

**The Industrial OMiLAB Innovation Corner in Vienna:
Modelling of Intelligent Behaviour
Dr. Robert Woitsch, BOC, Vienna, Austria**

Agenda



- ▶ Introduction
- ▶ The OMiLAB Innovation Corner
 - ▶ Setting of OMiLAB Innovation Corner
 - ▶ Actions within OMiLAB Innovation Corner
- ▶ The H2020 EU Project Change2Twin: Focus Business Model Creation
 - ▶ Usage of the OMiLAB Innovation Corner
 - ▶ Extension of the OMiLAB Innovation Corner
- ▶ The H2020 EU Project BIMERR: Focus on Organisational Model
 - ▶ Usage of the OMiLAB Innovation Corner
 - ▶ Extension of the OMiLAB Innovation Corner
- ▶ The FFG Project complAI: Focus on Robot Interaction
 - ▶ Usage of the OMiLAB Innovation Corner
 - ▶ Extension of the OMiLAB Innovation Corner
- ▶ Reflection and Next Steps



Digital Environments in Action

An Introduction

Introduction

Mega Trend: Digital Transformation

<http://reports.weforum.org/digital-transformation/>

Digital Transformation via new Business Models

https://www.youtube.com/watch?v=fZ_JOBCLF-I

Digital Optimisation via improved Business Models

<http://www.vrcoaster.com/>

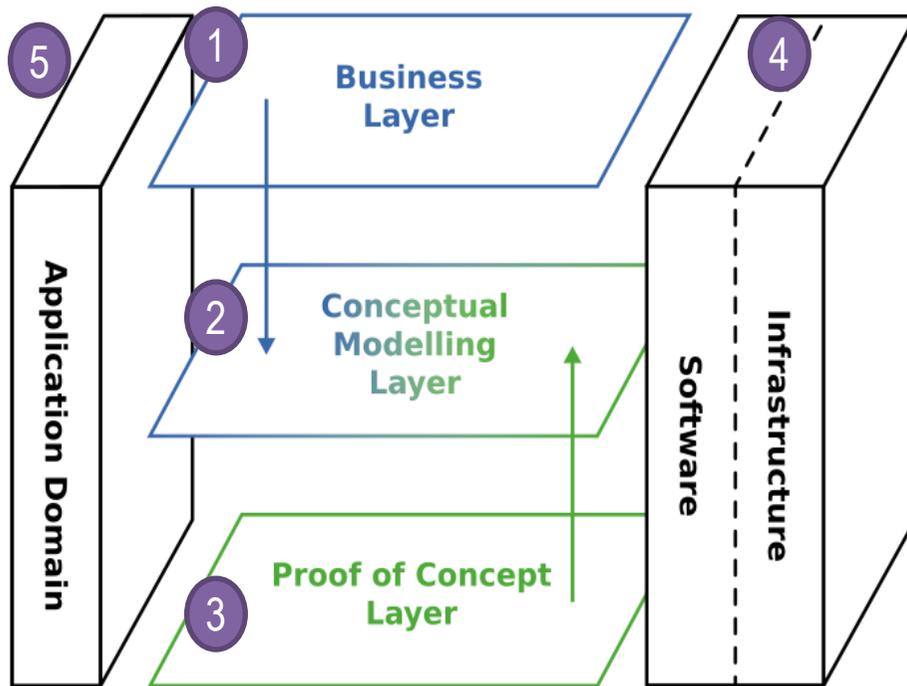


OMiLAB Innovation Corner



The **Challenge for organisations** is to identify those **AI and & robotic services** that **support making business** and avoid those digital services that raise risks, are **incompliant, raise difficulties or do not pay off.**

OMiLAB – Open Innovation for Digital Transformation



Innovate, Develop and Evaluate Digital Services considering:

1. **Scenario Layer** – using Scene2Model Environment
2. **Conceptual Model Layer** – using the Bee-Up Tool
3. **Run-time Layer** – using Dobot Magician, Makeblock mbot
4. **Software** – using ADOxx, OLIVE, ...
5. **Application Domain**: i.e. Factory of the Future



The H2020 EU-Project Change2Twin: Focus on Business Model Creation

An Introduction

Project Fact Sheet



#	Short Name	Country
1	SINTEF	Norway
2	TTTECH	Austria
3	JOTNE	Norway
4	FB	Poland
5	TNO	Netherlands
6	BOC	Austria
7	UNIBO	Italy
8	CLOUDB	Switzerland
9	IR	France

#	Short Name	Country
10	HPCPSN	Poland
11	SPS	Germany
12	CORDIS	Netherlands
13	UNIT040	Netherlands
14	AUTHOR-E	Netherlands
15	ADDITIVE	Netherlands
16	GRAPHENSTONE	Spain
17	CT-Ingenieros	Spain
18	AETNA	Italy

Funding: *H2020-EU Project*

Project Type: *I4MS IA*

Start: *01.06.2020*

End: *31.05.2024*

Project Budget: *8 960 414 EUR* www.change2twin.eu



This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 951956.

“The main ambition of Change2Twin is to ensure that 100% of manufacturing companies in Europe have access to 100% of technologies needed to deploy a digital twin.”

Change2Twin will adopt the best practices developed so far in [I4MS](#):

- ▶ helping **manufacturing SMEs** in their digitalization efforts
- ▶ focusing on local support provided by **Digital Innovation Hubs (DIH)**
- ▶ Releasing **cascade grants** in two open calls:
- ▶ Specifically, we focus on three sub-objectives:
 - ▶ Developing and providing a truly end-to-end service to the manufacturing SMEs where the end user receives from its local, trusted party (DIH) a **thorough analysis of the digitalization potential** and a cross-border, ready-to-use recipe for implementation involving both components providers and an integrator.
 - ▶ Providing an **architecture-agnostic technology marketplace** with dedicated **knowledge models** supporting the DIH preparing the recipe for a **complete solution** in selecting the best components and most suitable providers for the SME.
 - ▶ Finding the minimal **interoperable model** facilitating modularity, composability and interchangeability of components used, regardless of the individual architectures or frameworks.

