Consistent Concurrent Design of Cyber-Physical Systems

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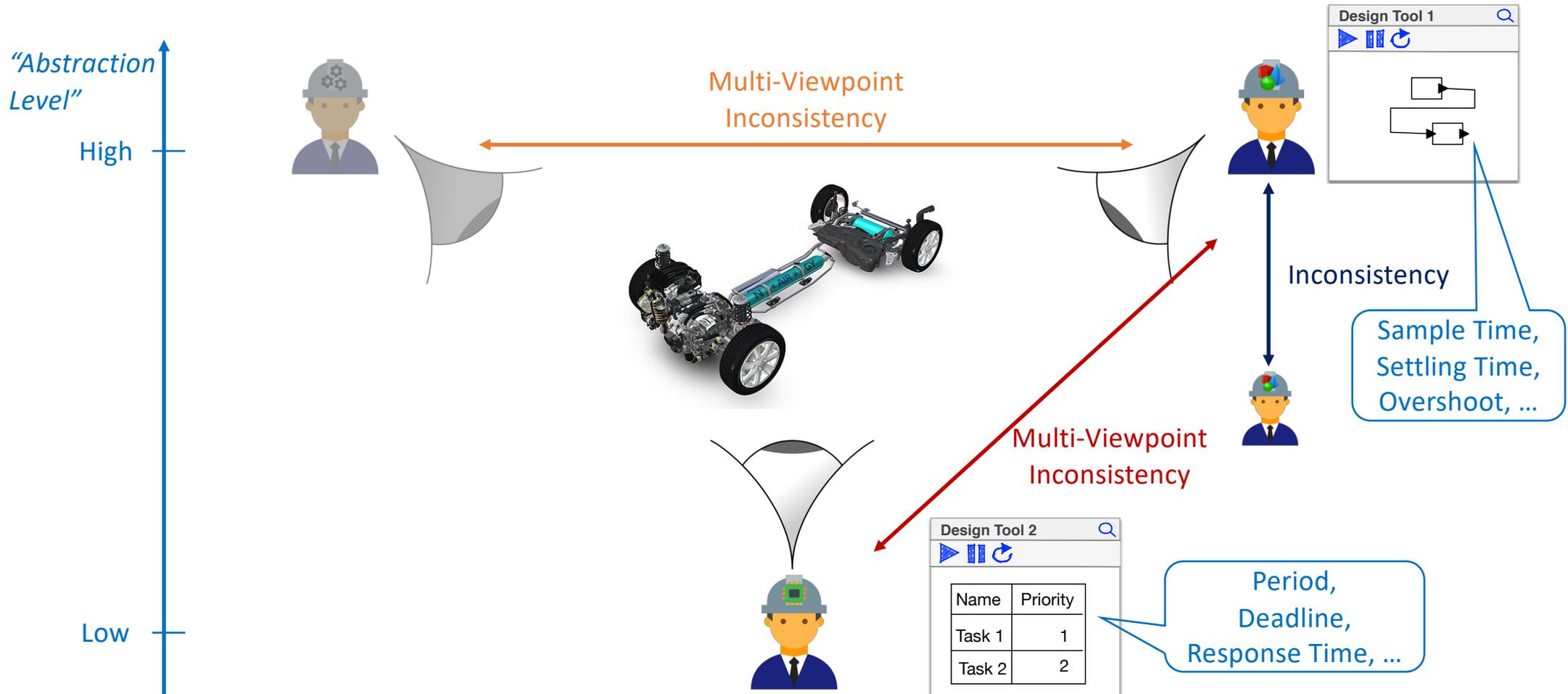
Ansymo
Antwerp Systems & Software Modelling
University of Antwerp

