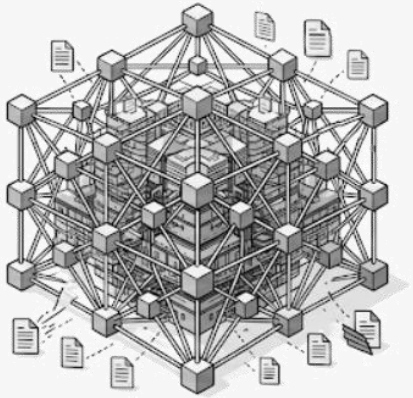
MBSE Vision 360

A Layered and Semantic Approach to Navigating Complex Models

Capella

lgm/ leading great movements

Challenges

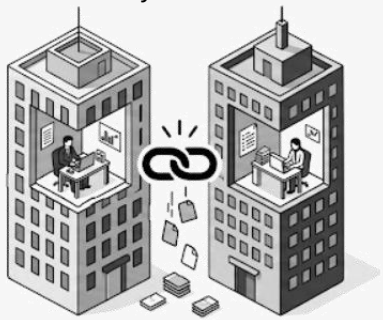


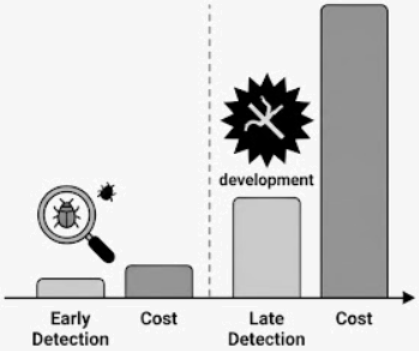
Exploding System Complexity

Modern systems are becoming increasingly **intricate**, rendering traditional document-based approaches obsolete and **risky**.

Isolated Business Silos

Multidisciplinary teams often work **disconnectedly** with little to no interaction, leading to **miscommunication**, data fragmentation, and integration **failures**. phase is critical for cost-efficiency.

