• Innovation Takes Off

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

FAST ROTORCRAFT IADP
General Introduction

Brussels, June 2016
FRC Overview – Clean Sky 2 Context

Vehicle IADPs

- Fast Rotorcraft
  - Finmeccanica
  - Airbus Helicopters

- Large Passenger Aircraft
  - Airbus

- Regional Aircraft
  - Finmeccanica

Large Systems ITDs

- Eco-Design
  - Fraunhofer Gesellschaft

- Airframe ITD
  - Dassault – Airbus Defense & Space – Saab

- Engines ITD
  - Safran – Rolls-Royce – MTU

- Systems ITD
  - Thales – Liebherr

Technology Evaluator (TE)

- German Aerospace Center (DLR)
FRC – 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**
- Helicopter
  - MOBILITY GAP
  - Helicopter
- Turboprop
  - Regional Airport
- Turbofan & CROR
  - Large Airport

**MISSIONS**
- EMS, SAR, Coast guard
- Disaster relief
- Oil & Gas offshore
- Corporate Transport
- Air Taxi
FRC – Filling the Mobility Gap

**MISSIONS**
- EMS, SAR,
- Coast guard
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- Oil & Gas offshore
- Corporate Transport
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**AIRFIELD**
- Unprepared Area
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  - Door-to-Door
- Heliport
  - Local airfield
- Regional Airport
- Large Airport

**TRANSPORT RANGE & PRODUCTIVITY**
- Local Transport
- Short range
- Medium Range
- Long Range

**TURBOPROP**
- Helicopter
  - Compound R/C
  - Tilt-Rotor A/C
- Helicopter
  - Door-to-Door
  - Helideck
- Heliport
  - Local airfield
  - Regional Airport
  - Large Airport

**MOBILITY GAP**

**Clean Sky Joint Undertaking**

CS2 Info Day CfP04, Brussels 22.06.2016
FAST Rotorcraft have unique capabilities for:

- **Life & Saving and Society**
  (SAR, EMS, fire fighting, disaster relief)
- **Homeland Security, Law Enforcement**
- **Transport**
  (fly from- & to- airports and congested large cities, reach remote areas with limited infrastructures, e.g., airliners, shuttle services, deepwater oil & gas platforms, etc.)

**But mobility severely limited by low speed, time to perform missions & fuel consumption & environnemental impact**
FNM & AH have background to challenge foreign competitors and stay at the forefront of global rotorcraft industry via 2 new configuration civil demo that will showcase:

- VTOL advanced mobility solutions
- Reduced Environmental Footprint
To develop and test **two new configurations of rotorcraft** bridging the gap between conventional helicopters and utility / commuter fixed wing aircraft: both in speed and range/productivity.

The Fast Rotorcraft IADP consists of two concurrent demonstrators, the Tiltrotor demonstrator and the Compound Rotorcraft demonstrator along with transversal activities relevant for both fast rotorcraft concepts.
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FAST ROTORCRAFT IADP
Topics related to FRC WP2 – LifeRCraft Demonstration Project

Airbus Helicopters
François TOULMAY / Philippe CABRIT

Brussels, June 2016
LifeRCraft (1) - The Compound Rotorcraft
A new game–changing rotorcraft

Not an airplane, better than a helicopter:
a compound VTOL* architecture that retains
the best of both aircraft types

Unique capabilities:
✓ Hover/Vertical flight: as good as helicopter
✓ Cruise speed exceeding 220 kt (410 km/h)

Enabling to meet expectations for door-to-door mobility,
environment protection, citizens’ health & safety:
✓ Shorter time for Rescue & Emergency, Air Taxi
✓ Acoustic footprint & CO2 emission lower than helicopter
✓ Eco-friendly materials, greener life cycle

Thanks to a comprehensive demonstration that will:
✓ De-risk the integration of this new configuration thru the supply chain
✓ Pave the way for development & marketing prior non-EU competitors to secure market share of European rotorcraft industry.

(1) LifeRCraft= Low Impact, Fast & Efficient RotorCraft.

NB: images may not reflect CS2 demonstrator sizing & components (for illustration purpose only)

(*) VTOL: Vertical Take-Off & Landing
Example of benefit: Emergency Medical Service
Full Coverage within 1 Flight Hour

Required rescue bases:
- 7 to 8 bases with conventional H/C (main land only)
Example of benefit: Emergency Medical Service - Full Coverage within 1 hour

**Required rescue bases:**
- 7 to 8 bases with conventional H/C (main land only)
- 4 to 5 bases with compound R/C (land & islands)
Weight, weight, and weight... Even more crucial than for helicopters, why?

