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ITEA 3 is a EUREKA strategic ICT cluster programme

Exploitable Results by Third Parties

16001 SPEAR

Project details

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Name: **rfFmu2Aml** (CA)		
Input(s):	Main feature(s)	Output(s):
▪ FMUs ▪ AML project file	▪ Import AML project files ▪ Import FMU models (Version 1.0& 2.0) ▪ Define FMU start input signals ▪ Link FMUs to devices into AML ▪ Export AMLX file with linked FMUs	▪ AMLX

Unique Selling Proposition(s):	▪ Import AML project files based on AutomationML standard ▪ Import FMU models based on Functional Mock-up Interface standard ▪ Export AMLX containers based on AutomationML standard
Integration constraint(s):	▪ FMU must be on FMI standard 1.0 and 2.0 ▪ AML files must be exported from DELMIA & ProcessSimulate (other AML exports are not tested) ▪ Windows 10 OS ▪ .NET Framework 4.6.1
Intended user(s):	▪ Mechanical Engineer ▪ Virtual Commissioning Engineer ▪ Project coordinator
Provider:	▪ EKS InTec GmbH
Contact point:	▪ Anton Strahilov, anton.strahilov@eks-intec.de
Condition(s) for reuse:	▪ License Required

Latest update: 10.08.2020

Name: **rfCSPy (SE)**		
Input(s):	Main feature(s)	Output(s):
▪ AMLX container ▪ FMUs	▪ Import AMLX as simulation configuration ▪ Ran synchronized simulation based on FMI 1.0 & FMI2.0 ▪ Communication with RF::Suite via ShM	▪ Ran Simulation results
Unique Selling Proposition(s):	▪ Real-time environment ▪ rfCSPy FMI 1.0 & 2.0 Co-Simulator ▪ Use AutomationML with FMUs	
Integration constraint(s):	▪ AMLX container exported via rfFmu2Aml ▪ FMU must be on FMI standard 1.0 and 2.0 ▪ Windows 10 OS ▪ Python 3.7 ▪ FMPy 0.2.11 Python Library	
Intended user(s):	▪ Virtual Commissioning Engineer ▪ Process Simulation Engineer	
Provider:	▪ EKS InTec GmbH	
Contact point:	▪ Anton Strahilov, anton.strahilov@eks-intec.de	
Condition(s) for reuse:	▪ License Required	
	Latest update: 10.08.2020	

Name: **rfFmu2Shm (RSC)**		
Input(s):	Main feature(s)	Output(s):
▪ None	▪ Send and receive signal values to / from rfCSPy in soft-real-time	▪ Online data

Unique Selling Proposition(s):	▪ Send & Receive data in soft-real-time from rfCSPy to ShM and vice versa (RF-Suite) ▪ rfFmu2Shm is a FMU based on FMI Version 2.0
Integration constraint(s):	▪ rfCSPy co-simulator is required
Intended user(s):	▪ Virtual Commissioning Engineer ▪ Process Simulation Engineer
Provider:	▪ EKS InTec GmbH
Contact point:	▪ Anton Strahilov, anton.strahilov@eks-intec.de
Condition(s) for reuse:	▪ Free FMU based on rfCSPy

Latest update: 10.08.2020

Name: **rfRos2ShM (RSC)**		
Input(s):	Main feature(s)	Output(s):
▪ Signal configuration from rfCSPy	▪ Send and receive signal values to / from ROS in soft-real-time	▪ Online data
Unique Selling Proposition(s):	▪ Send & Receive data in soft-real-time from / to ShM (RF-Suite) ▪ Using of ROS standard to split a co-simulation on several Single Board Computers (ARM)	
Integration constraint(s):	▪ C++ source code is required ▪ Code must compiled for each new configuration ▪ Windows 10 OS ▪ exported configuration from rfCSPy	
Intended user(s):	▪ Virtual Commissioning Engineer ▪ Process Simulation Engineer	
Provider:	▪ EKS InTec GmbH	
Contact point:	▪ Anton Strahilov, anton.strahilov@eks-intec.de	
Condition(s) for reuse:	▪ Open Source	
	Latest update: 10.08.2020	

Name: **rfSpearApp (SE & CA)**		
Input(s):	Main feature(s)	Output(s):
▪ Native ABB robot programs	▪ Ran real robot programs by different speed configuration for each sub robot program ▪ Export process description with corresponding energy profiles	▪ process description as XML file ▪ CSV files with all energy profiles for each sub-program
Unique Selling Proposition(s):	▪ Extracting of robot movements from real ABB robot programs ▪ Run of extracted robot programs by different speeds ▪ Get power flow & energy consumption of robot moves by different speeds ▪ Export of robot program process with energy profiles for rfProcessExpert	
Integration constraint(s):	▪ ABB robot programs only ▪ ABBRobotStudio 6.08 (rfSpearApp as Add-on) ▪ .NET Framework 4.6.1	
Intended user(s):	▪ Virtual Commissioning Engineer ▪ Process Simulation Engineer	
Provider:	▪ EKS InTec GmbH	
Contact point:	▪ Anton Strahilov, anton.strahilov@eks-intec.de	
Condition(s) for reuse:	▪ Add-On License Required (EKS InTec) ▪ ABBRobotStudio License Required (ABB)	
	Latest update: 10.08.2020	