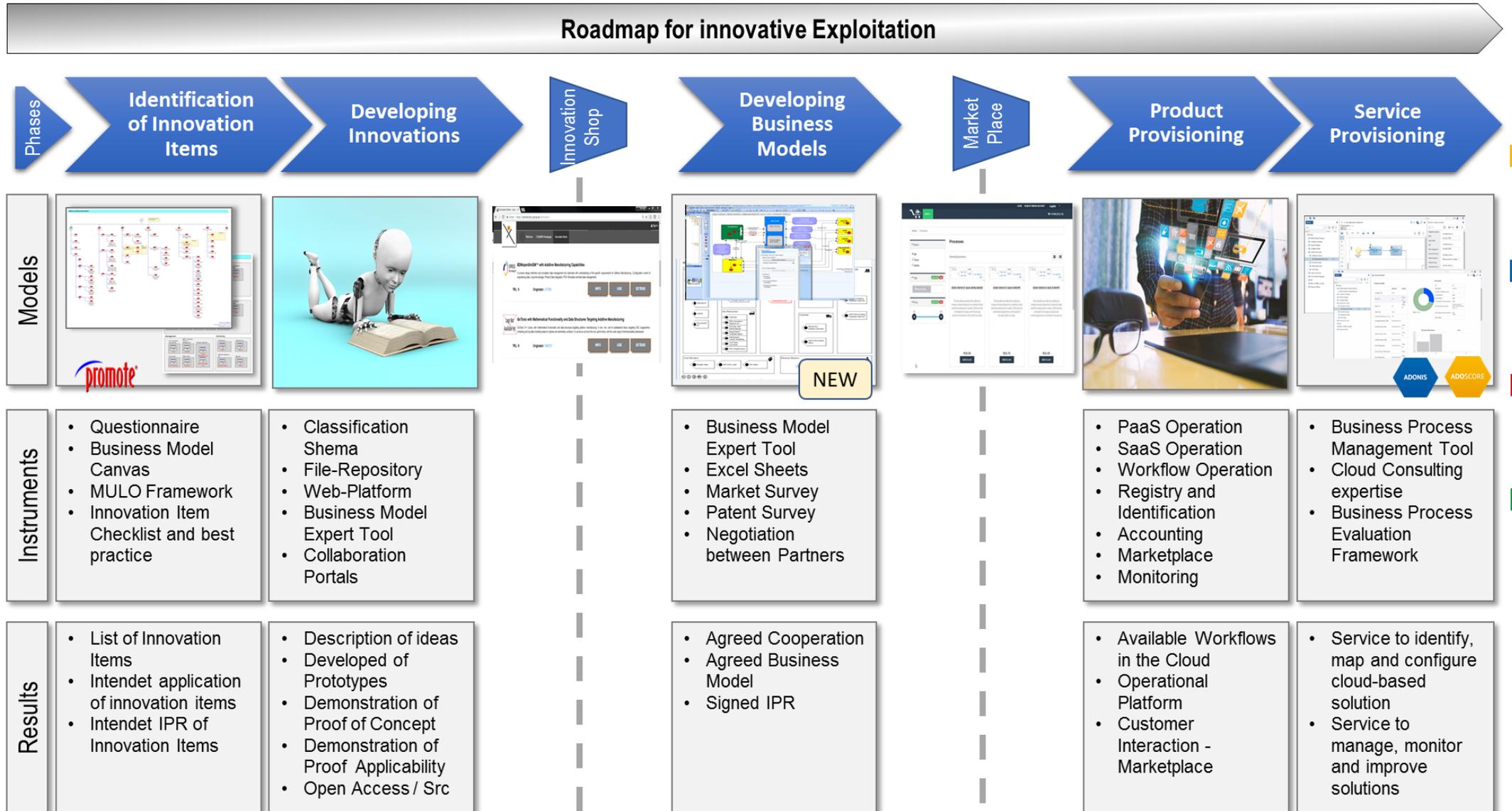
Use Case: Business Model Creation



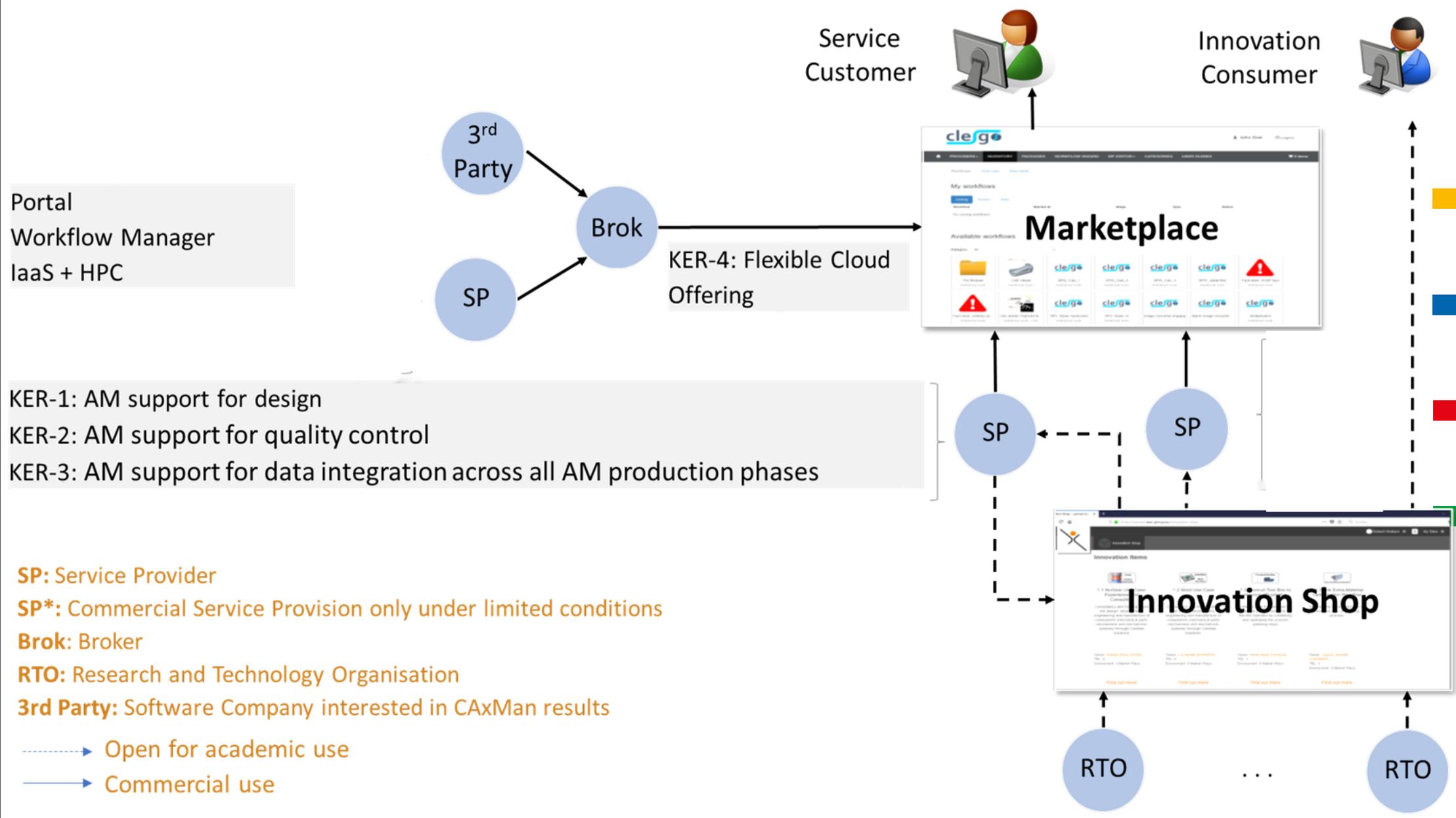
change2twin.eu

**Which „Market-Models“?
What Knowledge is Needed?
How to extract that
Knowledge?**

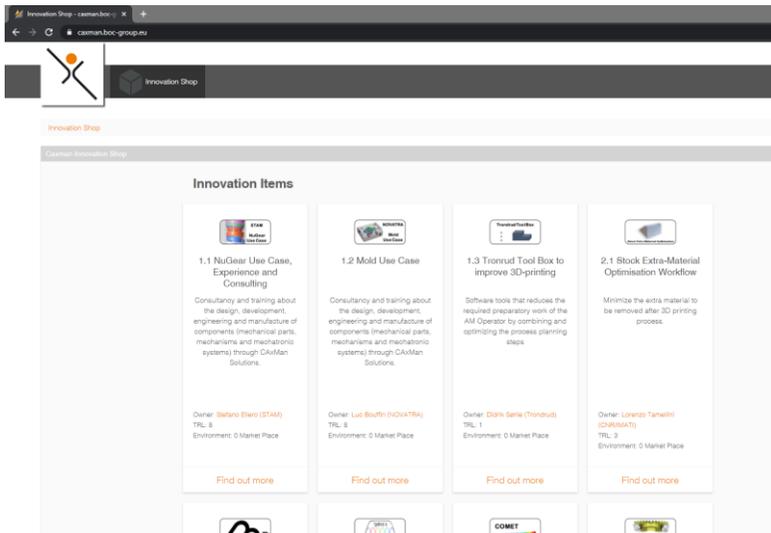
Roadmap for innovative Exploitation



The Value Chain of the EU-Project „CaxMan“

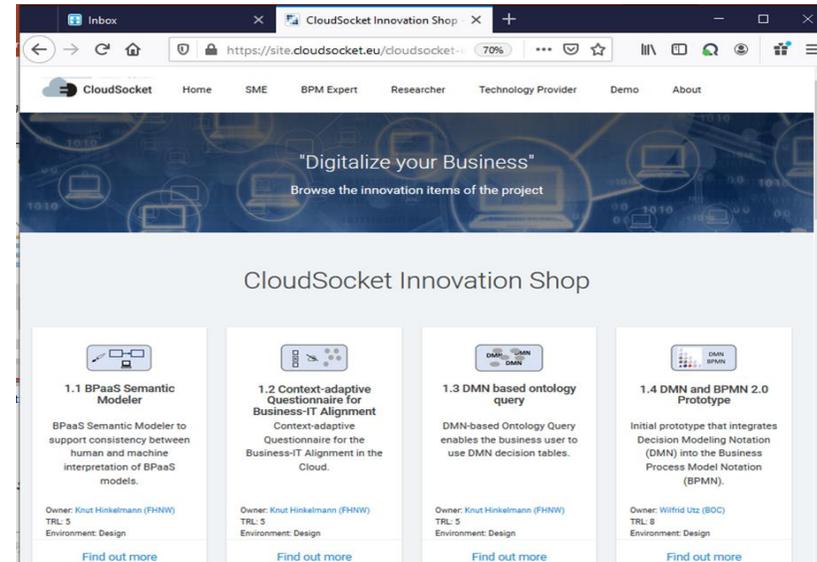


Some Innovation Shops form EU-Projec



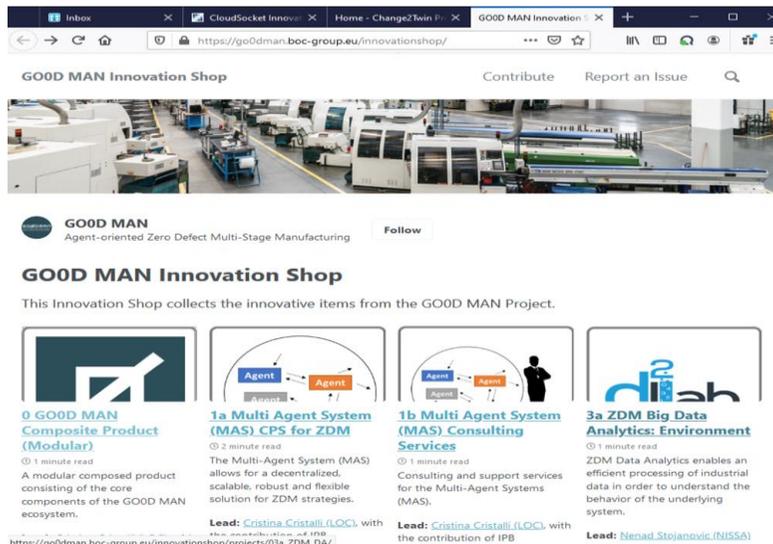
23 Innovation Items

<https://caxman.boc-group.eu/innovation-shop>



16 Innovation Items

<https://site.cloudsocket.eu/cloudsocket-innovation-shop>



15 Innovation Items

<https://go0dman.boc-group.eu/innovationshop/>

How to model such Innovation Shops?

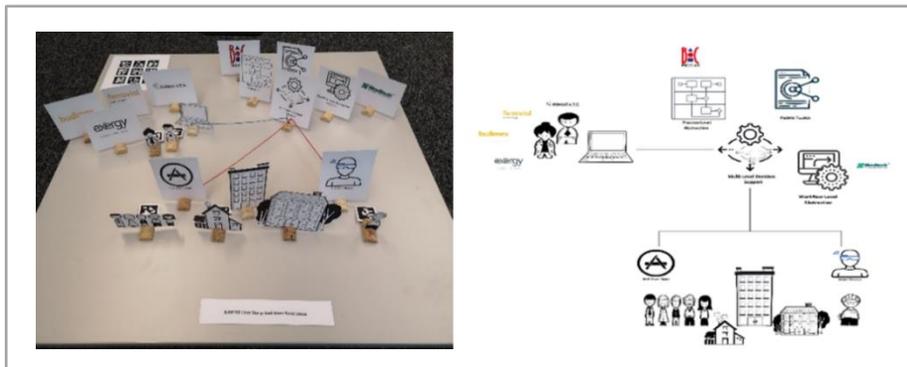
How to model Marketplaces?

What Knowledge is Needed?

How to extract that Knowledge?

OMiLAB Innovation Corner: Default Setting

Scene2Model

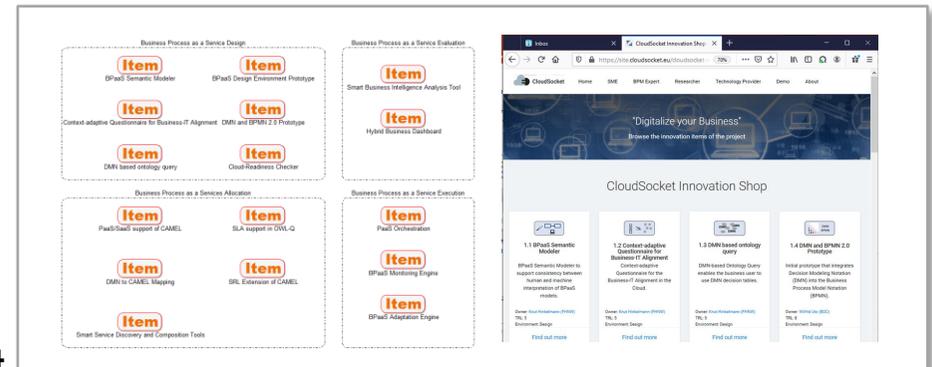


Innovation



Requirement

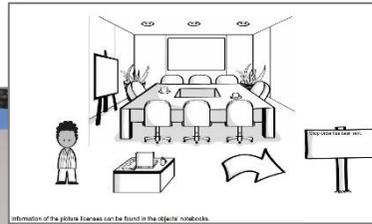
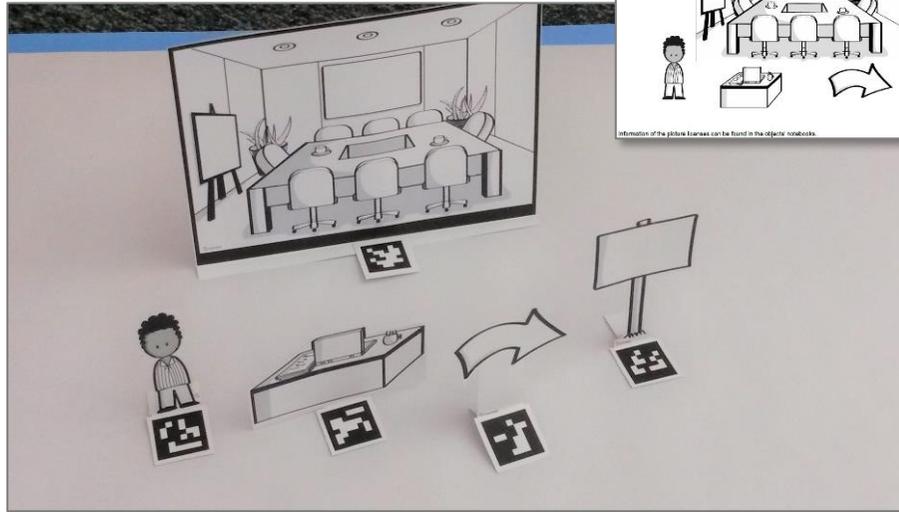
Model of Digital Offerings



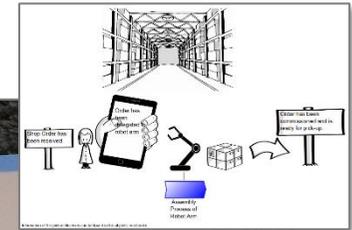
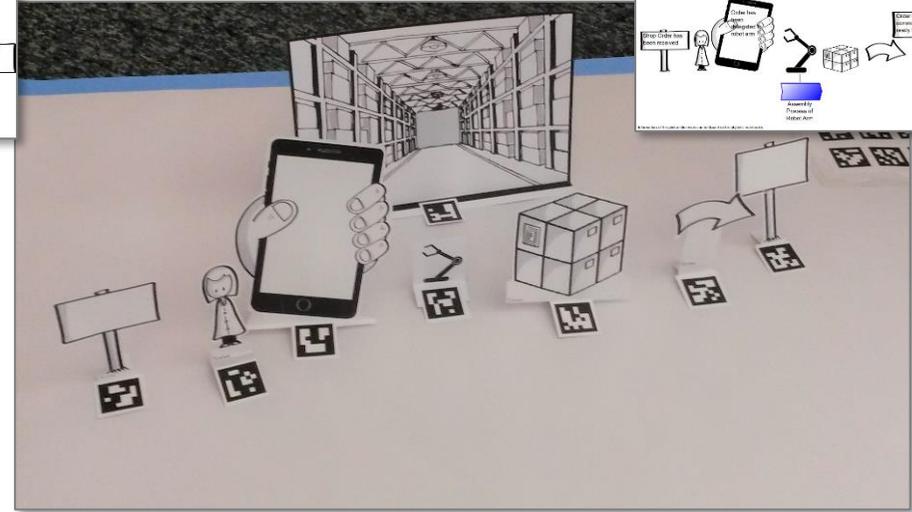
Scene2Model Environment



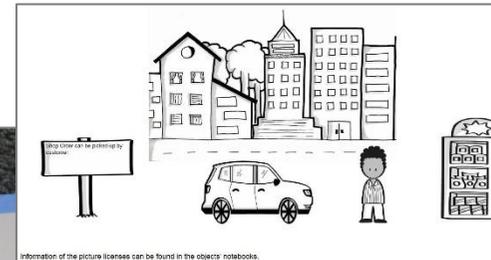
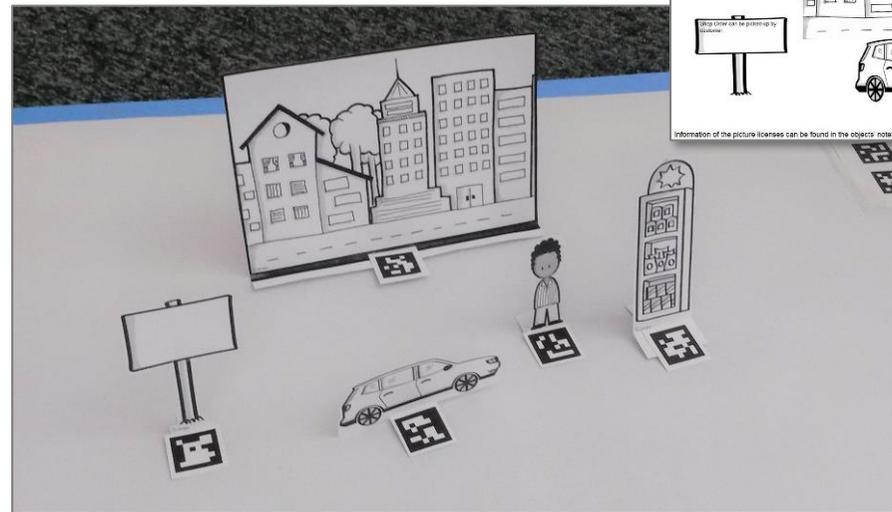
Scene 1: Online Ordering



Scene 2: Automated Assembly



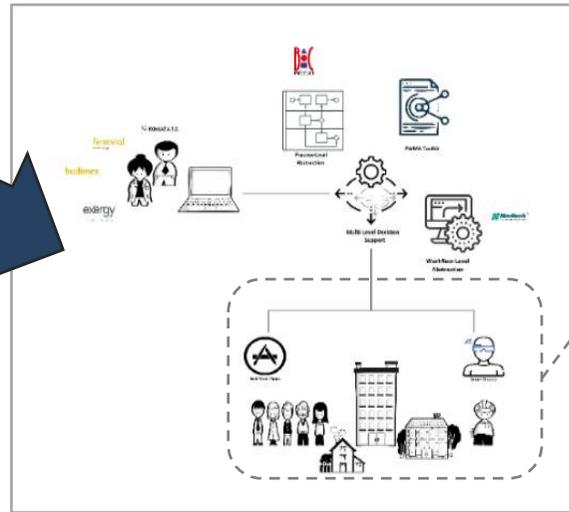
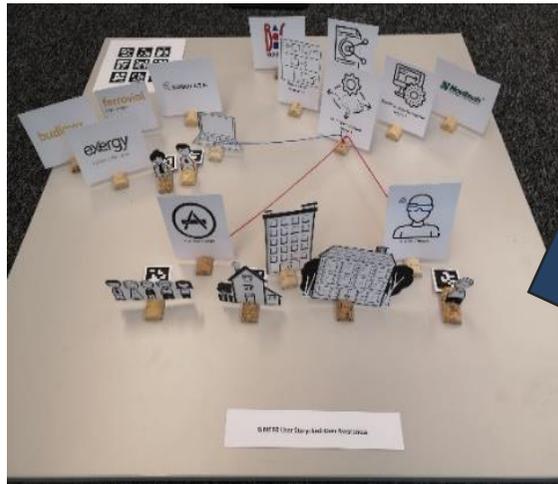
Scene 2: Manual Pick-Up at boxes



