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ARCADIA: Model-Based Collaboration for System, Software and Hardware Engineering

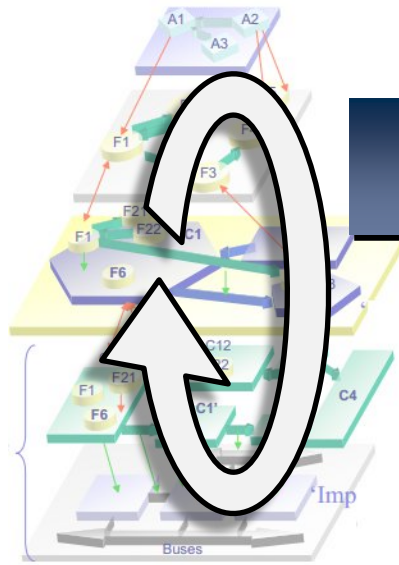
An architecture-centric, tool-supported method

Jean-Luc Voirin & Stéphane Bonnet
CSD&M 2013

THALES

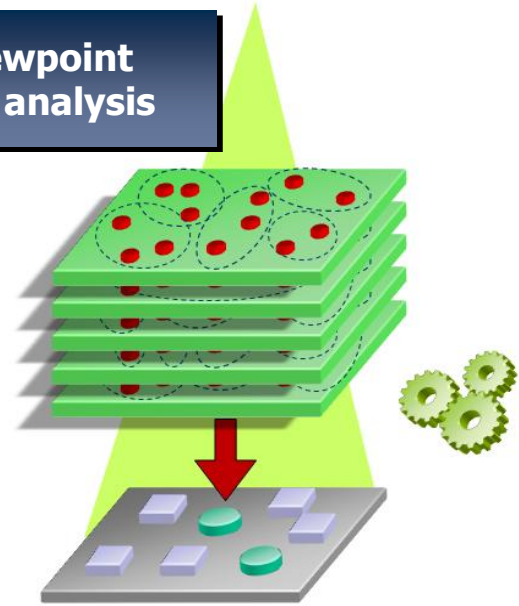
- 1 Essentials of the Arcadia method
- 2 Arcadia-dedicated modeling workbench
- 3 Return on experiment

Requirements for a Scalable and Adaptable Method



Early validation in short decision loop

Multi-viewpoint trade-off analysis

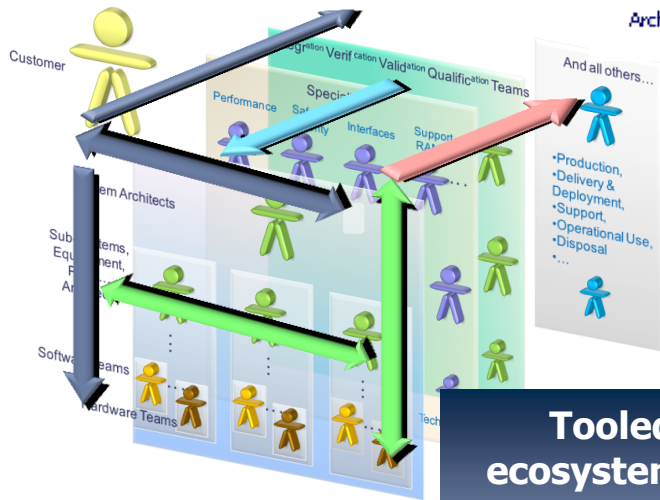


Highly flexible

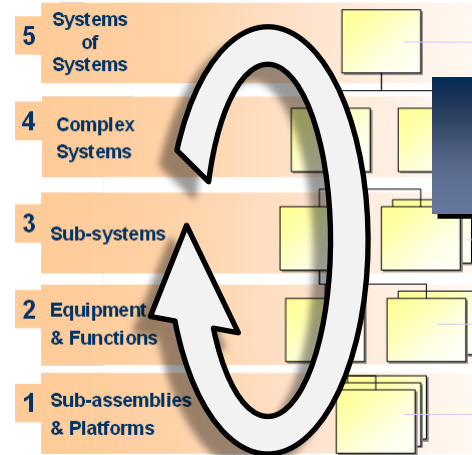


Identifying?

