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Eclipse-Based RobMoSys Tooling: Papyrus4Robotics

Huascar Espinoza, CEA

Tutorial at ACM / IEEE 21st Int. Conf. On Model Driven Engineering Languages and Systems (MODELS)

Copenhagen, 16.10.2018

https://robmosys.eu
https://discourse.robmosys.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 732410.

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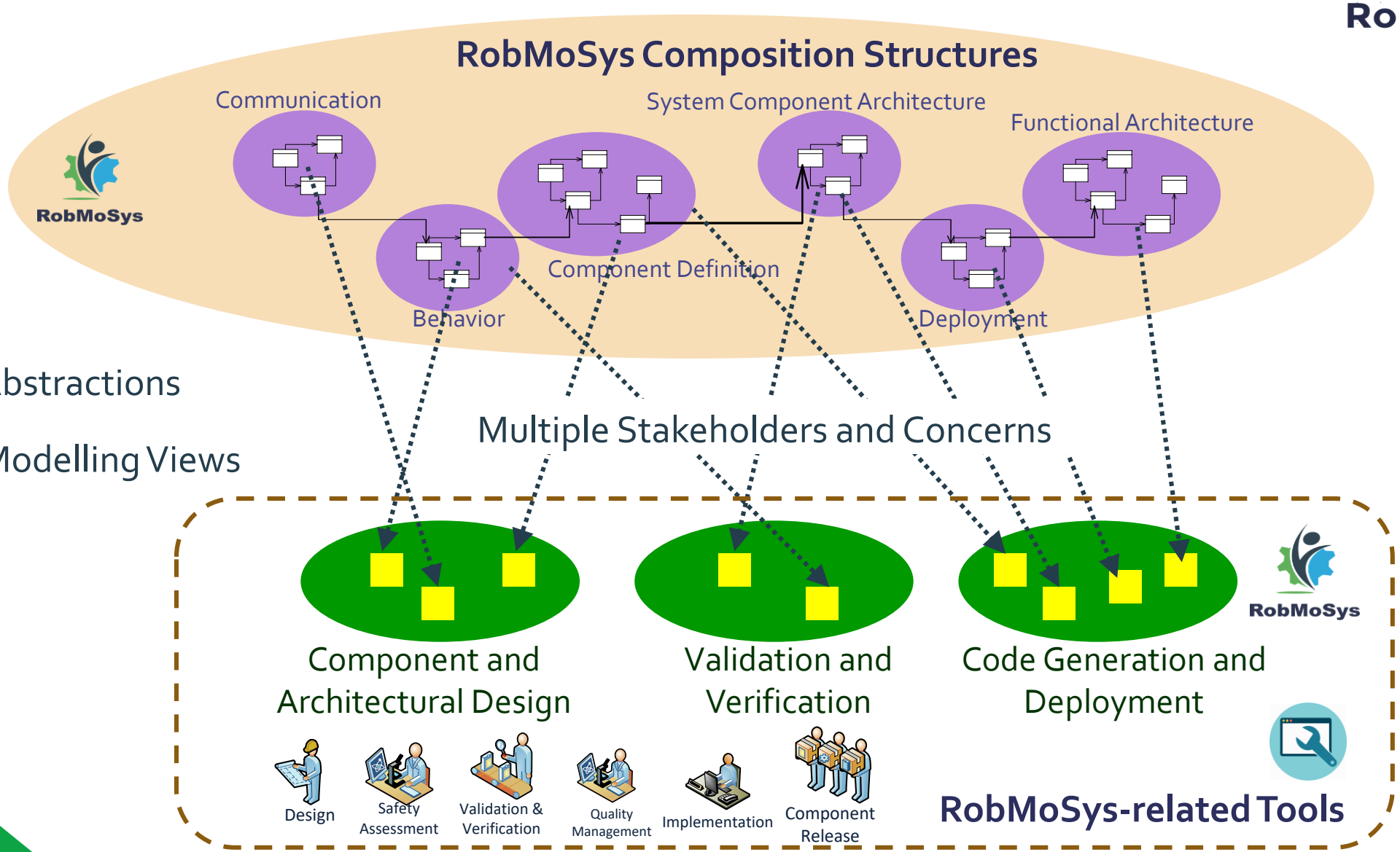
Papyrus4Robotics Toolchain

RobMoSys Model-Driven Approach



Viewpoints in Papyrus (1/2)

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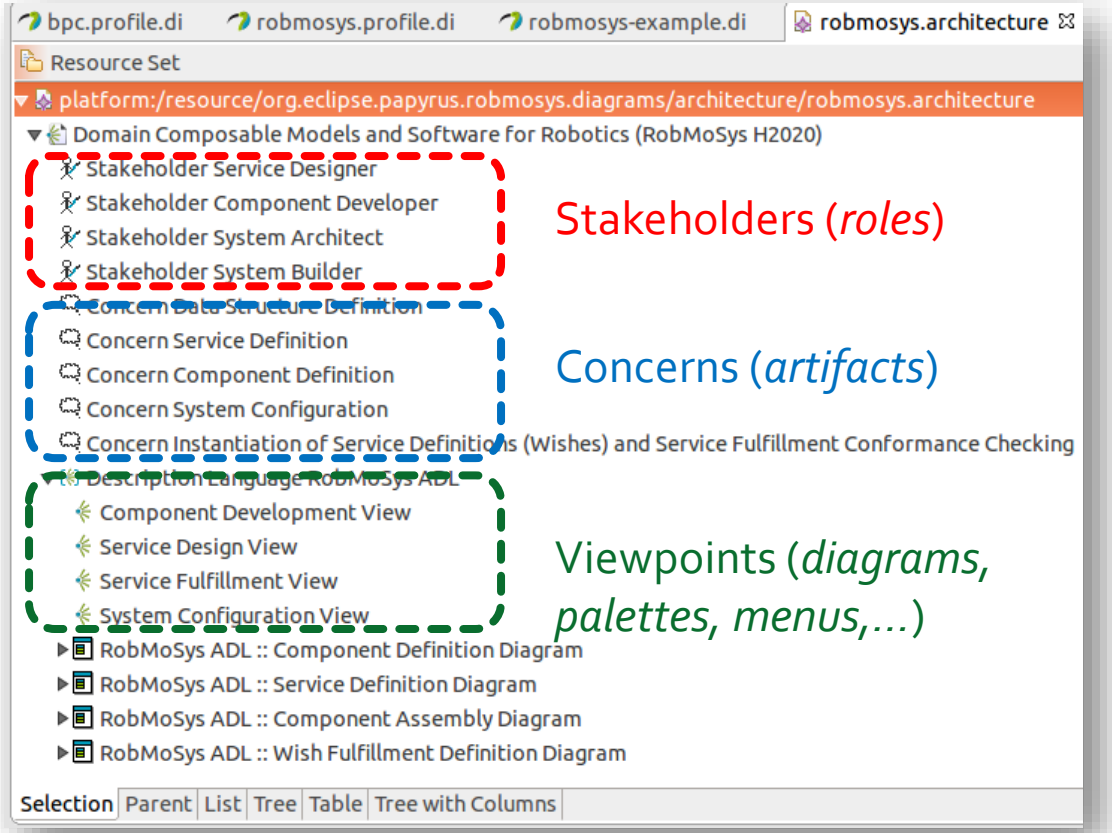
Aligned to ISO 42010