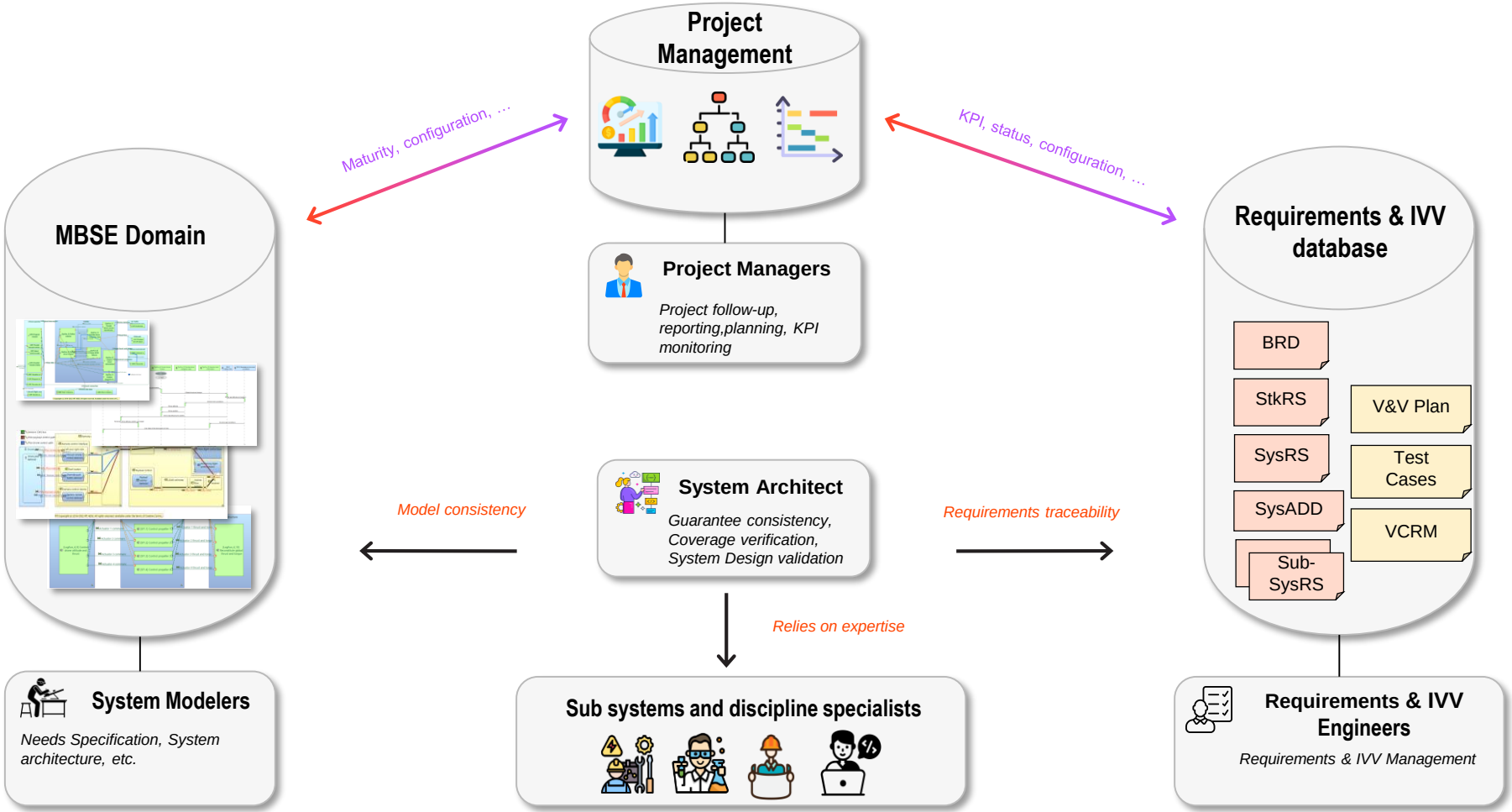




The Cost of Late Discovery

Finding and fixing anomalies late in the development cycle is exponentially more **expensive**. Early detection during the design phase is critical for cost-efficiency.

Context

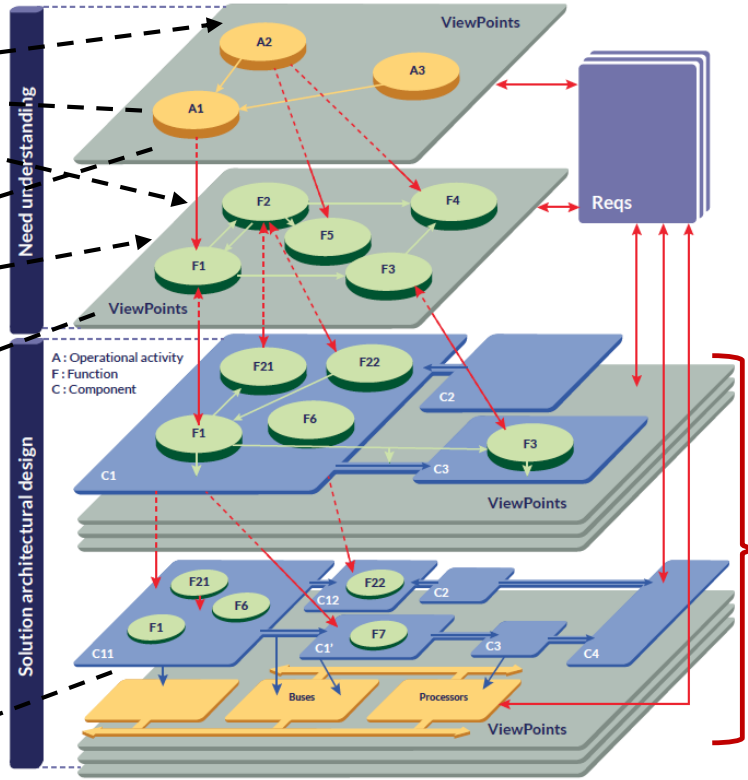

Project Management
Maturity, configuration, …
KPI, status, configuration, …
MBSE Domain
Requirements & IVV database
Project Managers
Project follow-up, reporting,planning, KPI monitoring
BRD
StkRS
SysRS
SysADD
Sub-SysRS
V&V Plan
Test Cases
VCRM
Model consistency
System Architect
Guarantee consistency, Coverage verification, System Design validation
Requirements traceability
Relies on expertise
System Modelers
Needs Specification, System architecture, etc.
Sub systems and discipline specialists
Requirements & IVV Engineers
Requirements & IVV Management

Why using Model Based Systems Engineering approach ?

