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Eclipse-Based RobMoSys Tooling: SmartMDSD Toolchain Hands-On Session

MODELS 2018, Copenhagen

Dennis Stampfer, Alex Lotz, Christian Schlegel



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



Outline

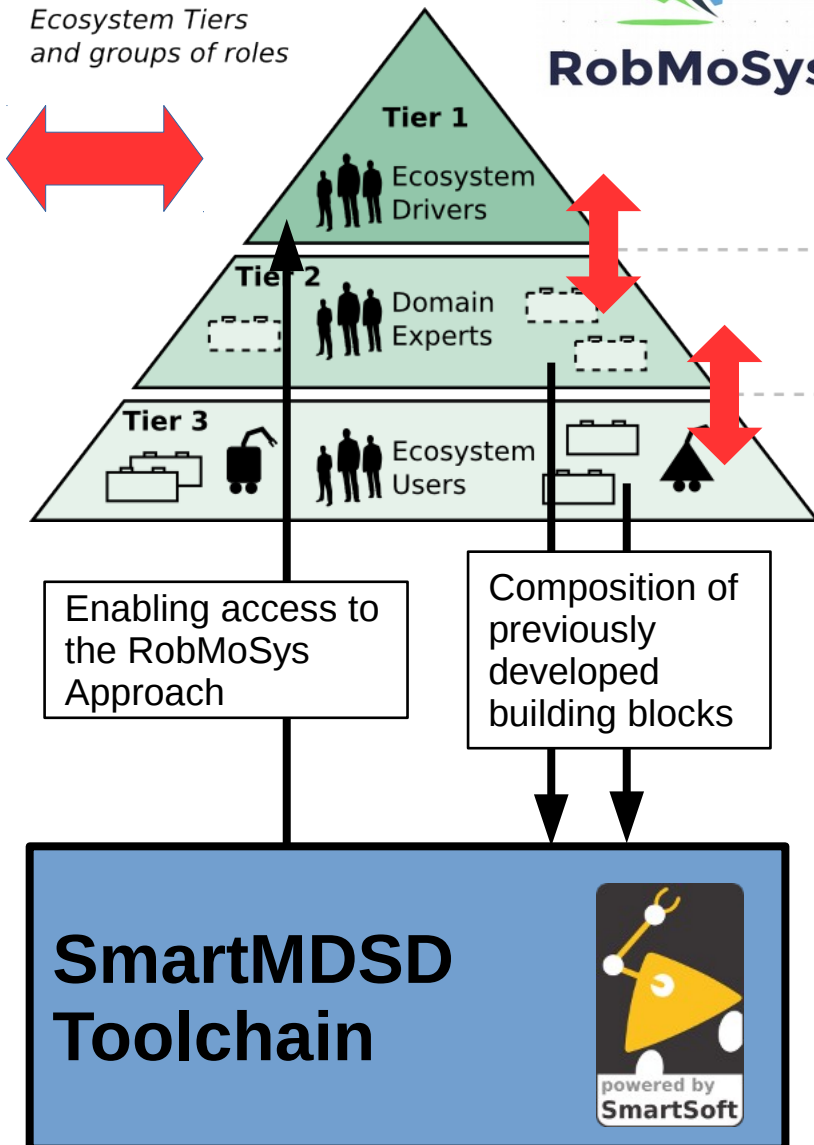
- Very concrete hands-on session with the RobMoSys conformant SmartMDSD Toolchain to get a **look-and-feel of a concrete robotics example**
- **Tooling User-View:** insights into how model-driven software development in robotics looks and feels like
- Tooling Developer-View

What is the SmartMDSD Toolchain?

- The SmartMDSD Toolchain is an Integrated Development Environment (**IDE**) for robotics software to support system composition according to the structures of RobMoSys.
- **Enabling access** to the RobMoSys structures.
- **Guidance** through tooling (thanks to underlying meta-models)
- Previous version “**v2**” **very mature**:
 - **TRL6**
 - Development artifacts are **shipped worldwide** within products of FESTO and REC
- Supporting a variety of communication infrastructures:
 - CORBA, ACE, DDS, OPC UA



Ecosystem Tiers
and groups of roles



Focus and Strengths of the SmartMDSD Toolchain for Robotics Users

- Strong grounding to **development artifacts**
 - e.g. very strong in code-generation and underlying SmartSoft Framework
- Strong to model and **develop concrete software components**
- Strong in building **real systems**
- **Content** available for RobMoSys Tier 2 and Tier 3 available for download!
 - Domain Models, Software Components, Systems
- Also includes:
 - Analysis via SymTA/S
 - Simulation (Player/Stage, Morse, Gazebo)

RobMoSys Tutorial, MODELS 2018, Copenhagen, Denmark
Dennis Stampfer, Alex Lotz, Christian Schlegel



