Year 3 Review
Brussels, February 24th, 2011

*Transversal Activity*

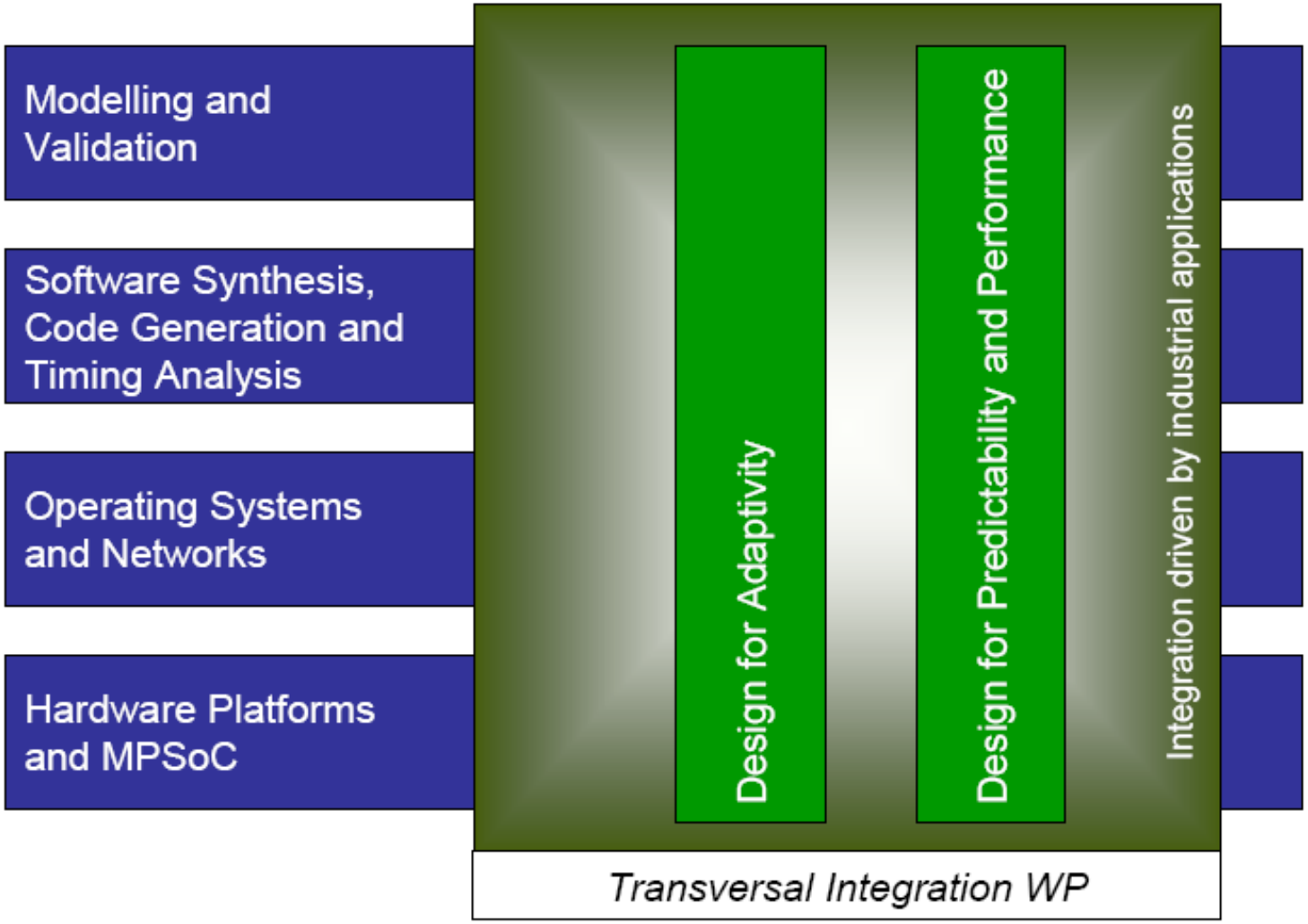
*Achievements and Perspectives :*

# Integration Driven by Industrial Applications

leader : Alberto Sangiovanni Vincentelli

University of Trento

# High Level Objectives: Structure of the WP



# Main Trends in the Area

- High-tech industry is transforming into an ecosystem of system integrators and (1,2,3,...-tier) component suppliers
- To maintain quality and productivity such ecosystems must be managed as virtual vertically integrated industries
- This goal requires an explicit understanding of the relevant design flow(s) in an ecosystem, and ways to integrate methods and tools into such flows
- Research on design methods and tools that disregards design flows runs the risk of being industrially irrelevant

# High-Level Objectives

- Goals:
  - To provide the “meta rules” for design flows according to which the design transformations are carried out and interfaces are built;
  - To provide an environment to the clusters to foster the integration their results into relevant design flows.
- Five approaches:
  1. Package design methods out of the thematic cluster results for relevant industrial segments;
  2. Identify main common features shared by different domains and work towards developing methods to address these topics.
  3. Use workshops and Artist Design Meetings to enlarge the reach
  4. Participate to standard bodies
  5. Work directly with industry and encourage start-up formation

# Cluster Participants

**This activity is de facto open to all core partners in the consortium, who can use the specific budget for this activity to attend technical meetings and to organize workshops and visits**

Most active participants:

- ESI
- KTH ICES
- IMEC
- OFFIS
- TU Braunschweig
- Trento
- University of Bologna
- USAAR

# Building Excellence

**Aims**:

- Involve industry in Artist Design to foster research interactions and discussions on trends and challenges
- Keep Clusters informed about industrial trends and opportunities
- Integrate research teams working on different tools and design approaches so that the outcome is industrially relevant

**Instruments**:

- Meetings with interested partners and industry representatives at Conferences, Workshops and special Artist Design events
- Encourage start-up creation

# Overview of the Cluster's Activities

- **Design flows  for automotive and aerospace**
  Leader: ASV (TRENTO)
  - *interaction with COMBEST, ARTEMIS, US companies and research organizations…*
  - *outcome: meetings and impact on new directions (see interviews New York Times, KTVU Channel 2 SFO, CESAR, MBAT, iFEST,…., 2 invited papers in Proceedings of the IEEE on automotive and software design, META project, Musyc…)*
- **Design flows for health and nomadic**

  Leader ESI
  - *interaction with GENESYS, ARTEMIS, …, NOKIA, Philips, NXP*
  - *outcome: meetings and industrial contracts*
- **Investigate other important application domains**

  Leader: ASV (Trento)
  - *Energy Efficient Buildings*
  - *Identified synthetic biology*

# Overall Assessment

**Achievements**

- Vision confirmed by industrial participants
- Successful Workshops (Greenembed at CPS week, International Workshop on Bio Design Automation)
  - More than 100 participants from Academia, large and small industry, VC, research organizations, government agencies
- Start-ups (at least 5, some are still under wraps) and direct contacts with industry (e.g., Luca Benini Chief Architect at STM Advanced System Technology Division)

