

---

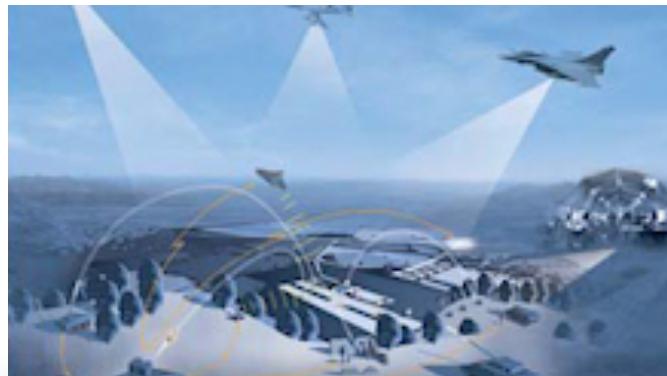
# The GEMOC Initiative

*On the Globalization of Modeling Languages*  
<http://www.gemoc.org>

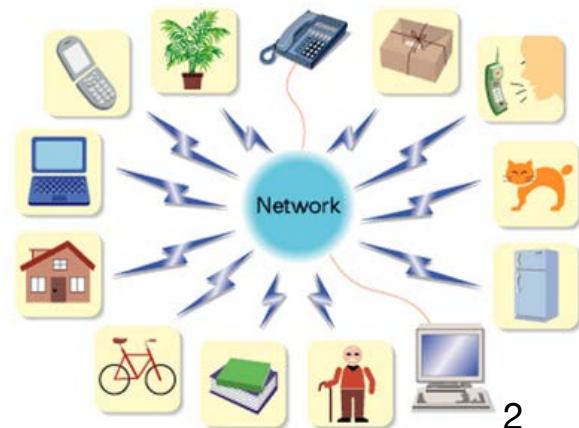
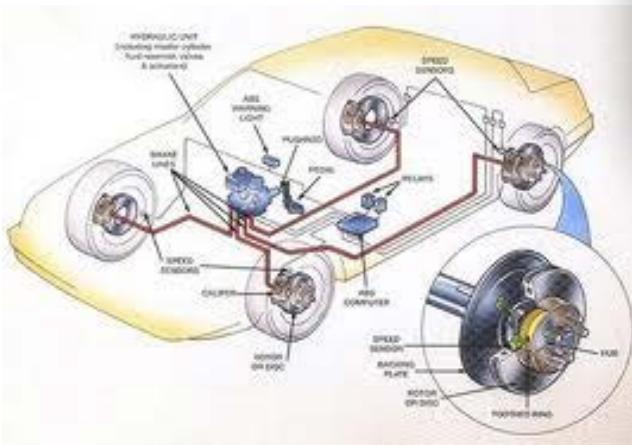
Contact: Benoit Combemale  
[benoit.combemale@irisa.fr](mailto:benoit.combemale@irisa.fr)

Version: June, 2013

# Context

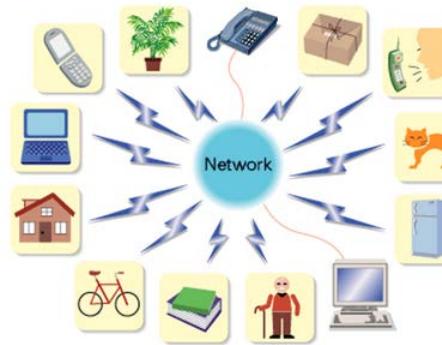
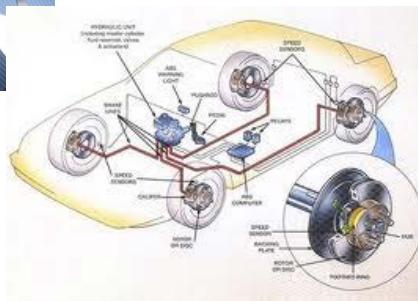


