MDE/SLE: From Theory to Practice

Project on Farming Modeling

ESIR3, 2014-2015

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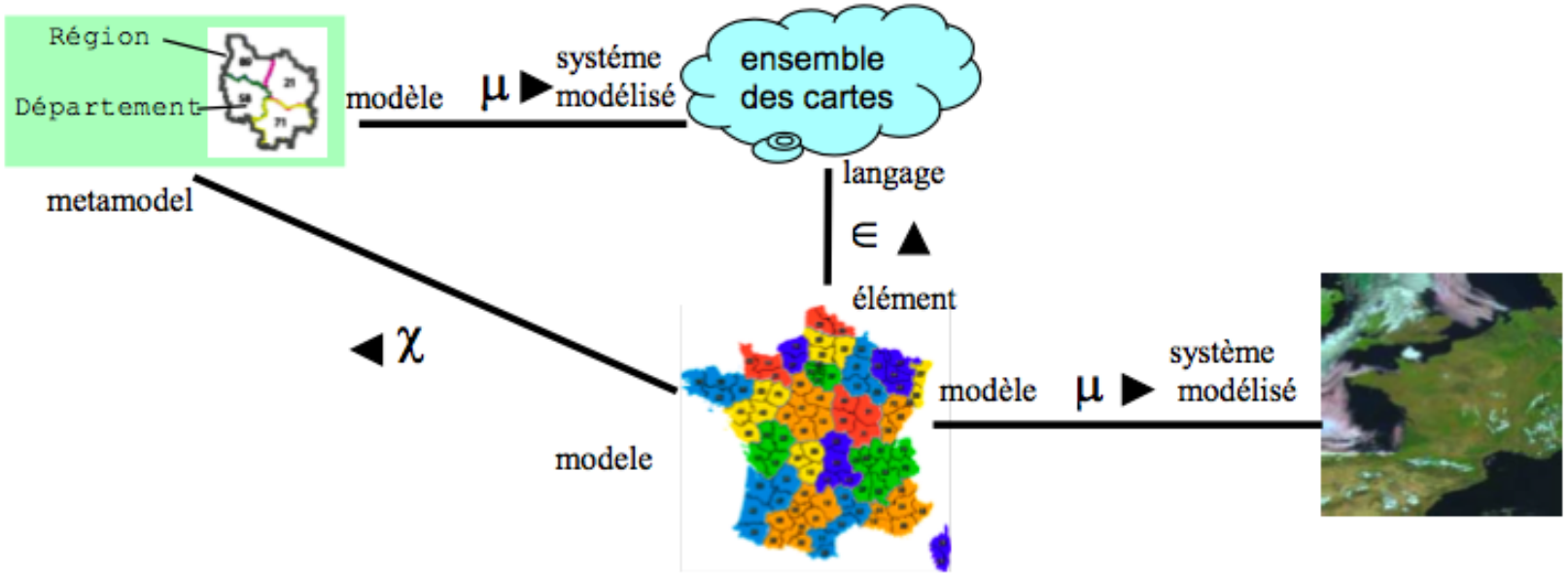
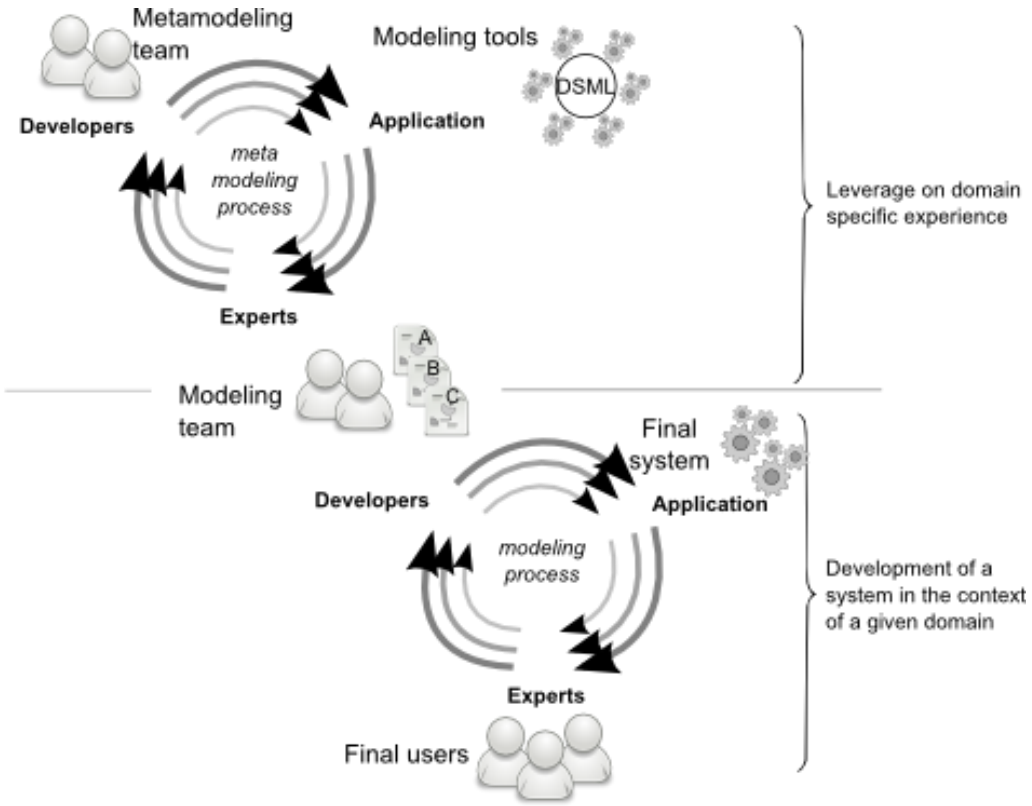
Metamodeling



J.-M. Favre, J. Estublier, M. Blay-Fornarino, "L'ingénierie dirigée par les modèles. Au-delà du MDA," Hermes Science Publications, 2006.

