



AGILE4.0

Towards cyber-physical collaborative aircraft development

German Aerospace Center (DLR) | *Luca Boggero*

AGILE 4.0 Project Consortium

EU-funded projects managed by CINEA: Aviation success stories

ILA Berlin Air Show | 22nd June 2022



AGILE 4.0



*Towards cyber-physical
collaborative aircraft development*

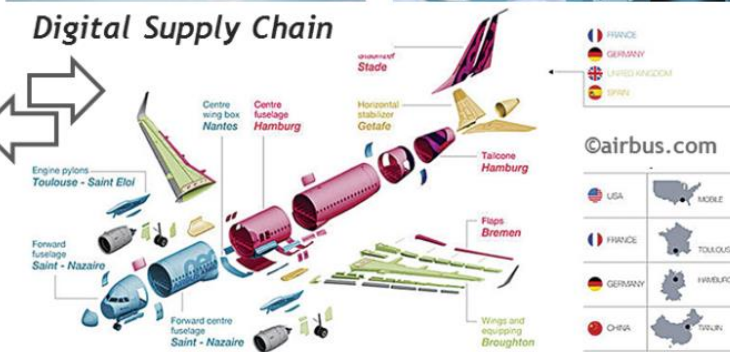
Towards cyber-physical collaborative aircraft development



Human-centric



Digital Supply Chain



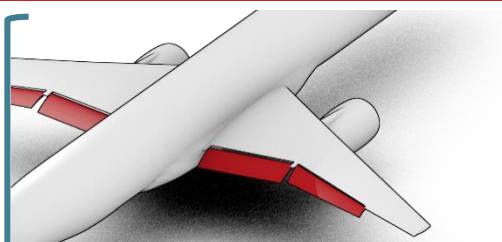
- **Coordinated by DLR Hamburg**

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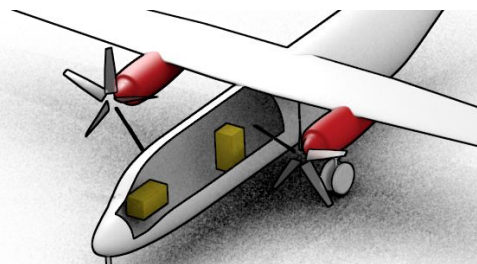
Industrial-driven Applications



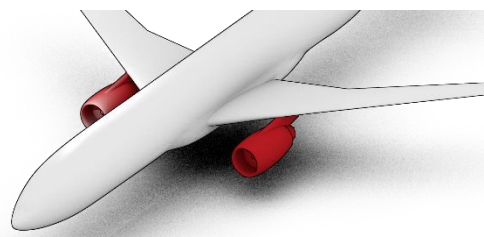
- MBSE Approach
- Ontologies
- Models
- Platforms
- Decision Making
- Optimization
- Competences