OMiLAB Innovation Corner: Project specific Extension

- *Mdoelling „Digitalisation Offering“*
- *Scene2Model Semantic Extension*
- *Requiemnt and Capability Matching*

Matching Requirements and Capabilities

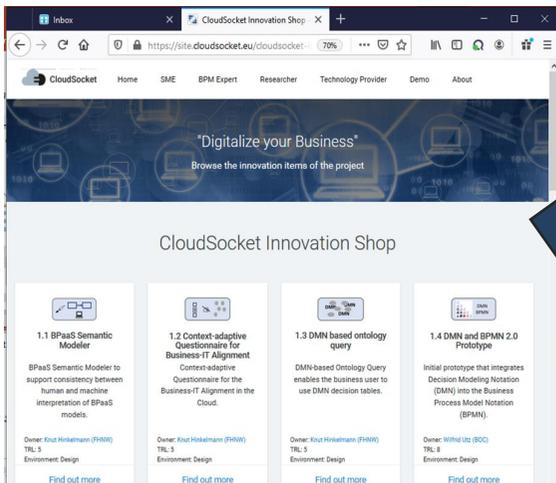


Requirement

Digital Twin of Automated Processes

Matching through

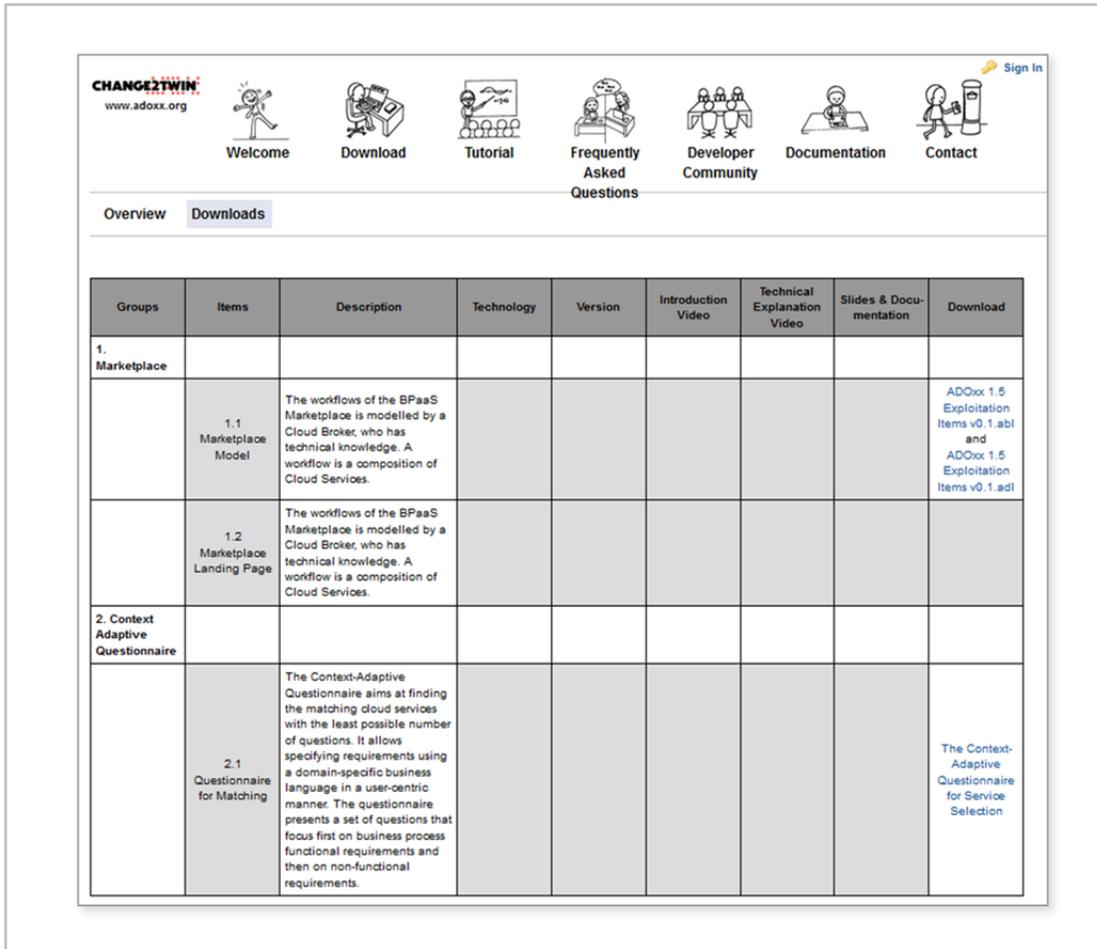
Semantic Inference



Capability

Digital Twinning of Business Processes

Access to Results



The screenshot shows the CHANGE2TWIN website interface. At the top, there is a navigation menu with icons for Welcome, Download, Tutorial, Frequently Asked Questions, Developer Community, Documentation, and Contact. Below the navigation menu, there are tabs for Overview and Downloads. The main content area displays a table with the following data:

Groups	Items	Description	Technology	Version	Introduction Video	Technical Explanation Video	Slides & Documentation	Download
1. Marketplace								
	1.1 Marketplace Model	The workflows of the BPaaS Marketplace is modelled by a Cloud Broker, who has technical knowledge. A workflow is a composition of Cloud Services.						ADOxx 1.5 Exploitation Items v0.1.abl and ADOxx 1.5 Exploitation Items v0.1.adl
	1.2 Marketplace Landing Page	The workflows of the BPaaS Marketplace is modelled by a Cloud Broker, who has technical knowledge. A workflow is a composition of Cloud Services.						
2. Context Adaptive Questionnaire								
	2.1 Questionnaire for Matching	The Context-Adaptive Questionnaire aims at finding the matching cloud services with the least possible number of questions. It allows specifying requirements using a domain-specific business language in a user-centric manner. The questionnaire presents a set of questions that focus first on business process functional requirements and then on non-functional requirements.						The Context-Adaptive Questionnaire for Service Selection

<https://adoxx.org/live/web/change2twin/downloads>

The H2020 Project BIMERR: Focus on Organisational Model

Project Fact Sheet



THE UNIVERSITY
of EDINBURGH



budimex



POLITÉCNICA



ferrovial
agroman



Funding: H2020-EU Project

Project Type: RIA

Start: 01.09.2019

End: 30.09.2022

Project Budget: 6 933 320 EUR

www.bimerr.eu



This project has received funding from the **European Union's Horizon 2020** research and innovation programme under grant agreement No 820621

The Project Idea

<https://bimerr.eu/>

THE PROJECT

OVERVIEW OF THE PROJECT

In a nutshell, BIMERR is related to the Building Information Modelling (BIM) and its main target are stakeholders from the AEC (Architecture, Engineering & Construction) field. The project has the intention to design and develop a new toolkit to support renovation stakeholders during the renovation process of existing buildings, from concept to delivery. Mainly, it should comprise of various tools:



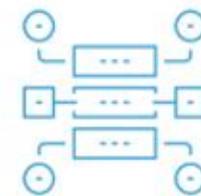
Enhanced Building Information Models



Decision Support System



Process Management Tool



Interoperability Framework

Use Case: Renovation of Building

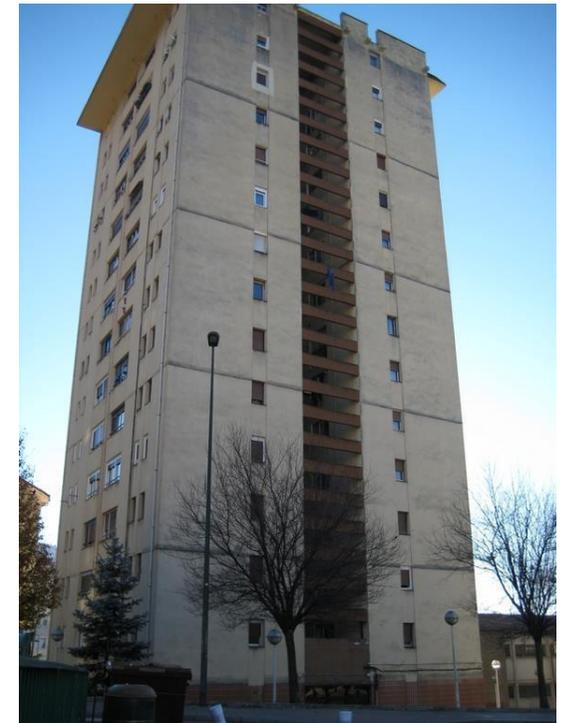


Image: Ferrovia

Renovation Process Analysis & Tools

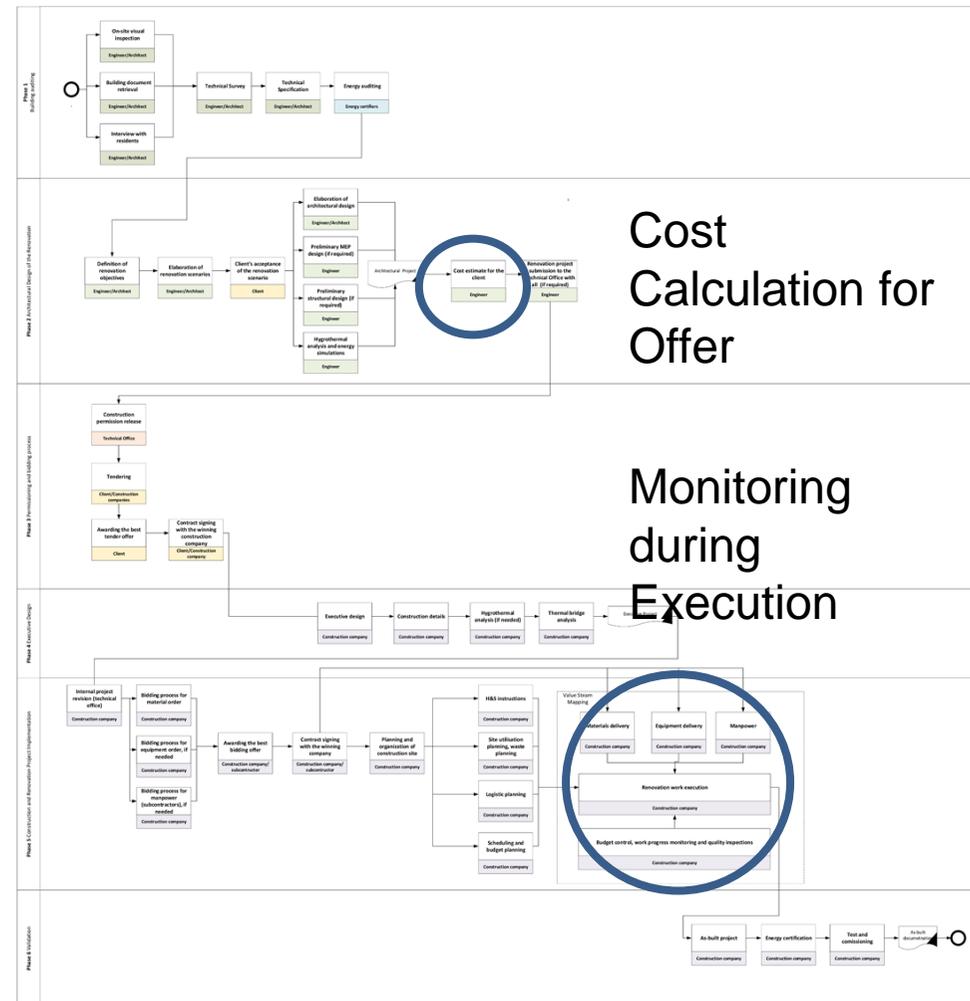
- ▶ To **understand the renovation process** from conception to delivery, extract opportunities to develop a **digital twin** by creating flexible process models that enable the renovation designer/planner to **optimally schedule and simulate jobs** based on custom objective functions
- ▶ To **refine and re-purpose powerful process automation and workflow management tools** for the construction domain in order to link the digital twin into the real-world, hence simulated processes become real world processes.
- ▶ To create tools for **process simulation** to **estimate the impact of unpredictable factors**, develop formal verifications and complex dependency analysis for the renovation process to provide the basics for a digital twin.
- ▶ To create a **cross-layer monitoring** framework evaluating close to real-time and simulated alternative process options so as to **optimize cost, time, disruption, etc.** in a continuous and – with respect to decision support – real time manner.



