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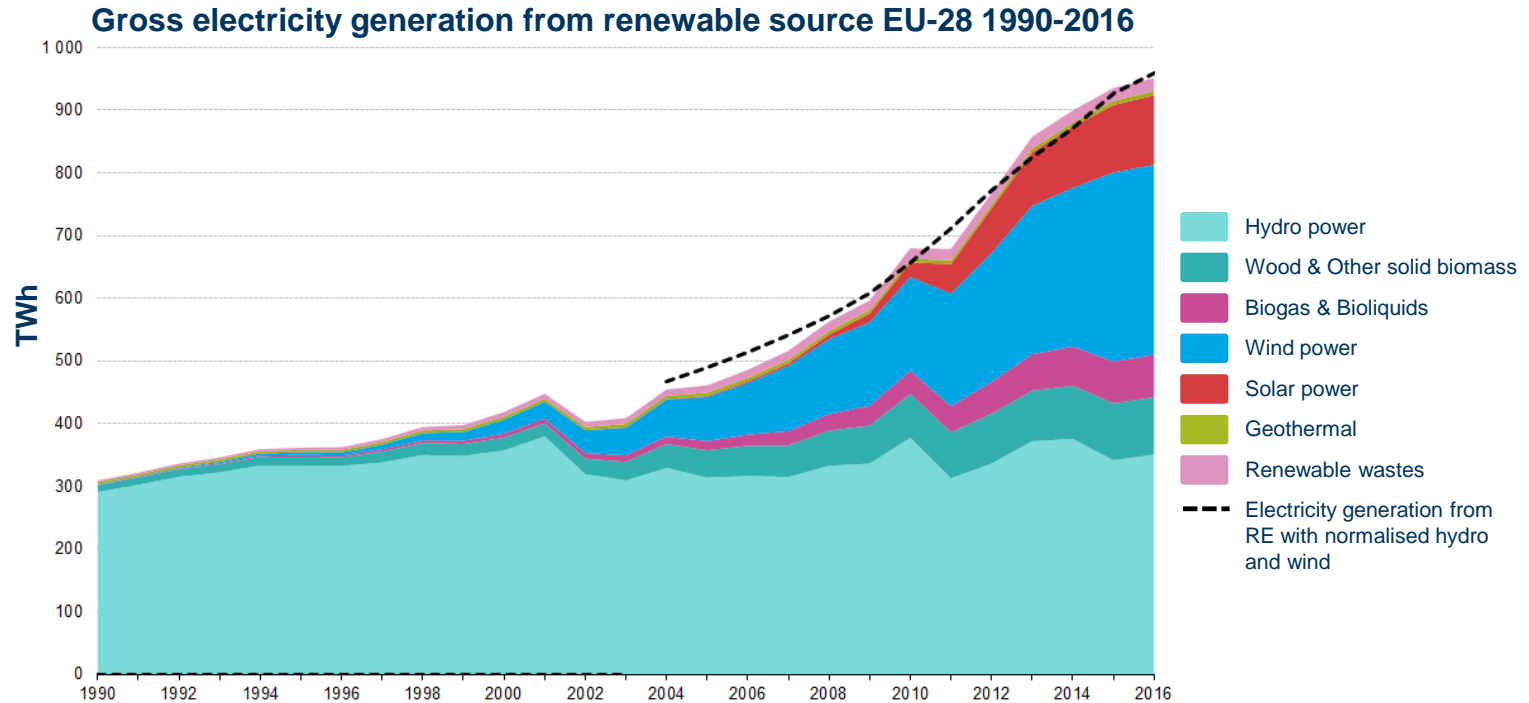
RUHR-UNIVERSITÄT BOCHUM

USING AUTOMATIONML TO DESCRIBE THE DYNAMIC BEHAVIOR OF A PRODUCTION SYSTEM

25.10.2018 Gothenburg

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WHERE DO WE COME FROM?



https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Figure_5-Gross_electricity_generation_from_renewable_sources_EU-28_1990-2016.png

WHAT ARE THE CONSEQUENCES?