ARCADIA
Architecture Analysis & Design Integrated Approach

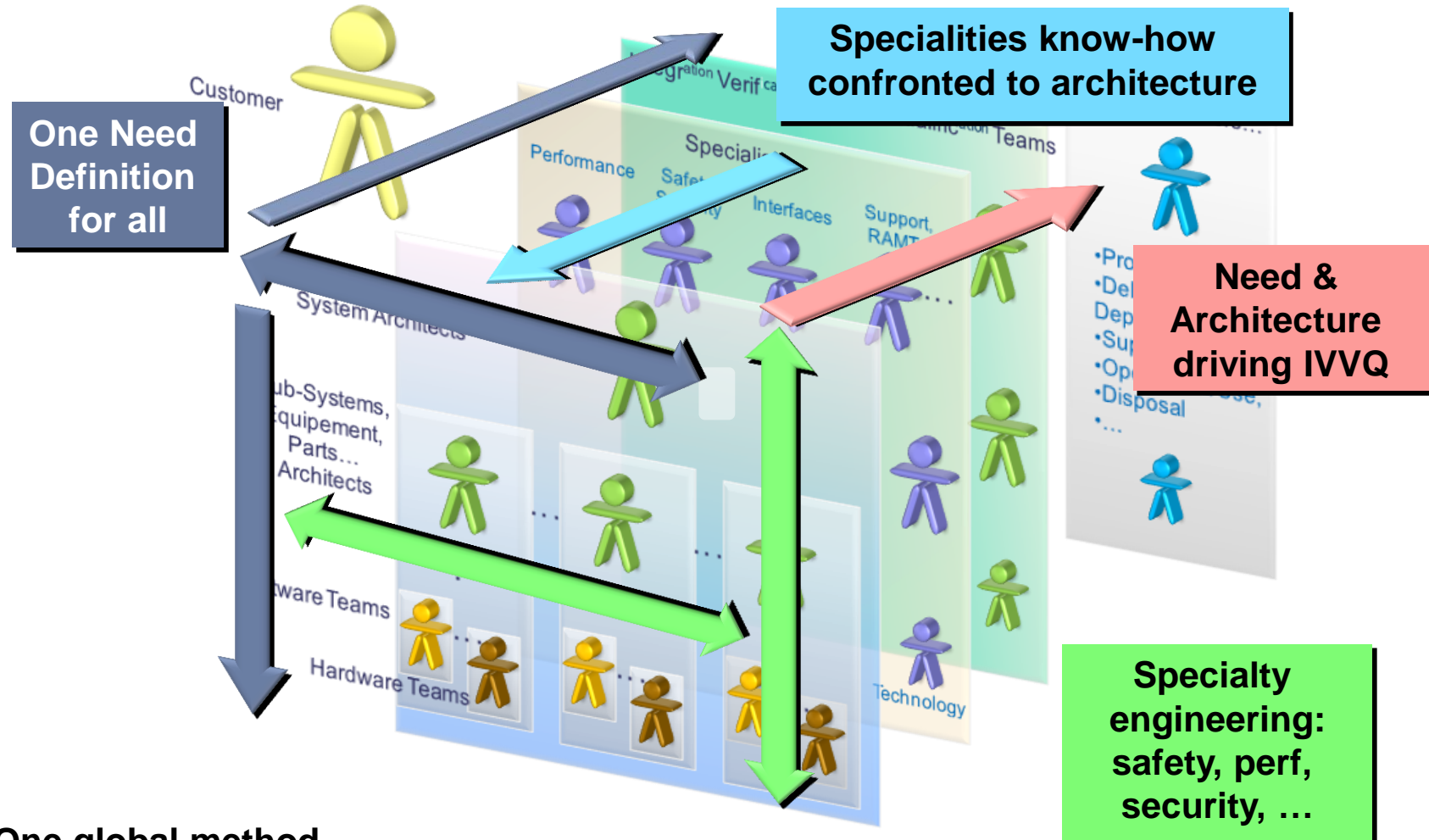


Tooled-up ecosystem-wide collaboration



Multi-level impact analysis

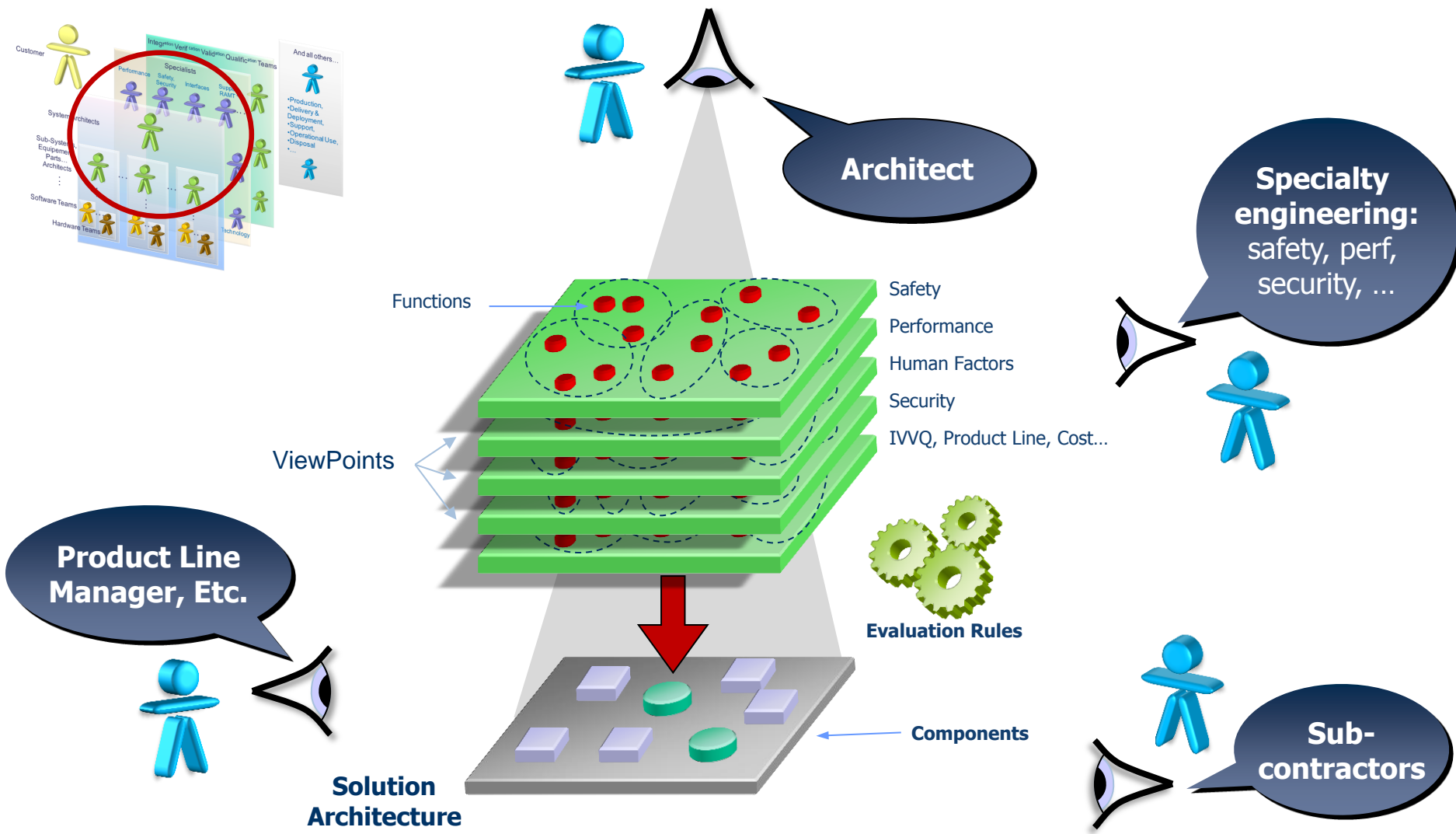
ARCADIA Goals & Action Means



One global method,
adaptable/adapted to each domain

Efficiently support and secure the engineering collaboration

Early Validation: Specialties Know-How Confronted to Architecture



Multi-viewpoint trade-off analysis (see ISO 42010 standard)