Image: BIMERR Consortium

When to use Process Management in Renovation

1. **Costs and times estimation** to support “**cost calculation**” during the “**architectural and design phase**”
2. Preparation of simulation and measurement to support “**budget control**” during “**construction renovation implementation**”
3. **Costs and times simulation** and measurement during “**construction renovation implementation**”
4. **Continues Lessons Learned** and creation of Organisational Knowledge Base



Renovation Processes

Model different renovation processes with enough abstraction to support all use cases

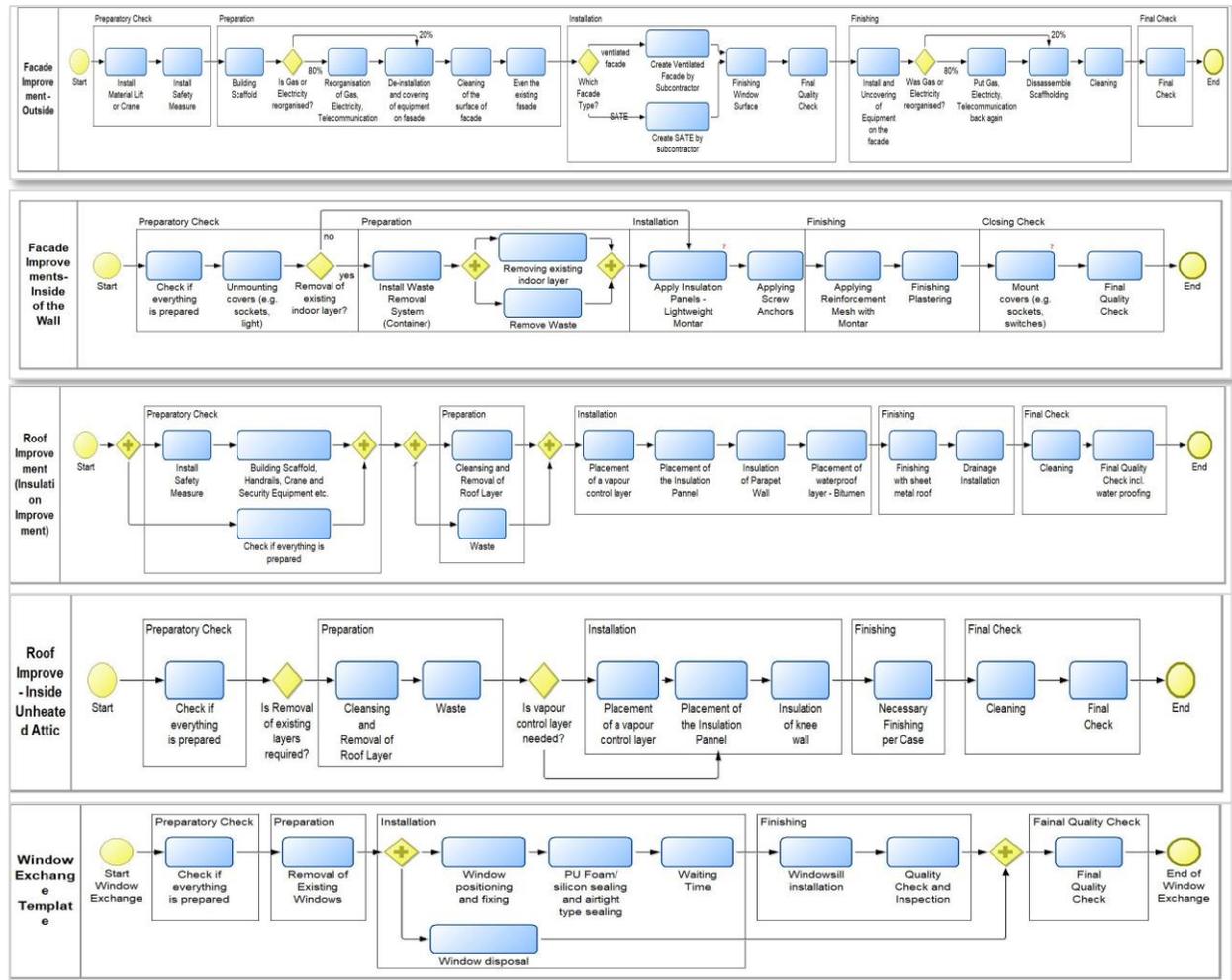
► Facade Improvements

- Outside of the wall
- Inside of the wall

► Roof Improvements

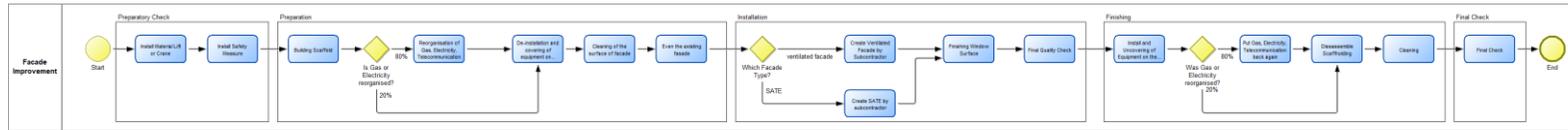
- External insulation
- Internal unheated attic

► Windows Exchange



From Template to Instance and Workflow

Template

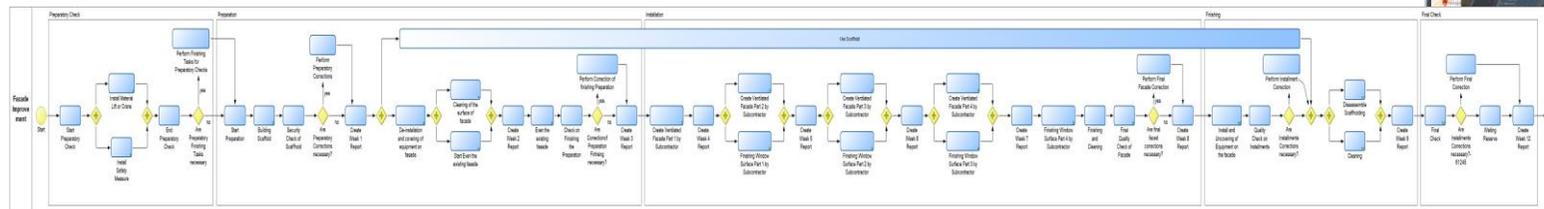


Transformation from Template to concrete Use Case

- Monitoring and Simulation
- Collaborative Reflection



Instance

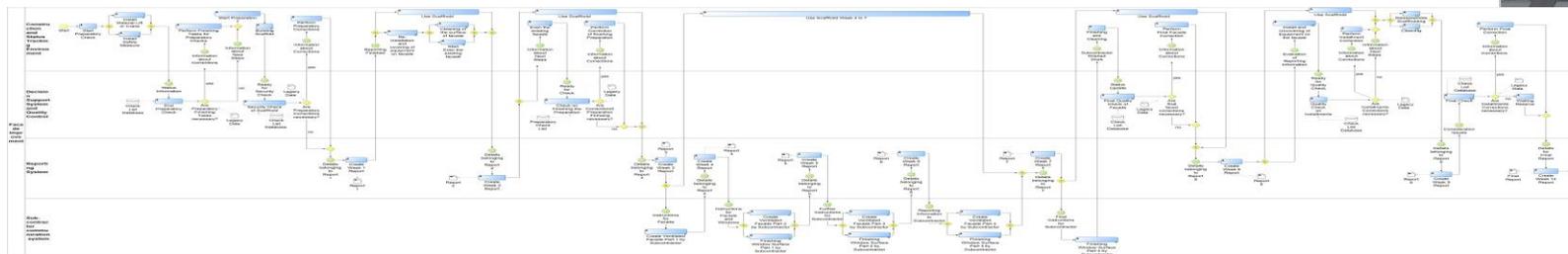


Transformation from Concrete Use Case to Workflow

- Enriched Digital Twin of Renovation Process
- Process Mining to generate additional knowledge



Workflow



OMiLAB Innovation Corner: Default Setting

Development Toolkit
Modelling Toolkit
Building Blocks



Documentation
Support
Development Spaces



Deployment Packages
Micro Services
Service Connectors

Meta Modelling and Microservice Environment

- ▶ For the design of the construction process, we used ADOxx with an imported BPMN library that is available at ADOxx.org
- ▶ For the simulation, we used the opensource petri-net based simulation service from ADOxx.org and extended it that it can read different parameters for each simulation run. We call this a token-based configuration of the simulation algorithm.
- ▶ For the monitoring, we used the opensource dashboard service from ADOxx.org and configured it that the dashboard can be used in the context of processes.
- ▶ For the mining, we use a third-party application called CELONIS and integrated it by exchanging log data and process information.
- ▶ For the process improvement we implemented a new service called Model-Wiki, that shares models via an XWIKI and enables co-operative evaluation of the models via comments from experts.