# Plans for Year 3 (as presented in Year 2 Review)

- Continue working with the network built so far (joint research, papers, special journal issues, conferences, workshops)
- Link into USA Energy Initiatives
- Continue organizing international meetings on topics of interest to the community:
  - **DATE March 2010**:
    - ASV Key Note
  - **CPS Week April 2010**, 5 Conferences co-located (HSCC, ICCPS, IPSN,LCTES, RTAS): ASV Plenary Key Note on Wednesday
    - **GREEMBED 2010:** A. Sangiovani Vincentelli, Huascar Espinoza, European Software Institute ESI-Tecnalia, M Di Natale, Scuola Superiore St. Anna, R. Passerone, Trento,
    - **Formalisms for Embedded Systems Architecture description & visualization:** Martin Torngren, KTH
  - **DAC June 2010** (Automotive Tutorial + Panel**, IW Biology DA**)
  - **ES Week October 2010**
    - Health Tutorial
    - Transportation Safety Workshop

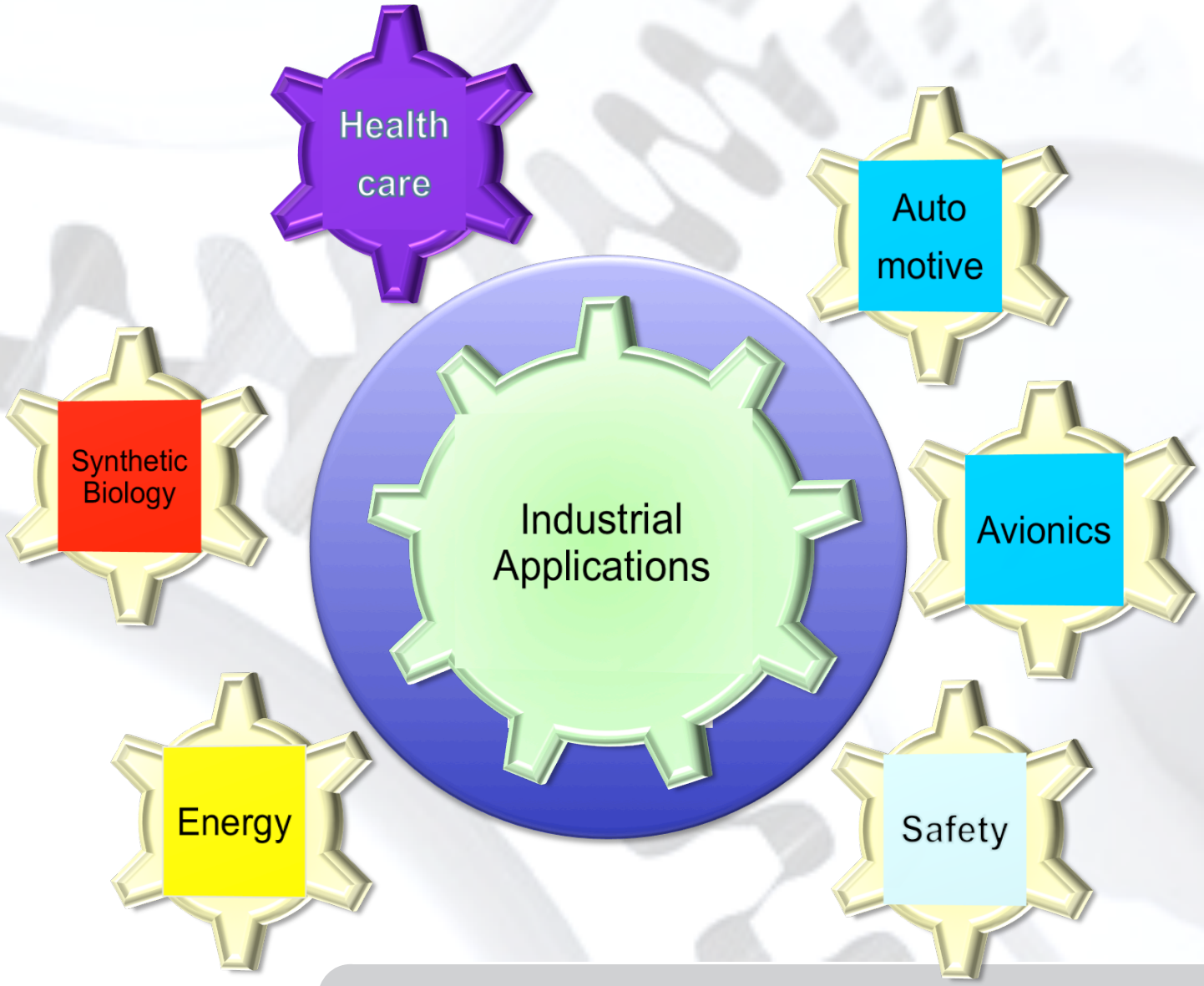
# Specific Initiatives

- Heterogeneous composition and Metro II
  (Trento, EPFL, UTC, Berkeley)
- CyberPhysical System Languages
  (IST, Trento, IBM, Raytheon, BAE Systems, ISIS/Vanderbilt, Rockwell, UTC, Boeing, Cadence, Synopsys, Mentor and Freescale)
- Design of component-based heterogeneous distributed systems
  (Verimag, ISIS/Vanderbilt)
- Electrical Architecture for Cars (TUBS, TRENTO, GM)
- CPS Week: Stockholm, March 2010 (all, ASV Plenary Talk)
- GREEMBED during CPS week: (Trento, Scuola Superiore di Sant'Anna)
- IWBDA during DAC (Trento, Berkeley, Caltech, MIT, Stanford....)

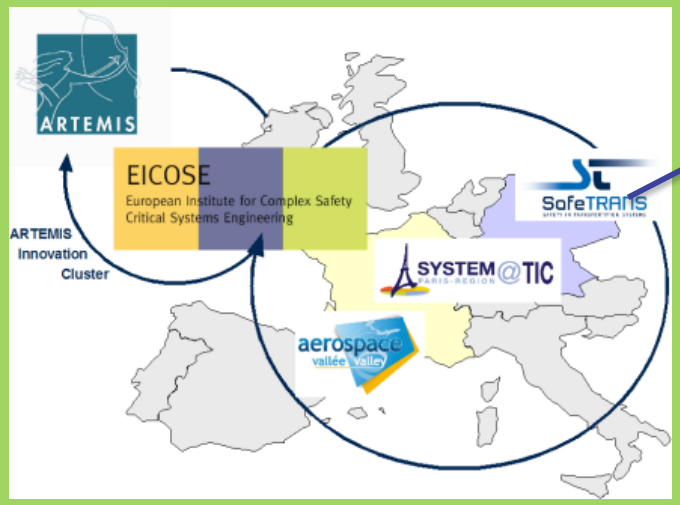
# Outline

- Modus Operandi of our Cluster and roles of OFFIS, ESI, IMEC and ICES
- Automotive Activities
- Energy Efficiency Activities
  - Greembed 2010
- Health, Synthetic Biology and Nomadic Activities
  - Workshop of Bio EDA
- Future activities