RobMoSys

Used in products delivered by

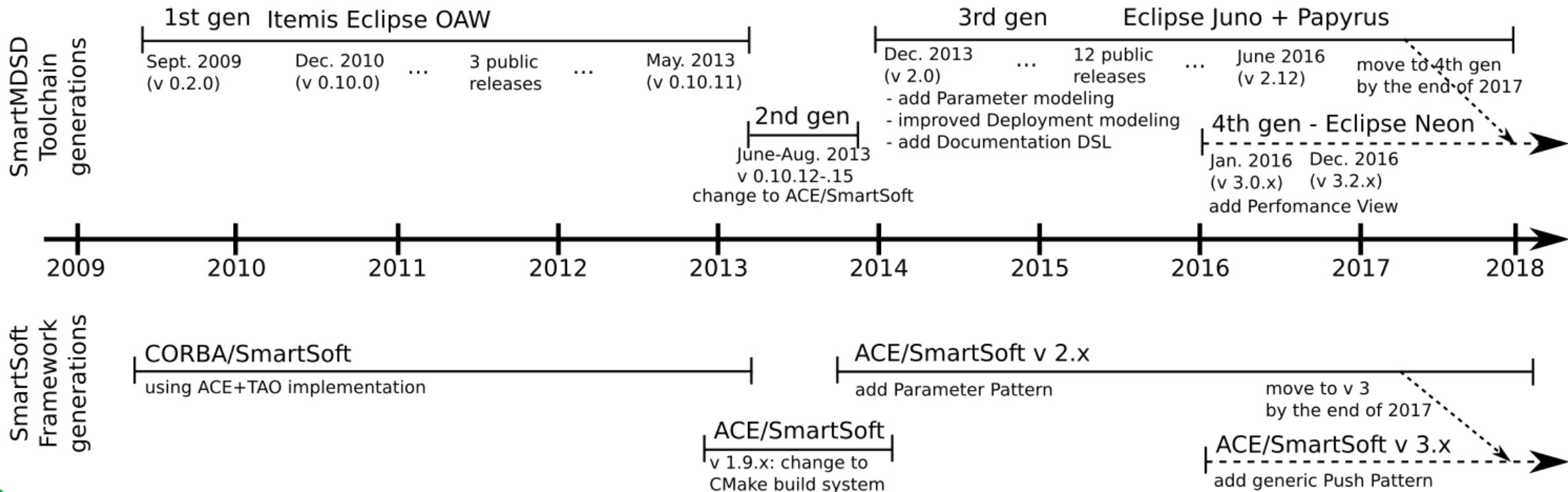
FESTO





The SmartMDS Toolchain: History

- SmartMDS Toolchain in development **since 2009**
- SmartMDS Toolchain **v3-generation**
 - “Fourth” Generation
 - First stable release March 2018



Applications built with the SmartMDS Toolchain

<https://www.youtube.com/user/RoboticsAtHsUlm>



RobMoSys



Industry 4.0 Intralogistics Demonstrator (>2017)



Collaborative Robot Butler Scenario (<2017)



Intralogistics Scenario: Flexible Commissioning wit...
63 views · 4 months ago

Intralogistics Scenario: Flexible Commissioning wit...
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Intralogistics Scenario: Demonstrating Flexible...
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Industry 4.0 Robot Commissioning Fleet in Intr...
912 views · 1 year ago

SmartMDS Toolchain v3 Technology Preview includin...
302 views · 1 year ago

Mobile Agricultural Robot Swarms: OptiVisor
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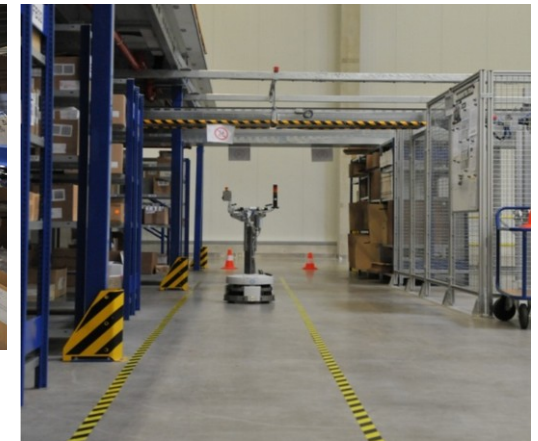
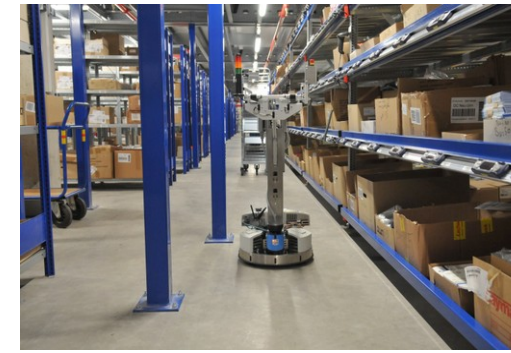
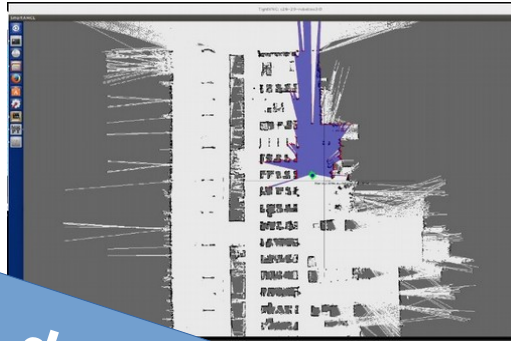


