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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**  
**RETEX AFIS - May 2014**

**THALES**

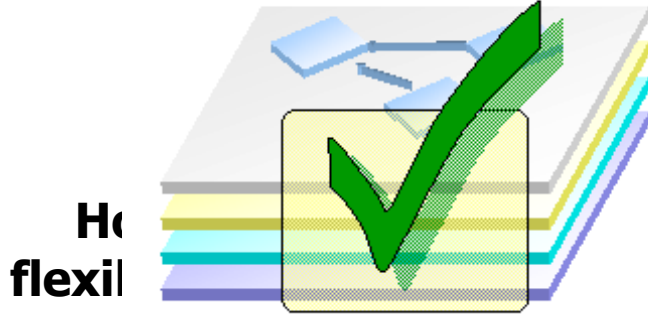
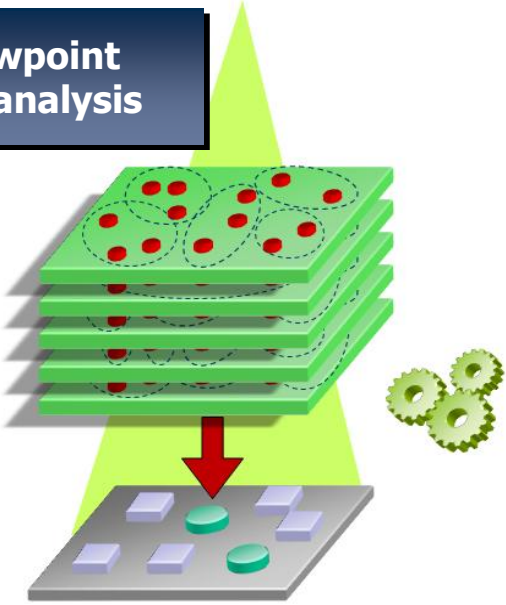
- 1 Essentials of the Arcadia method
- 2 Arcadia-dedicated modeling workbench
- 3 Return on experiment

