32nd Annual IEEE International Computer Software and Applications Conference
3d IEEE Workshop on **Engineering Semantic Agent Systems**

INVENTIVE

An Ontology of Environments, Events, and Happenings

Vadim Ermolayev, Natalya Keberle
Zaporozhye National University

Wolf-Ekkehard Matzke
Cadence Design Systems GmbH

Knowledge representation

Agents, domain expertise

July 28, 2008, Turku, Finland

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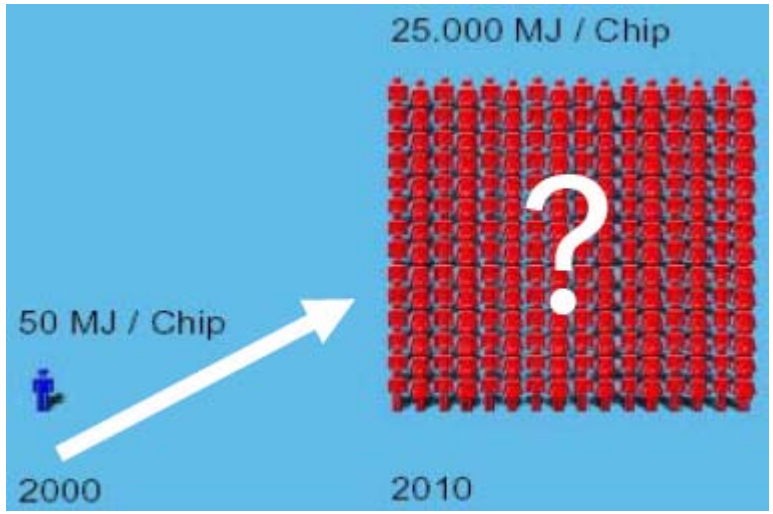
Outline

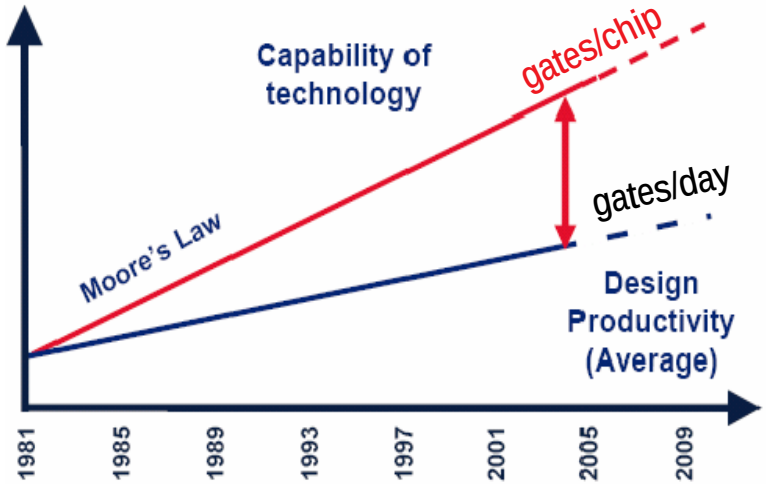
- Material that is important, but not in the paper …
  - Space constraints, or some progress beyond the CR
- Why do we need E2H in Performance Simulation Initiative?
- What is the place of E2H ontology in our KR framework?
- What are the (reasons for) our ontological choices? With examples …
  - Environments; Time; Events versus Actions; Events Versus Happenings
- Implementation and Use

Performance Simulation Initiative

- R&D project of Cadence Design Systems GmbH
  - 2005 - ongoing
  - Goal: Assess and Manage Performance in Engineering Design
  - Domain: Microelectronics and Integrated Circuits
  - Method: knowledge-intensive, agent-based simulation of:
    - A Design System and
    - A Dynamic Engineering Design Process
- A “horizontal” framework:
  - Plugged-in focused activities
  - Cooperation with other projects
    - PRODUKTIV+ (BMBF, http://www.edacentrum.de/produktivplus/)
    - ACTIVE IP (EC FP7, http://active-project.eu/)

Peter van Staa, Inv. talk at HoloMAS’2007





(Source: International Technology Roadmap for Semiconductors)

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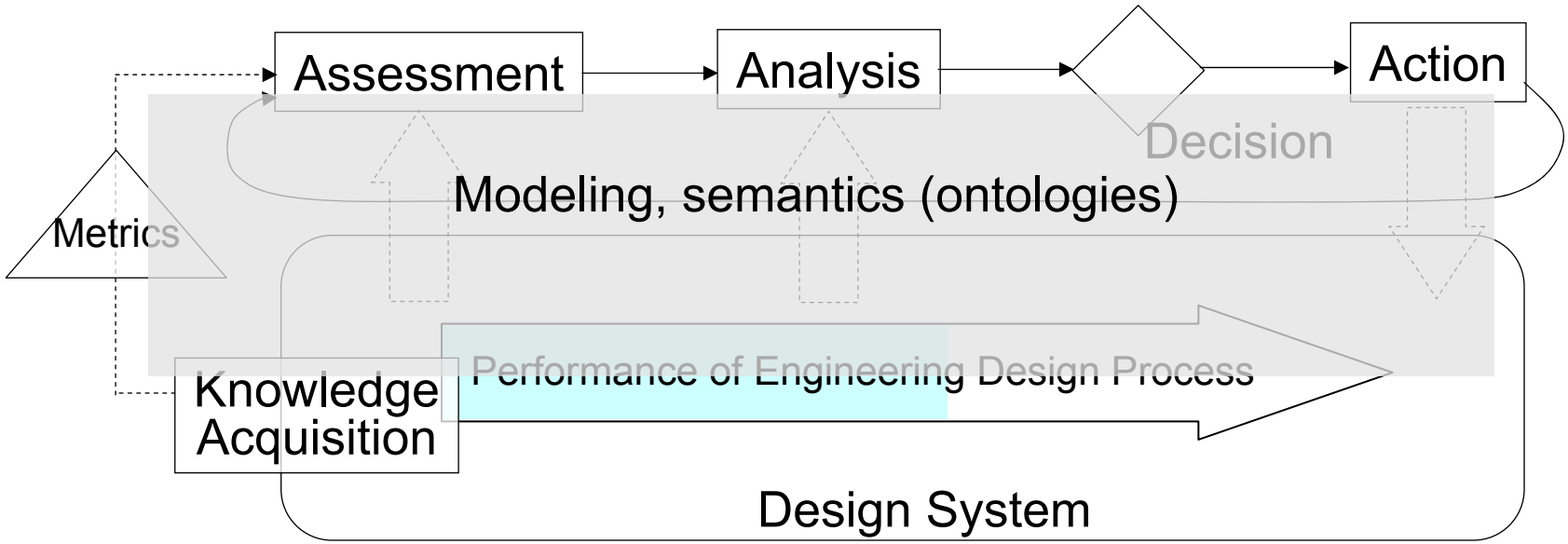
Performance Assessment and Management