Name: **rfProcessExpert (CA)**		
Input(s):	Main feature(s)	Output(s):
▪ XML & CSV file from rfSpearApp ▪ AMLX file rfFmu2Aml ▪ AML project file ▪ Real energy measurements as CSV file	▪ Add process description to an existing AML project file ▪ Add energy profiles to the process description ▪ Add plant devices to the process description ▪ Send Process description to the Optimization platform ▪ Request an process optimization from an Optimization Library Algorithm (OAL)	▪ process description as XML file ▪ CSV files with all energy profiles for each sub-program

Unique Selling Proposition(s):	▪ Simple describe of processes based on the SPEAR WP4 standard ▪ Request and comparison of optimisation results from OAL ▪ Perform of manual analysis
Integration constraint(s):	▪ FMU must be on FMI standard 1.0 and 2.0 ▪ AML files must be exported from DELMIA & ProcessSimulate (other AML exports are not tested) ▪ AMLX files must be exported from rfFmu2Aml ▪ XML & CSV file must be exported from rfSpearApp ▪ Windows 10 OS ▪ .NET Framework 4.6.1 ▪ Interface of the Optimization Library Algorithm (OAL) must be based on the SPEAR interface description
Intended user(s):	▪ Virtual Commissioning Engineer ▪ Process Simulation Engineer ▪ Production planer ▪ Maintenance engineers ▪ Production planer ▪ Energy planer
Provider:	▪ EKS InTec GmbH
Contact point:	▪ Anton Strahilov, anton.strahilov@eks-intec.de
Condition(s) for reuse:	▪ License Required
	Latest update: 10.08.2020

Name: **rfOpcUa2Op (RSC)**		
Input(s):	Main feature(s)	Output(s):
▪ none	▪ Send and receive signal values to / from real PLC in real-time	▪ Online data
Unique Selling Proposition(s):	▪ Send & Receive data in real-time from / to real PLC to RF::Suite via ShM as well as to optimization platform (OP) ▪ Using of OPC UA standard to communicate with a real PLC as server	
Integration constraint(s):	▪ Windows 10 OS ▪ .NET Framework 4.6.1 ▪ Interface of the Optimization Library Algorithm (OAL) must be based on the SPEAR interface description	
Intended user(s):	▪ Virtual Commissioning Engineer ▪ Process Simulation Engineer ▪ Production planer ▪ Maintenance engineers ▪ Production planer ▪ Energy planer	
Provider:	▪ EKS InTec GmbH	
Contact point:	▪ Anton Strahilov, anton.strahilov@eks-intec.de	
Condition(s) for reuse:	▪ License Required	
	Latest update: 10.08.2020	

Name: Power consumption on ABB Robot		
Input(s):	Main feature(s)	Output(s):
▪ Backup from an ABB Robot	▪ Evaluation tool that gives the ability to test different paths and speeds for the robot in an emulated environment and conclude a most green and economical movement for the robot.	▪ A more sustainable robot program

Unique Selling Proposition(s):	▪ One of a kind program for calculating power consumption
Integration constraint(s):	▪ ABB Robot with RobotWare later then RW6 ▪ Software RobotStudio
Intended user(s):	▪ Robot programmers ▪ Mechanical engineers ▪ Virtual Commissioning Engineer ▪ Project coordinator
Provider:	▪ AFRY
Contact point:	▪ Andreas Buhlin andreas.buhlin@afry.com
Condition(s) for reuse:	▪ License Required
	Latest update: 31.08.2020

Name: Making of FMU		
Input(s):	Main feature(s)	Output(s):
▪ Programs ▪ Documentation ▪ Product knowledge	▪ Standardize of virtual component for easy test and error handling	▪ Virtual commissioning and plug and play ▪ Increased value

Unique Selling Proposition(s):	▪ FMU makes it possible to standardize components of a production cell which gives a “plug and play” solution ▪ Increase the value of the product by making it easier to get in to production
Integration constraint(s):	▪ Good documentation of the working of the product
Intended user(s):	▪ Virtual Commissioning Engineer ▪ Product owner
Provider:	▪ AFRY
Contact point:	▪ Andreas Buhlin andreas.buhlin@afry.com
Condition(s) for reuse:	▪ License Required

Latest update: 31.08.2020

Name: Making of Real Digital Twin		
Input(s):	Main feature(s)	Output(s):
▪ Programs to components (Robot, PLC, HMI, SCADA) ▪ Documentation	▪ Validation of code ▪ Validation of safety system ▪ Design review in Virtual Reality ▪ Training of personnel in Virtual Reality ▪ Validation of future update of code and production	▪ Decreased downtime ▪ Shorter commissioning ▪ Short ramp up time

Unique Selling Proposition(s):	▪ Ability to test system before commissioning can show “surprises” that could be problem later in commissioning and production ▪ Possibility to test system before commissioning ▪ Ability to test new code or products for the system, without interfering with production
Integration constraint(s):	▪ PLC Siemens 1500-system ▪ ABB Robot ▪ TIA Portal ▪ PLC Sim Adv ▪ RobotStudio ▪ Simit ▪ CTE
Intended user(s):	▪ Virtual Commissioning Engineer ▪ Product owner ▪ Production planer ▪ Maintenance personnel ▪ Project coordinator
Provider:	▪ AFRY
Contact point:	▪ Andreas Buhlin andreas.buhlin@afry.com
Condition(s) for reuse:	▪ License Required
	Latest update: 31.08.2020

