EXAELIA

Flying Testbeds for Novel Long-Range Aircraft

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Flying Testbeds to Accelerate the Development of Disruptive Long-Range Aircraft

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Flying Testbeds (FTBs) for the Development of Disruptive Long Range Aircraft: why?

Societal: to reduce aviation's global climate impact

- Take the opportunity to go beyond transfer of Clean Aviation (CA) technologies to long-range
- **Target: radical aircraft configurations / novel propulsion concepts / enabling technologies, expecting at least doubling reduction of carbon emissions w.r.t. such transfer of CA technologies**

Scientific/capabilities:

- USA /China: large X-plane/FTB investments: strut-braced wing (USA currently paused), blended wing body
- European experience:
  - Clean Sky BLADE (laminar flow), Clean Sky 2 SFD & DEP-SFD (scaled), industrial/national/European flying test beds and flight test demonstrators (e.g., Clean Aviation)
  - Scaled flight order of magnitude cheaper than full-scale flight

Europe needs to start FTBs to de-risk such radical aircraft configurations through deep understanding of their criticalities

EXAELIA project: key facts and figures

EXAELIA

EXperimental Aircraft
for European Leadership
In Aviation

Starting date
01/01/2025

Duration
42 months

23 partners
from 13 European countries

Project Coordination
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GA Number
101191922
Topic: HORIZON-CL5-2024-D5-01-10
Funding Scheme: RIA

10 members
engaged in the Industrial Advisory Board

Consortium members

- NLR
- ONERA – The French Aerospace Lab
- CIRA – Italian Aerospace Research Centre
- DLR – Deutsches Zentrum für Luft- und Raumfahrt – German Aerospace Center
- Łukasiewicz Institute of Aviation
- INTA – Instituto Nacional de Técnica Aeroespacial
- INCAS
- AIT Austrian Institute of Technology
- CEiiA
- Cranfield University
- University of Stuttgart, Germany
- University of Patras
- TU Delft
- hit09
- EASN technology innovation services
- Chalmers
- Technische Universität Braunschweig
- Bauhaus Luftfahrt – The Aviation Think Tank
- Aristotle University of Thessaloniki
- ISAE-SUPAERO
- OrangeAerospace
- Università degli Studi di Napoli Federico II
- UP

EXAELIA Objectives

with their logic/methodology

O1 - **Concepts of promising commercial aircraft configurations identified and designed** [..] being suitable for long range missions (beyond 9000 km) [..]

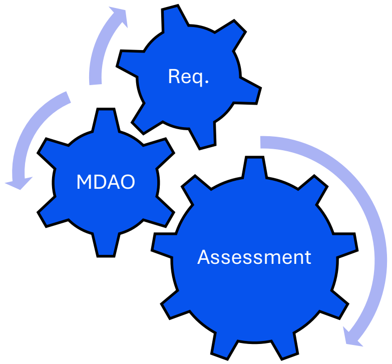
O2 - **Critical aspects of these aircraft configurations identified, including their radically new technologies,** with focus on the critical aspects that need to be de-risked by flight testing

O3 - **Mandatory innovative** (full-scale or scaled) **experimental aircraft** (flying testbeds) **identified** for de-risking the critical aspects that need flight testing.

O4 - **Novel flying testbed families and flight tests predesigned** with technology development plans until first flight

O5 **- European exploitation strategy disseminated for the promising aircraft configuration concepts, including their radically new technologies, and the novel flying testbeds.** Dissemination [..]

Expected key results



Advanced engineering methodologies

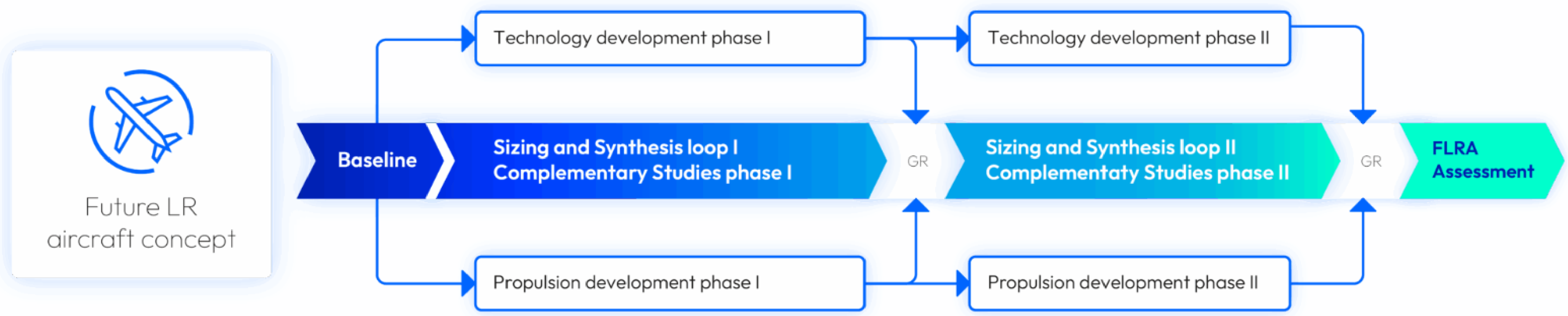
EXAELIA Future Long Range Aircraft (Objectives O1, O2)