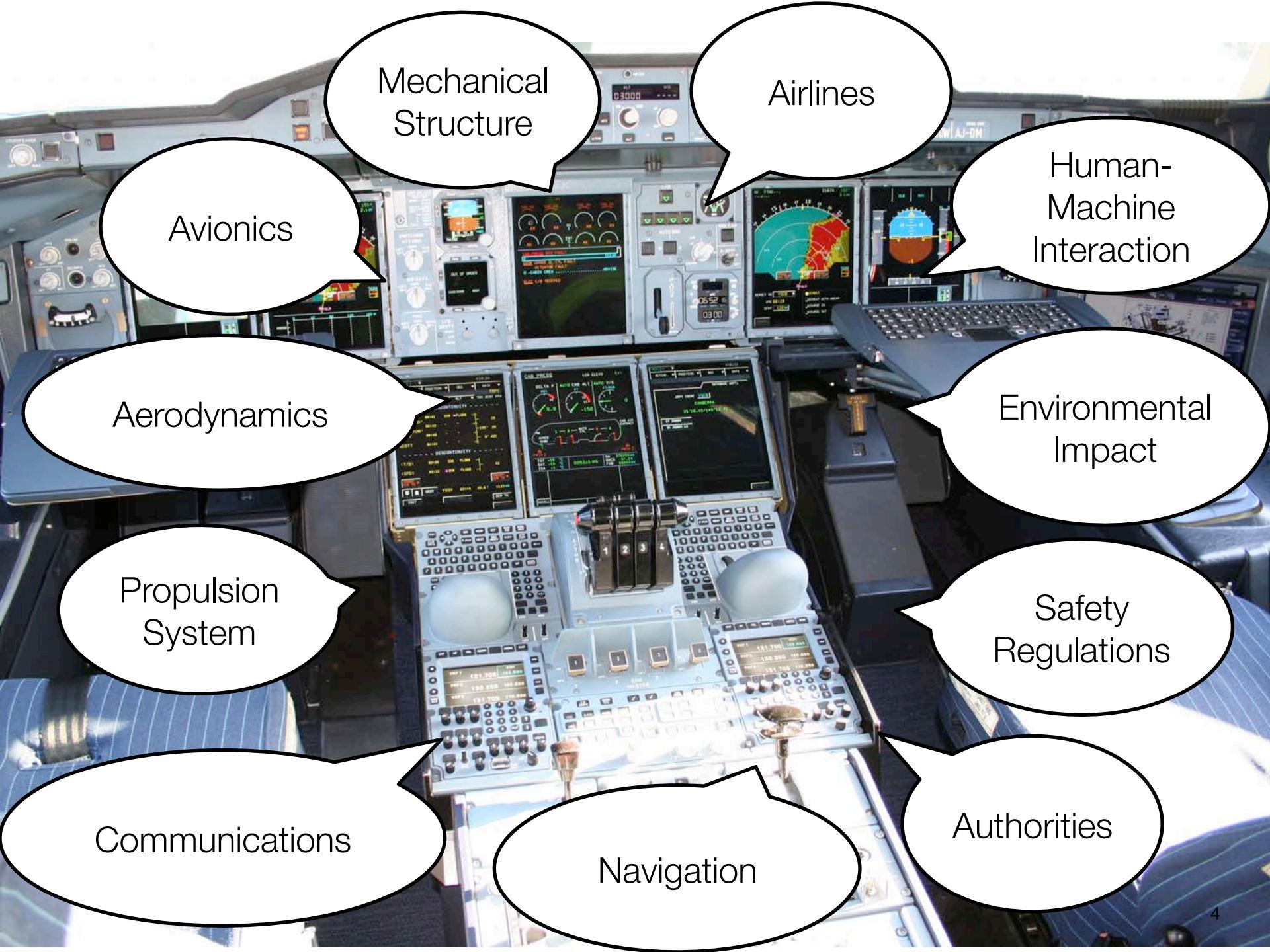
## Software intensive systems



# Complex Software-Intensive Systems

- deal with multiple concerns  
⇒ require *global analysis and execution*
- integrate heterogeneous parts  
⇒ require *global service*
- manage evolution of concerns and the emergence of new concerns  
⇒ require evolution and creation of tools and methods for software development





Avionics

Mechanical  
Structure

Aerodynamics

Propulsion  
System

Communications

Navigation

Airlines

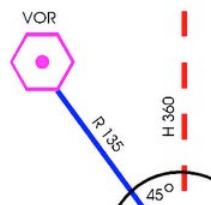
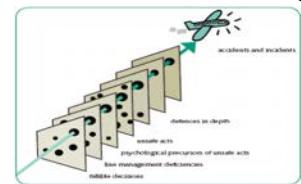
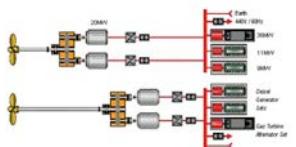
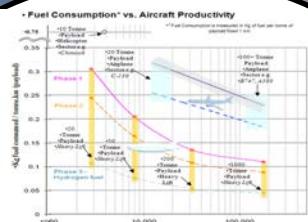
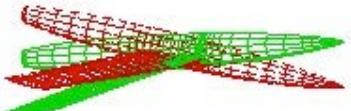
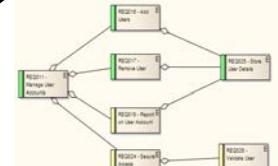
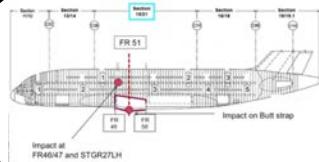
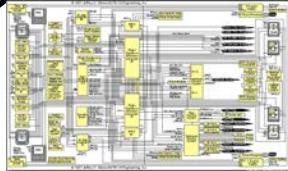
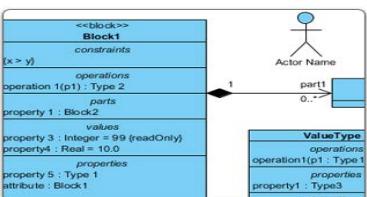
Human-  
Machine  
Interaction

