Towards a European Roadmap for Fostering OSLC Adoption in Systems Engineering Development?

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An Example of Large European Project: CRYSTAL

“Seamless Life-Cycle Collaboration for Safety-Critical Systems Engineering”

- **68 partners** from **10 countries**
- **$87M** total budget
- **European key players** from different industrial domains
- Large companies developing embedded systems act as technology users and use case providers
- Large tool providers, SMEs and researchers as technology providers
- **4 Industrial Sectors (Aerospace, Automotive, Rail, Healthcare)**
Agenda

- Interoperability related activities in large European projects
- Towards the establishment of a sustainable structure for interoperability specifications (in CP-SETIS)
- Some technical challenges we are facing with OSLC
- Some dissemination material from CRYSTAL
- KTH contributions to the Lyo OSLC reference implementation
Today’s situation in industrial companies
The CRYSTAL Vision

Enable New Engineering Methods

Open Integration Platform

Tool Layer

Users get better ways of working

- Standardized Interoperability Specifications (IOS)
- Connect tools to expose & link data

Industrial Workflows
**IOS History & Evolution**

- **Pre-Project Phase** (from 2010)
  - Safe, iFEST, CESAR, MBAT projects
    - Proof of concept,
    - OSLC as one basis,
    - Extensions to Testing & Analysis

- **CRYSTAL Project Phase** (until mid 2016)
  - Extension of IOS to additional concepts & standards
  - Fostering adoption of IOS by Tool Vendors and Industrial End-Users

- **After Project Phase**
  - Coordination Action (H2020 CP-SETIS)
  - new projects (ITEA3 ASSUME, ECSEL ENABLE-S3)
Examples:
- Heterogeneous co-simulation
- Real-Time Data Measurement and Calibration
- etc.

Interoperability Specification (IOS)

<consists of>

Lifecycle IOS

<consists of>

Non-Lifecycle IOS

Data Integration across Tools, Data Repositories and Engineering Phases
e.g., Traceability across the whole product development lifecycle

Examples:
- IOS Variability Management
- IOS Safety Management
- etc.

Follow the process advocated by OSLC for specifying domains

NLC Domain

<adopts>

Bridges for Integration with Lifecycle IOS

Examples:
- OSLC Core specs
- Examples of “OSLC Domains”:
  - OSLC RM Spec,
  - OSLC QM Spec,
  - etc.

Example from CRYSTAL:
- Full-fledge traceability support between OSLC Requirements, Design Artifacts, and Simulation Results generated by FMI
- Autosar to OSLC bridge
- ReqIF to OSLC bridge
Current Content of the CRYSTAL IOS

- **Lifecycle IOS**
  - Adopted from OSLC
    - OSLC Core, CCM, TRS
    - OSLC RM, AM, QM, Asset, Change Request Domains
  - CRYSTAL extensions to existing Domains
    - RM, AM (extensive ones), QM
  - New Domains
    - Knowledge & KPIs Management
    - Formal Requirement Management
    - Verification & Validation
    - Variability Management
    - Safety & Risk Management
  - New Domains from other projects
    - Human Factor Modeling (from the HoliDes project)
    - AM extensions (from ASSUME/Scania)

- **Non-Lifecycle IOS**
  - FMU/FMI standard for co-simulation

- **Bridges**
  - AUTOSAR / EAST-ADL to OSLC
  - OMG ReqIF to OSLC

(Public release)
Context and current situation

- Current situation is characterized by a **wide variety of activities**, which are only **partly coordinated**
  - Several **follow-up projects** building and extending the IOS

- **New European projects** emerging that **aim at interoperability** solutions for development tools

- Interoperability related projects are step-by-step converging towards a common definition of the IOS
Challenges

1. Organizational & Strategical
   • A common vision and mission, shared by all major stakeholders, for supporting lifecycle data and tool interoperability for CPS Engineering has to be established
   • Aligning the as yet only partially coordinated European IOS-related activities and paving the way for establishing the IOS as a major set of standards in CPS Engineering.

2. Technical
   • Coordination of IOS cross-project extensions (complementary & orthogonal concerns)
   • A clear bridge has to be defined between the on-going definition of the IOS and other widespread Interoperability and Engineering Standards commonly used by European developing organizations
     • related to “Data Exchange” besides “Data Integration”
CP-SETIS – Coordination Action kick-started in 2015

Goals

- **Align all IOS related forces** within Europe to support a common IOS Standardization Strategy, aiming at formal standardization process of the IOS

- The definition and implementation of **sustainable IOS Standardization Activities** supporting both, formal standardization of ‘stable’ IOS versions as well as extensions of IOS, if possible within existing structures that survive the lifespan of single projects
CP-SETIS WPs & Possible Implementation

- **Past Project CESAR**
- **Past Project iFEST**
- **Past Project MBAT**
- **CRYSTAL**
- **EMC2**
- **Future Project**
- **Future Project**

### ARTEMIS-IA Working Groups

- **WP0 Management and Coordination**
  - Defines IOS strategy
  - Be focal point and point of contact for all IOS related activities
  - Define stable IOS Versions for WG Standardization
  - Evaluate results from existing projects
  - Organize cross-project workshops
  - Give recommendations to projects
  - Incubate new projects

- **WP1** Model of sustainable IOS Standardization Activities
  - Promotes Standards to tool vendors and end users
  - Evaluate existing standards
  - Negotiates cooperation with standard organizations
  - Create WGs in Standardization bodies
  - Assign IOS label to standards