# Industrial Integration



# OFFIS – Industrial Network




OFFIS
INSTITUTE FOR INFORMATION TECHNOLOGY

Cooperations with ArtistDesign Partners

- TUBS
- TRENTO
- INRIA
- Verimag
- CEA
- IST
- KTH
- Aalborg University
- …

VOLVO

EADS astrium

AleniaSIA

DAIMLER

EADS DEFENCE & SECURITY

Sagem Défense Sécurité

BOSCH Technik fürs Leben

Continental

BTC Embedded Systems

AIRBUS

SIEMENS Transportation Systems

AVL

CRF CENTRO RICERCHE FIAT

AUTOSAR

AbsInt Angewandte Informatik

THALES

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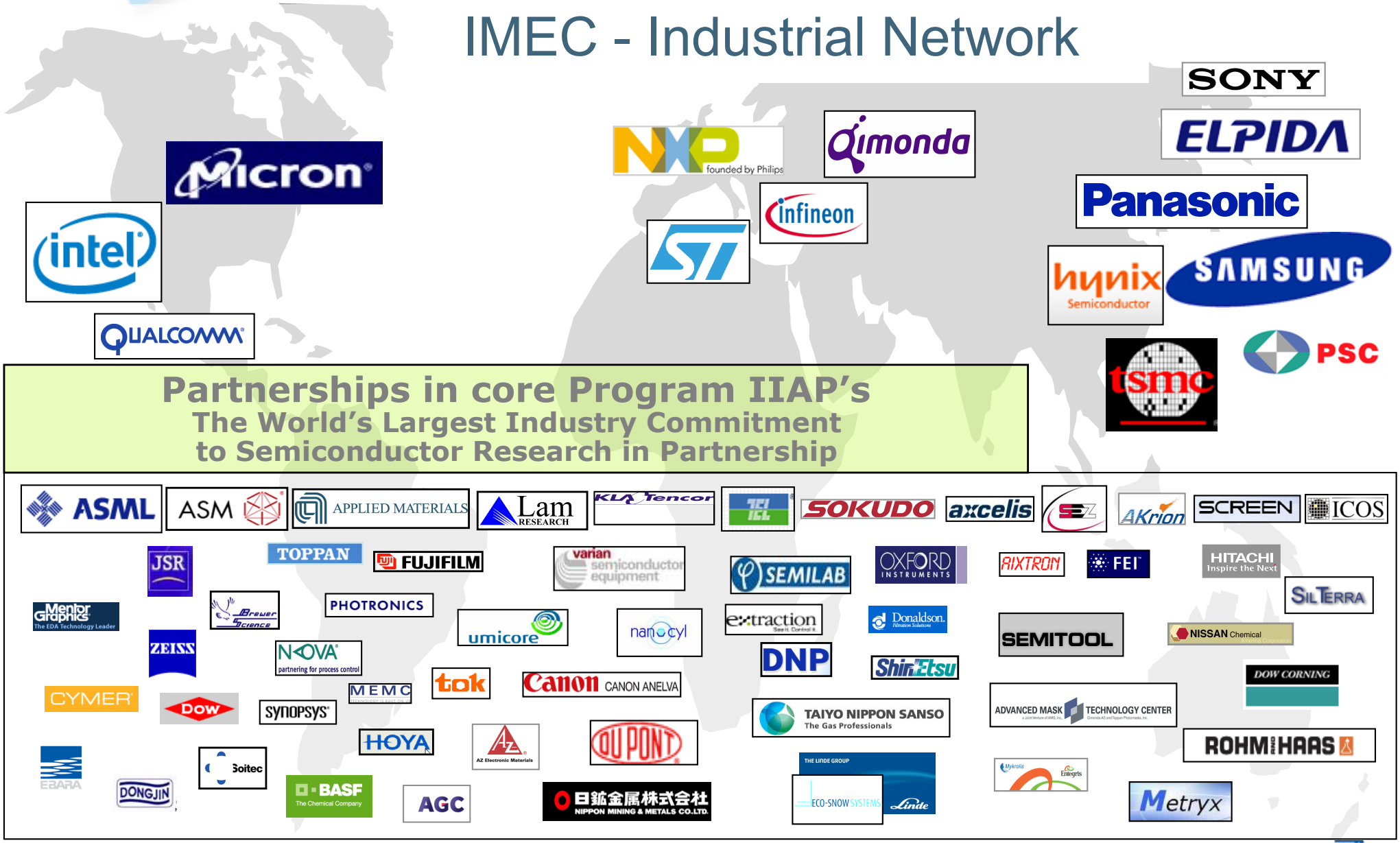
# IMEC - Industrial Network



# ESI - Industrial Network

Noldus Information Technology

PHILIPS
Consumer Electronics
Medical Systems
Research
Applied Technologies

NXP founded by Philips

Technolution AUTOMATION TECHNOLOGY

THALES

TNO

ASML

FEI COMPANY TOOLS FOR NANOTECH

océ

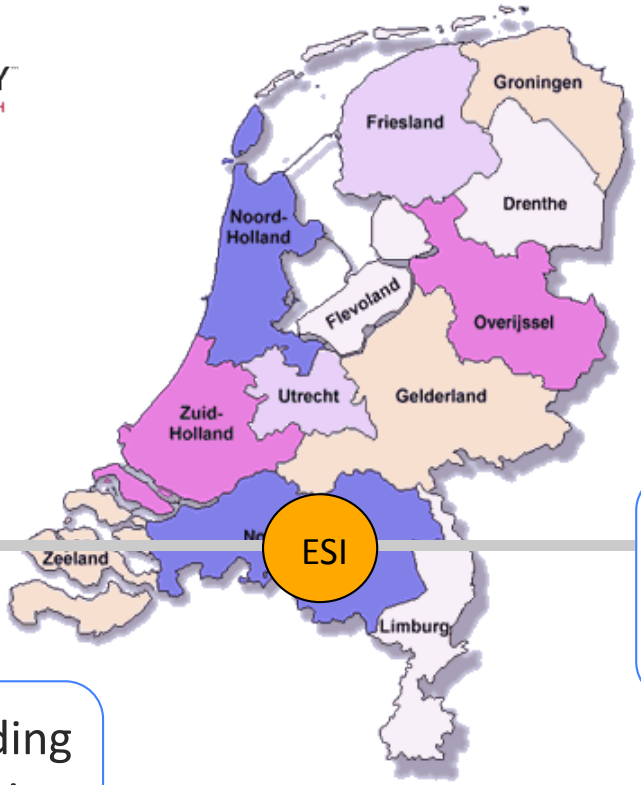
VANDERLANDE INDUSTRIES

CHESS

Imtech ICT

TASS software professionals

DEMCON advanced mechatronics



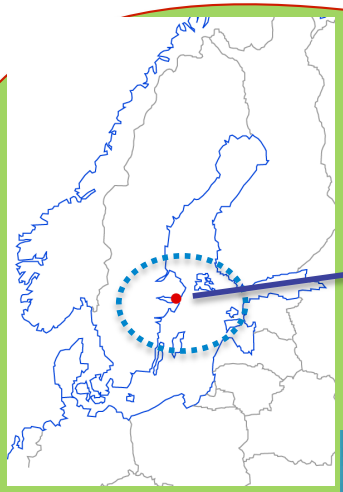

Industrial Network

Research cooperation with all Dutch universities with embedded systems research

Research cooperation with leading high-tech multinational industries & SME's

SEVENTH FRAMEWORK PROGRAMME

# KTH ICES – Industrial Network



KTH VETENSKAP OCH KONST

Cices
Innovative Centre for Embedded Systems

ARTEMIS

Cooperations with ArtistDesign Partners

- LTH, MDH, LIU
- Offis
- INRIA
- CEA
- ALES (PARADES),
- Trento
- Aveiro
- DTU, Bologna,
- …

