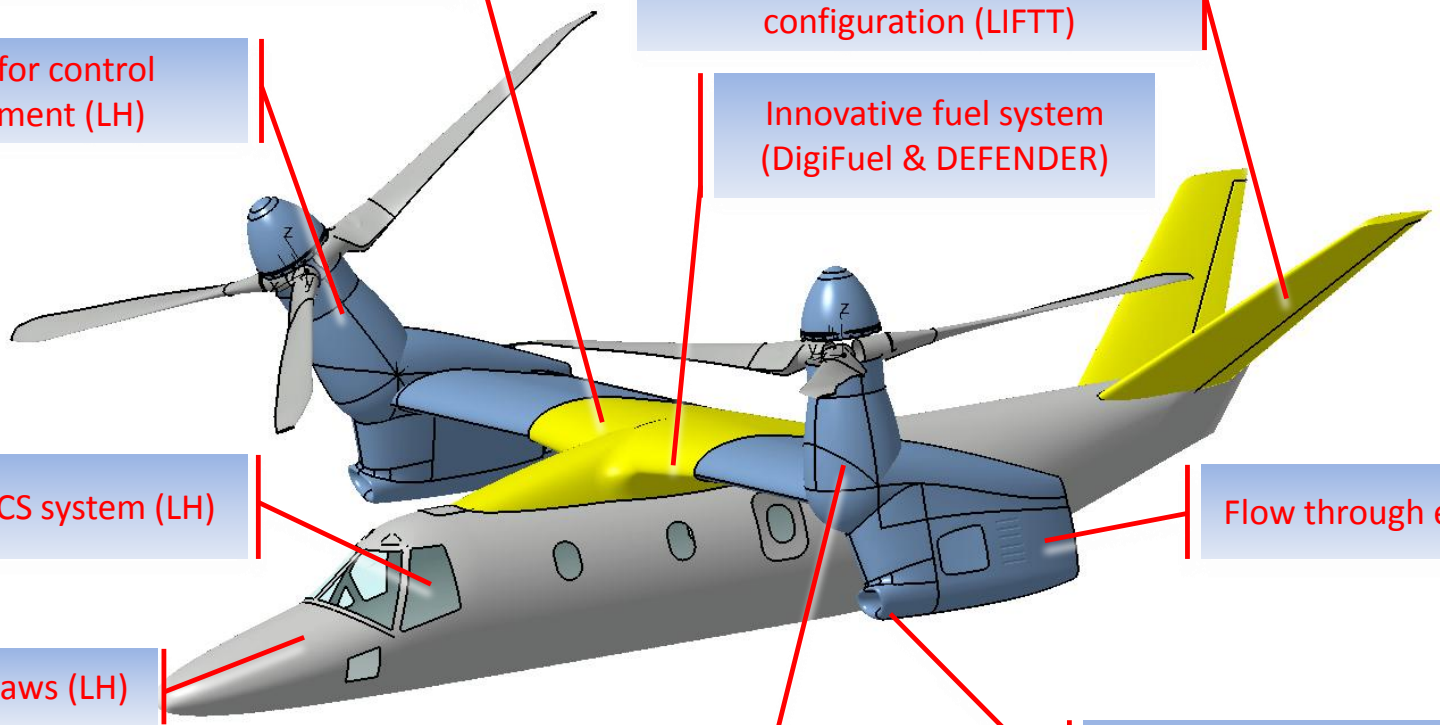
Key objectives will be pursued within CS2 by a Technology Demonstrator focusing on the Design & Development effort of **Key Enabling Technologies**:

1. Fixed-engine, Split Gearbox Drivetrain concept
2. Efficient Nacelle architecture
3. Advanced Wing architecture
4. Optimized Tail configuration
5. Advanced Modular, Distributed & Scalable Flight Control System

Throughout this effort the development and validation of predictive models and tools for air vehicle performance (including environmental), efficiency and productivity

NGCTR-TD Objectives

New Technologies to be tested within CS2 for First Flight (TRL =6)



