Model Based Systems Architecture – Consider the UX perspective

Kyle Hall – Airbus

Tough questions

What benefit do <u>I</u> get from MBSE?

But, <u>I</u> am not a System Engineer.

<u>This</u> is too complex!

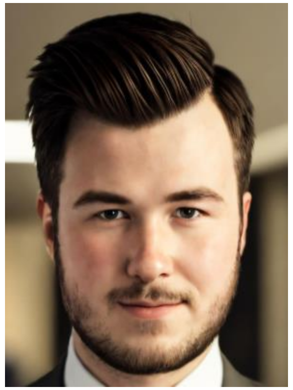
Presenters Bio

Kyle Hall
Data Driven System Engineer

Engineering Methods

AIRBUS

Kyle.Hall@airbus.com



Kyle Hall is a Data Driven System Engineer within Airbus Commercial Aircraft, based in Filton (Bristol), UK

Kyle graduated from the University of Bristol, majoring in Physics. Kyle joined Airbus in 2016, supporting the development of rapid and scalable surrogate modelling techniques and the MoSSEC common metadata standard (ISO 10303-243), eventually becoming the MoSSEC project lead in 2022.

Today Kyle is a key member of the Airbus transdisciplinary Engineering Methods team, maturing and supporting the implementation of many new and innovative methodologies for Airbus' varied portfolio.

According to ChatGPT (GPT-4) September 2024

What benefit do I get from MBSE?

1. Improved Communication and Collaboration Visualization of complex systems and use of Unified Languages such as SysML.	**2. Enhanced Requirements Management** Traceability improvements that are useful for early identification of inconsistencies and errors in V&V.
3. Early Detection of Problems MBSE enables earlier simulation and analysis, allowing for continuous validation and refinement throughout the development lifecycle.	**4. Increased System Quality and Consistency** MBSE ensures that the entire system and its subsystems are considered holistically, leading to better overall system design.
5. Improved Efficiency & Productivity Reduced development time, through model reuse, task automation and early validation, reducing time spent on rework and corrections.	**6. Better Risk Management** MBSE allows engineers to model and simulate different “what-if” scenarios, to assess risk, optimize the design and managing requirement changes.
7. Support for Complex System Design MBSE allows you to manage systems at different levels of abstraction, helping to break down complex systems into manageable parts.	**8. Seamless Lifecycle Integration** MBSE integrates all phases of the system development lifecycle maintaining coherence across each stage. Models can evolve with the system, providing a consistent framework for handling system upgrades or changes.

According to ChatGPT (GPT-4) September 2024

But, I am not a System Engineer.

1. Improved Communication Across teams Visual models help non-systems engineers grasp how different components interact, bridging technical and non-technical stakeholders.	**2. Better Collaboration** Shared understanding through a common framework and language, leading to fewer misunderstandings.
3. More Effective Project Management The traceability of requirements and risk management simulation opportunities allow for projects to be tracked, with schedules and resources being adjusted accordingly.	**4. Reduced Rework and Costs** Early error detection, even if you are not designing the system, you benefit from fewer last-minute changes and crises due to issues being caught early.
5. Simplified Documentation If you’re responsible for documentation, MBSE can automate large parts of this process, reducing the need for manual writing.	**6. Enhanced Problem-Solving and Innovation** MBSE gives you a holistic view of how changes affect the entire system, helping you make more informed design choices across disciplines.
7. Future-Proofing Your Skills Even if you’re not a systems engineer, gaining a familiarity with MBSE will make you more versatile and valuable. Understanding MBSE can enhance your ability to contribute to modern, complex projects.	In summary, even if you’re not a systems engineer, MBSE helps improve communication, collaboration, project visibility, and efficiency across the board. It allows non-systems engineers to engage better with the overall system design and development process, making it a valuable tool no matter your specific role.

According to ChatGPT (GPT-4) September 2024

This is too complex!

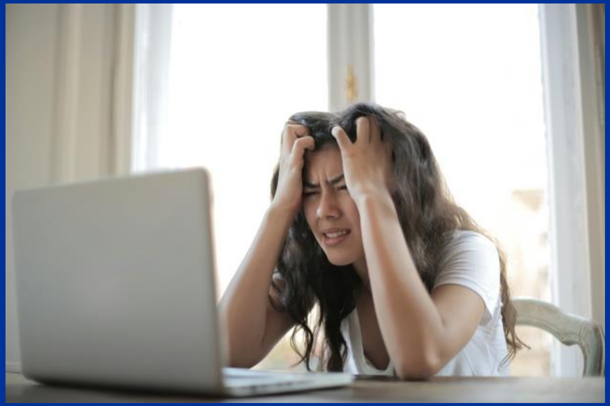
I understand! Let me simplify it for you. Even if you're not a systems engineer, MBSE (Model-Based Systems Engineering) can help you in the following simple ways:	**1. Clear Communication** MBSE uses visual models instead of complex documents, making it easier for everyone to understand what's going on.
2. Fewer Mistakes By showing how everything in the system is connected, MBSE helps catch errors early, so there are fewer surprises and less last-minute fixing	**3. Better Teamwork** Different teams (software, hardware, management) can all work from the same model, reducing confusion and making collaboration easier.
4. Easier Tracking If something changes in the project (like a requirement or design), MBSE shows how it affects everything else. This helps you see the impact of changes and plan accordingly.	**5. Saves Time** Automating things like documentation and testing means less manual work for you and a faster overall process.

In short, MBSE makes complex projects easier to understand, reduces mistakes, improves teamwork, and saves time, no matter your role.

Tough questions – Let's ask ChatGPT

Photo credit: “Woman in White Shirt Showing Frustration” by Andrea Piacquadio

Clearly ChatGPT didn't understand the ***context*** here!



The user is not finding the benefits complex to understand, rather how they interact with MBSE.

Are we approaching the problem of MBSE adoption incorrectly?

Agenda

1 **Digital systems**
Fundamentally how do they operate?

2 **Feeding a SE mindset**
How these digital systems all feed an SE mindset and thus MBSE Architecture Models

3 **Standardization**
Stating the need for industry standardization across several key fields

4 **UX perspective**
Provide key principles to improve the user experience of MBSE.

5 **Q&A**

Agenda

1

Digital systems

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Q&A

Standardization areas for Digital Thread technology

Standardization areas for Digital Thread technology

A. Common content specification

Standardization areas for Digital Thread technology

A. Common content specification

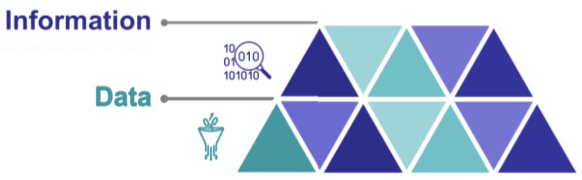
B. Common technical data / digital model specifications

Standardization areas for Digital Thread technology

A. **Common content specification**

B. **Common technical data / digital model specifications**

C. **Contextual Metadata Layer (CoML) specifications**



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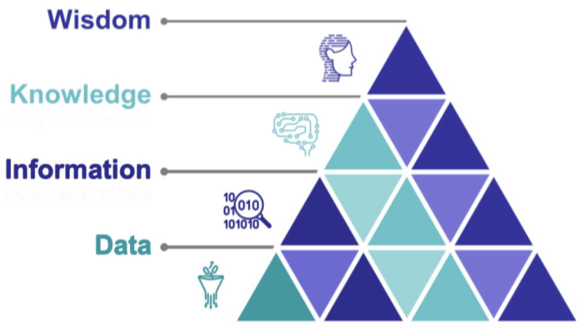
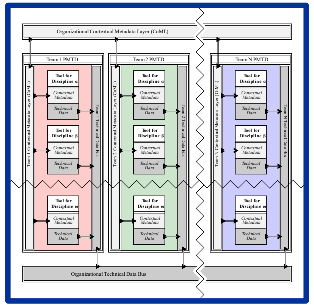