McGill
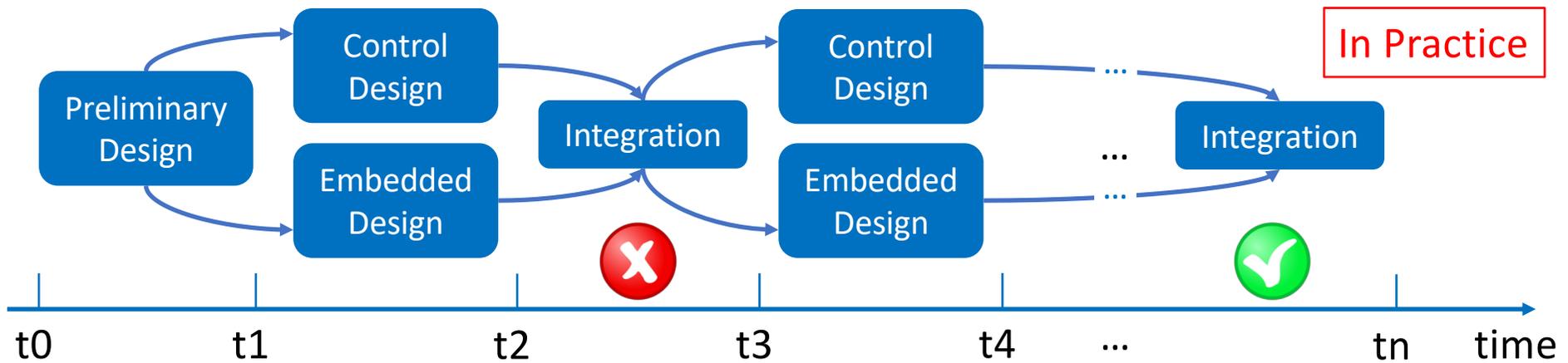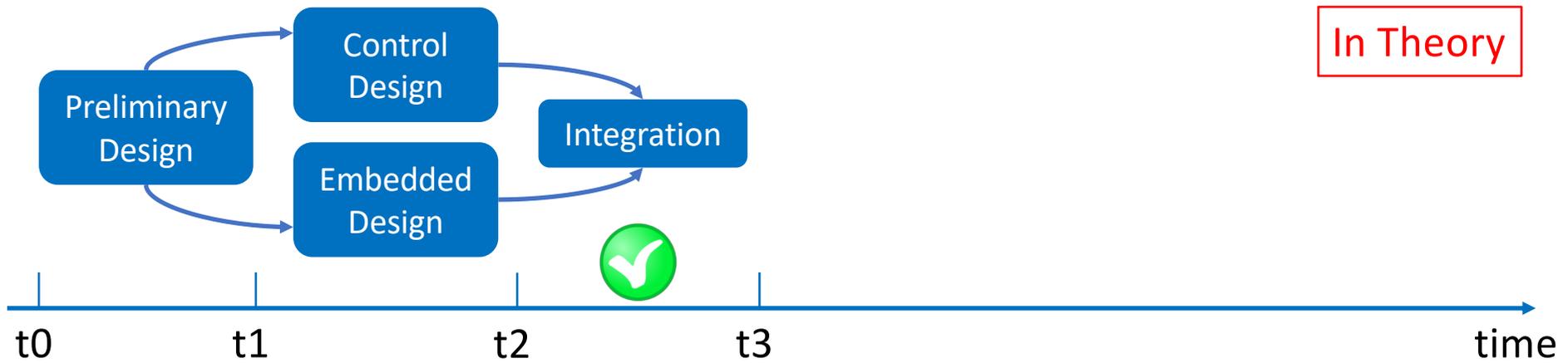School of Computer Science

FLANDERS
MAKE
MANUFACTURING INNOVATION NETWORK

Why (is it a problem)?

"Abstraction Level"

