MODEL BASED SYSTEMS ENGINEERING : ARIANE GROUP LESSONS LEARNED

Stuttgart 13 march 2018

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01
INTRODUCTION

ARIANE GROUP EXPERIENCE IN COMPLEX SYSTEMS ENGINEERING

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ARIANE GROUP EXPERIENCE IN COMPLEX SYSTEMS ENGINEERING

CIVIL SECTOR

- Development and production of Ariane 5 and Ariane 6 launchers
- Solid rocket motors for the Vega launcher
- Research and design studies for future launch systems

Ariane 5

Ariane 6

DEFENSE

Legacy mission of supporting France's nuclear deterrent force as prime contractor for strategic ballistic missiles

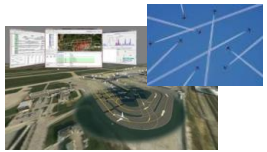
M51

PRODUCTS, EQUIPMENT & SERVICES

Building on its original core business, **ArianeGroup** also offers a range of derivative products and associated services for civil and military applications

Space Surveillance

Air Traffic Management



Nuclear Infrastructures

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02
CHALLENGES AND VISION

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SYSTEM ENGINEERING : OUR CHALLENGES

The design of Launcher, Missile services is a multidisciplinary activity that requires the contribution of numerous experts in specific and various domains (mechanics, thermic, software, avionics, telecommunications, power, propulsion, safety, costing, etc.).

Our system are more and more complex and new challenges appeared as production pulled cycle, cost and delay reduction.

To succeed, this requires the implementation of an efficient Systems Engineering approach and effective communication between the domains and sub-contractors throughout the project's life cycle :

- **from the definition of the needs to the maintenance, including the design, development, IVV, manufacturing and operations phases.**

➔ **The challenges are to improve our ability to capture, analyze, share, and manage the information associated with the complete specification and design of the system.**

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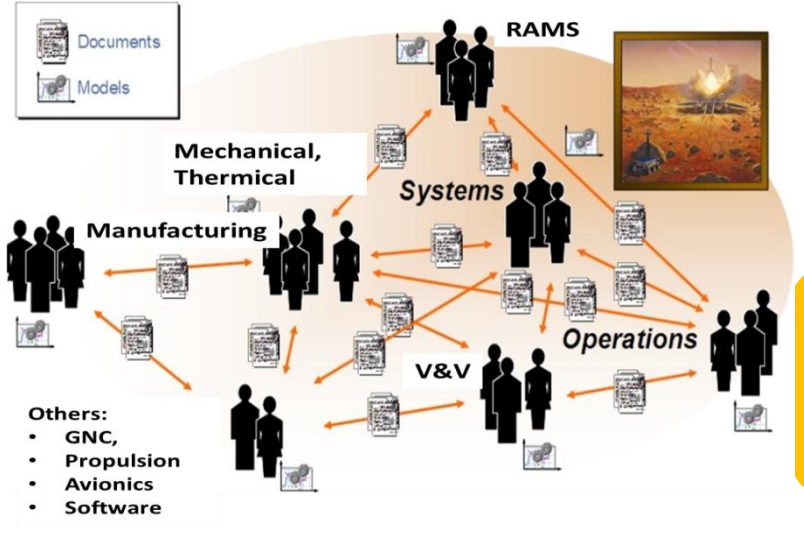
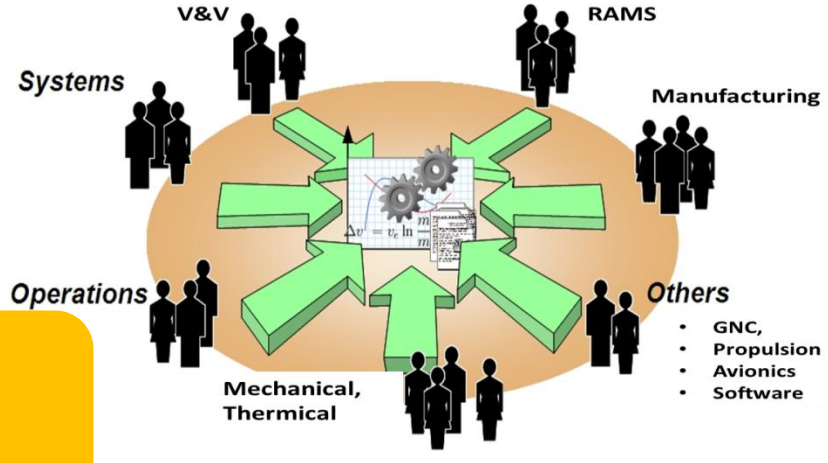
SYSTEM ENGINEERING : OUR VISION

