

AGILE AIRCRAFT 3RD GENERATION MDO FOR INNOVATIVE COLLABORATION OF HETEROGENEOUS TEAMS OF EXPERTS

AGILE PROJECT

A COLLABORATIVE MDO APPROACH

FIRST EUROPEAN OPENMDAO WORKSHOP
12-13 OCTOBER 2017, TOULOUSE



Pier Davide Ciampa
Team lead MDO



Deutsches Zentrum
für Luft- und Raumfahrt
German Aerospace Center

Aircraft Design & Systems Integration
Hamburg

*"Can We Establish a
Collaborative MDO community?"*



This project has received funding from the European Union's Horizon 2020 research and innovation framework programme under grant agreement No 636202

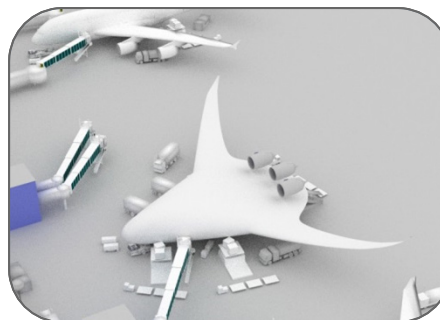
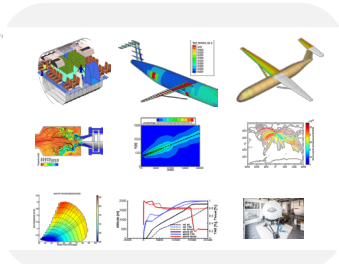
HORIZON 2020
PROJECTS

Evolution of MDO in aeronautics

Operational

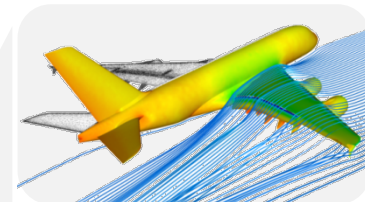


Multidisciplinary

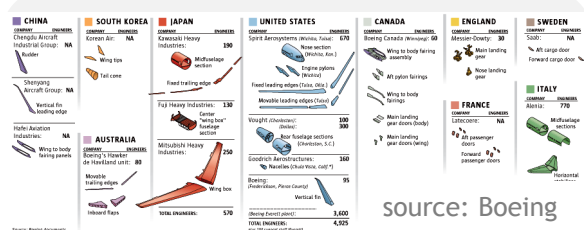


source: dlr.de

Technologies



source: dlr.de



source: Boeing

Extended Supply Chain

source: p.d. ciampa, b.nagel, "The AGILE Paradigm: the next generation of collaborative MDO," AIAA 2017-4137



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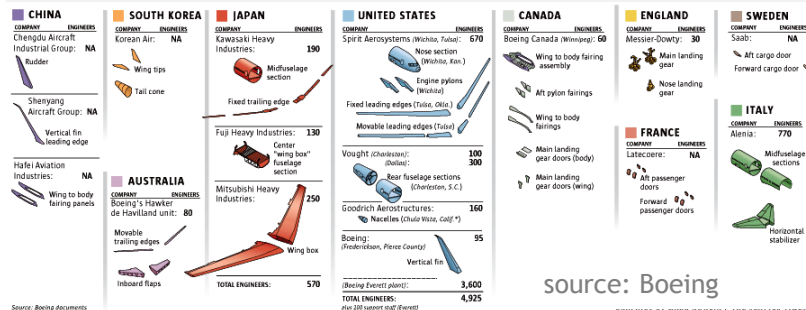
Today's Challenges for aircraft development (and MDO)

- Aircraft Product Development → large number of **parts** and design **sub-processes**
- Cross-organizational → **distributed** and **heterogeneous** knowledge and expertise
- Much more constraints → higher level integration of design aspects

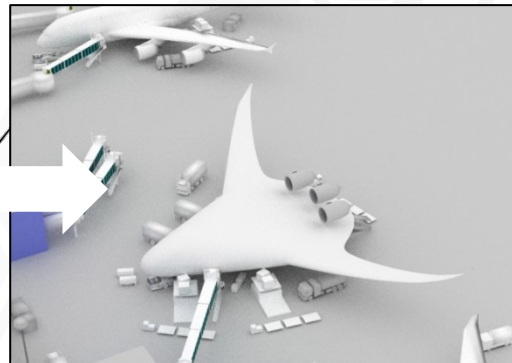
How to enable effective Collaborative MDO?

Today (~10 years from TLAR to flight)

Tomorrow?