High

Low

Multi-Viewpoint Inconsistency

Multi-Viewpoint Inconsistency

Inconsistency

Design Tool 1

Sample Time, Settling Time, Overshoot, …

Design Tool 2

Name	Priority
Task 1	1
Task 2	2

Period, Deadline, Response Time, …
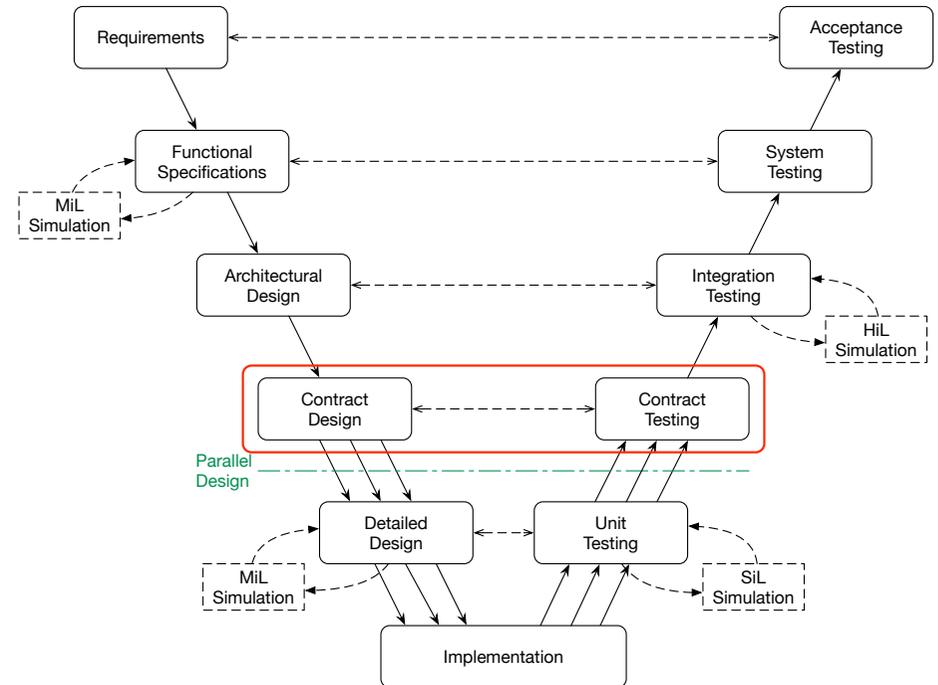
Why (is it a problem)?

In Theory

In Practice

What (is the solution)?
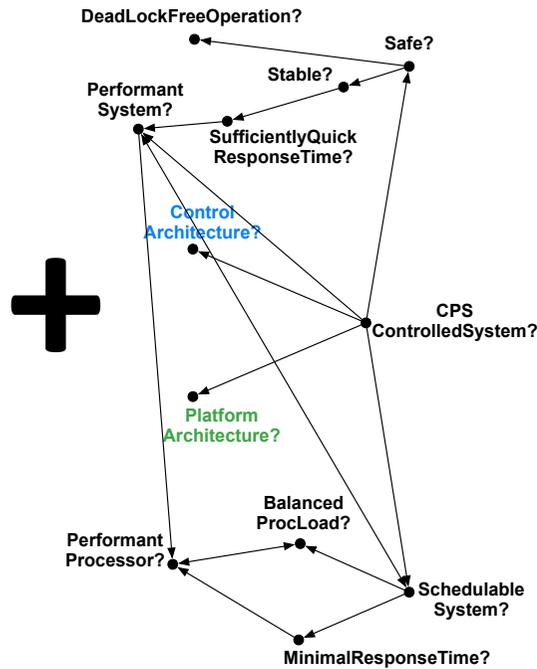
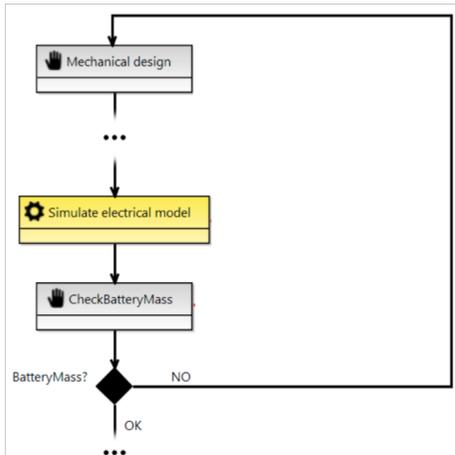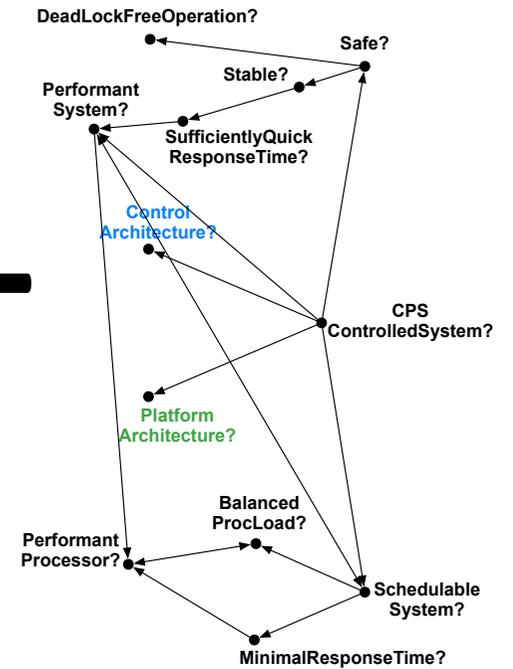## Inconsistency detection and resolution

