Tool Repositories, ESCHER and continuing the legacy of the CHESS ITR

Edited and Presented by
Janos Sztipanovits
ISIS, Vanderbilt University
ESCHER Research Institute

• Established in 2003 as a new model for transitioning government funded research to industry.
• Vanderbilt spinout: January 04
• Activities:
  - Repository setup and operation
  - Roadmapping
  - Contract management
  - Outreach
Why Do We Need Escher?

"Tool repositories, ESCHER...", J. Sztipanovits

Oct. 4, 2006; Chess Review
Driving Forces

• Accelerating product development cycles
• Global competition – global marketplace
• Easy access to venture capital
• Heightened government responsiveness
• R&D friendly legislation
• More system innovations – fewer “gadgets”

Result:

• Demise of large industrial research labs
• Weakened ability to create and hold a technology advantage
• Increased emphasis on consortia, partnering, and cost – sharing
• Increased importance of “community development”
R&D Model - 2

2000’s

INDUSTRY

Mission-Oriented R&D

Customer Consortia

UNIVERSITY

Publication Consulting Students Spinoff Licensing

Performers Consortia

$ USG

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The ESCHER Model

Escher is a New Approach to Transition

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Unknowns

• **Scope:** Specific programs / Embedded Systems/Specific Industry / Software Program / any IT results
  
  What scope can be managed?

• **Structure:** Research Institute vs. Industry Association,
  
  Membership vs. No Members, Governance that involves companies but protects long-term vision

• **Funding:** Government/ Industry Mix,  Need for long-term commitment,
  
  Program vs. Office,  Deliverables vs. Overhead (Repository)

• **Value Proposition:** Business case that justifies long term participation,
  
  Who in the government is feeling the “pain” of the inefficient transition process?
The **Escher Research Institute** is:

A *non–profit corporation* that provides *services* to enable

the *transition of government - funded*

*information technology research* results to *customers*.
Services

• Consortium Management
  - Pooled funding sources for a single project
  - Coordination of multiple performers
  - "Neutral party" non-competitive status – smoothing IP and other issues
  - Mechanism for maturing / customizing results for customers
  - Unified customer voice provides guidance to performers

• Software Repository
  - Virtual "transition partner" with quality requirements
  - Bridging timing mismatch
    - Keeping teams together during the interim
    - Keeping results "fresh" until markets mature
  - Researchers can build on prior results – programs build on one another

• Roadmapping

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Value Proposition

To government:

- Better / Easier Program Management
  - “Honest broker” consortium management
  - End game for early stage technology program
  - Collaborative development – build on previous results

To industry:

- Pooled funding saves money – management hassle
- Avoids anti-trust problems
- Coordinated voice in influencing government funding direction

To university performers:

- Access to industrial funding
- Transition path multiplies value of university research
- Avoids peer-managed consortium problems
- More value means it is easier to attract government funding

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ESCHER Structure

- **Structure:** 501(c)(3) Non-profit Research Institute
- **Initial Board of Directors**
  - Prof. Janos Sztipanovits – Vanderbilt U
  - Prof. Shankar Sastry – UC Berkeley
  - Prof. Doug Schmidt – Vanderbilt U
- **Initial Funding**
  - **Corporate:** General Motors, Raytheon, Boeing
  - **Government:** National Science Foundation, DARPA,
- **Initial Focus:** Tool Chain for Embedded System Design based on Model – Integrated Computing (MIC)
### Repository Criteria

<table>
<thead>
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<th>Tool Qualification Criteria</th>
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<td>Intellectual Property (IP) Rules</td>
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<td>Tool Dependencies</td>
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<td>Functional Integrity</td>
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<td>User Support Criteria</td>
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<td>Development QA Processes</td>
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<td>Domain Applicability</td>
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Repository Architecture

Publicly Accessible Area

- OEP challenge problems
- Tool chains examples
- Tool evaluations
- Discussion boards

Controlled Access Area

- Bug Reports Database
- Authentication Module
- Bug Reporting & Motinornig
- Tool chains
- Tool evaluations
- OEP Challenge Problems
- "Proprietary" Design Flows

Authenticated Users (Contributors, Tool Developers, etc.)

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Tools

Below you will find an ESCHER summary and links for several tools. Each tool described below is developed by organizations separate from ESCHER. For more information on a specific tool, please visit that tool’s website via the provided link.