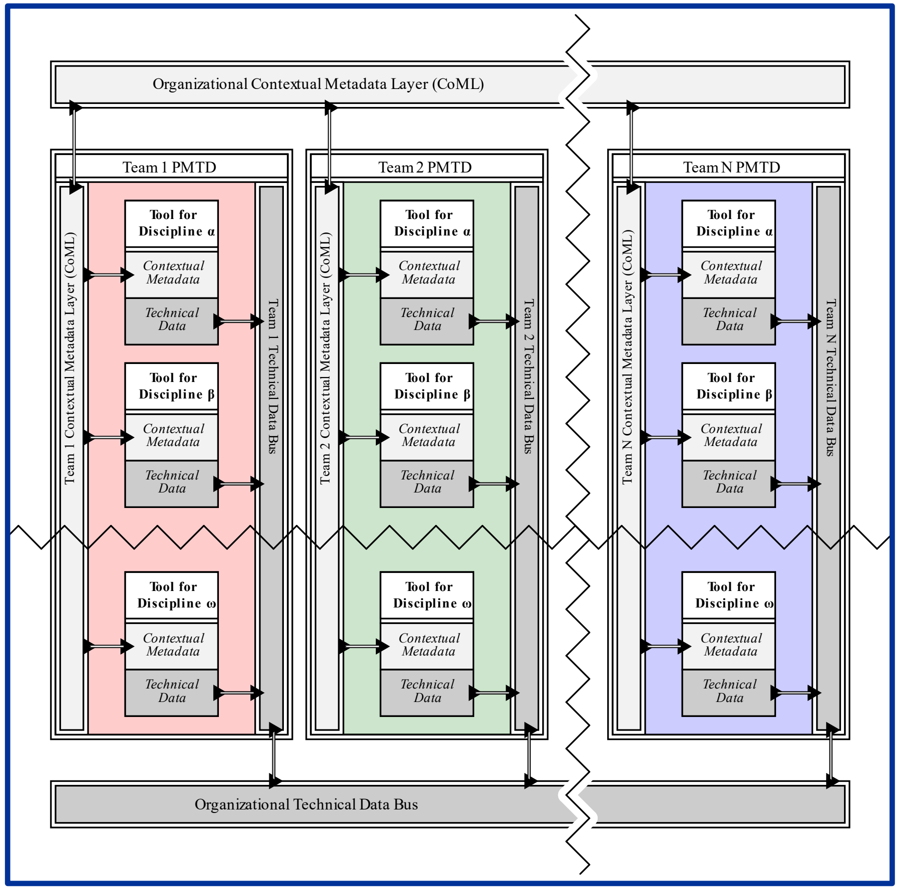
D. **Common communication specifications**

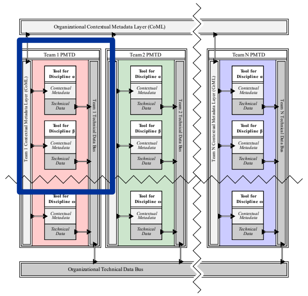
From the 2024 SciTech publication:

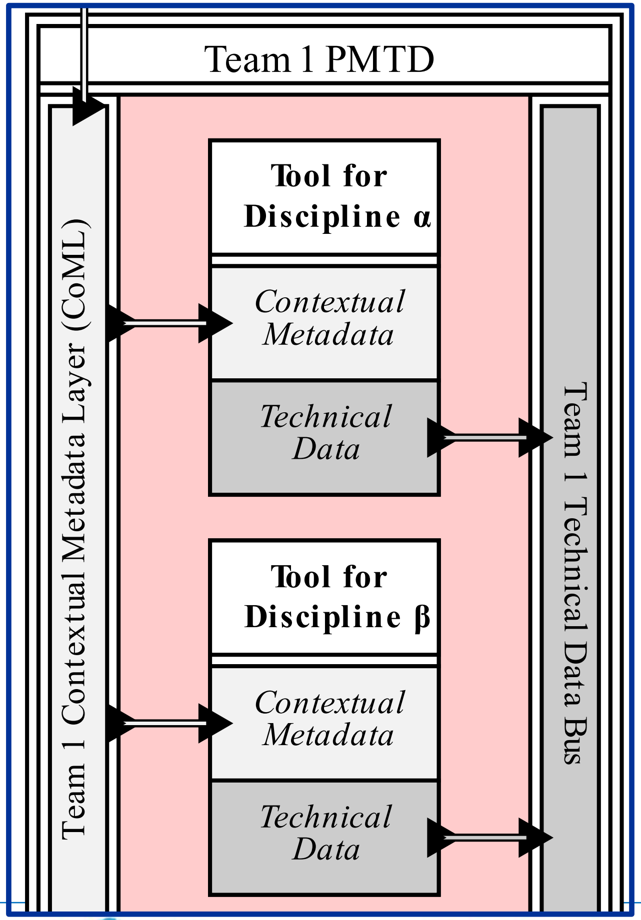
Standardizing technical understanding to support a robust, archivable and accessible digital thread – Supported by ISO 10303 STEP and IEC/ISO 81346 standards

By Kyle Hall and Jonathan Taylor,








Team 1 PMTD
Team 1 Contextual Metadata Layer (CoML)
Tool for Discipline α
Contextual Metadata
Technical Data
Tool for Discipline β
Contextual Metadata
Technical Data
Team 1 Technical Data Bus

From the 2024 SciTech publication:

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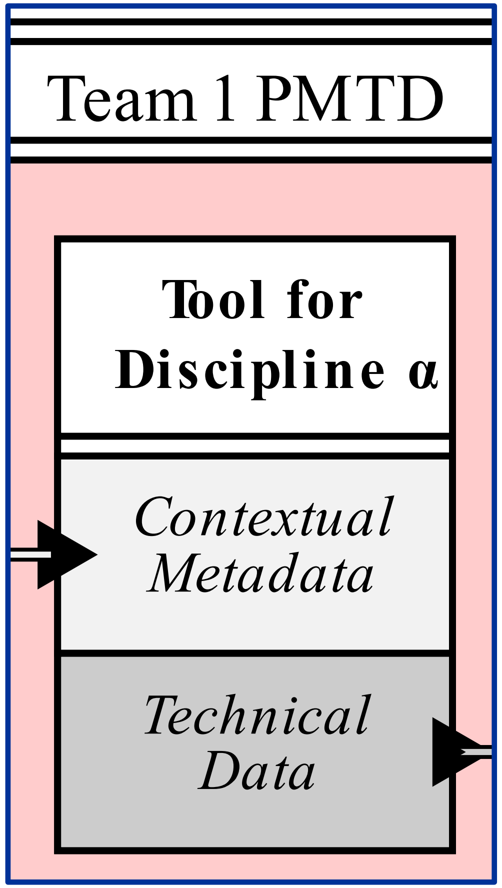
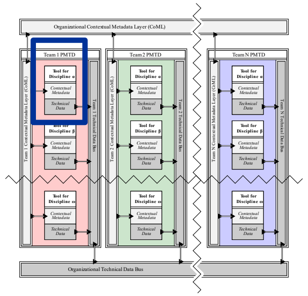
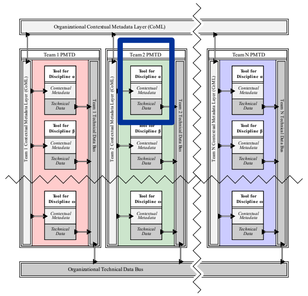
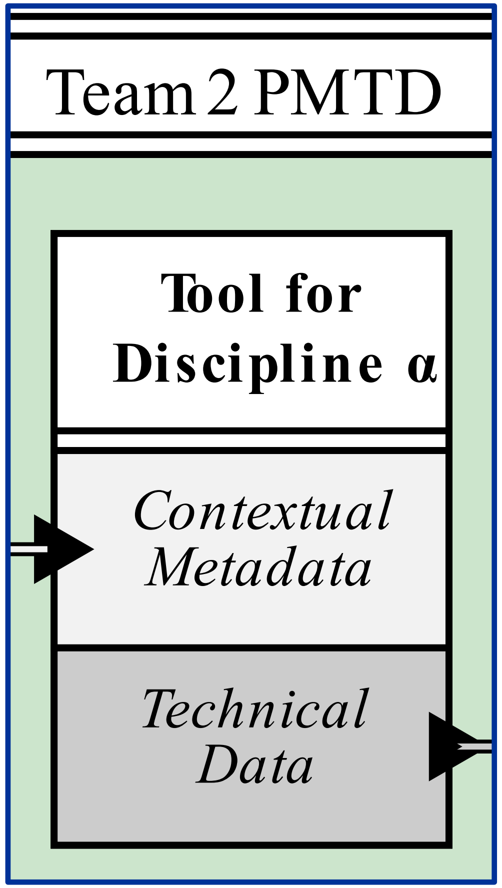
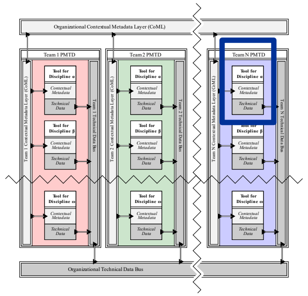
By Kyle Hall and Jonathan Taylor, Copyright © 2024 by Airbus Operations Limited