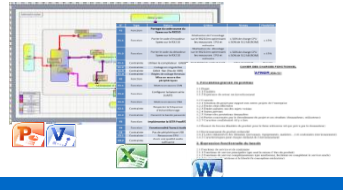


- Specifications
- Requirements
- Interfaces
- Functions
- Data
- System archi, design
- Analysis & Trade-off



Future: Shared system model with multiple views, and connected to discipline models

Today: Standalone models related through documents



➔ **Our vision is that in 2025 we will have a framework similar to the Digital Mock-up for system engineering disciplines.**

03

USES CASES & CULTURAL CHANGE

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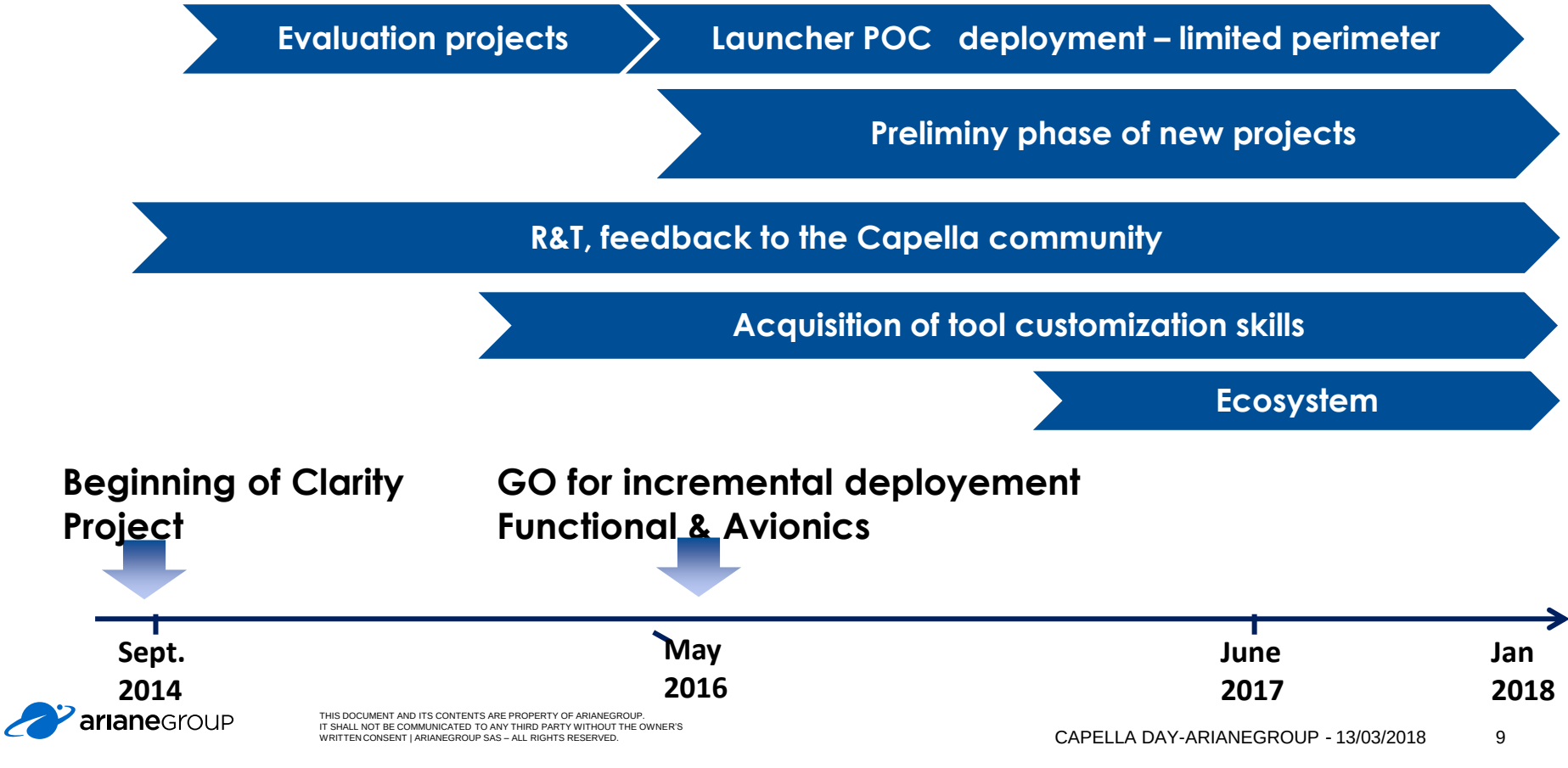
CLARITY AND CAPELLA IN ARIANE GROUP