# Requirements for a Scalable and Adaptable Method



**Early validation in short decision loop**

**Multi-viewpoint trade-off analysis**

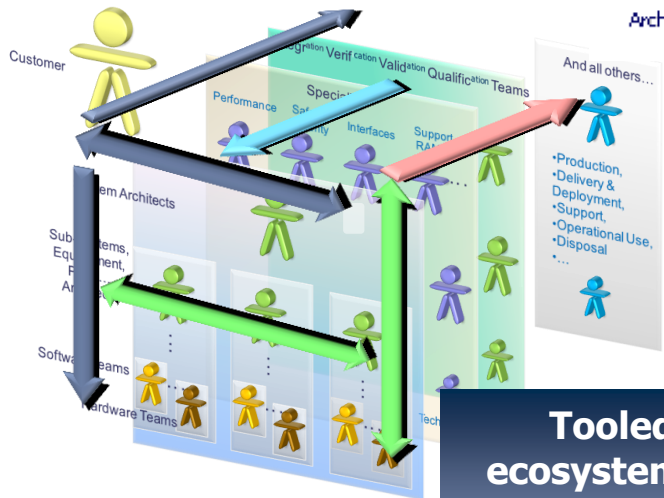


**Highly flexible**

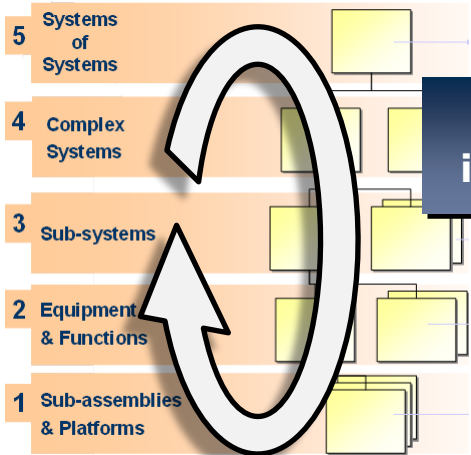
**Identifying?**

## ARCADIA

Architecture Analysis & Design Integrated Approach