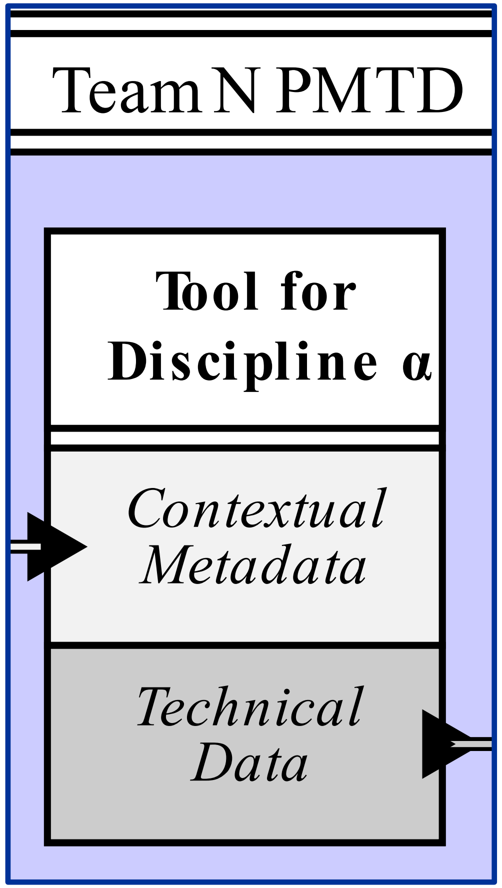







Team 2 PMTD
Tool for Discipline α
Contextual Metadata
Technical Data

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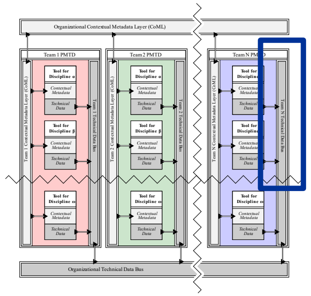
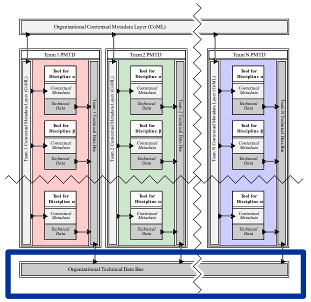
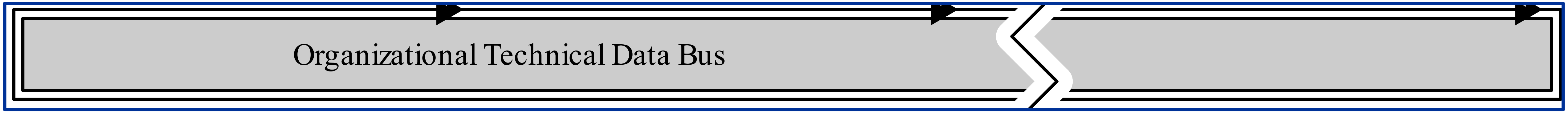
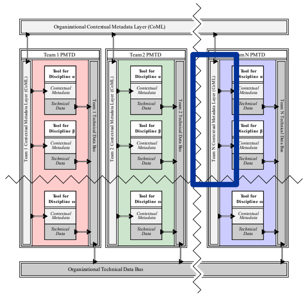
Tool for Discipline α
Contextual Metadata
Technical Data

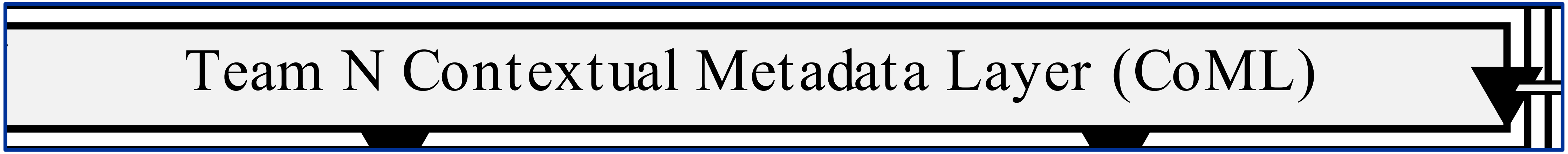


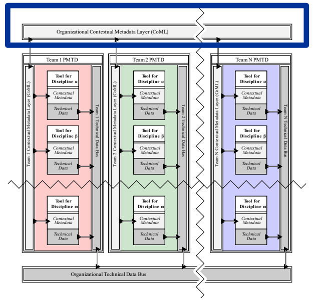

Team N Technical Data Bus

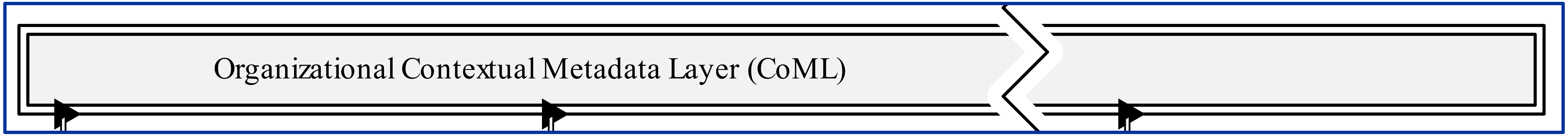



Organizational Technical Data Bus




Team N Contextual Metadata Layer (CoML)

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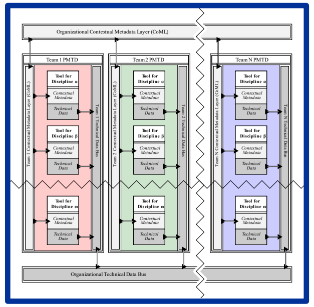

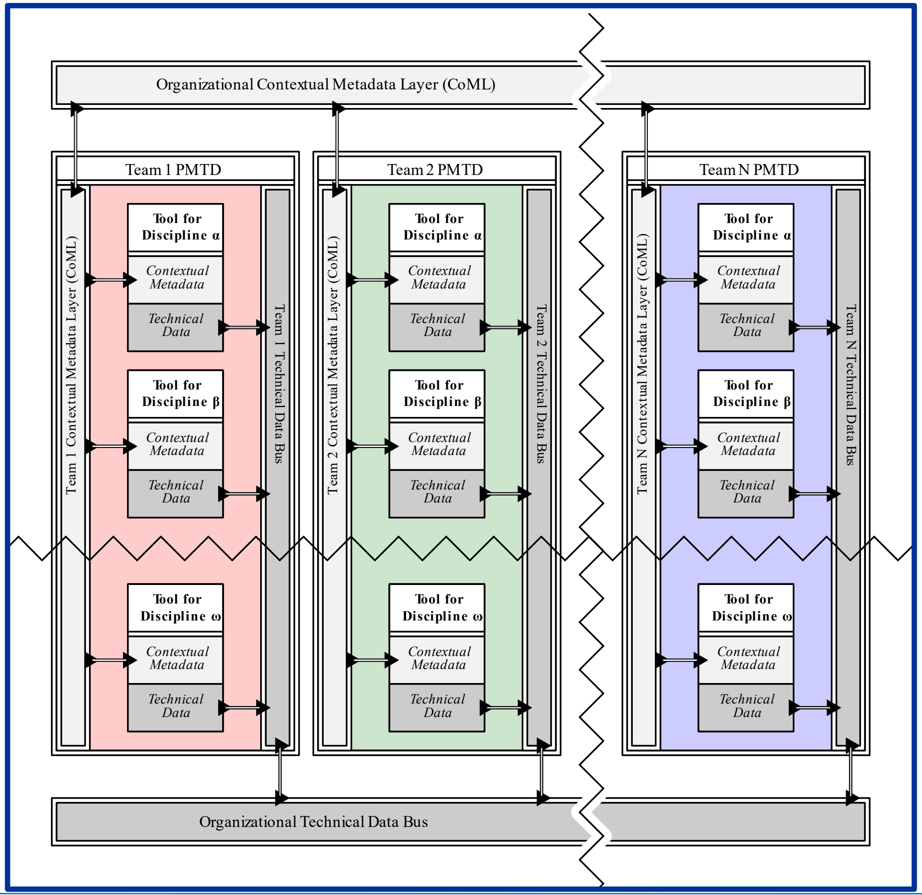
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Provide key principles to improve the user experience of MBSE.