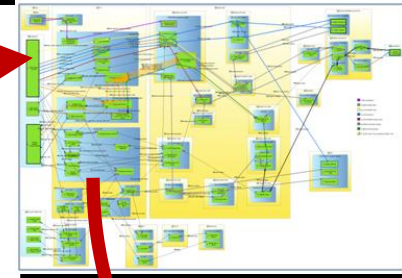
Mastering Complexity through Multiple Abstraction Levels



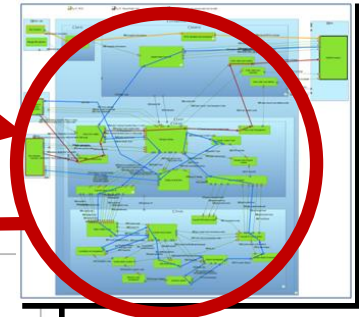
System Engineering



Sub-Systems Engineering



Software/Hardware Engineering



Maintaining consistency across engineering phases

Using ARCADIA Engineering Models to Drive IVVQ



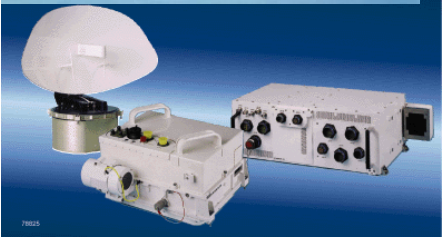
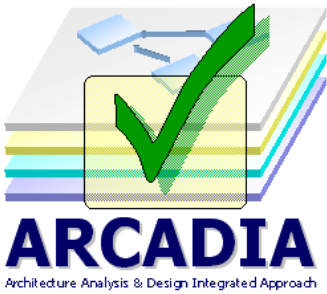
Define IVV Strategy

Focus on Functional Content and Architecture



Operational Need, Functional Contents

Master Development Ups and Downs



System Components

Control Maturity of Deliveries



Optimize IVVQ Globally
(incl. Enabling Systems / Test Means)



Test Benches

Mission System
Radars
Receiver
Software/HW

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Manage Information Complexity

- Automatic synthesis, simplification on diagrams, modelling aids
- Modularity (viewpoints and transitions)
- Separation of concerns through viewpoints and diagram layers

Ease Capitalization

- Concepts
- Engineering rules
- Architectural assets
- Centralize information managed by specialized tools

Manage a Common Reference Model

- Configuration management
- Collaboration between stakeholders (multi-user access on a shared model)
- Coupling with change management, test environments, documentation generation, etc.

Arcadia-supporting tools are crucial for the best benefit of the method

Rationale for an Arcadia-Dedicated Workbench

Several Alternatives

- Arcadia method is tool-agnostic
- Tooling can be minimal... or sophisticated
- Profiling UML/SysML would be a natural option

Thales previous experiences with UML Profiling

- Poor adoption by system engineers
- Meta-models constrained by UML concepts
- Representations constrained by existing UML diagrams



Development of a dedicated workbench (DSL)

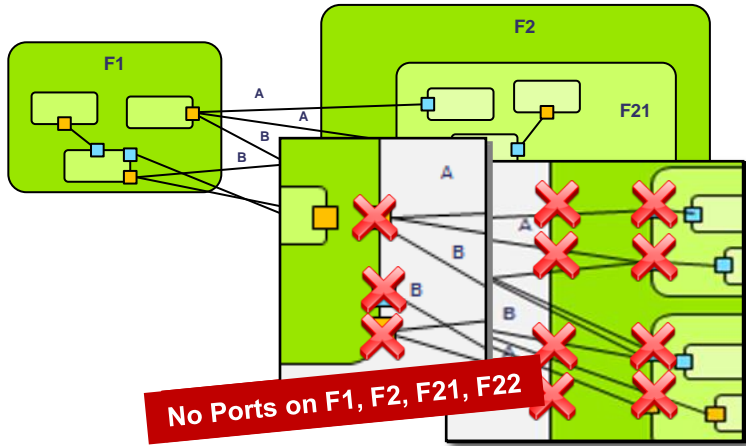
- Freedom both in language and representation
- Close to UML/SysML, interoperable with MODAF-like Architecture Frameworks
- Extensible in many ways for domain-specific purposes (Sirius / Eclipse EMF foundations)