source: Boeing



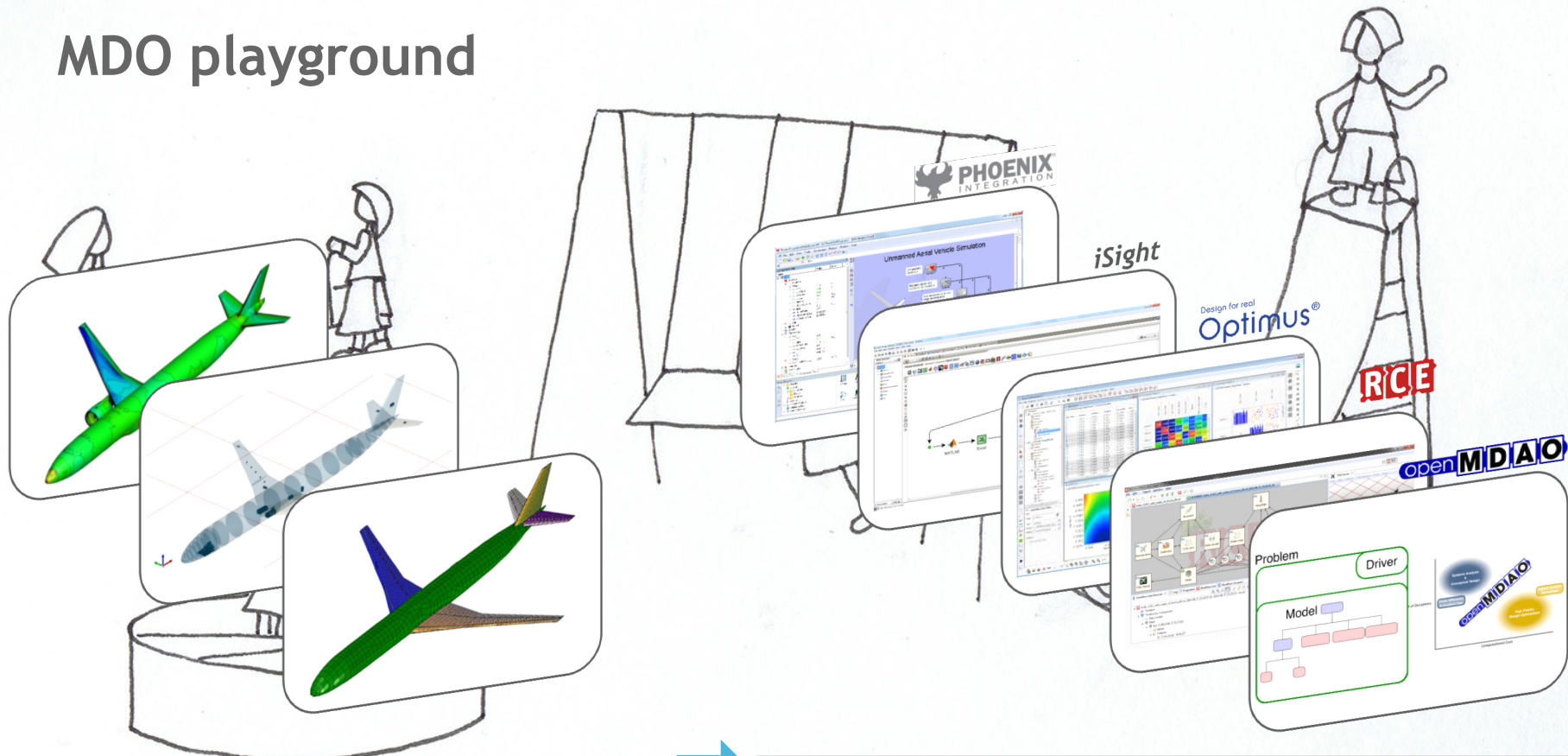
source: dlr.de

Number of parts: 6 millions
Design changes per year: 150 000

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MDO playground



Pool of Simulation Tools

Integration and Optimization environments
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Current Challenges in MDO RTD Projects

“Setup” challenges

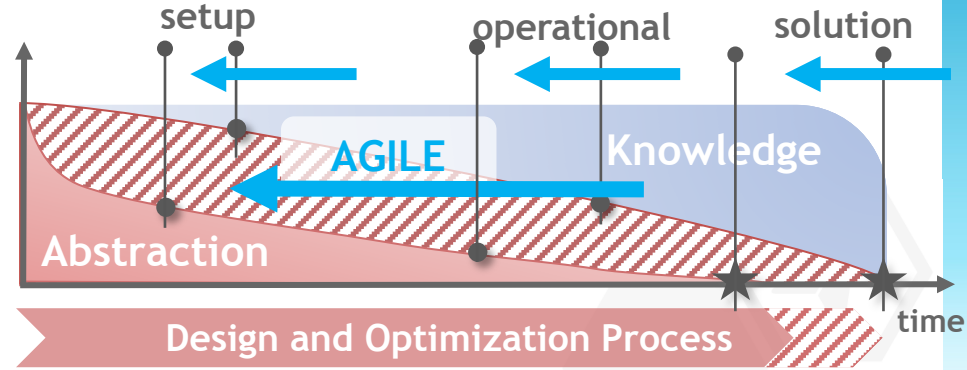
- Define and deploy large MDO processes
- Connecting cross-organizational competences
- Enable coherent products descriptions

“Operational” challenges

- Support the collaborative decisions making
- Facilitate re-configuration of the design processes
- Flexible integration new competences, requirements

“Solution” challenges

- Achieve an optimal and robust solution
- Achieve it within the available time



Setup phase: 60% - 80% project time*

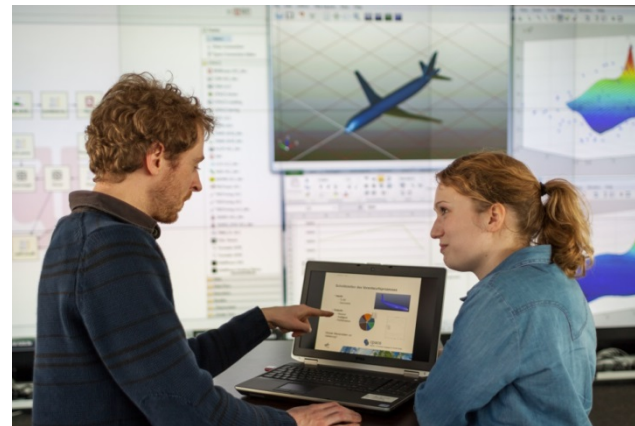
*survey of last 20 years of MDO RTD oriented projects [3-5 yrs],
source: p.d. ciampa, b.nagel, "The AGILE Paradigm: the next generation of collaborative MDO," AIAA 2017-4137