Applications built with the SmartMDSD Toolchain

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RobMoSys

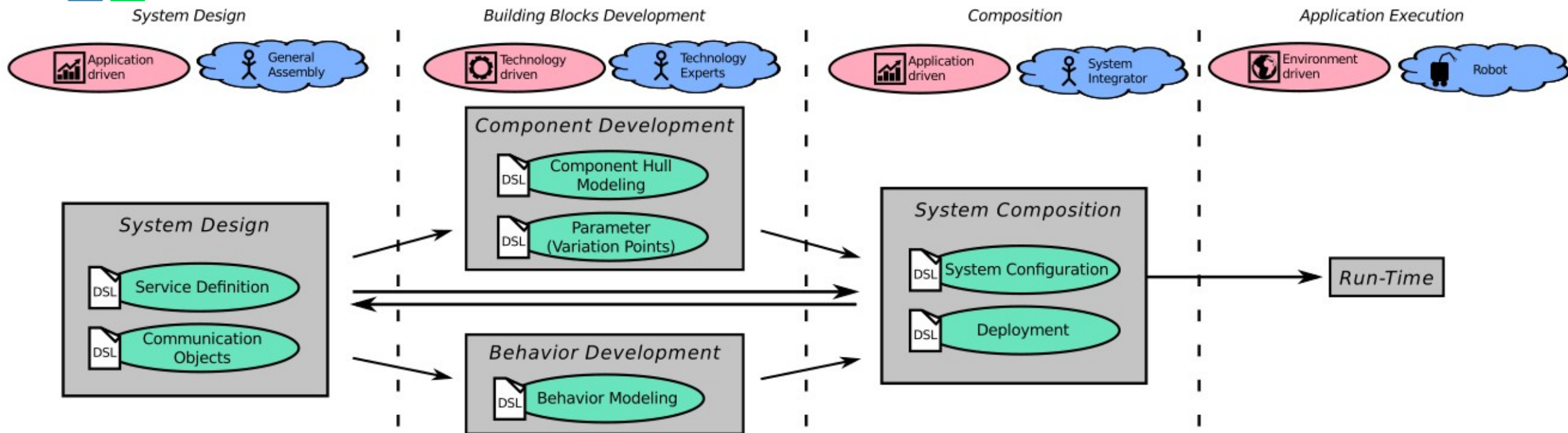


The demo that follows will feature an excerpt of these robots

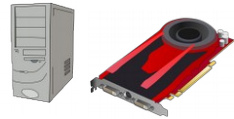


System Development Workflow

- For robots that act, tooling has to **support from the first to the last step**
- The development workflow is one specific path through the web of the RobMoSys Ecosystem that touches different roles: **Separation of Roles!**



RobMoSys Ecosystem Organization



Examples of the PC Analogy

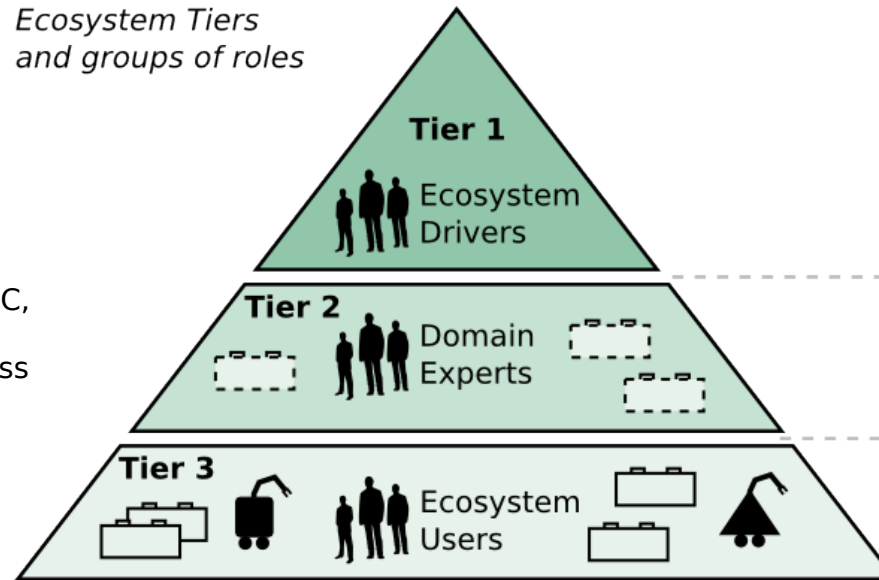
e.g. Semiconductor standards, computer architecture, USB, PCIe, modern use of ethernet, etc.

e.g. laptop PC, desktop PC, industry PC, ATX, ITX, Mini-ITX, VGA, HDMI, SATA, IDE, CPU socket, GPU socket, USB mass storage, etc.

e.g. graphics card, CPU, TPM, Memory, power supply, USB SSD Hard disc, USB stick, etc.