- Additional components: wing and lateral rotors
- Strong engines & power train

Aerodynamic efficiency: Also crucial!

- Cruise: low drag, high Lift-to-Drag ratio
- Hover/ vertical flight: efficiency & manoeuvrability

Cost efficiency: Must outperform helicopter

- Operating cost (per kg payload/km)
- Recurring cost

Unique opportunity to mature innovative technologies up to TRL 6 and showcase them for future compound and helicopter products
LifeRCraft Work Breakdown Structure

- WP2.1: Project management & integration activities (AH)
- WP2.2: Airframe Structure (AHD)
- WP2.3: Landing system (AH)
- WP2.4: Lifting rotor (AH)
- WP2.5: Lateral rotors (AH)
- WP2.6: Mechanical drive: MGB, LGB, shafts (AH - AHP)
- WP2.7: Power plant: Engines - adaptation & installation (AH)
- WP2.8: Electrical system: power generation, distribution & storage (AH - AHD)
- WP2.9: Actuators (AH)
- WP2.10: Avionics & Sensors (AH)
- WP2.11: Cabin & Mission Equipment (AH – AHD)
- WP2.12: Flight control, AFCS, nav systems (AH)
- WP2.13: Validation, verification demonstration: ground tests, flying demonstrator (AH)

WP numbers are referring to FRC project:
MGB: Main Gearbox
LGB: Lateral Gearbox

In ITD Airframe

Clean Sky
Joint Undertaking
From Clean Sky GRC to Clean Sky 2 FRC

**GRC3 – Electrical Systems**

**GRC1**
Passively Optimized Blade Active Gurney Flaps

**GRC2 - Low Drag Design**
- Hub fairing
- Mast fairing
- Aft body
  - Improved shape
  - Vortex generators
  - Strakes

**GRC5 - Noise Abatement**

**GRC6**
Mat & Proc. / Eco

Decrease of Induced Power
High Level Schedule

LifeRCraft Project (WP2)


- WP for partner preparation
- Partnership set-up
- Pre-design studies
- Architecture, general spec & preliminary interfaces
- General design
- Detail interfaces
- Detailed design
- Components manufacturing
- Mechanical drive system tests (back-to-back, 2 steps)
- System integration testing
- Flying demo assembly
- Demonstrator ground tests
- Demonstrator flight tests
- LifeRCraft Project synthesis

PDVR: Preliminary Design Verification Review
PDR: Preliminary Design Review
CDR: Critical Design Review
TR-FC: Test readiness review, Flight Clearance

TRL gates

3 4 5 6
## CFP04 Overview of FRC topics

<table>
<thead>
<tr>
<th>Identification Code</th>
<th>Title</th>
<th>Type of Action</th>
<th>Value (Funding in M€)</th>
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<td>Full Electric Air Pressurization and Conditioning Management of</td>
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<td>Inhabitant Compartments and Utilities Air Supply for Next Generation</td>
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<td>Civil Tilt Rotor</td>
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FRC-02-17: Bird strike - Erosion Resistant and Fast Maintainable Windshields

• Topic Manager: **Airbus Helicopters**; collab. = Implementation Agreement
• Indicative Funding Value, duration: **0,600 M€; 50 Months**
• Type of Action: **IA**

• Overview:
  Complete set of lightweight windshields to be developed, manufactured and tested
  Opportunity to develop a lightweight innovative windshield fulfilling the requirement of a non-pressurized high speed rotorcraft aircraft:
  – Bird strike resistant (CS29),
  – Low drag,
  – Compatible with water repellent treatment...
  – De-fogging capability
  – Compatibility with electrical anti-icing.