NGCTR-TD Objectives

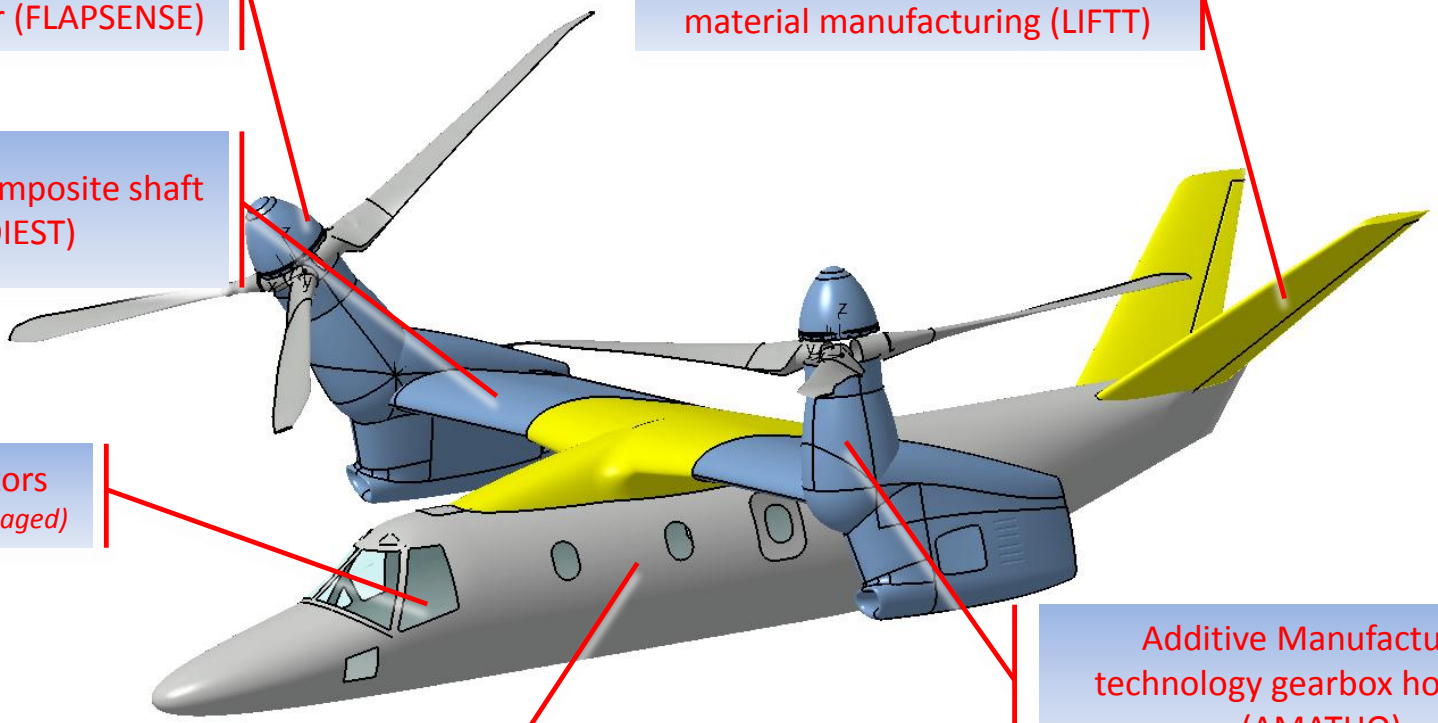
New Technologies to be tested within CS2 after First Flight (TRL =<6)

Wireless Slipring (CONSTANCE) & Innovative Flapping Sensor (FLAPSENSE)

Supercritical composite shaft (STEADIEST)

Active inceptors *(Partner to be engaged)*

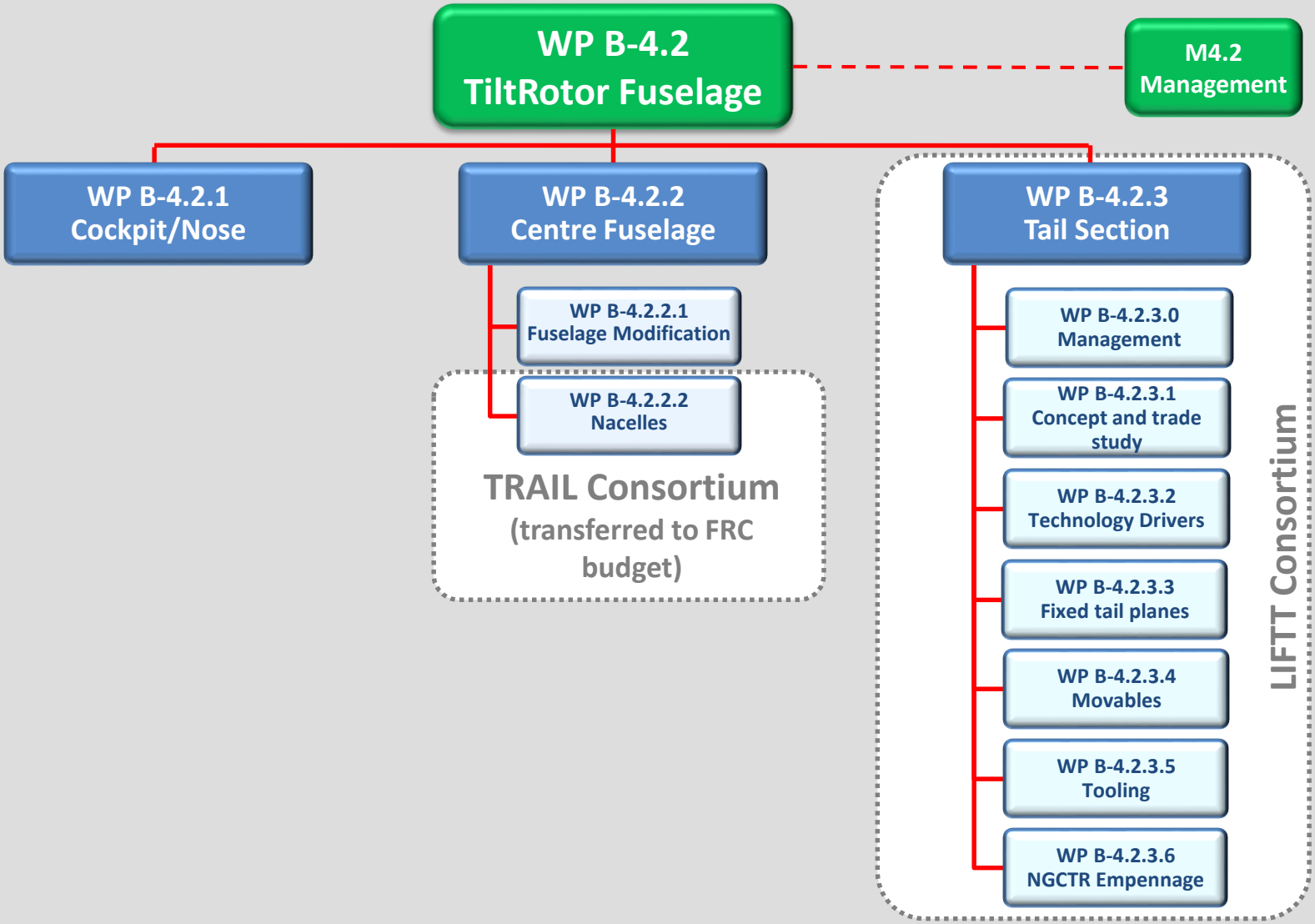
General System new applications (i.e. Electrical low pressure compressor, ...) (ELECTRA)