- Supports formalisation of complex architectures
- Facilitates consistency checks and validation
- Enhance quality of requirements
- Gives a formalized syntax and semantics

- May require important learning curve
- In many organization, needs 3 different roles
    - Systems Architect
    - Requirements Engineer
    - MBSE specialist who formalizes the systems architect decisions
- Models and requirements needs to be shared with several stakeholders in the organization for who the model is not appropriate information exchange format
- Architecture and requirements are key elements which need to be assessed by many stakeholders within the project
- Project Management office need simplified visualization to easily monitor progress of architecture

ISO 15288 Activities	Requirement Documents
Concept of Operations – Business or Mission Requirements	BRD
Operational Concepts (and scenarios) – Stakeholder Needs & Requirements	StkRS
System Requirements definition	SysRS
System Architecture Definition	SAD
(Sub) Systems Requirements definition	SubSystems RS

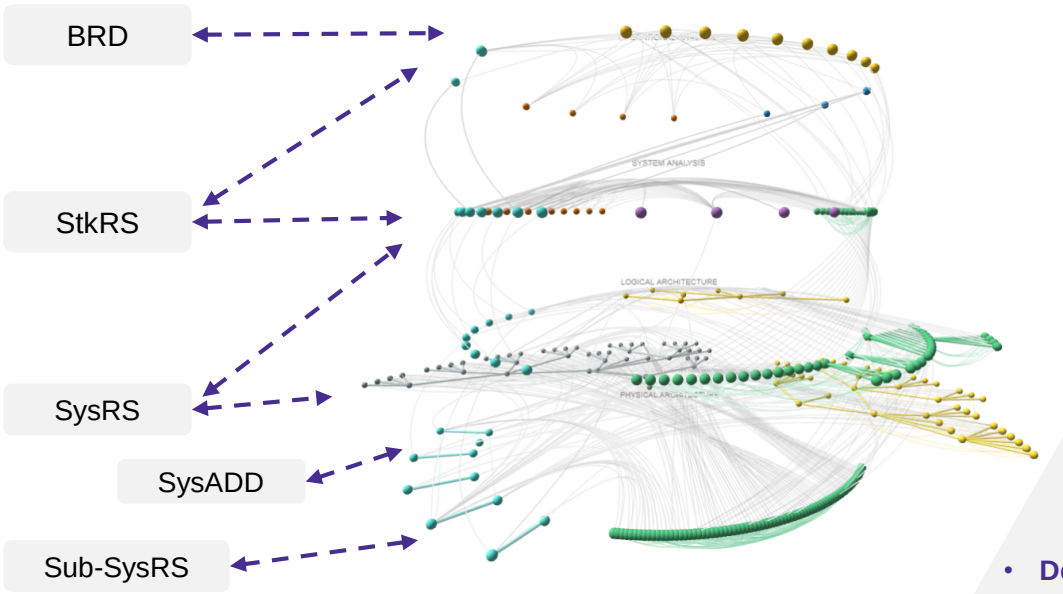


Operational Analysis
What the users of the system need to accomplish

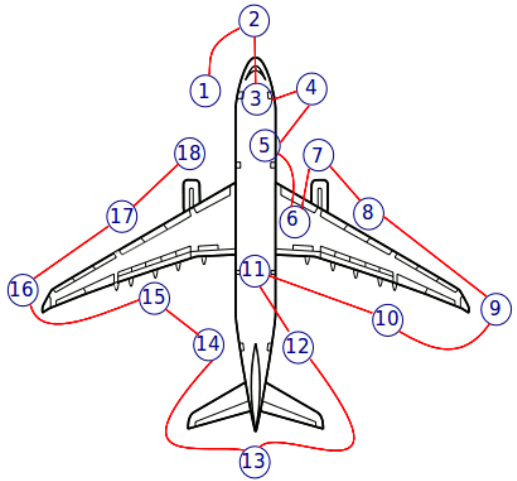
Functional & Non Functional Need
What the system has to accomplish for the users