Consequences → Reduction of the design space

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<http://agile-project.eu>

EU funded H2020 project: 06/2015-06/2018

- 19 International Partners (EU, Russia, Canada)
- ~ 9M EUR, ~120 MM
- Coordinated by DLR in Hamburg
- Only recent EU project **dedicated to next generation MDO processes**

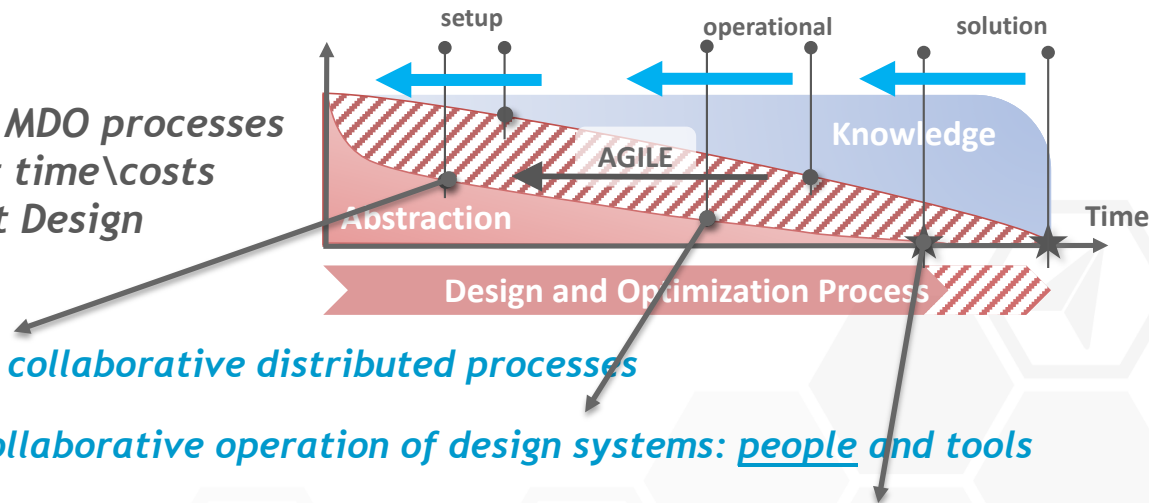
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AGILE Ambition

Objectives:

- Realize the next generation of MDO processes
- Reducing aircraft development time\costs
- Enabling Collaborative Aircraft Design



AGILE Configurations

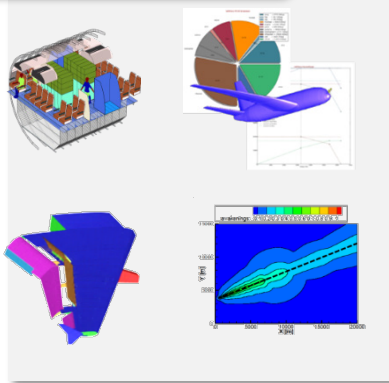


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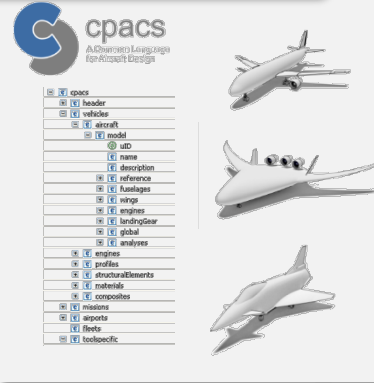