Inconsistency avoidance

How (do we implement the solution)?

Inconsistency detection and resolution

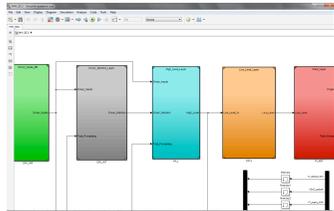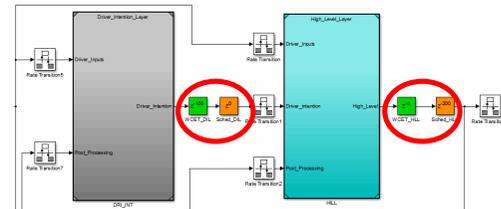**+**

Inconsistency avoidance

Assumptions

Guarantees

+

How (do we implement the solution)?

Inconsistency avoidance: Contract-Based Co-Design

Augmented Control View

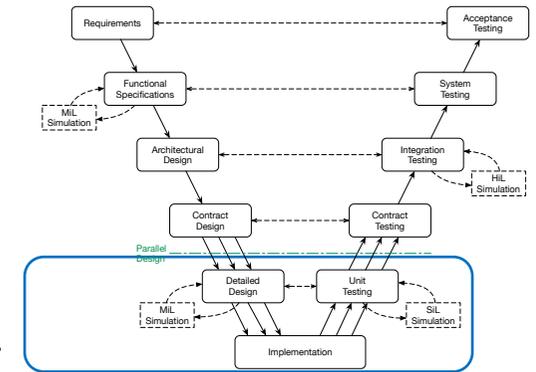## High-Level Control

- ❖ numbInstr: 8000..8500
- ❖ samplingFrequencyHPP: 333Hz..500Hz
- ❖ processorSpeedHPP: ..5MHz
- ❖ wcet: 1.0ms..1.3ms
- ❖ wrt: 1.6ms..1.8ms
- ❖ stADelay: 1.6ms..1.8ms
- ❖ processorLoadHPP: ..40%
- ❖ Priority: ..2

CBCD Tool
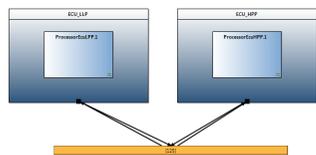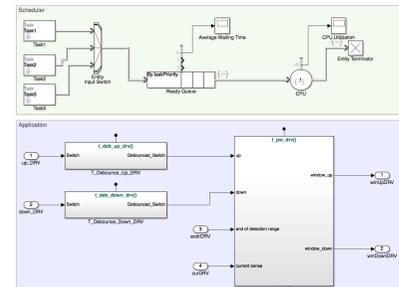
Augmented Embedded View

