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

An architecture-centric, tool-supported method

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CSD&M 2013
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
- ARCADIA: Architecture Analysis & Design Integrated Approach
- Tooled-up ecosystem-wide collaboration
- Multi-level impact analysis

How to improve agility and flexibility of overall engineering?
ARCDIA Goals & Action Means

One Need Definition for all

Specialities know-how confronted to architecture

Need & Architecture driving IVVQ

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

**Master Development Ups and Downs**

**Control Maturity of Deliveries**

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

Operational Need, Functional Contents
System Components
Test Benches

Mission System
Radar
Receiver
Software/HW
Agenda

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## Method-Supporting Tool: A Key Enabler

<table>
<thead>
<tr>
<th>Manage Information Complexity</th>
<th>Ease Capitalization</th>
<th>Manage a Common Reference Model</th>
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<tbody>
<tr>
<td>Automatic synthesis, simplification on diagrams, modelling aids</td>
<td>Concepts</td>
<td>Configuration management</td>
</tr>
<tr>
<td>Modularity (viewpoints and transitions)</td>
<td>Engineering rules</td>
<td>Collaboration between stakeholders (multi-user access on a shared model)</td>
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<td>Separation of concerns through viewpoints and diagram layers</td>
<td>Architectural assets</td>
<td>Coupling with change management, test environments, documentation generation, etc.</td>
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<td>Centralize information managed by specialized tools</td>
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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

No Ports on F1, F2, F21, F22

« Simplification mode » active
Overview of the Modeling Workbench Main Features

Edition Tools
Layered diagrams, Tables, Editors
Overview of the Modeling Workbench Main Features

**Main Features**

- Embedded Methodological Guide
- Edition Tools
  - Layered diagrams, Tables, Editors

**System Analysis**

- Operational Analysis
- System Analysis: Formalize System Requirements
- Logical Architecture

**Edition Tools**

- Layered diagrams
- Tables
- Editors
Overview of the Modeling Workbench Main Features

Model Analysis
Semantic browser, Model check, Etc.

Edition Tools
Layered diagrams, Tables, Editors

Embedded Methodological Guide

Consistency (22 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

Components (2 items)
- Collect meteo data
- Weather

Dataflows (16 items)
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Overview of the Modeling Workbench Main Features

**Logical Architecture**
- 

**Physical Architecture**
- 

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Layered diagrams, Tables, Editors

**Embedded Methodological Guide**

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

**Iterative Transition Tools**
Traceability, Generation
Overview of the Modeling Workbench Main Features

- **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

Model Monitoring
- Progress, metrics

Edition Tools
- Layered diagrams, Tables, Editors

Embedded Methodological Guide

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Main Features
- Model Analysis Semantic browser, Model check, Etc.
- Embedded Methodological Guide
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Overview of the Modeling Workbench Main Features
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**Extensibility**
New diagrams, new layers, M2 extensions, Etc.

**Model Monitoring**
Progress, metrics

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

**Iterative Transition Tools**
Traceability, Generation

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

**Embedded Methodological Guide**

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

Quick demonstration!
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Return on experiment

**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
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+

### Daily users
1000+

### Projects
200,000+

Diagrams / Models
Nodes / Diagrams
Model Elements
Thank you for your attention!

Any Questions?