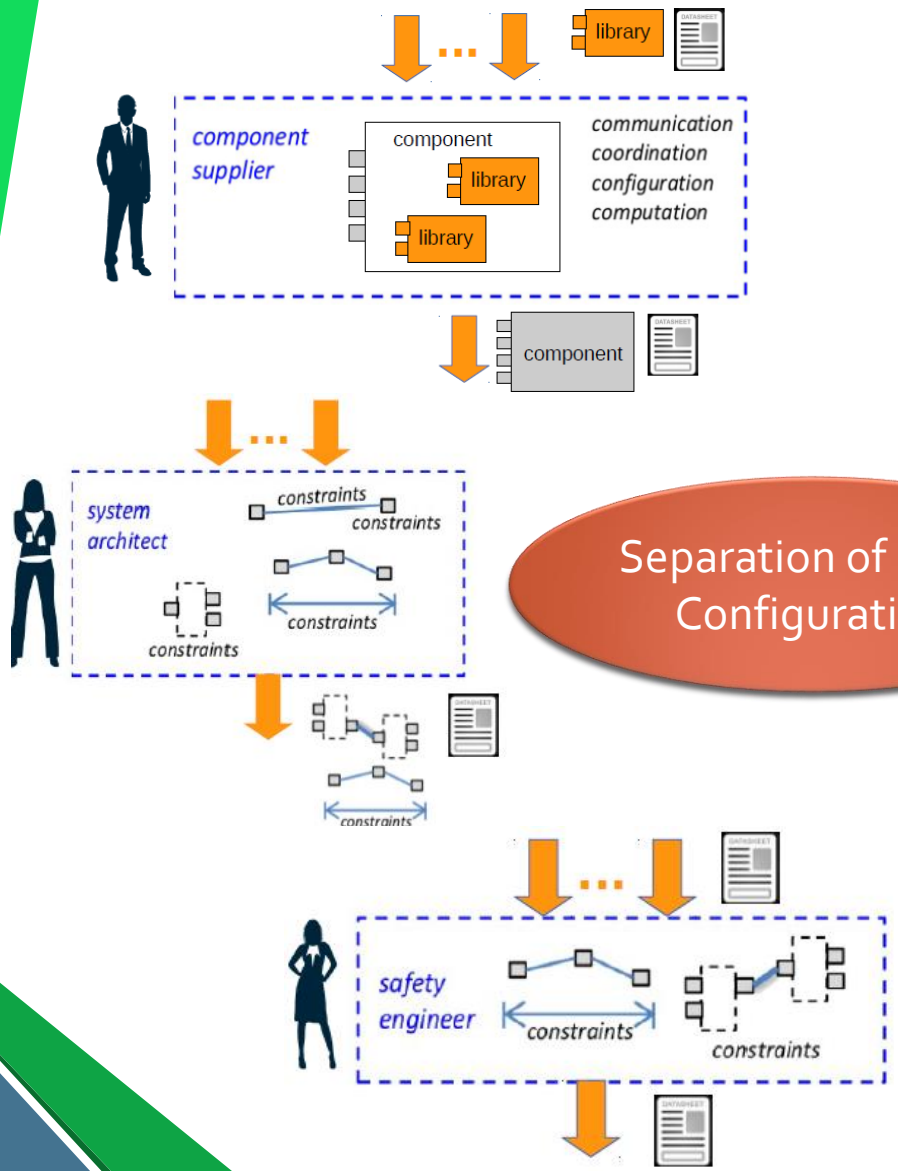
RobMoSys (Papyrus) Architecture Framework



Stakeholders (*roles*)

Concerns (*artifacts*)

Viewpoints (*diagrams, palettes, menus,…*)



Separation of Roles Configuration

Viewpoints in Papyrus (2/2)

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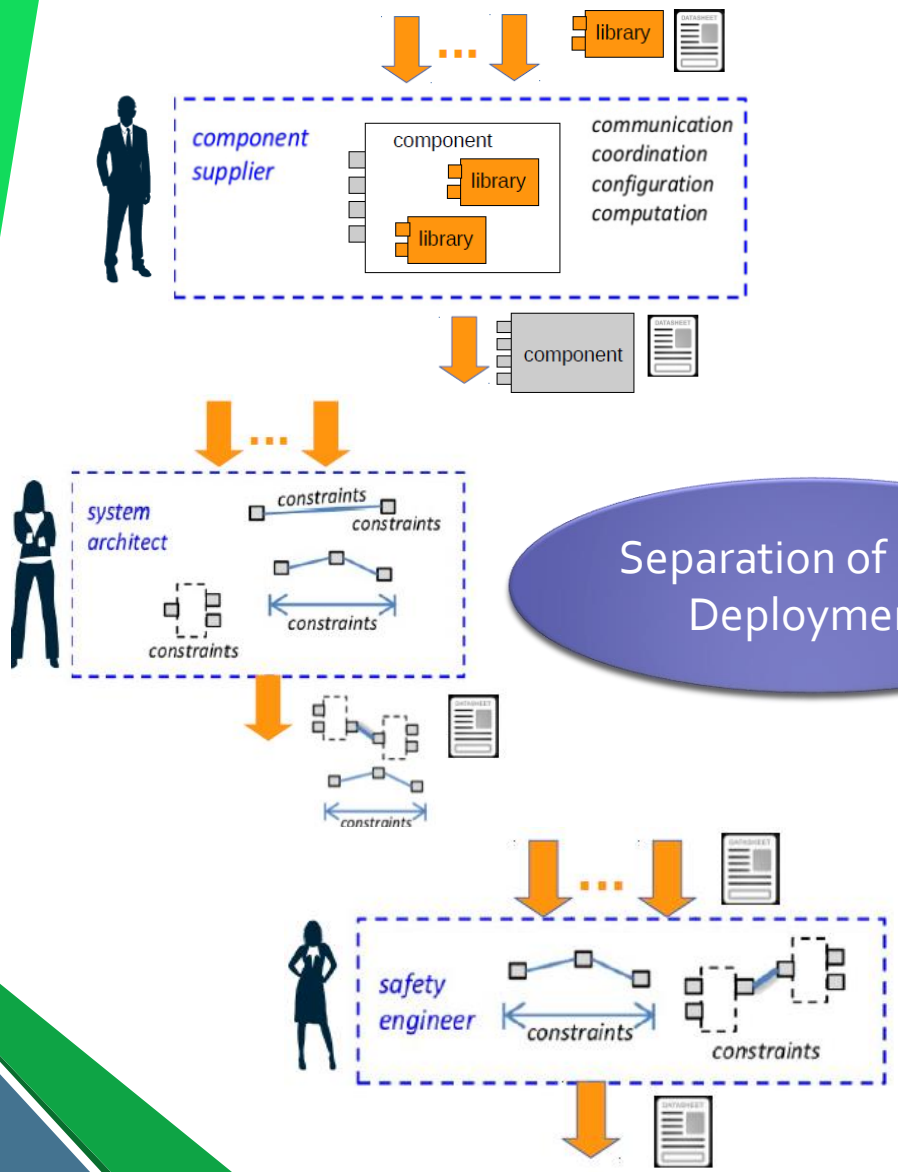
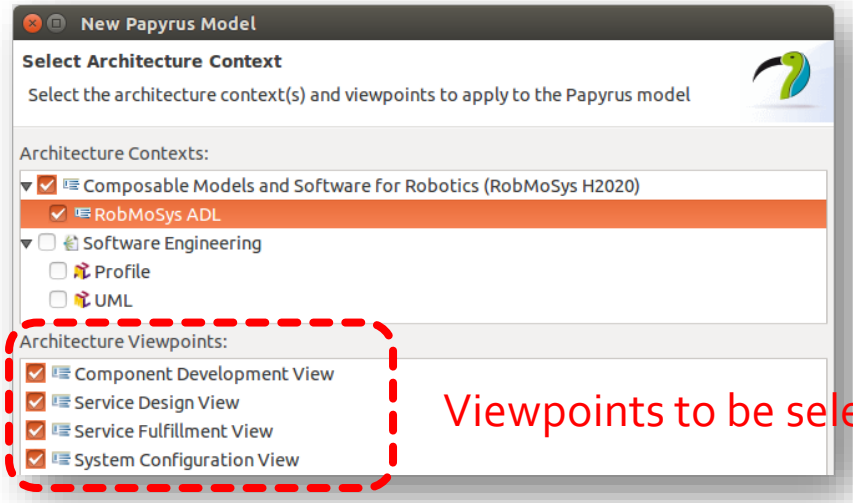
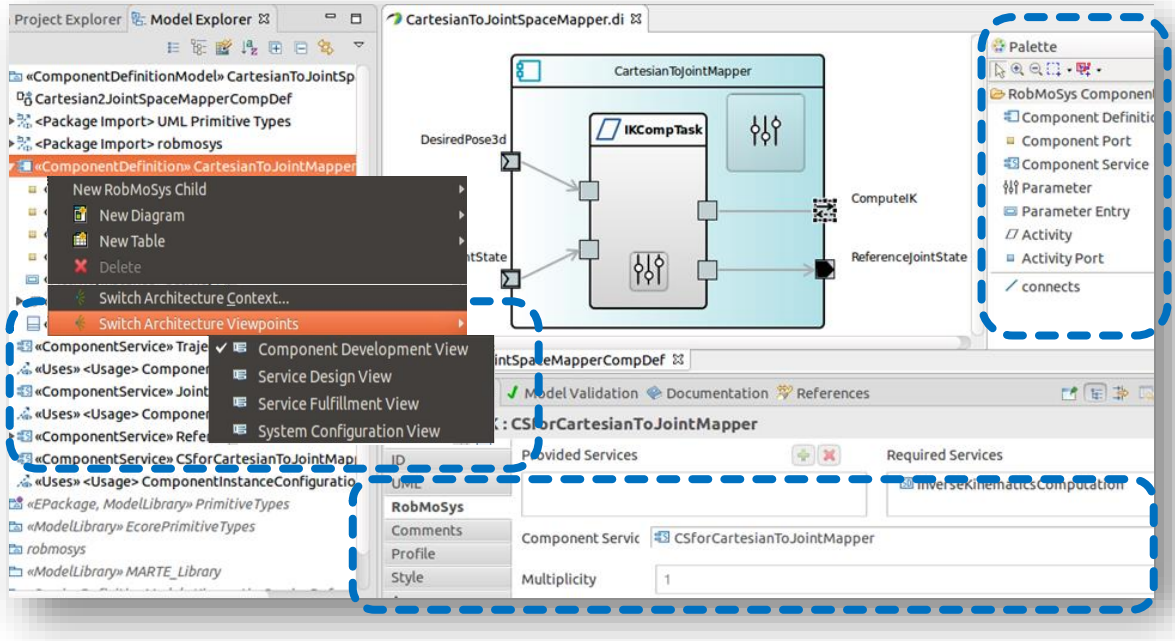