Environmental  
Impact

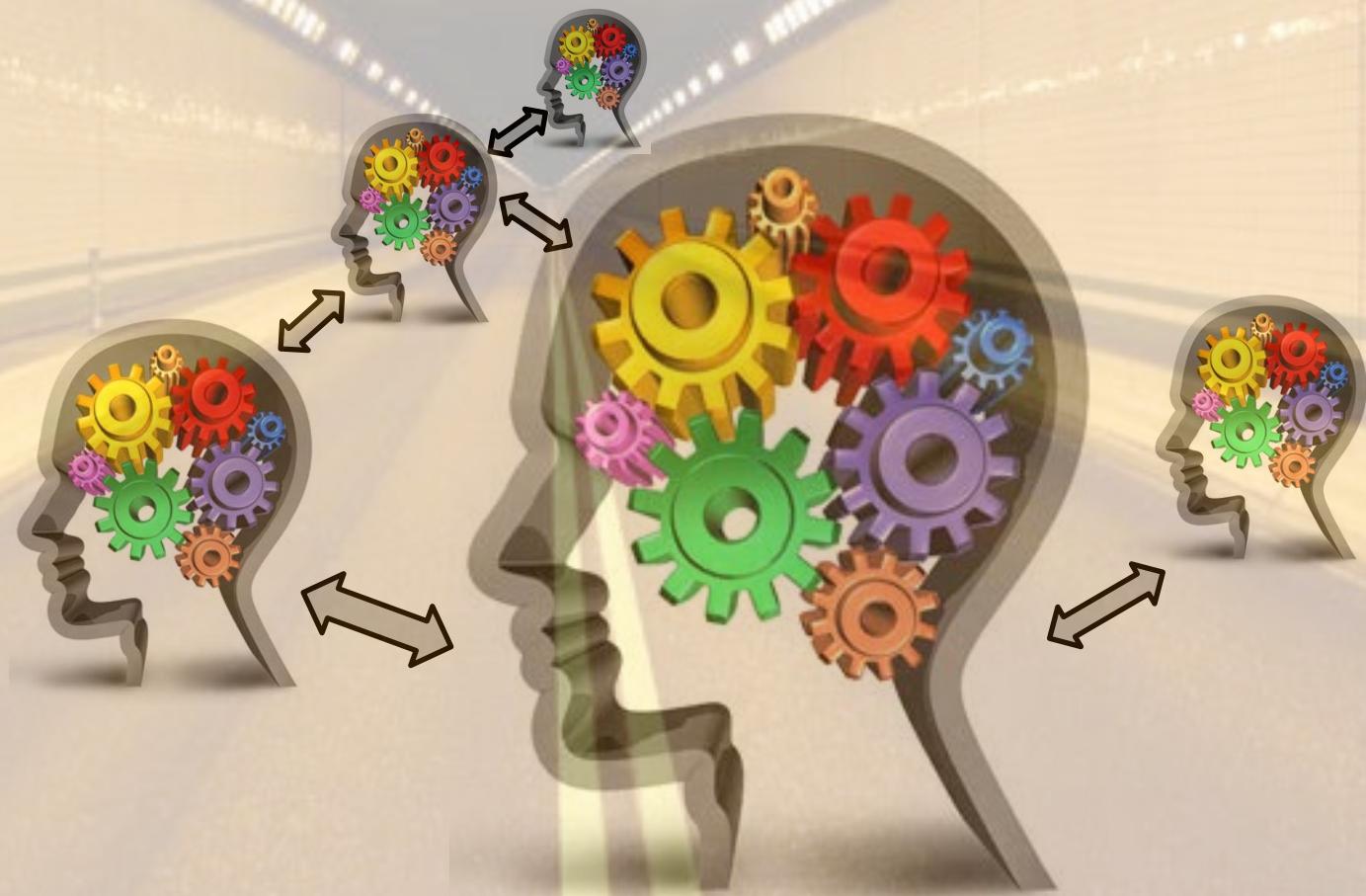
Safety  
Regulations

Authorities

# Heterogeneous Modeling Languages

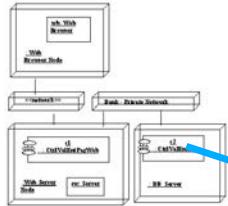


# Heterogeneous Modeling in Global Software Engineering

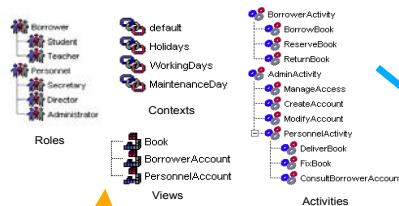


# Model Driven Engineering...

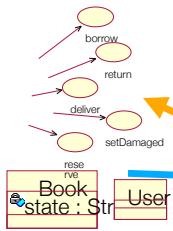
## Distribution



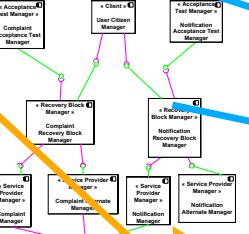
## Security



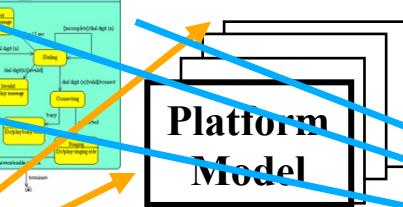
## Use case model



## Fault tolerance



## Functional behavior



Platform Model



Change one Aspect and  
Automatically Re-Weave:  
From AORE, SPL to DAS

Design Model

Code Model

## => Software Language Engineering

---

- The separation of concerns...