Engineering Design Processes, Microelectronics and IC



"Design productivity breakthroughs [are] mandatory to win the design race!"

Peter van Staa, Bosch Automotive Electronics

Inv. talk at HoloMAS'2007

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Environments, Events, Happenings
and Observers

- **Event**: a manifestation of a **Phenomenon** which can be sensed (and measured)
  - **Phenomenon**: season change
  - **Event**: Spring
- **Happening**: an act of **Event** sensing by a particular **Observer**
  - in different **Environment**s:
    - I sensed Spring in Australia (take-off), but Autumn in Europe (landing)
  - By different **Observer**s:
    - I sensed a flight attendant passing by
    - But my buddy - a rabbit crossing the runway
- **Environment**: a temporal aggregation of **Object**s which surround the **Object** or the **Process**
  - **Object**: Me or **Process**: Take-off
  - **Environment**: The aircraft, the crew, the other passengers, the runways, the control tower, the rabbits and the seagulls around, …

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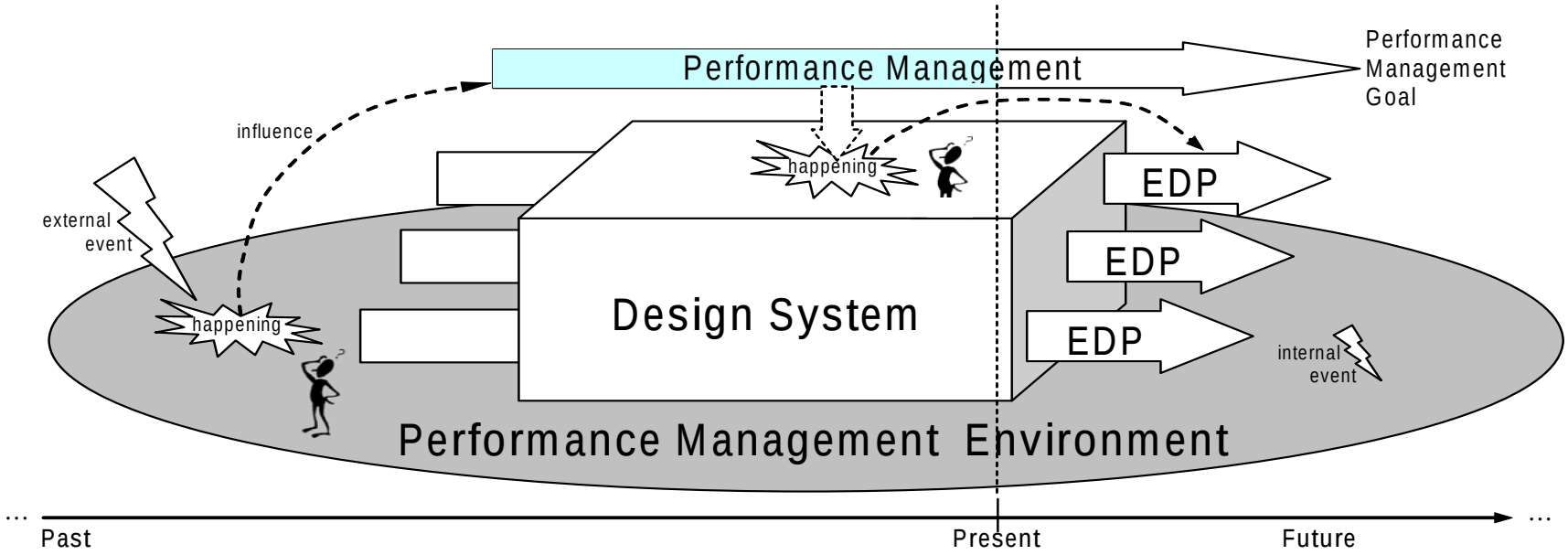
Environments, Events, and Happenings in PSI

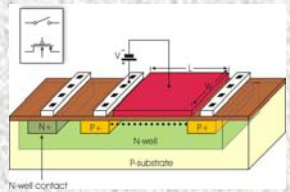
- Agent-based simulation:
  - Nested, dynamic, stochastically influenced **Environment**s
  - Collaborative, loosely defined, ramified, “stochastic” **Process**es
  - **Actor**s playing different **Role**s in different **Process**es



Engineering Design or Another World of “Death March Projects”*

* Coined by Edward Yourdon, Death March, Prentice Hall, 2003

Faster! Cheaper! Smaller!