Separation of Roles Deployment



Viewpoints to be selected

Viewpoint-Customized Environment



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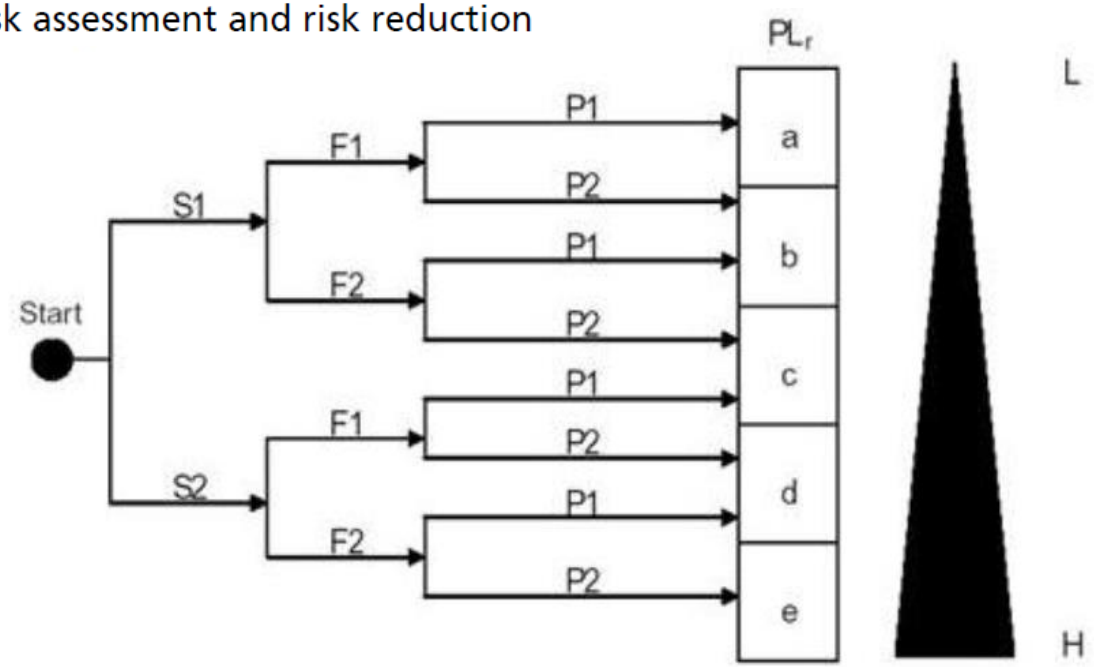
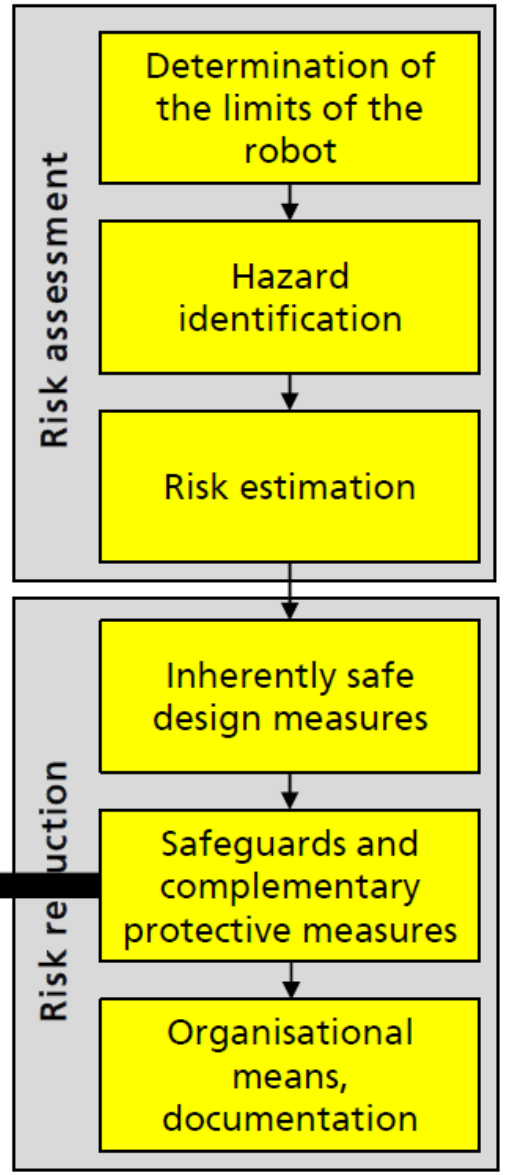
Safety Analysis with RobMoSys

Applicable Safety Standards in Robotics

ISO 12100 – Safety of machinery – General principles for design – Risk assessment and risk reduction





ISO 13849-1 – Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design

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Functional Safety

Electronics, Software

= safety related (part of the) control system

IEC 62061 – Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems

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Why Models for Safety Assessment?

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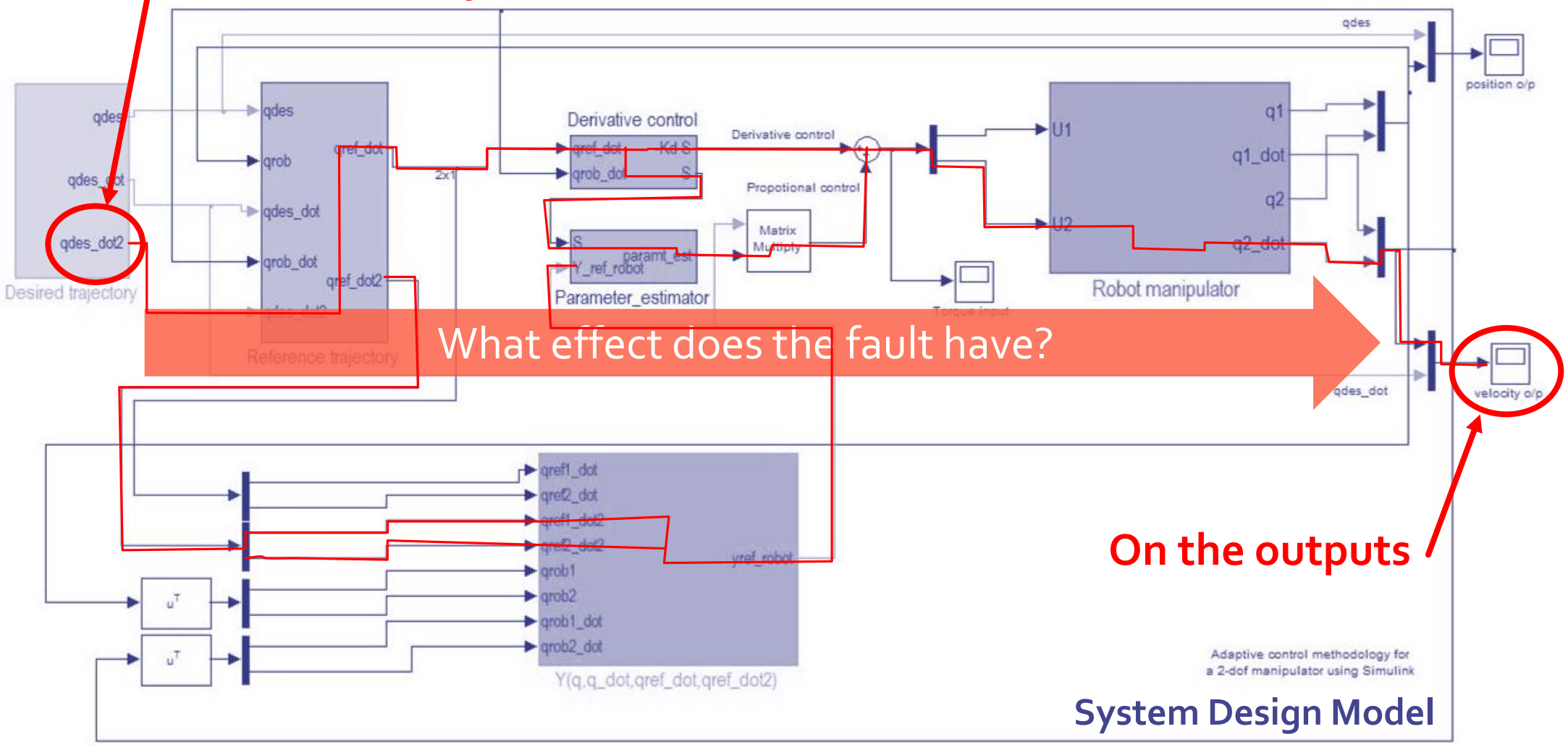