BPMN Meta Model

KPI Meta Model

Simulation Engine

Verification Engine

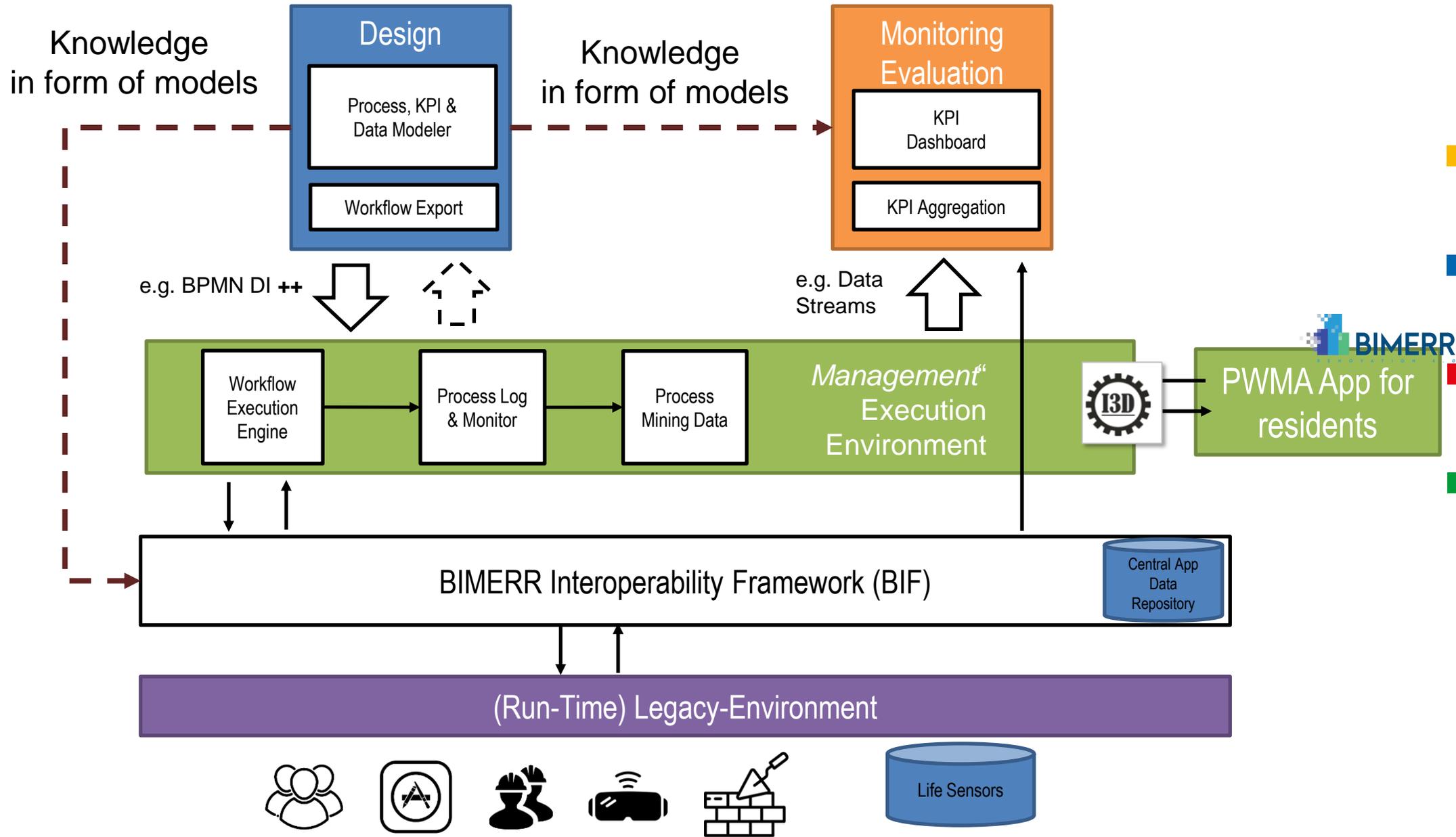
KPI Dashboard

Excel Connectors

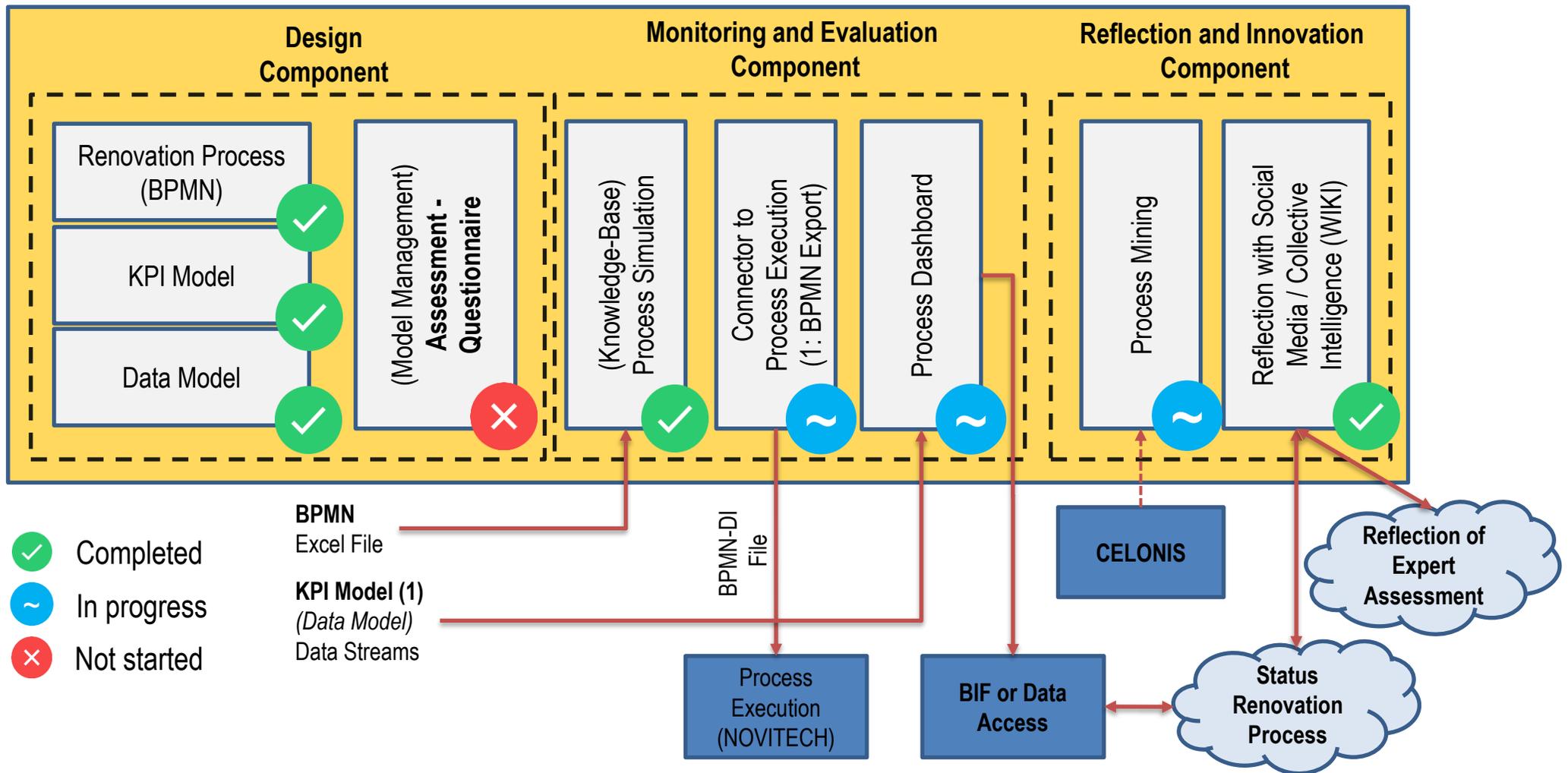
CELONIS Connector

XWIKI Connector

Renovation Process Analysis



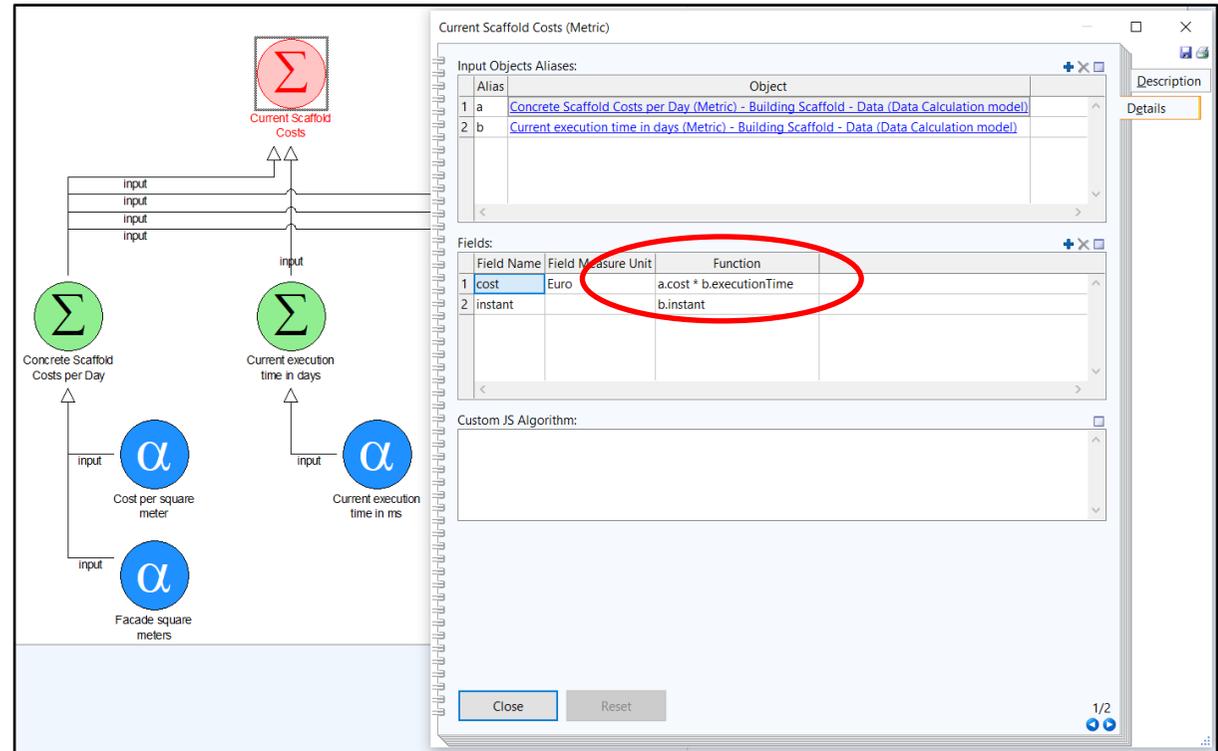
Design Environment Components



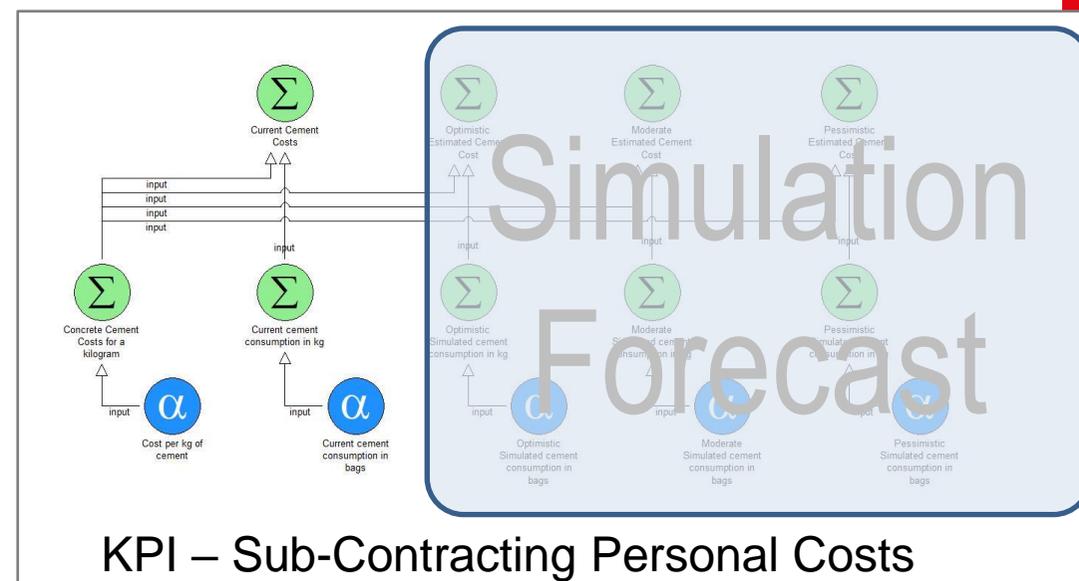
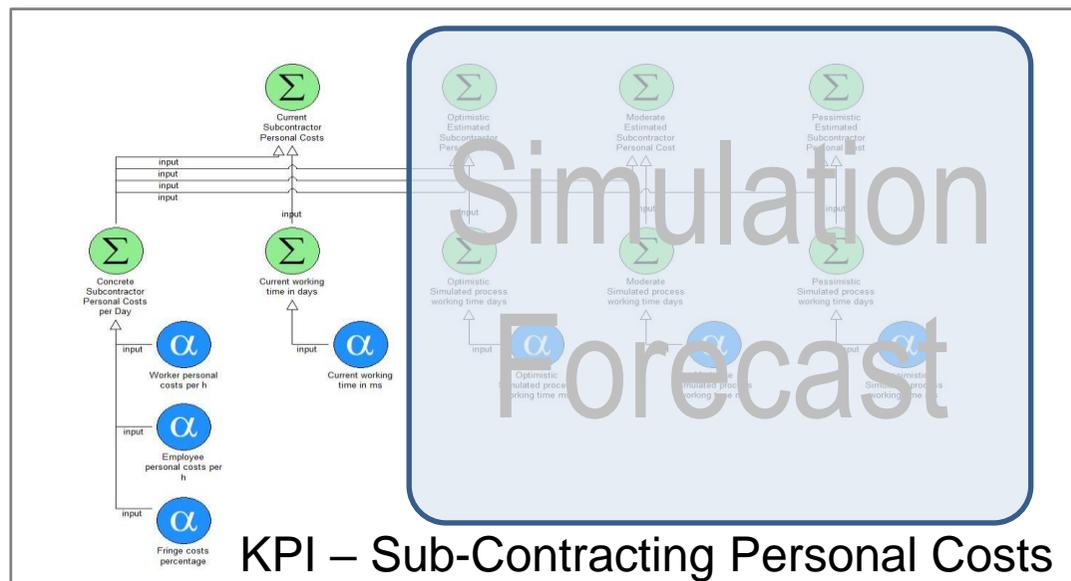
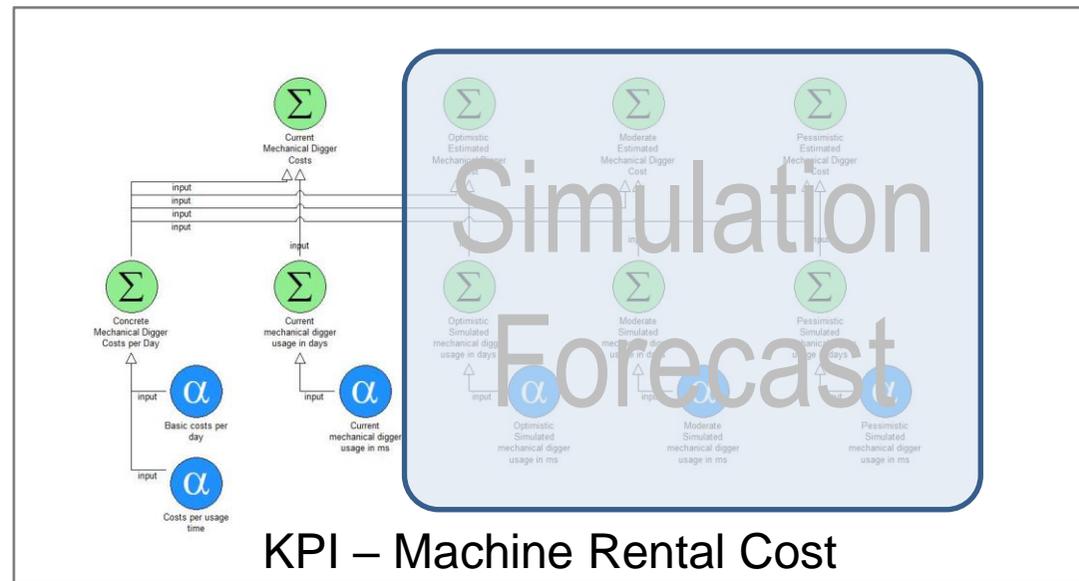
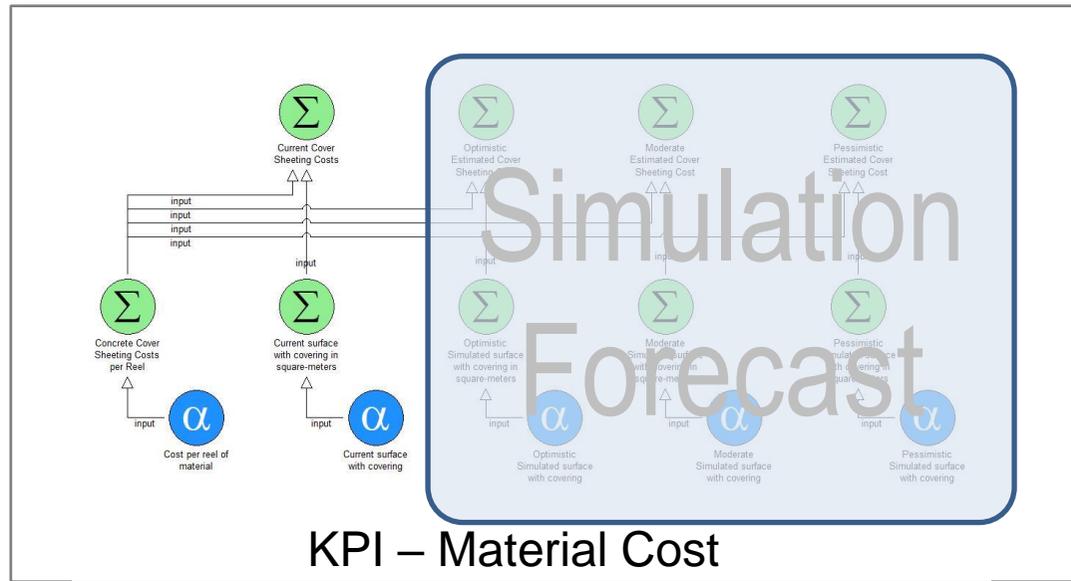
Data model - Current Scaffold Costs

- ▶ Every Metric is calculated with a Function.
- ▶ Every function use aliases of required inputs
 - a) Estimated Scaffold Costs per Day
 - b) Current execution time in days
- ▶ Function: $a.cost * b.executionTime$

- ▶ Alpha indicators are responsible to get data from external sources
 - ▶ Excel file from simulation results
 - ▶ Used as inputs for Metrics