Roadmap
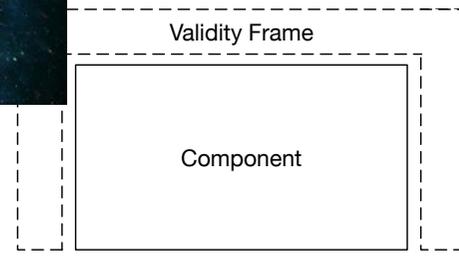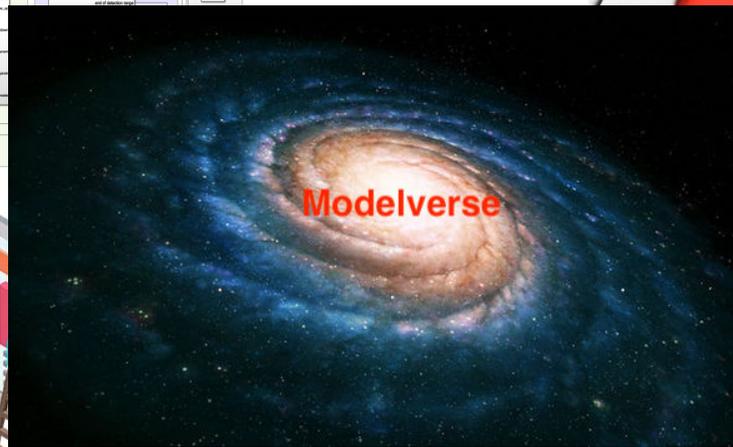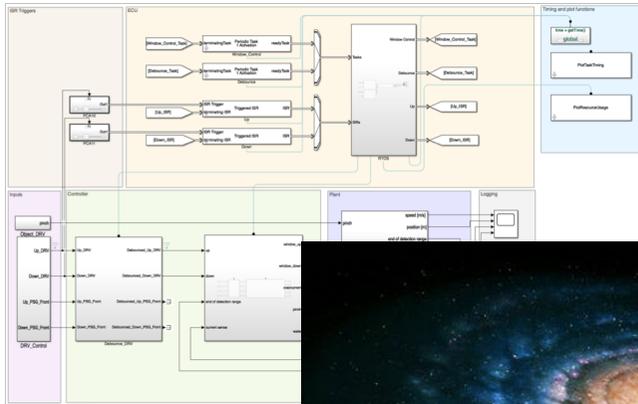
CSE_CoDesign_ICON   POC/IM   *time*

Modelverse

Contract

Management

TRACEABILITY

Validity Frame

Component

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Related Work

Albert Benveniste, Benoît Caillaud, Dejan Nickovic, Roberto Passerone, Jean-Baptiste Raclet, Philipp Reinkemeier, Alberto L. Sangiovanni-Vincentelli, Werner Damm, Tom Henzinger, and Kim G. Larsen. Contracts for Systems Design : Theory. Technical Report RR-8759, INRIA, 2015.

Albert Benveniste, Benoît Caillaud, Dejan Nickovic, Roberto Passerone, Jean-Baptiste Raclet, Philipp Reinkemeier, Alberto L. Sangiovanni-Vincentelli, Werner Damm, Tom Henzinger, and Kim G. Larsen. Contracts for Systems Design: Methodology and Application cases. Technical Report RR-8760, INRIA, 2015.

Patricia Derler, Edward A. Lee, Stavros Tripakis, and Martin Törngren. Cyber-Physical System Design Contracts. In Proceedings of the ACM/IEEE 4th International Conference on Cyber-Physical Systems, ICCPS '13, pages 109–118, New York, NY, USA, 2013. ACM.

Pierluigi Nuzzo, Alberto L. Sangiovanni-Vincentelli, Davide Bresolin, Luca Geretti, and Tiziano Villa. A Platform-Based Design Methodology With Contracts and Related Tools for the Design of Cyber-Physical Systems. Proceedings of the IEEE, 103(11):2104–2132, 2015.

Martin Törngren, Ahsan Qamar, Matthias Biehl, Frederic Loiret, and Jad Elkhoury. Integrating viewpoints in the development of mechatronic products. Mechatronics, 24(7):745–762, 2014.

István Dávid, Joachim Denil, Klaas Gadeye, and Hans Vangheluwe. Engineering Process Transformation to Manage (In)consistency. In Proceedings of the 1st International Workshop on Collaborative Modelling in MDE (COMMitMDE), volume 1717 of CEUR Workshop Proceedings, pages 7–16, 2016.

Ken Vanherpen. A Contract-Based Approach for Multi-Viewpoint Consistency in the Concurrent Design of Cyber-Physical Systems. PhD Thesis, University of Antwerp, 2018.