*Airframe components
flap\HTP*



*On-board systems
Propulsions*



*Propulsion, cabin,
avionics, winglet*

Production

FOKKER
AEROSTRUCTURES

1 *Manufacturing*

Certification

BOMBARDIER

3 *Electrification*

Upgrade

LEONARDO

6 *Retrofitting*

← EMBRAER

2 *Supply chain*

← EMBRAER

AIRBUS

4 *Maintenance*

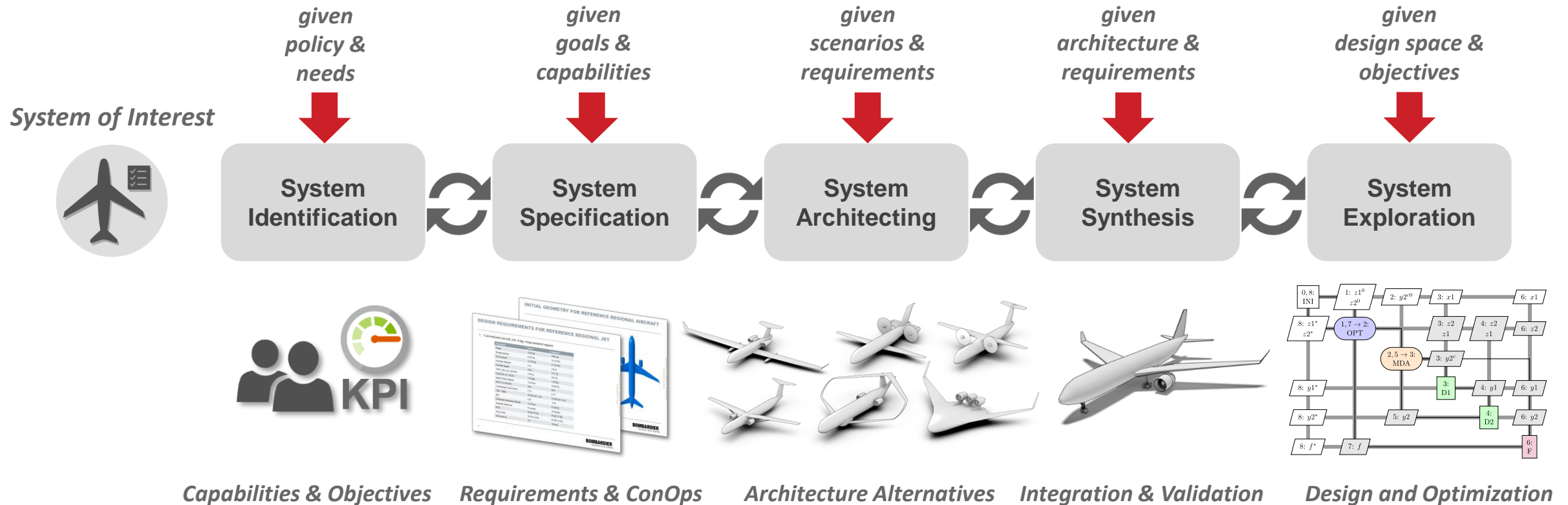
5 *Certification*

BOMBARDIER

7 *Family concept*

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Systems Engineering Approach for the Development of Aeronautical Systems



upstream architecting **SE** (document or model based)

Accelerating

downstream product design **MDO**

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Shifting from document based to Model Based Engineering Approaches (MBE)