New tailcone & empennage material manufacturing (LIFTT)

Additive Manufacturing technology gearbox housing – (AMATHO)

AIR ITD
NGCTR-TD Work Package Structure



NGCTR WBS - Clean Sky 2 Demonstrators Definition & Plan

- CO_2 and Noise Footprint reduction
- Reduced cost of ownership (operating & MRO)
- Fast Forward Speed
- High Efficiency, High Productivity

D10 4. Optimized Tail configuration

D6 2. Efficient nacelle architecture D7

D5 3. Advanced Wing architecture

D4 1 .Fixed-engine, Split gearbox drivetrain concept

D9

D8 5. Advanced Modular, Distributed & Scalable FCS

D1 Wind Tunnel Model

D2 TDH – Tie Down Tilt Rotor

D3 Flying Demo

D4 Drive system and components

D5 Wing Assembly

D6 Engine-nacelle integration

D7 Fuel system components

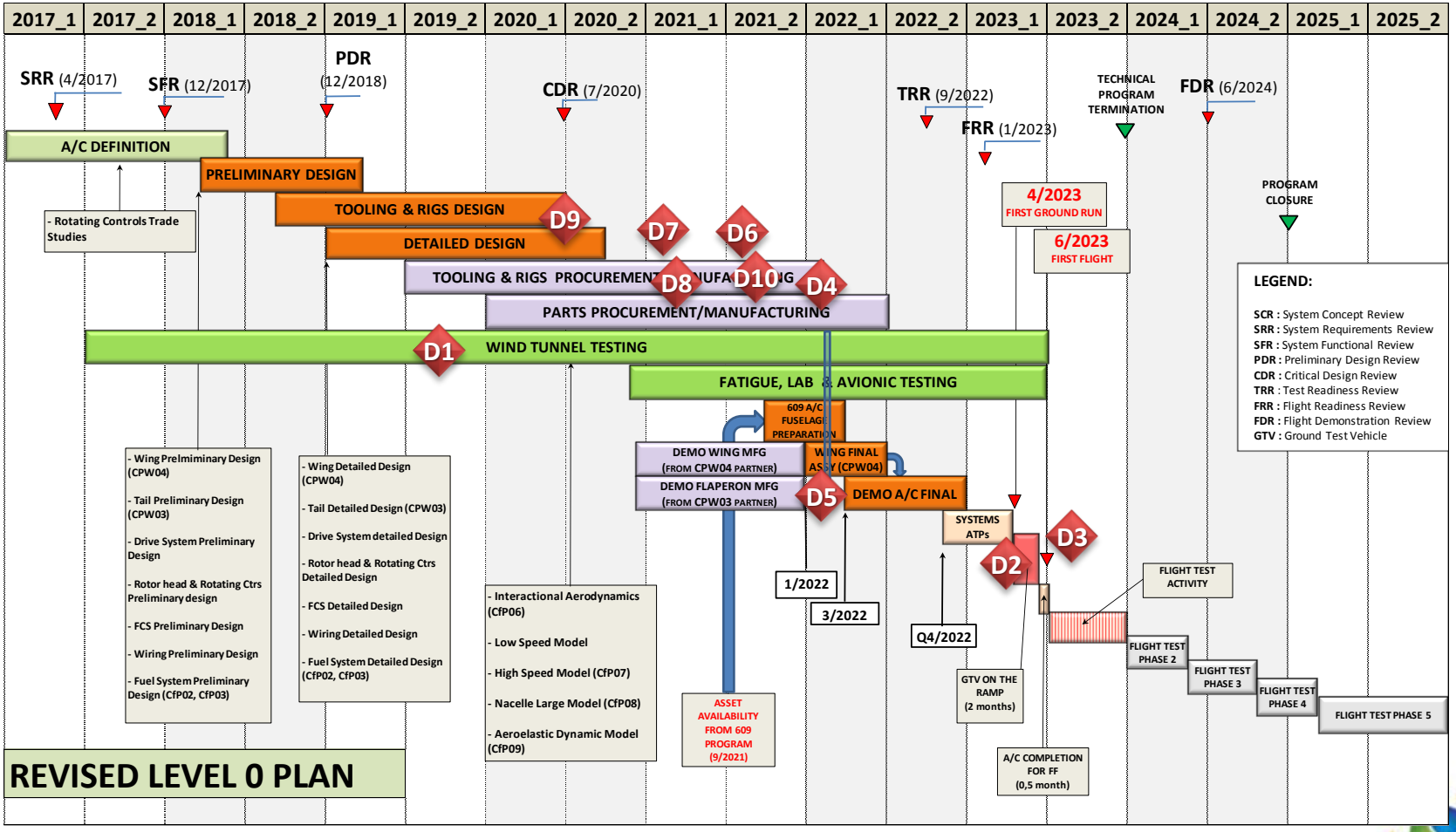
D8 Flight control and Actuation systems and components (SaIL)