SCANIA

ENEA

Prevas

VOLVO

VOLVO

Stoneridge

ABB

ERICSSON
TAKING YOU FORWARD

Haldex, SKF, StJude, Maquet
Atlas Copco

AIRBUS

DAIMLER

EADS
DEFENCE
& SECURITY

CRF CENTRO RICERCHE FIAT

Continental

SIEMENS
Transportation Systems

AVL

AleniaSIA

Sagem Défense Sécurité
Groupe SAFRAN

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THALES

SEVENTH FRAMEWORK PROGRAMME

# Innovative Centre for Embedded Systems

- A KTH-based centre for embedded systems
  - A proactive effort in the embedded systems area
  - ICES acts as a Network & Catalyst
    - **6,4 times gain factor**
- Current members
  - ABB, Enea, Ericsson, Freescale, Mathworks, Prevas, Scania, Semcon/EIS, Stoneridge, ÅF
  - Four KTH schools and several groups encompassing
    - Computer science, SW engineering, Computer engineering, Automatic Control, Communication, HMI, Mechatronics
- Main themes: System architecture, Softvare verification, Methodology

www.ices.kth.se

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  - Greembed 2010
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  - Workshop of Bio EDA
- Future activities

# CESAR – Cost-efficient methods and processes for safety relevant embedded systems

## Objective

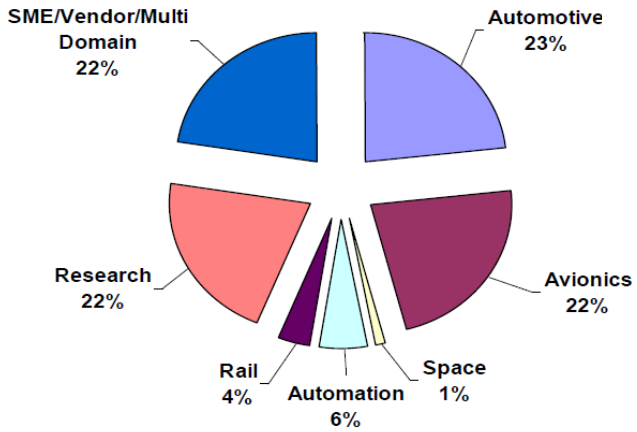
- **Interoperability Standard (IOS)** for the development of relevant embedded systems, which are compliant to domain-specific safety standards

## Approach

- Common semantical basis(Meta Modeling)
- Focussing on
  - Requirements Engineering
  - Component-based design
  - Development process
- Implemented as a Reference Technology Platform (RTP)
- Innovative analysis techniques based on the IOS
- Cross domains
  - But with domain specific tailorin

## Partners

- 55 partners
- Industry driven
  - (78% Industry / 22% Academics
-


8.2.2011

# CESAR Partners

- **Automotive Industry**
  - ACCIONA - ES
  - AVL - AT
  - Delphi - FR
  - Fiat Research Center - IT
  - Infineon Technologies – DE
  - Infineon Technologies Austria - AT
  - Volvo Technology Corporation – SE
- **Avionics + Space**
  - Airbus – DE
  - Airbus – FR
  - Airbus - UK
  - AleniaSIA-IT
  - Astrium Satellites - F
  - Cassidian (EADS Defence Electronics) - DE
  - EADS Innovation Works - DE
  - Hellenic Aerospace Industries - GR
  - Messier-Bugatti - FR
  - SAGEM - FR
  - SNECMA - FR
  - Thales – FR
  - Thales Avionics – FR
  - Thales Communications - FR
  - TURBOMECA - FR

**Automation**

ABB – SE, NO
Danieli Automation – IT

**Rail**

ABB - NO
Ansaldo - IT
Siemens - DE

- **Vendors/High-tech Companies**
  - AbsINT- DE
  - Critical Software - PO
  - Dassault Systems- FR
  - Elsag Datamat Test Automation – IT
  - ESI - ES
  - Esterel Technologies – FR
  - Formal Software Construction Ltd* - UK
  - Geensoft- FR
  - BTC Embedded Systems AG- DE
  - Quintec – UK
  - ViF - AT

**Research Institutes**

Aristotle University of Thessaloniki- GR
**CEA List -FR**
CNRS Heudiasyc, IRIT, LAAS - FR
DLR Institute of Transportation Systems – DE
Fraunhofer Gesellschaft; Fokus & IESE - DE
**INRIA - FR**
Industrial Systems Institute - GR
**Kungliga Tekniska Högskolan- SE**
Norwegian University of Science and Technology
National Technical University of Athens - GR
**OFFIS - DE**
ONERA -FR
Oxford University - UK
SINTEF - NO
**University Bologna - IT**
University of Trieste- IT
University of Manchester - UK

**Countries:**

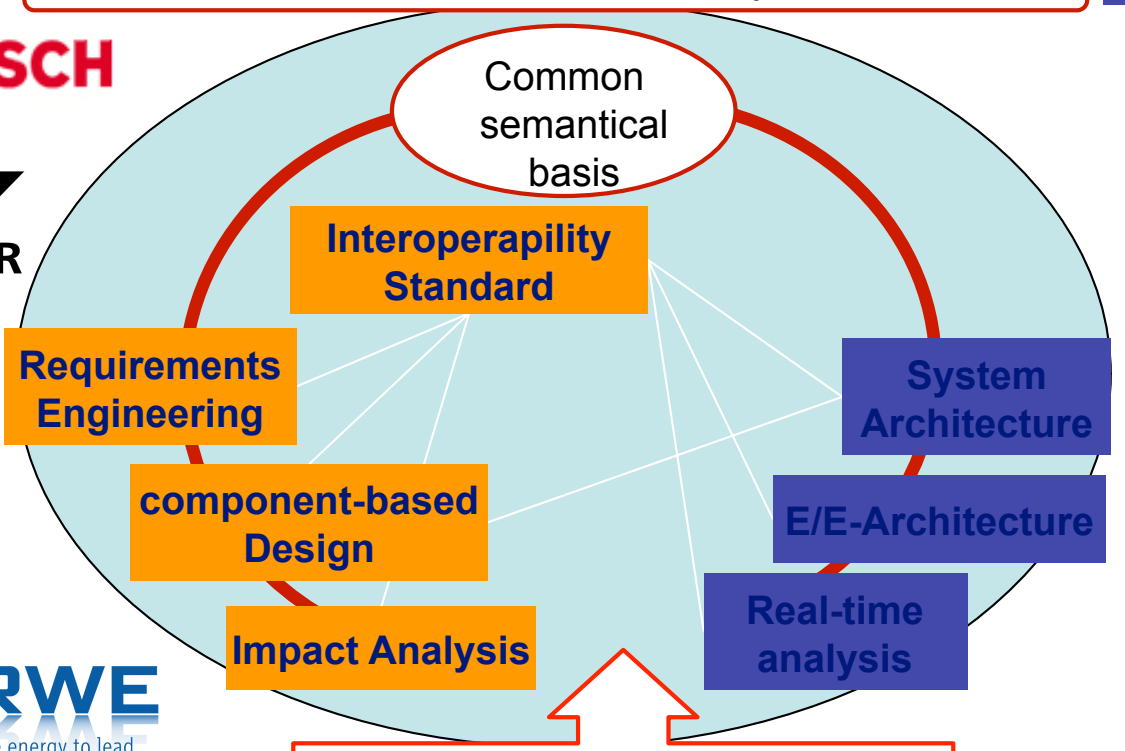
- Austria
- France
- Germany
- Greek
- Italy
- Norway
- Portugal
- Spain
- Sweden
- UK