Credits: Yiannis Papadopoulos, University of Hull, U.K

Safety Analysis with RobMoSys

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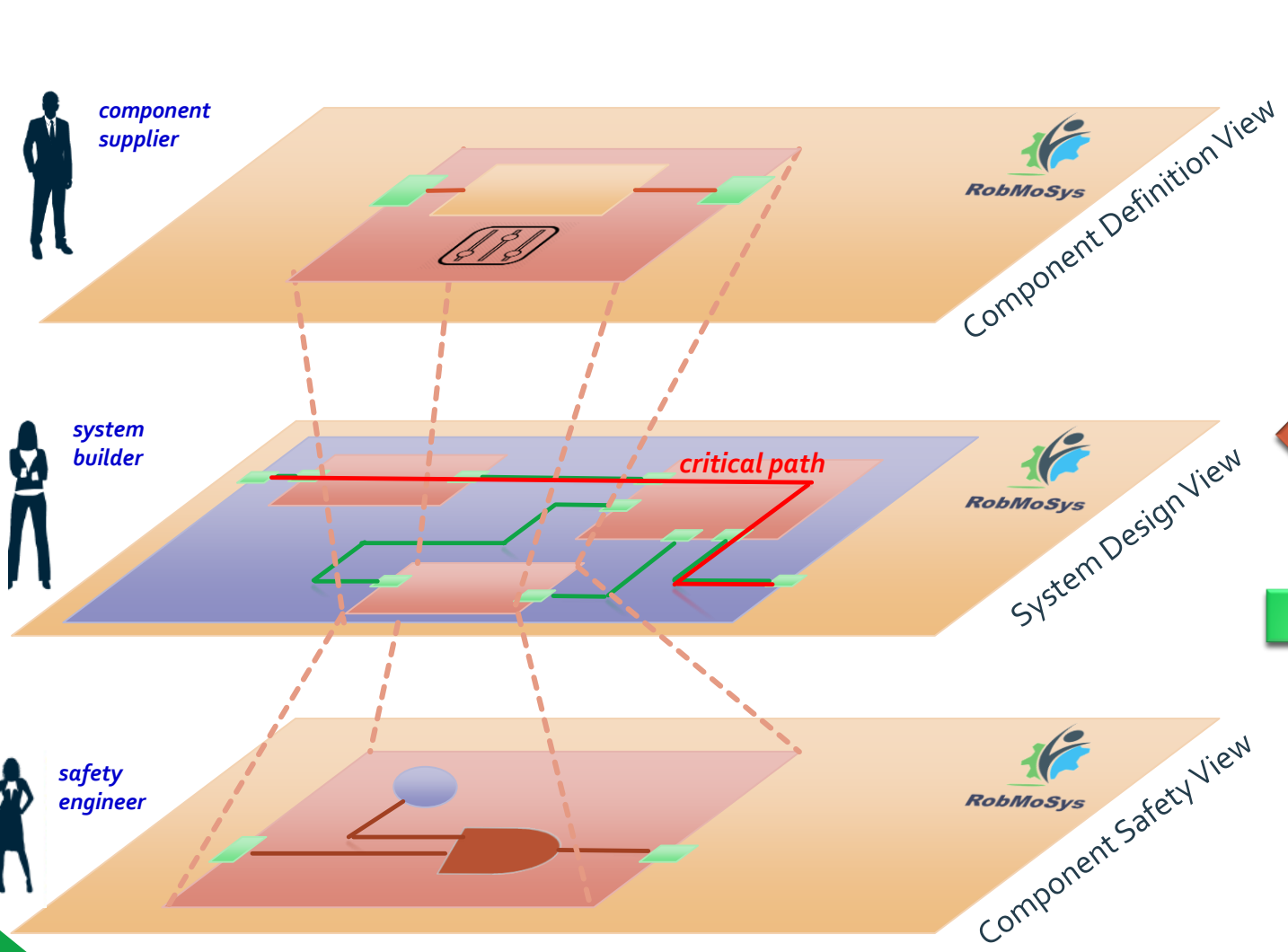