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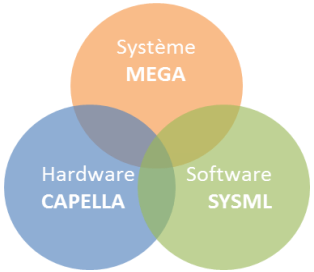
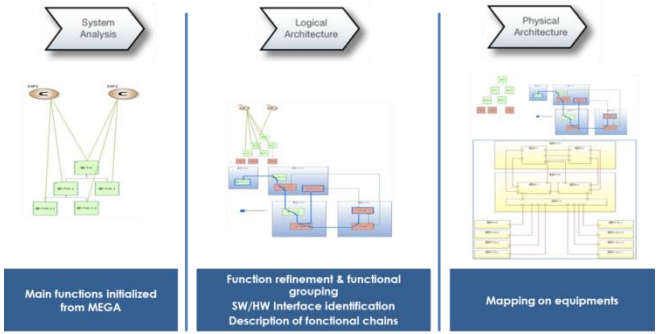
AR6 LAUNCHER : EXTENTED AVIONICS WITH CAPELLA

Objective :

- **Complete the System – Hardware – Software MBSE triptych.**
  - Build Guideline limited to useful concept for not expert modeler
  - Generate the documentation asking for review with M2DOC





Difficulty :

- **Launcher design was already started**
- **Capella & ecosystem is still in evolution**
- **Architecture modelling tool is a cultural change for Avionics teams**

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RAMS* WITH CAPELLA

Objectives:

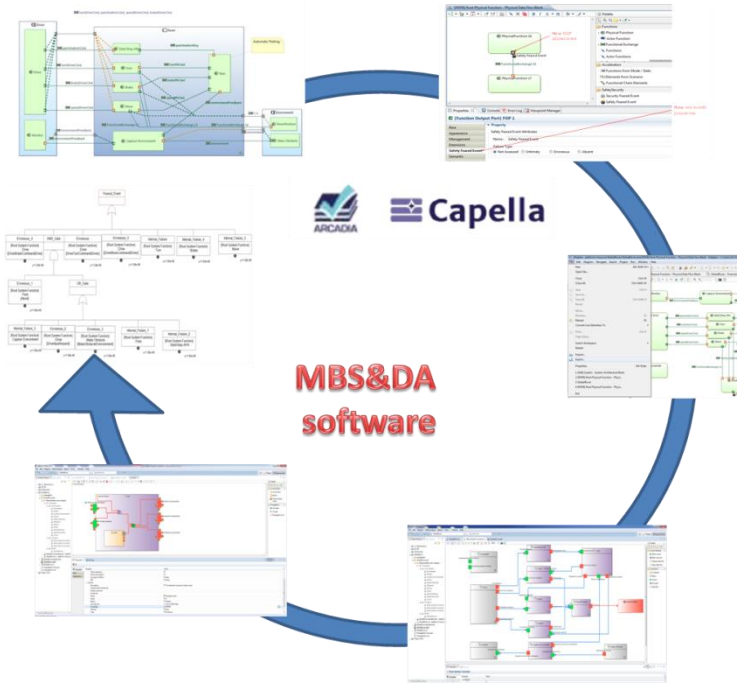
- **Consider the Model Based Approach in RAMS process (MBSE and MBSA)**
  - To improve transfer of information from SE to RAMS discipline for carrying out classical Safety and Dependability analyses
  - To extend the model based approach to the RAMS activities (MBSnDA) and Propose data structure for the RAMS results