Different KPI Calculations for different Cost Types



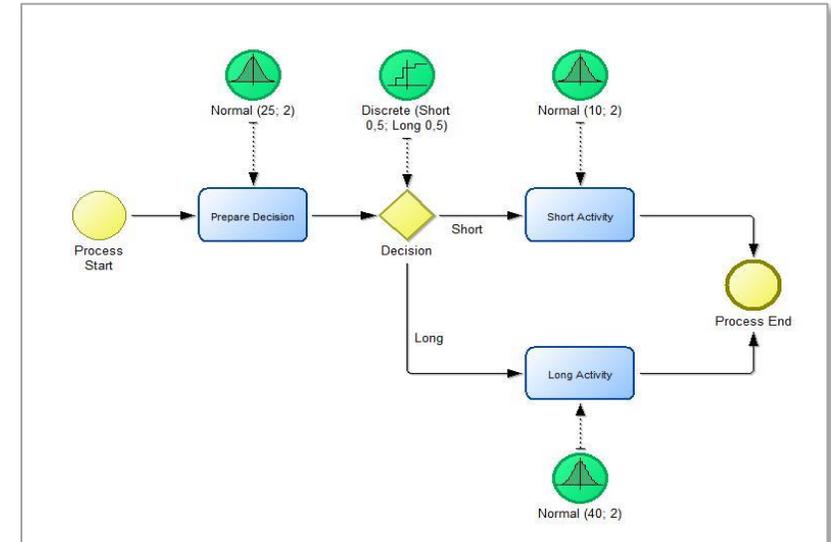
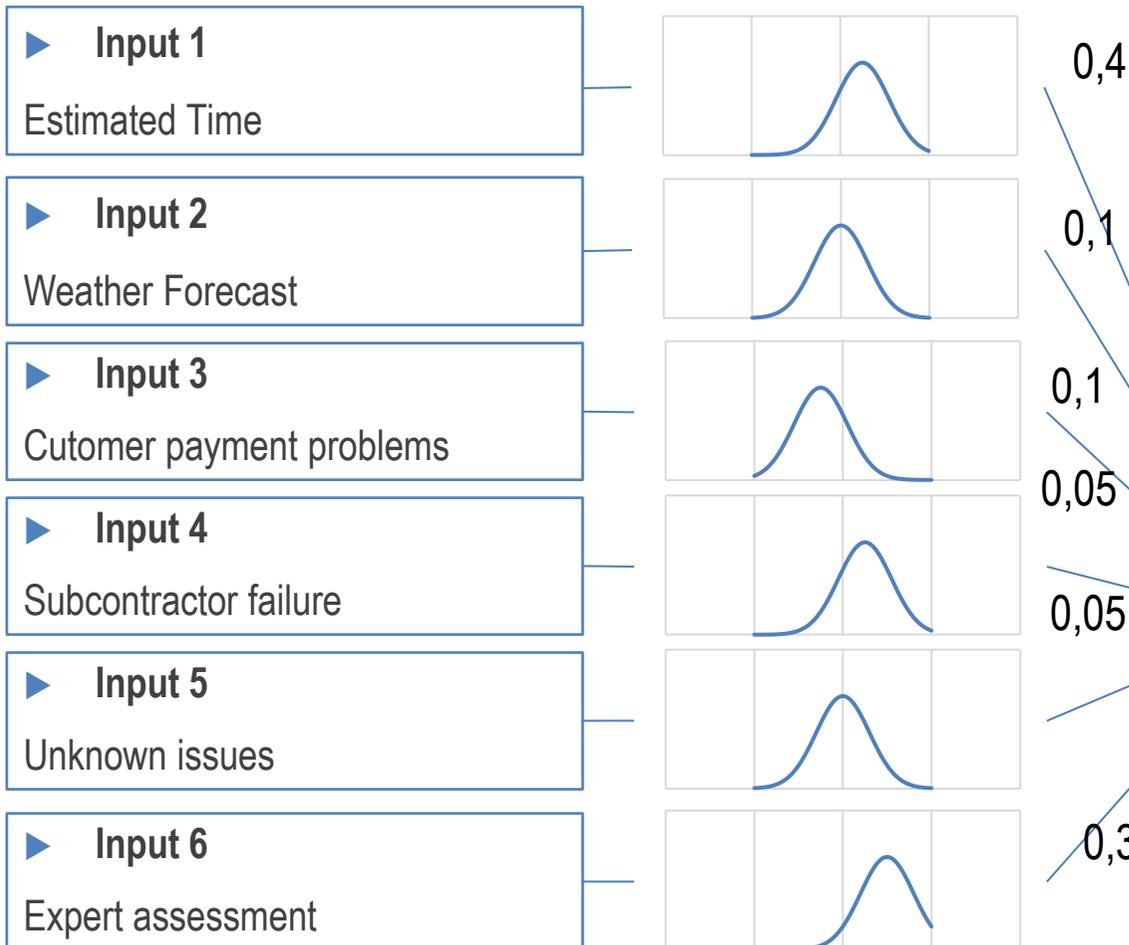
OMiLAB Innovation Corner: Project specific Extension

- *Knowledge-Based Simulation*
- *KPI Dashboard for Renovation Processes*
- *Model Wiki for Collaboration*
- *Process Mining for Improvement*

Knowledge-Based Simulation of Renovation Process

Weighted Distribution Input

The input for e.g. “execution time” is the result of the combination of the normal distribution of all the inputs with respect of their weights



Simulation Input

	A	B	C	D	E	F	G	H	I	J	K	L
1		Weighted Calculated time (ms)	Weighted Calculated time (minutes)	Average task time	Awr Weight	Expert assessment	Exeprt weight	Mean	a:			
2	Action-1	1178749,283	19,65	14	0,50	25	0,50	20	3			
3	Action-1	1323704,74	22,06	19	0,50	25	0,50	20	3			
4	Action-1	1330165,782	22,17	19	0,50	25	0,50	20	3			
5	Action-1	1303370,952	22,01	19	0,50	25	0,50	20	3			
6	Action-1	1313995,12	21,90	19	0,50	25	0,50	20	3			
7	Action-1	1238391,098	20,47	16	0,50	25	0,50	20	3			
8	Action-1	1285668,755	21,43	18	0,50	25	0,50	20	3			
9	Action-1	1422725,976	23,71	22	0,50	25	0,50	20	3			
10	Action-1	1447795,614	24,13	24	1,00							
11	Action-1	1294992,448	21,58	22	1,00							
12												

Simulation of Renovation Process - Output



Process Modeller Dashboards Simulation Model Wiki xWiki Process Mining

Please select the file containing the model to simulate and press the Simulate button. Supported file format is BPMN.

General results

	Measure	Details
Average Cost:	0.00	
Max Cost:	0.0	Trace: t.1
Min Cost:	0.0	Trace: t.1
Total Costs:	0.00	
Average Executions Time:	00:024:20:31:23	
Max Executions Time:	00:036:13:25:59	Trace: t.1
Min Executions Time:	00:033:20:56:20	Trace: t.1
Total Executions Time:	00:138:20:18:29	
Total Runs:	4	
Total Traces:	1	
Total Paths:	1	

Paths Infos

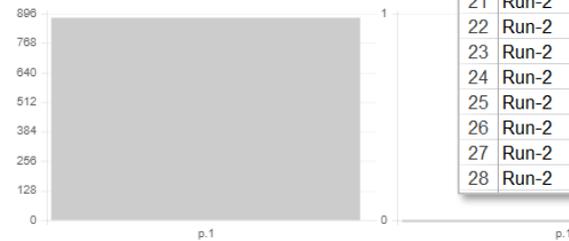


Path details

Id:	p.1
Probability:	100.00%
Is deadlocked:	false

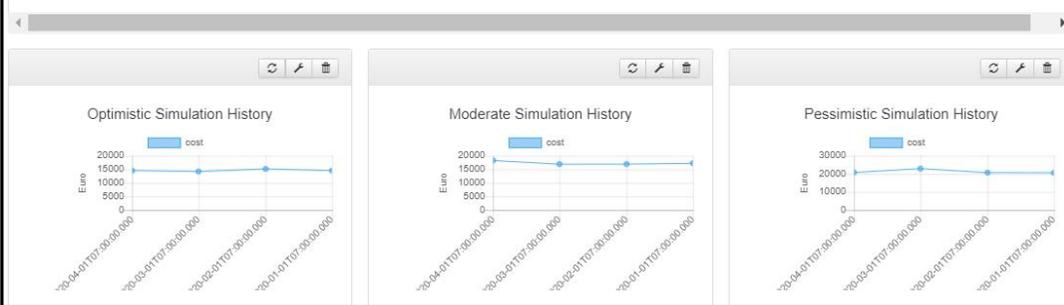
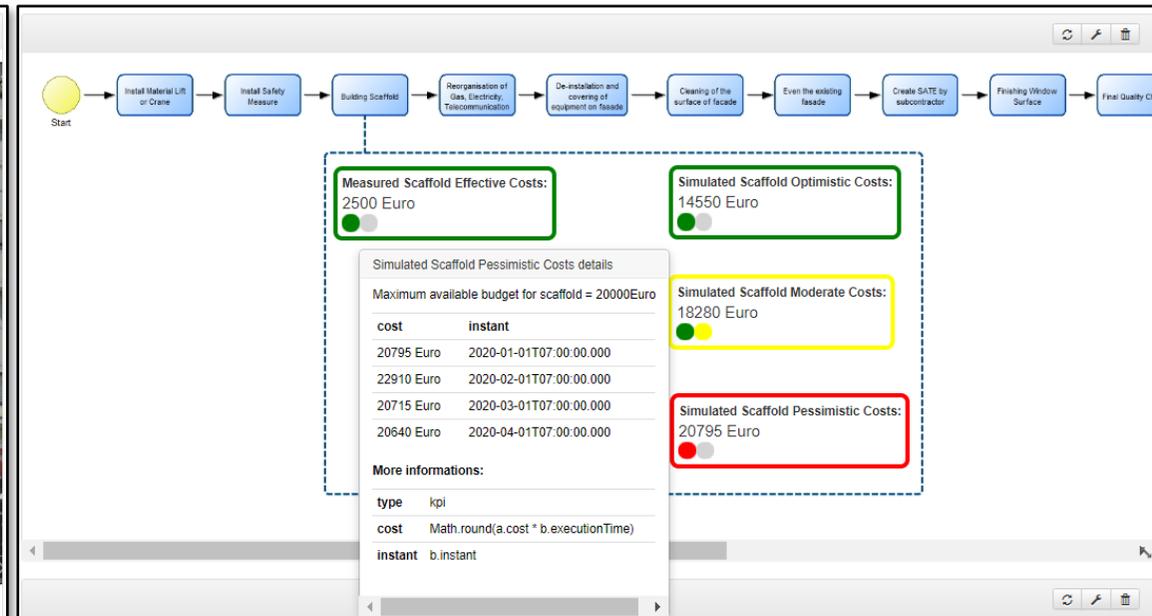
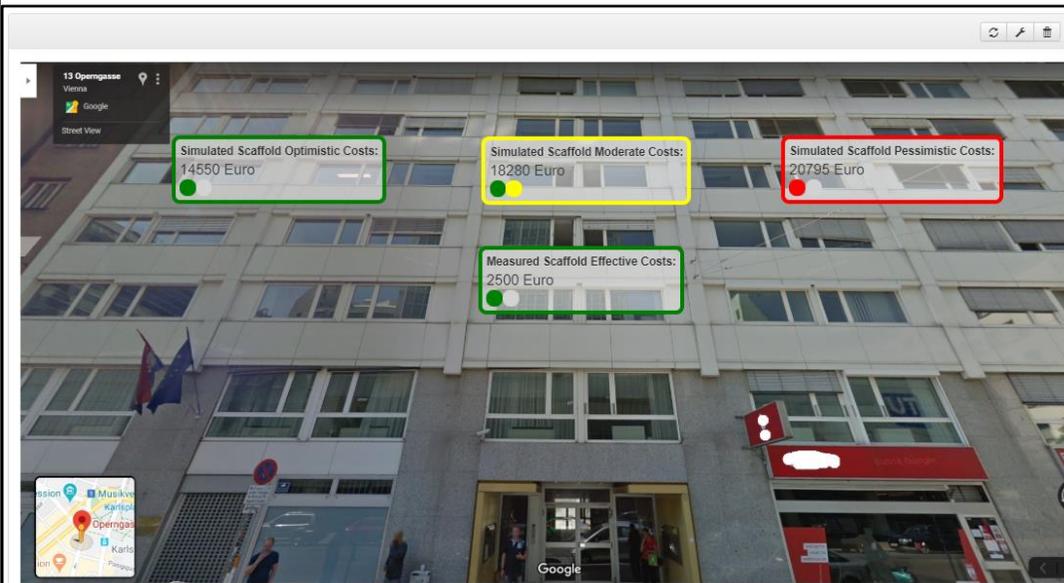
Paths: p.1 ▼

Execution Time (hours)



	A	B	C	D
1	Run-1	Install Material Lift or Crane	2019-06-03T07:19:45.130	1185013
2	Run-1	Install Safety Measure	2019-06-03T07:42:02.710	1337697
3	Run-1	Building Scaffold	2019-06-03T08:22:30.171	2427461
4	Run-1	Reorganisation of Gas, Electricity, Telecommunication	2019-06-03T08:43:48.560	1278389
5	Run-1	De-installation and covering of equipment on facade	2019-06-03T09:06:48.813	1380253
6	Run-1	Cleaning of the surface of facade	2019-06-03T09:30:20.251	1411438
7	Run-1	Even the existing facade	2019-06-03T09:54:33.524	1453273
8	Run-1	Create SATE by subcontractor	2019-06-03T10:17:44.185	1390661
9	Run-1	Finishing Window Surface	2019-06-03T10:40:38.600	1374415
10	Run-1	Final Quality Check	2019-06-03T11:02:44.870	1326270
11	Run-1	Install and Uncovering of Equipment on the facade	2019-06-03T11:24:47.257	1322387
12	Run-1	Put Gas, Electricity, Telecommunication back again	2019-06-03T11:49:55.457	1508200
13	Run-1	Dissassemble Scaffolding	2019-06-03T00:11:59.375	1323918
14	Run-1	Cleaning	2019-06-03T00:34:55.511	1376136
15	Run-1	Final Check	2019-06-03T00:57:16.136	1340625
16	Run-2	Install Material Lift or Crane	2019-06-04T07:19:39.540	1179540
17	Run-2	Install Safety Measure	2019-06-04T07:42:21.346	1361806
18	Run-2	Building Scaffold	2019-06-04T08:20:58.770	2317424
19	Run-2	Reorganisation of Gas, Electricity, Telecommunication	2019-06-04T08:43:31.618	1352848
20	Run-2	De-installation and covering of equipment on facade	2019-06-04T09:06:46.347	1394729
21	Run-2	Cleaning of the surface of facade	2019-06-04T09:28:54.801	1328454
22	Run-2	Even the existing facade	2019-06-04T09:50:51.580	1316779
23	Run-2	Create SATE by subcontractor	2019-06-04T10:13:02.241	1330661
24	Run-2	Finishing Window Surface	2019-06-04T10:36:34.801	1412560
25	Run-2	Final Quality Check	2019-06-04T10:57:37.205	1262404
26	Run-2	Install and Uncovering of Equipment on the facade	2019-06-04T11:18:38.772	1261567
27	Run-2	Put Gas, Electricity, Telecommunication back again	2019-06-04T11:39:17.552	1238780
28	Run-2	Dissassemble Scaffolding	2019-06-04T00:02:10.800	1372456