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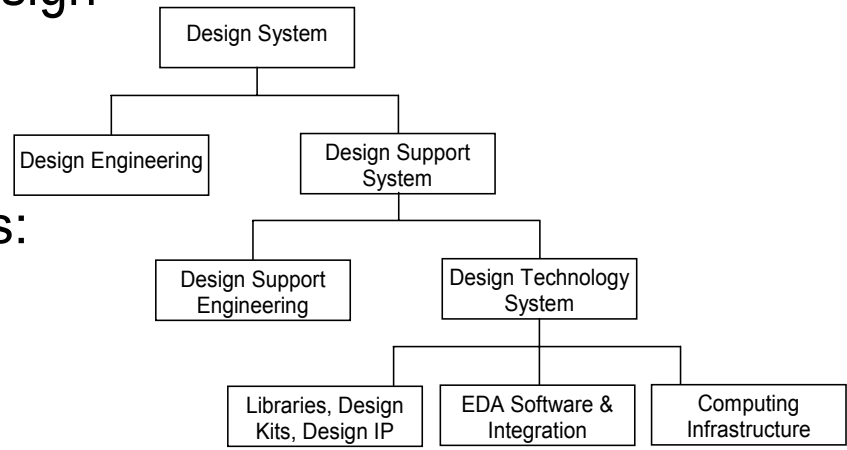
Environments, Events, and Happenings in PSI

Examples in Microelectronics and IC Design



- Environments:
  - Of an Engineering Design Process:
    - A Design System
  - Of a Designer – previous slide
- Events:
  - Internal to a Design System: Netlist Design Artifact representation for the designed chip has met quality requirement
  - External: Spec change by a customer
- Happenings:
  - I found out that the Netlist provided by my fellow college is crap
  - My fellow college found the bug in my GDS II layout
  - I noticed that the block design provided by ABC does not fit the interface
  - …

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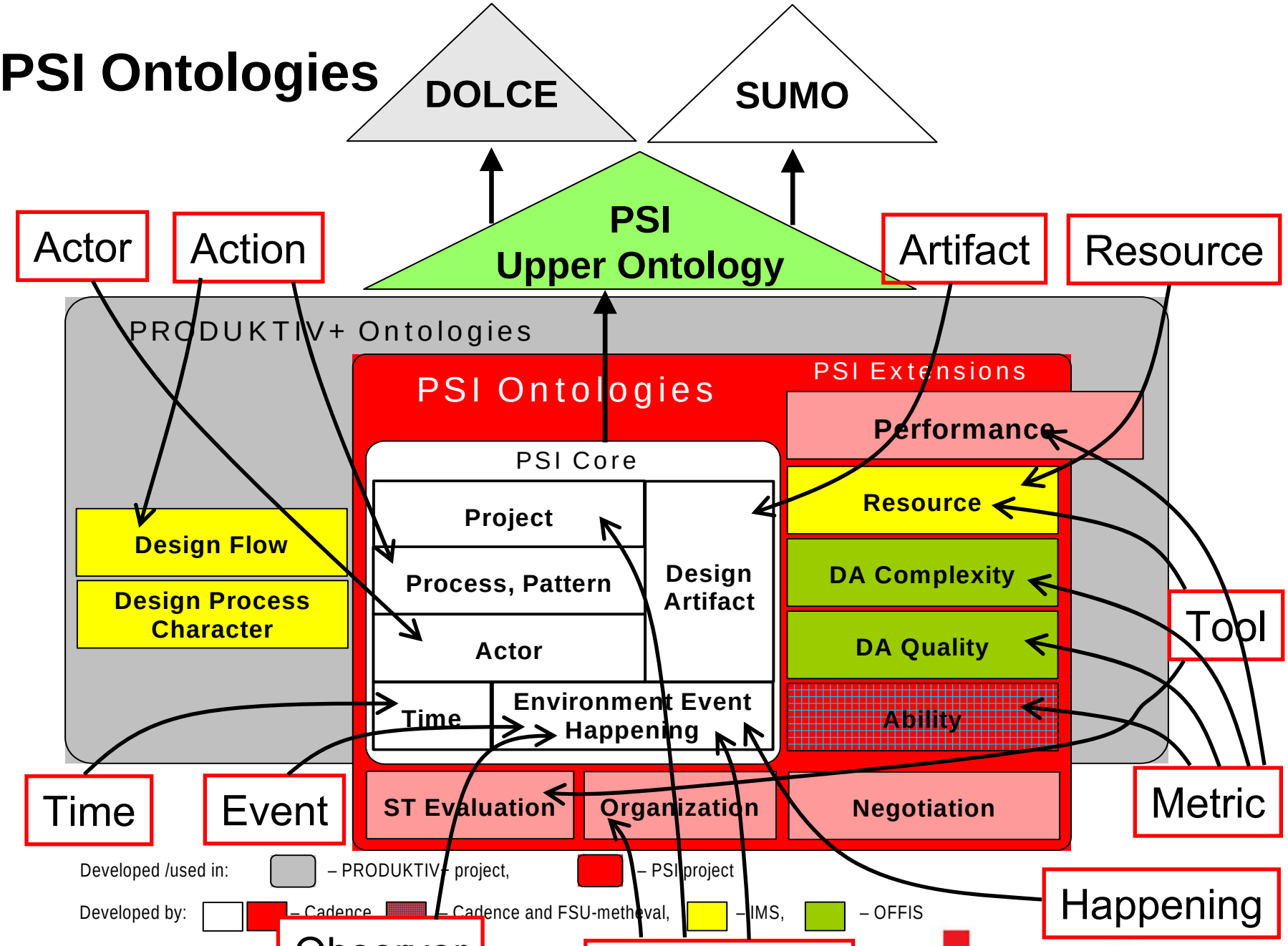
PSI Ontologies