Metamodeling



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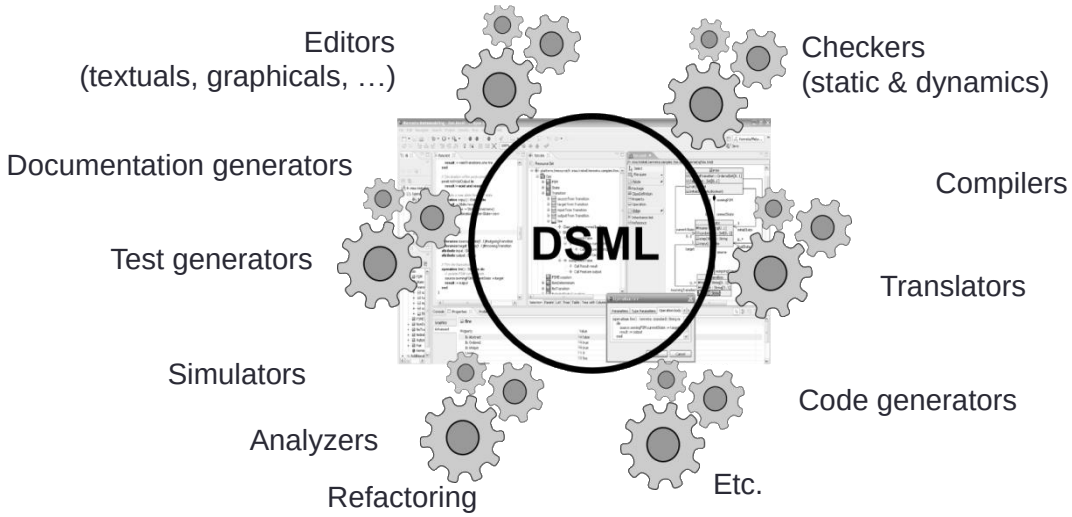

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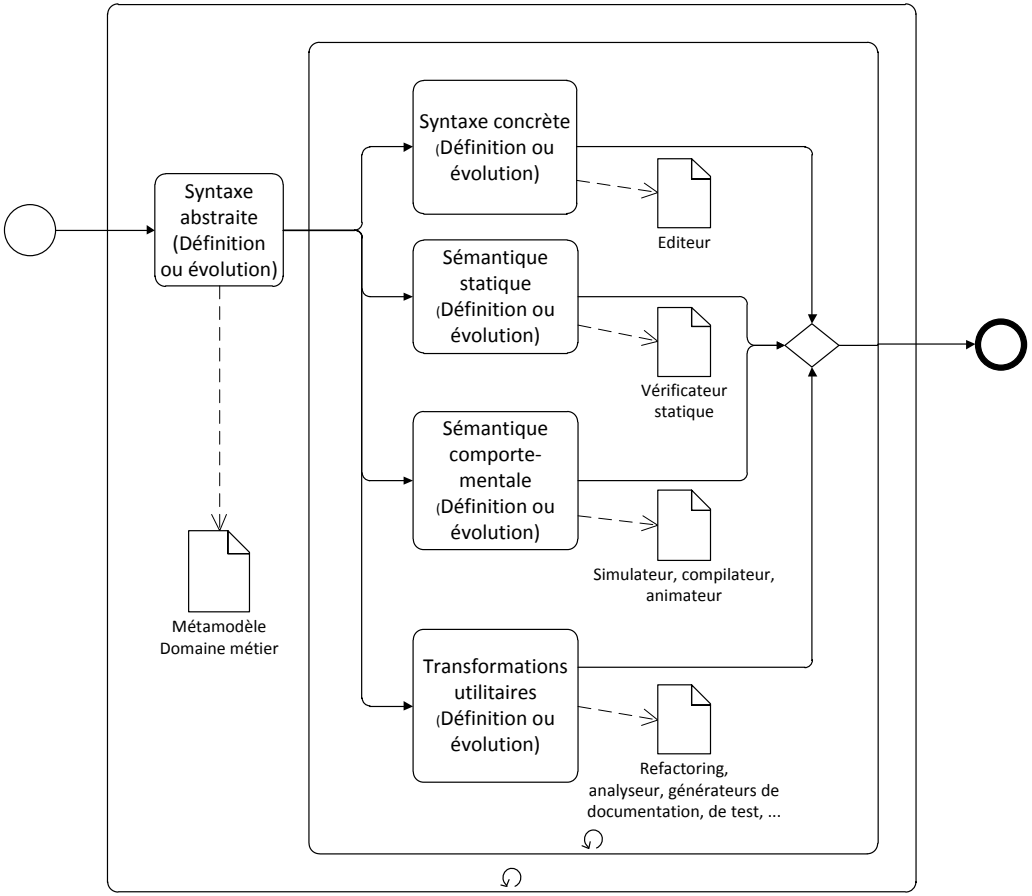

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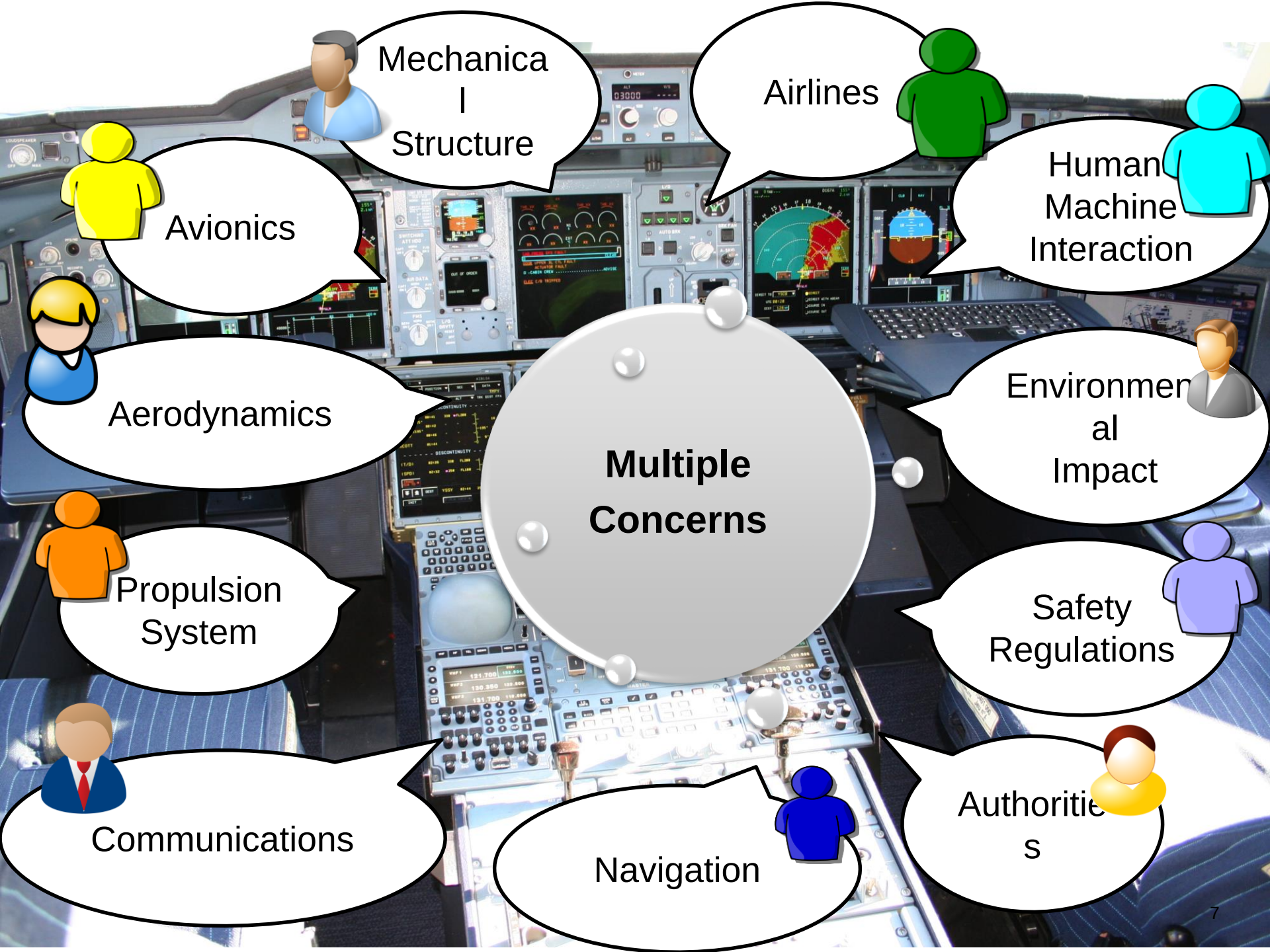
Software Language Engineering (SLE)