Logical Architecture
How the system will work to fulfill expectations

Physical Architecture
How the system will be developed and built



- **Get an overview of the data model and relations without MBSE expertise**
  - → Explore 3D topology, dynamically educate users, and view native diagrams.
  - → Search instantly and view native diagrams.
- **Assess design and architecture decisions as a non-specialist**
  - → Search instantly and view native diagrams.
- **Assess architecture progress, traceability, and consistency**
  - → Define and run quality checks, trace requirements, and assess semantic coherence via AI.
- **Detect allocation inconsistencies or optimization opportunities**
  - → Evaluate interfaces complexity.
- **Review functional allocations and geographical distribution**
  - → Visualize end-to-end chains,



1 = L forward fuselage
2 = Nose
3 = Landing gear
4 = R forward fuselage
5 = R center fuselage
6 = R center wing
7 = R engine
8 = R wing leading edge
9 = R wing tip
10 = R wing trailing edge
11 = Rear landing gear
12 = R aft fuselage
13 = Tail & APU
14 = L aft fuselage
15 = L wing trailing edge
16 = L wing tip
17 = L wing leading edge
18 = L engine

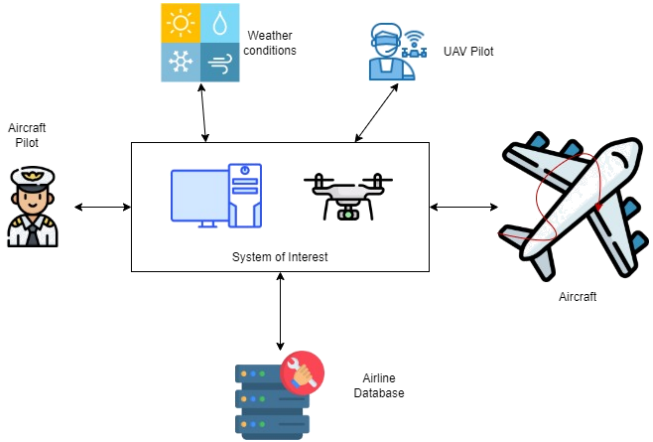
Parking brake must be on before start of inspection.

Environment

- Aircraft to inspect
- Pilot / Maintenance operator
- External environment (weather conditions)
- Data Bases of known problems
- Power supply

System of Interest

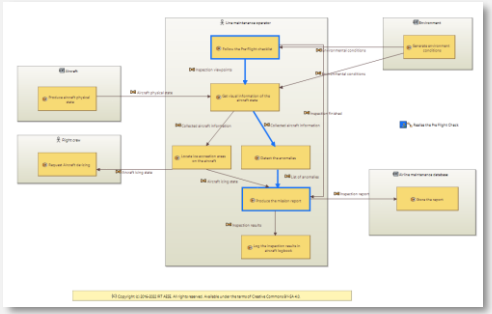
- Drone control Desk
- Remote control
- Unmanned Aircraft Vehicle to sense specific aircraft point of interests

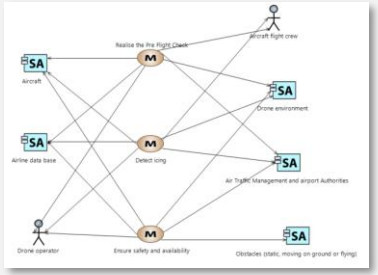


Goals

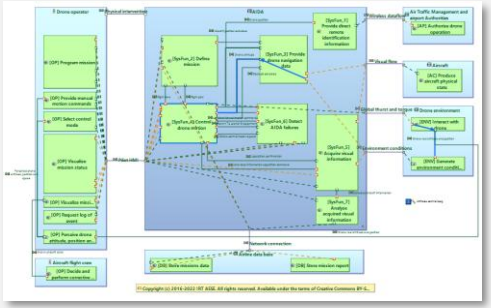
- Perform check before flight
- Access to specific views
- Automate the process
- Detect anomalies (ice, damaged areas, tools, …) before allowing a flight to take-off