*Modularization [Parnas72] to allow the structure of the product to resemble the structure of the organization that designed it [Conway68]*

- ... at the language level

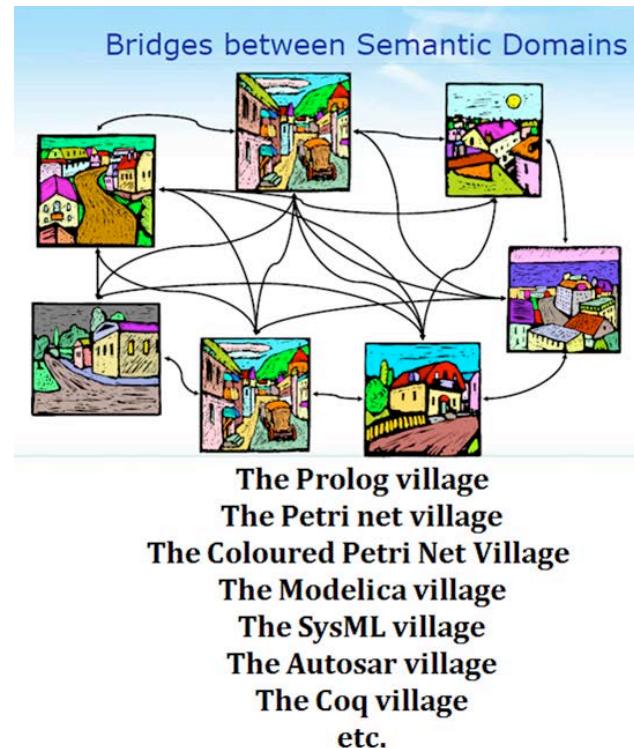
*Domain-Specific (Modeling) Language (DSML) should serve to implement a solution in terms of a problem (socio-technical coordination [Herbsleb07]).*

- requires to manage the relations between languages

*to avoid social isolation and non sharing information (as observed for example in the use of APIs [Souza04])*

# At some point in the software lifecycle...

- Interoperable and Collaborative Models



## The Village Metaphor

A. Vallecillo. "A Journey through the Secret Life of Models".

Dagstuhl seminar on Model Engineering of Complex Systems (MECS), Aug. 2008.

# Across the software life cycle...

- Executable, Composable and Intuitive Models (i.e., *runware*) from design to run time

⇒ the two-way tunnel-digging



The tunnel digging analogy  
[Harel et al., SoSyM'12]

# Challenges

---

- *Model Driven Engineering*  
    → *Software Language Engineering*
- Language relationships should be capitalized  
    ⇒ from transformation to composition
- Global model coordination and analysis  
    ⇒ from design to runtime



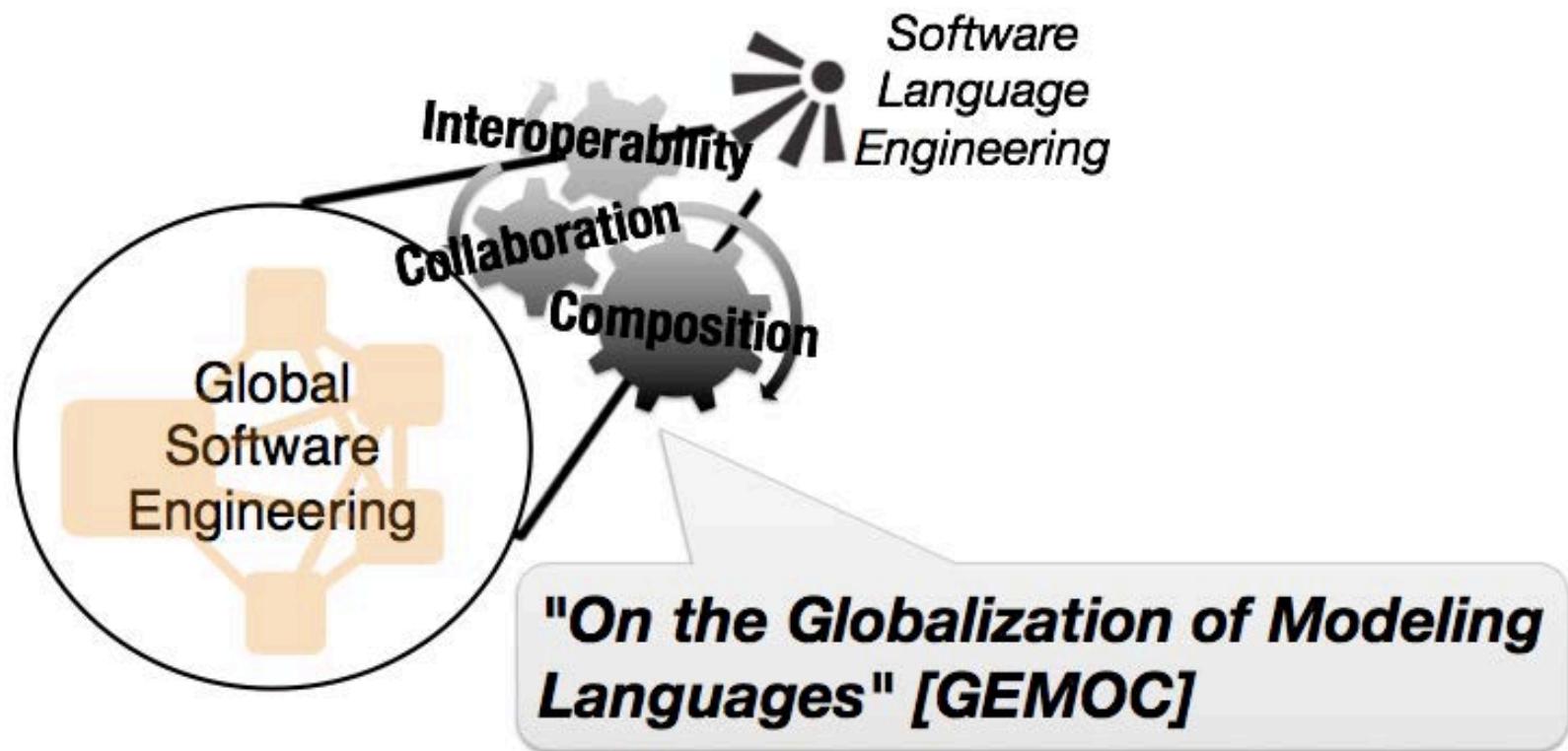
# Gemoc

The word "Gemoc" is written in a large, bold, sans-serif font. The letters are primarily dark grey, except for the two "o"s which are a lighter blue. A thin, light-grey diagonal line with a slight curve at the bottom right cuts across the letters from the top left.