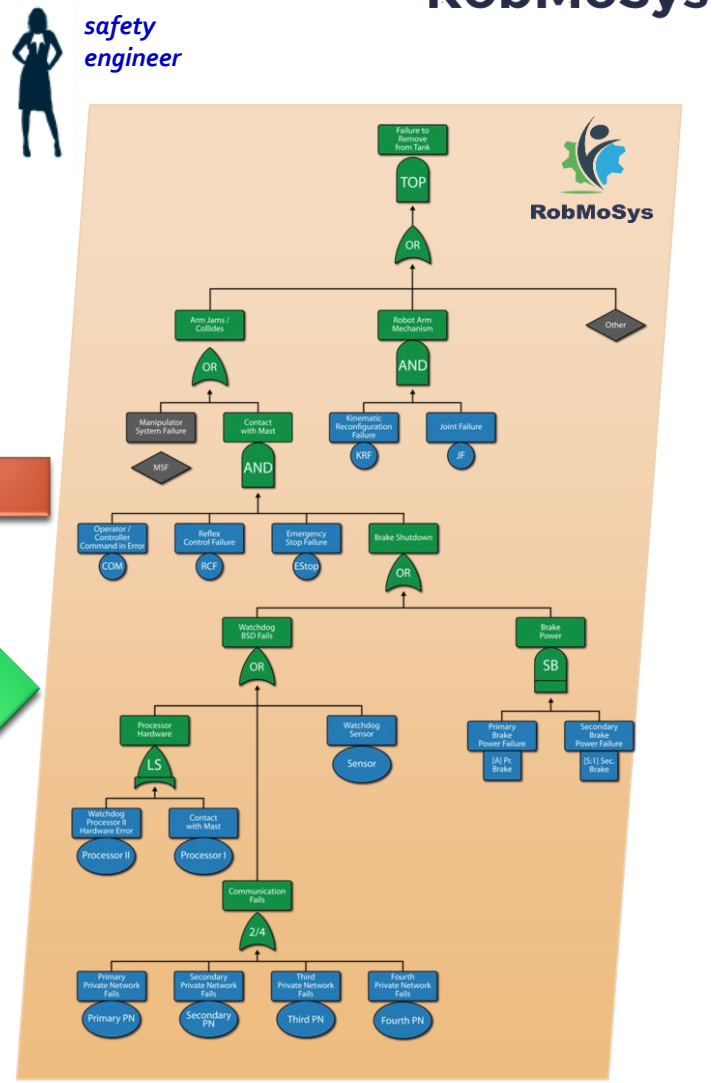

Fault Tree Analysis (FTA) View

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Safety Analysis Example

Safety Analysis Use Case Scenario

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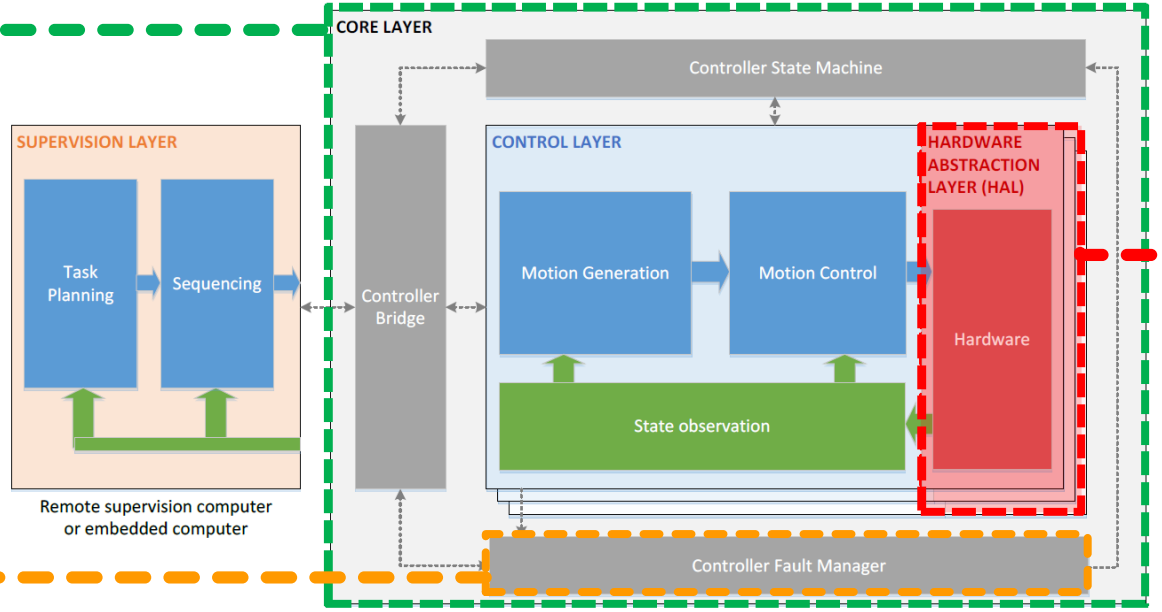
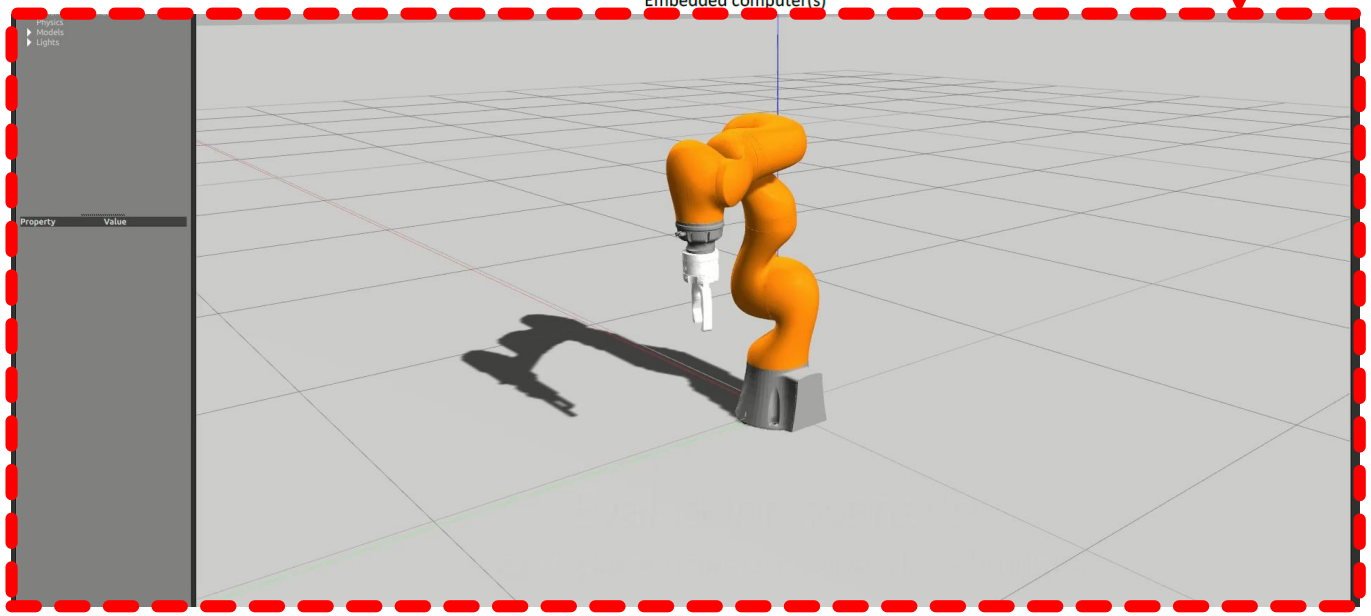
- Design of a real-time Cartesian impedance controller, in torque mode.



- Identify the critical faults to be monitored to avoid unintended movements (hazard), that may cause collisions (harm).



Scenario Workflow

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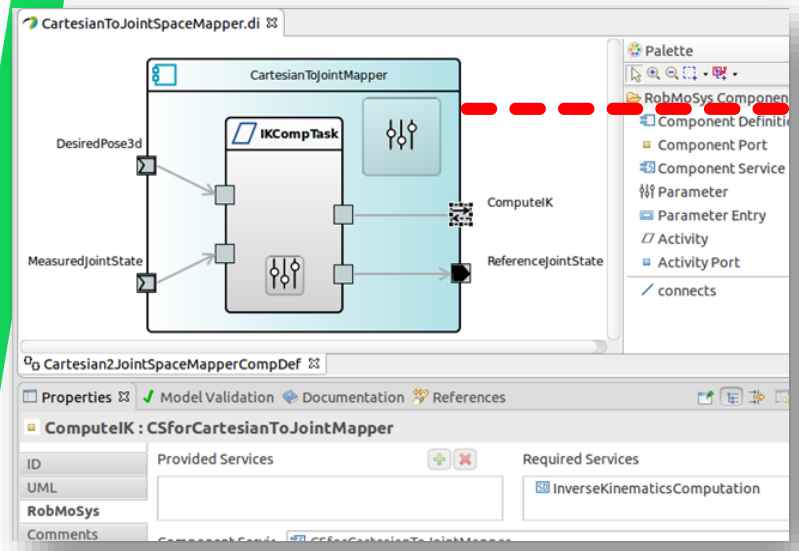
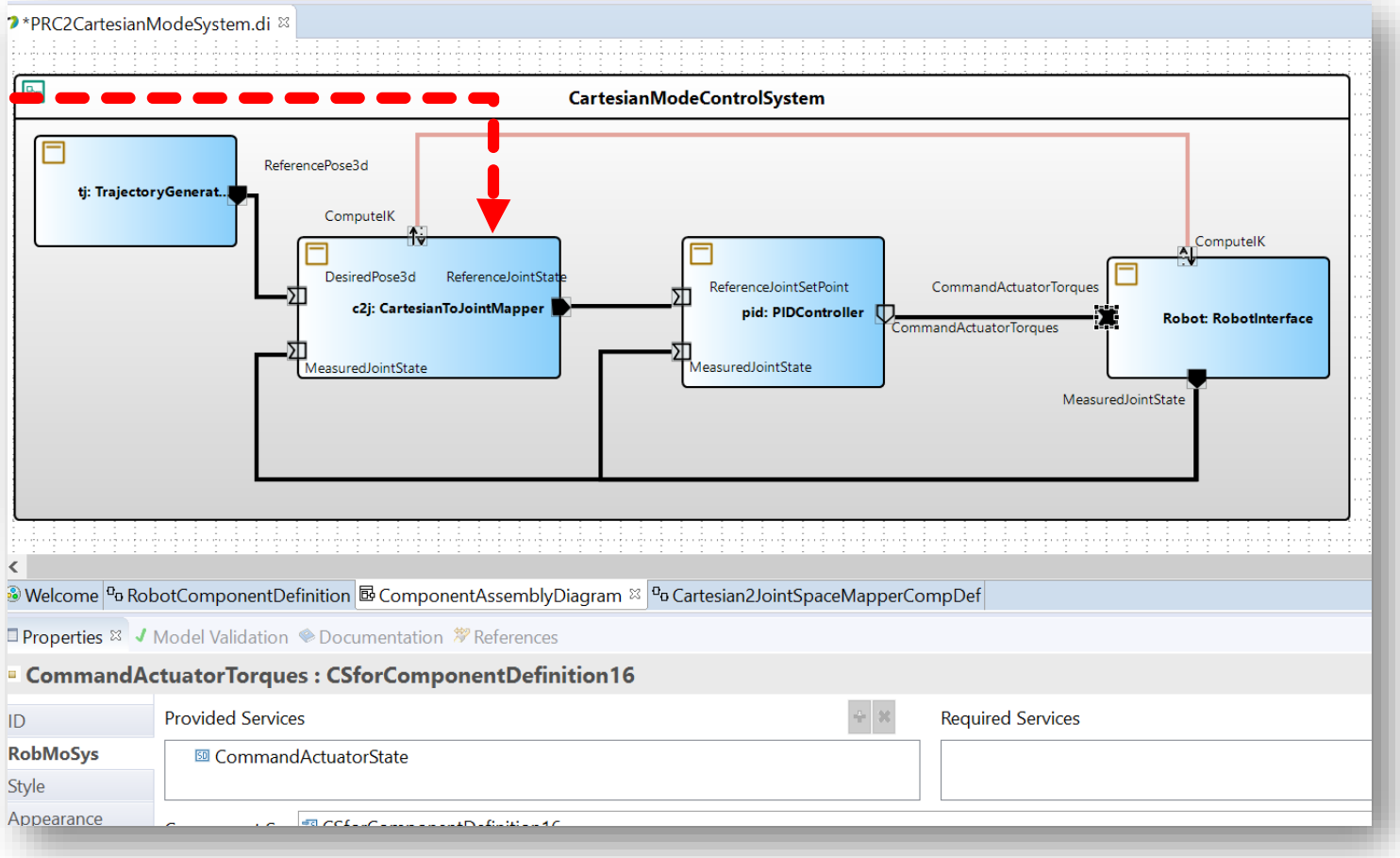
component supplier