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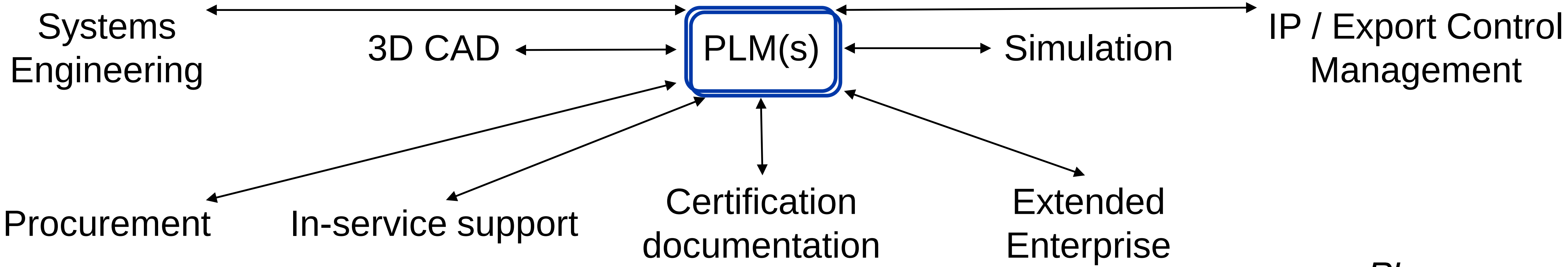
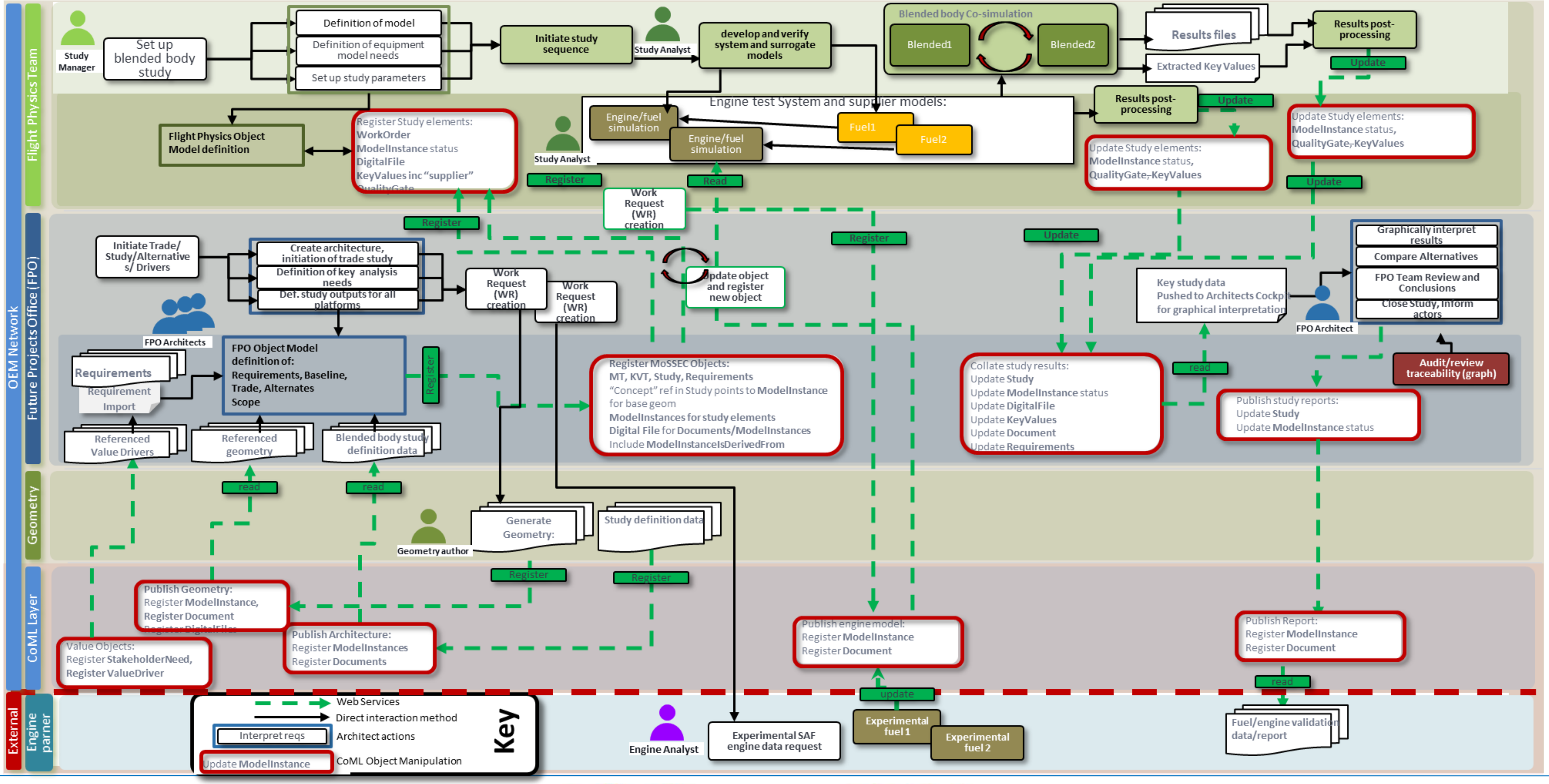
Its clear in a Systems Engineering mindset that we have multiple systems that interact throughout the lifecycle and feed federated sources of truth



Plus more…

Theoretical collaboration to conceptualise a blended body A/C with experimental fuels



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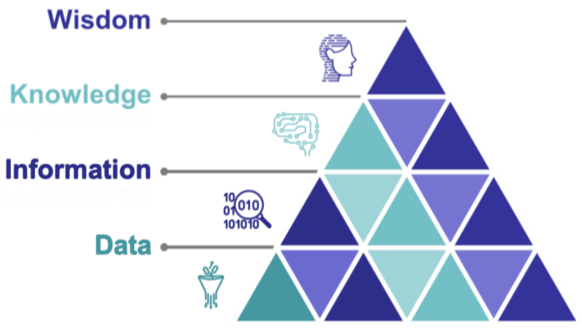

D. **Common communication specifications**

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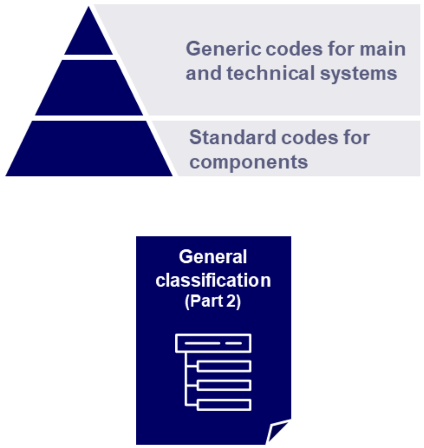
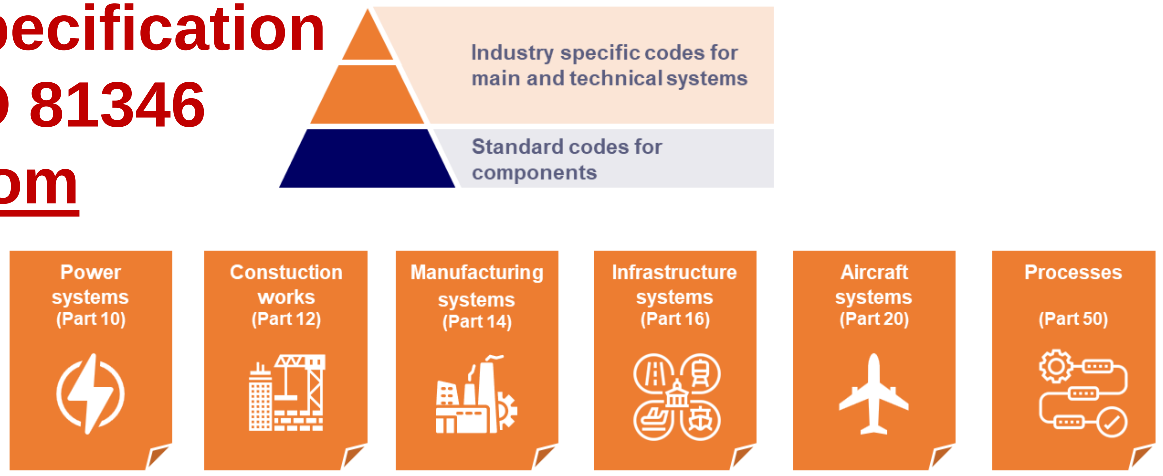