Name: Energy Manager in AGX		
Input(s):	Main feature(s)	Output(s):
▪ AGX simulation	▪ Calculating and extracting energies for motors, constraints and rigid bodies.	▪ Energy consumption for motors ▪ Work done by motors ▪ Change in potential energy for rigid bodies and constraints ▪ Kinetic energy and change in kinetic energy for rigid bodies ▪ Dissipation for rigid bodies and constraints

Unique Selling Proposition(s):	▪ Use of energy tracking in simulation models to develop: ○ Energy optimized model predictive control and trajectory planning ○ Energy optimized machine learning control systems ○ Energy optimized mechanical design ○ Energy optimized full system design, e.g. robot cells and entire factory lines
Integration constraint(s):	▪ Requires an installation of AGX Dynamics or AGX Dynamics for Unity.
Intended user(s):	▪ Autonomous systems engineer ▪ Machine learning engineer ▪ Control systems engineer ▪ Production planner ▪ CAD-designer ▪ Etc.
Provider:	▪ Algoryx Simulation AB
Contact point:	▪ contact@algoryx.se
Condition(s) for reuse:	▪ License for AGX Dynamics or AGX Dynamics for Unity. For some motors, the license must include the DriveTrain module.

Latest update: 31.08.2020

Name: Energy optimization of robot station algorithm		
Input(s):	Main feature(s)	Output(s):
▪ Robot programs ▪ Energy signatures per motion	▪ Computes the energy optimal speed for each robot motion ▪ Will keep the cycle time of the station	▪ Updated robot programs ▪

Unique Selling Proposition(s):	▪ Reduces the energy use of a robot station between 10-30% ▪ Reduces the peak power significantly ▪ Can be used with any robot since the results only tunes the speed of the robot motions
Integration constraint(s):	▪ An energy signature for each motion must be possible to compute using real measurements or accurate simulation. ▪ The optimization allows the robots to move slower instead of going full speed and then wait. Energy optimization is therefore only possible in stations where the robots sometimes need to wait for other operations.
Intended user(s):	▪ Automotive manufacturing or similar highly automated industries.
Provider:	▪ Chalmers University of Technology
Contact point:	▪ Kristofer.bengtsson@chalmers.se
Condition(s) for reuse:	▪ Open source ▪

Latest update: 31.08.2020

Name: Energy optimization of robot station algorithm		
Name: NX MCD Simulation		
Input(s):	Main feature(s)	Output(s):
▪ FMU ▪ CAD Model	▪ Roboter Simulation ▪ Energy Consumption Simulation ▪ Integration of FMUs ▪ Multibody Simulation with reactions	▪ Energy Consumption ▪ Visualization

Unique Selling Proposition(s):	▪ Energy consumption simulation based on real CAD Data ▪ Integration of FMU in development process
Integration constraint(s):	▪ FMU must be on FMI standard 1.0 and 2.0 ▪ CAD as STEP or Parasolid
Intended user(s):	▪ Mechanical Engineer ▪ Project coordinator
Provider:	▪ Reeb-Engineering
Contact point:	▪ Jörg Reeb, joerg.reeb@reeb-engineering.de
Condition(s) for reuse:	▪ License Required
	Latest update: 31.08.2020

Name: Visualization Use case AGV		
Input(s):	Main feature(s)	Output(s):
▪ FMU ▪ Path for AGV	▪ Realtime AGV energy consumption simulation ▪ Path optimization regarding time and energy consumption	▪ Visualization ▪ Real time energy consumption simulation
Unique Selling Proposition(s):	▪ Energy optimization for given paths ▪ AGV battery forecast	
Integration constraint(s):	▪ Path as points from a given starting point ▪ Minimum and maximum velocities and accelerations	
Intended user(s):	▪ Virtual Commissioning Engineer ▪ Project coordinator	
Provider:	▪ Reeb-Engineering	
Contact point:	▪ Jörg Reeb, joerg.reeb@reeb-engineering.de	
Condition(s) for reuse:	▪ License Required	
	Latest update: 31.08.2020	

Name: Energy Measurement		
Input(s):	Main feature(s)	Output(s):
▪ Real AGV ▪ Sensor	▪ Real Energy values of AGV ▪ Mass and velocity dependent measurements	▪ Energy consumption formulas ▪ Basis for FMUs

Unique Selling Proposition(s):	▪ Energy consumption for any AGV ▪ Simple adaption of FMUs due to the measurement results
Integration constraint(s):	▪ Definition of payload ▪ Velocity definition for use scenarios
Intended user(s):	▪ Virtual Commissioning Engineer ▪ Mechanical Engineer
Provider:	▪ Reeb-Engineering
Contact point:	▪ Jörg Reeb, joerg.reeb@reeb-engineering.de
Condition(s) for reuse:	▪ Measurement setup