- **Production systems must become more energy-efficient**
 - Minimizing energy consumption
 - Reduce peak loads
 - Minimize energy costs

- **Production systems must react to renewable energies**
 - Make dynamic changes
 - Adopt to available energy
 - Adopt to electricity price

HOW DO SOLVE THE PROBLEM?



- Layout optimization
- Cycle optimization
- Production planning and control optimization



GOAL:
Optimization
platform

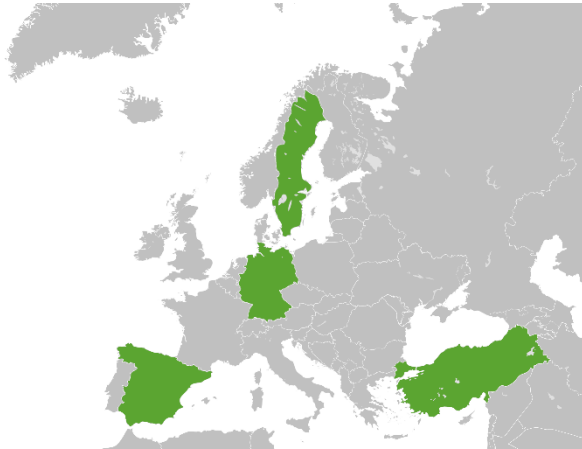




SPEAR

<https://spear-project.eu>

Smart Prognosis of Energy with Allocation of Resources



Duration: 09/2017-08/2020

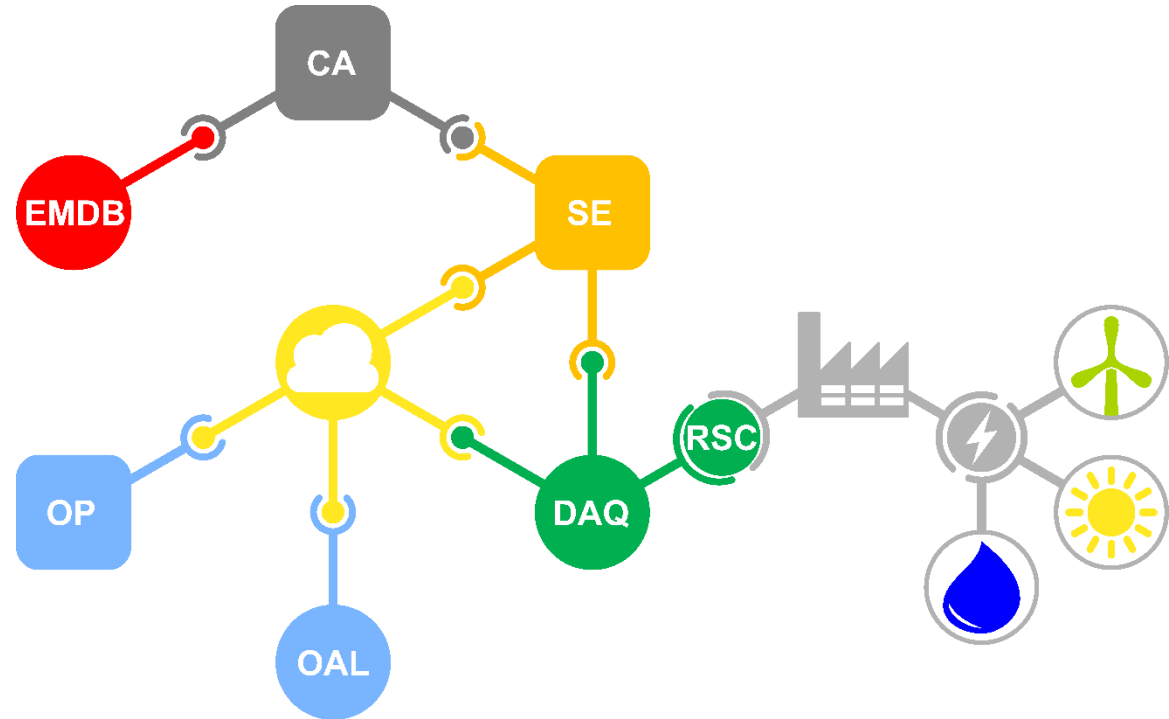
**19 Partners from
Germany, Spain, Sweden and Turkey**