Achievements:

- **Either extract, from System Models, sufficient information to initiate RAMS models in a dedicated platform**
- **And enhance the System Models of Safety and Dependability information in a MBSE platform**

2018 perspectives

- **Develop the Capella/MBS&DA software connector to automatizing the data transfers**



*Reliability Availability Maintainability Safety

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VALIDATION & VERIFICATION WITH CAPELLA

Objectives:

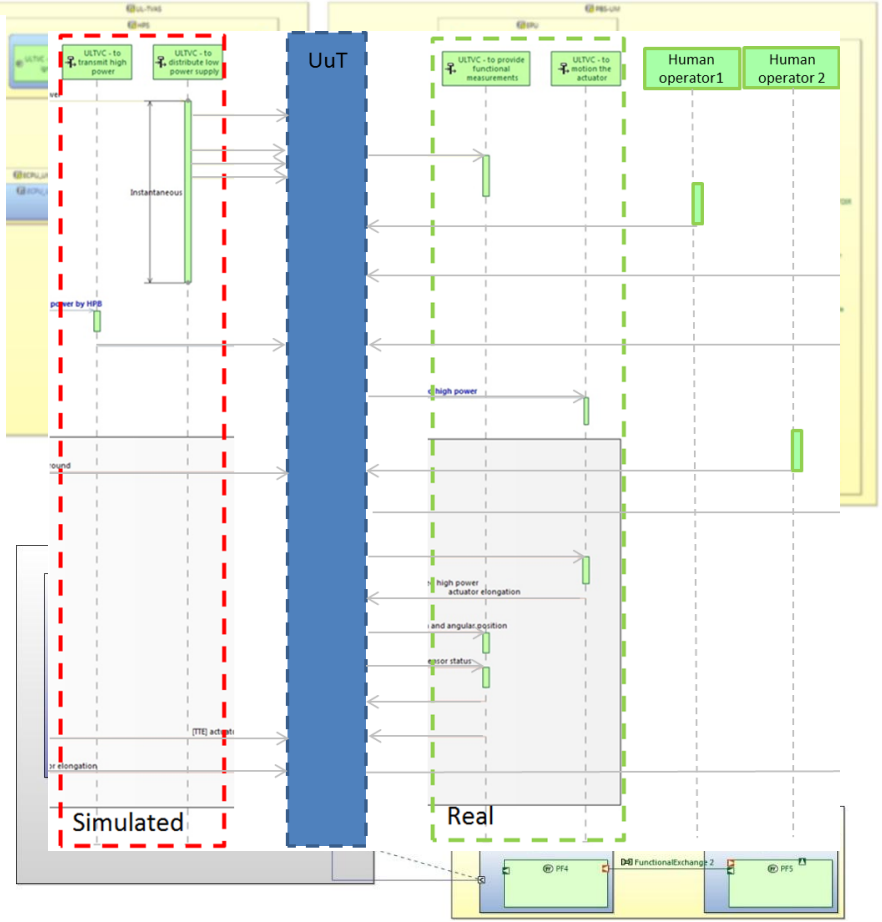
- **Demonstrate CAPELLA (MBSE tool) capacities to help to define V&V test scenario in early design phase**