system builder

Define System Architecture: Connectors, Service Instantiation, Data exchanged



Define Components: Ports, Services, Parameters, Activities



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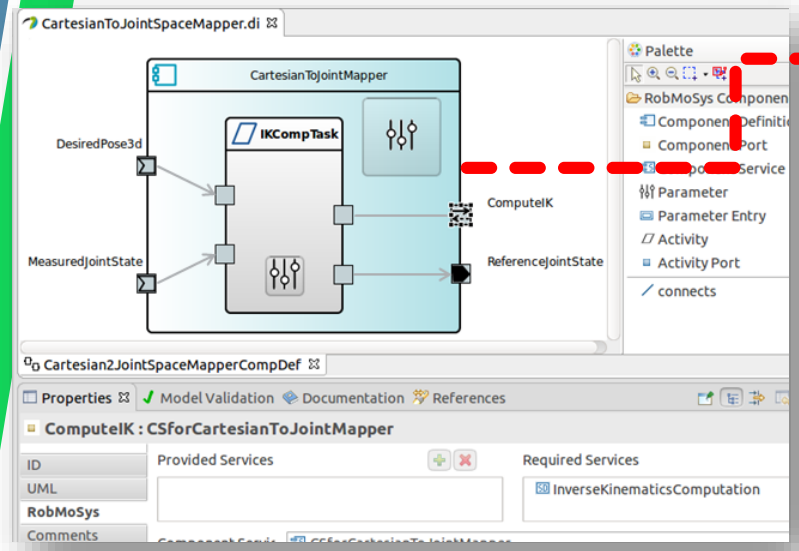
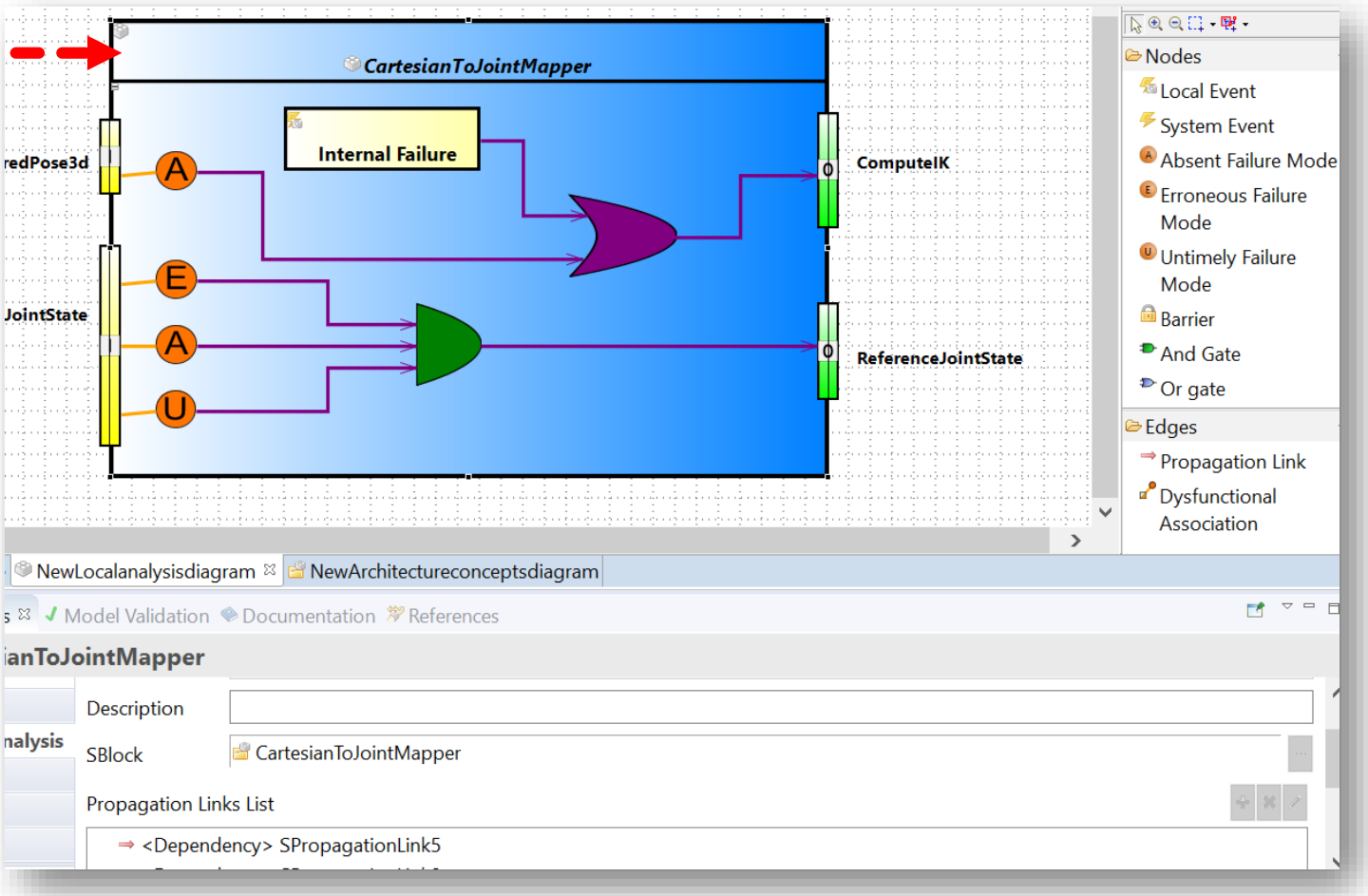
component supplier

safety engineer

Associate failure modes to ports, internal failures, propagation links, and barriers





It defined the potential fault propagation inside each component

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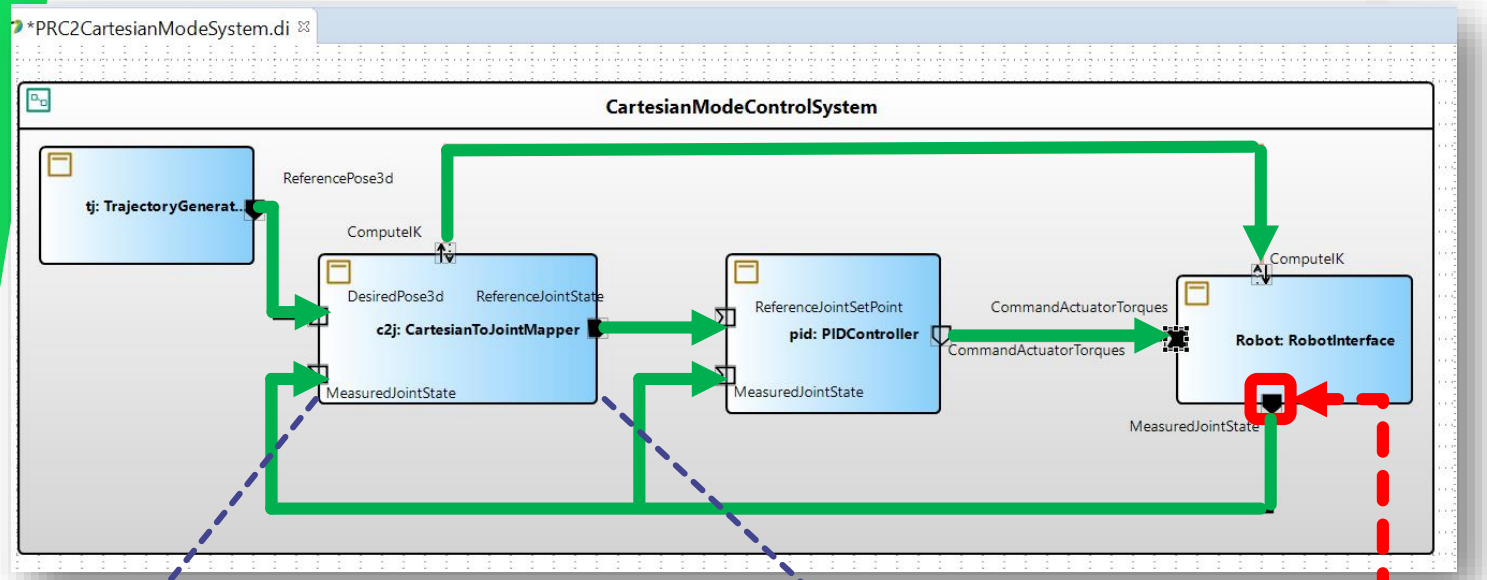
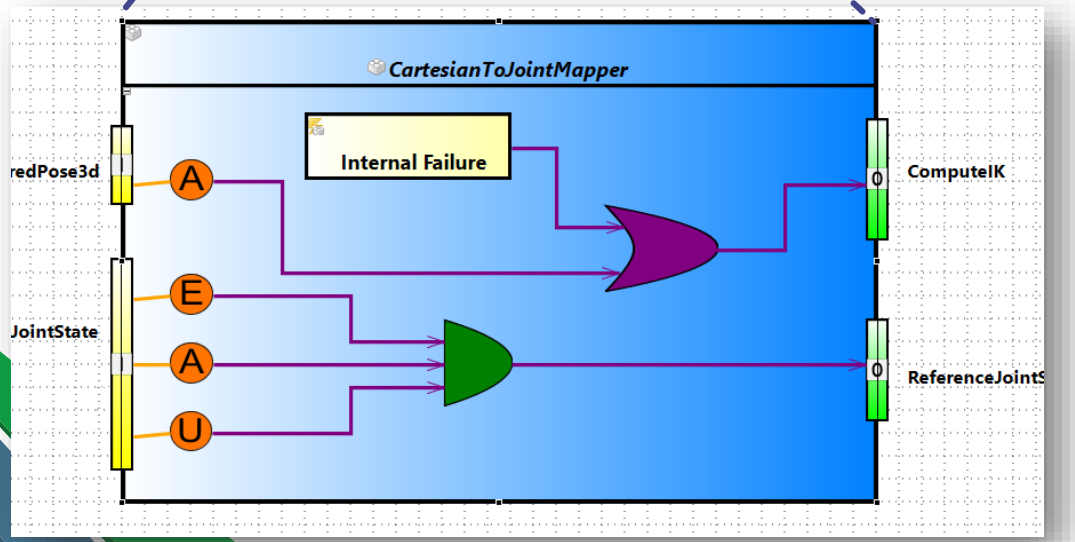