Coordinator: EKS InTec GmbH (Germany)

SPEAR ARCHITECTURE



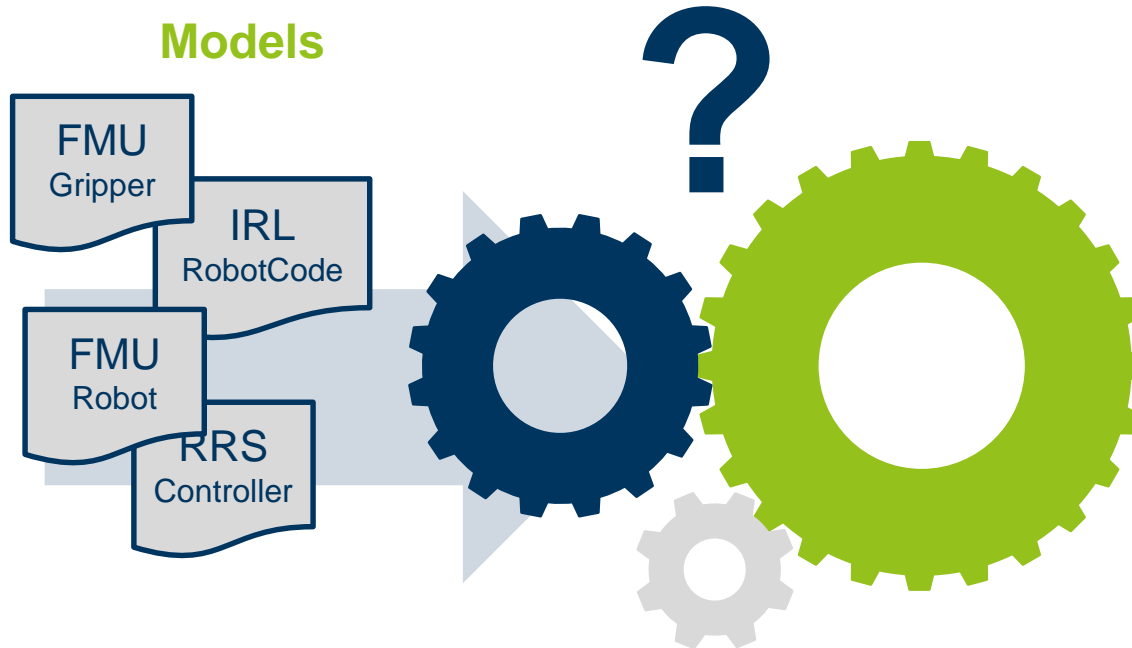
-  Energy Model Database
-  Configuration Assistant
-  Simulation Environment
-  Optimization Platform
-  Optimization Algorithms
-  Data Acquisition
-  Reality Simulation Connector