RobMoSys Ecosystem Tiers and groups of roles



Examples of Robotics

e.g. robotics architectural patterns and robotics composition structures (service-oriented software component model, robotics task models, communication patterns, etc.)

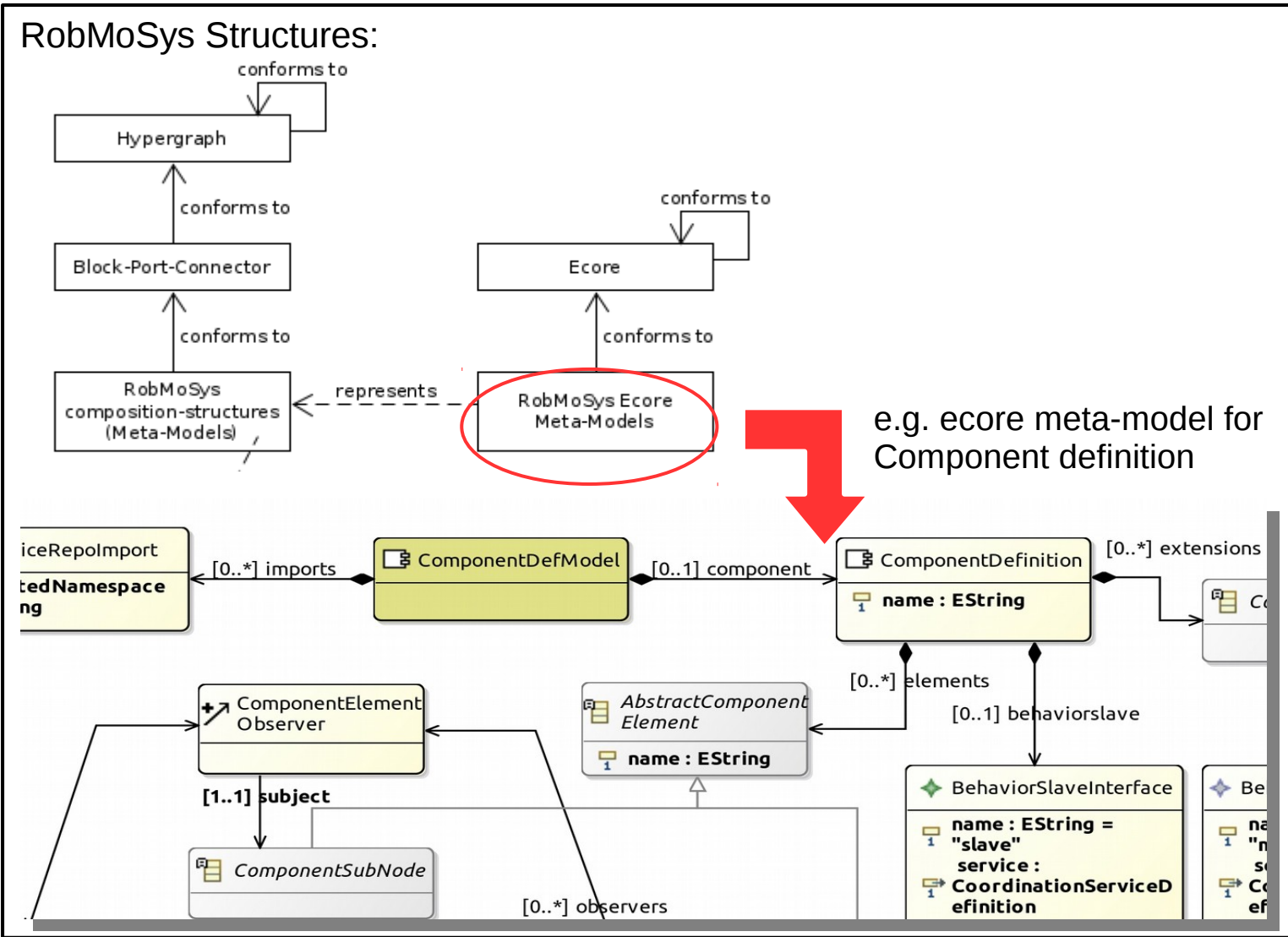
e.g. Flexible Navigation Stack, Active Object Recognition Stack, Motion-Perception-World-Model Stack

e.g. robotics software components (Motion Planning, SLAM, Object Recognition), robotics functional libraries (MRPT, OpenCV, PCL), applications (Pilots, Logistics Fleet, Production Cell, Healthcare Servicerobot), etc.