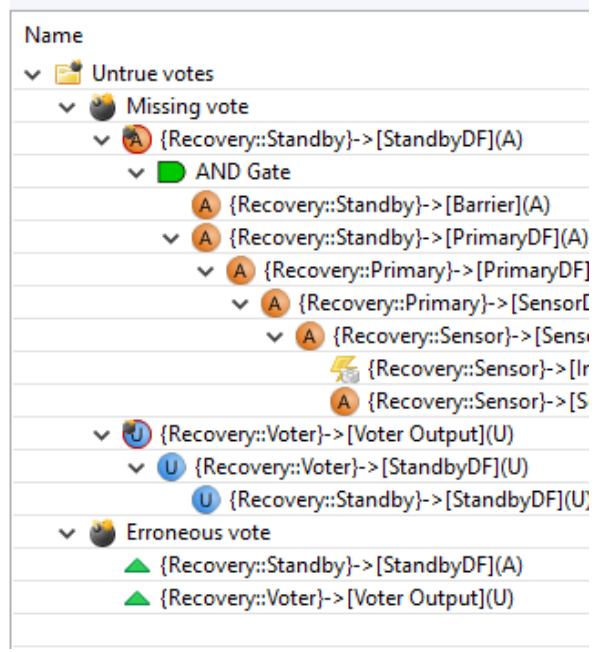


Set to "Top Event"

This defines the (high-level) safety requirement:

"pick & place trajectory speed < 250 mm/s"

Fault Propagation Tree



* solver under development

1. 2. 3. **4. Critical Path Identification**

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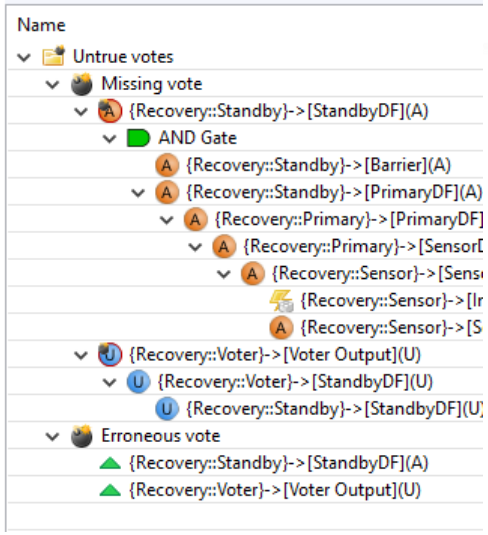