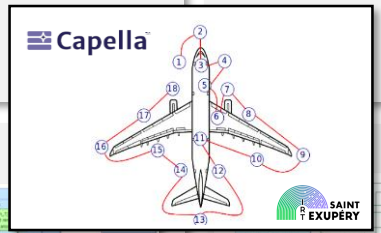
Operational Analysis

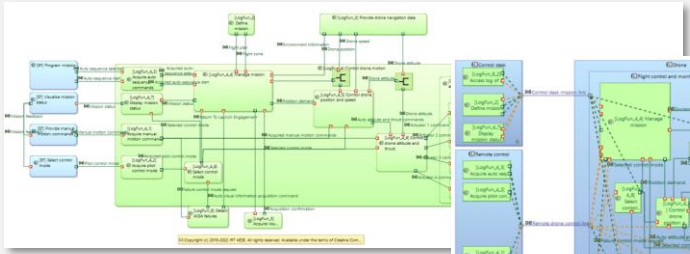


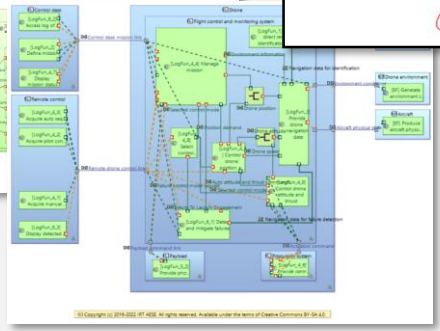


System Analysis

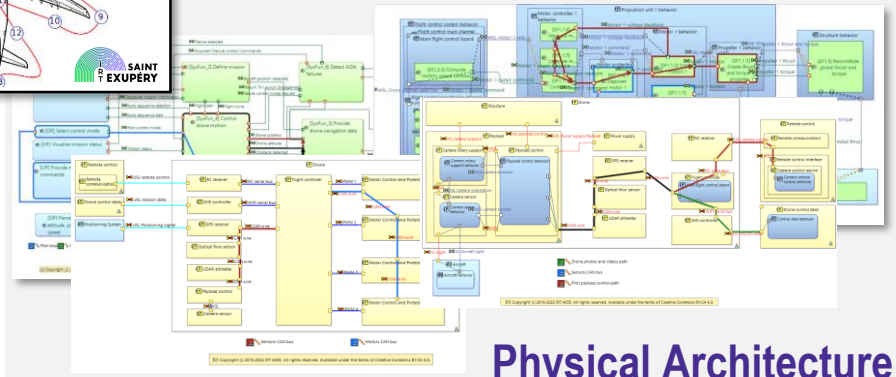








Logical Architecture



Physical Architecture

Discover MBSE Vision 360

- **Democratize MBSE**

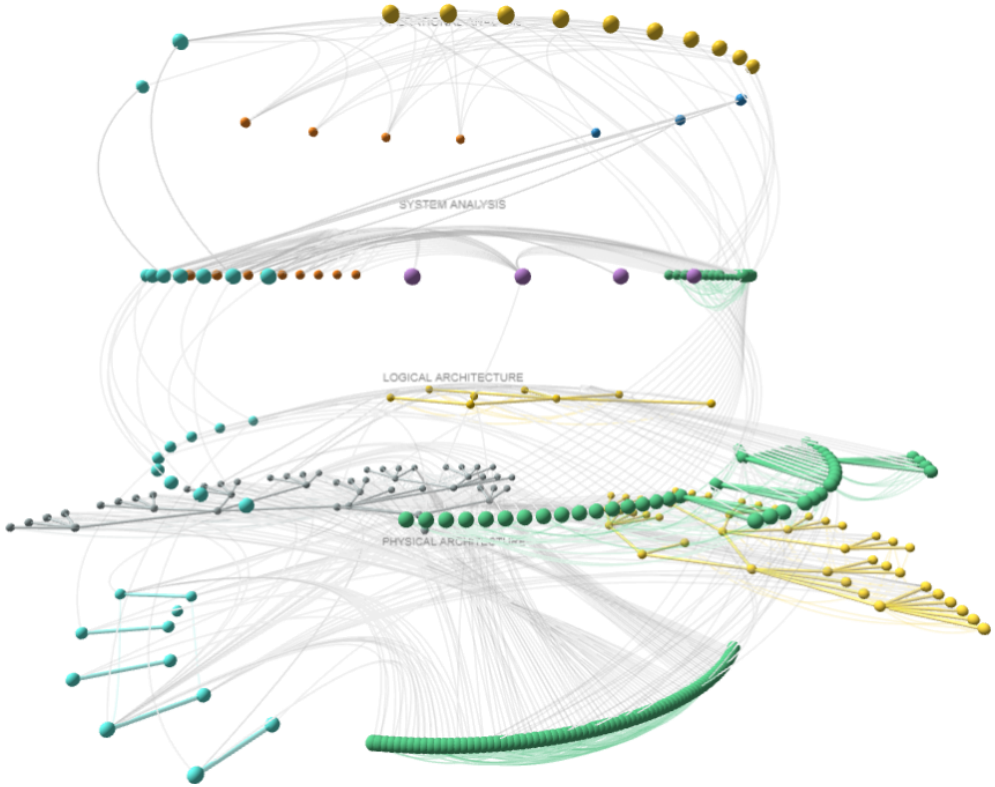
  UC1 - Accelerating project onboarding and system discovery

  UC2 - Visualizing connections and traceability

- **Support model experts**

  UC3 – Review model quality

  UC4 - Evaluate interfaces design and architecture complexity

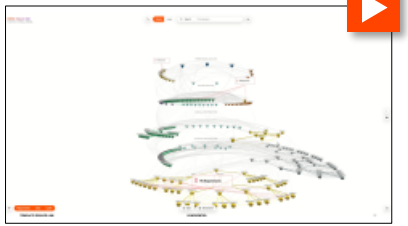


Use case 1 – Accelerating project onboarding and system discovery

- **Target audience:** Project Newcomers, Project Managers, Non-MBSE Stakeholders.
- **Objective:** Allow everyone to instantly understand the system architecture without needing a Capella license or MBSE training.