System
Identification

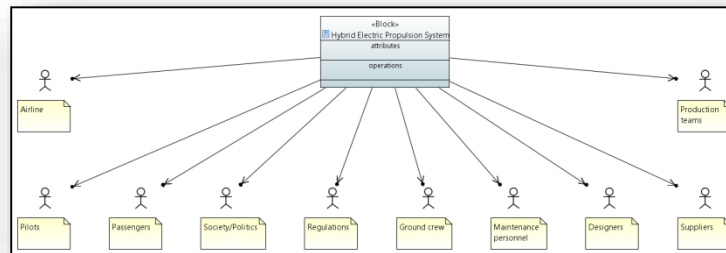
System
Specification

System
Architecting

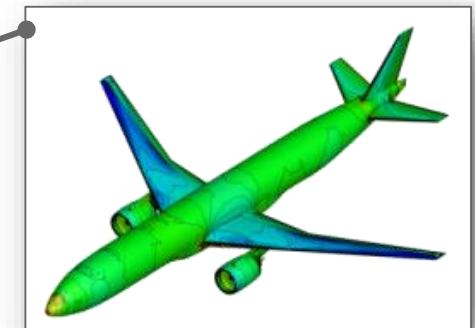
System
Synthesis

System
Exploration

Stakeholders



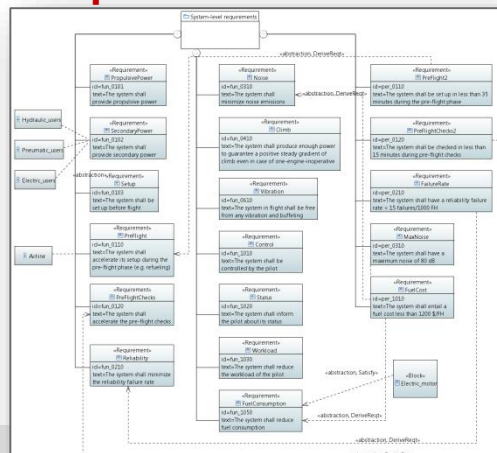
Disciplinary Capability



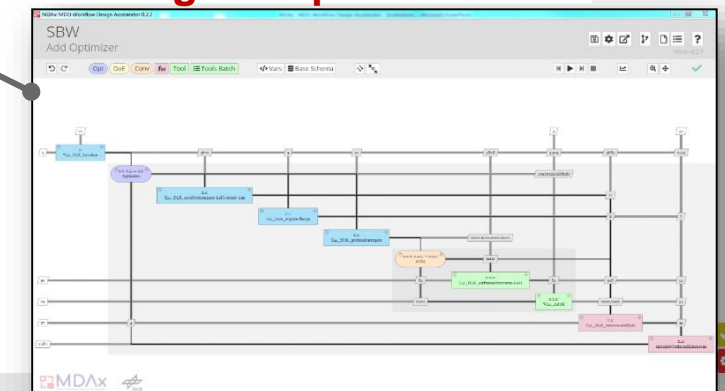