# National View (Germany)
# CESAR and SPES2020

CESAR

Cross domains, compliant to safety standards

SPES2020




**SPEEDS**

- Contract-based Design
- Heterogeneous Rich Components

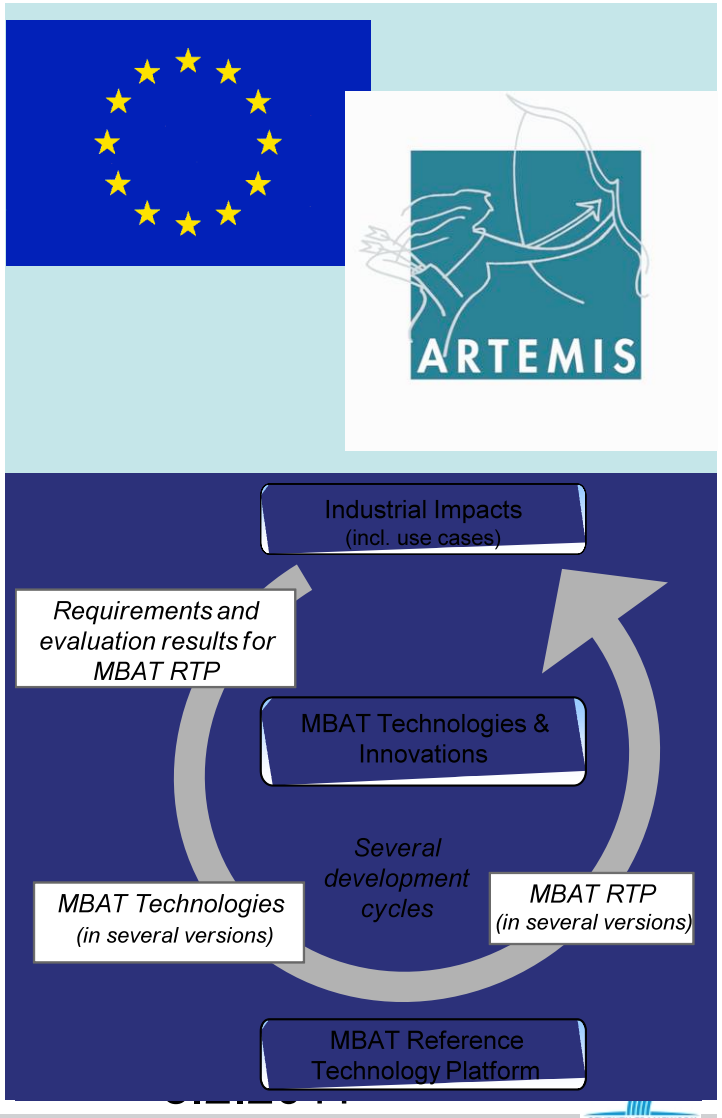
# MBAT – Combined Model-based Analysis and Testing of Embedded Systems

**Objectives**

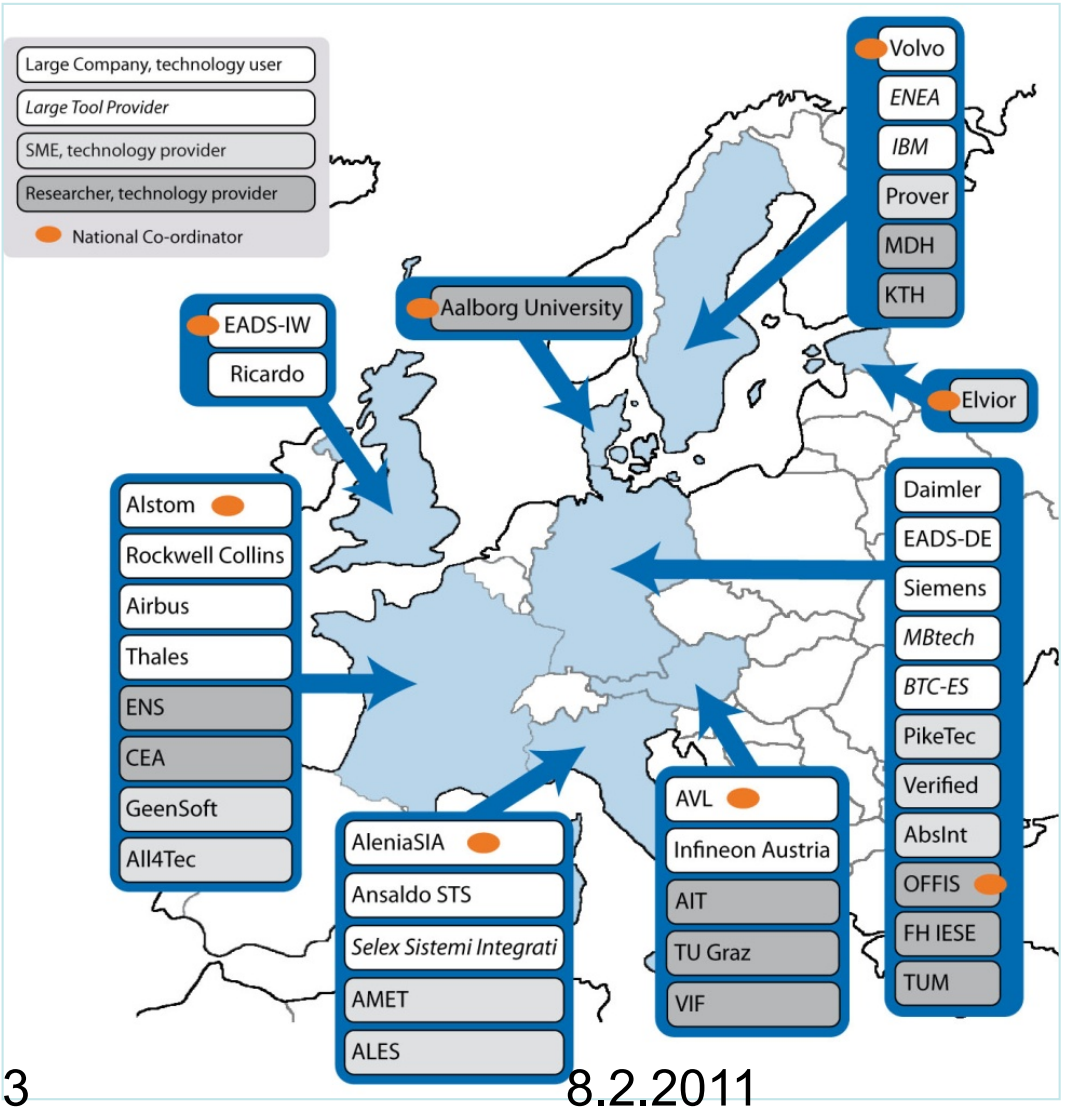
- Provide Europe with a new leading-edge Reference Technology Platform for effective and cost-reducing Validation and Verification of Embedded Systems