D9 Digital Mock-Up (DMU)

D10 Airframe Structural Components

NGCTR WBS - Clean Sky 2 Demonstrators Definition & Plan

Master Level "0" Plan Status:



10th Call for Proposal (CfP10) – Fast RotorCraft IADP

- **AIR-02-81:** Active Flow control on Tilt Rotor lifting surfaces
- **AIR-02-82:** Innovative approaches to interior Noise Control for Next Generation Civil Tilt Rotor
- **AIR-02-83:** Innovative weight measurement system for Tilt Rotor application
- **AIR-02-84:** Modular platform development for Tilt Rotor final assembly

Fast RotorCraft IADP
10th Call for Proposal
Open Day

AIR-02-81: Active Flow control on Tilt Rotor lifting surfaces

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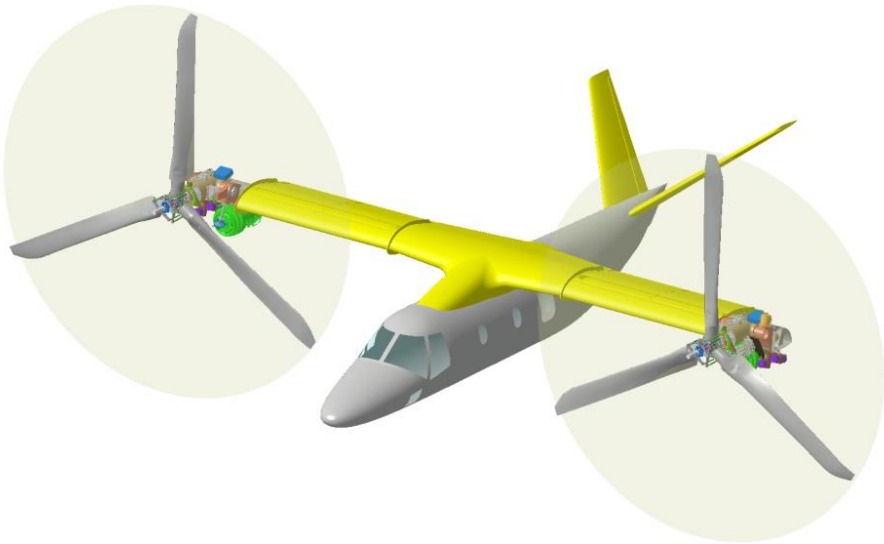
AIR-02-XX: Active Flow control on Tilt Rotor lifting surfaces

- Topic Manager: **Leonardo Helicopters** ;
- Collab.= Implementation Agreement
- Indicative Funding Value: **600 k€ ;**
- Duration: **24 Months**
- Type of Action: **IA**



- Overview: Objectives:
- For the Next Generation Civil Tilt Rotor configuration active devices to maximize the efficiency of the aerodynamic surfaces shall be investigated.
- Objective:

  To investigate the application of pulsed air blowing devices with Zero Net Mass Flux (ZNMF) to control the vortical flow on the relevant lifting non-rotating surfaces (empennages, wing) on a Tilt Rotor configuration

Workpackages (cont'd)

WP1: Capture of the relevant flow behaviour

- With the support of the Topic Manager, the Applicant shall analyse by CFD the flow field development past the tilt rotor configuration to identify the key and relevant locations prone to separated and vortical flows that can benefit from active devices to control/delay/cancel them.