Source of Truth



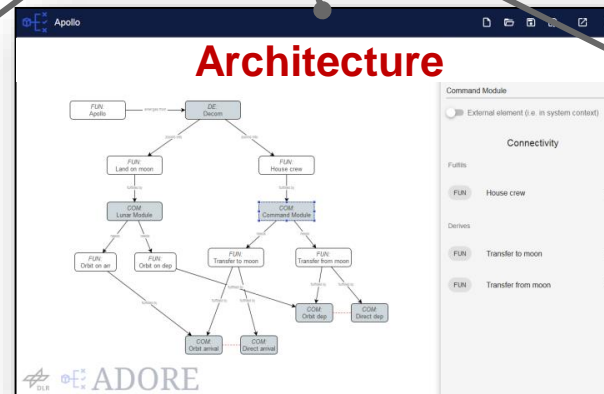
Requirements



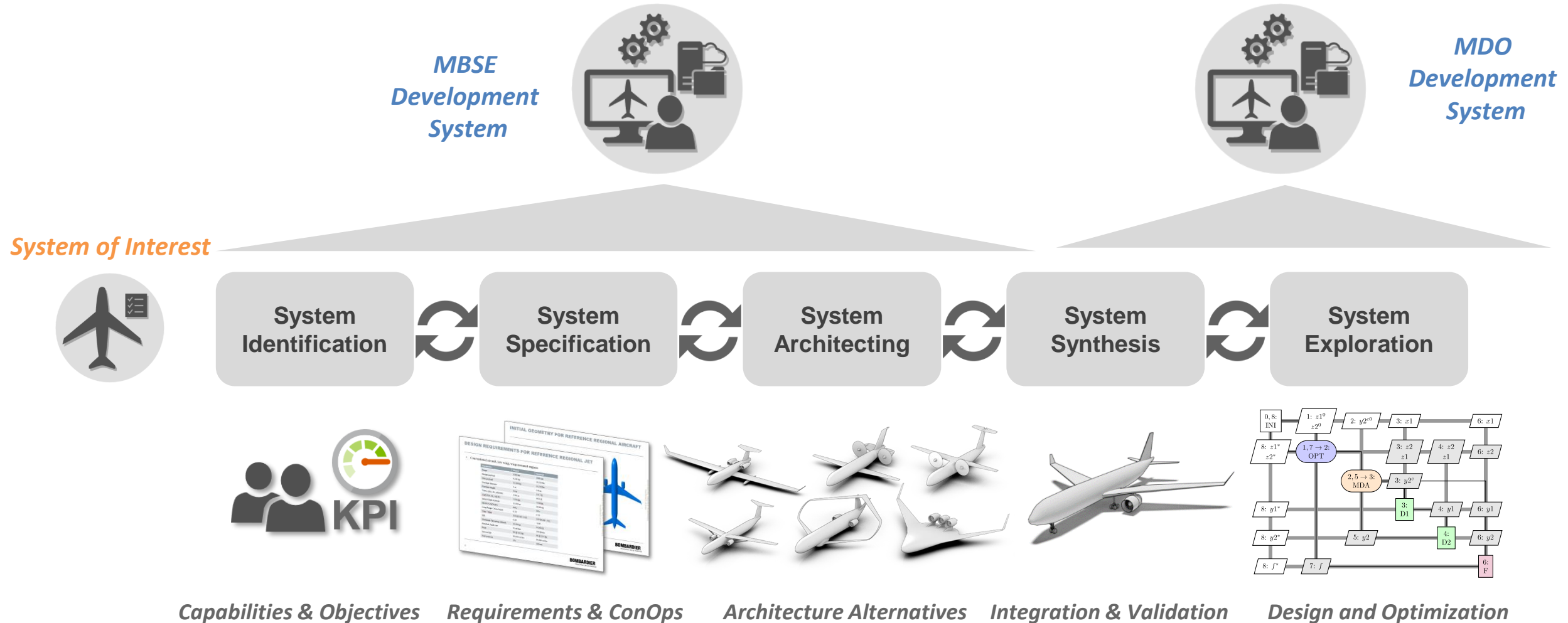
Design & Opt. Process



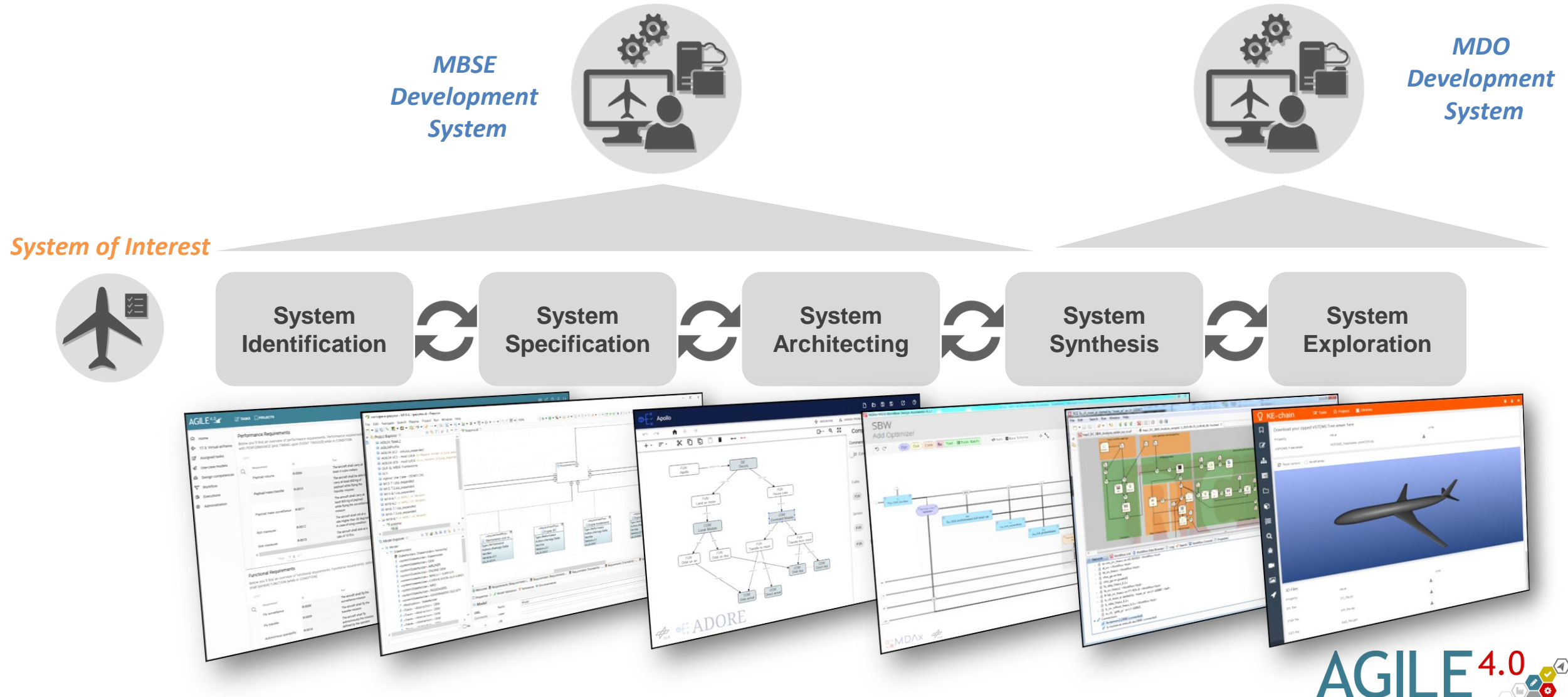
Architecture



The “Development Systems” in AGILE4.0

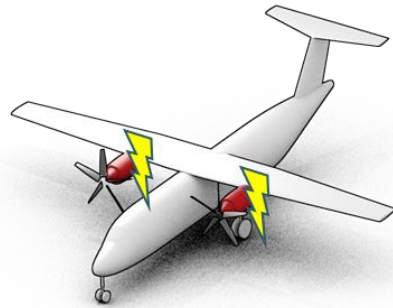


The “Development Systems” in AGILE4.0