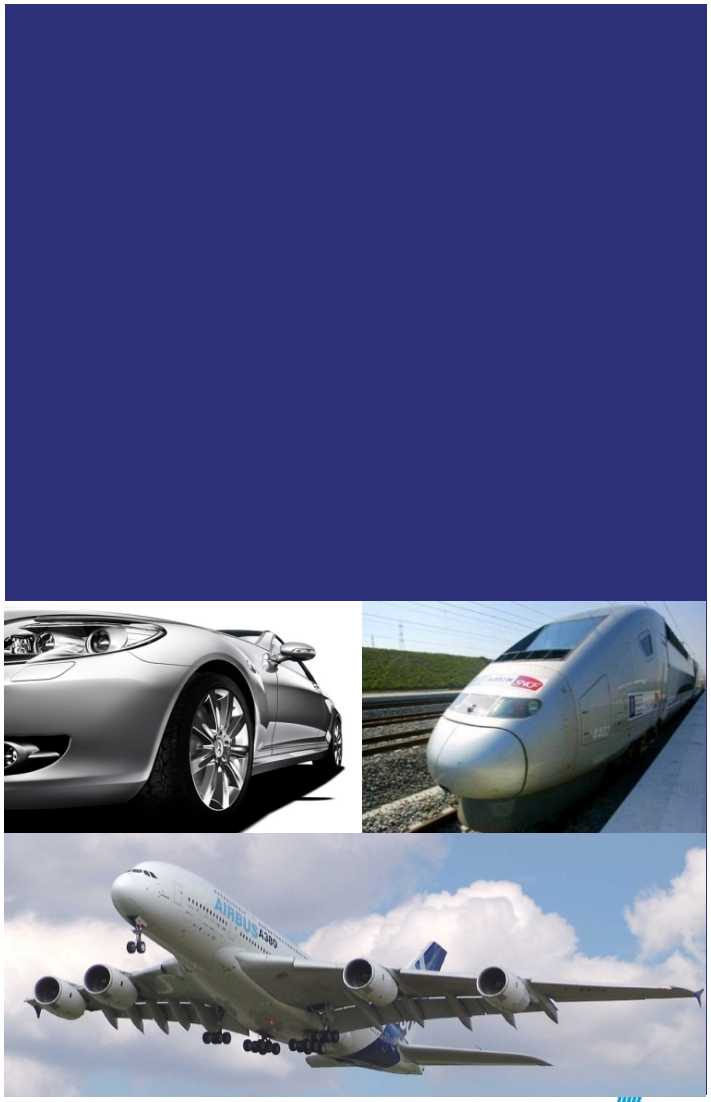
**Approach**

- Based on meta models and compatible components to enable construction of customized System Analysis & Test Environments
- Combined Model-based Analysis & Test Methodology including innovative analysis and test case generation techniques on different development levels
- Tool support based on an interoparability standard (RTP)
  - Compliant to CESAR RTP
- Industry driven (cross domains)
  - Business needs
  - Use case and derived requirements



# MBAT Partners

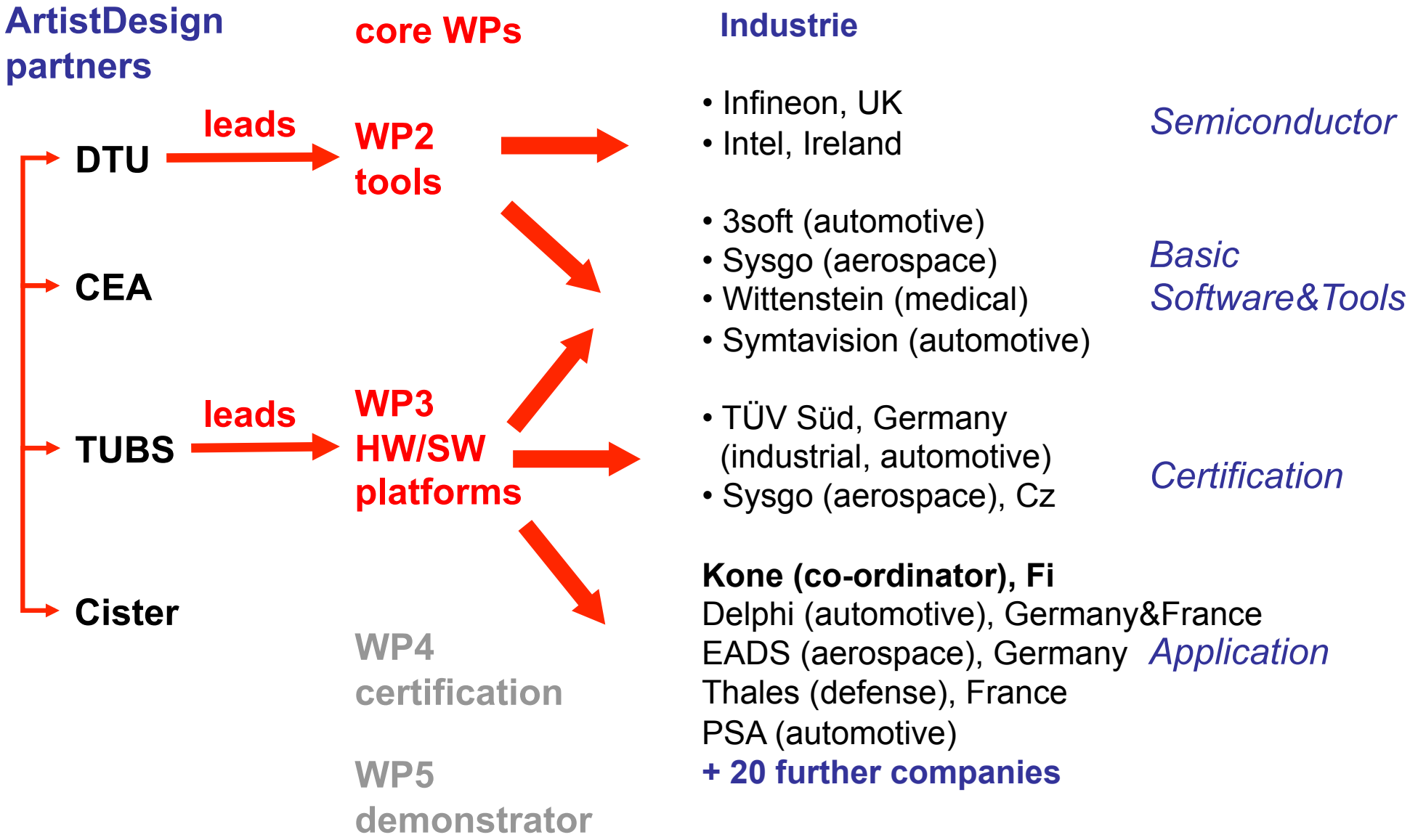


# RECOMP project

- **RECOMP = "Reduced Certification Costs using Multi-core Platforms"**
- **EU ARTEMIS project – 2nd call –** ***ranked 2nd (of more than 40)***
- **Major research areas**
  - tools support for certifiable multi-core platforms
  - design and implementation of safety-related, certifiable multi-core platforms
  - cost-efficient certification techniques for multi-cores based on state-of-the standards, e.g. IEC 61508, *target: mixed criticality*
- **Large project consortium**
  - 41 partners from 9 countries, 25M€ budget
  - ArtistDesign partners played *key role* in project development and organization (country coordinators, WP leaders)
  - started 4/10