- Application of systematic, disciplined, and measurable approaches to the development, use, deployment, and maintenance of software languages

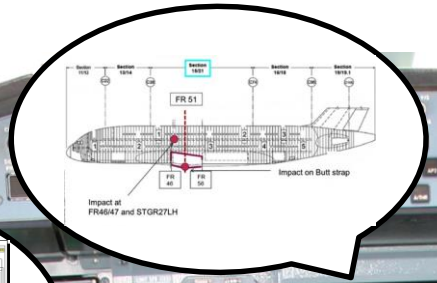
- Supported by various kind of "**language workbench**"
  - Eclipse EMF, xText, Sirius, GEMOC, Papyrus
  - Jetbrain's MPS
  - MS DSL Tools
  - Etc.

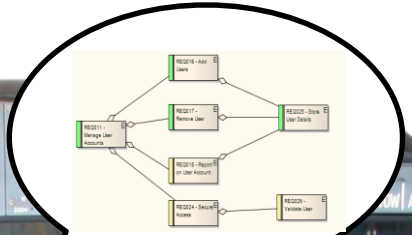
- Various shapes and ways to implement software languages
  - External, internal or embedded DSLs, Profile, etc.

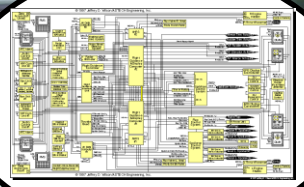
- More and more literature, a dedicated Intl. conference (SLE, cf. http://www.sleconf.org)…

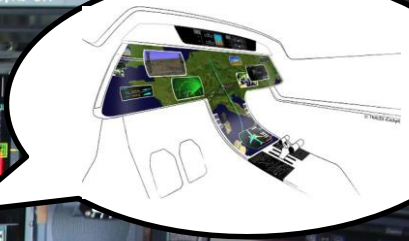

Mechanical Structure
Airlines
Avionics
Human Machine Interaction
Aerodynamics
Multiple Concerns
Environmental Impact
Propulsion System
Safety Regulations
Communications
Navigation
Authorities