The windshields will be installed on the canopy subject of the topic CFP03-FRC-02-09 (previous call)
FRC-02-18: Flight Management System Providing Noise Abatement Flight Procedures for Compound Rotorcraft

- Topic Manager: **Airbus Helicopters**; collab. = Implementation Agreement
- Indicative Funding Value, duration: **1 M€; 45 Months**
- Type of Action: **IA**

**Overview:**

**State of the art:**
- LPV (Landing Performance with Vertical Guidance) steep approach
- Approach PBN (Performance Based Navigation) 3D

**Opportunity to develop:**
- 4D profile approach with speed management
- Altitude tuning
- Steep approach with higher slope
- Identification of dedicated flight mode phase (rotorcraft based or airplane based)
- Complex trajectory with curve element
- Enhanced HMI with touchscreen
FRC-02-19: Full Fairing of the Main Rotor Head for the LifeRCraft Demonstrator

- Topic Manager: **Airbus Helicopters**; collab. = Implementation Agreement
- Indicative Funding Value, duration: **0,4 M€; 42 Months**
- Type of Action: **IA**
- Overview:

  A full rotor head fairing to be developed, manufactured. A key of the hybrid high speed aircraft is the **drag reduction**, rotor head is one of the main contributor to the overall drag.

  Opportunity to design, test, and implement new concept of partial air sealing between mobile parts.

  In addition the full fairing should be design regarding the following criteria:
  - Bird strike resistant (CS29),
  - Mass optimized,
  - Cost efficient solution,
  - Maintenance accessibility.

The rotor head fairing will be installed on the main rotor (FRC WP 2.4)
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Information Day dedicated to the 4th Call for Proposal (CfP04)

FAST ROTORCRAFT IADP
Topics related to FRC WP1 – Next Generation Civil TiltRotor Project

Leonardo Helicopters
Neil HARRIS

Brussels, June 2016
Setup and Implementation
Technical Challenges & Strengths to Meet Requirements

- Advanced Fly-by-Wire flight control system
- Three modes of operation: Conventional, Short and Vertical Take-Off and Landing providing operational flexibility
- Efficient engines-nacelle integration for minimal drag and weight and maximum serviceability
- Tilting rotors and split transmission with fixed engine to permit multiple engine choices
- Fuselage design for dual use and maximum mission flexibility
- Landing gear supporting airplane, STOL and vertical take off and landing modes
- Aerodynamically efficient low-noise Proprotor design
A platform to advance technology
Next Generation Civil Tiltrotor
Notional Schedule

2014
2015
2016
2017
2018
2019
2020
2021
2022
2023

CDR
Prelim Studies, Architecture, Specifications
CleanSky outcomes

Components & Subsystems Development & Testing

First Flight

Flight Validation
Architecture, Technologies, Operations
full certification

Calls for Proposal
FRC-02-14: Hydrophobic Windscreen Protection for Next Generation Civil Tilt Rotor

- Topic Manager: **Leonardo Helicopters**; collab.= Implementation Agreement
- Indicative Funding Value, duration: **0.750 M€ ; 36 Months**
- Type of Action: **IA**
- Overview:
The design, development, manufacture, testing and flight qualification of hydrophobic coating protection system to be applied on Next Generation Civil Tilt Rotor as an enabler for wiperless windscreens.
  - Heavy Rain intensity;
  - Compatible with existing windshield technologies, e.g. Acrylic, Glass, etc...;
  - Invariant to optical properties of the windshield;
  - Compatible with ice protection technology;
  - Compatible with commercial aviation cleaning fluids;
  - Operating temp. of -55/+55°C; non-operating/storage temp. of -60/+85°C;
  - Operate altitude range of -2000ft/30000ft;
  - REACH compliant.
FRC-02-16: Flight critical wireless slip ring for Next Generation Civil Tilt Rotor

• Topic Manager: Leonardo Helicopters; collab. = Implementation Agreement

• Indicative Funding Value, duration: 0,750 M€; 48 Months

• Type of Action: IA

• Overview:
The objective is to develop and deliver flight critical wireless slip ring units for civil tiltrotor proprotors. Representative test items will be used for structural and environmental testing and the flight cleared components will be integrated in the tiltrotor rotor system.
  — Data rate 10 Mbit/sec, minimum
  — Power transmission: 5 A @ 28 Vdc
  — Compliance to SAE AS9100
  — Damage tolerant design (CS-29)
  — Minimum weight

Note:
Preliminary allowed geometrical envelope and electrical/mechanical interfaces shall be provided to the interested applicants after signature of a dedicated Non Disclosure Agreement.
Any questions on the Call and topics can be addressed to the following mailbox:

Info-Call-CFP-2016-02@Cleansky.eu

Deadline to submit your questions:

16th August 2016, 17:00
Q&A

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Thank You
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