A common content specification could be IEC / ISO 81346
www.81346.com

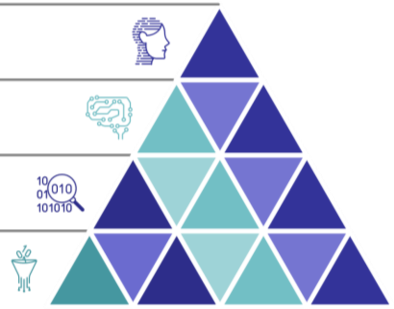


A common Contextual Metadata Layer (CoML) standard could be

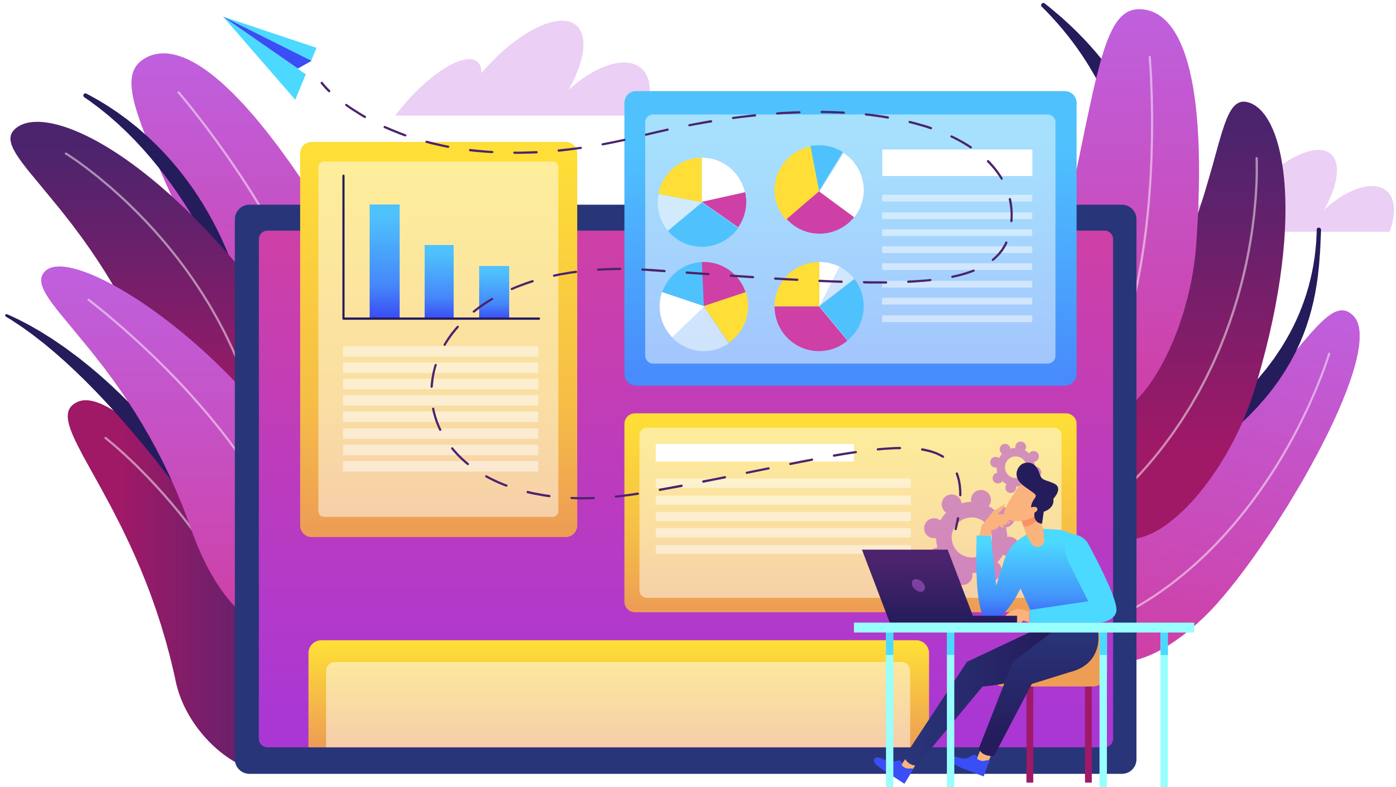
MoSSEC –
ISO 10303-243:2021 and
ISO 10303-4443:2022

C. Contextual Metadata Layer (CoML) specifications

D. Common communication specifications



“**MoSSEC** enables the connection of Modelling and Simulation capabilities, supporting MDAO across an organization, and their Extended Enterprise, following a robust, archivable and accessible ISO methodology.”



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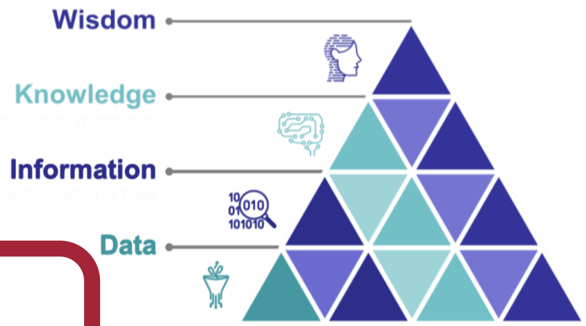

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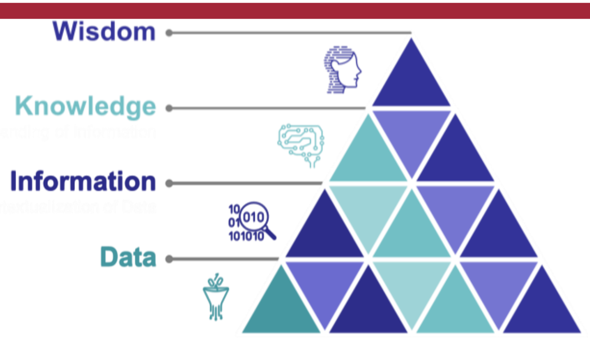
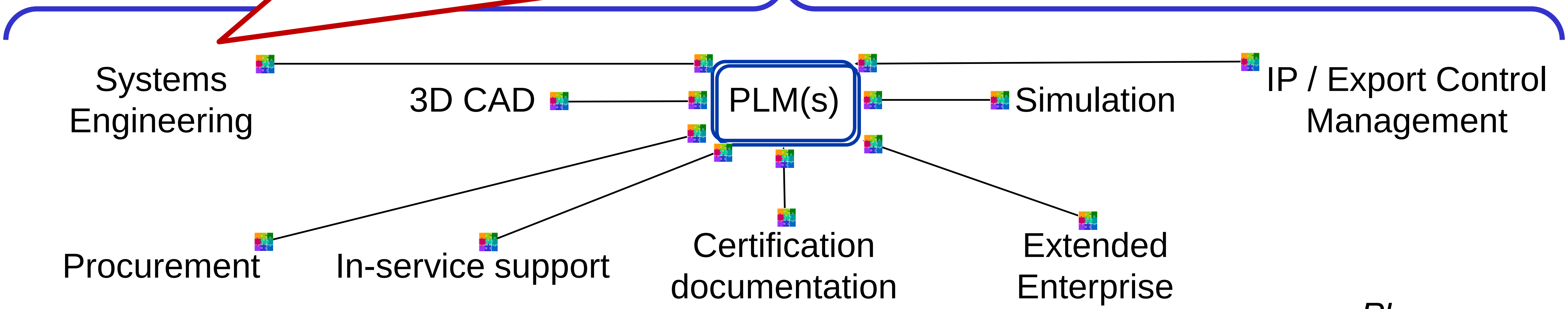


D. **Common communication specifications**

Introducing MoSSEC – Slide from GPDIS 2023 –
“MoSSEC Standardised context to unlock robust digital continuity”

Technical Data Specifications for Systems Engineering:

ISO 10303-233:2012 [Now out of date]
or
(Syntax e.g. SysML) + (Framework e.g. UAF) +
(Missing interop communication spec – API coming in SysML v2)
[OMG Cascade project proposes resolving these issues]