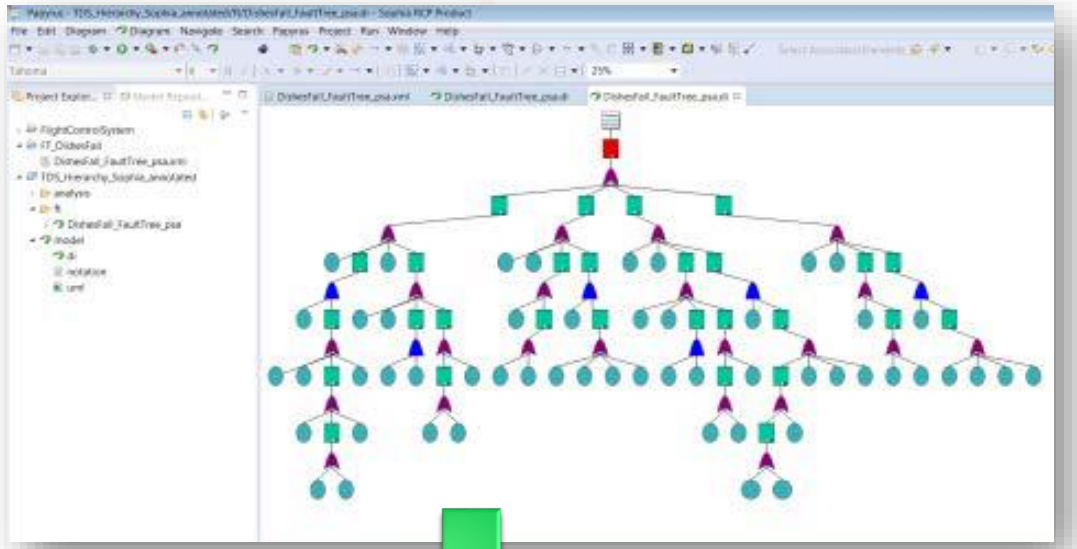

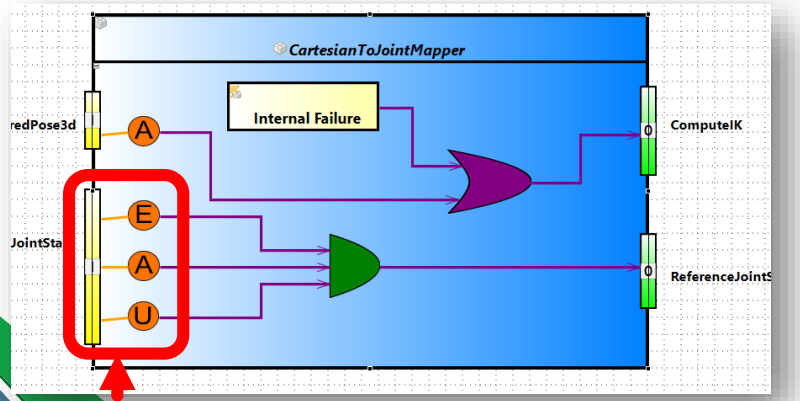

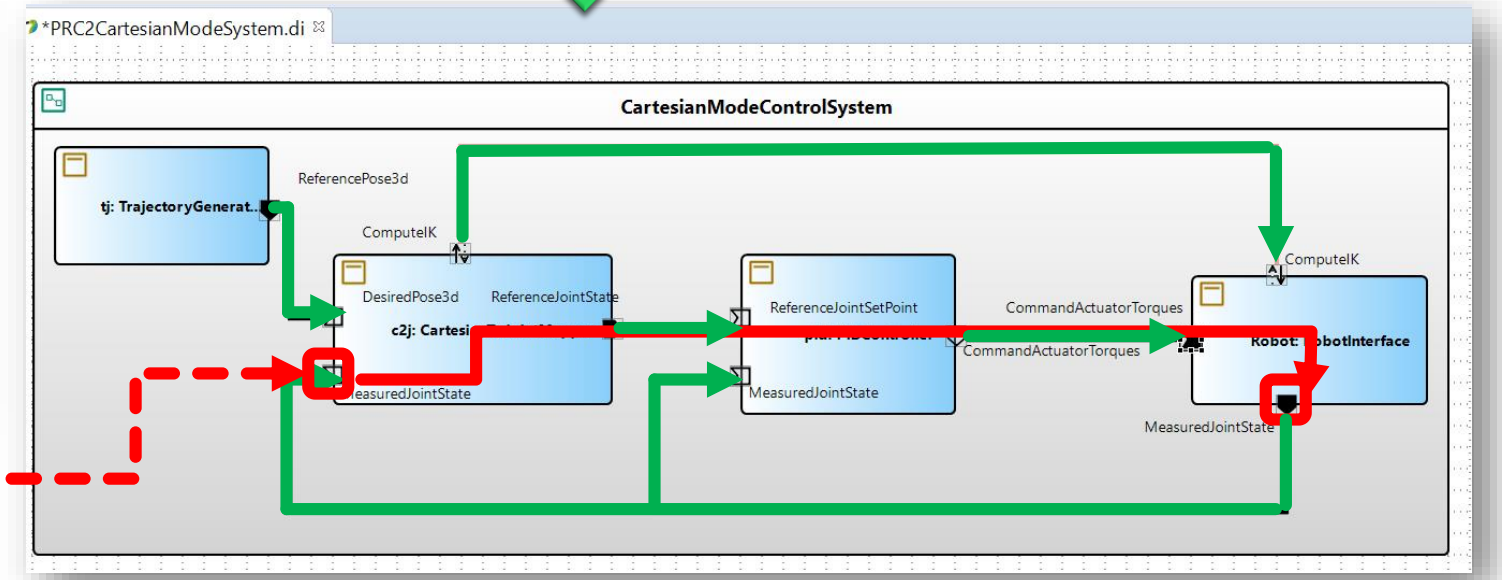

Faults that must be monitored and mitigated

Papyrus4Robotics Roadmap

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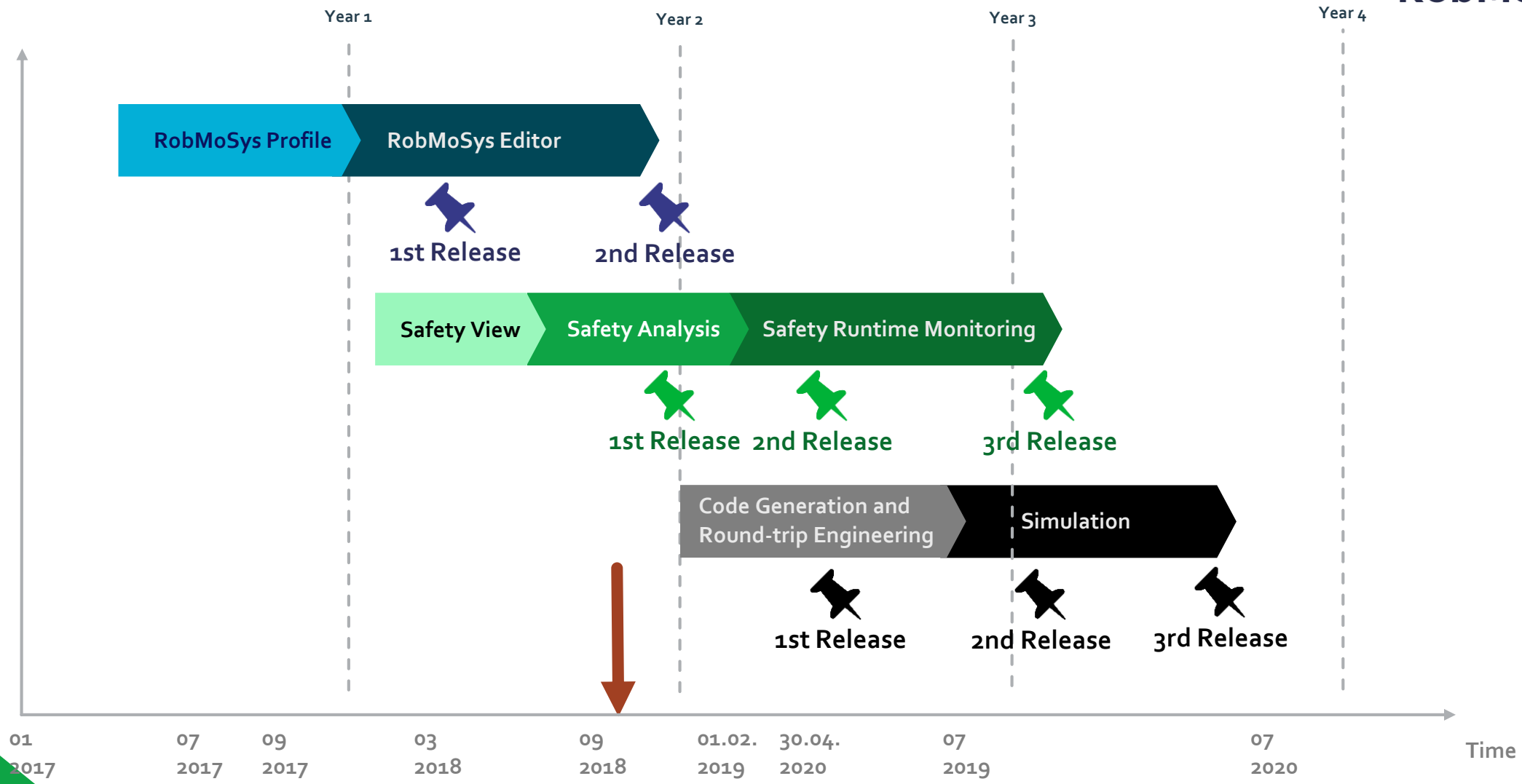

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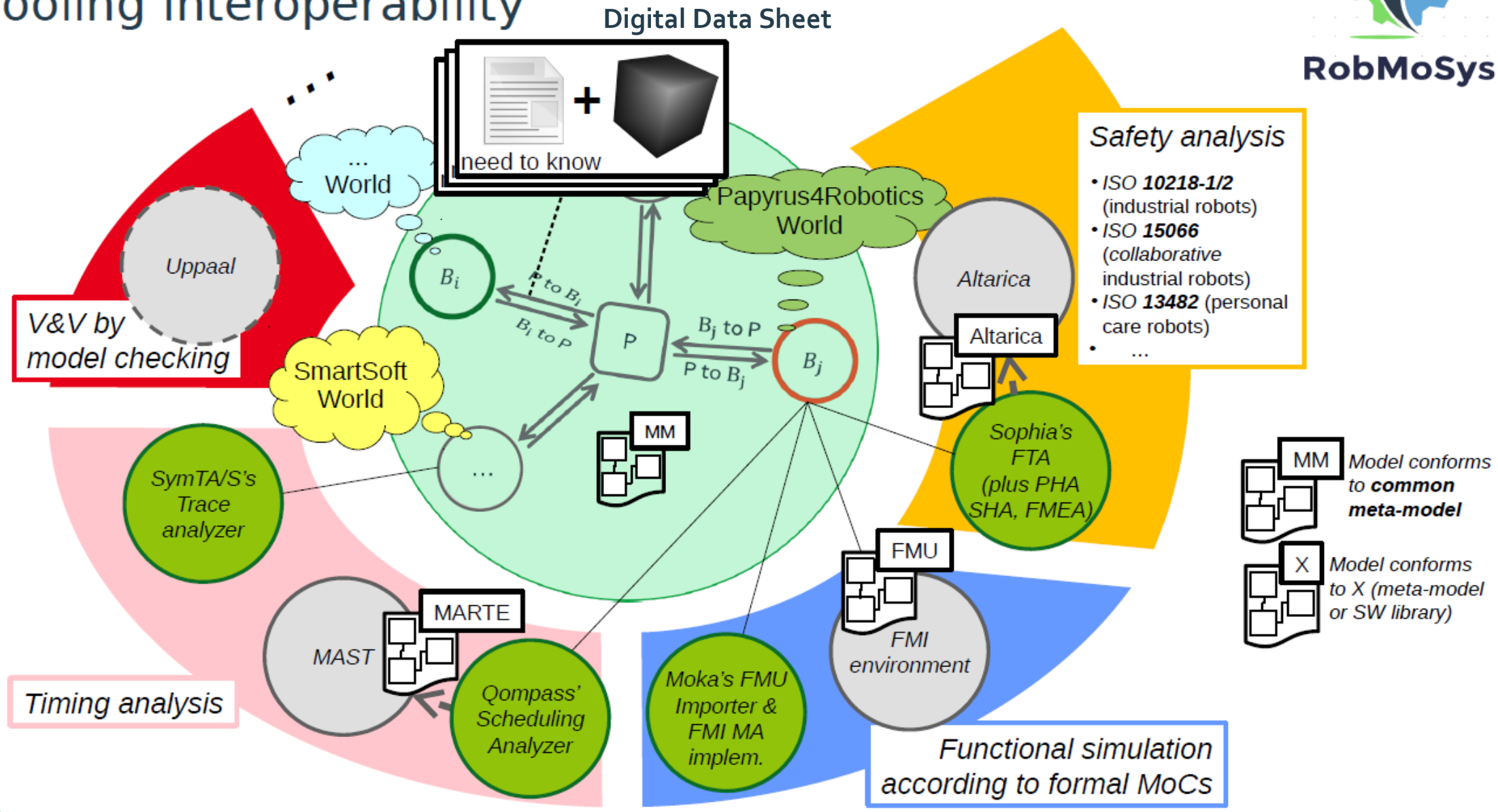
Thanks!
Questions?

Tooling Interoperability



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Ambition of Creating Models