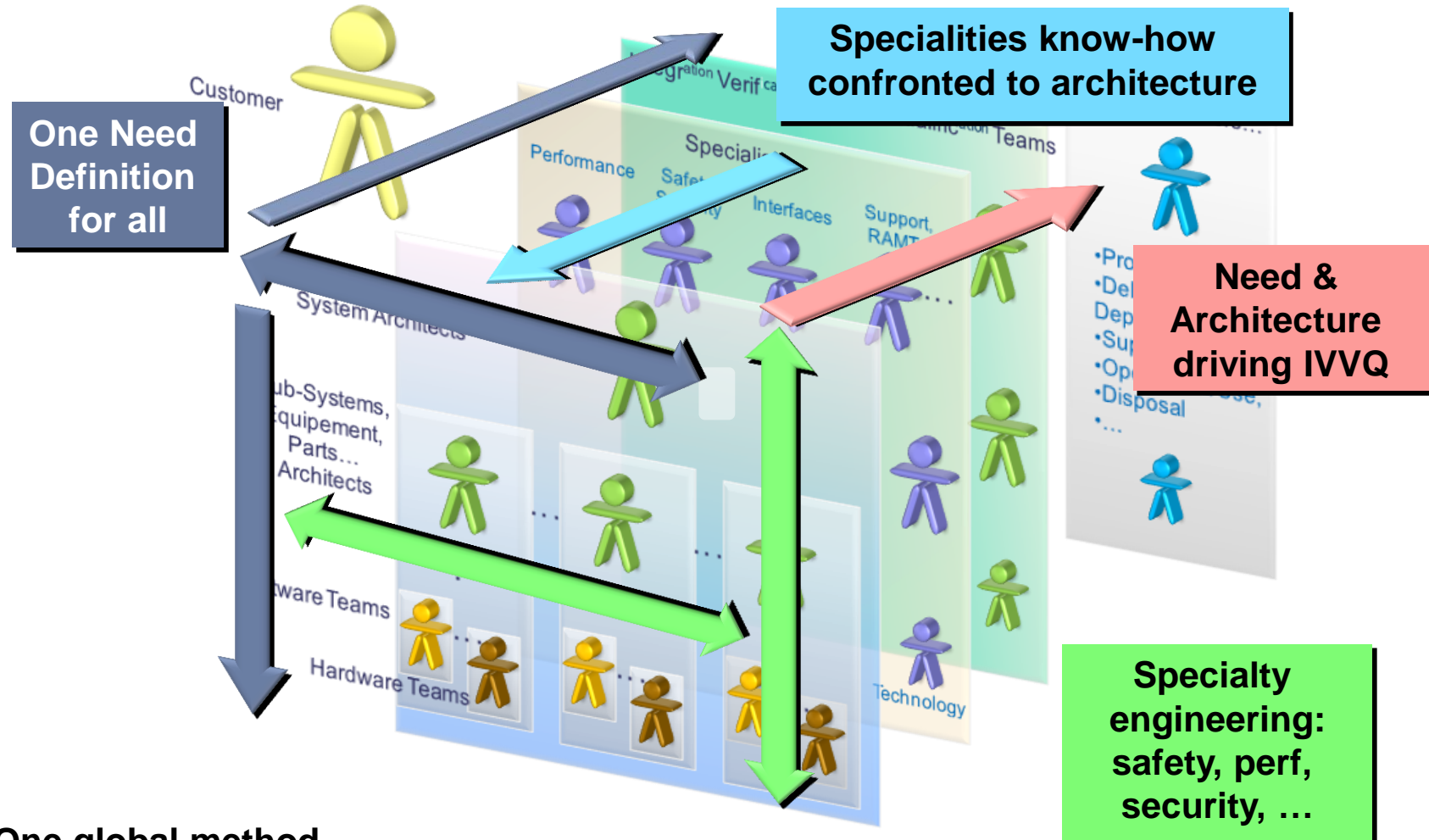


**Tooled-up ecosystem-wide collaboration**



**Multi-level impact analysis**

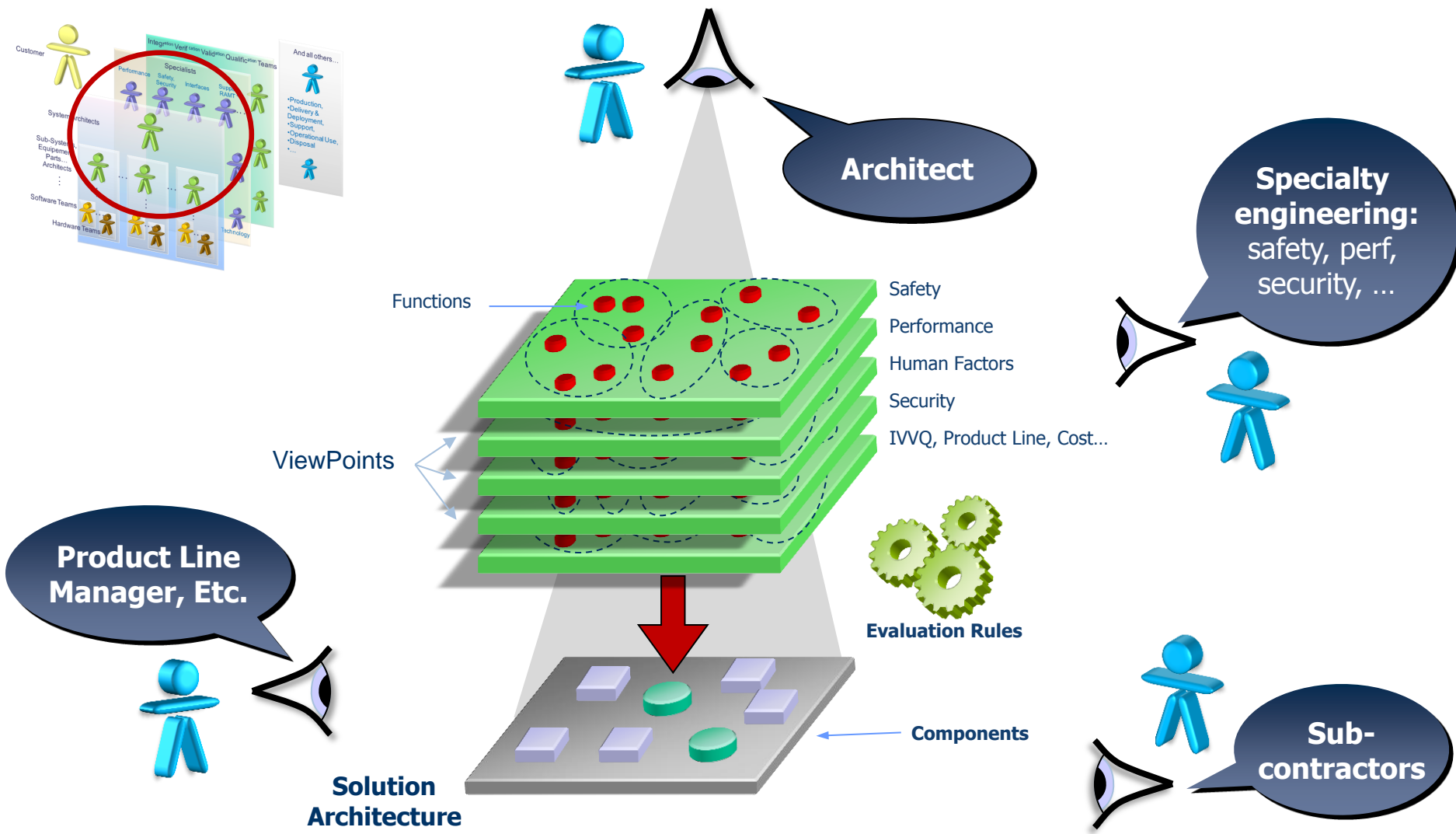
# ARCADIA Goals & Action Means



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)



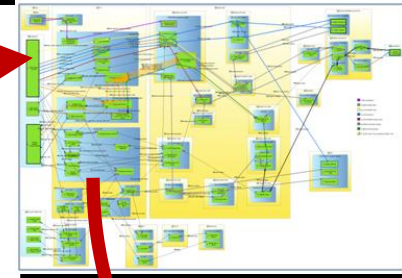
# Mastering Complexity through Multiple Abstraction Levels