WP2: Modelling of the ZNMF effects

- The Applicant shall model the ZNMF (Zero Net Mass Flux) devices effects by inserting appropriate boundary conditions into the basic flow solver used in WP1. The Applicant shall demonstrates, in the Proposal, to have yet developed and applied a robust methodology to synthetize the complex active devices flow field behaviour when embedded in an external shear flow (It is out of the scope of this project to develop this synthetized method).

Workpackages

WP3: Optimization of the location and performance of active control devices

- The Applicant shall now optimize the location and the active parameters of the ZNMF devices, in order to achieve some target aerodynamics benefits, as quantified by the Topic Manager

WP4: Summary and recommendation for ZNMF application

- The activity culminates in a summary Report where all benefits/drawbacks of the application of the ZNMF on Tilt rotor surfaces will be described, giving recommendation and guidelines for the installation of such devices to maximise the aerodynamics efficiencies of the surfaces.

AIR-02-XX: Active Flow control on Tilt Rotor lifting surfaces

Expected capabilities from the Applicant

- Computational resources (hardware and software) suitable for the scopes of the activities in the specified timescale
- Proven capability and skill in flow analysis and optimization
- Proven capability to handle and model active flow controls devices
- Proven capability to manage projects by gathering several and different specialized skills (numerical simulation, flow field analysis, optimization) and demonstrated capability to guarantee the project scheduling and milestones.

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AIR-02-82: Innovative approaches to interior Noise Control for Next Generation Civil Tilt Rotor

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AIR-02-XX: Innovative approaches to interior Noise Control for Next Generation Civil Tilt Rotor

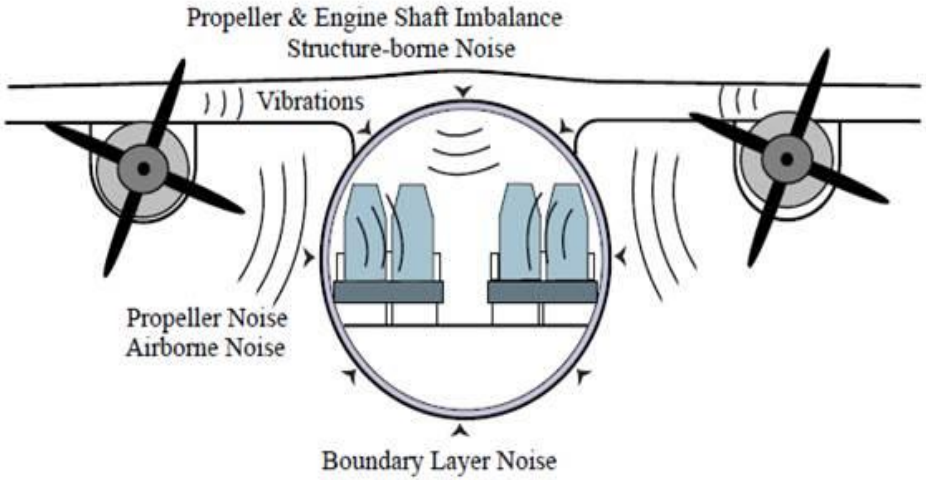
- Topic Manager: **Leonardo Helicopters** ;
- Collab.= Implementation Agreement
- Indicative Funding Value: **600 k€ ;**
- Duration: **36 Months**
- Type of Action: **RIA**
- Overview:
  For the Next Generation Civil Tilt Rotor configuration a more accurate procedure to investigate the noise paths and a dedicated active noise control are required.
- Objective:

  To investigate innovative approaches for interior Noise Control for Next Generation Civil Tilt Rotor

AIR-02-XX: Innovative approaches to interior Noise Control for Next Generation Civil Tilt Rotor

WP1: Advanced TPA

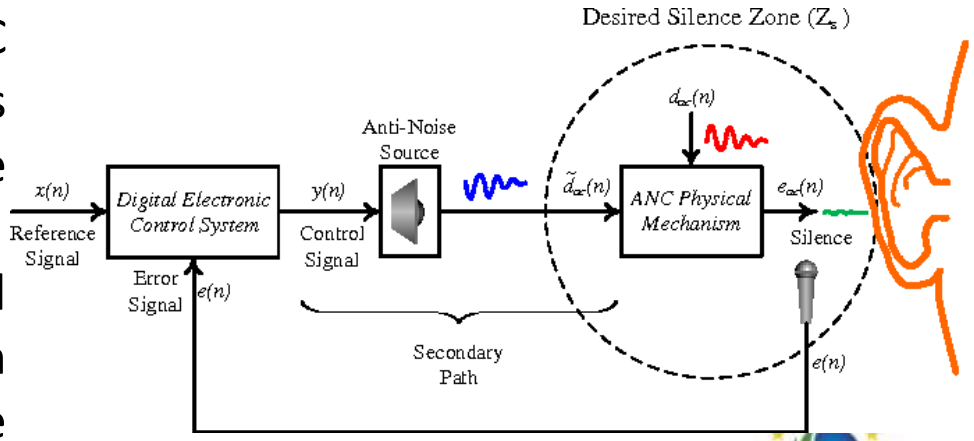
- The Applicant shall quantify and rank the transmission paths of the noise, determining the relative contribution.
- In order to reach the final target, the applicant shall:
  - Study the partition of the aircraft in several subsystems and choose the significant subsystems of the problem;
  - Analyse the limitations at experimental level for the ATPA test;
  - Perform the ATPA test on the aircraft. It includes test on ground and at the defined flight conditions.
  - Calculate the numerical parameters from ATPA results (i.e. coupling loss factors, internal loss factor)