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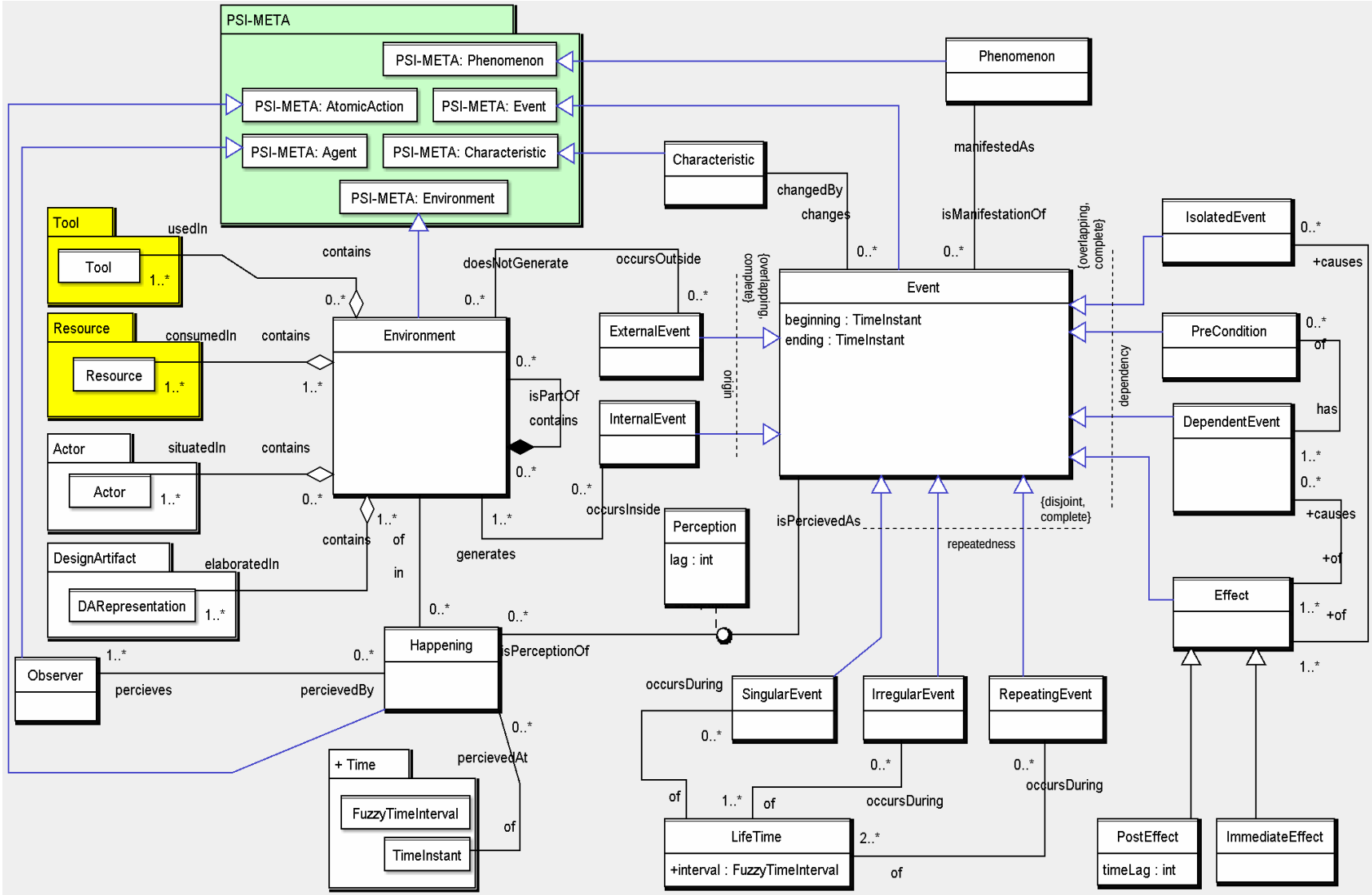
PSI Environment-Event-Happening Ontology



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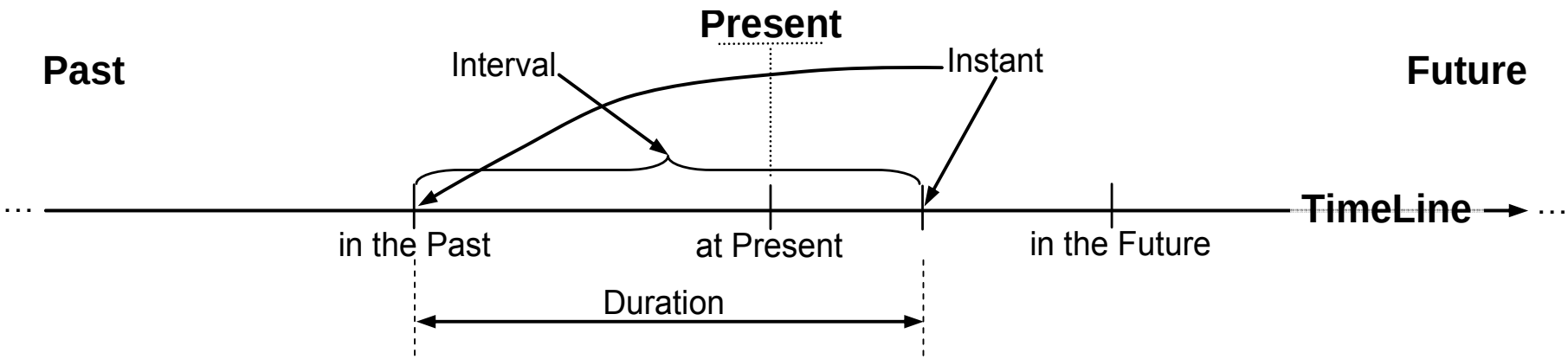
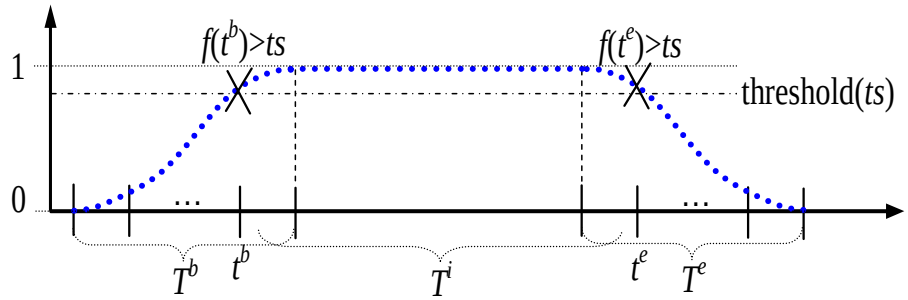
PSI Time