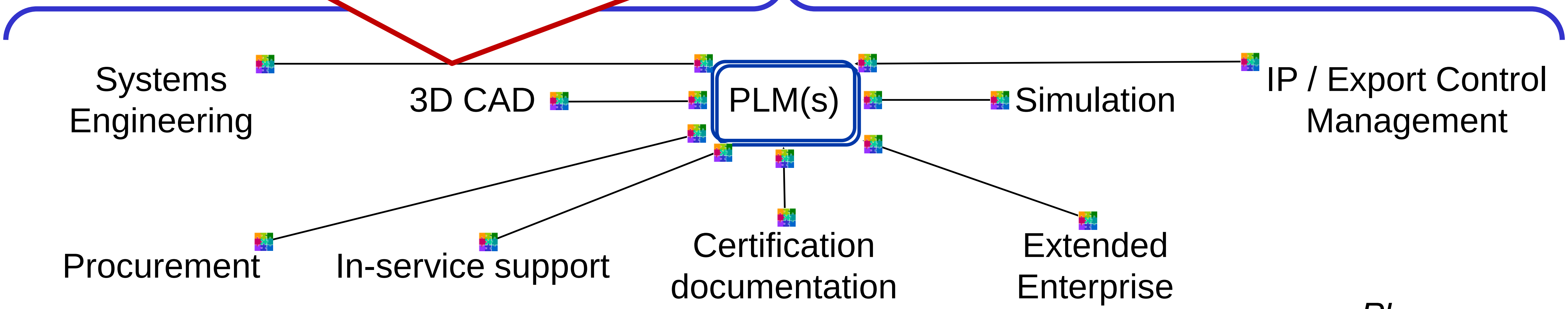


Plus more…

Introducing MoSSEC – Slide from GPDIS 2023 – “MoSSEC Standardised context to unlock robust digital continuity”

Technical Data Specifications for 3D CAD:

ISO 10303 – 242
Managed Model-Based 3D Engineering
<u>The most famous STEP standard</u>



Plus more…

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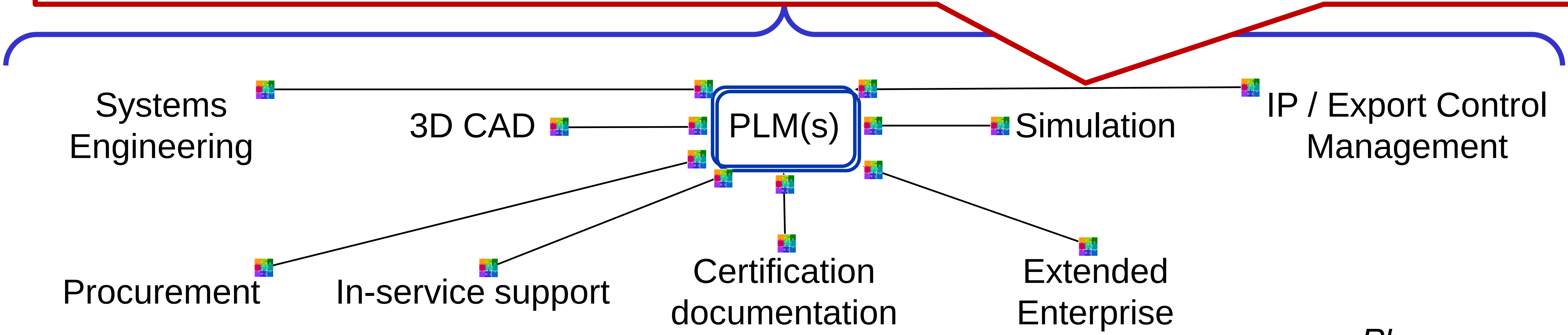
Technical Data Specifications for Simulation:

FMI / FMU
and
eFMI for embedded systems



Plus more…

Technical Data Specifications for Simulation:

In Airbus we use the AirSupply collaborative hub… standardizing procurement operations

Image credit:
https://www.airbus.com/en/be-an-airbus-supplier/airsupply

Procurement

In-service support

Certification documentation

Extended Enterprise

Plus more…

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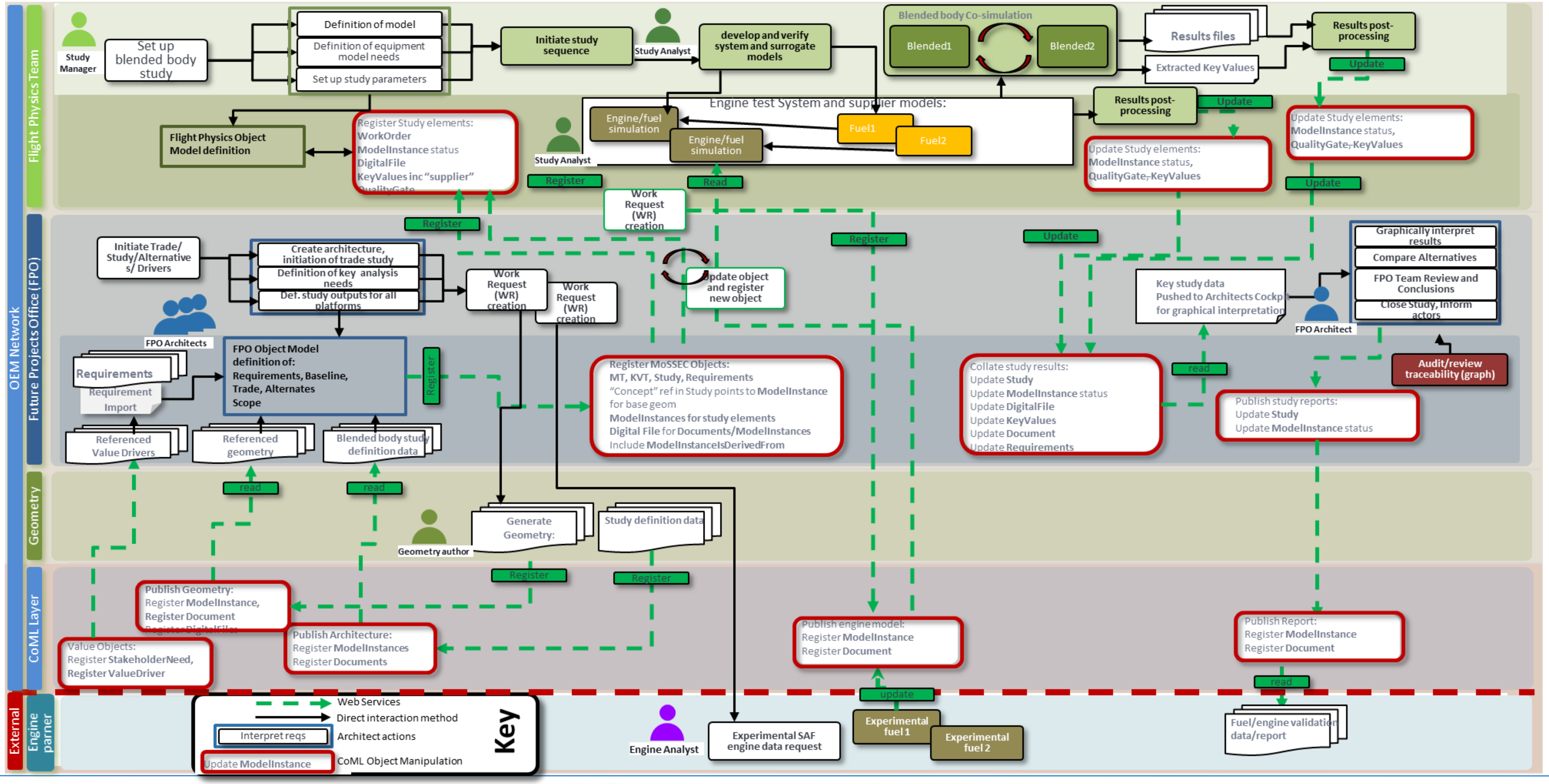
Theoretical collaboration to conceptualise a blended body A/C with experimental fuels



What benefit do I get from MBSE?