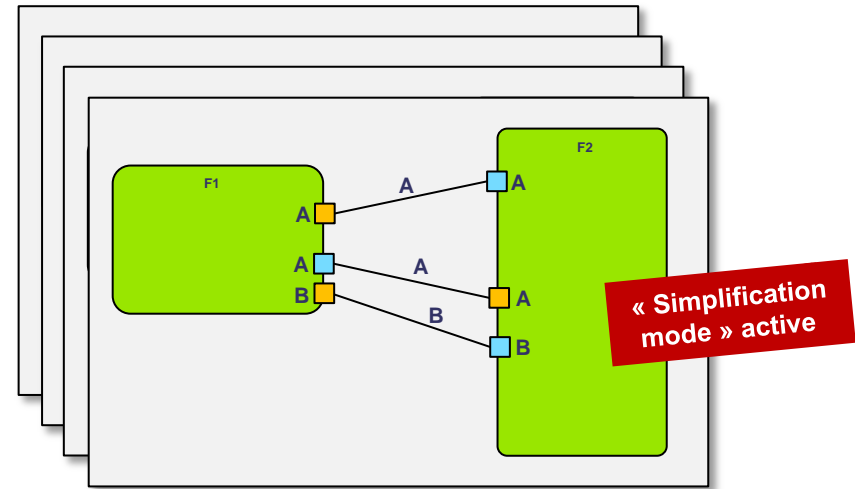
Focus on Two Keys of the Arcadia Modeling Workbench