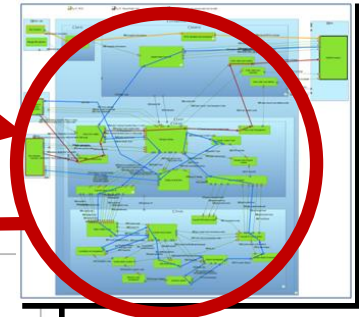
**System Engineering**



**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**

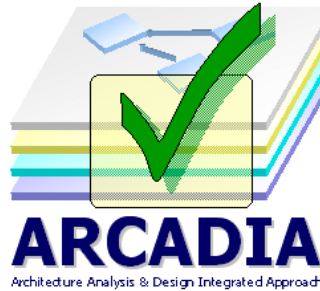


**Control Maturity of Deliveries**



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

Mission System  
Radar  
Receiver  
Software/HW



**System Components**



**Test Benches**

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



# Method-Supporting Tool: A Key Enabler

## 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)

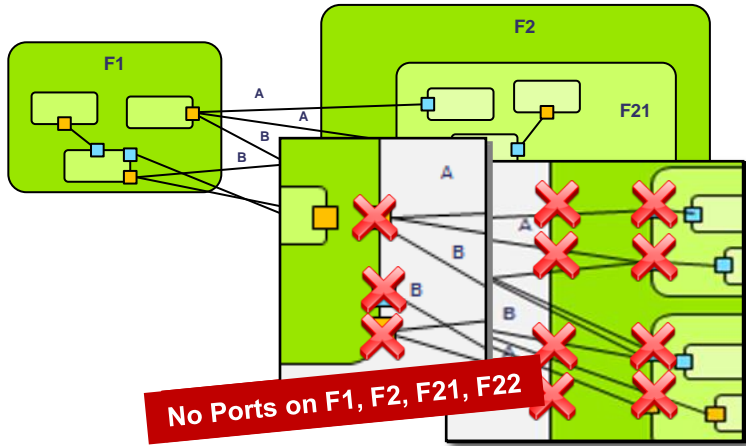
- Freedom both in language and representation
- Close to UML/SysML, interoperable with MODAF-like Architecture Frameworks
- Extensible in many ways for domain-specific purposes (Sirius / Eclipse EMF foundations)



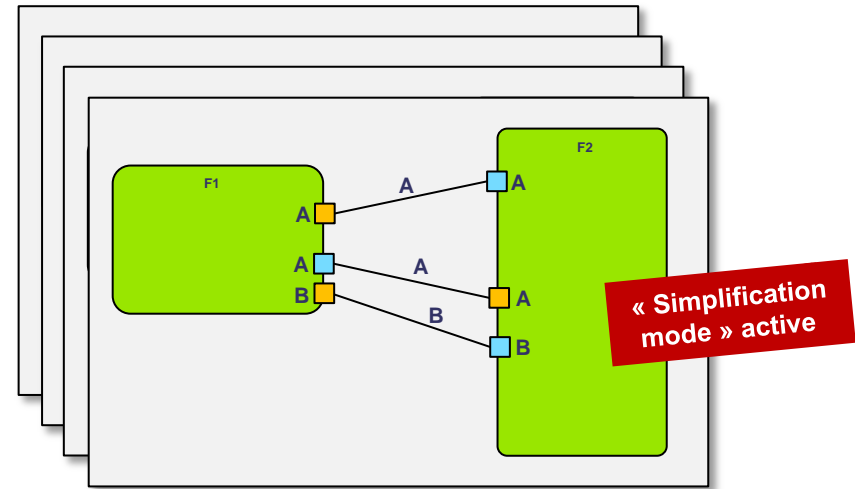
# Focus on Two Keys of the Arcadia Modeling Workbench