Latest update: 31.08.2020

Name: Joystick for manual AGV control in Siemens NX MCD		
Input(s):	Main feature(s)	Output(s):
▪ 3-axis Joystick ▪ Arduino data	▪ SHM Y200 linking in Siemens NX MCD ▪ Movement of AGV via Joystick	▪ Energy consumption of manual path in real time ▪ Virtual AGV control

Unique Selling Proposition(s):	▪ Energy consumption for any AGV in manual mode ▪ Industry 3-axis Joystick for realistic controlling behaviour
Integration constraint(s):	▪ 3-axis
Intended user(s):	▪ Virtual Commissioning Engineer ▪ Mechanical Engineer
Provider:	▪ Reeb-Engineering
Contact point:	▪ Jörg Reeb, joerg.reeb@reeb-engineering.de
Condition(s) for reuse:	▪ License Required
	Latest update: 31.08.2020

Name: KANCA EMS (Energy Management System)		
Input(s):	Main feature(s)	Output(s):
▪ Induction Furnace Consumption (kWh) ▪ Forging Line Electric Consumption (kWh) ▪ Electric consumption for pressurized air (kWh) ▪ Billet Temperature (C°) ▪ Billet Frequency ▪ Product information from SAP System ▪ Price information (manually per month)	▪ Calculates kWh/kg online & real-time ▪ Calculates, evaluates and logs electrical anomalies ▪ Counts and calculates the cost of reworks online & real-time ▪ Logs values based on the inputs and SAP information ▪ Calculates consumption per single product. ▪ Line-ups the products based on Energy Efficiency	▪ Online Screens (Dashboards) for technical users ▪ kWh/kg value and energy cost of the single automotive product ▪ Warning messages and Logs ▪ Temperature records and Scrap records.

Unique Selling Proposition(s):	▪ EMS (Energy Management Systems) are not generally integrated with MES (Manufacture Enterprise Systems). That's why production facilities should buy one of each from different integrators and apply to their System. ▪ In our Case Study the Scada System is unique because there is only one system can do all the Scada Features, Recordings, evaluation and act.
Integration constraint(s):	▪ WinCC ▪ SAP System (ERP Software) ▪ Energy Doctor & Energy Medic ▪ ENTES Energy Analyzer Hardware & Software ▪ Windows Server Software & Licensing
Intended user(s):	▪ Energy Efficiency Management (Manager) ▪ Production Leader (Manager) & chiefs & responsible ▪ Maintenance Manager & workers & technicians ▪ Machine Operators
Provider:	▪ Kanca El Aletleri Çelik Dövme Sanayi A.Ş. ▪ ENTES
Contact point:	▪ Erkut.findik@kanca.com.tr ▪ Taner.makas@kanca.com.tr
Condition(s) for reuse:	▪ Terms will be discussed for a possible consultancy only. (As Kanca and Entes we could only give consultancy for an intended user.)
	Latest update: 31.08.2020

Name: **Instant Data Collector**		
Input(s):	Main feature(s)	Output(s):
▪ Analyzer device ▪ Connected modem info ▪ Connection info ▪ Power line	▪ Read instant data from device in a specific period ▪ Evaluate parameter values using parameter data type and multiplier ▪ Record device data to DB	▪ DB Record ▪ Real-Time Data
Unique Selling Proposition(s):	▪ Multiple communication protocols support ▪ Auto detection of device model ▪ Concurrent readings with asynchronous architecture ▪ Cross-platform, operating system independent	
Integration constraint(s):	▪ Communication protocol library (e.g. modbus) ▪ DB connection ▪ .NET Core Framework >=3.0	
Intended user(s):	▪ Software Engineer ▪ DB Admin ▪ Researcher	
Provider:	▪ ENTES Elektronik Cihazlar Imalat ve Ticaret A.S.	
Contact point:	▪ Cem Şengezer, csengezer@entes.com.tr	
Condition(s) for reuse:	▪ License Required (ENTES)	
	Latest update: 31.08.2020	

Name: **Periodic Data Collector**		
Input(s):	Main feature(s)	Output(s):
▪ Analyzer device with logging ability ▪ Connected modem info ▪ Connection info ▪ Power line	▪ Read historical log data from device ▪ Evaluate parameter values using parameter data type and multiplier ▪ Record device data to DB	▪ DB Record ▪ Data from device logs
Unique Selling Proposition(s):	▪ Acquire past data from a newly-connected device ▪ Multiple communication protocols support ▪ Auto detection of device model ▪ Concurrent readings with asynchronous architecture ▪ Cross-platform, operating system independent	
Integration constraint(s):	▪ Communication protocol library (e.g. modbus) ▪ DB connection ▪ .NET Core Framework >=3.0	
Intended user(s):	▪ Software Engineer ▪ DB Admin ▪ Researcher	
Provider:	▪ ENTES Elektronik Cihazlar Imalat ve Ticaret A.S.	
Contact point:	▪ Cem Şengezer, csengezer@entes.com.tr	
Condition(s) for reuse:	▪ License Required (ENTES)	
	Latest update: 31.08.2020	