- **WP2** Identification of Cross-Projects IOS Challenges

- **WP3** Fostering IOS Support and Industrial Acceptance

- **WP4** IOS Standardization Roadmap

- **WP5** Standardization SRA

- **WP6** Promotion & Dissemination

- **Future Project**

Projects develop proposals (specs) for IOS extensions / IOS modifications / new standards

- **Tool User**
- **Tool Provider**
- **RO**

### ASAM
- Calibration Data Management WG
- Network Configuration WG

### OASIS
- Configuration Management WG
- Requirements Management WG

### OMG
- ...
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<th>Associated Partners</th>
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<td>Austrian Institute of Technology (AIT), Austria</td>
<td>ABB, Sweden</td>
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<td>ARTEMIS-IA Industrial Association, Europe</td>
<td>Airbus, France, Germany, UK</td>
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<td>SafeTRANS, Germany (coordinator)</td>
<td>European Telecommunications Standards Institute (ETSI), Europe</td>
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<td>Siemens, Germany</td>
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<tr>
<td>Thales, France</td>
<td>→ More are being invited to join</td>
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Some Technical Challenges of OSLC specs

- Specification / Guidelines for handling **Data Exchange** scenarios
  - Via engineering standards
  - Via company-specific “OSLC domains”
  - Via basic “raw” file exchanges

- The “Magic Triangle”
  - Version / Configuration / Variants

- Authentication & Access Rights Management not standardized
Towards a new distinction between normative and informative OSLC specs?

*Just a brainstorming!*

Already within the scope of OSLC/OASIS

**OSLC Core**
- Linked-Data Platform for RDF,
- HTTP C.R.U.D. RESTful operations,
- OSLC-defined Resources,
- OSLC Core Resource types

**OSLC CCM**
- Version & Configuration Management

**OSLC DUI & Resource Previews**
- Delegated User Interface Dialogs

**OSLC Reporting**

**OSLC Automation Support**

**OSLC Asset Manag.**

**OSLC Quality Manag.**

Not yet formally in the scope of OSLC/OASIS

**Notifications?**

**Access Control?**

**Users Manag.?**

**Authentication?**

**VM?**
- Variability Management

**VPM?**
- Viewpoint Management

**Knowledge Manag.**

**Detailed Arch. Manag.**

**Safety & Risk Manag.**

**Formal Req. Manag.**

**Human Factors**

**Formal Analysis**

**FMI/FMU Mapping**

**Company-Specific Models**

... etc ...

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• Some technical challenges we are facing with OSLC

• Some dissemination material from CRYSTAL
  • Public Use Cases
  • Generic Engineering Methods

• KTH contributions to the Lyo OSLC reference implementation
Purpose of the CRYSTAL Public Use Cases

• Describe typical engineering challenges with respect to (tool) interoperability for specific industrial sectors
  • In particular for Aerospace and Automotive

• Perform prototyping of IOS concepts

• Facilitate the presentation of CRYSTAL results in publications without facing IPR concerns
  • Documented *Engineering Methods* (or “Integration Scenarios”) and their mapping onto IOS concepts
  • Engineering Models available
Example of the CRYSTAL Aerospace Public Use Case
Definition of De-icing System for Regional Turboprop Aircraft

Clustering of Engineering Methods

RTP related

Set-up of SEE, including user rights

Process Management

System Design and Analysis related

Analyze Requirements

Define Domain Model

Heterogeneous Simulation

Verify Design Against Requirements

Trade-Off Analysis

Extend for FMU Export

Add Safety

Generate Fault-trees / TBD

Add Feature

Product Line Engineering

“Common Services” related

Search Data

Traceability/ Change Impact Analysis

Support collaborative working

Put all data under Configuration Control

Test Support

Provide Specification

Maintain Consistency between multi-viewpoint models

Versioning / Archiving

Andreas Mitschke – Airbus Group
Frédéric Lointet – KTH / OFFIS
Envisioned Prototype for Implementation

Communication via Network (e.g. Intranet or Secure Internet)

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Developing IOS and generic Engineering Methods in CRYSTAL

- Describe Use cases
- Define engineering methods and artefacts exchanged
- Apply generalised engineering methods
- Consolidate engineering methods across Use cases
  - IOS needs
  - gEMs
- Evaluate improved tool
- Validate Engineering Method
- Use of system engineering environment
- Collect IOS candidates
- Define IOS architecture
- Create Interoperability specification
- Create IOS tool adapters

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How to use IOS for a typical work process?
- Sample generalised Engineering Methods show how to map to IOS
- Cross-domain engineering steps and engineering functions
- Categorised according to ISO 15288
- Based on Engineering methods collected in Use cases

Current gEMs being developed in CRYSTAL
- Tests coverage of requirements
- Simulation management
- Version & configuration management
- Safety management
- Certification (draft)
- Drafts: Variability Management / ReqIF-OSLC / Trade-off Analysis
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OSLC Reference Implementation / Community Building

- Building up momentum around Lyo should be fostered!

- KTH contributions so far
  - OSLC4J code generators (part of Lyo)
  - Modeling support for Linked Data

OSLC EMF Meta Model

Vocabulary based on Linked Data
- An Eclipse Graphical User Interface

Automatic Generation

Generated OSLC4J Front-Ends
Thanks for your attention!

CRYSTAL website
http://www.crystal-artemis.eu

CP-SETIS website (under construction)
http://cp-setis.eu

CRYSTAL IOS V2 & Public Use Case Deliverables (publicly released)
http://www.crystal-artemis.eu/deliverables.html

Lyo/KTH Code Generators
https://wiki.eclipse.org/Lyo/AdaptorCodeGeneratorWorkshop