AIR-02-XX: Innovative approaches to interior Noise Control for Next Generation Civil Tilt Rotor

WP2: Advanced Active Noise Control (ANC)

- The Applicant shall collect all experimental data (noise and vibration) useful to give the aircraft environment scenario needed for the design phase.
- The Applicant will be responsible for the required inputs (kind and position of the sensors, acquisition system parameters and configuration, etc.), data acquisition and related post-processing.
- The Applicant shall define the ANC system and estimate the expected noise reduction, evaluated using suitable testing and/or mathematical model.
- The Applicant shall define the ANC architecture and all the components will be prepared and installed on the aircraft for testing.
- In order to test the ANC system, all the components defined in the design and development phase will be integrated into the aircraft for performance assessment.



AIR-02-XX: Innovative approaches to interior Noise Control for Next Generation Civil Tilt Rotor

Expected capabilities from the Applicant

- Computational resources (hardware and software) suitable for the scopes of the activities in the specified timescale
- Proven capability and skill in dynamical testing (FRF, TPA, ATPA) of structures.
- Proven capability to interface experimental and numerical activities (extrapolation of model parameters).
- Proven capability in the development of ANC architectures for aircraft.
- Proven capability to manage projects by gathering several and different specialized skills (numeric, testing) and demonstrated capability to guarantee the project scheduling and milestones.

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AIR-02-83: Innovative weight measurement system for Tilt Rotor application

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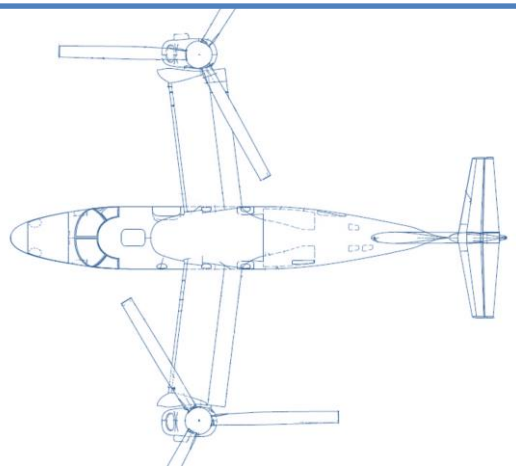
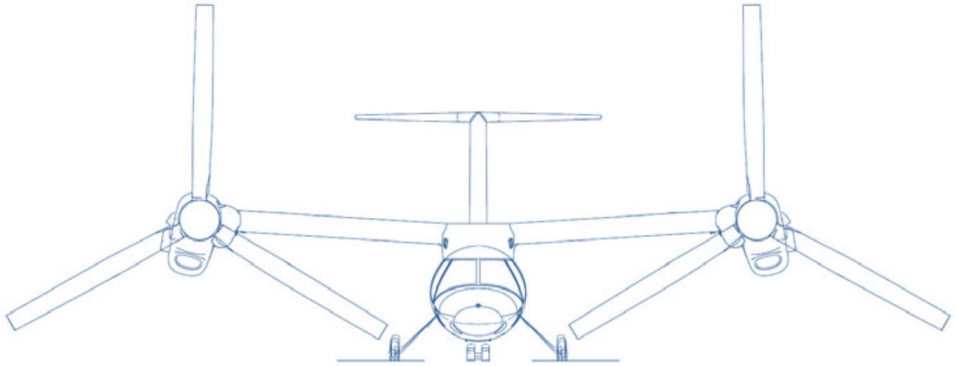
AIR-02-XX: Innovative weight measurement system for Tilt Rotor application

- Topic Manager: **Leonardo Helicopters** ;
- Collab.= Implementation Agreement
- Indicative Funding Value: **0,8 M€ ;**
- Duration: **24 Months**
- Type of Action: **IA**
- Overview: Measuring and tracking aircraft weight and balance in respect of the technical configuration required for the specific demonstration objective is a key ground testing activity required for release to flight.
- Objectives: The scope of this project is to develop an innovative automatic weight measurement system for tiltrotors aimed at improving the accuracy of weight and balance data (including conversion moment calculations), reducing Flight Line times and improving operators ergonomics

AIR-02-XX: Innovative weight measurement system for Tilt Rotor application

Objective of the project





Helicopter (VTOL) Mode

Airplane (A/P) Mode

To be measured:

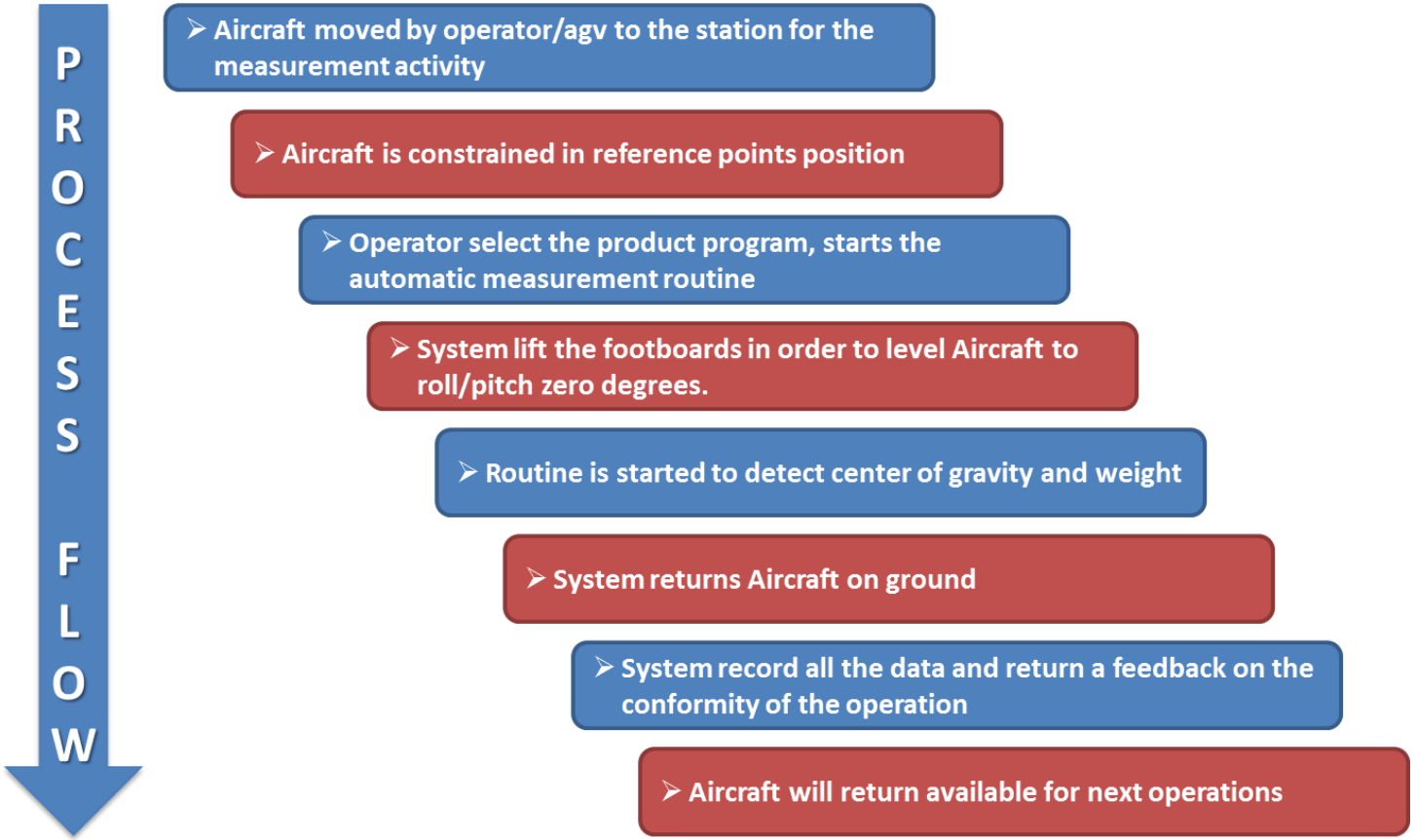
- *Weight*

To be calculated

- *Center of Gravity*
- *Conversion Moment*

AIR-02-XX: Innovative weight measurement system for Tilt Rotor application

Main weight management phases to be implemented



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AIR-02-84: Modular platform development for Tilt Rotor final assembly