Name: **Periodic Values**		
Input(s):	Main feature(s)	Output(s):
▪ DB records of device log data ▪ Date range ▪ Device Id ▪ Parameter Id	▪ Get historical log data of device for a specific date ▪ Visualize periodic data in line chart	▪ Array of values for all phases by device log period
Unique Selling Proposition(s):	▪ Acquire historical data even after connection problems ▪ Acquire past data from a newly-connected device ▪ Cross-platform, operating system independent ▪ Visually analyze parameter data trends	
Integration constraint(s):	▪ DB connection ▪ ApexCharts.js library ▪ .NET Core Framework >=3.0	
Intended user(s):	▪ End user ▪ Energy solution provider ▪ Energy planner ▪ Electrical engineer	
Provider:	▪ ENTES Elektronik Cihazlar Imalat ve Ticaret A.S.	
Contact point:	▪ Cem Şengezer, csengezer@entes.com.tr	
Condition(s) for reuse:	▪ License Required (ENTES)	
	Latest update: 31.08.2020	

Name: **Facility Comparison**		
Input(s):	Main feature(s)	Output(s):
▪ DB records of energy consumption data ▪ Dates range ▪ Facility categories	▪ Get energy consumption data for all facilities for specific dates range ▪ Find out facility consumption averages among similar facilities ▪ Evaluate facility consumption differences among similar facilities ▪ Export consumption, averages and differences data to excel	▪ Energy consumption values of all facilities ▪ Energy consumption averages of facility categories ▪ Energy consumption deviations of facilities ▪ Excel exported data ▪
Unique Selling Proposition(s):	▪ Compare energy consumptions for similar facilities and plan energy efficiency strategies ▪ Find out the best and the worst facilities for energy costs ▪ Evaluate facility consumptions in a category-based context	
Integration constraint(s):	▪ DB connection ▪ .NET Core Framework >=3.0 ▪ NPOI Excel Export Library =2.4.1	
Intended user(s):	▪ End user ▪ Energy solution provider ▪ Energy planner ▪ Electrical engineer	
Provider:	▪ ENTES Elektronik Cihazlar Imalat ve Ticaret A.S.	
Contact point:	▪ Cem Şengezer, csengezer@entes.com.tr	
Condition(s) for reuse:	▪ License Required (ENTES)	
		Latest update: 31.08.2020

Name: **Consumption Details**		
Input(s):	Main feature(s)	Output(s):
▪ DB records of energy consumption data ▪ Dates (Date-1 and Date-2) ▪ Display period ▪ Facility Id ▪ Energy type ▪ Display unit	▪ Get energy/gas/water consumption data for specific dates ▪ Visualize energy data in line chart ▪ Compare consumptions change for two dates ▪ Evaluate consumption data for all facility floor, section and loads ▪ Export consumption details data to excel	▪ Array of values for all selected dates by display period ▪ Table data ▪ Chart data ▪ Excel exported data

Unique Selling Proposition(s):	▪ Evaluate energy/gas/water consumptions and plan energy costs ▪ Cross-platform, operating system independent ▪ Visually analyze consumption data trends ▪ Find out energy usage of sections of facility ▪ Find out energy usage of load categories of facility ▪ Plan energy consumption costs by comparing similar dates
Integration constraint(s):	▪ DB connection ▪ ApexCharts.js library ▪ NPOI Excel Export Library =2.4.1 ▪ .NET Core Framework >=3.0
Intended user(s):	▪ End user ▪ Energy solution provider ▪ Energy planner ▪ Electrical engineer
Provider:	▪ ENTES Elektronik Cihazlar Imalat ve Ticaret A.S.
Contact point:	▪ Cem Şengezer, csengezer@entes.com.tr
Condition(s) for reuse:	▪ License Required (ENTES)

Latest update: 31.08.2020

Name: **Facility Building**		
Input(s):	Main feature(s)	Output(s):
▪ Facility Id ▪ Facility floors data ▪ Facility sections data ▪ Facility loads data	▪ Visually design facility floor and section layout ▪ Visually add energy consumption devices (loads) to sections ▪ Match real world devices to facility floor/section or loads ▪ Name and define load properties for reporting purposes	▪ Facility layout info ▪ Facility layout-device matches ▪ Facility load properties

Unique Selling Proposition(s):	▪ Materialize and integrate abstract device data to visual facility layout data ▪ Easily visualize facility layout with isometric design ▪ Enable facility/floor/section/load based evaluation (not device) for energy reports
Integration constraint(s):	▪ DB connection ▪ .NET Core Framework >=3.0 ▪ Angular.js library
Intended user(s):	▪ End user ▪ Energy solution provider ▪ Energy planner ▪ Electrical engineer
Provider:	▪ ENTES Elektronik Cihazlar Imalat ve Ticaret A.S.
Contact point:	▪ Cem Şengezer, csengezer@entes.com.tr
Condition(s) for reuse:	▪ License Required (ENTES)

Latest update: 31.08.2020

Name: **Robot simulation with ROS (SE)**		
Input(s):	Main feature(s)	Output(s):
▪ Goal point(s) for path planning (visual or textual format)	▪ adapted model of the IRB 6700-235 robot ▪ path planning with the ROS industrial component MoveIt ▪ visualisation with the ROS components Rviz and Gazebo	▪ (Visualised) path, values for joint angles over time
Unique Selling Proposition(s):	▪ Usage of ROS standard components: MoveIt, Rviz, Gazebo for path planning and visualisation	
Integration constraint(s):	▪ Ubuntu 18.04 on a desktop PC (for simulation and visualisation) ▪ Ubuntu Mate on a RaspberryPi (for simulation)	
Intended user(s):	▪ Simulation Engineer	
Provider:	▪ Paderborn University	
Contact point:	▪ Bernd Kleinjohann, bernd.kleinjohann@c-lab.de ▪ Lisa Kleinjohann, lisa.kleinjohann@c-lab.de ▪ Jan Stenner, jan.stenner@upb.de ▪ Nils Weidmann, nils.weidmann@upb.de	
Condition(s) for reuse:	▪ Software available on request	
	Latest update: 31.08.2020	