3D Model navigating

- Explore the model in a Global or Layered view.
- Learn each element's role, layer context through built-in pedagogy tips.



Model Breakdowns

- Drill into hierarchical breakdowns.
- Visualize cross layer architecture.
- Export hierarchical trees snapshots to compare evolution.

Dashboard

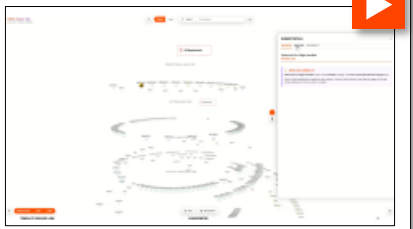
- Monitor project health across requirements, architecture, interfaces and review metrics.

Use case 2 – Visualizing connections and traceability

- **Target:** System Engineers, V&V Engineers, Safety Experts.
- **Objective:** Explore how an element interacts with others and guarantee that all the initial needs are covered by the final design.

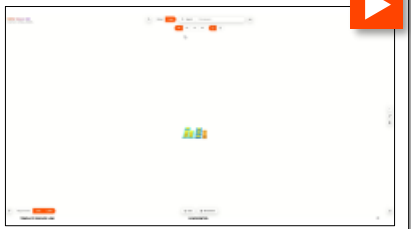
Trace relations

- Analyze propagation, what breaks if you change or remove an element.
- Run traceability paths across layers to justify design against needs.