***On the Globalization  
of Modeling Languages!***

# An Initiative...

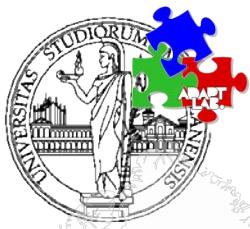
Focuses on SLE tools and methods for interoperable, collaborative, and composable modeling languages



# ... Constantly Growing



# ... Constantly Growing



**FIU**  
FLORIDA  
INTERNATIONAL  
UNIVERSITY

**THALES**

**i3s**  
sophia antipolis

THE UNIVERSITY OF  
**ALABAMA**  
ENGINEERING

 **MathWorks®**

**POLARSys**

**Colorado State**  
University

  
**AIRBUS**

**Atos**

  
**Supélec**

  
**Univerza v Mariboru**

Študentski svet



**ENSTA**  
Bretagne

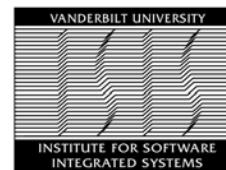
  
Institut de Recherche en Informatique de Toulouse

**RWTHAACHEN**  
UNIVERSITY

CNRS  
INPT  
UPS  
UTT

  
**obeo**  
Model Driven Company

  
**Inria**  
informatics mathematics

VANDERBILT UNIVERSITY  
  
INSTITUTE FOR SOFTWARE  
INTEGRATED SYSTEMS

**UNT**  
UNIVERSITY OF  
**NORTH TEXAS™**  
Discover the power of ideas

# The GEMOC Initiative *is born!*

---

An open initiative to

- coordinate (between members)
- disseminate (on behalf the members)

worldwide R&D efforts on the globalization of modeling languages

<http://gemoc.org>

- Advisory Board: Benoit Combemale (Fr.), Robert B. France (USA), Jeff Gray (USA), Jean-Marc Jézéquel (Fr.)
- Funded by complementary and successive projects
- IP left to PCA of each projects

# Current Projects

*completed, ongoing*

CNRS GDR GPL  
Specific Action  
2011

- Survey of the techniques and tools to compose DSMLs and their respective MoCs
- *Partners: IRISA (Triskell), I3S (Aoste)*
- Cf. <http://gemoc.org/as2011>

ANR INS  
GEMOC  
2012-2016

- A Language Workbench for Heterogeneous Modeling and Analysis of Complex Software-Intensive Systems
- *Partners: Inria (Triskell), I3S (Aoste), IRIT, ENSTA-Bretagne, Thales, Obeo*
- Cf. <http://gemoc.org/ins>

CNRS PICS  
MBSAR  
2013-2015

- Travel funds for permanent staff and PhD students
- *Partners: IRISA (Triskell), CSU*
- Cf. <http://gemoc.org/mbsar>

# ANR INS GEMOC (2012-2016)

"A Language Workbench for Heterogeneous Modeling and Analysis of Complex Software-Intensive Systems »

Tools and methods for the definition and coordination of heterogeneous executable modeling languages over heterogeneous models of computation

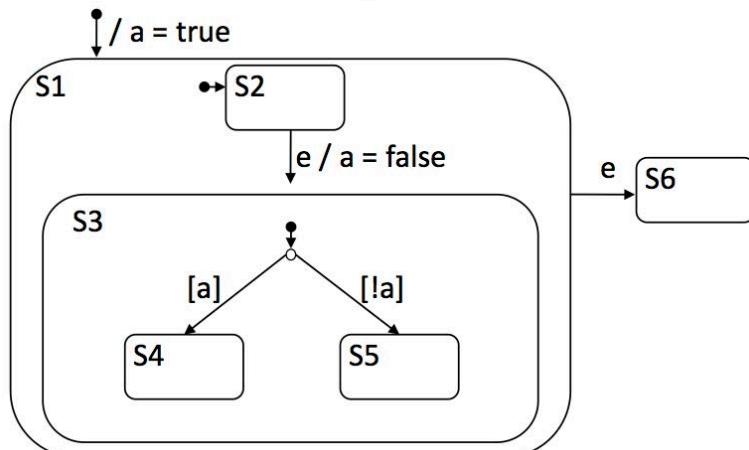
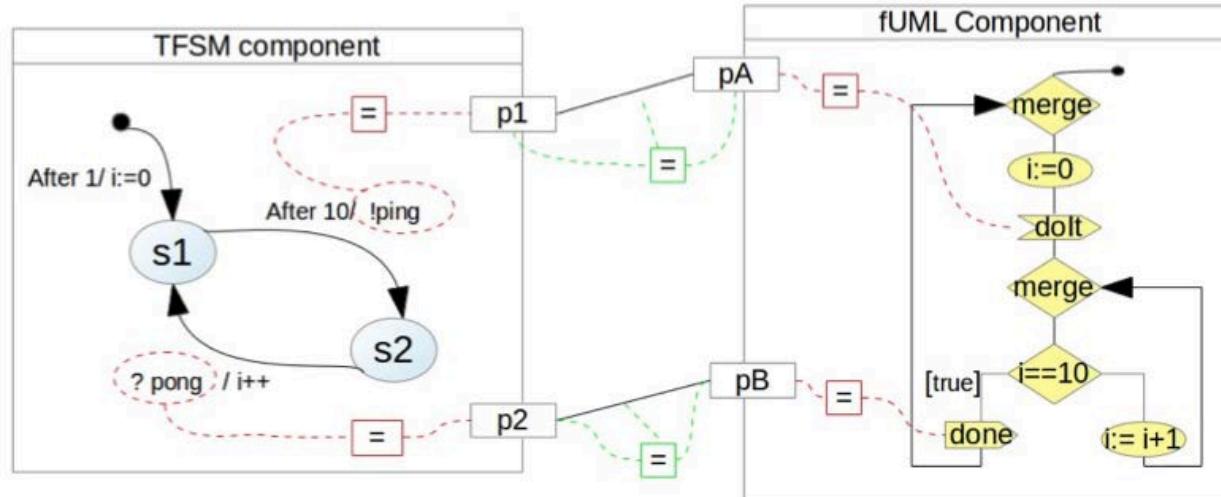