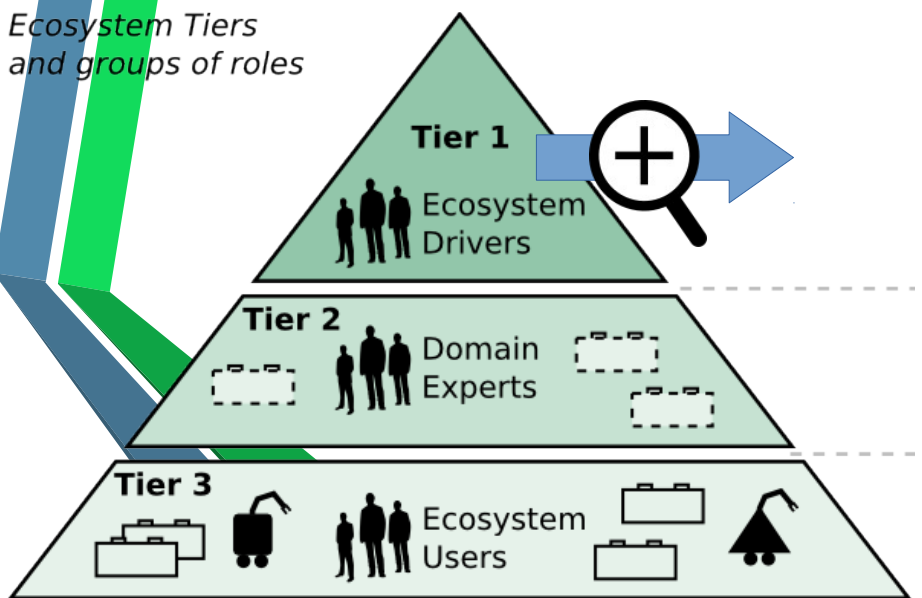
SmartMDSD Toolchain Walkthrough Support for RobMoSys Tier 1

The SmartMDSD Toolchain implements the RobMoSys composition structures using Ecore. RobMoSys **structures become accessible** to Tier 2 and Tier 3 users!

Example: Component Definition Meta-Model



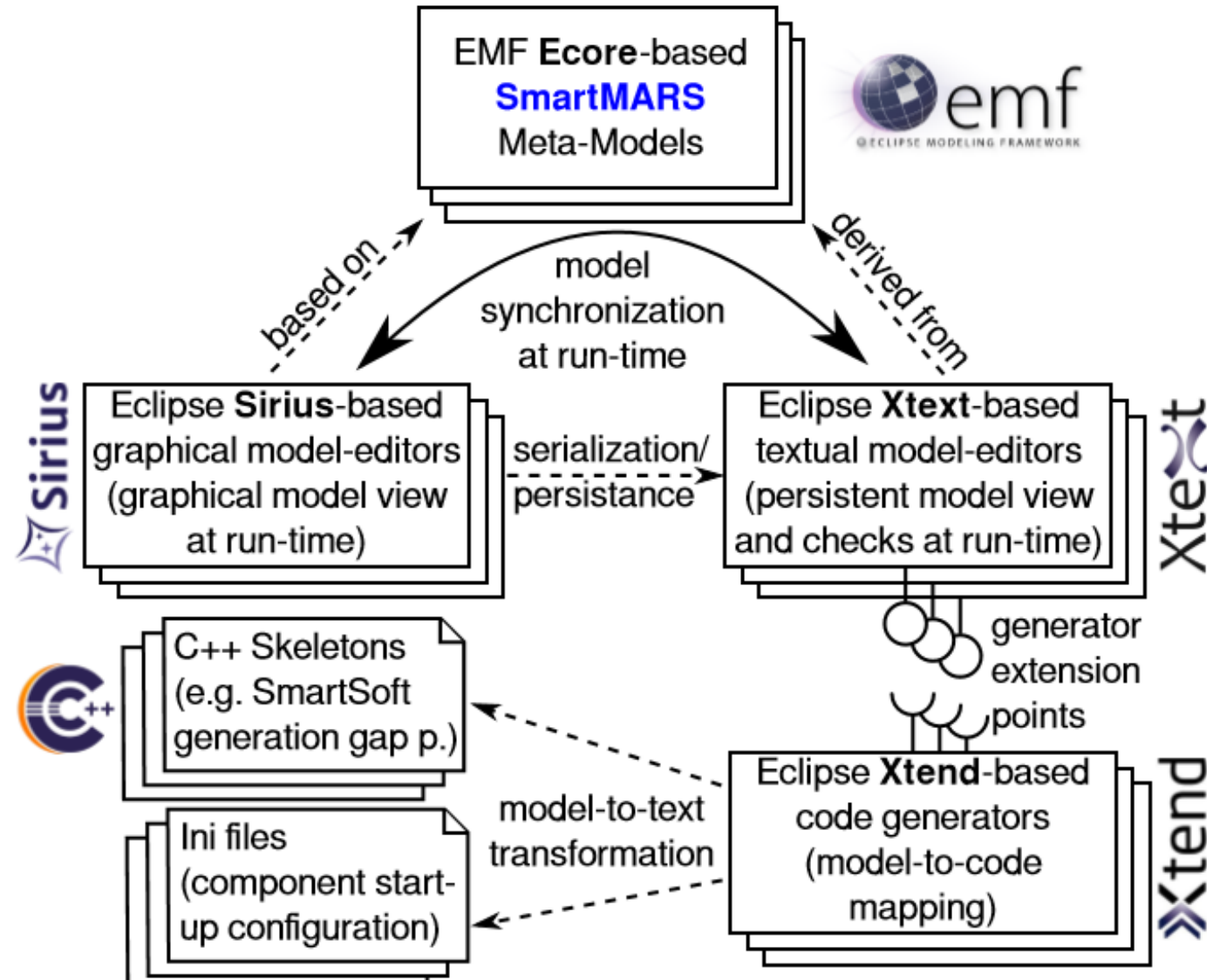
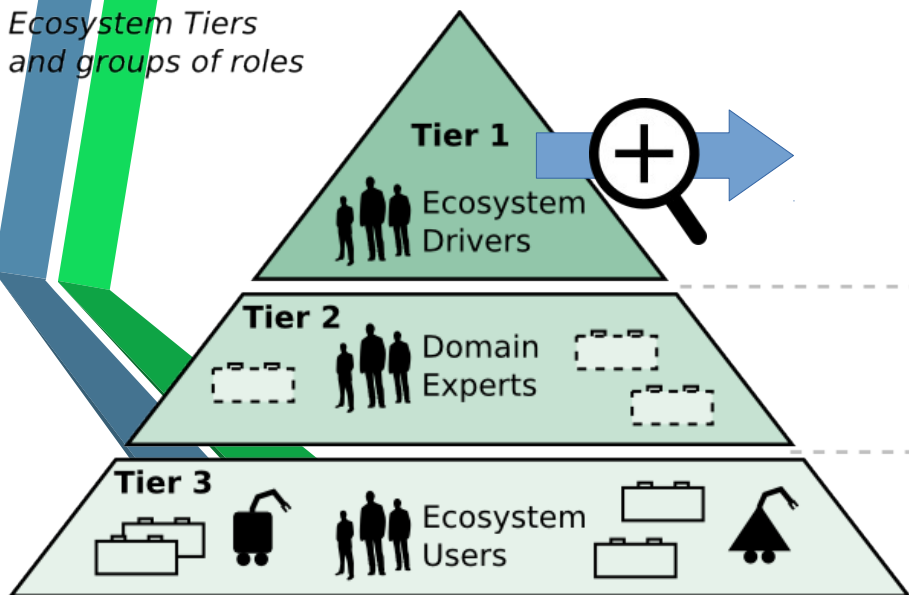
Ecosystem Tiers and groups of roles