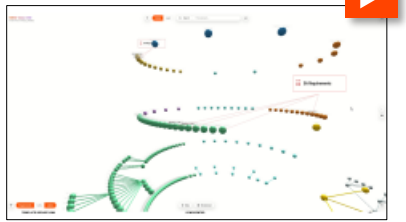
Visualize model allocations

- Visualize allocation and deployment inside each architectural layers.
- Spot unallocated functions and undeployed physical behaviors



Design – Requirements traceability

- Follow aggregated links between architecture and specifications.
- Display contextual graphs to focus on scenario.



Use case 3 – Review model quality

- **Target:** Model Conceptors, System Architects.
- **Objective:** Automatically detect modeling defects and secure the model's quality before major milestones

Quality checks

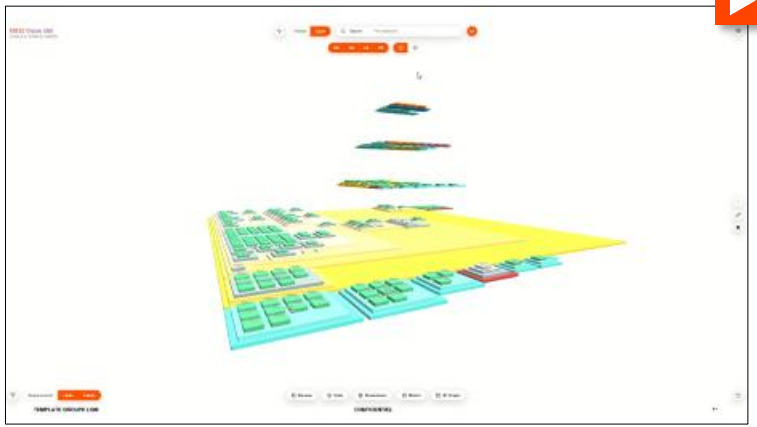
- Apply built-in or custom rule lists to highlight and export no-conformant elements.
- Import your rules presets.

Use case 4 – Evaluate interfaces design and architecture complexity

- **Target:** System Architects, Interface Managers
- **Objective:** Demystify the complexity of system exchanges and generate Interface Control Documents (ICDs).

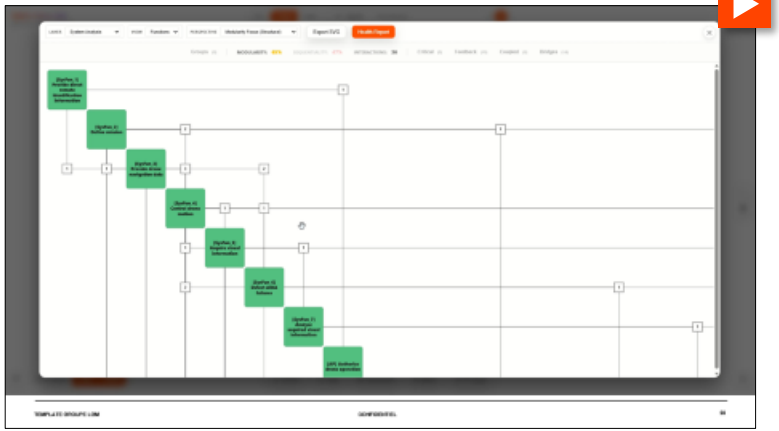
End-to-End Functional chains and exchanges traceability

- Highlight functional chains and interface flows directly on the 3D Layer view.
- Display and export contextual graphs for a specific chain or exchange path.



N² Matrix - Decoding Complexity

- Built-in N² matrices per layer to identify high coupling elements.