<http://gemoc.org/ins>

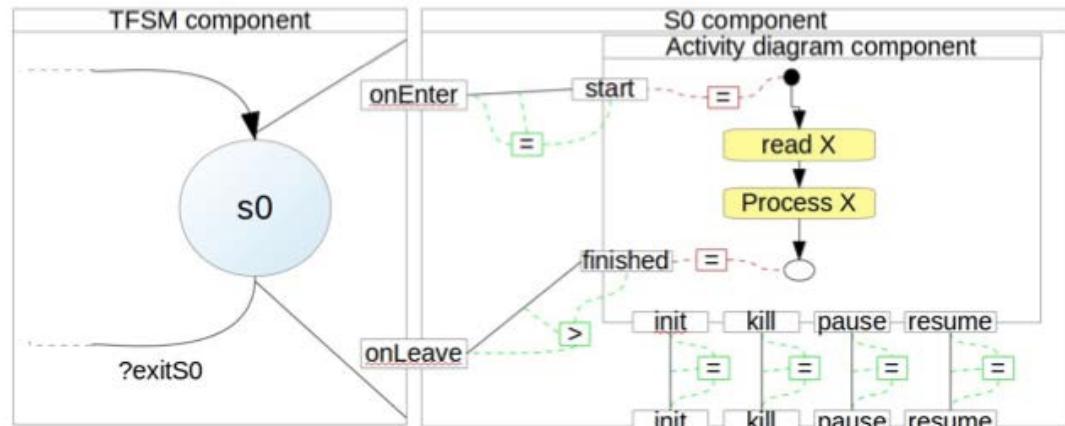
# Model Composition

Many possible interactions between models  
(structural vs. behavioral, flat vs. hierarchical, refinement...)

here are some examples of compositions of executable models



Event "e" leads to  
S4 (UML), S5 (Rhapsody), or (S6) Stateflow



# Executable Metamodeling

---

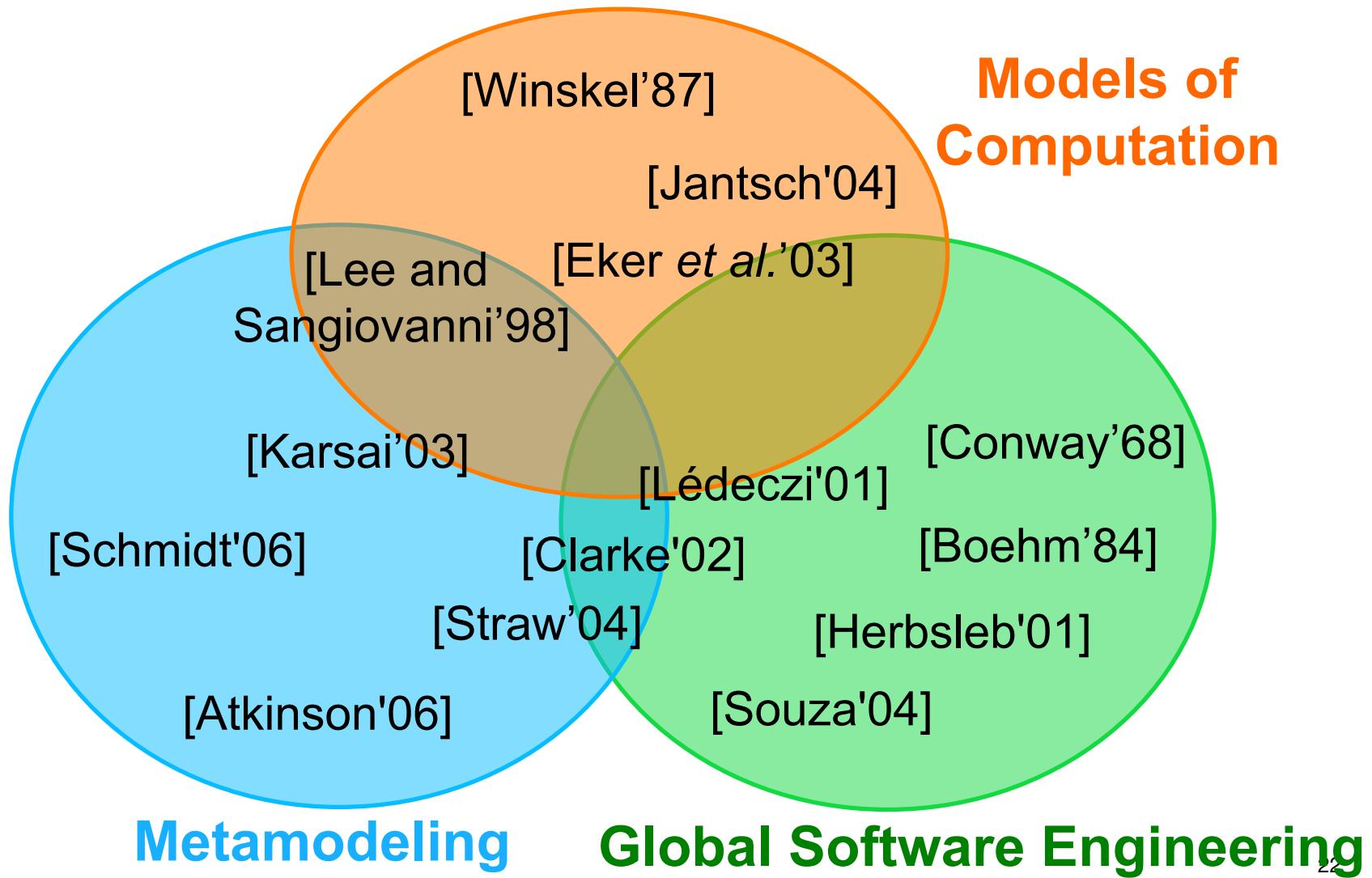
- Effective environments for the design and implementation of executable domain specific languages (e.g., Kermeta at Inria)
- BUT these environments do not allow the integration of heterogeneous models of computation (concurrency, communication...)