Tooling Developer View: Internal realization of the SmartMDSD Toolchain

- 22 Ecore Meta-Models
- 21 Modeling views (graphical and textual)

Ecosystem Tiers and groups of roles

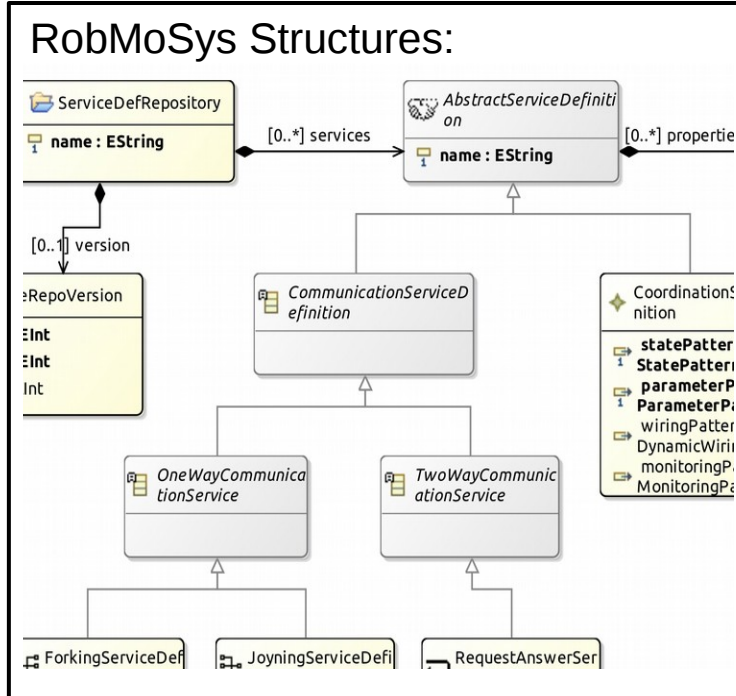




SmartMDSD Toolchain Walkthrough Support for RobMoSys Tier 2

The SmartMDSD Toolchain supports in modeling domain structures (**domain models**) according to the RobMoSys composition structures.