- Linear, anisotropic, discrete (Time Crisp)
- Time intervals are fuzzy (Time Fuzzy)
  - "Springing" schedules
  - Accounting for stochastic appearance
  - …



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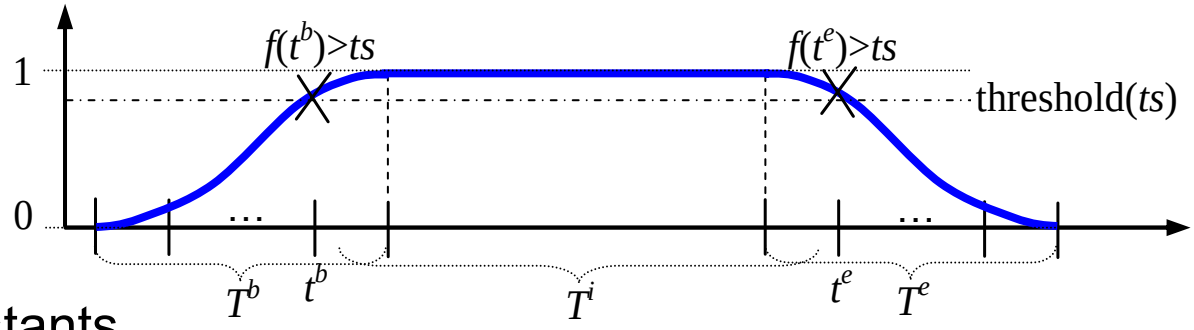
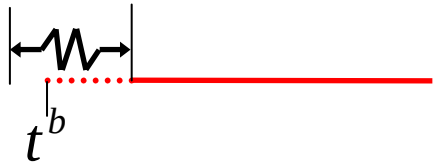
Time Fuzzy: Extension of Time Crisp (Allen)



- Fuzzy time interval:
  $I = \{T^b, T^i, T^e, f\}$
- T^i - the Core – inner instants
- Beginning and Ending sets:
  - Beginning ($T^b = \{t_j^b\}$): $\forall t_j^b : t_j^b > t^b \rightarrow t_j^b \in T^i$
  - Ending ($T^e = \{t_j^e\}$): $\forall t_j^e : t_j^e < t^e \rightarrow t_j^e \in T^i$



- Discrete membership function: $f : Z \rightarrow [0,1]$ - individual for Agents
- Thresholds: reputation and confidence
- Rich set of axioms extending Allen's time interval logic
- More details in our UNISCON 2008 paper

  Ermolayev, V., Keberle, N., Matzke, W.-E., Sohnius, R.: Fuzzy Time Intervals for Simulating Actions. In: Kaschek, R., Kop, C., Steinberger, C. and Fliedl, G. (Eds.) Information Systems and Business Technologies. Proc. 2nd Int. Conf. UNISCON 2008, Apr. 22 – 25, 2008, Klagenfurt, Austria, LNBIP Vol. 5, 429-444

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Event vs Action

- Occasionality vs pro-activity
- Event:
  - Objective manifestation of a tangible change in an Environment
- Action:
  - A kind of an Event
  - Performed by Agent
  - Who has a goal to be reached
  - Decision

Falling
(unintentional)

Acting
(pro-active)

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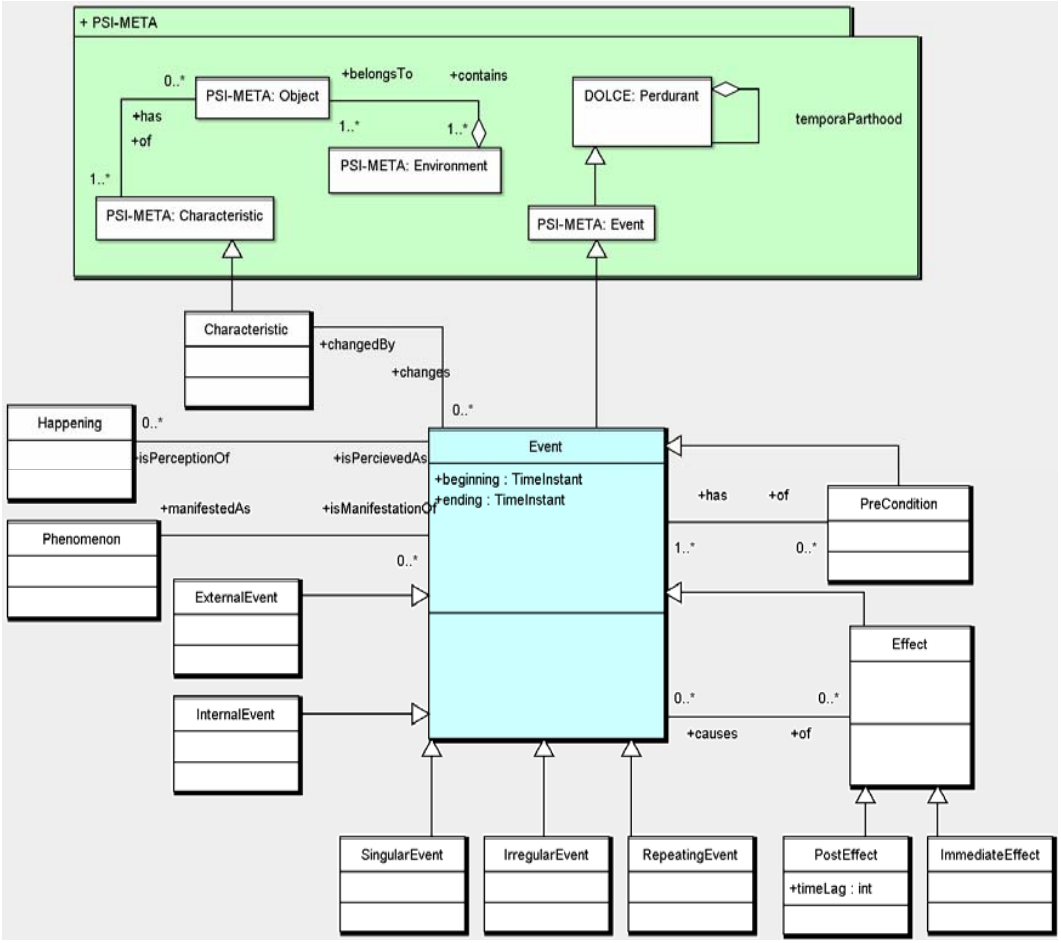