Next generation MDO enablers

design competences

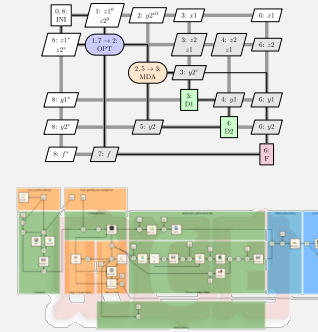


common language

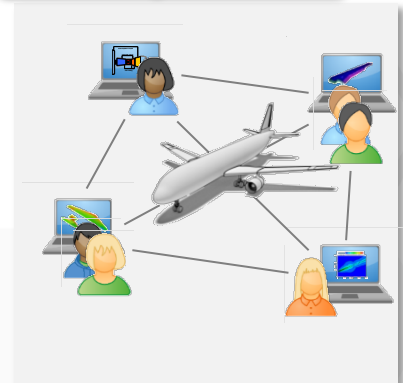


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process orchestration

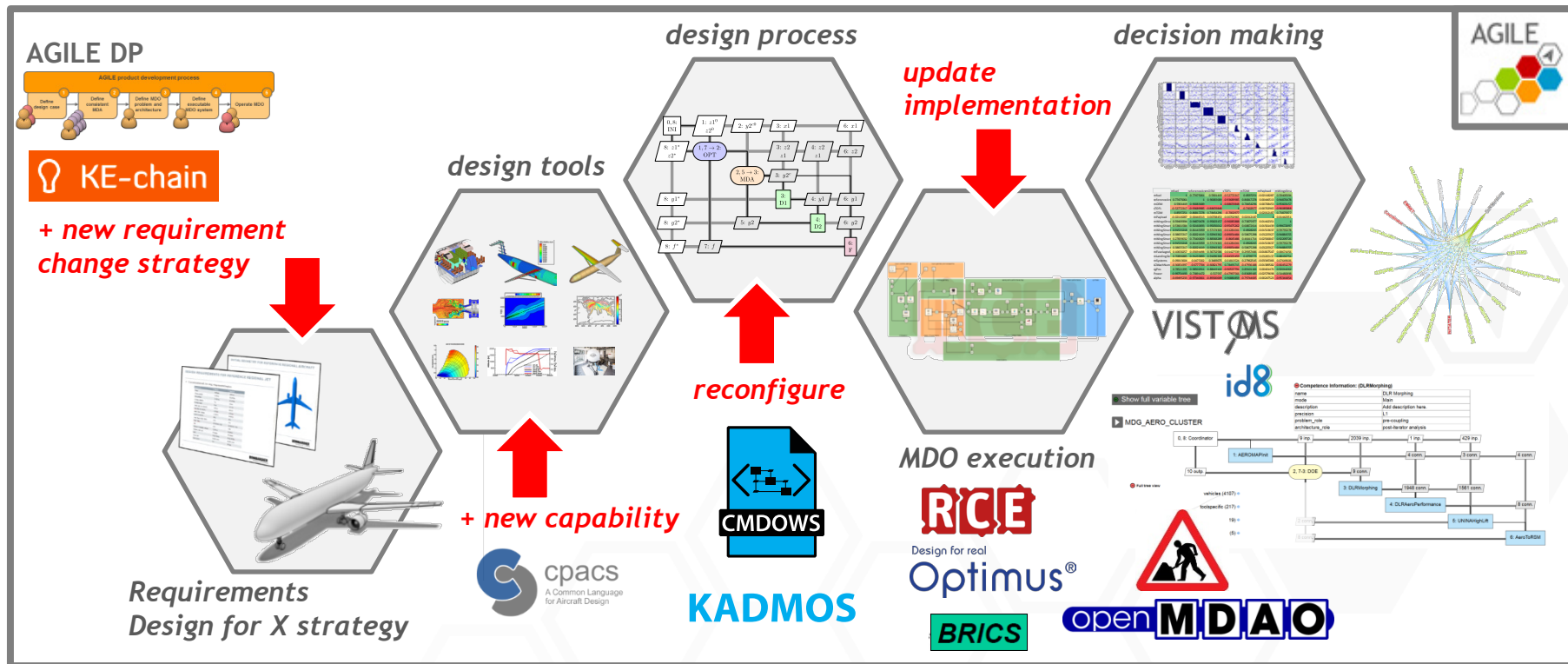


knowledge integration



AGILE Development - *Phases*

AGILE Framework



source: p.d. ciampa, b.nagel, "The AGILE Paradigm: the next generation of collaborative MDO," AIAA 2017-4137



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AGILE Development - *Participative Agents*

- Define the design task and product metrics
- Formalize the design phases and process(-es)



Architect

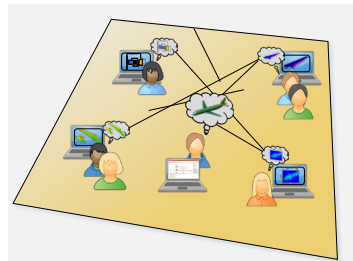
Integrator



- Formulate the integration and optimization strategy
- Formalize the MDO process(-es)

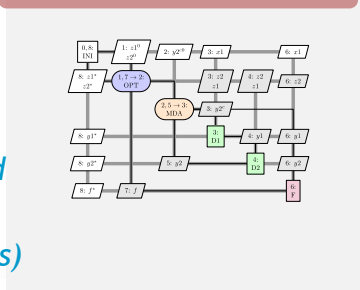


Design Task

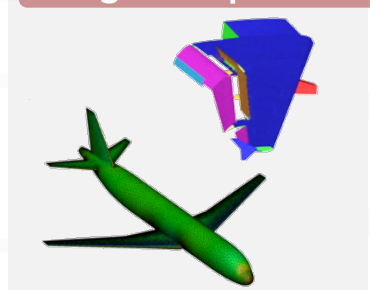


Collaboration

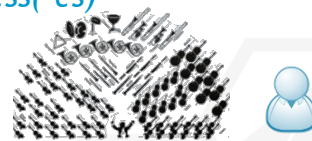
MDAO Process



Design Competence



- Enable the collaborative operation of the system
- Formalize the collaborative process(-es)



Collaborative Eng.

