CRYSTAL
Seamless Life-Cycle Collaboration for Safety-Critical Systems Engineering

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Today’s situation at industrial companies

- **AEROSPACE**
- **AUTOMOTIVE**
- **HEALTH CARE**
- **RAILWAY**

### Industrial Workflows

- **Fragmented IT**
- **High maintenance costs**

### Tool Layer

- **Analysis Tools**
- **Functions Database**
- **Testing Databases**
- **Product Definition**
- **Requirements Databases**

- **Develop concepts**
- **Plan System**
- **Integrate System**

- **High manual effort to handle data**
- **Impact on quality and safety**

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The tool-integration problem

Point-to-point Integrations don’t scale

Monocultures lock you in

Maintenance, management, and change costs go up over time

Ongoing and unexpected costs drain resources

Creating new integrations is unpredictable

Past choices restrict present action and future vision

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The CRYSTAL Vision

Enable New Engineering Methods

Open Integration Platform

Tool Layer

• Standardized Interoperability Specification
• Connect tools to expose & link data

Users get better ways of working

Industrial Workflows
CRYSTAL has the critical mass to generate impact

- 68 partners from 10 countries
- €82M budget
- European key players from different industrial domains
- Large companies developing embedded systems act as technology users and case providers
- Large tool providers, SMEs and researchers as technology providers
The Integration Problem

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The CRYSTAL Approach

- Establish an **Interoperability Specification (IOS)** to come to an **internationally recognized standard**
- Enable **non-disruptive** adoption
  - Integration into existing environments
  - Step-by-step evolution
- Facilitate **App culture** for System Engineering Environments (SEEs)
  - Component-based architecture
Scope of CRYSTAL

Model-based safety-critical systems engineering

Design for reusability, safety, and traceability support

Standardized interoperability („ARTEMIS - CRYSTAL - IOS“)

Systems engineering environment (RTP, platform builder, bricks)
Standardize tool interaction, but not a tool’s capabilities!

- Separate data from tool functions
- Apply IOS as the central standard
Loosely Coupled Federated Integration by Minimal and Sufficient Specifications

**IOS**

Shared Artifacts for Lifecycle Interoperability

- **Model**
  - **Element**
  - **Element**

**loosely coupling**

- **Model**
  - **Element**
  - **Element**

**IOS Adaptor**

**Specific models and standards**

- **Detailed Model A**
- **Tight Coupling** (e.g. Import/Export)
- **Detailed Model B**

**Tool A**

**Tool B**

**Generic Semantics**

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Example 1
Traceability Requirements <-> Simulation Models <-> Test Cases

- Integration of Authoring Tools in ALM Environments
Example 1 (cont’d)
Traceability Requirements <-> Simulation Models <-> Test Cases
Obtaining Minimal and Sufficient Specifications
CRYSTAL’s User-driven Approach

The **IOS** and **Technology Bricks** (tools, tool-components, interface specifications, standards ...) are strictly derived from user needs!
Assisted System Engineering Environment (SEE) configuration

Company/Product-Specific Development Process

Platform Builder

Tailored System Engineering Environment
CRYSTAL Consortium

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- Large tool providers, SMEs and researchers as technology providers will improve and implement technology bricks
- 71 partners from 10 countries
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IOS Evolution & Relation to other Projects

Pre-Project
- ... CESAR
- SAFE
- iFEST
- MBAT IOS
- Proof of concept
- First prototypes

Project Phase
- CRYSTAL IOS
- “Close-to-real-world” demonstrators
- Iterative development process
- Collaboration with standardization bodies

Post-Project
- Standardized IOS
- Extensive Industrial Uptake

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Improved system development
- Lower cost / less time
- Lower risk
- Less rework
- Higher Quality

Increased flexibility for OEMs
- No vendor-lock-in

New market opportunities for tool providers
- Facilitate innovation and market entry

Ensure Europe’s leading edge position in development of safety-critical embedded systems