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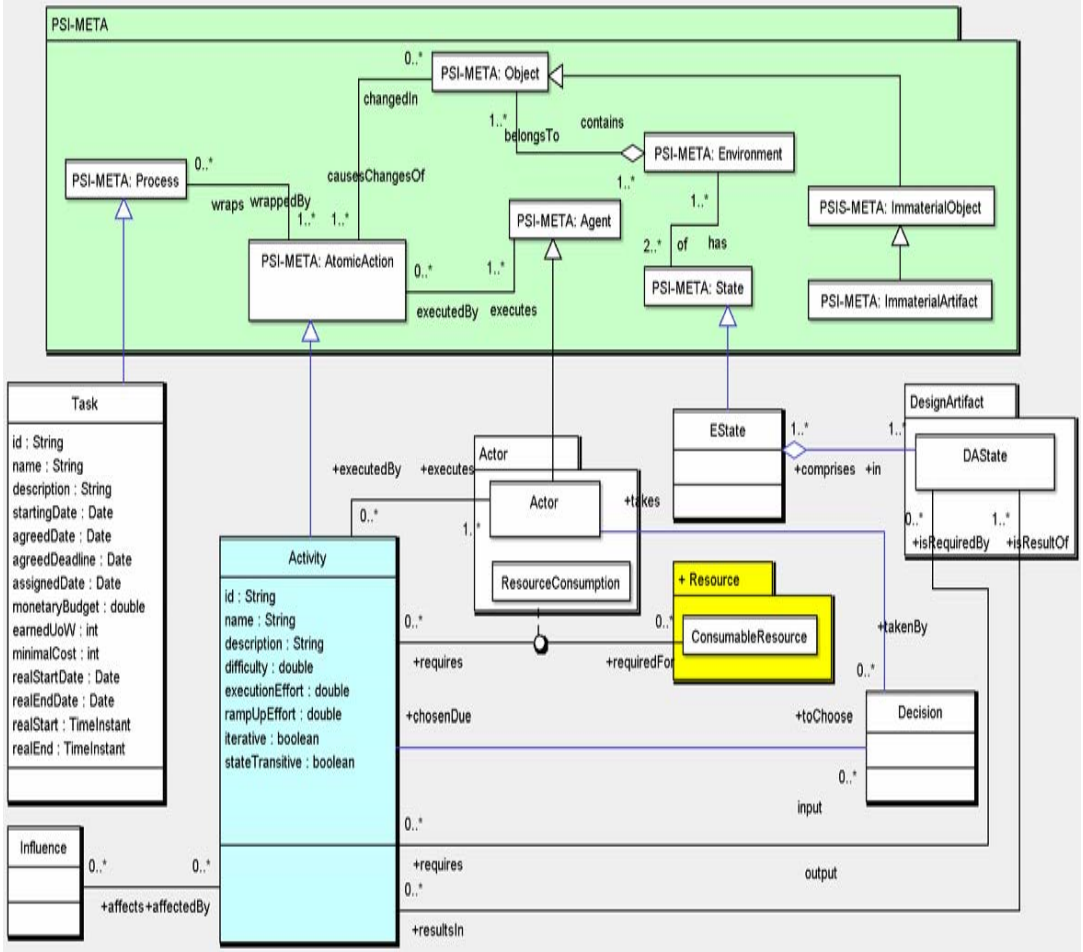