Specialist



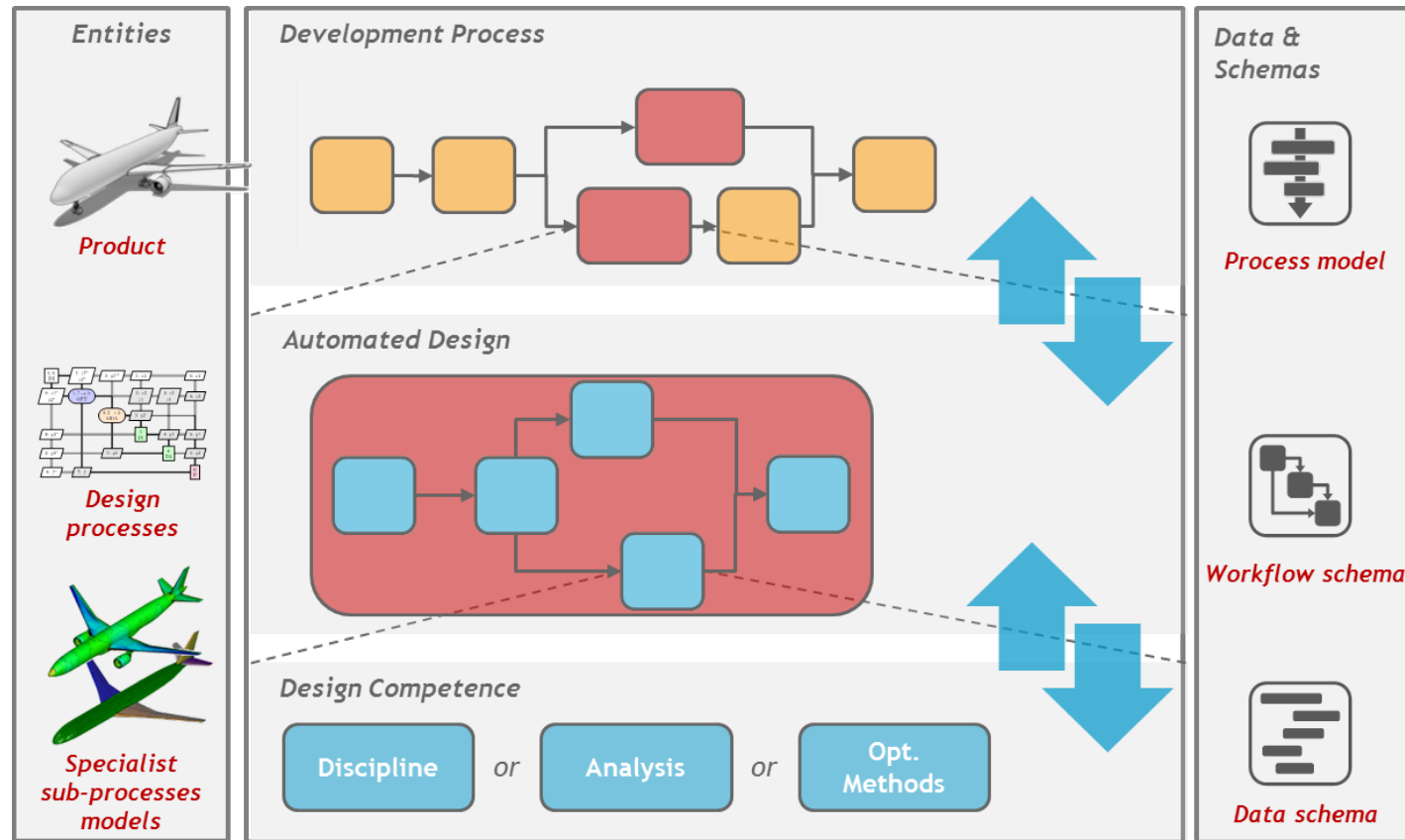
- Provide Design Capabilities
- Formalize the disciplinary knowledge

source: p.d. ciampa, b.nagel, "The AGILE Paradigm: the next generation of collaborative MDO," AIAA 2017-4137



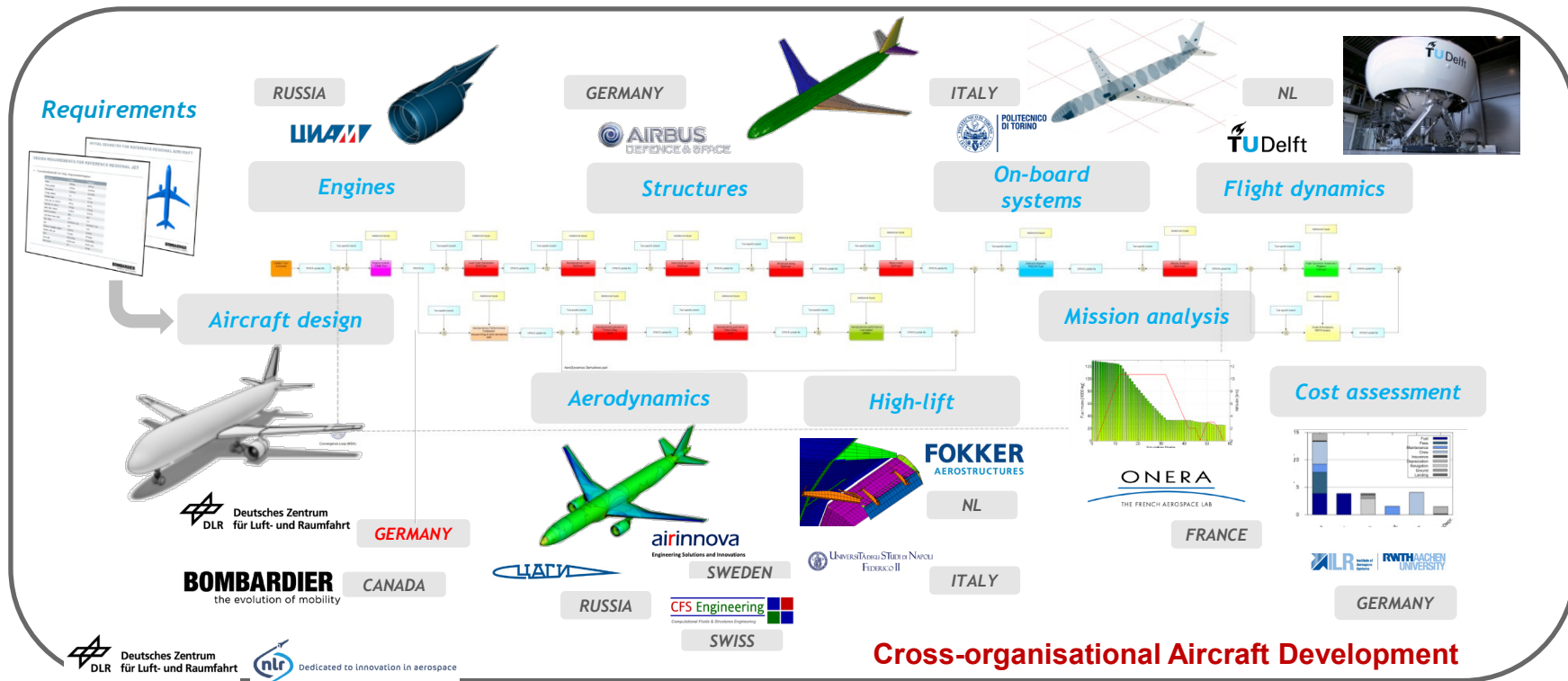
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AGILE Development - *Architecture*



source: p.d. ciampa, b.nagel, "The AGILE Paradigm: the next generation of collaborative MDO," AIAA 2017-4137

AGILE - Collaborative Process From TLAR to...flying!!!