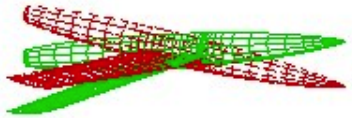
Heterogeneous Modeling

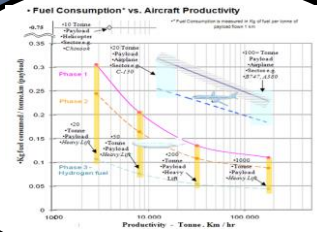


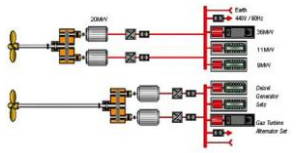


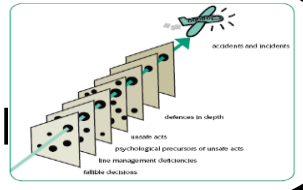


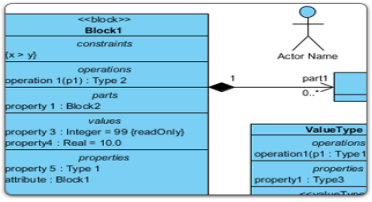


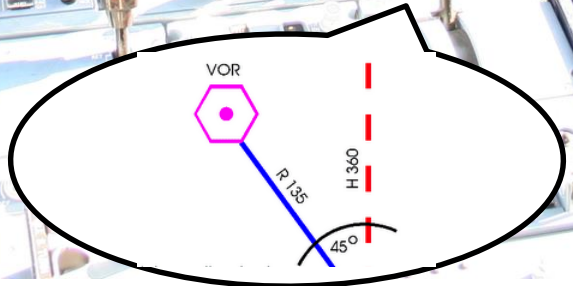




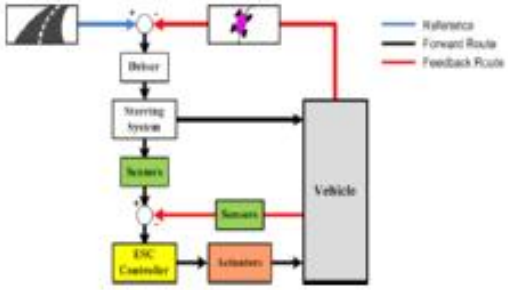




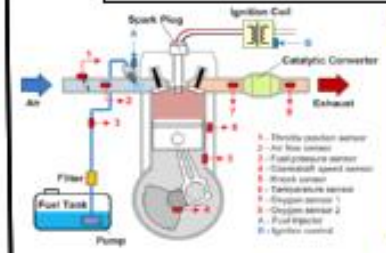




ADAPTIVE CRUISE CONTROL SYSTEM

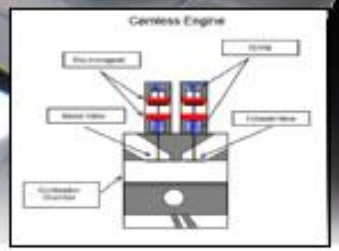


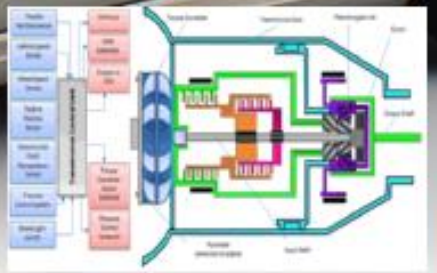
ENGINE CONTROL



COMMUNICATION SYSTEMS

ENTERTAINMENT SYSTEM





ELECTRONIC VALVE TIMING CONTROL

TRANSMISSION CONTROL

Application Domains

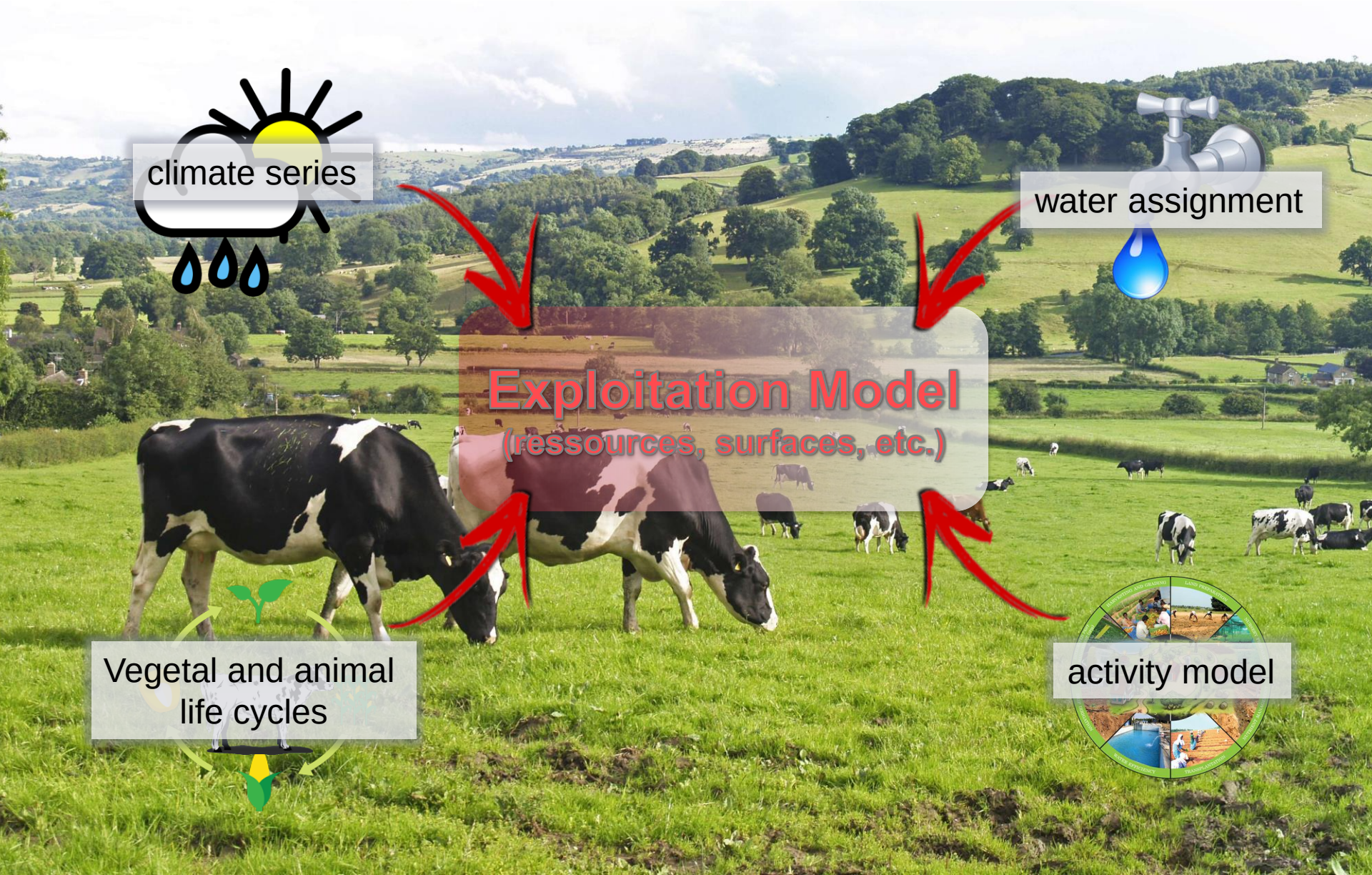
- Initially motivated by industry in complex embedded, critical and/or real-time systems
- Now widely used in most domains of software and systems engineering (home automation, internet of things, adaptive systems…)
- And… what about beyond?

G. Mussbacher, D. Amyot, R. Breu, J.-M. Bruel, B. Cheng, P. Collet, B. Combemale, R. France, R. Heldal, J. Hill, J. Kienzle, M. Schöttle, F. Steimann, D. Stikkolorum, J. Whittle, *"The Relevance of Model-Driven Engineering Thirty Years from Now,"* MoDELS 2014: 183-200

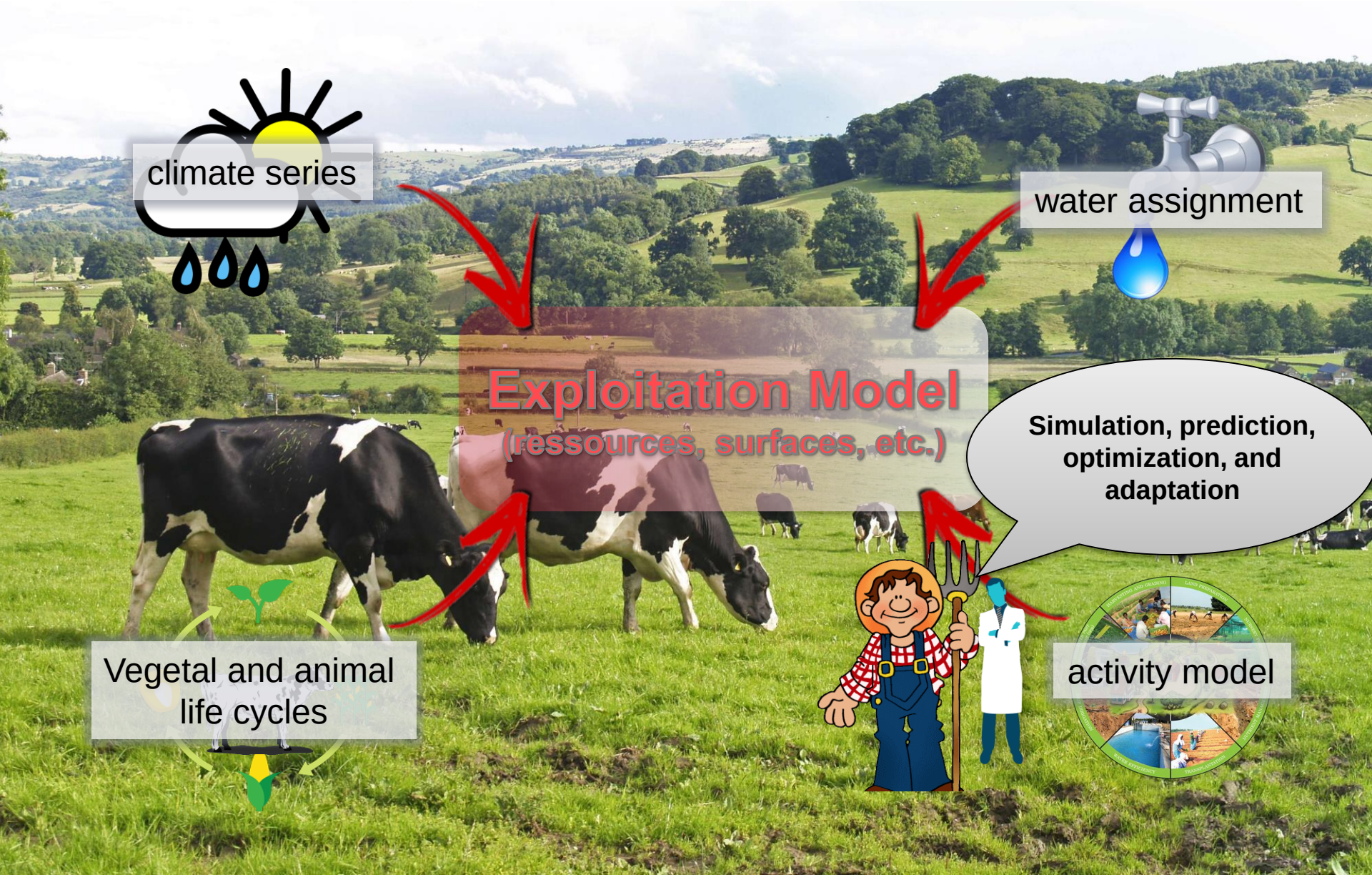
See also the Sustainability workshop at Modularity 2015: http://sustainability15.inria.fr