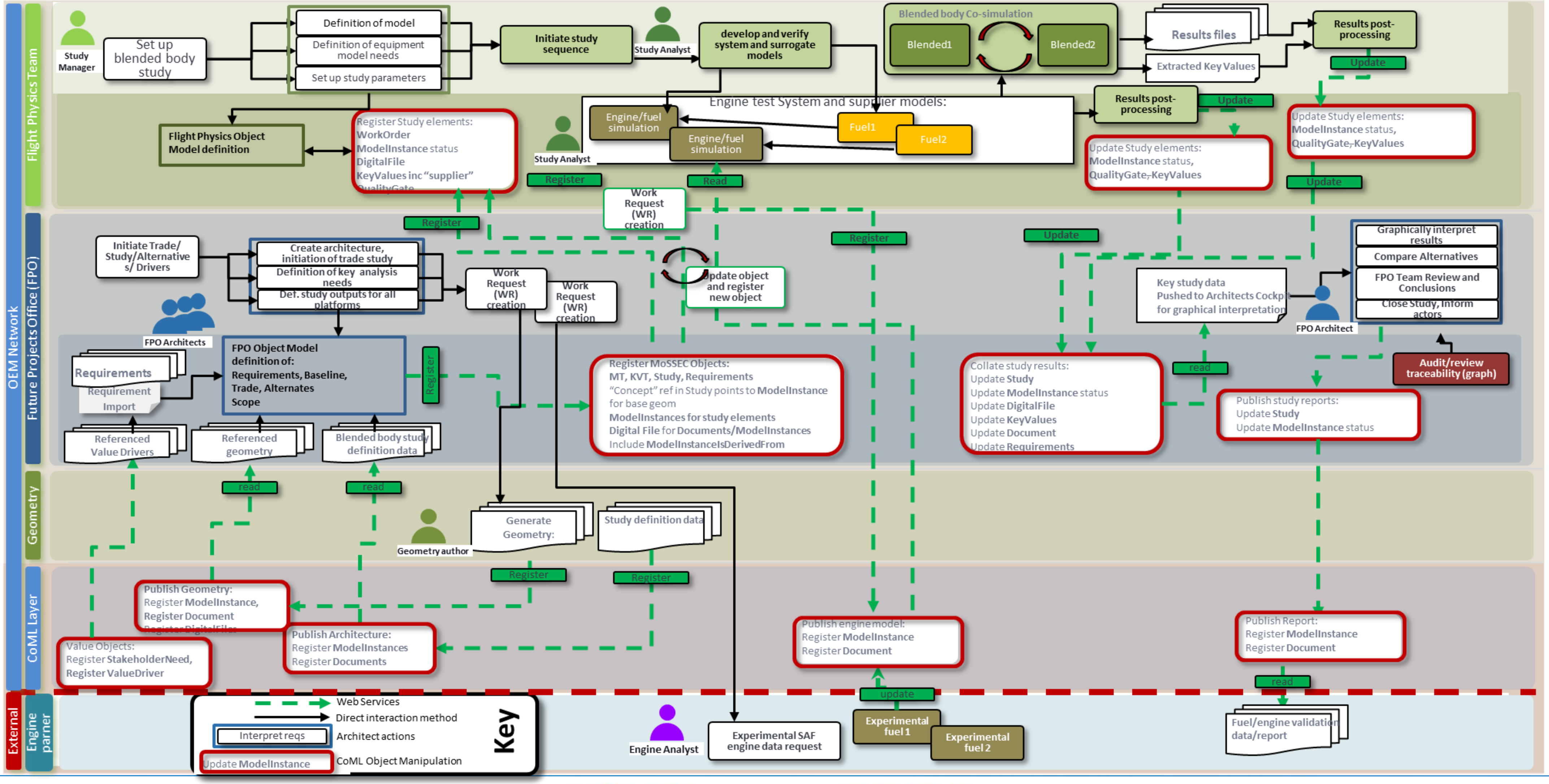
But, I am not a System Engineer.

This is too complex!

Tough, but logical truths

- **System Engineering Experts are NOT inherently Good UX Engineers.**
- **System Engineering Experts decode requirements into technically optimum frameworks.**
- **UX Engineers are experts at identifying the optimum way users should interact with a system to meet the user requirements.**
- **An assumption that everybody can encode their knowledge into an MBSE Architecture with the tools we have today is nonsensical.**
- **Why do we have to use the tools we have today?**
- **Systems Engineering Experts must work with UX Engineers to understand how the User should interact with an MBSE Architecture. What are the <u>"CORE knowledge services"</u> they can both offer and require?**
- **Use the four standards model of Digital Systems - Code into the Architecture the CORE knowledge services to accept inputs and provide outputs that logically make sense to your users.**
- **Maintain the federated sources of truth – but make them accessible!**

Theoretical collaboration to conceptualise a blended body A/C with experimental fuels



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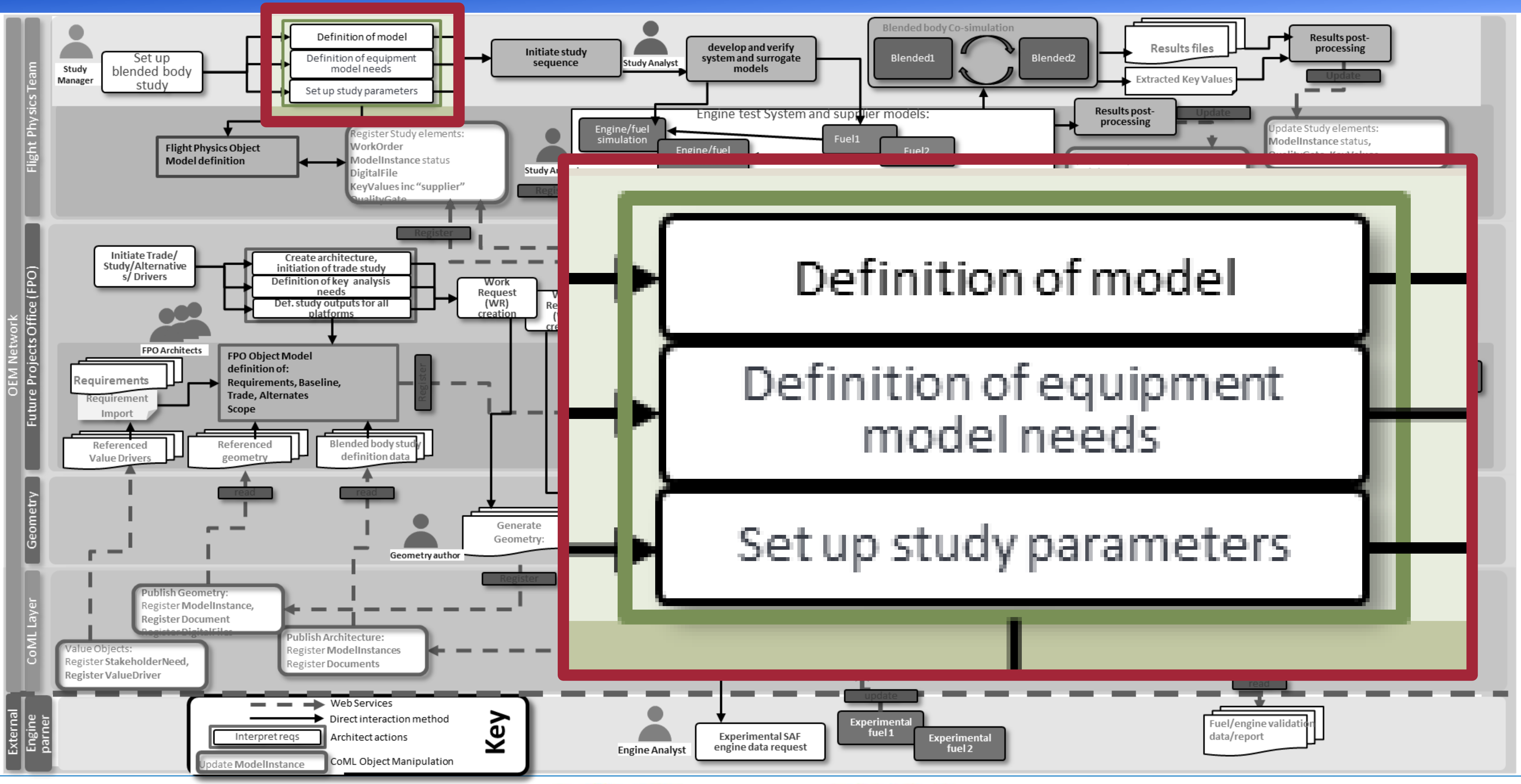