# Models of Computation

---

- Effective environments to deal with the execution and analysis of models based on heterogeneous models of computation (e.g., Ptolemy at UC Berkeley, ModHel'X at Supélec)
- BUT these environments do not allow adaptation to specific business/application domains

# Heterogeneity and SE

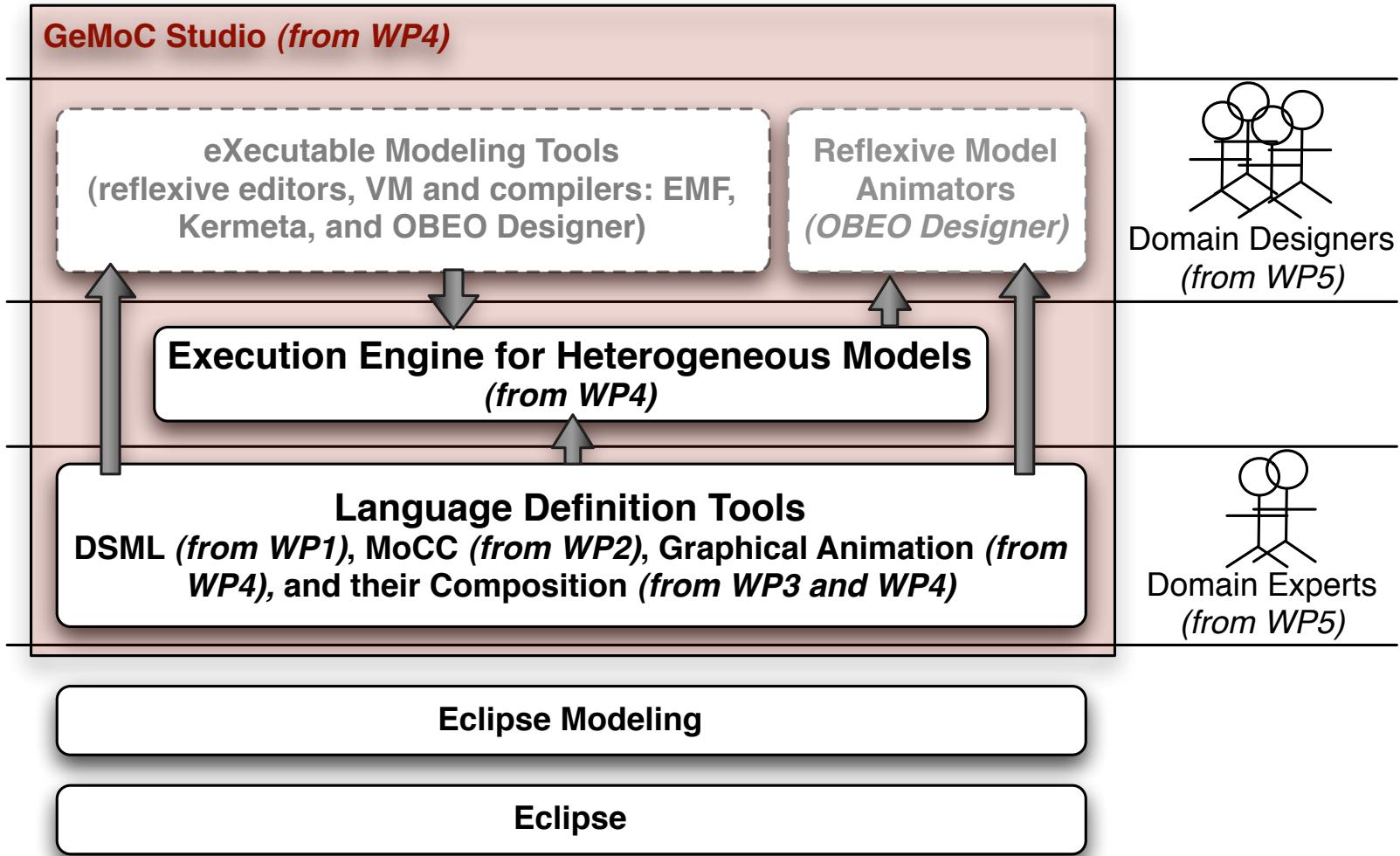


# ANR INS GEMOC: Issues

---

- **Scientific Issues:**
  - Formal foundations for composable software language design and implementation
  - Formal foundations for semantic coordination of software languages
  - Associated tool-supported methodology leveraging on executable metamodeling and models of computation
- **Technical Issues:** an Eclipse-based GEMOC studio integrating
  - A language worbench
  - A language coordination and execution engine
  - A workbench for viewpoint definition and animation over heterogeneous models

# ANR INS GEMOC: Expected Studio



# Cross Road Traffic Light

<http://youtu.be/gT1QULmFkLM>

The screenshot displays the Eclipse IDE interface with several open windows related to a traffic control system:

- Debug - fr.inria.aoste.gemoc.example.semaphore/TrafficControl/trace/Simulation2013\_0617\_224845/TrafficControl\_MoCC2013\_0617\_224845.vcd - Eclipse SDK**: This window shows the UML statechart model for the "TrafficControl" system. It includes two statecharts: "Control" and "Semaphore0". The "Control" statechart has states "Night" and "Day", with transitions triggered by "isNight" and "isDay" events. The "Semaphore0" statechart manages traffic lights (Green0 and Red0) with transitions triggered by "doGreen" and "doRed" events.
- Simulation**: This window displays waveforms for various events over time steps 0 to 30. The events shown include mainBlock::Red0\_entering, mainBlock::Red0\_leaving, mainBlock::Red0\_to\_Green0\_fire, mainBlock::Green0\_entering, mainBlock::Green0\_leaving, mainBlock::Green0\_to\_Red0\_fire, mainBlock::switch\_occurs, mainBlock::Day\_to\_Day\_fire, and mainBlock::minutes\_ticks.
- Traffic Control: on Night**: This window provides a 3D visualization of a cross-road intersection. It shows four traffic lights (one at each corner) and the flow of vehicles. A status bar at the bottom indicates "Day" and "Night" modes, and a timer showing "61 minute".
- Console**: This window contains the timing specification and logs for the simulation steps 29 and 30.

```

priority specification : 2013_0617_224845
Timing Output (VCD Generation) :3 ms