## Hiding complexity: Model ≠ Representations

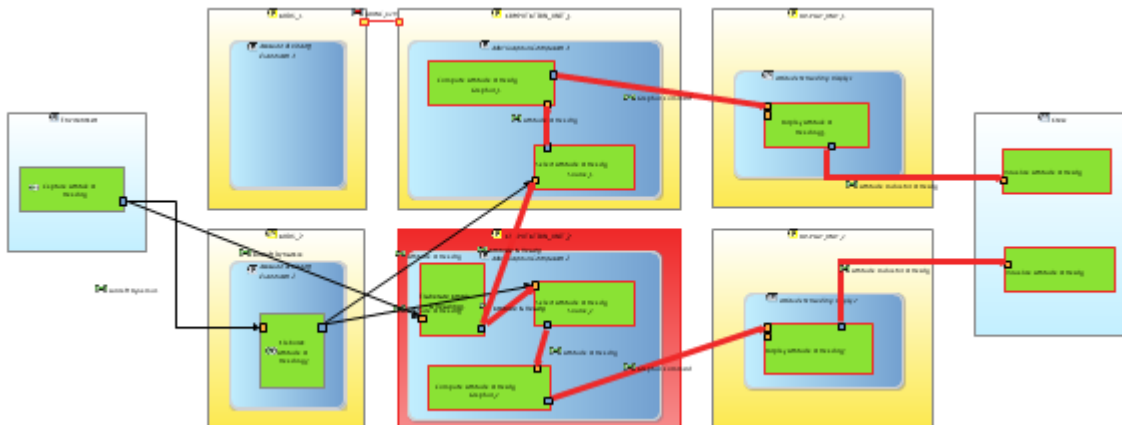
*Actual Model Content*






*Graphical Representations*

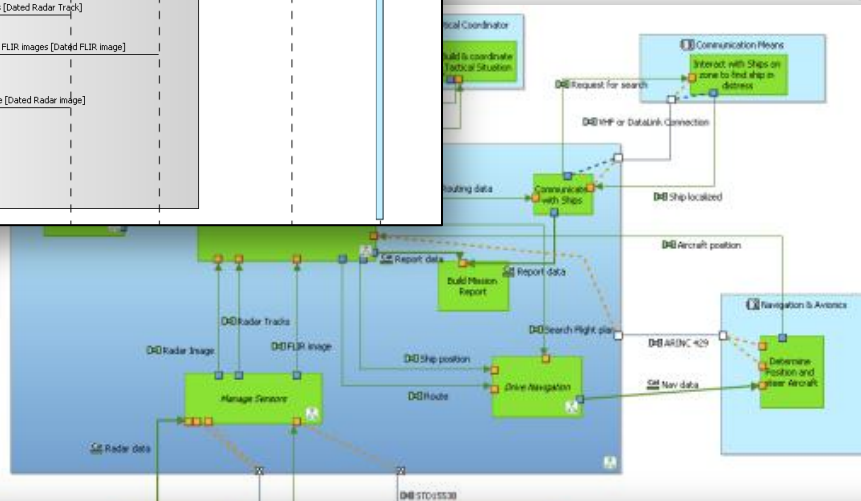
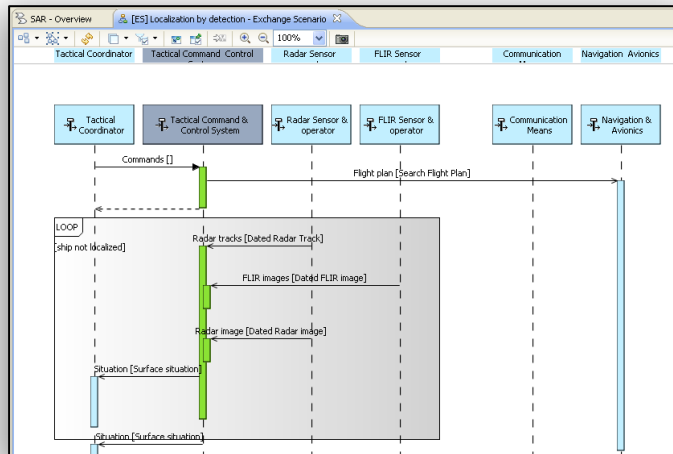