Fuel and aircraft configurations

- SAF-powered Blended Wing Body (BWB)
- H_2-powered BWB
- H_2-powered Tube-And-Wing (TAW)

<u>Each configuration with:</u>

- 1-2 advanced propulsion concepts
- Enabling aircraft technologies
- Enabling engine technologies



Flight test needs

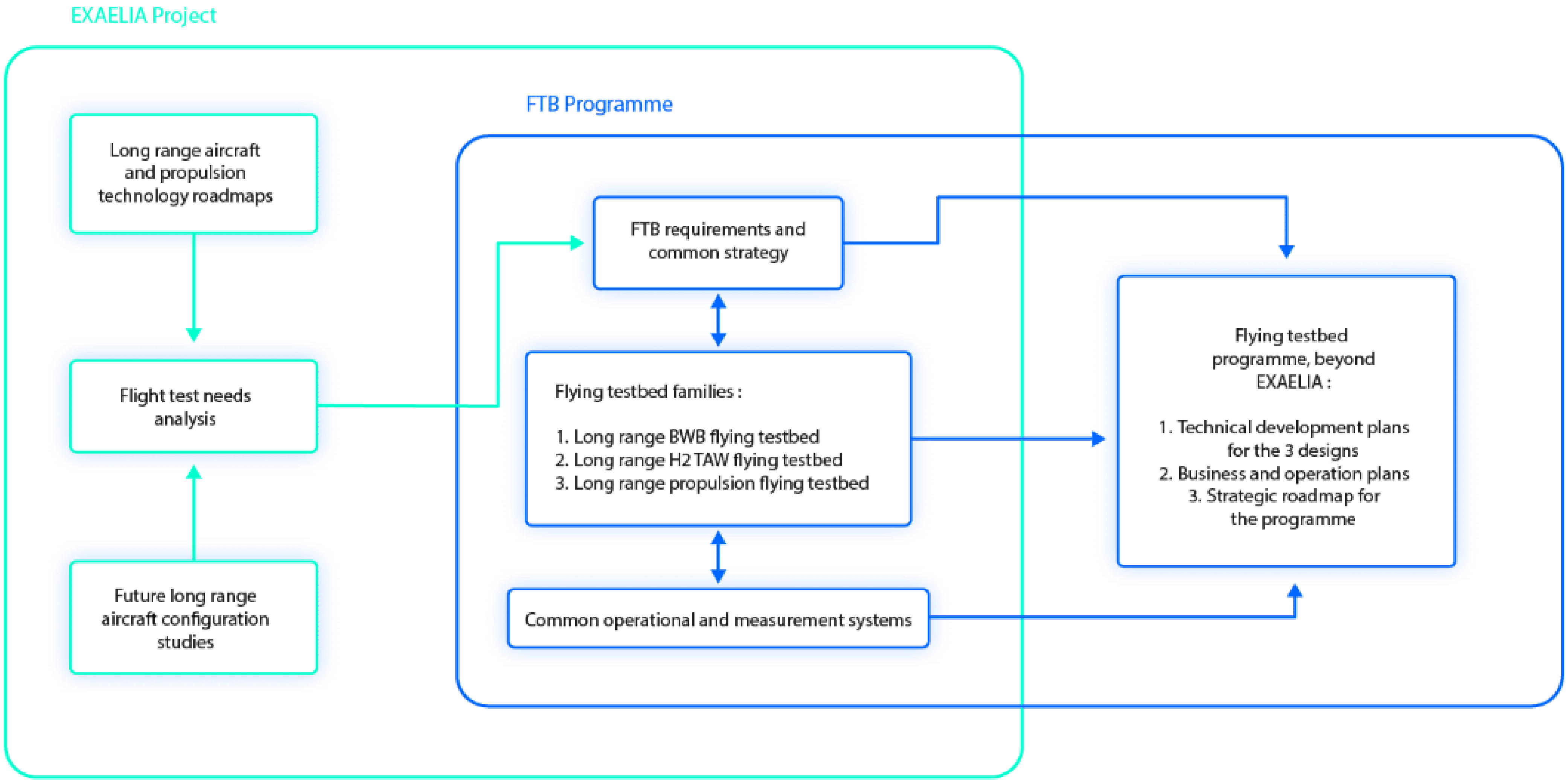
\ A/c concept FTB family \	SAF-powered BWB	H2-powered BWB	H2-powered TAW
LR BWB	x	x	
LR H2 TAW			x
LR propulsion Unconventional engine integration	x	x	x
LR propulsion Integration of novel powertrain concepts	x	x	x