Timing Output (EMF Code Execution) :85 ms
Timing Output (Obeo ViewPoint Animator) :471 ms

Simulation (Step 29)
Timing Output (VCD Generation) :3 ms
Timing Output (EMF Code Execution) :89 ms
Timing Output (Obeo ViewPoint Animator) :500 ms

Simulation (Step 30)
Timing Output (VCD Generation) :4 ms
fire: Green0 to Red0 -> doRed
Timing Output (EMF Code Execution) :142 ms
Timing Output (Obeo ViewPoint Animator) :1112 ms

```

- oCC2013\_0617\_224845.vcd**: This window shows the GroovyWrapper Java application console output, which tracks the ticks and requests for the traffic light system.

# ANR INS GEMOC: Identification

- Project Coordinator: Benoit Combemale ([benoit@gemoc.org](mailto:benoit@gemoc.org))
- Consortium: Inria, CNRS I3S, INPT IRIT, ENSTA Bretagne, Thales, Obeo
- External Partner: Supélec
- Date: 01.12.12 – 30.03.16 (40 months)
- Budget: 2 700 000 €
- Supported by the *French Agency for Research (ANR)*
  - ▶ Program *Ingénierie Numérique et Sécurité (INS 2012)*
  - ▶ Grant n°ANR-12-INSE-0011
  - ▶ ANR Funding: 982 720€
- Competitiveness clusters: Image & Réseaux, Aerospace Valley, Systematic

➡ Visit <http://gemoc.org/ins>



# GEMOC MEETING

---

July 1<sup>st</sup>, 2013, Montpellier, France  
co-located with ECMFA, ECOOP and ECSA 2013  
*Research-Project Symposium*

- Official launch of the GEMOC Initiative
- Working group on the classification of the relations between modeling languages
- Coordination EU-US, and intra EU

<http://gemoc.org/meeting-ec2013/>

# GlobalDSL 2013

---

## International Workshop on *The Globalization of Domain Specific Languages*

July 2<sup>nd</sup>, 2013, Montpellier, France

co-located with ECMFA, ECOOP and ECSA 2013

- Topics of interest include *composability*, *interoperability*, *modularity*, *reuse*, and *variability* of programming/modeling languages
- Keynote by Prof. Dr. Bernhard Rumpe on "*Compositional Model-Based Software Development*"

<http://gemoc.org/globalsl2013>

# GEMOC 2013

---

## International Workshop on *The Globalization of Modeling Languages*

September 29<sup>th</sup>, 2013, Miami, Florida, USA

co-located with MODELS 2013

- Topics of interest include *composability and interoperability of heterogeneous modeling languages, model and metamodel composition, multi-paradigm modeling and simulation*
- An open forum for sharing experiences, problems and solutions on the conjoint use of multiple modeling languages.

<http://gemoc.org/gemoc2013>