Basic Tools
- **CHARON** - Hybrid systems modular specification and design tool
- **AIRES** - Timing and schedulability analysis tool
- **Gotto** - Time-triggered programming environment
- **Checkmate** - Hybrid systems analysis tool
- **TimeWeaver** - Embedded systems component modeling and design tool

Tool Suites
- **Model-Integrated Computing (MIC) Tool Suite**
  - **QME** - Meta-programmable modeling tool
  - **UDM** - Model management tool
  - **GREAT** - Model transformation tool
  - **DESERT** - Design space exploration tool
  - **Polarity II Tool Suite** - Modeling and Design tool suite
Repository Portal 2/3

GME

GME Tool Info

The Generic Modeling Environment is a configurable toolkit for creating domain-specific modeling and program synthesis environments. The configuration is accomplished through metamodels specifying the modeling paradigm (modeling language) of the application domain. The modeling paradigm contains all the syntactic, semantic, and presentation information regarding the domain; which concepts will be used to construct models, what relationships may exist among those concepts, how the concepts may be organized and viewed by the modeler, and rules governing the construction of models. The modeling paradigm defines the family of models that can be created using the resulting modeling environment.

The metamodeling language is based on the UML class diagram notation and OCL constraints. The metamodels specifying the modeling paradigm are used to automatically generate the target domain-specific environment. The generated domain-specific environment is then used to build domain models that are stored in a model database or in XML format. These models are used to automatically generate the applications or to synthesize input to different COTS analysis tools.

GME has a modular, extensible architecture that uses MS COM for integration. GME is easily extensible; external components can be written in any language that supports COM (C++, Visual Basic, C#, Python etc.). GME has many advanced features. A built-in constraint manager enforces all domain constraints during model building. GME supports multiple aspect modeling. It provides metamodel composition for reusing and combining existing modeling languages and language concepts. It supports model libraries for reuse at the model level. All GME modeling languages provide type inheritance. Model visualization is customizable through decorator interfaces.

Documents

Documentation:
- Feature Summary
- GME Multi User Readme

Papers:
- The Generic Modeling Environment
- Model Integrated Computing in the Large
- Composition and Cloning in Modeling and Meta-Modeling
### Repository Portal 3/3

#### ISIS-ESCHER

**Project:** CAPE (CAPE)

- **Lead:** Larry Howard
- **Reports:** Open Issues | Road Map | Change Log | Popular

**Open Issues:** (By Priority)

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#### DESERT (DES)

- **Lead:** Sandeep Neema
- **Reports:** Open Issues | Road Map | Change Log | Popular

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#### eLMS (eLMS)

- **Lead:** Larry Howard
- **Reports:** Open Issues | Road Map | Change Log | Popular

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#### GME (GME)

- **Lead:** Arno Lenz
- **Reports:** Open Issues | Road Map | Change Log | Popular

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### Login or Sign Up

- **Username:**
- **Password:**

- **Remember my login on this computer?**
- **Log In**

**Not a member?** Sign up for an account.
Repository Status

- Fully operational
- Research groups engaged in the maturation program maintain quality criteria
- Active user community at both sides of the wall
- Strong interest in the tool and in the transitioning model
Transitioning Highlights: FCS Program

Model Reuse & Round Trip Engineering

- Use authoritative, vetted model as the integration, certification, and documentation source
- Leverage multiple integration efforts by reusing the models and generating meaningful artifacts
- Reduce cost of certification by reducing erroneous analysis
- Mitigate integration risk by working out integration issues in the models and analyzing the goodness of the integration

ESCHER played crucial role in acceptance of the MIC tool suite in the FCS program

The ESCHER Repository continue growing and improving due to the generated user interest

Challenges in scaling and complexity contributed to research ideas in meta-model composition

Result is better understanding the opportunities and limits of the technology

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Transitioning Highlights: Software and Systems Test Track

Required SSTT infrastructure components:
- Modeling tools and model libraries
- Model transformation tools
- Instrumentation and analysis tools
- Simulation engines
- Composition platforms

ESCHER was part of the Boeing/Raytheon team winning the Phase I of the SSTT project in June, 2006

This is the first time that ESCHER acts as an independent contractor

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