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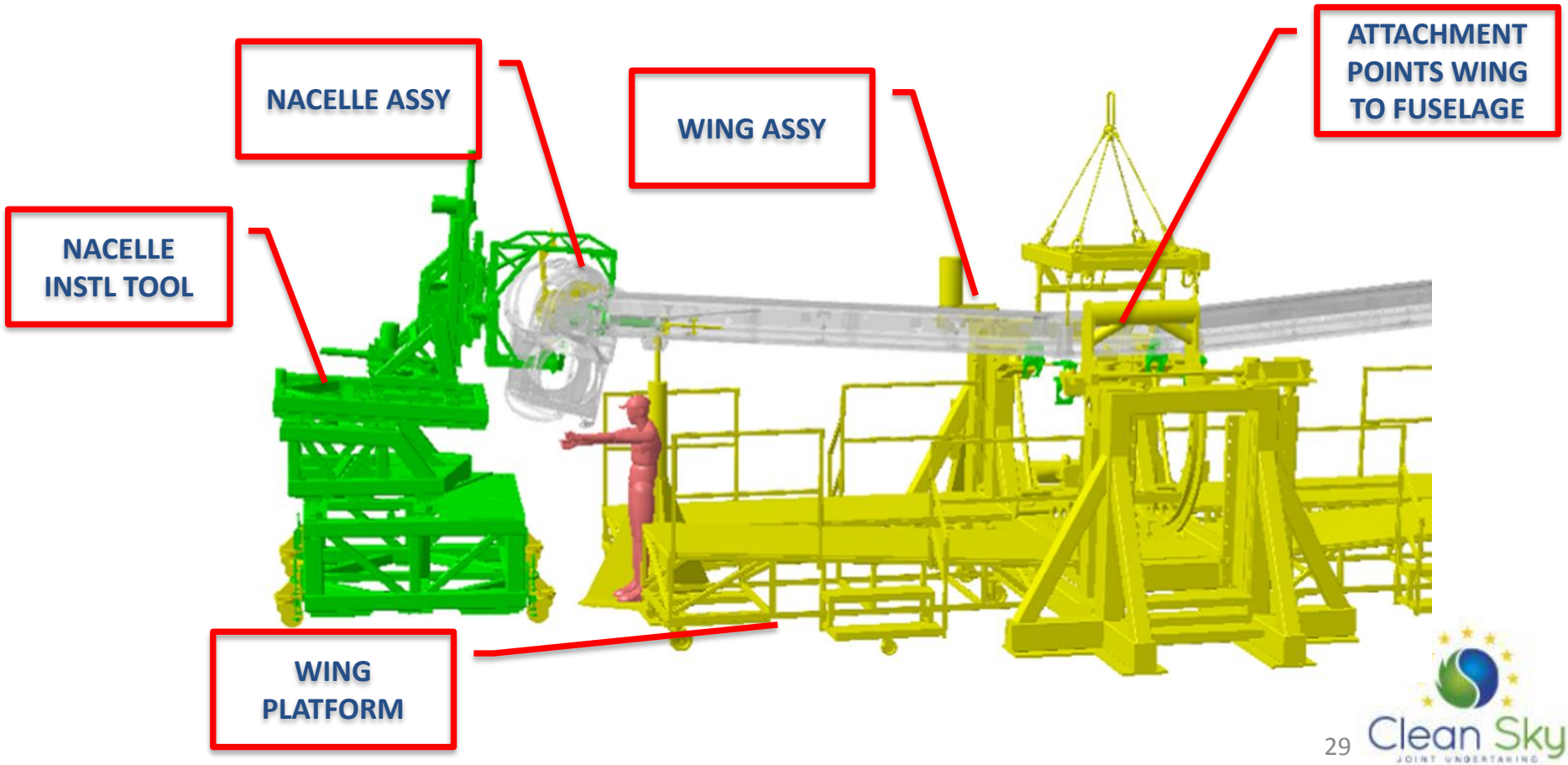
AIR-02-XX: Modular platform development for Tilt Rotor final assembly

- Topic Manager: **Leonardo Helicopters** ;
- Collab.= Implementation Agreement
- Indicative Funding Value: **1,0 M€ ;**
- Duration: **20 Months**
- Type of Action: **IA**
- Overview: The innovative architecture of the NextGen Civil TiltRotor leads to the need of new suitable methods and tools to ensure the assembly of this demonstrator in a more efficient way, with particular attention to wing assembly, system and subsystems installation and nacelle integration.
- Objectives: The aim of the activity is to design and produce an innovative multi-functional Jig in order to perform structural assembly of NextGen Civil Tilt Rotor wing, wing systems installation, nacelle installation and relevant functional Test

AIR-02-XX: Modular platform development for Tilt Rotor final assembly

NGCTR ASSEMBLY FLOW- MAIN JIG REQUIRED



NGCTR ASSEMBLY FLOW- MAIN JIG REQUIRED

WING

ACTIVITY TO BE PERFORMED:

- *STRUCTURAL PROVISION INSTL*
- *NACELLE INSTL*
- *WING TO FUSELAGE INSTL*
- *SYSTEMS INSTL*

MAIN TARGET TO BE CHECKED:

- *DRIVE SYSTEM SHAFT ALIGNMENT*
- *NACELLE ALIGNMENT*
- *GOLDEN POINT ALIGNMENT (tbc)*

PLATFORM/JIG/TOOLING NEEDED:

1. *WING PLATFORM*
2. *WING TO FUSELAGE TOOL*
3. *NACELLE ALIGNMENT TOOL*

NGCTR ASSEMBLY FLOW- MAIN JIG REQUIRED

NACELLE

REFERENCE ATTACHMENT POINTS:

TO BE AGREED WITH ENGINEERING

ACTIVITY TO BE PERFORMED:

- *NACELLE BUILD UP:*
  - *STRUCTURAL PROVISION INSTL*
  - *SYSTEMS INSTL (PIPES , CABLE, ENGINE, POWERPLANT)*

MAIN TARGET TO BE CHECKED:

- *NACELLE ENGINE ATTACHMENT POSITION (TBC)*

PLATFORM/JIG/TOOLING NEEDED:

1. *NACELLE BUILD-UP STAND*