First analysis:

- BWB configurations:
  - Flight dynamics and control, especially at low speed
  - Unconventional engine integration
- H2-powered TAW configuration:
  - Structural dynamics and aeroelasticity of the slender wings, equipped with novel technologies
- H2-powered aircraft:
  - Integration of novel powertrains or powertrain components

Further needs: some already envisaged, with modularity; scaled & full-scale: families

EXAELIA Flying Test Bed families (Objective O3, O4)



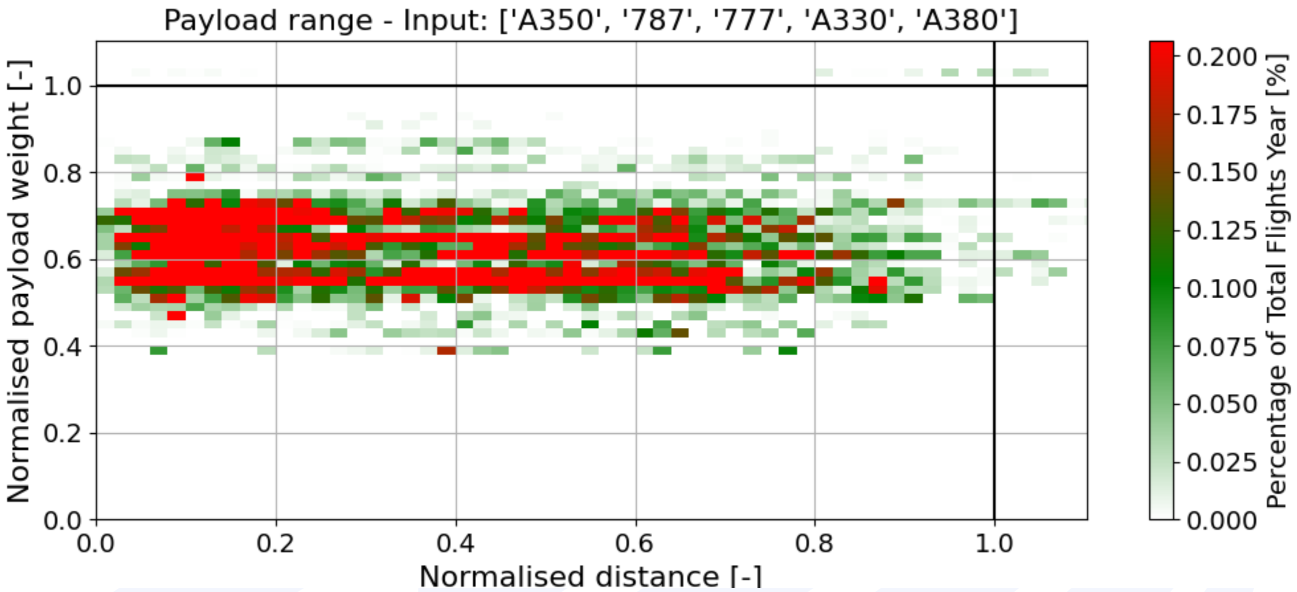
Family concepts defined and for each family a preliminary design is targeted

First project results: Needs and requirements for future long range aircraft (beyond

- Needs and requirements for future long range aircraft:
  - Current use long range aircraft
  - Future trends
  - Implications for future long range aircraft
- Top level aircraft requirements (TLARs) for aircraft concept studies

Current use long range aircraft

- Cruise Mach 0.82-0.85 (most recent: 0.85)
- Full capability (payload-range) mostly not used
- Wing span max. 65 m (aerodrome cat. E) (except A380)
- About 50% operating from Cat. F aerodromes (wing span max. 80 m)