Hiding complexity: Model ≠ Representations

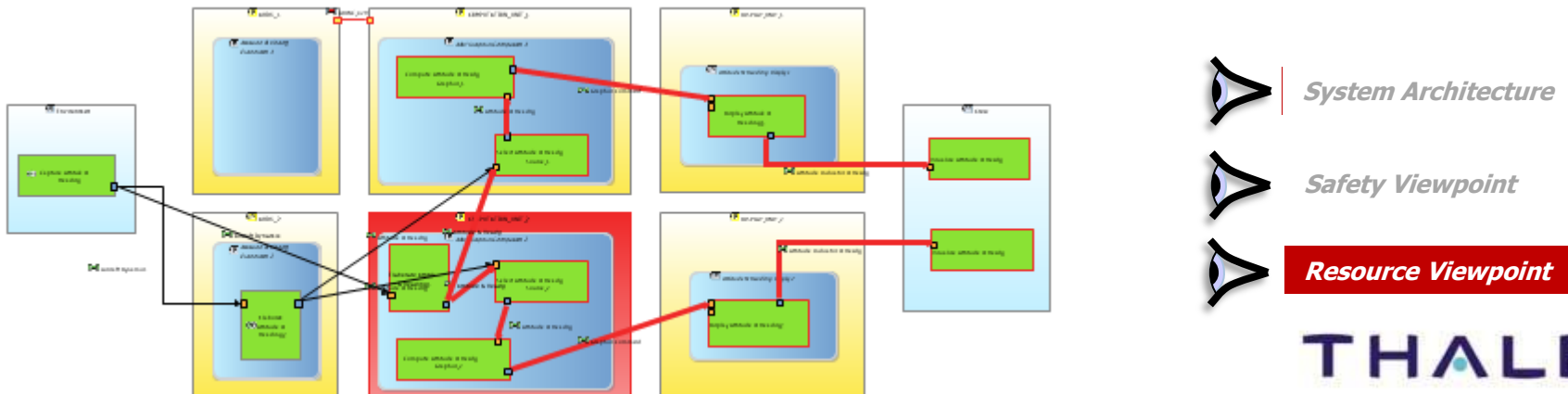
Actual Model Content



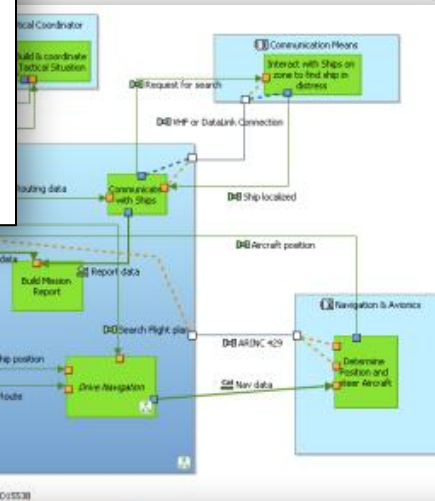
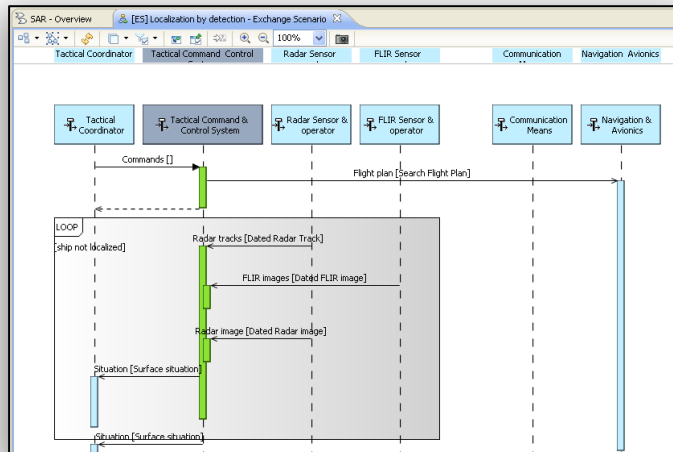
Graphical Representations



Layered / filtered diagrams for viewpoint visualization



Overview of the Modeling Workbench Main Features



	① Search & Rescue	② Manage Situation	③ Assess Situation	④ Process Situation from Radar	⑤ Compare Radar / Flir Information	⑥ Determine Position of Distress Ship	⑦ Elaborate
① Search & Rescue	X						
② Manage Situation							
③ Assess Situation							
④ Process Situation from Radar				X			
⑤ Compare Radar & Flir Information					X		
⑥ Determine Position of Distress Ship						X	
⑦ Elaborate Picture of global Situation							X
⑧ Compute geographic Position							
⑨ Compute estimated Time of Arrival							
⑩ Manage Radar / FLIR cross designation							
⑪ Ensure automatic tracking							
⑫ Manage actions							
⑬ Manage Navigation							
⑭ Manage Search Pattern							
⑮ Route Aircraft towards Distress Ship							



Edition Tools
Layered diagrams,
Tables, Editors

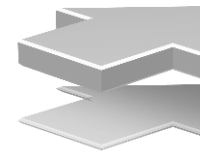
Overview of the Modeling Workbench Main Features

The screenshot shows the 'EOLE_AF - Overview' window with the 'System Analysis' phase selected. The main workspace contains three navigation buttons: 'Operational Analysis', 'System Analysis' (highlighted in yellow with the subtitle 'Formalize System Requirements'), and 'Logical Architecture'. Below these are several task lists:

- Transition From Operational Activities
- Define Actors, Missions and Capabilities
- Refine System Functions, describe Functional Exchanges
 - [SFBD] Create a new Functional Breakdown diagram
 - [SDFB] Create a new Functional Dataflow Blank diagram
 - [FS] Create a new Functional Scenario
- Allocate System Functions to System and Actors
- Define Interfaces and describe Interface Scenarios
- Transverse Modeling

On the right, the 'Diagrams Viewer' panel is visible, featuring a search bar and a tree view of diagram types:

- Common
 - Class Diagram Blank
 - Exchange Scenario
 - Functional Chain Description
 - Function Scenario
 - Modes and States
- System Analysis
 - Contextual Mission
 - Contextual System Actors
 - Missions Blank
 - Missions Capabilities Blank
 - System Actors - Operational Actors/
 - System Architecture Blank
 - System Data Flow Blank
 - System Function Breakdown
 - System Functions - Operational Activ