Name: **Development and simulation of a robot arm (SE)**		
Input(s):	Main feature(s)	Output(s):
▪ Goal states for the joints	▪ simple robot arm with six joints, built using servo motors	▪ Energy consumption values ▪ further physical data
Unique Selling Proposition(s):	▪ Demonstration of the connection of real production hardware to a simulation environment ▪ FMI and ROS standards in use	
Integration constraint(s):	▪ PyFMI library ▪ ROS components Gazebo and Rviz ▪ ROS industrial component MoveIt	
Intended user(s):	▪ Simulation Engineer	
Provider:	▪ Paderborn University	
Contact point:	▪ Bernd Kleinjohann, bernd.kleinjohann@c-lab.de ▪ Lisa Kleinjohann, lisa.kleinjohann@c-lab.de ▪ Jan Stenner, jan.stenner@upb.de ▪ Nils Weidmann, nils.weidmann@upb.de	
Condition(s) for reuse:	▪ Software available on request	
	Latest update: 31.08.2020	

Name: **Dashboard for energy model allocation (SE)**		
Input(s):	Main feature(s)	Output(s):
▪ Energy models in FMU format	▪ Multiple energy models (FMUs) can be run in parallel on different Raspberry Pis to simulate the energy consumption of physical components. ▪ FMUs can be allocated to a Raspberry Pi at run-time via a dashboard running on a desktop computer.	▪ ROS messages with energy values and time stamps
Unique Selling Proposition(s):	▪ Scalability due to distributed simulation on low-cost hardware ▪ Configurability via a single dashboard for all simulated components	
Integration constraint(s):	▪ Raspbian on RaspberryPi ▪ FMPy library	
Intended user(s):	▪ Simulation Engineer	
Provider:	▪ Paderborn University	
Contact point:	▪ Bernd Kleinjohann, bernd.kleinjohann@c-lab.de ▪ Lisa Kleinjohann, lisa.kleinjohann@c-lab.de ▪ Jan Stenner, jan.stenner@upb.de ▪ Nils Weidmann, nils.weidmann@upb.de	
Condition(s) for reuse:	▪ Software available on request	
	Latest update: 31.08.2020	

Name: **Energy model simulation with remote startup (SE)**		
Input(s):	Main feature(s)	Output(s):
▪ Energy models in FMU format ▪ ROS messages containing the system state (e.g. in form of joint angles)	▪ energy models can be simulated on different platforms ▪ output values can be visualised by a Python-based web application (flask)	▪ ROS messages containing physical data, such as load and speed, for computing the energy consumption
Unique Selling Proposition(s):	▪ RaspberryPis can be added at runtime to simulate further physical components ▪ Remote startup functionality makes it unnecessary to connect I/O devices to the RaspberryPi	
Integration constraint(s):	▪ The energy model has the form of an FMU compiled for a certain platform (while all common platforms are supported)	
Intended user(s):	▪ Simulation Engineer	
Provider:	▪ Paderborn University	
Contact point:	▪ Bernd Kleinjohann, bernd.kleinjohann@c-lab.de ▪ Lisa Kleinjohann, lisa.kleinjohann@c-lab.de ▪ Jan Stenner, jan.stenner@upb.de ▪ Nils Weidmann, nils.weidmann@upb.de	
Condition(s) for reuse:	▪ Software available on request	
	Latest update: 31.08.2020	

Name: AMLX Configuration Assistance (CA)		
Input(s):	Main feature(s)	Output(s):
▪ FMUs ▪ AMLX Container	▪ Import FMUs ▪ Import AMLX Container ▪ Connect Variables of multiple FMUs ▪ Export valid AMLX-Container with integrated Energy Models as FMU and Meta-Data provided as AutomationML-Document	▪ AMLX
Unique Selling Proposition(s):	▪ Convert FMUs to valid AMLX Container without any expertise or manual effort ▪ Connect multiple FMUs and provide them standardized for automatic configuration of the simulation environment	
Integration constraint(s):	▪ FMU must be on FMI standard 1.0 and 2.0	
Intended user(s):	▪ Mechanical Engineer ▪ Virtual Commissioning Engineer ▪ Energy Model Provider (Component manufacturer)	
Provider:	▪ Ruhr-Universität Bochum	
Contact point:	▪ Jannis Sinnemann, sinnemann@lps.rub.de	
Condition(s) for reuse:	▪ Open source	
	Latest update: 31.08.2020	