Example of Models and Results of the Applications

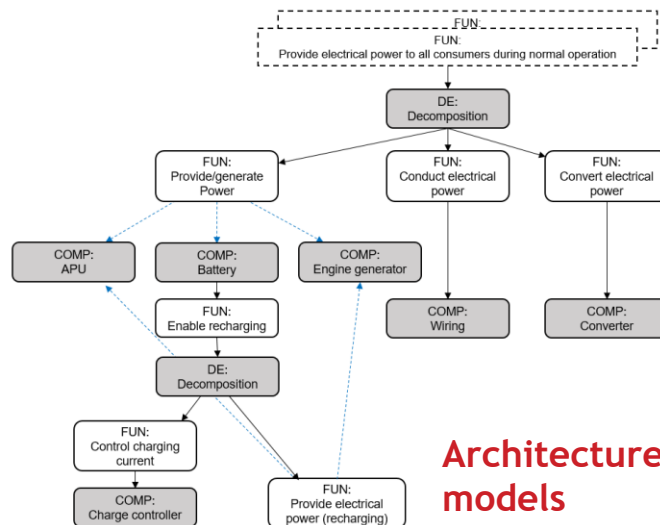
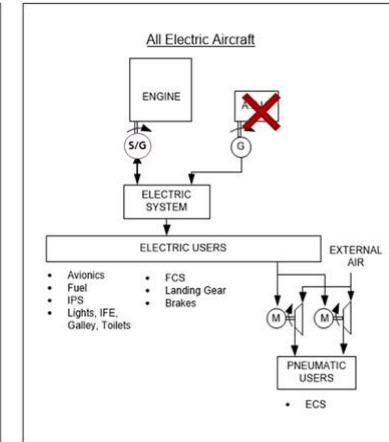
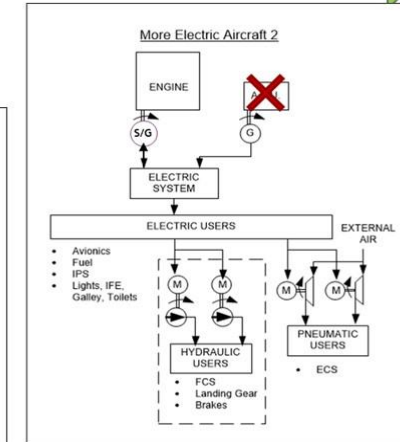
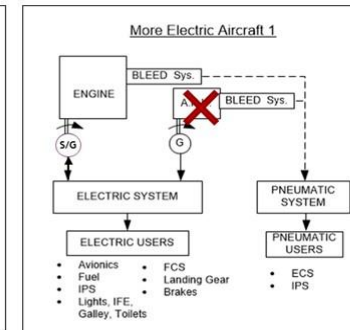
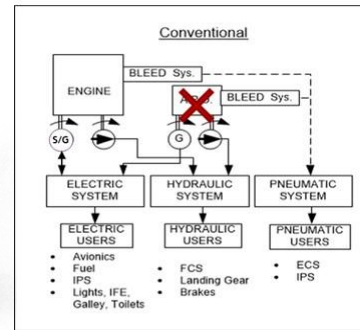
"Electrify the aircraft safely"