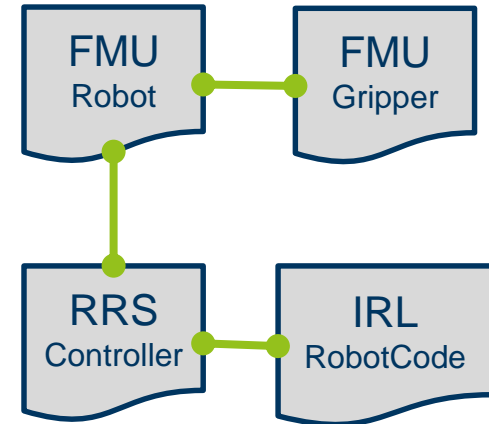
SIMULATION CONFIGURATION

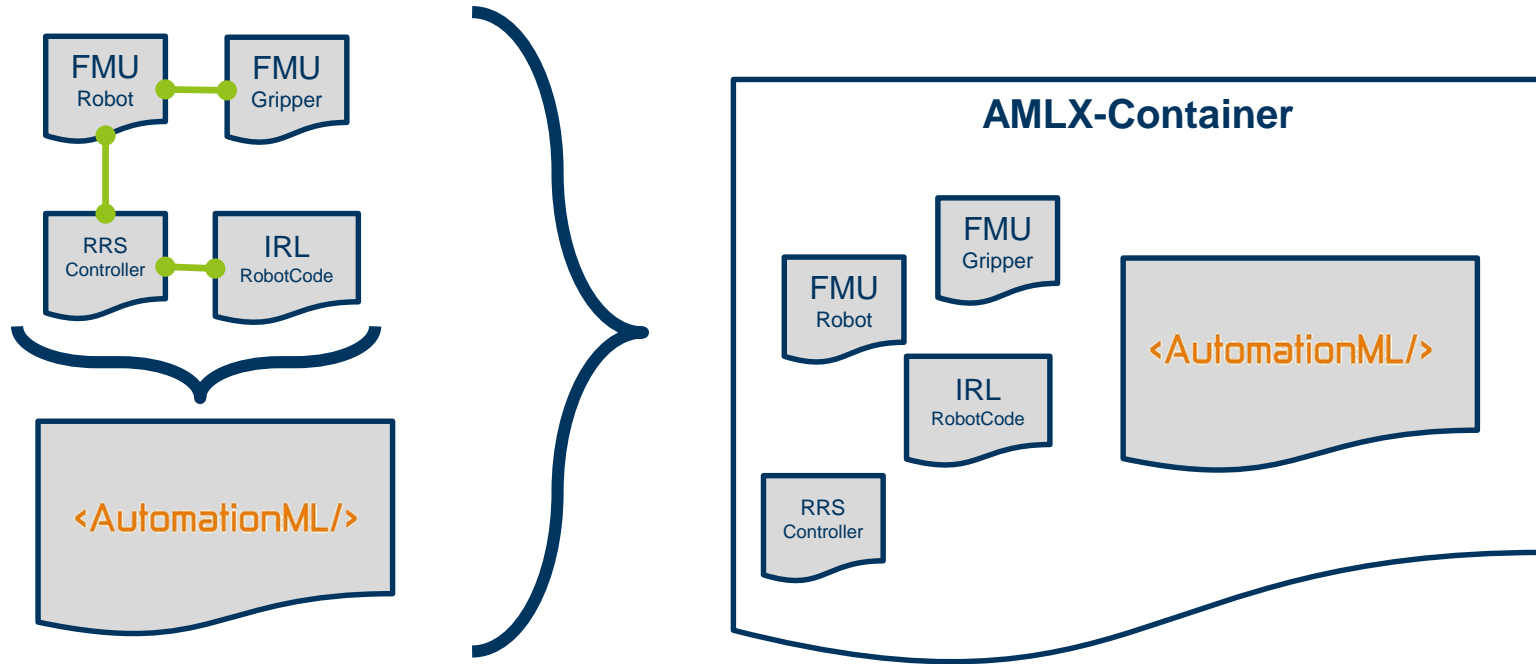


Models



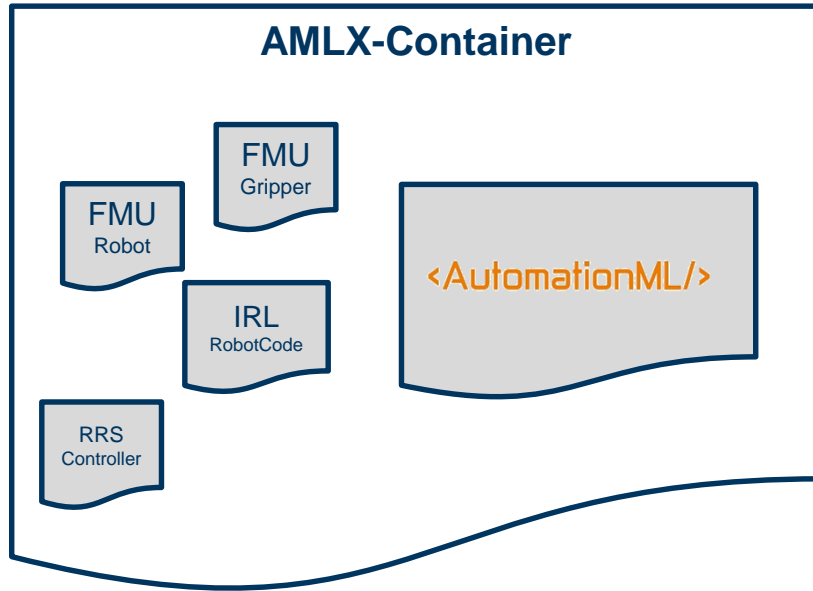
Simulation Environment



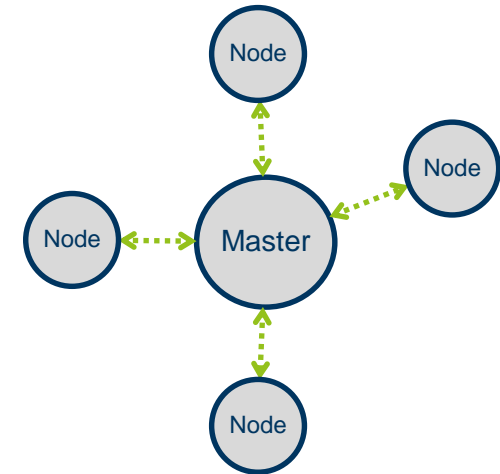


- **Models are created abstractly in AutomationML**
 - Implementation of the standards as SystemUnitClass
 - Creation of RoleClasses for the identification of the models by the Simulation Environments
- **Models can be imported via the configurator and an InternalElement will be automatically created**
 - Variables of the FMU will be automatically included in the InternalElement of the model
 - Original FMU file will be referenced in the InternalElement
- **Linking of the models can be executed**
- **AMLX container will be exported with the AML configuration file and the corresponding models**

