Information Societies Technology (IST)

Advanced Research and Technology for Embedded Intelligence in Systems

WORKING DOCUMENT

System Design Methods and Tools
-
Priorities Analysis

Editor: Ian Philips, …

Status - Version: First Draft
Date: 7/7/2006
Confidentiality Level: Confidential

Acknowledgements

The editors acknowledge contributions by all the other contributors.

Document revision history

Date	Version	Editor/Contributor	Comments
7/7/2006	1.0		First draft – Results from the ARTEMIS Summer cap
18/7/2006	1.1	Alun Foster	Incorporation of first feedback and text augmentation

Table of Contents

1 INTRODUCTION

The Strategic Research Agenda (SRA) developed, though open consultation, by the members of various ARTEMIS working groups, contains an extensive list of research topics that are felt to be the most important issues to be tackled in the short to medium term. As a refinement that will help guide proposers of projects in the short term that wish to refer to the ARTEMIS SRA, ARTEMIS members delegated experts to an extensive working session, during which the priorities for the short term were put forward and discussed for each of the major industrial SRA domains. The results of this workshop are documented in this and two accompanying documents.

The research topics identified as most urgent may be taken as a guide when proposing research projects for execution under the Framework Programme 7 of the European Commission, under the EURKA clusters ITEA-2 or MEDEA+, or indeed under locally focussed research projects. In all cases, the results will contribute to the long-term objectives of ARTEMIS.

2 RANKING OF THE PRIORITIES

The SRA identifies 'Design Methods and Tools' as an important area of research. Design methods and tools are essential for rapid design and prototyping, without which it is unrealistic to attempt development of such complex systems.

The objectives for research in this area are: design efficiency, systematic design, productivity and quality.

The priorities have been ranked by the organizations represented at the Summer Camp as follows:

[Note – the DM&T part of the SRA does not contain paragraph or table numbers. This renders it difficult to make clear cross-references in this document. This is something that will be addressed in the next release of the SRA]

		Tools Implementation	**Process Optimisation**
System-level modelling: Model-based Design / System Engineering	49	Architecture Tools	Model-based design Flow
Test / validation / verification	32	Integration tools	Model-Based V&V flow
Tool Integration	23	Integration tools / Transversal tools	Global HW/SW Verification and Optimisation
Tools and methods for affordable certification	22	Idem	idem
Resource management	20	Architecture Tools	idem
Tools for Product Line Engineering	16	Transversal tools	
Simulation environment that can mix physical elements and virtual models ("Co-Simulation")	15	Architecture Tools	Model-Based design flow
Traceability: Requirements to product, visible at any step of the process	13	Transversal tools	

The right hand columns indicate the major topics of the SRA's Research Priorities Architecture, which classifies research into the Implementation of tools, and into the establishment of optimised design flow processes. The priorities in the underlying classification from the SRA are added in the text below.

Priorities have been split into three categories:

1. Highest priority
    - System-level modelling: Model-based Design / System Engineering
    - Test / validation / verification
2. High priority
    - Tool Integration
    - Tools and methods for affordable certification
3. Medium priorities
    - Resource management
    - Tools for Product Line Engineering
    - Simulation environment that can mix physical elements and virtual models ("co-simulation")
    - Traceability: Requirements to product, visible at any step of the process

3 IDENTIFICATION OF THE HIGHEST PRIORITIES

The following two topics were recognised as most significant by the largest group of representatives.

3.1 System-level modelling: Model-based Design / System Engineering

Issues that will be specifically addressed modelling of functional and non-functional features, composability of models, heterogeneous models, modelling of the user (human interfaces), formal methods for model-based design, Architecture Description Language, meta-languages to describe distributed ES architectures, compiler validation (automatic code generation as well as HW), dealing with uncertainty (incomplete requirements, imprecise models), modelling of security/safety/dependability environment, virtualisation, black through white-box models.

Tools and design processes that contribute, in an integrated fashion, to elevating the abstraction level at which architecture exploration and design of the system, and ultimately the product. The SRA section on ***Functional Design tools***, and the complete section on ***Model-based Design Flow Optimisation*** are relevant in this.