Integration of **certification constraints** for aircraft with conventional and **innovative systems** in the MDO process

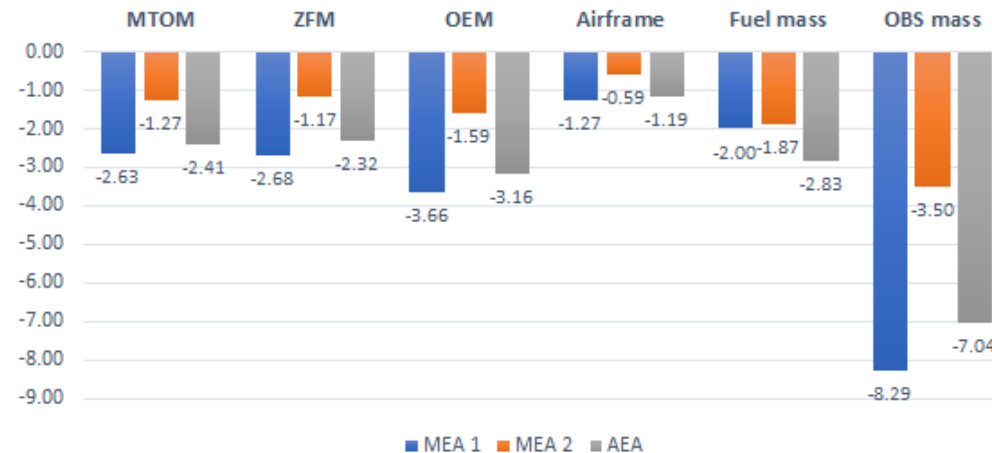
Increasing OBS Electrification Level →

- 4 different architectures with increasing level of electrification



Architecture models

Masses: Δ [%] ref. conventional



source: Fioriti et al., Multidisciplinary design of a more electric regional aircraft including certification constraints, AIAA 2022

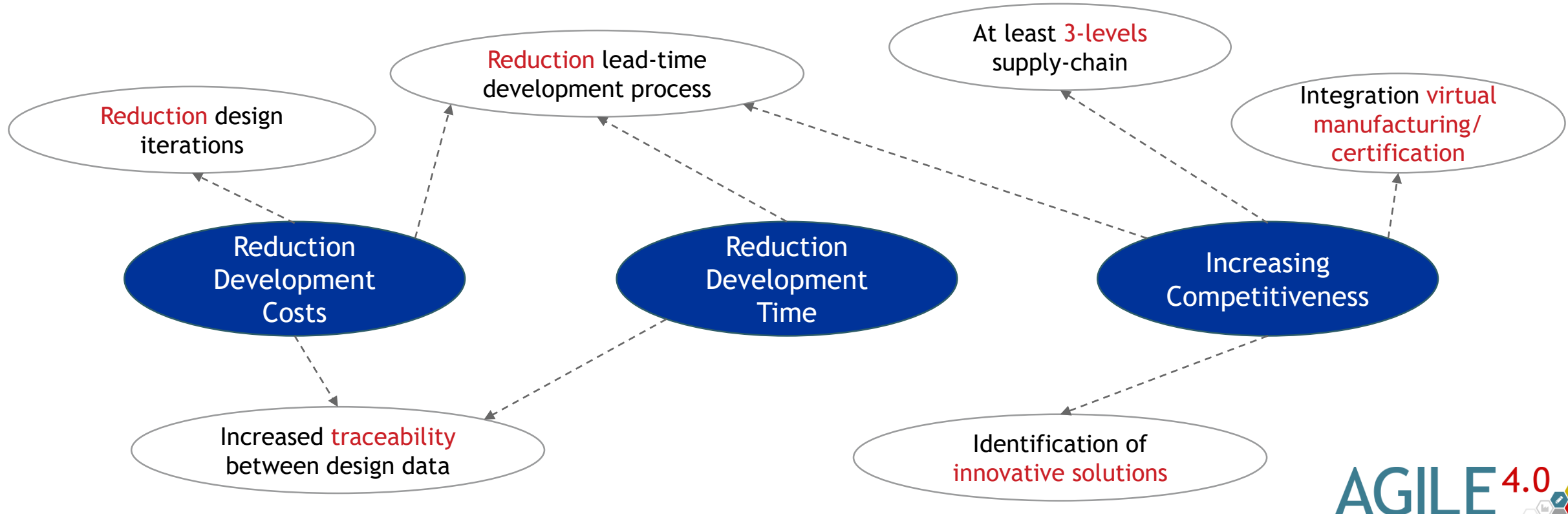
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Benefits of the digital AGILE 4.0 development approach