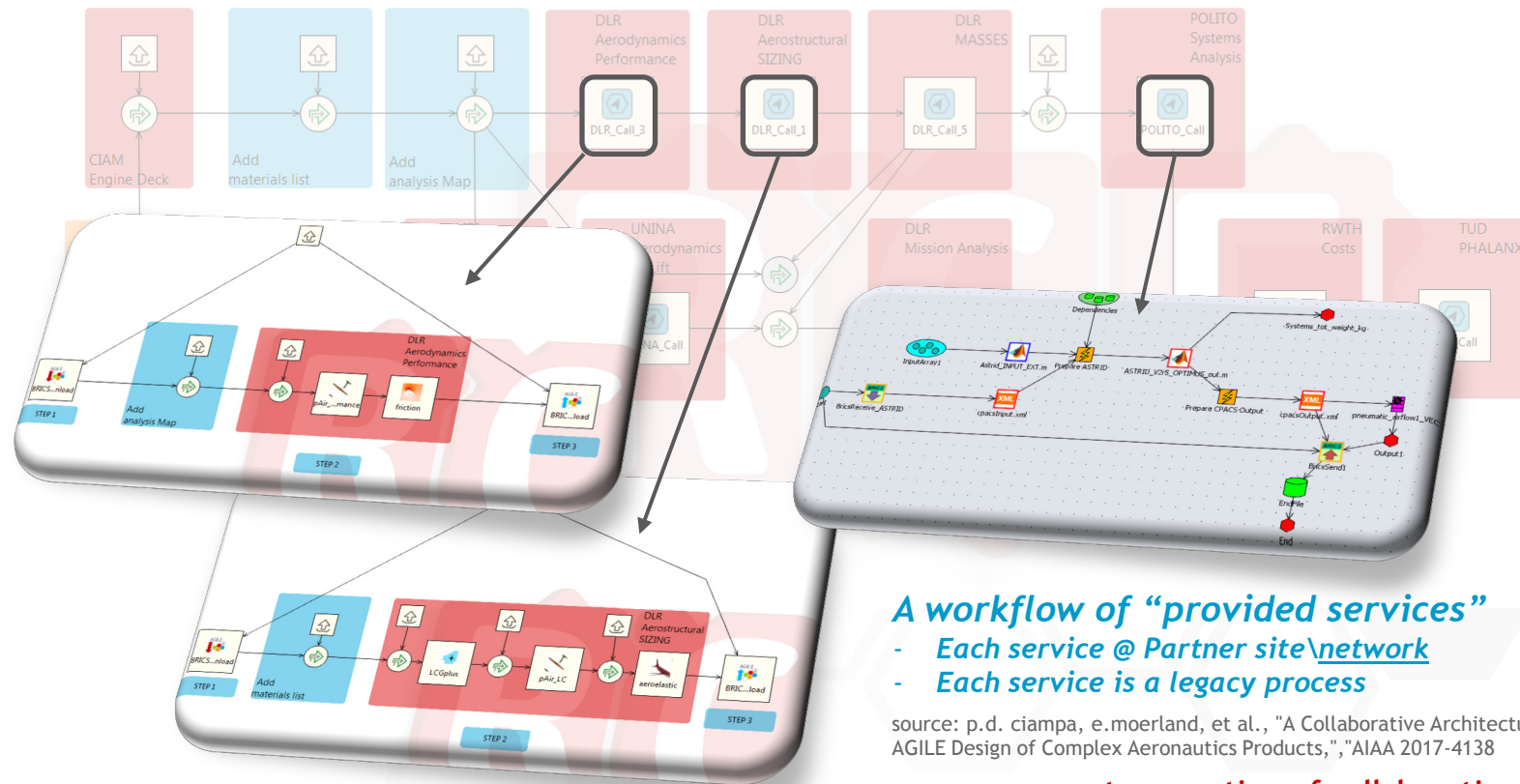
Cross-organisational Aircraft Development

source: p.d. ciampa, b.nagel, "The AGILE Paradigm: the next generation of collaborative MDO," AIAA 2017-4137

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AGILE - Service Oriented Architecture



A workflow of “provided services”