## Layered / filtered diagrams for viewpoint visualization



-  System Architecture
-  Safety Viewpoint
-  Resource Viewpoint

# Overview of the Modeling Workbench Main Features



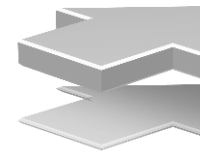
	① Search & Rescue	② Manage Situation	③ Assess Situation	④ Process Situation from Radar	⑤ Compare Radar Flir Information	⑥ Determine Position of Distress Ship	⑦ Elaborate
① Search & Rescue	X						
② Manage Situation							
③ Assess Situation				X			
④ Process Situation from Radar							
⑤ Compare Radar & 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 displays the 'System Analysis' workflow in the Modeling Workbench. The main window is titled 'EOLE\_AF - Overview' and shows a navigation bar with three stages: 'Operational Analysis', 'System Analysis' (highlighted in yellow with the subtitle 'Formalize System Requirements'), and 'Logical Architecture'. Below the navigation bar, a list of tasks is shown, including 'Transition From Operational Activities', 'Define Actors, Missions and Capabilities', 'Refine System Functions, describe Functional Exchanges' (expanded to show sub-tasks like '[SFBD] Create a new Functional Breakdown diagram', '[SDFB] Create a new Functional Dataflow Blank diagram', and '[FS] Create a new Functional Scenario'), 'Allocate System Functions to System and Actors', 'Define Interfaces and describe Interface Scenarios', and 'Transverse Modeling'. On the right, the 'Diagrams Viewer' panel is visible, featuring a search bar and a tree view of diagram types such as 'Class Diagram Blank', 'Exchange Scenario', 'Functional Chain Description', 'Function Scenario', 'Modes and States', and various 'System Analysis' templates.



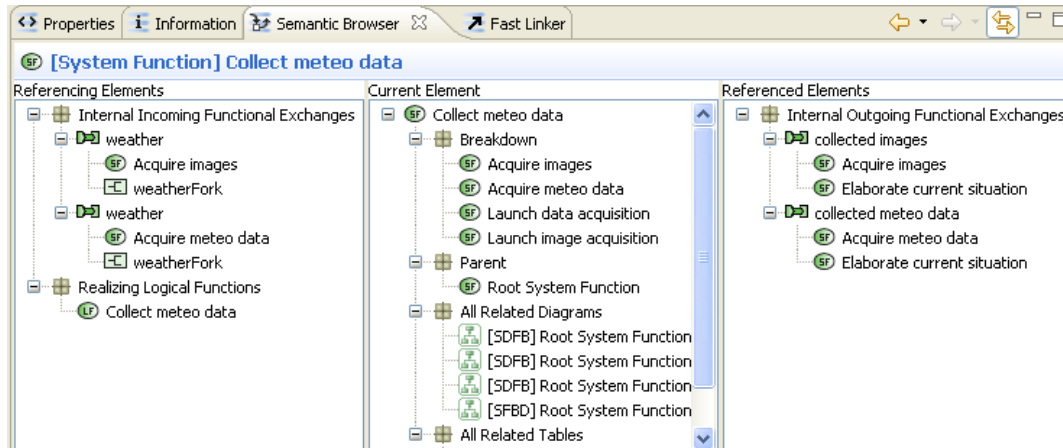
**Edition Tools**  
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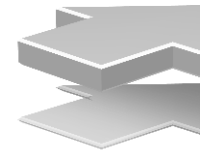
**Embedded  
Methodological  
Guide**



# Overview of the Modeling Workbench Main Features



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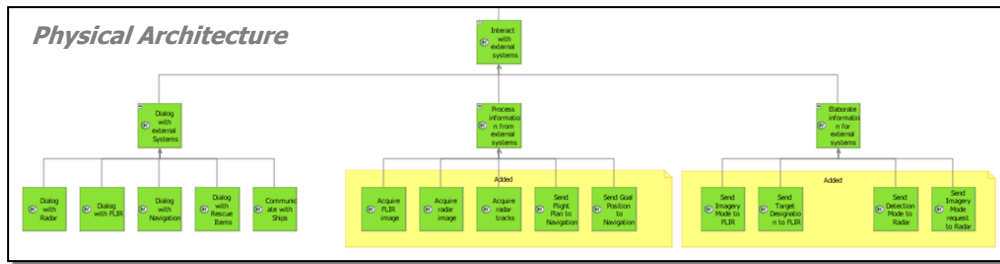
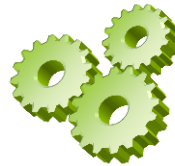
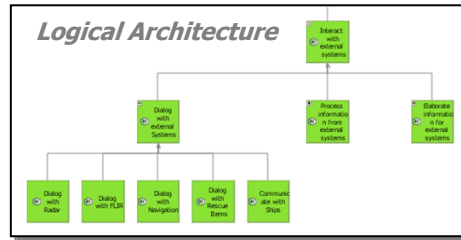


Consistency (22 items)			
Components (2 items)			
Dataflows (16 items)			
Acquire meteo data (Function) shall be realized by Capture temperature (Function) : both contain	Warning	TC_DF_14	
Both bounds of Functional Exchange should realize bounds of the realized FunctionalExchange.	Warning	TC_DF_05	
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

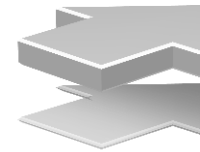
**Model Analysis**  
Semantic browser,  
Model check, Etc.