Monitoring and Simulation of Renovation Process



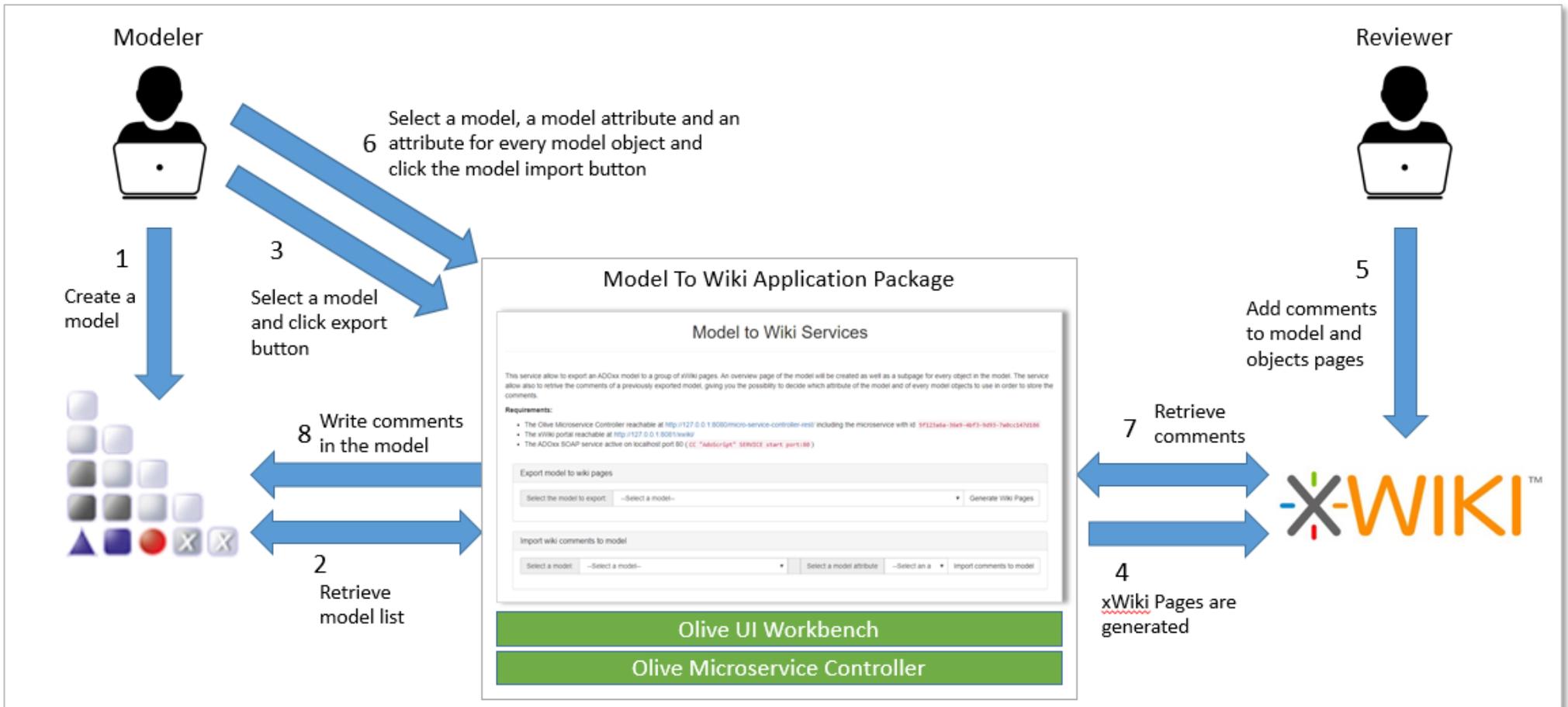
MODELS

Building Scaffold - KPIs

GOALS

Goal	Value	Status
Scaffold Cost		●●●
Simulated Scaffold Pessimistic Costs	20795 Euro	●●●
Pessimistic Estimated Scaffold Cost	20795 Euro	●●●
Concrete Scaffold Costs per Day	500 Euro	●●●
Facade square meters	100 m ²	●●●
Cost per square meter	5 Euro	●●●
Pessimistic Simulated process execution time days	41.59 days	●●●

Collective Intelligence - Model Wiki scenario



Access to Results

Groups	Items	Description	Technology	Version	Introduction Video	Technical Explanation Video	Slides & Documentation	Download
1. Process Design Tool	1.1 Renovation Process Design	Our process-oriented approach puts the renovation process in the centre in order to build a digital twin that is structured considering the renovation process model, and consists values according time stamps, cost calculations as well as additional domain-specific information that is provided by domain experts.	ADOxx 1.5 BIMERR- Business Process Management for Renovation 4.0 (Based on ADOxx 1.5)	BIMERR 1.0_A1.5	Introduction of Renovation Process Modeling	Technical Explanation of Renovation Process Modeling	Renovation Process Design and Design Tools for Renovation Process	ADOxx 1.5 Platform and ADOxx 1.5 BPMNv1.01.abl
	1.2 KPI Design	The Renovation process KPI design tool is an application build with ADOxx, a meta-modelling platform that allows to define your own meta-model and automatically generate the modelling environment for you accordingly it.	KPI Design Toolkit (Based on ADOxx 1.5)	BIMERR 1.0_A1.5	Introduction of KPI Modeling and Mapping Interoperability Framework	Technical Explanation of KPI Design and KPI Dashboard	Renovation Process and Key Performance Indicator (KPI) Design and Renovation Process KPI Design Tool	KPI Dashboard
2. Process Simulation Tool	2.1 Knowledge Based Process Simulation	The simulation of a renovation process complements the monitoring by providing a forward-looking simulation of the renovation process and hence estimates the expected duration and execution time.	ADOxx 1.5 BIMERR- Design Component for Renovation 4.0 (Based on ADOxx 1.5)	BIMERR 1.0	Introduction of Simulation of Renovation Process	Technical Explanation of Simulation of Renovation Process	Knowledge-Based Process Simulation and Simulation of Renovation Process	Knowledge Based Model Simulation
3. Process Mining Tool	3.1 Process Mining	Process mining is used to support the analysis and evaluation of business processes. Trends and patterns in the process data are interesting for the improvement of processes. Therefore, data mining algorithms are applied on the process data.	Integration of 3rd Party Tools	OLIVE2CELONIS_V0.1	Introduction of Process Mining of Renovation Process	Technical Explanation of Process Mining of Renovation Process	Process Mining and Process Mining of Renovation Process	NA
4. Process Collaboration Tool	4.1 Process Model Wiki	The Model Wiki web application allow to generate xWiki pages from any model in the ADOxx modelling environment and as soon as the pages are generated allow to import any existing comments in the wiki back to the model.	Model to Wiki Application	OLIVE2XWIKI_V0.1	Introduction of Model Wiki Application	Technical Explanation of Model Wiki Application	Process Model Wiki and Collaborative Reflection of Renovation Process	Model2Wiki

<https://adoxx.org/live/web/bimerr/downloads>

The FFG-Project complAI: Focus on Robot Interaction

Project Fact Sheet



BOC Asset Management GmbH
www.boc-eu.com



JOANNEUM RESEARCH ROBOTICS
www.joanneum.at/robotics



**UNIVERSITY OF VIENNA – INSTITUTE of
PHILOSOPHY**
<https://philtech.univie.ac.at/>



**Johannes Kepler University Linz –
Department for Criminal Law**
<https://www.jku.at/institut-fuer-strafrechtswissenschaften/>

Funding: *FFG – Austrian Research Promotion Agency*

Project Type: *Study*

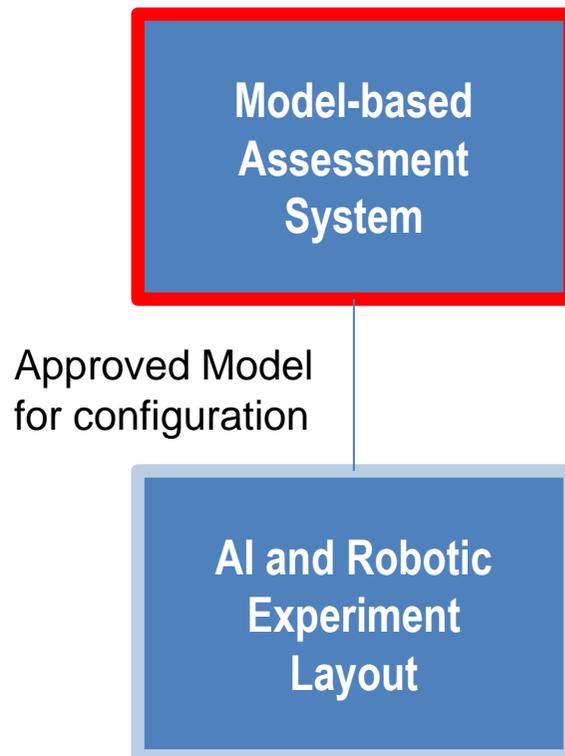
Start: *01.02.2020*

End: *31.01.2021*

Project Budget: *241.678 EUR*

Challenge:

How to model AI, Robotic and assess compliance

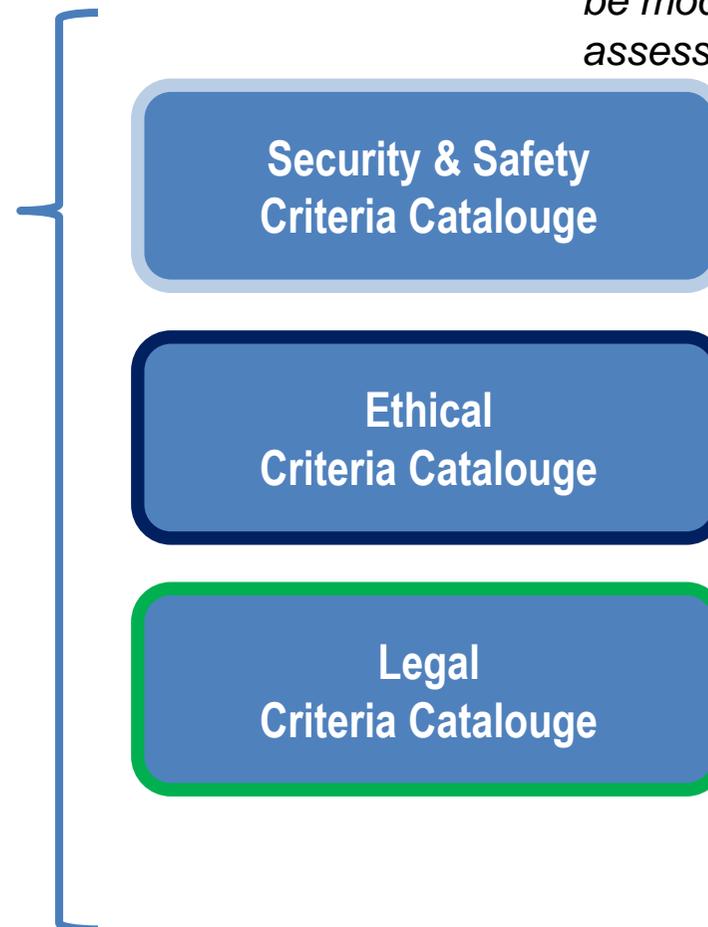


Challenge:

How to operate compliant model on robotic platform

Challenge:

How to create criteria catalogues that can be modelled and assessed



*Use Case:
Digital Supermarket*

Possible Digital Applications in Retail



- **Store Traffic Recognition**
 - Observation and visualisation of store traffic in order to better place expensive premium products or introduce new products.
- **In-Store Concierge**
 - Mobile robots guide customer to find the right product. e.g. Lowe's
- **In-Store Voice Commerce and Consultancy**
 - Consultation and advertisement of products
- **Automatic Check-Out Shopping Cart**
 - Products get automatically scanned and checked-out when put into the shopping cart, complementary products are automatically suggested on screen,
- **Smart Building**
 - Access Management – using biometric data
 - Thief Detection – using smart cameras to detect thieves
 - Hazard Management – using cameras to detect broken products or wet floors
 - Power Management – using sensors for energy efficiency
- **24h employee free Shop**
 - Cashier less shop that has open 24 / h

Based on innovation talk „AI in Retail“ at Retail Austria at 24.01.2020 from enlite.AI

Selected Challenge for Use Case Experiments



- **Robot Arm**

- AI: Image Recognition & decision
- AI-Technology: Convolutional Neuronal Network and Rules
- Meta Model: BPMN, Flowchart, DMN
- Goal: Flexibilization and Compliance

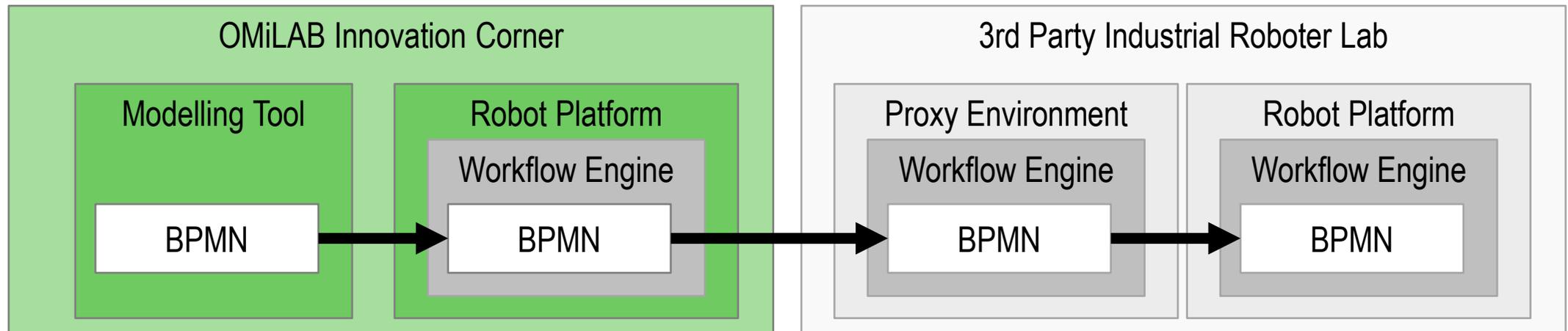
- **Mobile Platforms**

- AI: Task Allocation
- AI-Technology: Multi Agent Systems
- Meta Model: Goal Model, DMN, incl. semantic for optimisation
- Goal: Optimization

- **Cooperative Human – Robotic Assembly Scenario**

- AI: Sensor & Context Interpretation
- AI-Technology: Rule-based Systems
- Meta Model: Petri Net, DMN, incl. semantic lifting
- Goal: Safety