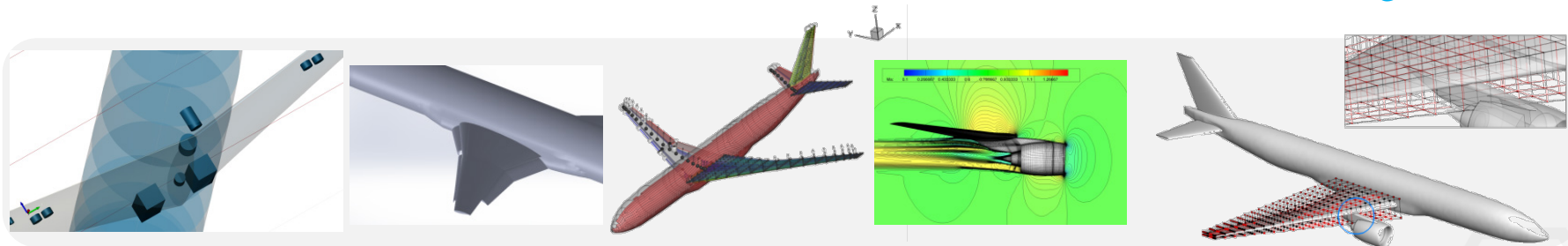
- Each service @ Partner site/network
- Each service is a legacy process

source: p.d. ciampa, e.moerland, et al., "A Collaborative Architecture supporting AGILE Design of Complex Aeronautics Products," "AIAA 2017-4138

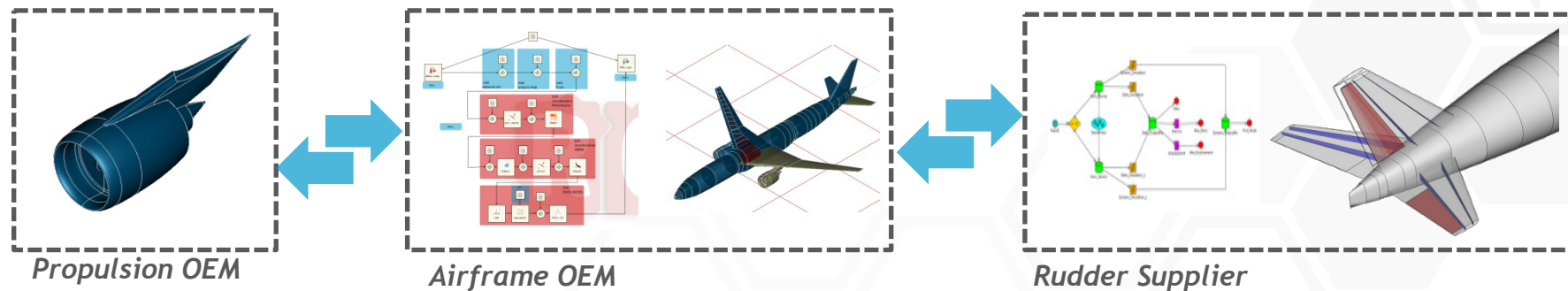
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AGILE use cases & Scenarios

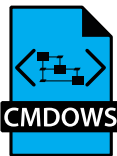
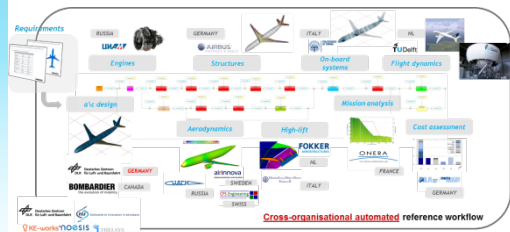
Execute Models @ Partners



Multiple Scenarios



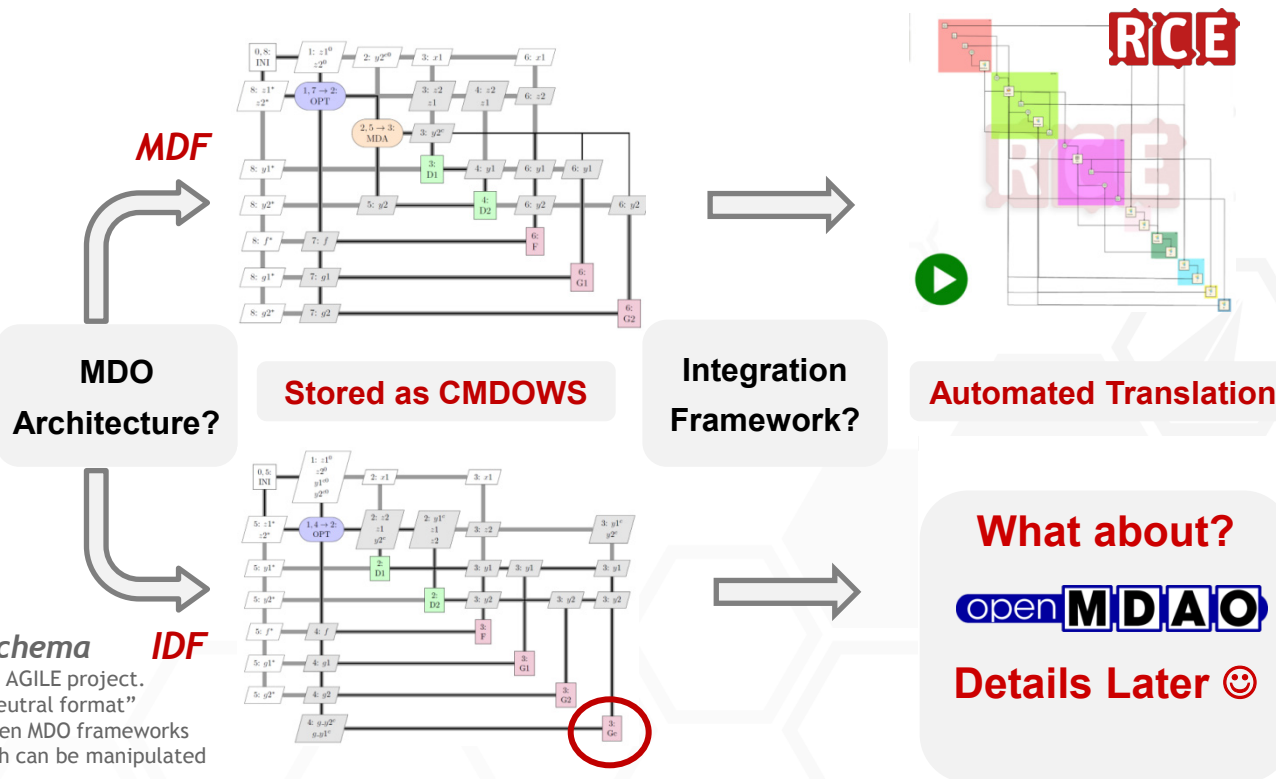
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Common MDO Workflow Schema