Name: Sistrade Energy Data Acquisition Platform		
Input(s):	Main feature(s)	Output(s):
▪ Equipment Analog Consumption Measurement	▪ Acquire energy consumption data from legacy production equipments (retrofitting) ▪ Acquisition of 60 energy descriptor signals per equipment (three-phase)	▪ Digital Consumption Data (60 energy descriptor signals per monitored equipment)
Unique Selling Proposition(s):	▪ Virtually compatible with all software energy management platforms ▪ Unlimited scalability ▪ Possibility of implementation on legacy production equipments as part of transition to Industry 4.0 paradigm (bottom up data flow) ▪ Allows productive equipment monitoring and usage without the expense of having to buy new equipments ▪ Possibility of plug-and-play integration with Sistrade Energy Optimization Platform ▪ Unlimited data history collection ▪ Possibility of integration with industrial SCADA systems	
Integration constraint(s):	▪ Total equipment chain length needs to be less than 2km	
Intended user(s):	▪ Companies with legacy analog equipments with no sensors ▪ Plant Managers	
Provider:	▪ Sistrade Software Consulting, SA	
Contact point:	▪ Regina Correia, regina.correia@Sistrade.com	
Condition(s) for reuse:	▪ License Required	
	Latest update: 31.08.2020	

Name: Sistrade Energy Optimization Platform		
Input(s):	Main feature(s)	Output(s):
▪ Digital Energy Data (Real Machine Data Acquisition) ▪ Production Data ▪ Energy Models ▪ User Parameters ▪ Energy Suppliers	▪ Energy Tariffs Management ▪ Energy Provider Management ▪ Multiple Energy Management (Electricity, Gas, etc) ▪ Equipment Energy Mapping ▪ Energy Sensor Management ▪ Full integration of Energy Data (Consumption and Forecast) with production data (Products, Production Orders, User, sites) ▪ Real-time Energy consumption monitoring, with possibility of drill down ▪ Real-time Energy consumption prognosis ▪ Historic Consultation ▪ Multi user and Multi Role management ▪ Assessment of economic gains ▪ Assessment of energy savings ▪ Simulation – hypothesis testing of alternative energy-efficient production scenarios ▪ Decision Support for enhanced energy consumption ▪ Effective user modelling and permission system	▪ Production and Energy data ▪ Reports (Visual and textual) ▪ Energy Data feedback to production systems (MES and ERP)
Unique Selling Proposition(s):	▪ Fully integrated monitoring/prognosis/optimization platform, fully integrating energy data acquisition with production data ▪ Flexibility: ability of effectively mapping energy consumption on diverse industrial equipments, layouts, with different types of sensing options ▪ Specific optimization-tailored solution (versus energy management solution) ▪ Plug-and-play integration with different data acquisition platforms ▪ Possibility of standalone use or with different ERP/MES/Production Management Systems ▪ Visibility of economic gains ▪ Enhanced Decision Support through integration with ML-powered energy prognosis ▪ Multi device-ready: available for Industrial Andon Boards, touch screens, Computers, Tablets and Smartphones ▪ Quick Installation and Easy to use	

Name: Sistrade Energy Optimization Platform	
Integration constraint(s):	▪ Data acquisition platform should contain data in SQL-compliant database for plug-and-play integration
Intended user(s):	▪ Production managers ▪ Top managers ▪ Maintenance managers ▪ Operators
Provider:	▪ Sistrade Software Consulting, SA
Contact point:	▪ Regina Correia, regina.correia@sistrade.com
Condition(s) for reuse:	▪ License Required
	Latest update: 31.08.2020

Name: Common Interface for Production Optimization Algorithms		
▪ Input(s):	▪ Main feature(s)	▪ Output(s):
▪ None	A document describing the common optimization API used by the different algorithms deployed in SPEAR, that can possibly be used as a more general API for industrial process optimization.	▪ None

Unique Selling Proposition(s):	• well-designed and consistent API following extended discussion with all partners in the SPEAR consortium • provides a range of possible model elements and features, such as variable energy prices and availability, tasks that can be executed in different modes, or intermediate products and other resources • aims to foster the interoperability of different optimization servers and clients, allowing a broader range of clients or servers to work with
Integration constraint(s):	• Servers and clients implementing the API have to use the REST and JSON format; respective libraries are available for most languages
Intended user(s):	• Users and providers of industrial optimization and scheduling algorithms
Provider:	• TU Berlin • ISEP
Contact point:	• Tobias Küster <tobias.kuester@dai-labor.de>
Condition(s) for reuse:	• Document will be published at the end of the project
	Latest update: 31.08.2020

Name: TUB Optimization Algorithm		
▪ Input(s):	▪ Main feature(s)	▪ Output(s):
Optimization Request	The (unnamed) Optimization Algorithm implemented for SPEAR by TU Berlin	Optimization Result / Schedule

Unique Selling Proposition(s):	• uses a genetic algorithm to find a (near) optimal production schedule for the given request • takes into account, among others, different task modes, variable energy prices and availability, and intermediate resources, including e.g. the SoC of buffer batteries • multi-objective optimization, can be used to optimize for energy costs, total energy usage, makespan, or a combination of those factors • optionally, a graphical UI can be used for configuring the optimization, loading requests, and viewing the results and intermediate steps
Integration constraint(s):	• Maven (for building) • Java 11 • can be used “headless” or with graphical UI
Intended user(s):	• Researchers who want to extend the algorithms • industrial users who want to adapt it to their own requirements not covered by the common API
Provider:	• TU Berlin
Contact point:	• Tobias Küster <tobias.kuester@dai-labor.de>
Condition(s) for reuse:	• Source code available upon request (negotiable, possibly to be open-sourced later)
	Latest update: 31.08.2020