Farming Modeling

Farming Modeling



Farming Modeling



Context

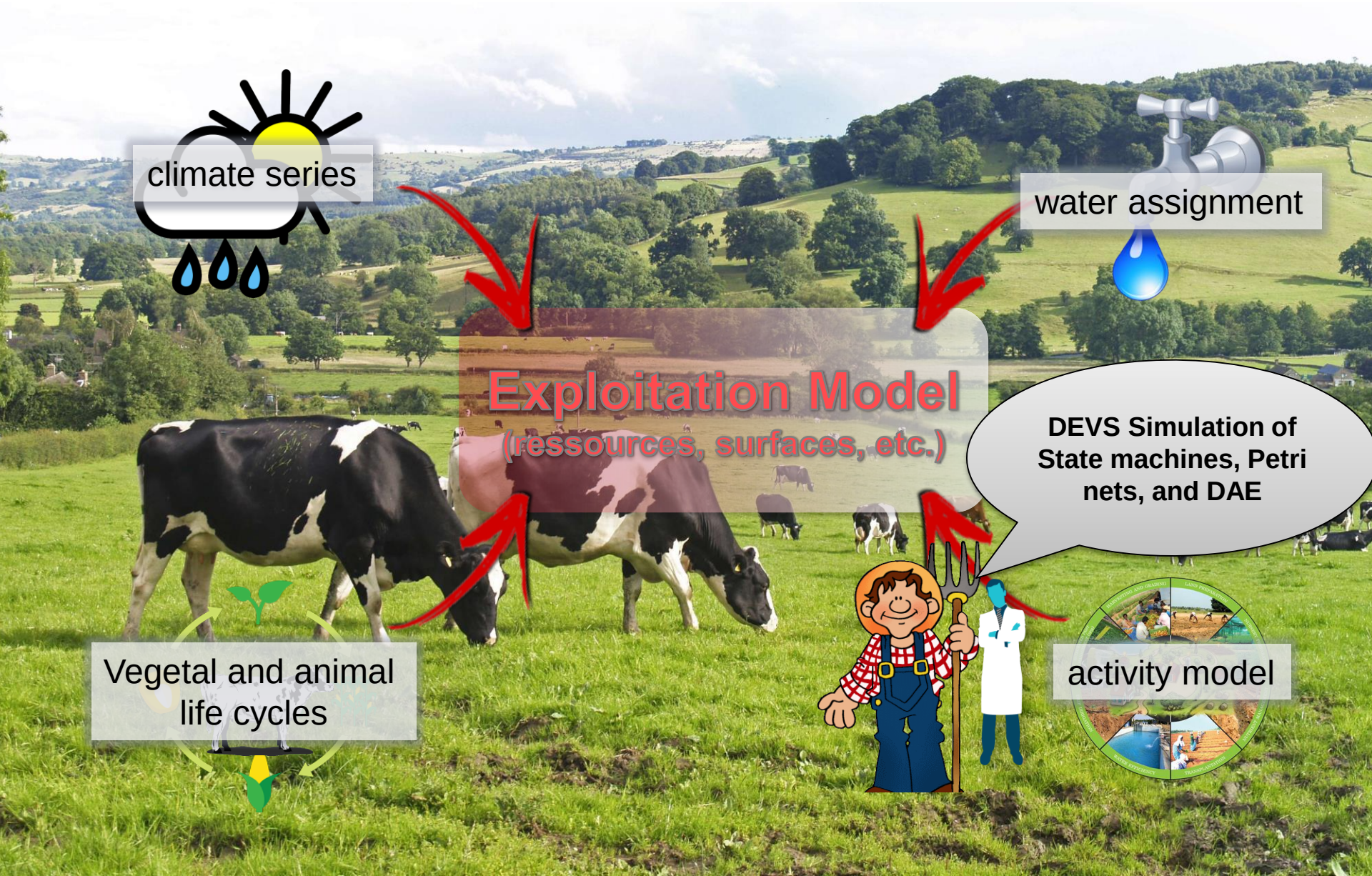
- Focus on exploitation models:
  - Functional description of the possible activities
  - Structural description of the exploitation
- External stimuli:
  - Climatic series
  - Biomass model
  - Water availability
- Still incomplete…:
  - no long-term cycles (annual simulation)
  - no animal life cycles
  - no economic and strategic issues

Context

- Users:
  - Scientists for simulation and recommendation
  - Farmers for prediction, optimization and adaptation

- Objectives:
  - Define the most efficient schedule for all the activities to be done (here, by simulation for optimization. Constraint resolution would be also investigated as an alternative)
  - Simulate and animate the progress along the timeline
  - (long term) Dynamic adaptation

Current practices



Domain-Specific Languages (DSLs)