Achievements:

- **Viewpoint development to create from launcher architecture model :**
  - Test Objectives
  - Selection of the Unit under Test
  - Creation of Test Family
  - Visualization of the functions allocated in a test

2018 perspectives

- **Finalize the Capella viewpoint to model test mean bench from equipment under test**
- **Develop linked test scenario diagram**



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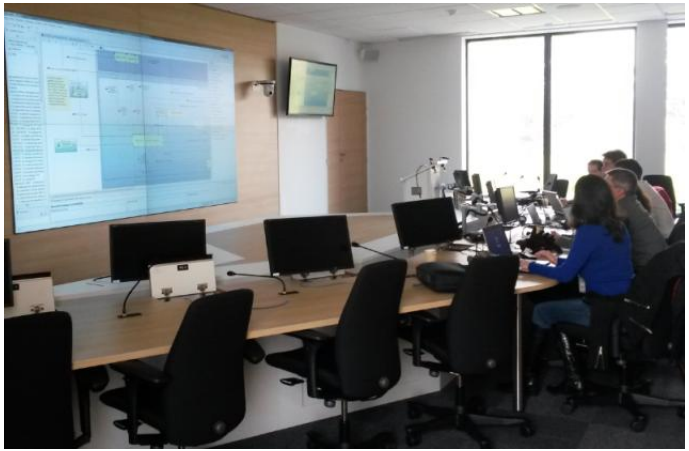
CULTURAL CHANGE: MBSE FOR ALL

Internal communication

Training session

Coaching



FeedBack : Don’t underestimate the effort to reach the team acceptance

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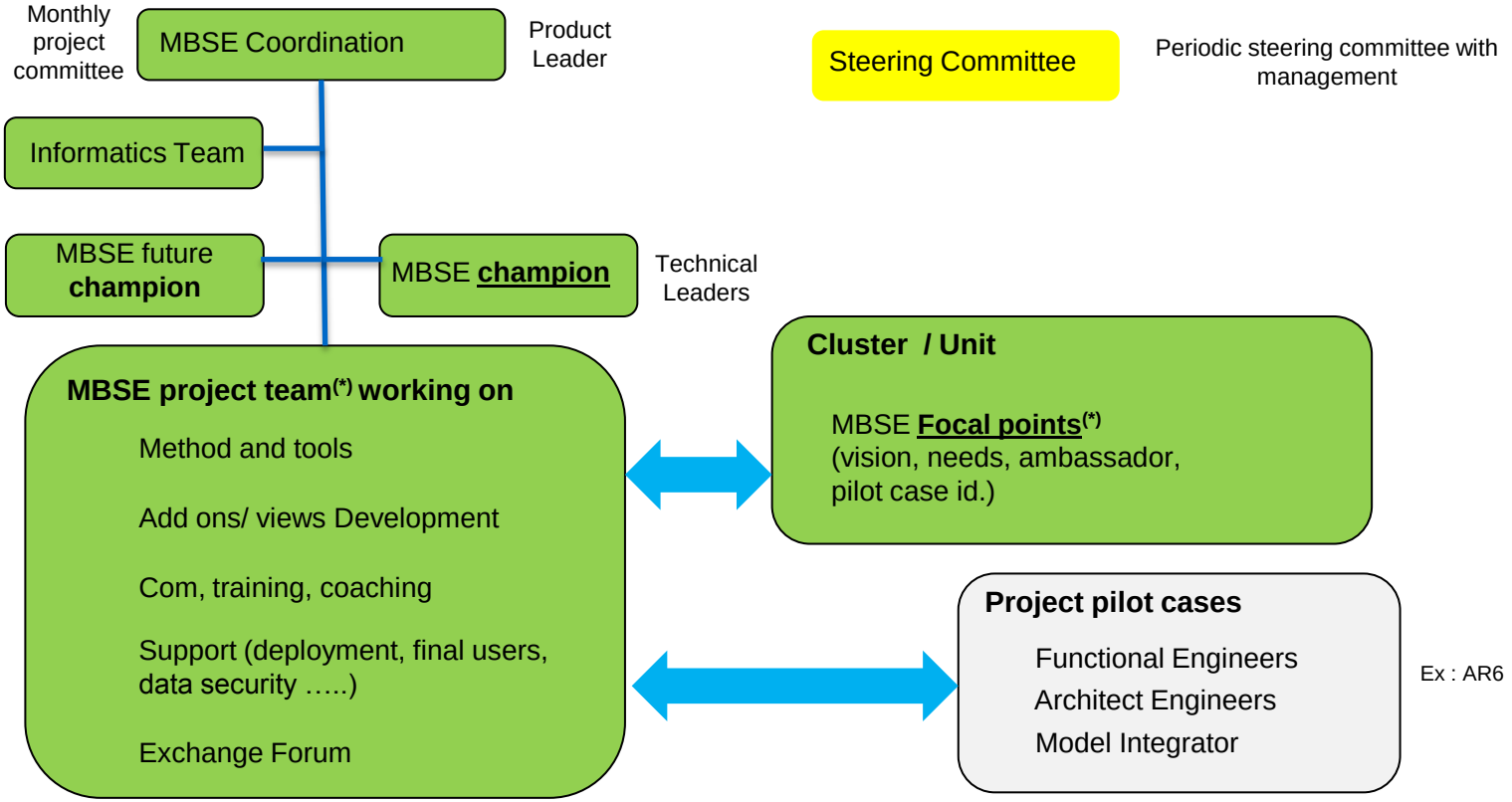
MBSE GOVERNANCE