- ④ MDO process description developed in AGILE project.
- ④ Formalizes the MDO processes in a “neutral format”
- ④ Enable to share MDO processes between MDO frameworks
- ④ Provides the MDO process model which can be manipulated

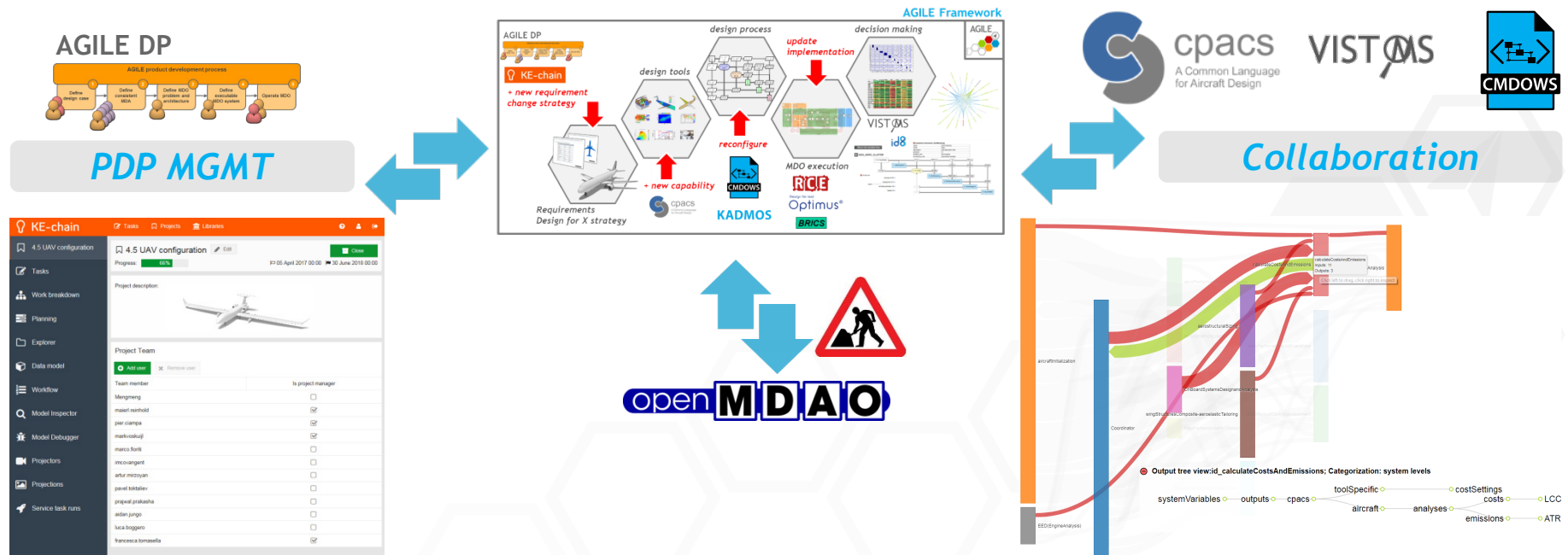
cmdows-repo.agile-project.eu



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AGILE Development Process

- Support the automation of collaborative MDO processes
- Management of Product Development Processes



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Next steps

■ Challenges for the next generation MDO

- Quick setup of large workflow of tools and people
- Deploy distributed cross-organizational design processes
- Lack of formalization of MDO processes

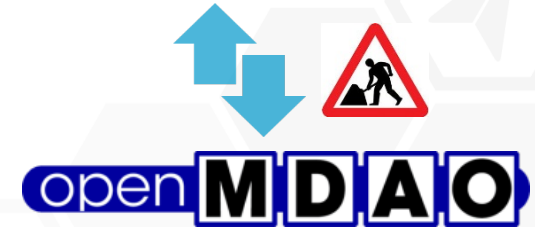
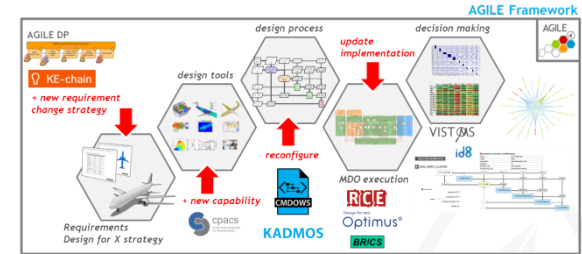
■ AGILE achievements

- A collaborative environment operational with 19 partners for multiple use cases and scenarios
- MDO processes formalized
- Product Development process streamlined

■ Exploitation in the (open)MDAO Community

- Extending the collaborative MDO community
- **What about AGILE supporting the setup of openMDAO problems?**

+ *setup of distribution MDO problem*



+ *resolving of the MDO problem*



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More information about AGILE:
www.agile-project.eu

Pier Davide Ciampa pier-davide.ciampa@dlr.de
 Team lead MDO



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 Collaborative MDO community?”***

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