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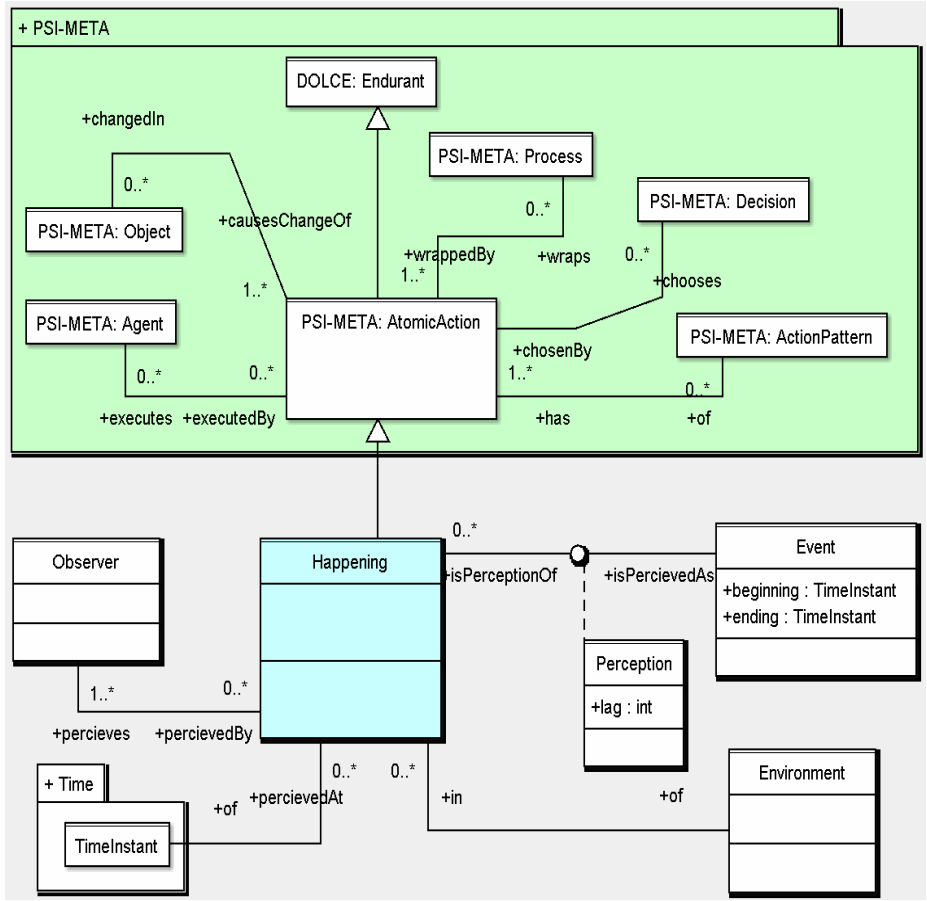
Event vs Happening

- A **Happening** is the perception of the **Event** by the **Observer** situated in the **Environment**
  - Happening → PSI-META:AtomicAction
  - Happening is instant (no duration)
  - Happening is performed by an Observer
  - Observer → PSI-META:Agent
- **Event**: Petrol retail price change
- **Happening**: I got the receipt with the new petrol price