# Overview of the Modeling Workbench Main Features



**Iterative Transition Tools**  
Traceability, Generation



**Edition Tools**  
Layered diagrams,  
Tables, Editors

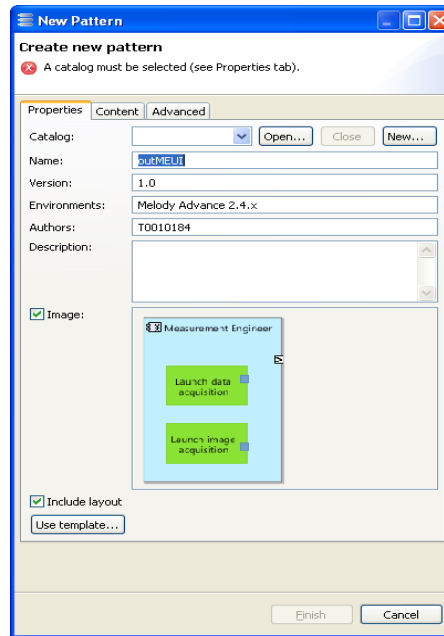


**Embedded  
Methodological  
Guide**

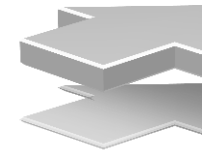


**Model Analysis**  
Semantic browser,  
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# Overview of the Modeling Workbench Main Features



**Edition Tools**  
Layered diagrams,  
Tables, Editors



**Embedded  
Methodological  
Guide**



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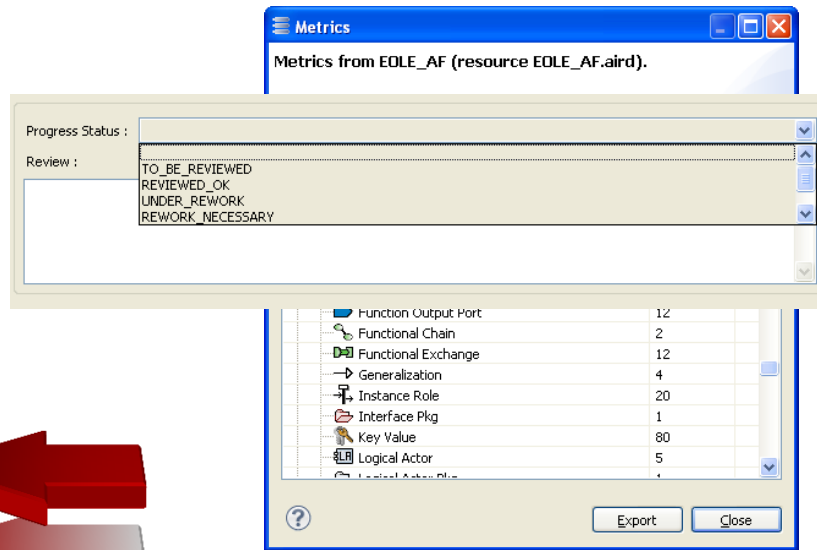


**Iterative Transition Tools**  
Traceability, Generation



**Modularity & Reuse**  
Libraries, Patterns,  
Etc.

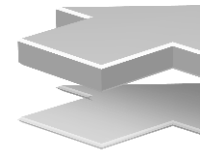
# Overview of the Modeling Workbench Main Features



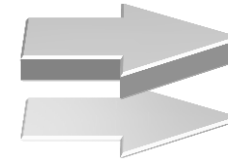
**Model Monitoring**  
Progress, metrics



**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

# Overview of the Modeling Workbench Main Features

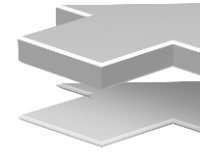
## Extensibility

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,  
Model check, Etc.



**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

**1,5M+** Model elements (« EObjects »)

**THALES**



**Thank you for  
your attention!**

**Any Questions?**