Example: **Service Definitions**

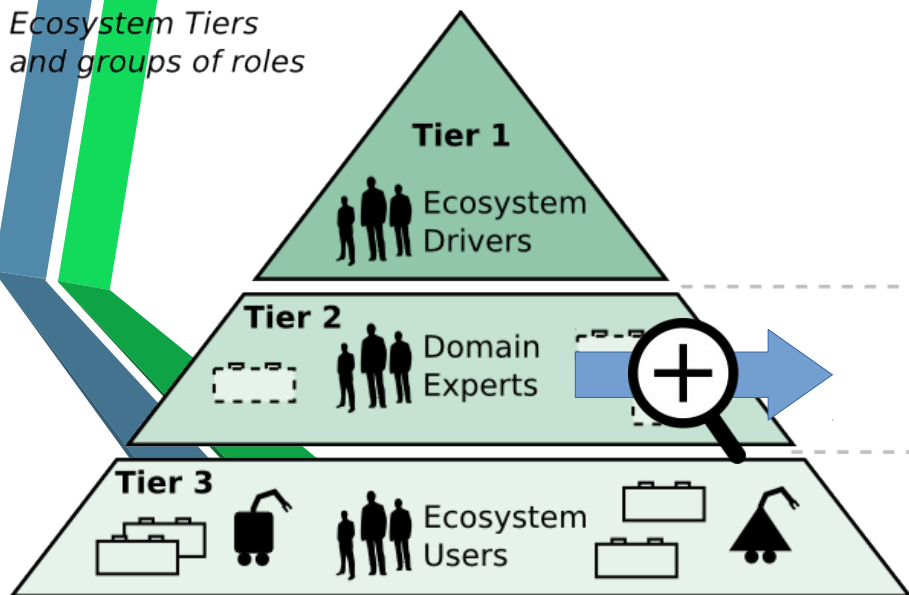


Role-Specific View:

```

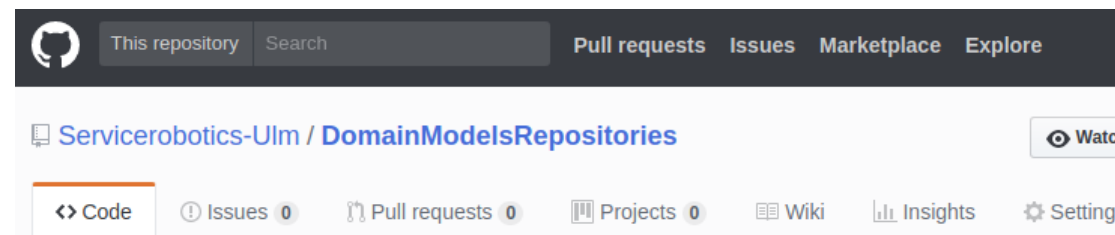
NavigationObjects.services {
  ActivationType=CommBasicObjects.CommBatteryPa
  EventType=CommBasicObjects.CommBatteryEvent
  EventStateType=CommBasicObjects.CommBatterySta
}
}
/**
 * Planner service definitions
 */
ForkingServiceDefinition PlannerGoalService {
  PushPattern < DataType = CommNavigationObjects.Co
}
ForkingServiceDefinition PlannerEventService {
  EventPattern <
  ActivationType=CommNavigationObjects.CommPlanr
  EventType=CommNavigationObjects.CommPlannerEve
  EventStateType=CommNavigationObjects.PlannerE
}
}
/**
 * Mapping service-definitions
  