Name: TUB Optimization Server		
▪ Input(s):	▪ Main feature(s)	▪ Output(s):
Optimization Request (JSON)	Server providing different REST services, making available the TUB Optimization Algorithm following the Common API, as a Docker image.	Optimization Result / Schedule (JSON)

Unique Selling Proposition(s):	• The afore-mentioned optimization algorithm, packages as a Docker image for easy deployment and use, providing the TUB optimization algorithm as a REST service following the common API • a second service for configuring the optimization algorithm (e.g. what mutation operations to use) • can be used via interactive Web UI or via REST service call
Integration constraint(s):	• Docker Runtime, available for all OS • about 800 MB of RAM for the image, possibly more for the shared Docker runtime itself
Intended user(s):	• Businesses who want to offer optimization services to clients • industries who want to self-host the optimization server
Provider:	• TU Berlin
Contact point:	• Tobias Küster <tobias.kuester@dai-labor.de>
Condition(s) for reuse:	• Docker image freely available on Docker Hub
	Latest update: 31.08.2020

Name: SPEAR_EM_Library		
Input(s):	Main feature(s)	Output(s):
▪ Parameters ▪ Boundary Conditions ▪ Measurements	▪ Framework for energy consumption modelling of production components ▪ Standardized definition of interfaces ▪ Use of well-established Modelica language ▪ Examples and use cases ▪ Python utilities supporting parametrization, automatic energy profiles generation and export of FMUs	▪ FMUs ▪ Energy Profiles to be used by optimizer or consumption dashboard
Unique Selling Proposition(s):	▪ Flexibility: customization for specific problems and easily extensible ▪ Platform independent ▪ Compatibility with several simulation environments ▪ Supports large number of physical domains and accurycy/performance levels ▪ Promotes collaboration, reuse and Know-How exchange	
Integration constraint(s):	▪ Modelica Solver / compiler, e.g. OpenModelica or JModeilca ▪ Python 3.7 environment ▪ FMU simulation environment, e.g. PyFMI , FMPy	
Intended user(s):	▪ Virtual Commissioning Engineer ▪ Process Simulation and Optimization Engineer ▪ Research Engineer	
Provider:	▪ TWT GmbH Science & Innovation	
Contact point:	▪ Alejandro Cárdenas Miranda, alejandro.cardenas@twt-gmbh.de	
Condition(s) for reuse:	▪ Conditional ▪ Only through commercial / research partnerships	
	Latest update: 31.08.2020	

Name: Experis Simulator		
Input(s):	Main feature(s)	Output(s):
▪ Energy profile ▪ Appliances profiles ▪ Environmental data ▪ Production data	▪ Modelling of industry production processes modelling following System Dynamics ▪ Products Demand Simulation ▪ Energy Consumption (& Carbon footprint) Simulation	▪ Demand forecast ▪ Energy consumption forecast ▪ Carbon footprint forecast
Unique Selling Proposition(s):	▪ Models demand taking into account external variables such as time of the year ▪ Allows to simulate the energy consumption based on the forecasted demand and the energy profiles of the different appliances	
Integration constraint(s):	▪ Requires energy profile of used appliances	
Intended user(s):	▪ Any type of bakery / coffee shop	
Provider:	▪ Experis	
Contact point:	▪ Gema Maestro - gema.maestro@experis.es	
Condition(s) for reuse:	▪ Affero GPL.	
Latest update: 31.08.2020		

Name: Experis Optimizer		
Input(s):	Main feature(s)	Output(s):
▪ Available data sources ▪ Energy requirements ▪ Energy profile	▪ Optimization of the combination of sources that satisfy the energy requirements, according to the energy profile	▪ Combination of sources and amount of energy required from each of them
Unique Selling Proposition(s):	▪ Provides the end user with more control over the energy sources the purchase their energy from ▪ Allows to optimize the purchase of energy, helping to save costs and ensuring a known origin of the energy.	
Integration constraint(s):	▪ Energy sources must provide the energy available in equal time intervals ▪ Energy sources must indicate if their origin is green	
Intended user(s):	▪ Any type of intelligent building: homes, shops, offices, industries, sport facilities	
Provider:	▪ Experis	
Contact point:	▪ Gema Maestro - gema.maestro@experis.es	
Condition(s) for reuse:	▪ Apache	
Latest update: 31.08.2020		

Name: Experis Marketplace		
Input(s):	Main feature(s)	Output(s):
▪ Combination of offers to purchase ▪ User information	▪ Allows to purchase a combination of energy sources	▪ Confirmation of the purchase

Unique Selling Proposition(s):	▪ Allows small energy providers to make their excess energy available and consumers to have more control over the sources they consume
Integration constraint(s):	▪ Infrastructure must allow for this scenario to be implemented
Intended user(s):	▪ Any type that requires transaction system to enable services purchase or transaction traceability
Provider:	▪ Experis
Contact point:	▪ Gema Maestro - gema.maestro@experis.es
Condition(s) for reuse:	▪ Apache

Latest update: 31.08.2020