Future trends

- Average number of seats per aircraft grew by 0.85% per year (2014-2018)
- European airport capacity constraints may require higher payload needs
- Higher population/GDP growth in upcoming economies may impact also payload & range needs
- Fuel cost increase is likely, a.o. due to policies
  - 2050: 240% increase wrt 2019 fuel cost levels, based on DESTINATION 2050 outlook and ICAO LTAG F3 scenario

Implications for future long range aircraft

- **Efficiency improvement** can dampen effect of rising ticket prices and demand effects
  - 60% efficiency improvement would limit increase of direct operating costs (DOC) to 20%
  - 30% efficiency improvement would yields DOC increase of 55%
- Larger wing span enables efficiency improvement.
- Recommendation to investigate benefits of **increasing wing span up to 80 metres** to prevent net disadadvantage to the climate
- **Increased payload capacity** emphasised over further extensions in range

Top level aircraft requirements for the EXAELIA concept studies

Building up deep understanding

Project TLARs:

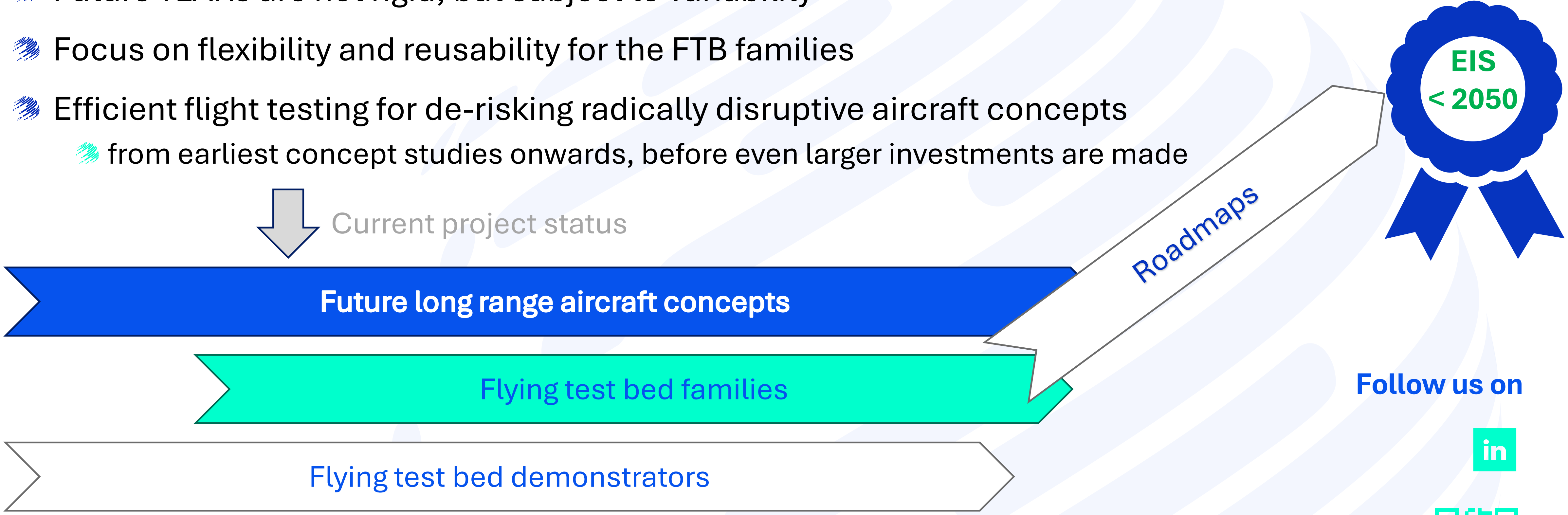
- A350 data: 12500 km range with payload of 53750 kg at cruise speed M=0.85 with max. operating altitude 14 km
  - Wing span relaxation to max. 80m

EXAELIA concept studies for building up deep understanding:

- Demonstrate building up deep understanding of radical aircraft concepts
  - Implementation of MDAO iterative processes to match the TLARs
  - Traceability of the impact of changes such as impact of wing span constraint relaxation from 65 m to 80 m
- Identify potential environmental benefits with respect to reference aircraft (A350)
- Help to identify critical uncertainties and contribute to motivation for flight test needs

Concluding remarks

- Future TLARs are not rigid, but subject to variability
- Focus on flexibility and reusability for the FTB families
- Efficient flight testing for de-risking radically disruptive aircraft concepts
  - from earliest concept studies onwards, before even larger investments are made



- Keep following EXAELIA on the pathway to European leadership in long range aviation

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