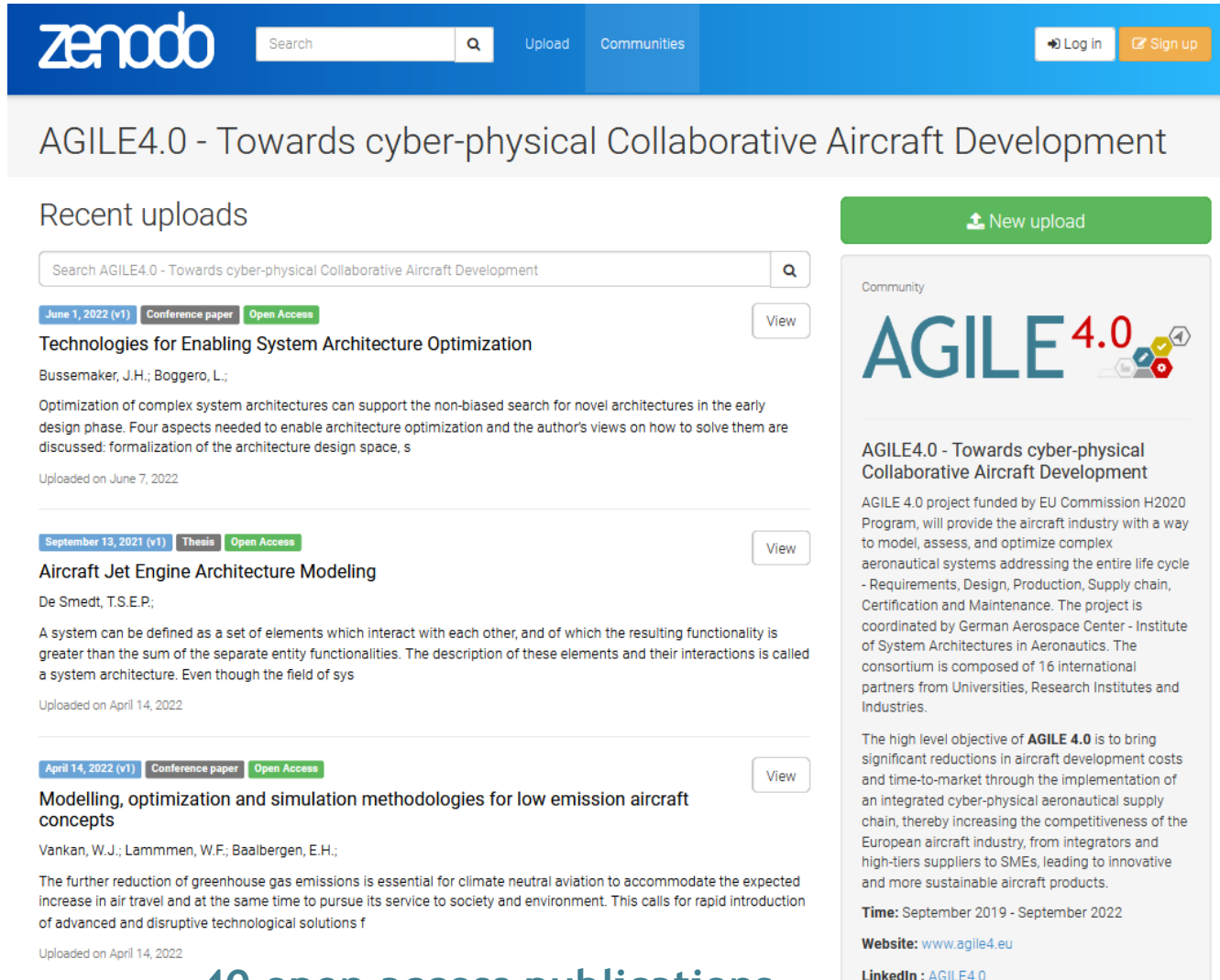


AGILE 4.0 project ambition:

“The high-level objective of AGILE4.0 is to bring significant reductions in aircraft development costs and time-to-market through the implementation of an integrated cyber-physical aeronautical supply chain, thereby increasing the competitiveness of the European aircraft industry, from integrators and high-tiers suppliers to SMEs, leading to innovative and more sustainable aircraft products”



Project Dissemination



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June 1, 2022 (v1) Conference paper Open Access View

Technologies for Enabling System Architecture Optimization

Bussemaker, J.H.; Boggero, L.;

Optimization of complex system architectures can support the non-biased search for novel architectures in the early design phase. Four aspects needed to enable architecture optimization and the author's views on how to solve them are discussed: formalization of the architecture design space, s

Uploaded on June 7, 2022

September 13, 2021 (v1) Thesis Open Access View

Aircraft Jet Engine Architecture Modeling

De Smedt, T.S.E.P.;

A system can be defined as a set of elements which interact with each other, and of which the resulting functionality is greater than the sum of the separate entity functionalities. The description of these elements and their interactions is called a system architecture. Even though the field of sys

Uploaded on April 14, 2022

April 14, 2022 (v1) Conference paper Open Access View

Modelling, optimization and simulation methodologies for low emission aircraft concepts