```

Ecosystem Tiers and groups of roles



Available content: Domain Models

See <https://github.com/ServiceRobotics-Ulm/DomainModelsRepositories>



SmartMDS Toolchain Walkthrough Support for RobMoSys Tier 3

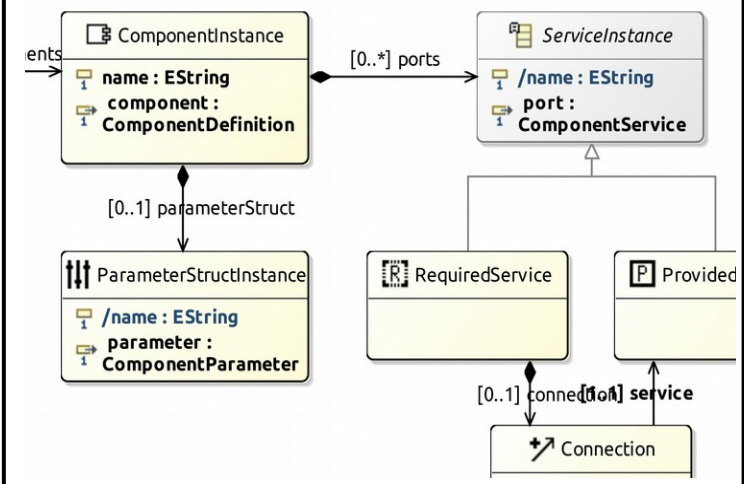


RobMoSys

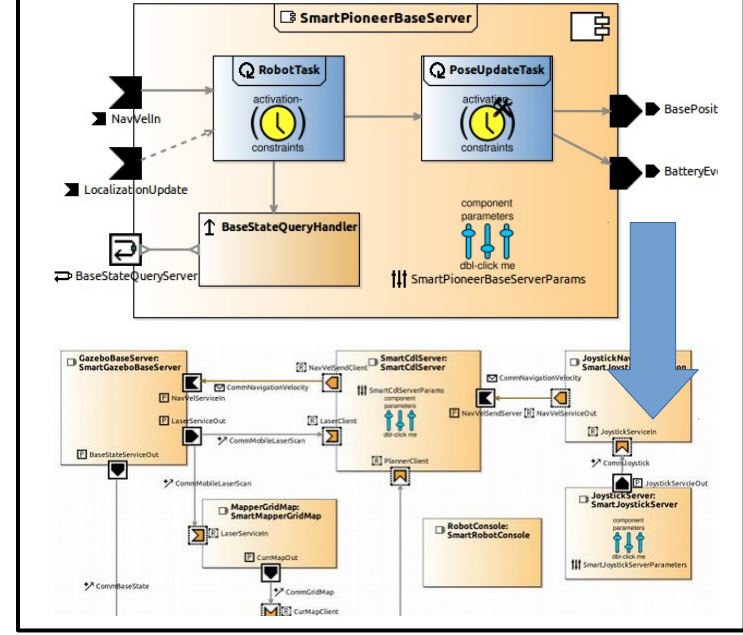
The SmartMDS Toolchain supports in **developing components** and in **composing** previously developed components to **systems**.

Example: **TiaGO Navigation**

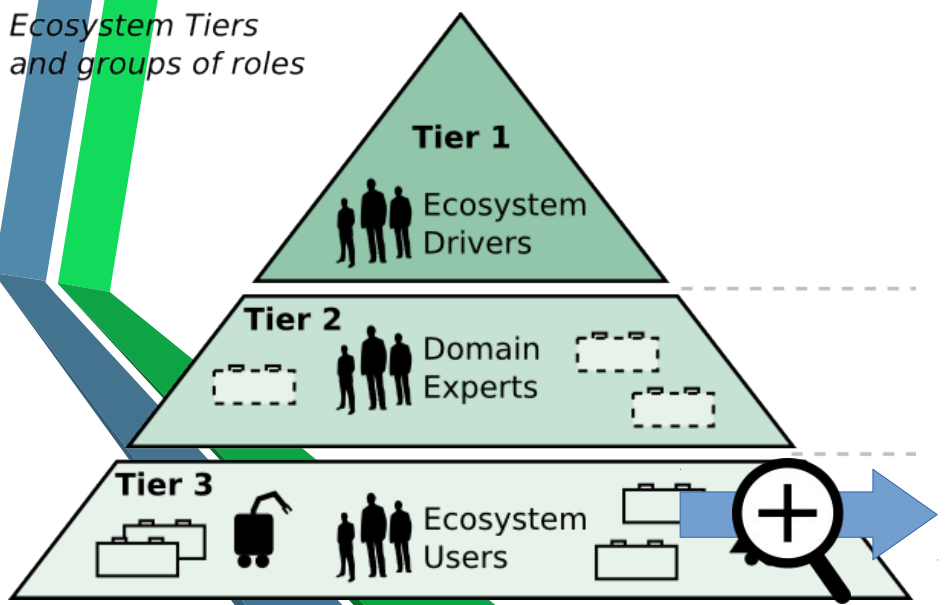
RobMoSys Structures:
e.g. Component Definition and System Component Architecture



Role-Specific View:



Ecosystem Tiers and groups of roles



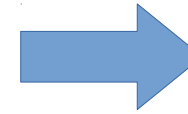
Available content: previously developed/modeled building blocks:
See <https://robmosys.eu/wiki/baseline:components:smartsoft>



Current State and Roadmap

Ready for users and contributors

- Current state: stable and **ready to use to build components and systems**
 - Design, Develop, Compose, Configure
 - Existing baseline of “content”:
 - Domain Models
 - Composable components for navigation systems: **Navigation stack** already available for **TIAGo and Pioneer**
 - In transition to a project of the **Eclipse Foundation**



Go in the broad! Features, Content, Pilots

- Roadmap
 - **Content** in transition to v3:
 - ~60 components in transition
 - Robot fleet support
 - Mobile manipulation
 - Connecting to various **communication infrastructures**: ROS, OPC UA, YARP
 - **Digital Data Sheet via modeling twin**
 - Integration of **ITP contributions**

Where to get the SmartMDSD Toolchain?

- Easy Entry:
 - Available as standalone installation
 - and **pre-installed/ready-to-go virtual machine image!**
- https://robmosys.eu/wiki/baseline:environment_tools:smartsoft:start

A lot of **examples** are available. **Tutorials** and **screencasts** to be available shortly.



Follow up on discourse.robmosys.eu



The screenshot shows a web browser displaying the RobMoSys Wiki page for 'The SmartSoft World'. The page title is 'The SmartSoft World'. The main text describes SmartSoft as an umbrella term for concepts and tools to build robotics systems. It mentions the 'SmartSoft approach' and 'model-driven tools'. A list of items is partially visible, with 'The SmartMDSD Toolchain' circled in red. A red arrow points from the 'Click here to DOWNLOAD' button to this circled item. The page also features a search bar, navigation links like 'Recent Changes', 'Media Manager', and 'Sitemap', and a sidebar with a 'Table of Contents'.



Live Demo

See text and video tutorials at servicerobotik-ulm.de
and robmosys.eu/wiki.