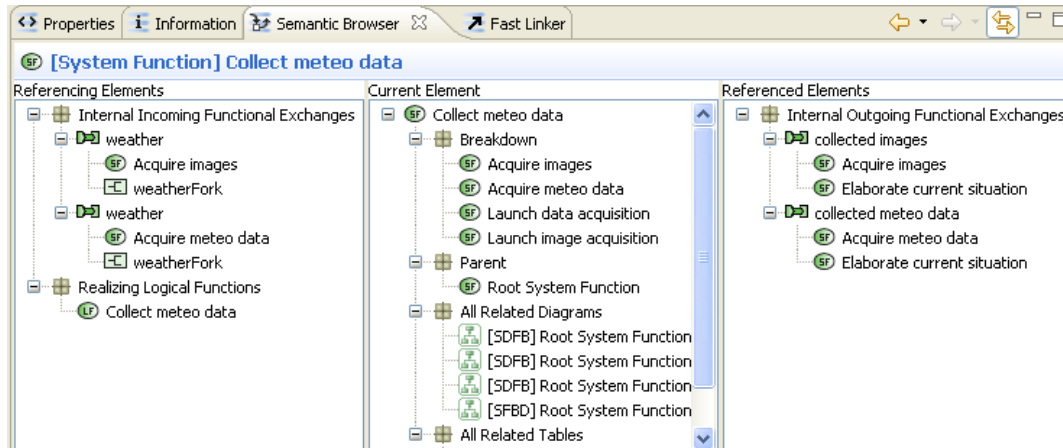


Edition Tools
Layered diagrams,
Tables, Editors

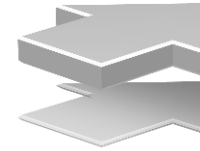


**Embedded
Methodological
Guide**

Overview of the Modeling Workbench Main Features



Edition Tools
Layered diagrams,
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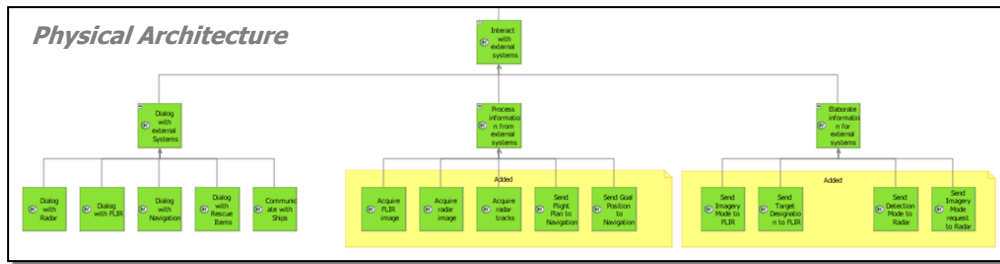
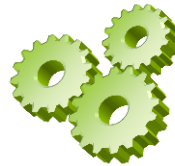
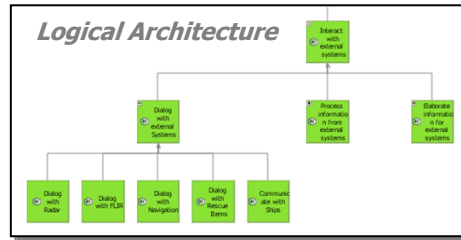


Consistency (22 items)			
Components (2 items)			
Dataflows (16 items)			
Acquire meteo data (Function) shall be realized by Capture temperature (Function) : both contain	Warning	TC_DF_14	
Both bounds of Functional Exchange should realize bounds of the realized FunctionalExchange.	Warning	TC_DF_05	
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Elaborate current situation (Function) shall be realized by Transmit data (Function) : both contain	Warning	TC_DF_14	

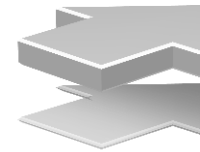


Model Analysis
Semantic browser,
Model check, Etc.

Overview of the Modeling Workbench Main Features



Iterative Transition Tools
Traceability, Generation



Edition Tools
Layered diagrams,
Tables, Editors

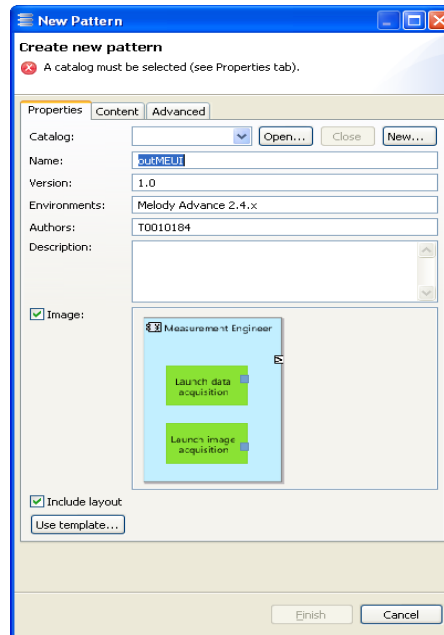


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Methodological
Guide**

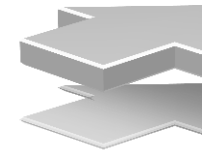


Model Analysis
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Overview of the Modeling Workbench Main Features



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**Embedded
Methodological
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Model Analysis
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Model check, Etc.