3.2 Test / validation / verification

Issues that will be specifically addressed are product-based V&V tools (as opposed to process-based V&V tools), stepwise verification and test (requirements and components).

Here, the need for cutting-edge tools that can be integrated into a complete process flow to support verification and validation at the product level are called for. Specifically, the V&V activity should become an integral part of the design process, rather than a “back-end add-on” as is presently the case. The tools must therefore support the definition and development of V&V strategies concurrently with the description and instantiation of the produt itself. The complete SRA section on ***Design, Implementation and Verification tools*** is applicable here, as is the secion on ***Model-Based Validation & Verification Flow Optimisation***.

4 IDENTIFICATION OF THE HIGH PRIORITIES

The following two topics were found worthy of consideration by the largest group of representatives.

4.1 Tool Integration

Issues that will be specifically addressed are Open Interface specification between tools and models within reference architecture, mutli-discipline / multi-site flows, adaptability to processes (Role-aware tool-chain).

This is addressed under the SRA sections Tool Integration Frameworks, but has influence on the tool development itself (***Design, Implementation and Verification tools***) and how these are seamlessly brought together.

4.2 Tools and methods for affordable certification

The necessarily post-design process of certification requires that relevant, supporting information from throughout the design flow is available, to reduce the tiem and effort required. This is particularly critical where methodologies allowing self-vertification to be done. These requirements should be taken together with section 4.1 of this document. The degree of certification varies amongst application domains. It is expected several application domains will be supported, benfitting from that the best practices as well as the optimisations developed.

5 IDENTIFICATION OF THE MEDIUM PRIORITIES

The remaining topics were not recognised by the larger community, but were still considered highly relevant by single representatives.

5.1 Resource management

In addition to the SRA description, issues that will be specifically addressed are power management, application mapping onto (scalable) multi-core platforms, design time and dynamic allocation, non-functional performance optimisation, trade-off optimality vs time-to-market.

Resource Management is a major issue described in the SRA section on ***Functional design tools.***

5.2 Tools for Product Line Engineering

Issues that will be specifically addressed are re-use (still an issue), problem of implementing engineering process into the business environment, tailoring of tools from other sectors, testing various ES-based variants, requirements analysis, optimisation for various variants, standards for requirements engineering (model, tool, API) and life cycle management, (in particular managing obsolescence).

These are addressed under the SRA section on ***Requirements and Traceability Management***, under Transversal Tool.

5.3 Simulation environment that can mix physical elements and virtual models ("co-simulation")

Issues that will be specifically addressed are references architectures supporting "X in the loop", real-time simulation, distributed systems architectures , algorithms and mechanisms for time-alignment of distributed RT-systems.

While the ability to simulate a system using different abstraction levels of functional descriptions is already feasible (if embryonic in some areas due to the need to optimise simulation tools to allow realistic simulation times for complex systems), the extension to include the influence of the physical world in which the system must operate is a vital yet difficult step. These are specifically adderessed in the SRA sections on ***System Architecture, Co-design, Distribution*** and ***Use of Heterogeneous & Multi-domain Models***.

5.4 Traceability: Requirements to product, visible at any step of the process

In addition to the section under ***Transversal Tools on Requirements and Traceability management***, we should particularly address the issue of multiple suppliers.

6 RECOMMENDED APPLICATION DRIVERS

The following list captures application drivers that participants to the ARTEMIS Summer Camp felt important to target, for development and valorisation of the ARTEMIS developed technologies.

Note: These are SUGGESTED, NON-PRIORITISED APPLCATIONS which can serve to use/prove results of ARTEMIS developed technologies. This is NOT an exclusive list, and it does NOT represent a mandatory set of requirements for research projects.

6.1 Transportation

Safety and efficiency

Also covering systems for engine/motor control for fuel efficiency and reliability

Travel assistance

6.2 Production and logistics

Covering the integration of autonomous process controls, sensor arrays, RFID etc…

6.3 Social and Health solutions

Mobile, remote, stationary

6.4 Communication Networks

Autonomy, self-organisation, ubiquitesness, security

6.5 Smart Systems

Sensors and Actuators
Evolution of Smart Cards