* MBSE project members could be from different cluster, unit but shall report MBSE project leader (could be also MBSE cluster focal point)

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04
CONCLUSIONS

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CONCLUSIONS

MBSE is considered as a key enabler of Ariane Group systems engineering vision

The current implementation of this process based on Arcadia / Capella shall be reinforced to :

- **Facilitate the creation of models across all engineering disciplines**
- **Enlarge model integration to other domains repository (requirements, Product Lifecycle Management, Digital Mock Up, …)**
- **Reinforce model integration between layers and between domains.**
- **Add new capabilities (reuse, variability, data security, configuration & change management, link with simulation and testing).**

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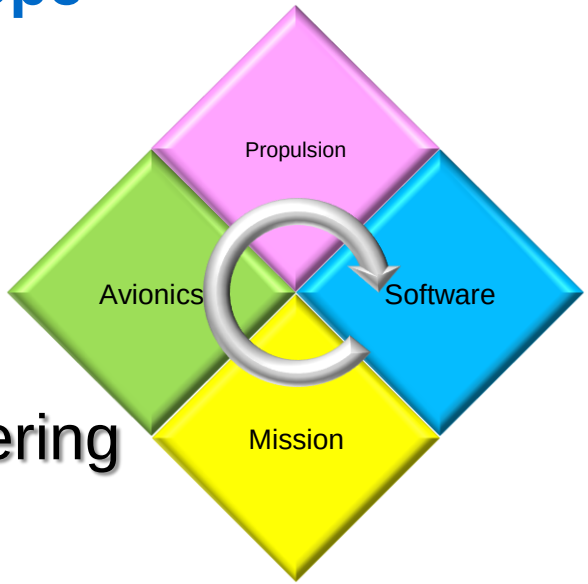
CONCLUSIONS

Next steps : Extension of MBSE scope

- ✓ Interface management
- ✓ Fluidic engineering
- ✓ Ground operations
- ✓ Assembly Integration Test engineering



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CONCLUSIONS

This is a must, as we need to drive innovation of future Capella versions while managing cost and lead time as well…

Therefore MBSE is an area where Ariane Group will continue with regular exchanges with Capella ecosystem.

Of course this is also an excellent area where Ariane Group is open and could request collaboration with partners.

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