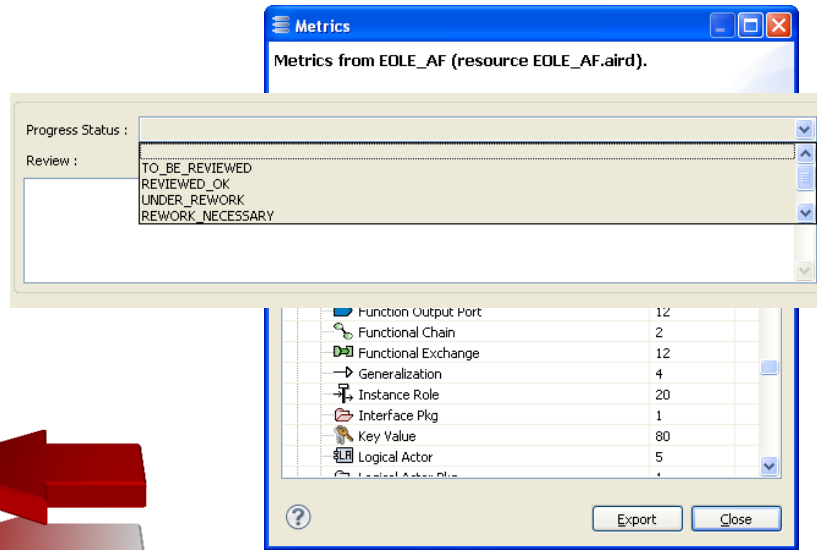


Iterative Transition Tools
Traceability, Generation



Modularity & Reuse
Libraries, Patterns,
Etc.

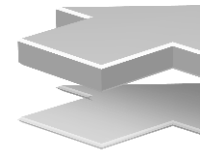
Overview of the Modeling Workbench Main Features



Model Monitoring
Progress, metrics



Edition Tools
Layered diagrams, Tables, Editors



Embedded Methodological Guide



Modularity & Reuse
Libraries, Patterns, Etc.



Model Analysis
Semantic browser, Model check, Etc.



Iterative Transition Tools
Traceability, Generation

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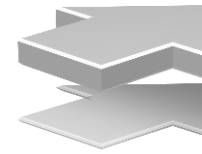
Extensibility

New diagrams, new layers,
M2 extensions, Etc.



Edition Tools

Layered diagrams,
Tables, Editors



**Model
Monitoring**
Progress,
metrics



**Embedded
Methodological
Guide**



Modularity & Reuse
Libraries, Patterns,
Etc.



Model Analysis
Semantic browser,
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Iterative Transition Tools
Traceability, Generation



Quick demonstration!

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Proven Benefits



- A strong lever for engineering transformation
- Field-proven in real industrial situations
- Leading to a better mastering of products, costs and cycles
- Improving architecture quality and sharing as well as IVV mastering

Deployed or under adoption in various Thales divisions, including industrial partnerships

Operational Deployment within Thales

Critical Information Systems

- Ground Exploitation Systems
- Command & Control (air, sea, railways...)
- Large secured Communication Networks...
- Satellite Control Networked Ground Stations

Embedded Systems

- Combat Systems (Radar, Self Protection, Optronics...)
- Mission Systems (Air, Sea, Ground)
- Satellite Constellations
- Avionics Suites
- Computing Systems
- Electrical Power Systems
- Thermal Cooling Systems
- Railways signalling Systems



Engineers trained per year

500+ Diagrams / Models

Daily users

1000+ Nodes / Diagrams

50+ Projects

200,000+ Model Elements



**Thank you for
your attention!**

Any Questions?