Project: Objectives

Help scientists and farmers to model and analyze farms using DSLs

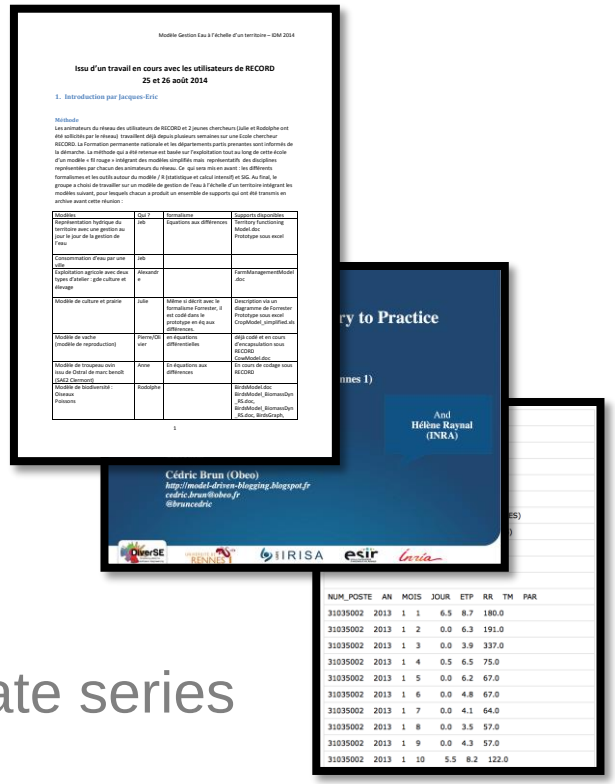
- Design and implement a set of required DSLs (incl. textual and graphical editors, and static checkers)
  - One DSL for describing the farming activities
  - One DSL for describing the exploitations
- Develop a model simulator (incl. graphical animation and model of the simulation results)
  - Metamodel of the semantic domain that capture the dynamic information (by combination of an extension of the syntactic domains, and as a separate domain)
  - Simulation inputs (climate series, various parameters…)
  - Operational semantics of the DSLs
- Develop a generator that provide a website to comprehensive description of the exploitation

Project: Materials

① 4-page document detailing the farming exploitation use case: `FarmingModeling-Description.pdf`

② The slides!

③ The climate series



④ A proof of concept

See all materials at: https://github.com/gemoc/farmingmodeling

Project: Expected Outcomes

- Tool supported DSLs for farming modeling, incl.:
  - Editors and static checkers (e.g., conformance, consistency)
  - Execution, Simulation, Animation
- Well-designed and well-structured demonstration (incl., annotated screencasts)
- Distribution as an open-source project (documentation, homepage, etc.)

Project: Organization

- 3 groups of 5/6 people
- Support:
  - during labs: be proactive!
  - by emails: include a clear subject, a precise description of the problem, and the necessary materials for reproduction (incl. your projects exported from Eclipse).
- Expected mood: open-minded, innovative, highly creative and strongly autonomous!
  - You demonstrate your ability to manipulate the tools and methods
  - You report your skills into the outcomes
  - Note: You invent the world!
  - Note: You compete with the other groups!

Project: Organization

- Phase #1: domain models
- Phase #2: editors
- Phase #3: simulator and animator
- Phase #4: generator

- Evaluation: January 23, 2015 (4pm-6pm)
  - 30 minutes per group, incl.
    - 10 minutes demonstrations of the results
    - 10 minutes description of the developments
    - 10 minutes Q/A

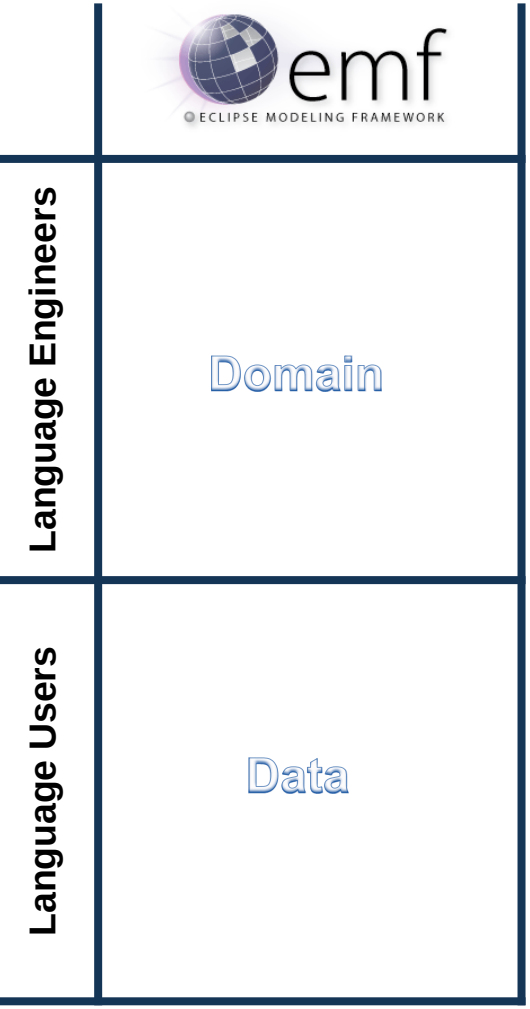
Project: Organization

- Evaluation on January 23, 2015 (4pm-6pm)
- 30 minutes per group, incl.
  - 10 minutes demonstrations of the results
  - 10 minutes description of the developments
  - 10 minutes Q/A
- Be prepared!

Project: Technologies

	emf ECLIPSE MODELING FRAMEWORK	Sirius	Xtext	Gemoc
Language Engineers	Domain	Viewpoint (graphical editor)	Grammar (textual editor)	Behavioral semantics (animator)
Language Users	Data	Views and static checking	Textual editing and static checking	execution, simulation and animation

Project: Technologies



Metamodels, including an Ecore description and the associated OCL constraints

- DSL #1: Exploitation
- DSL #2: Activities

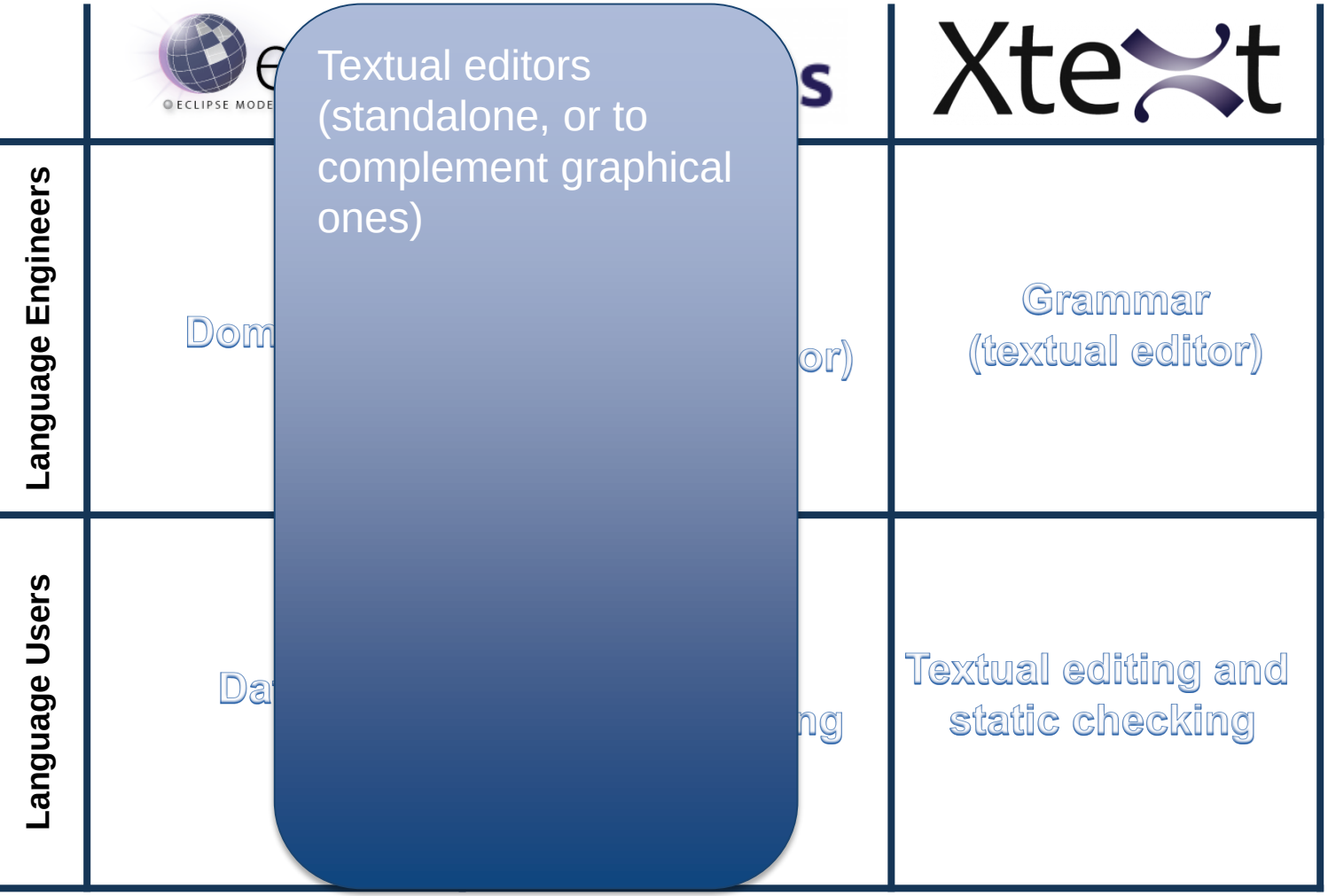
- Later on:
  - Simulation
  - Inputs

Project: Technologies

	emf ECLIPSE MODELING FRAMEWORK	Sirius
Language Engineers	Domain	Viewpoint (graphical editor)
Language Users	Data	Views and static checking

Graphical editors (at least for describing farming exploitations) and animators

Project: Technologies



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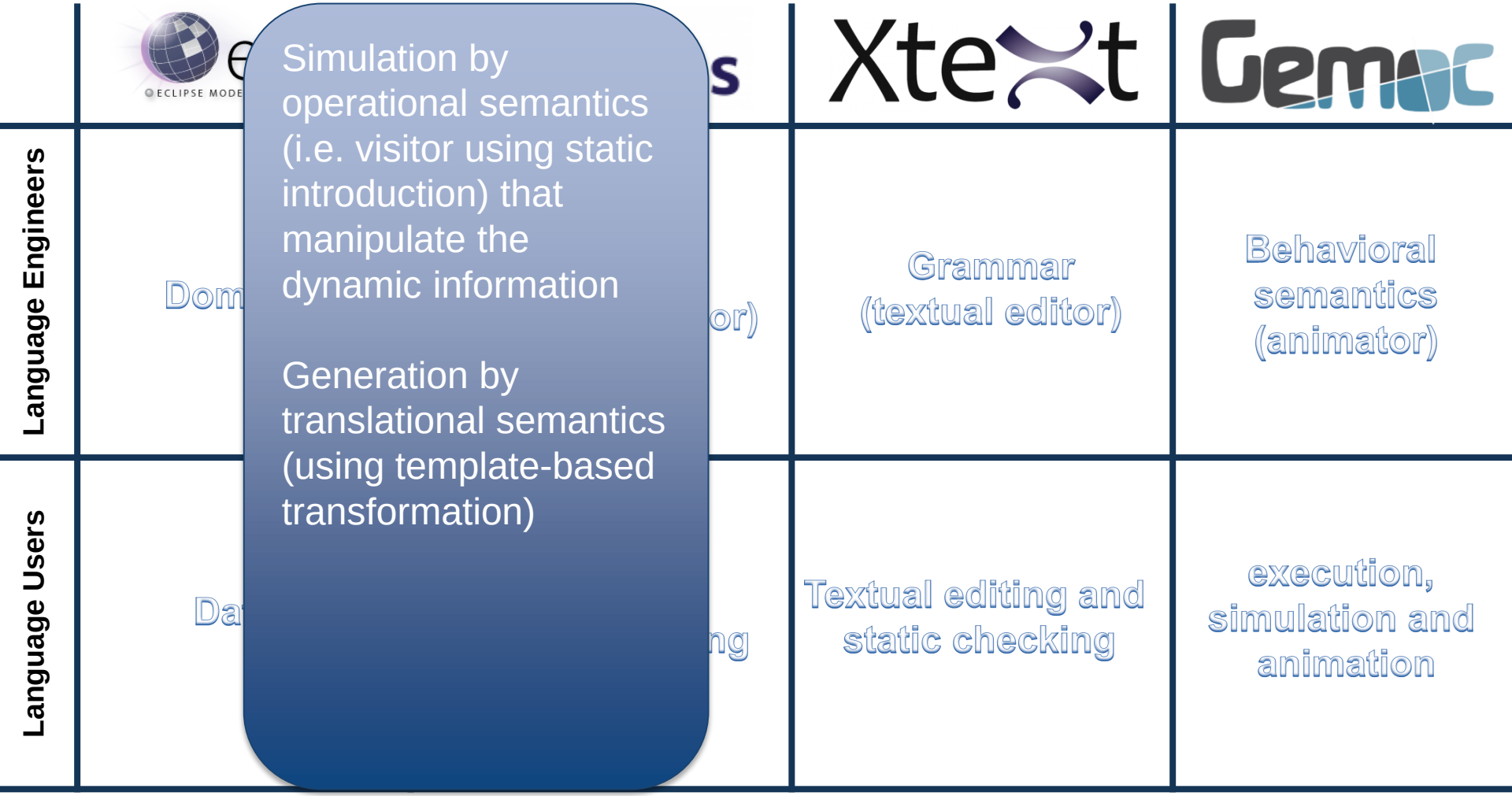


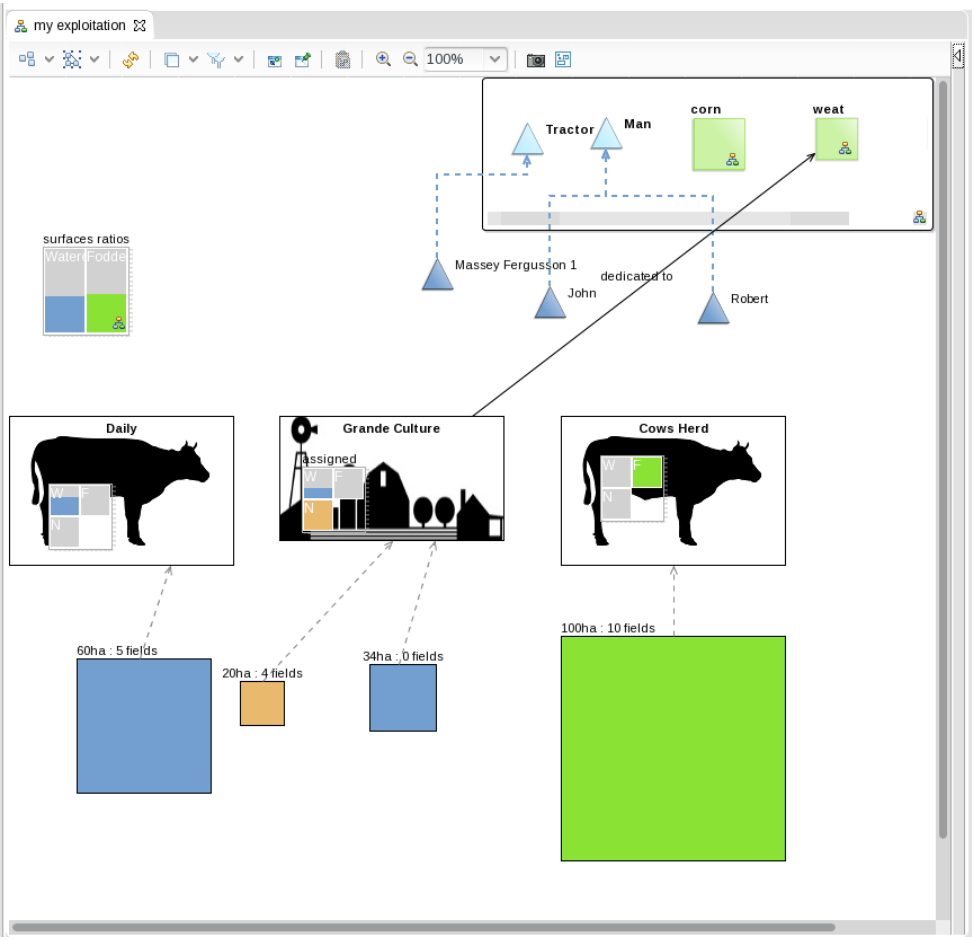
Project: Technologies

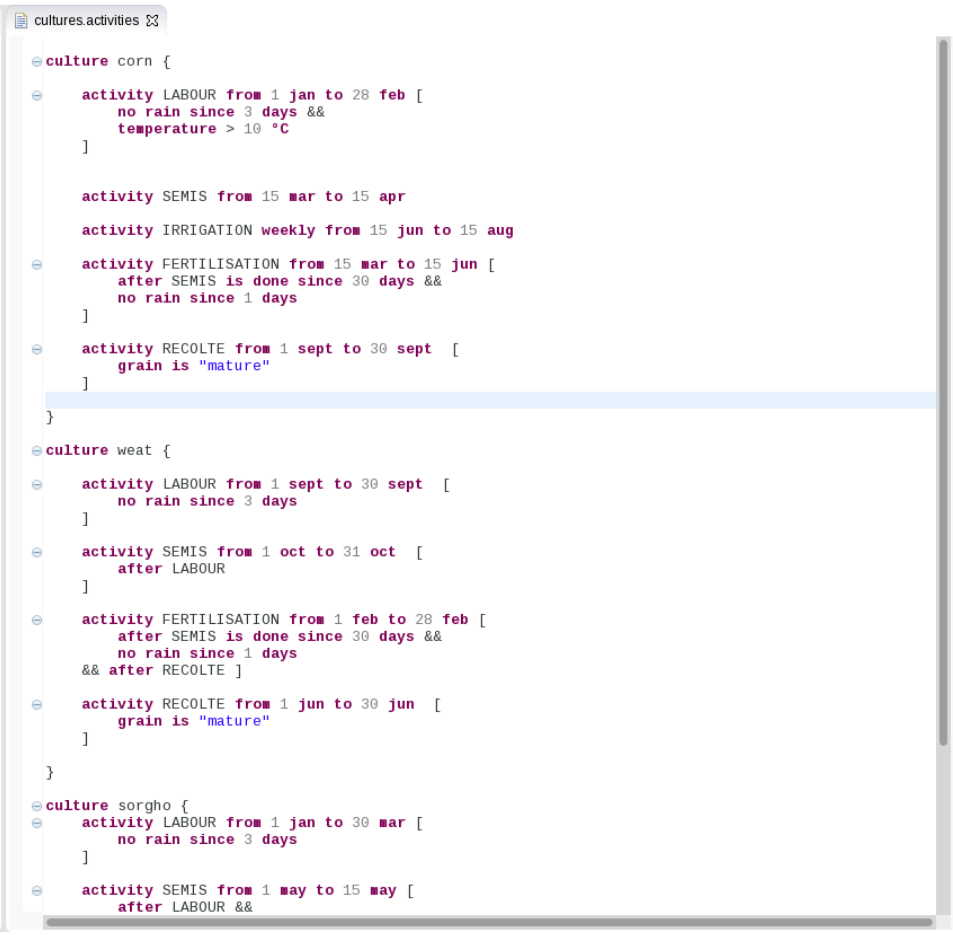
- Eclipse package (incl. EMF, Xtext, Sirius Xtend and GEMOC):
  - https://ci.inria.fr/gemoc/job/org.gemoc.gemoc_studio.root
  - available for all platforms

- Organize your project:
  - Use github (use the VCS, Wiki…)
  - Create a mailing list
  - Etc.

- Use English as maximum as possible

Project: Proof of concept





A first, yet incomplete, prototype (POC!)
https://github.com/gemoc/farmingmodeling


DEMO

Project: Proof of concept

- Source:
  - Language workbench (Farming DSLs, incl. editors only):

https://github.com/gemoc/farmingmodeling/tree/master/dev/**plugins**

  - Modeling workbench (Examples):

https://github.com/gemoc/farmingmodeling/tree/master/dev/**workspace_projects/MyExploitation**

- README:

https://github.com/gemoc/farmingmodeling/blob/master/dev/**README.textile**