Conclusion & Future Steps

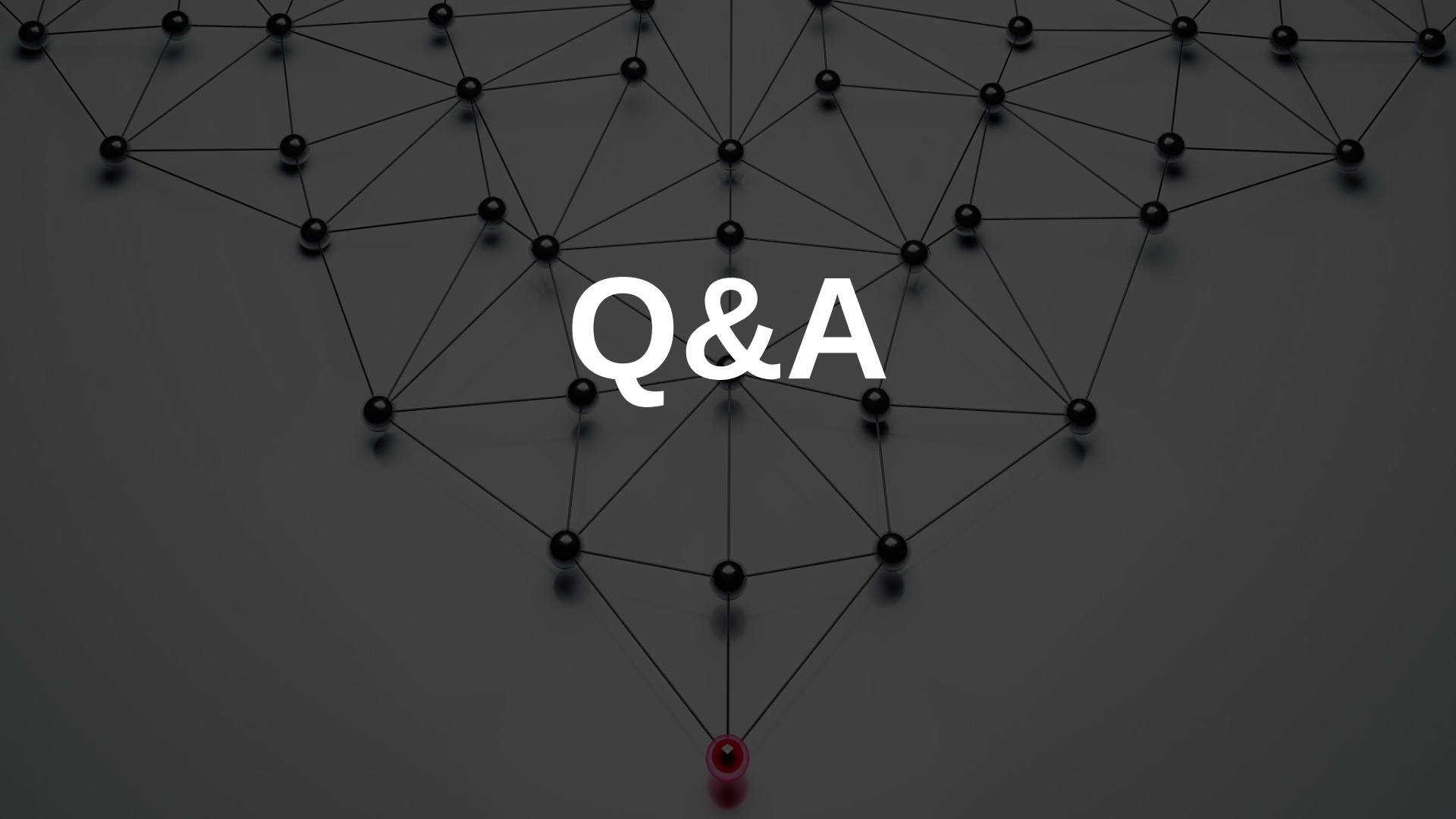
Proof of Concept is running on Capella models

Customer express Interest on:

- User friendly interface to explore and analyze model and traceability for non MBSE expert
- 3D View with distribution of functional chains, functions on different sections (space distribution)
- Easy to perform rule reviews

Potential Functionalities to explore with support of interested customer

- Monitoring Model progress (different versions) and associated KPIs
- Interface to perform peer reviews on the model (review checklists, review comments and consolidation)
- Extraction of Interface Control Documents
- Improve the Interfaces Analysis
- Support tradeoffs analyses
- Integration with SysML / SysML V2 models
- Integration of OSLC/SysML V2 API


Q&A

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