TRANSFER TO THE SIMULATION ENVIRONMENT

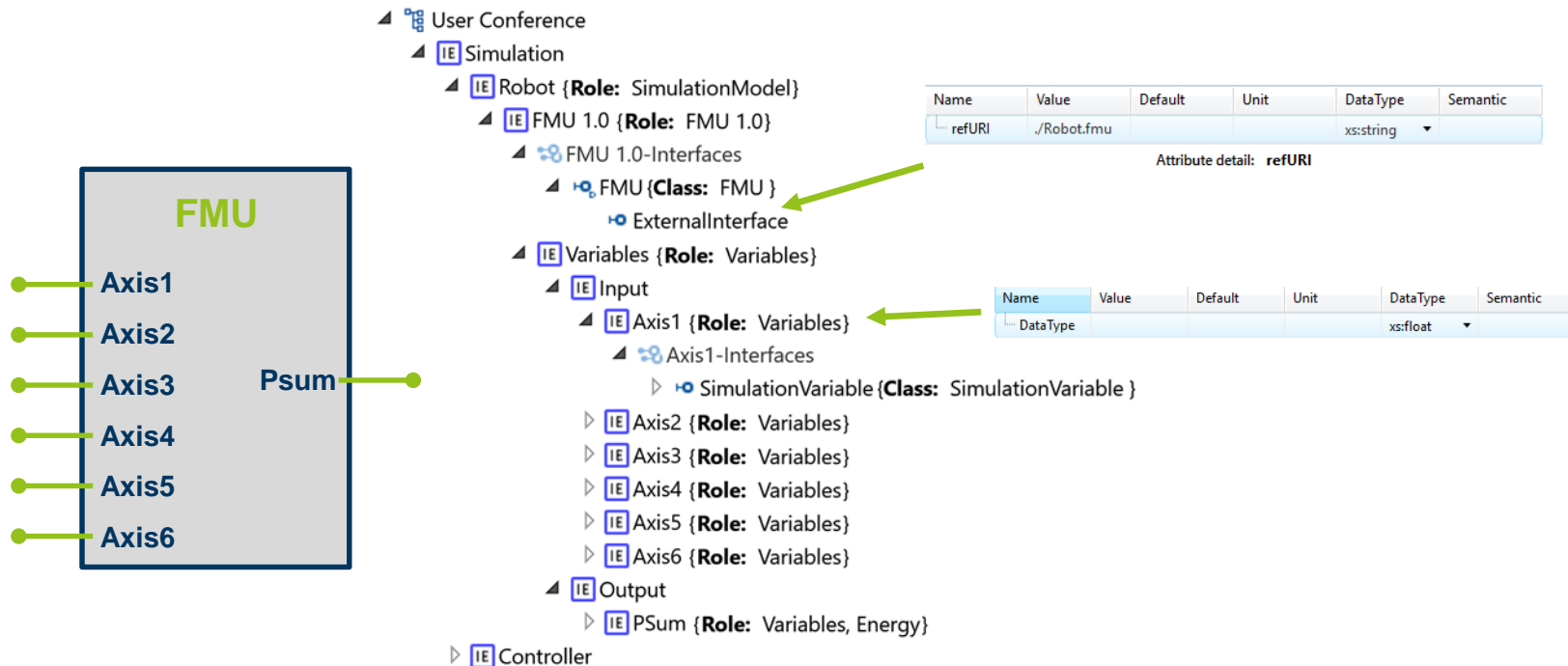


Robot Operating System (ROS)




- **Realistic Robot Simulation (RRS)**
 - Server-Client Architecture
 - Robot Controller Simulation (RCS) – modules are provided by the controller manufactures