# RECOMP consortium (25M€)



# Outline

- Modus Operandi of our Cluster and roles of OFFIS, ESI, IMEC and ICES
- Automotive Activities
- **Energy Efficiency Activities**
  - **Greembed 2010**
- Health and Nomadic Activities
- Future activities

# Based on Trento SEEC 2009 - Network

Workshop on
Green and Smart Embedded System Technology:
Infrastructures, Methods and Tools

# GREEMBED

## April, 12th
## Stockholm

## In conjunction with CPSWEEK 2010


**Organizers:**

**Alberto Sangiovanni Vincentelli**, U. Berkeley & U. Trento, USA
**Huascar Espinoza**, ESI-Tecnalia, Spain
**Roberto Passerone**, University of Trento, Italy
**Marco Di Natale**, University of St. Anna, Italy
**José Javier De Las Heras**, ACCIONA, Spain
**Daniela Cancila**, CEA LIST, France



**Organized & Funded by:**

Network of Excellence on Embedded Systems

ARTEMIS eDIANA Project

FP7 COMBEST Project

# Engineering Tomorrow's Designs

## Synthetic Biology

The creation of novel biological functions and tools by modifying or integrating well-characterized biological components into higher-order systems using mathematical modeling to direct the construction towards the desired end product.

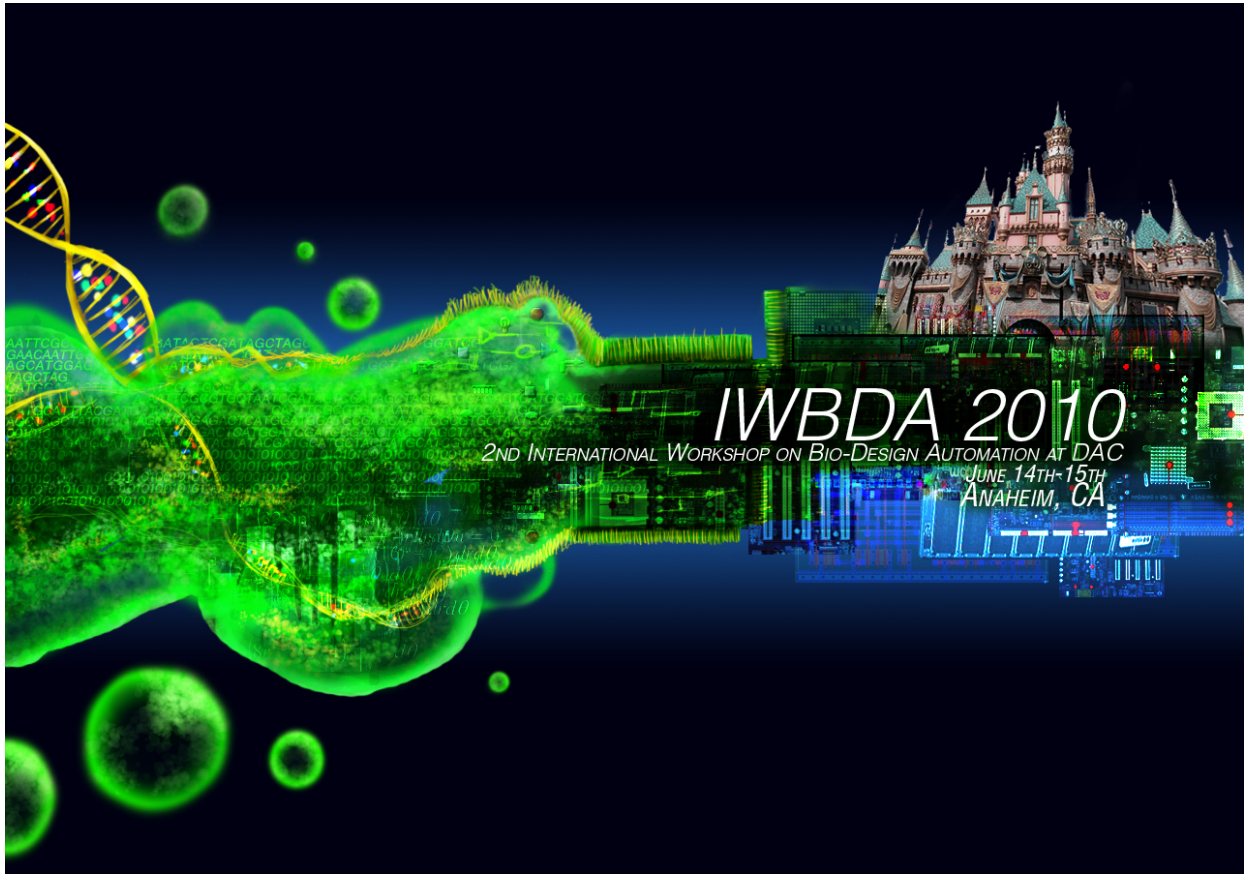
*Building life from the ground up* (Jay Keasling, UCB)
Keynote presentation, World Congress on
Industrial Biotechnology and Bioprocessing,
March 2007.

**Development of foundational technologies:**

Tools for hiding information and managing complexity

Core components that can be used in combination reliably

# Synthetic Biology



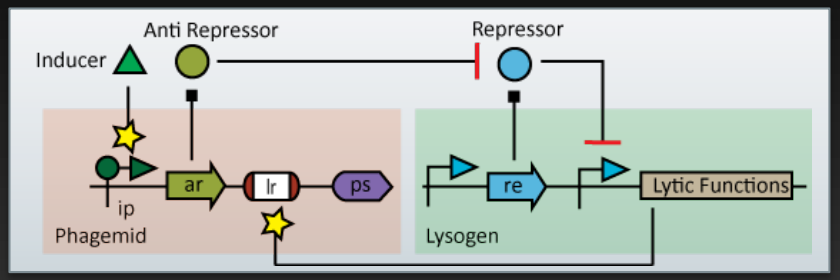

International Workshop on Bio-EDA

June 14-15th, Anaheim CA, at the Design Automation Conference (DAC)

**www.biodesignautomation.org**

# Synthetic Biology with PBD:
## Specification, Design, and Assembly: Putting it all together

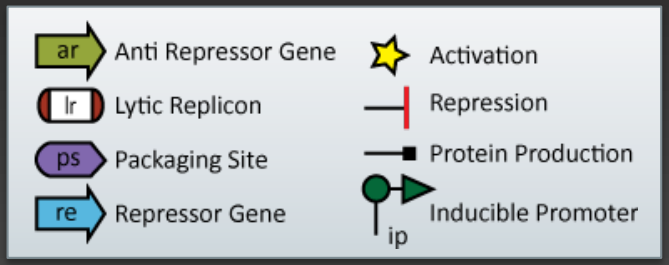
1. Decide on the general functionality desired.