Vankan, W.J.; Lammman, W.F.; Baalbergen, E.H.;

The further reduction of greenhouse gas emissions is essential for climate neutral aviation to accommodate the expected increase in air travel and at the same time to pursue its service to society and environment. This calls for rapid introduction of advanced and disruptive technological solutions f

Uploaded on April 14, 2022

~ 40 open access publications



Aim: Let students developing their aeronautical systems with the **AGILE 4.0 technologies**

Sep 2021-April 2022
For non AGILE4.0 members

Key numbers:

- 34 Students
- 20 Organizations
- 11 Nations
- 4 Continents
- 3 Teams
- 1 Winner

Format:

- Biweekly lectures
- Video tutorials
- Presentations
- DEMO sessions
- Homework
- Review

Objectives:

- Learn about **MBSE**
- Learn about **AGILE4.0 Technologies**
- Apply technologies on **their own** Task
- ...WIN THE Competition!





AIRBUS

BOMBARDIER

CFS Engineering
Computational Fluids & Structures Engineering

ONERA
THE FRENCH AEROSPACE LAB

UNIVERSITÉ
Concordia
UNIVERSITY

EMBRAER

Fokker
GKN AEROSPACE

ISAE
Institut Supérieur de l'Aéronautique et de l'Espace
SUPAERO

KE-works

LEONARDO

nlr

ILR Institute of Aerospace Systems
RWTH AACHEN
UNIVERSITY

Politecnico
di Torino
1859

TU Delft

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Thank you for your attention!



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Deutsches Zentrum
für Luft- und Raumfahrt
German Aerospace Center

Institute of System Architectures in
Aeronautics
HAMBURG

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HORIZON 2020

For more information:

