# Multidisciplinary Modelling in the Netherlands

**Frank Stappers** Lou Somers Michel Reniers

Dept. Mathematics and Computer Science,
Technische Universiteit Eindhoven
P.O. Box 513, 5600 MB Eindhoven, The Netherlands
{ F.P.M.Stappers L.J.A.M.Somers M.A.Reniers }@tue.nl

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## Outline

## Motivation

- Various disciplines are involved in the development of complex systems.
- Reduce time to market, increase product quality, add features . . .
- Techniques used today have mono-displinary focus.
- Integration phase has become problematic.

## Motivation

- TWINS: Optimizing HW-SW Co Design Flow for Software Intensive System Development
- Focus
  - Verification and validation of requirements and architecture models
  - Test-case generation
  - Hard-/software change and configuration management
  - Interdisciplinary ways to improve complex distributed and real-time embedded systems
- Solution: *Interdisciplinary modelling*.
- Opportunity to investigate current development trajectories.

## Approach

6 Industrial partners & 1 Technological partner

- Project requirement analysis
- Use case analysis
- Plenary meetings

Derived 5 topics for investigation:

*Testing, formal verification, simulation, model driven development, multi-disciplinary development language*

Current practice obtained via questionnaire:

- Design phase
- Integration phase
- System verification phase $\left\{ \begin{array}{c} \text{Observation} \\ \text{Simulation} \\ \text{Formal verification} \end{array} \right.$

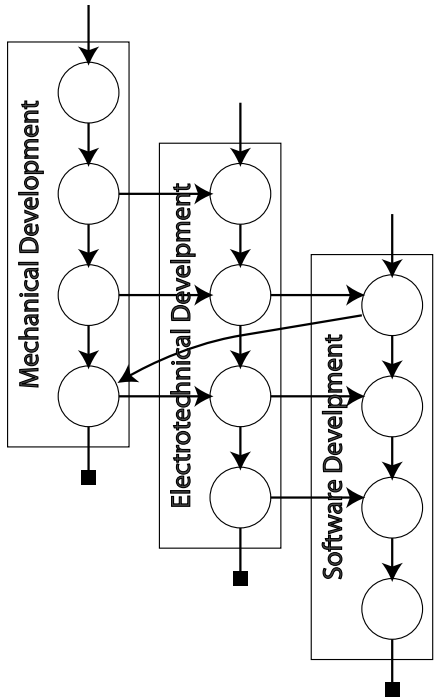
## Design Phase

- Product Development Design (V-model)
  - Extensions are used
  - Easy to understand
  - Difficult to track-and-trace development
  - Difficult to remove inconsistency between the product development design and the actual execution is encountered.
- System Design
  - System requirements
  - Mechanical Behaviour Designs (Matlab/Simulink)
  - Software designs (UML)
  - Statical physical designs (CAD)
  - Electrotechnical designs (PCB tools)

## Integration Phase

Problems relate to:

- Every system is unique
- Semantics and definition need to be accurate and complete
- Cross-cutting hierarchical levels
- Unforeseen practical coincidences in system realisation



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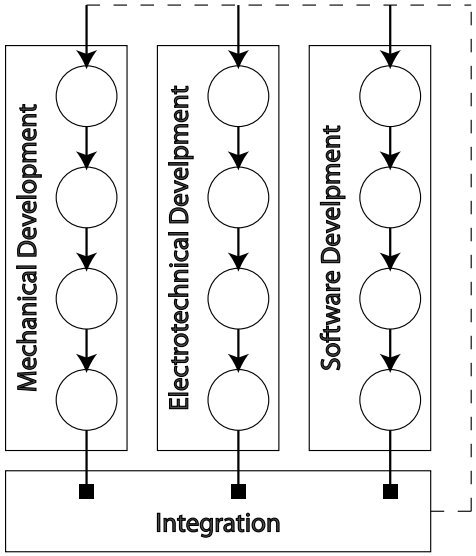

## System verification Phase

- System design level:
  - Informal manual techniques for consistency checks / simulation
  - Formal verification hardly used
- Realisation level:
  - Informal (use-cases derived) test scenarios
  - Special equipment needed for logging data
  - Conformance testing not is not widely used

## Future development

- Development of a multidisciplinary formalism; in which mono-disciplinary models can be systematically exchanged between disciplines.
- Automated formal verification techniques on the modelling and implementation level.
- Control synthesis for hybrid systems with the help of supervisory control.
- Visualisation techniques to gain better insight in complex system behaviour.

## Conclusion

- Discipline specific tools are often vendor locked
- Models serve particular purpose and require expert knowledge
- A multidisciplinary model could reduce the system development time
- Cohesion in the methods used by the various disciplines
- Technical solutions are a start for a interdisciplinary modelling

## The End

Questions?