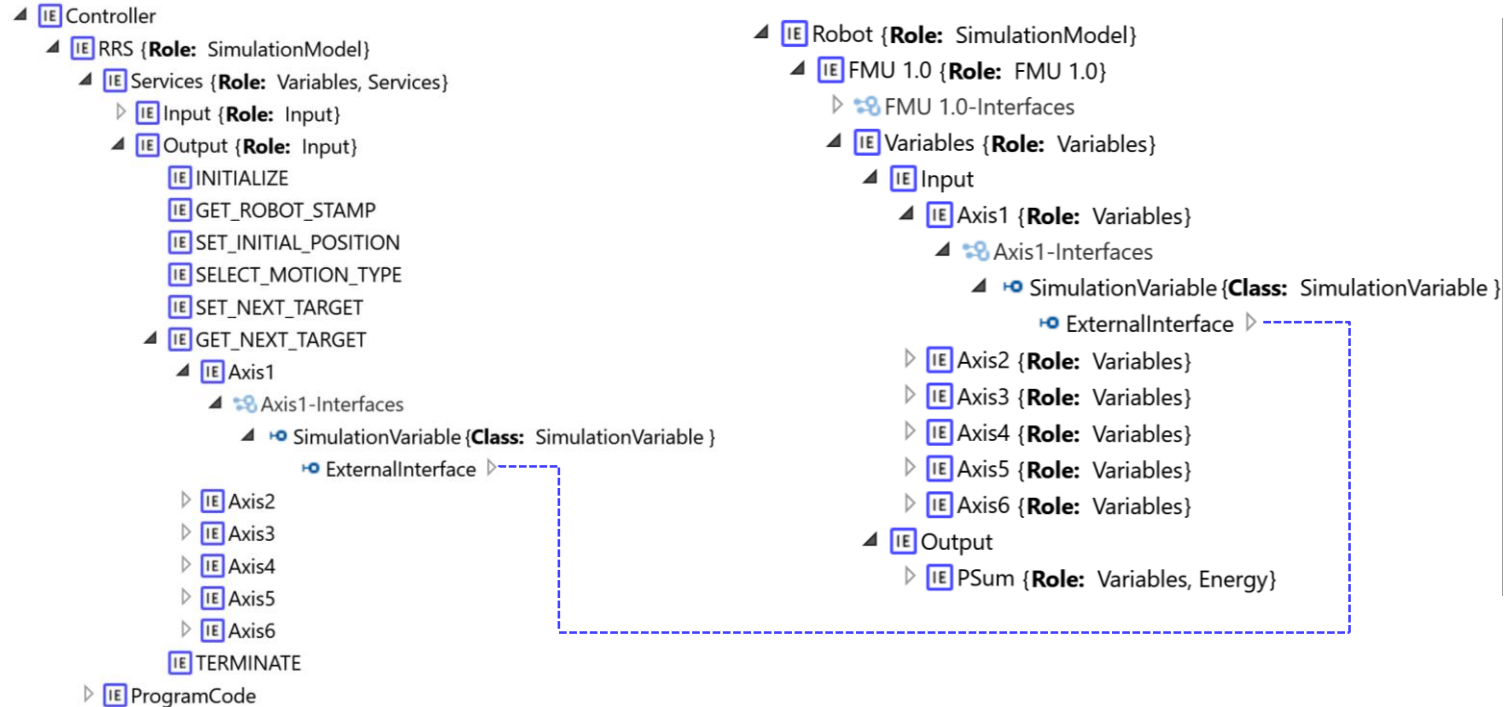




- ▲ **IE** Controller
 - ▲ **IE** RRS {**Role:** SimulationModel}
 - ▲ **IE** Services {**Role:** Variables, Services}
 - ▲ **IE** Input {**Role:** Input}
 - IE** INITIALIZE
 - IE** GET_ROBOT_STAMP
 - IE** SET_INITIAL_POSITION
 - IE** SELECT_MOTION_TYPE
 - IE** SET_NEXT_TARGET
 - IE** GET_NEXT_TARGET
 - IE** TERMINATE
 - ▲ **IE** Output {**Role:** Input}
 - IE** INITIALIZE
 - IE** GET_ROBOT_STAMP
 - IE** SET_INITIAL_POSITION
 - IE** SELECT_MOTION_TYPE
 - IE** SET_NEXT_TARGET
 - ▷ **IE** GET_NEXT_TARGET
 - IE** TERMINATE
 - ▷ **IE** ProgramCode



Name	Value	Default	Unit	DataType	Semantic
..... Opcode		101		xs:int ▼	
..... RobotNumber	1			xs:int ▼	
..... RobotPathName	./RRS/ABB/IR			xs:string ▼	
..... ModulePathName	./RRS/ABB			xs:string ▼	
..... ManipulatorType	IRB 6640-235			xs:string ▼	
..... CARRRSVersion	0			xs:int ▼	
..... Debug	0			xs:int ▼	



- **Production Systems have to adopt to renewable energy**
- **The SPEAR project will develop an optimization platform**
- **Model configuration for the Co-Simulation is executed with AutomationML**

- **Integrate other Roboter simulation tools like ABB RobotStudio, Gazebo or EKS Robsim**
- **Provide other possibilities for integrating robot program code**
- **Provide the configuration assistant as a web service**



Thank you for your kind attention!

Any questions?

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Chair of Production Systems

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