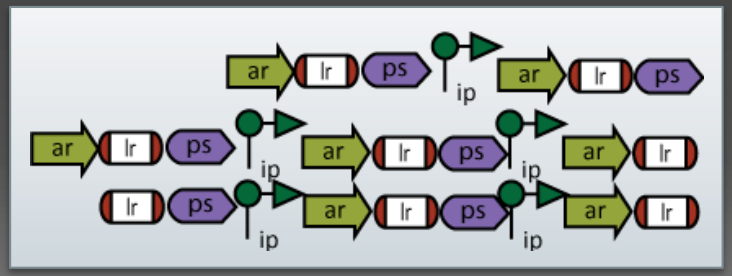

2. **Specify** the composition of the devices and the constraints on the system.

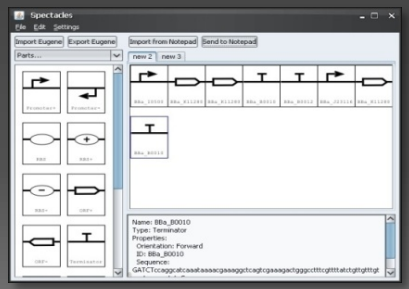
```
InduciblePromoter ip("ACTGGT…");
AntiRepressor ar("CATGGT…", "high");
Terminator t("GGTAAC…", 99);
LyticReplicon lr("CTTACC…", 110);

Rule r4a(rp1 NOTWITH lr);
Note(r4a);
```

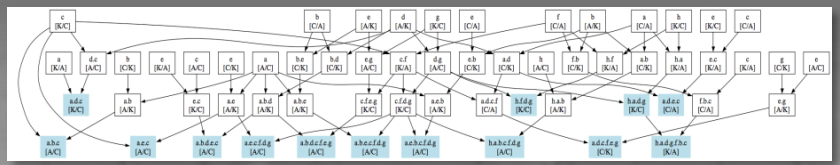



3. **Design** variations of the design, assign theoretical parts to physical samples, modify sequence, etc.

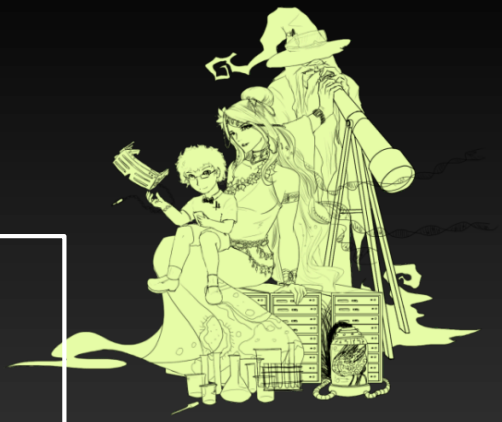


4. Send design to liquid handling robot **assembly** workflows, capture successes and failures as constraints for future designs, and save created devices.



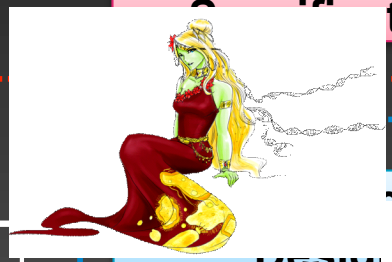
# PBD Synthetic Biology Design Flow



Part/Device/System Specification

Constrain Specificati

Executable tion



Data Exchange

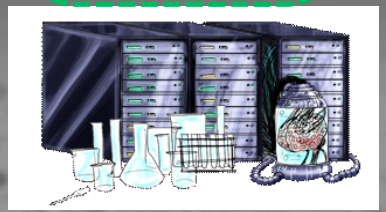
Part Repository

Part Design

Algorithm Design

Automated Assembly

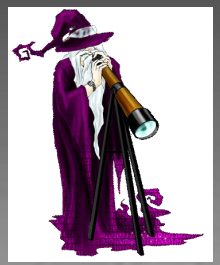
Assembly Analysis



1. **Specification** - Eugene
2. **Design** – Clotho and Spectacles
3. **Assembly** – Kepler

Future Work:

4. Standards – SBOL



# Start-ups founded by Artist Design Partners

- AbsInt (http://www.absint.com/), R. Wilhelm, USAAR, area: performance analysis
- SymtaVision, (www.symtavision.com), R. Ernst TUB spin-off, area: real-time system analysis and optimization for automotive and aerospace applications
- UP4ALL (www.uppaal.com) P. Pettersson, W. Yi, K. Larsen, A. David, U. Aalborg, area: formal methods
- Informatik Centrum Dortmund (ICD) (http://www.icd.de/index_eng.html), P. Marwedel, CEO, area: software for IT systems
- HiQE and Reniance (http://www.hiqe-capital.com/) (Italy) and GreenBox (US), ASV, area: energy efficiency HealthMicro ( http://sutisoft.com/hm1_3f/team.html)(US), ASV, area: health devices
- Eminence, G. Buttazzo, RTOS for multiprocessor Systems
- iNoCs, (http://www.inocs.com/), L. Benini, Uni. Bologna, area: Networks on chip.
- Rapita, (http://www.rapitasystems.com/) A. Burns, York, Chair of Board area: tools and services for worst-case execution time analysis (and associated forms of analysis)

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- Modus Operandi of our Cluster and roles of OFFIS, ESI, IMEC and ICES
- Automotive Activities
- Energy Efficiency Activities
  - SEEC 09
  - Projects
- Health and Nomadic Activities
  - Wshop on ES in Healthcare
- **Future activities**
  - Continue on path to excellence via support of industry interactions in automotive, Health and Energy, formations of Start-ups, wshop organization
    - Explore more deeply Synthetic Biology
    - Emphasis on Education and Training

# Plans for Year 4

- Continue working with the network built so far (joint research, papers, special journal issues, conferences, workshops)
- Bridge with USA DARPA and ARPA-E Energy Initiatives
- Continue organizing international meetings on topics of interest to the community:
  - **DATE March 2011**:
    - Two Special Sessions on Compositional methods (Organizers and Chairs, Sifakis and ASV)
  - **CPS Week April 2010**, 5 Conferences co-located (HSCC, ICCPS, IPSN,LCTES, RTAS):
    - **GREEMBED 2011:** A. Sangiovani Vincentelli, Huascar Espinoza, European Software Institute ESI-Tecnalia, M Di Natale, Scuola Superiore St. Anna, R. Passerone, Trento,
  - **DAC June 2011** (Automotive Workshop+ Panel, IW Biology DA)
  - **CDC 2011**
    - ASV Plenary Talk about compositional methods for embedded control systems
  - **Two papers on Contract Based Design** on the Proceedings of the IEEE
    - Basics and design methodology
    - Theory of Contracts
- Training and Education: Schools and Tutorials

# New Masters program at KTH in Embedded systems

- Starts autumn 2011
- Initiated and supported by ICES
  - A collaboration between the four KTH schools (ICT, CSC, EES and ITM)
  - Active involvement of industry
- Three specializations:
  - *Embedded platforms*
  - *Embedded software*
  - *Embedded control*
- CDIO education approach and innovation/ entrepreneurship (EIT ICTLabs)