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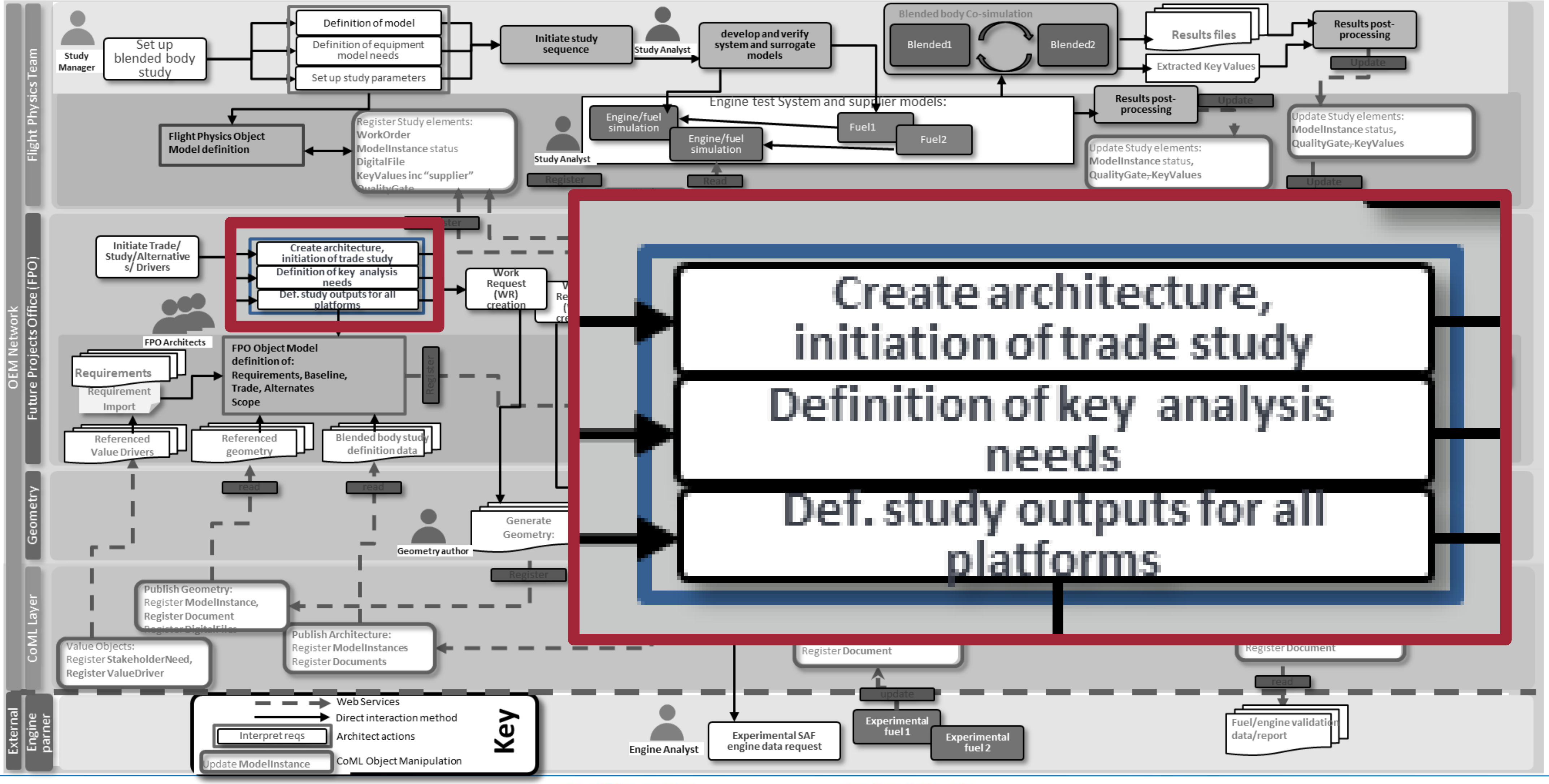

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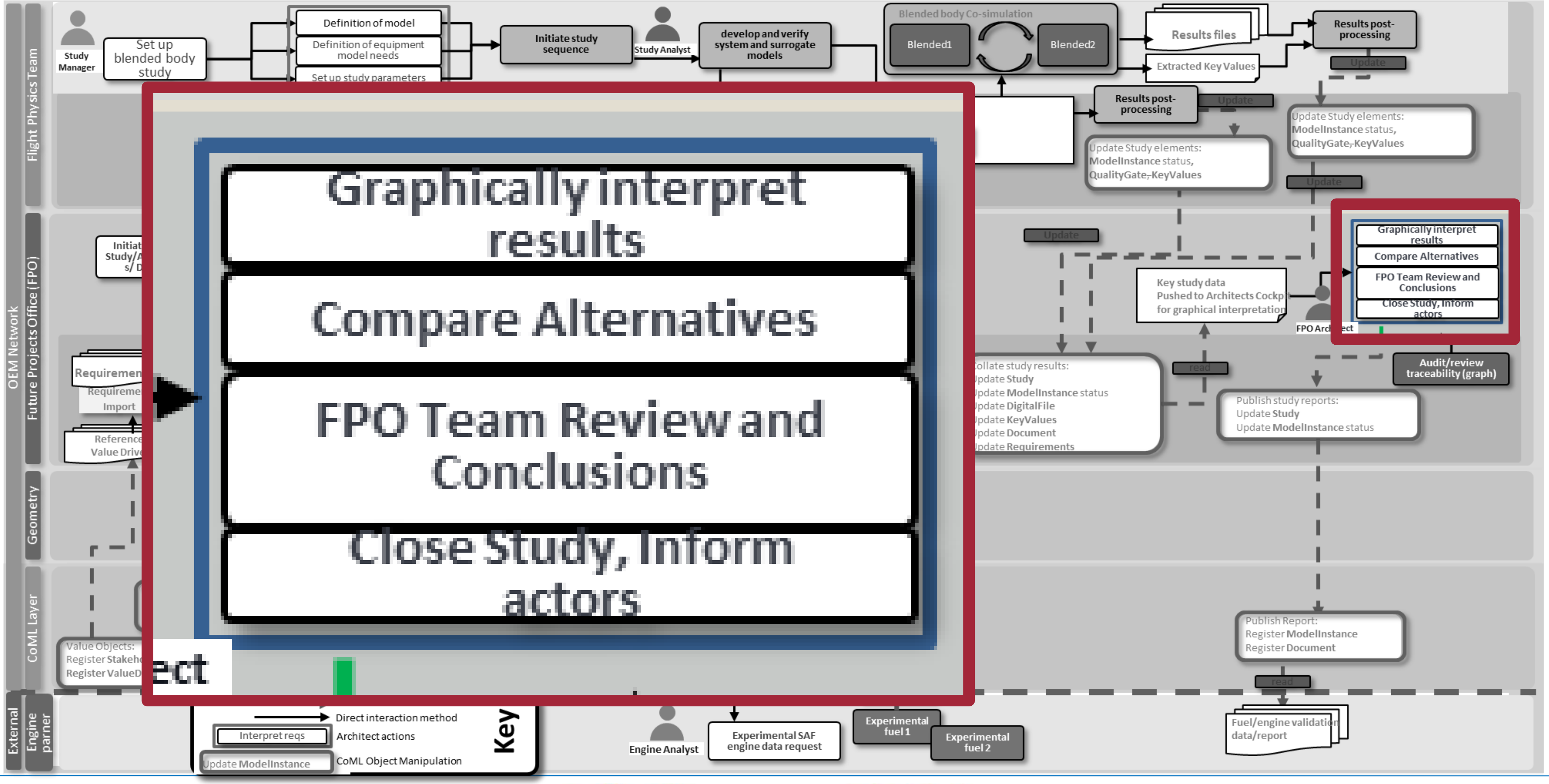

Tough, but logical truths

What benefit do <u>I</u> get from MBSE?

But, <u>I</u> am not a System Engineer.

<u>This</u> is too complex!

What benefit do I get from MBSE?

Learn what benefits your users NEED from MBSE

This is too complex!

Make it clear that they are System Engineers – they just don't know it

But, I am not a System Engineer.

This is too complex!

Tough questions

Make your MBSE Architectures accessible… don’t rely on Tools and Training

<u>This</u> is too complex!

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Model Based Systems Architecture – Consider the UX perspective

Kyle Hall – Airbus