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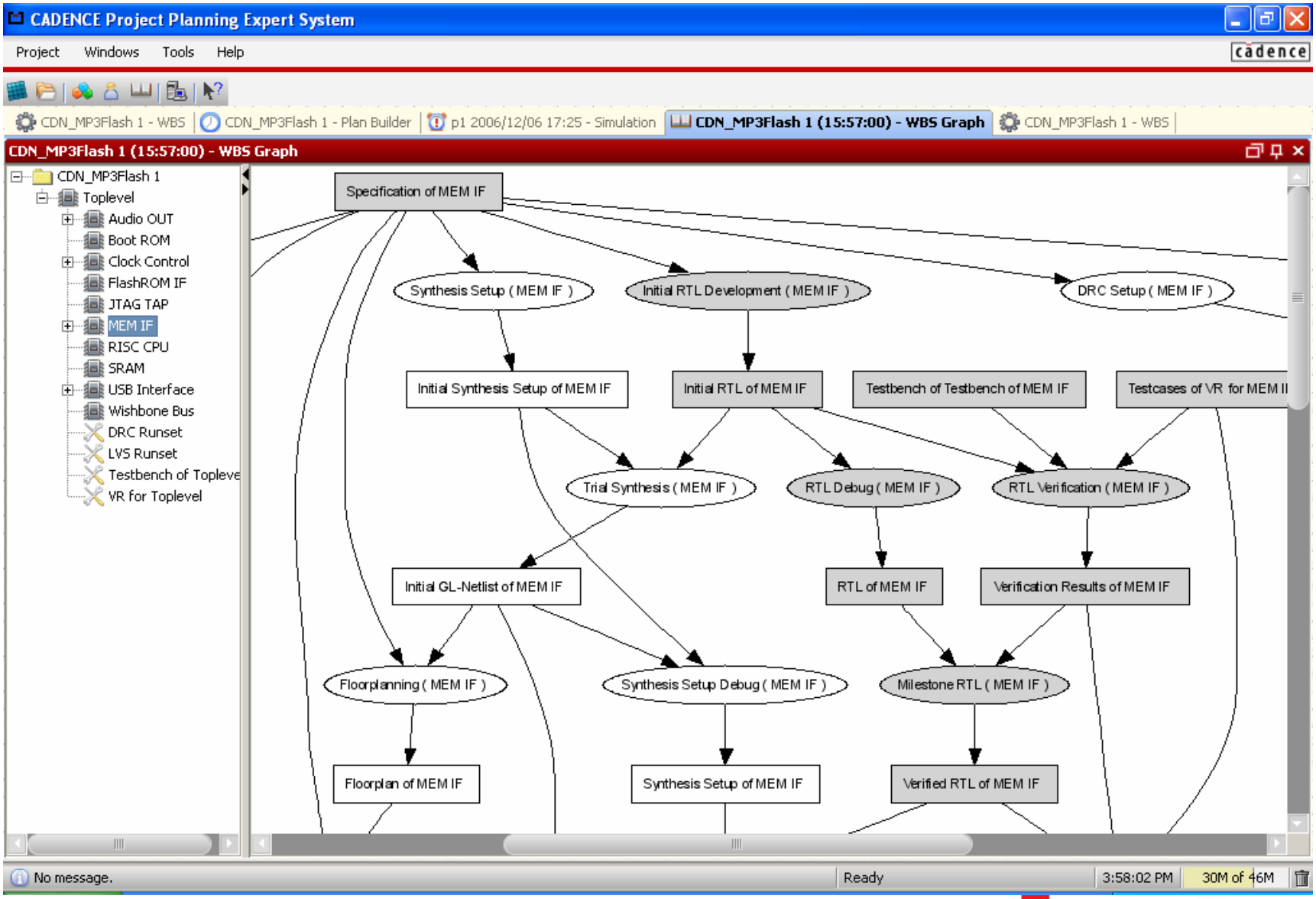
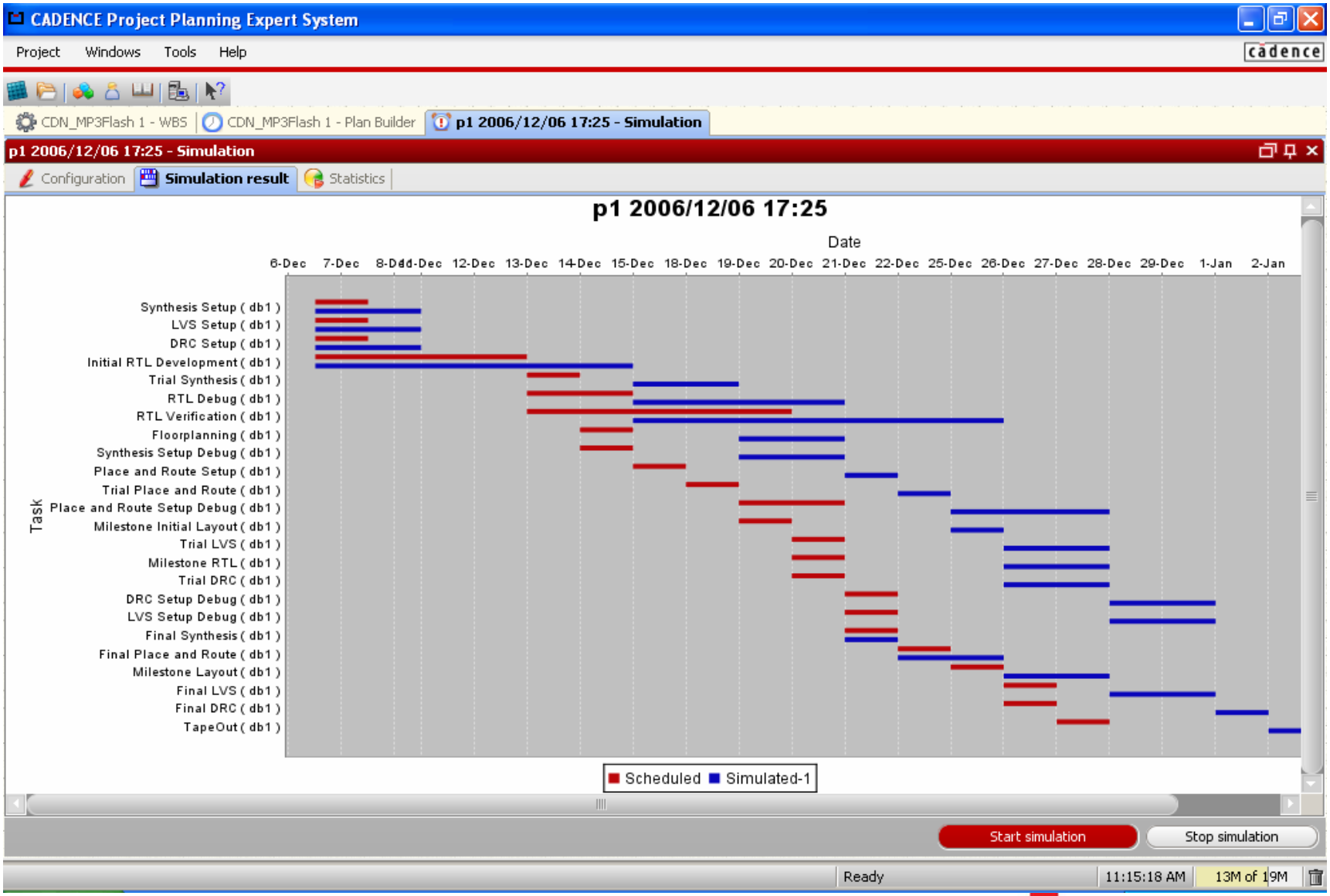
Simulation Tool: WBS generation



Simulation Tool: Design Process Simulation



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Summary and Outlook

- E2H ontology provides new modeling features for open, dynamic and semantically rich domains
  - e.g. Engineering Design
- E2H has been implemented (OWL-DL) a part of the Core of PSI Suite of ontologies v.2.2
- E2H has been evaluated (as part of PSI Core) using Shaker Modeling Methodology for Ontology Refinement
  - More details in our ER 2008 paper
- E2H is used (as part of PSI Core, Crisp Time) in Cadence Process Planning Expert System
- Future work:
  - Time Fuzzy enhancement used in Cadence Software
  - E2H refinement to model context sensitivity (e.g. for FP7 ACTIVE IP)

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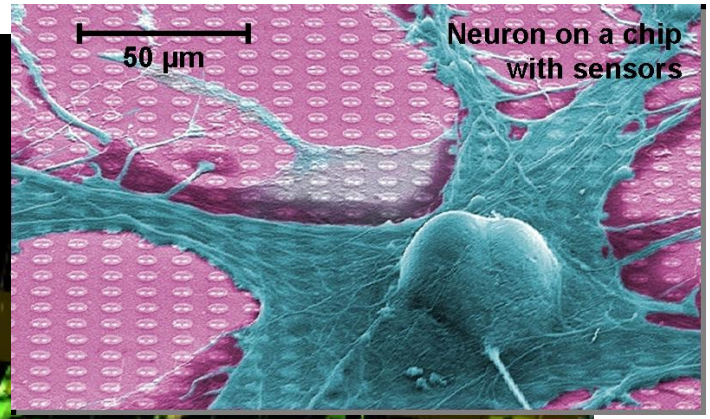
Questions Please



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