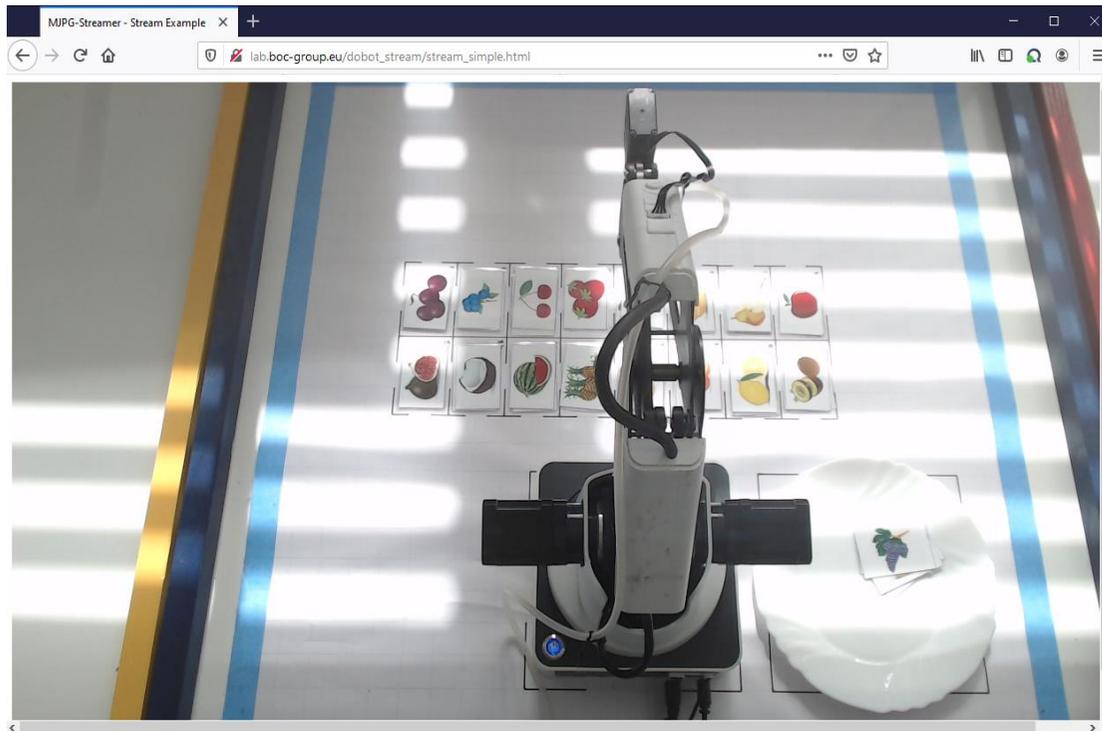
OMiLAB Innovation Corner: Default Setting



OMiLAB Default Setting

Live-Stream to Dobot Magician in BOC-OMiLAB Innovation Corner:

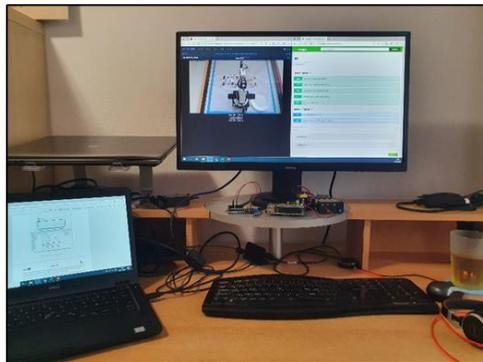
https://lab.boc-group.eu/Dobot_Magician_1_onboard/



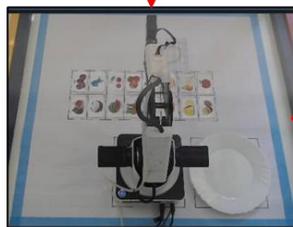
- The pre-packaged Dobot Magician was used to demonstrate the robot arm.
- The corresponding IoT Adapter – Raspberry-Pi – and corresponding SW– Tomcat Web-Application, Dobot-Magician interfaces.
- The pre-installed Modelling Toolkit Bee-Up is used for modelling the Petri-Net, the Flow Chart and the BPMN processes that accesses the IoT-Adapter.
- A third-party workflow engine was used.

+ „Reservation and Virtual Access Service“ to externally access the Dobot Magician

- **BOC OMiLAB-Innovation Corner:**
<http://olive.innovation-laboratory.org/lab-reservation-service/>
- **Deploying „Reservation and Virtual Access Service“ for local testing:**
<https://git.boc-group.eu/olive/lab-reservation-fast-deployment-package/-/releases>
- **Integration „Reservation and Virtual Access Service“ in your Modelling Tool using Bee-Up as sample:**
<https://git.boc-group.eu/olive/lab-reservation-beeup-integration>
- **Deploying „Reservation and Virtual Access Service“ for Production:**
<https://git.boc-group.eu/olive/lab-reservation-service>
- **Improving Source Code of „Reservation and Virtual Access Service“:**
<https://git.boc-group.eu/olive/lab-reservation-service-docker>



Remote
Connection



Project: Idea

Challenge:

How to model AI, Robotic and assess compliance

Business Domain Model:

- *BPMN-Business Processes*

Technical Robot Model:

- *Petri-Net*
- *Flow Chart*
- *BPMN Workflows*

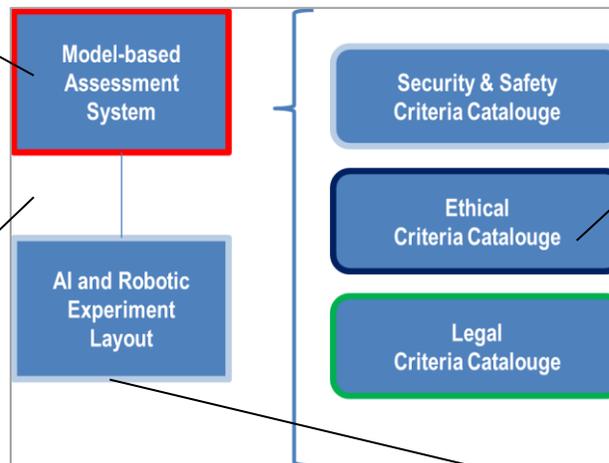
Artificial Intelligence

- *DMN-Rules*
- *CNN for image recognition*

Challenge:

How to create criteria catalogues that can be modelled and assessed

- *Questionnaire and Threshold Model*



Approved Model for configuration:

Questionnaire Model

- *Associating Questionnaire Model with Technical Robot Model*
- *Signing the Model*

Challenge:

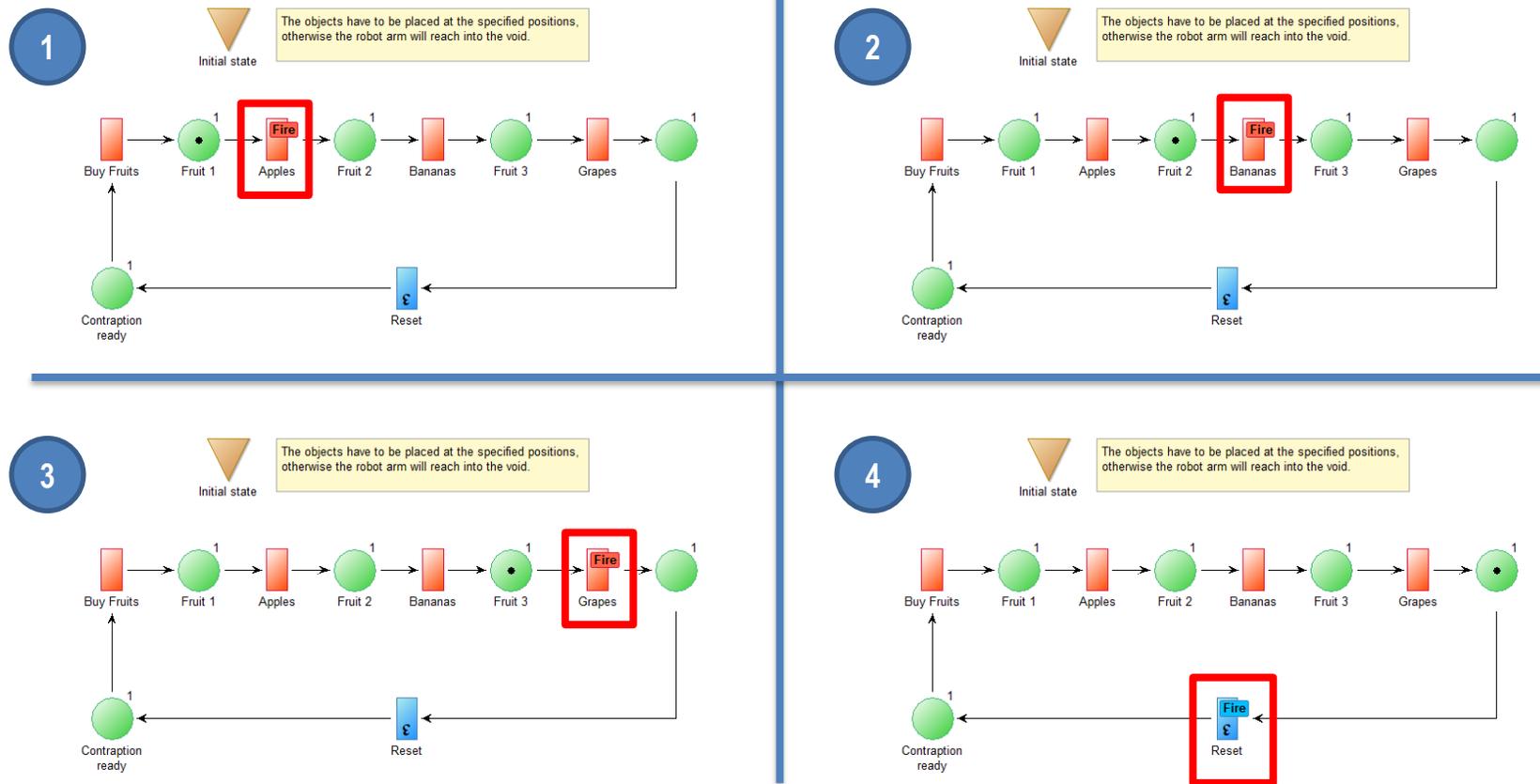
How to operate compliant model on robotic platform

Workflow Engine:

- *„Verified“ BPMN Processes*

Pick-and-Place Assembly

Fixed Sequence described with Petri-Net



Characteristic:

- Fixed Sequence
- Robot-Arm API interaction is implemented in transitions
- Orchestration is manually performed by user

Pick-and-Place Assembly

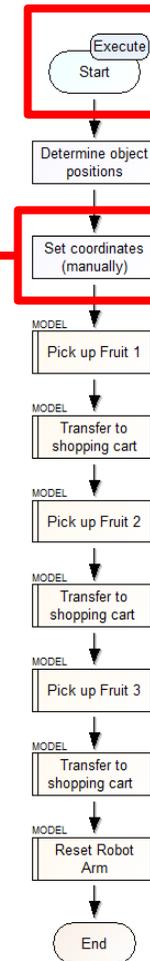
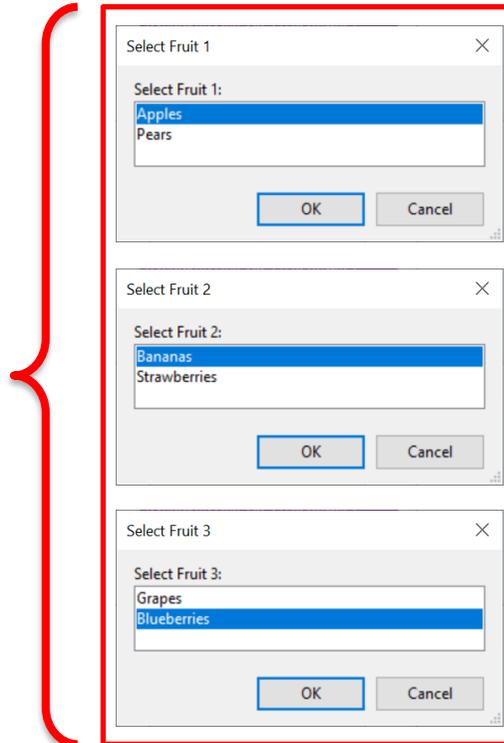
Variable Sequence described with Flow Chart

```

Set coordinates (manually) (Operation FC) - Operation code
# Selection Fruit 1
CC "AdoScript" LISTBOX entries:("Apples@Pears") toksep:("@") selection:
("Apples") title:("Select Fruit 1") boxtext:("Select Fruit 1")
}
IF (selection = "Apples") {
SETL xFruit1:(xPos1)
SETL yFruit1:(yPos1)
}
}
IF (selection = "Pears") {
SETL xFruit1:(xPos2)
SETL yFruit1:(yPos2)
}
}

# Selection Fruit 2
CC "AdoScript" LISTBOX entries:("Bananas@Strawberries") toksep:("@")
selection:("Bananas") title:("Select Fruit 2") boxtext:("Select Fruit 2")
}
IF (selection = "Bananas") {
SETL xFruit2:(xPos3)
SETL yFruit2:(yPos3)
}
}
IF (selection = "Strawberries") {
SETL xFruit2:(xPos5)
SETL yFruit2:(yPos5)
}
}

# Selection Fruit 3
CC "AdoScript" LISTBOX entries:("Grapes@Blueberries") toksep:("@")
selection:("Grapes") title:("Select Fruit 3") boxtext:("Select Fruit 3")
}
IF (selection = "Grapes") {
SETL xFruit3:(xPos4)
SETL yFruit3:(yPos4)
}
}
IF (selection = "Blueberries") {
SETL xFruit3:(xPos7)
SETL yFruit3:(yPos7)
}
}
958 characters
    
```



The objects have to be placed at the specified positions, otherwise the robot arm will reach into the void. (Requires Bee-Up 1.5 or newer.)

Manually entered coordinates

```

# Apples
SETL xPos1:(256)
SETL yPos1:(-158)

# Pears
SETL xPos2:(256)
SETL yPos2:(-107)

# Bananas
SETL xPos3:(256)
SETL yPos3:(-57)

# Grapes
SETL xPos4:(256)
SETL yPos4:(-9)

# Strawberries
SETL xPos5:(256)
SETL yPos5:(40)

# Cherries
SETL xPos6:(256)
SETL yPos6:(88)

# Blueberries
SETL xPos7:(256)
SETL yPos7:(135)

# Plums
SETL xPos8:(256)
SETL yPos8:(186)

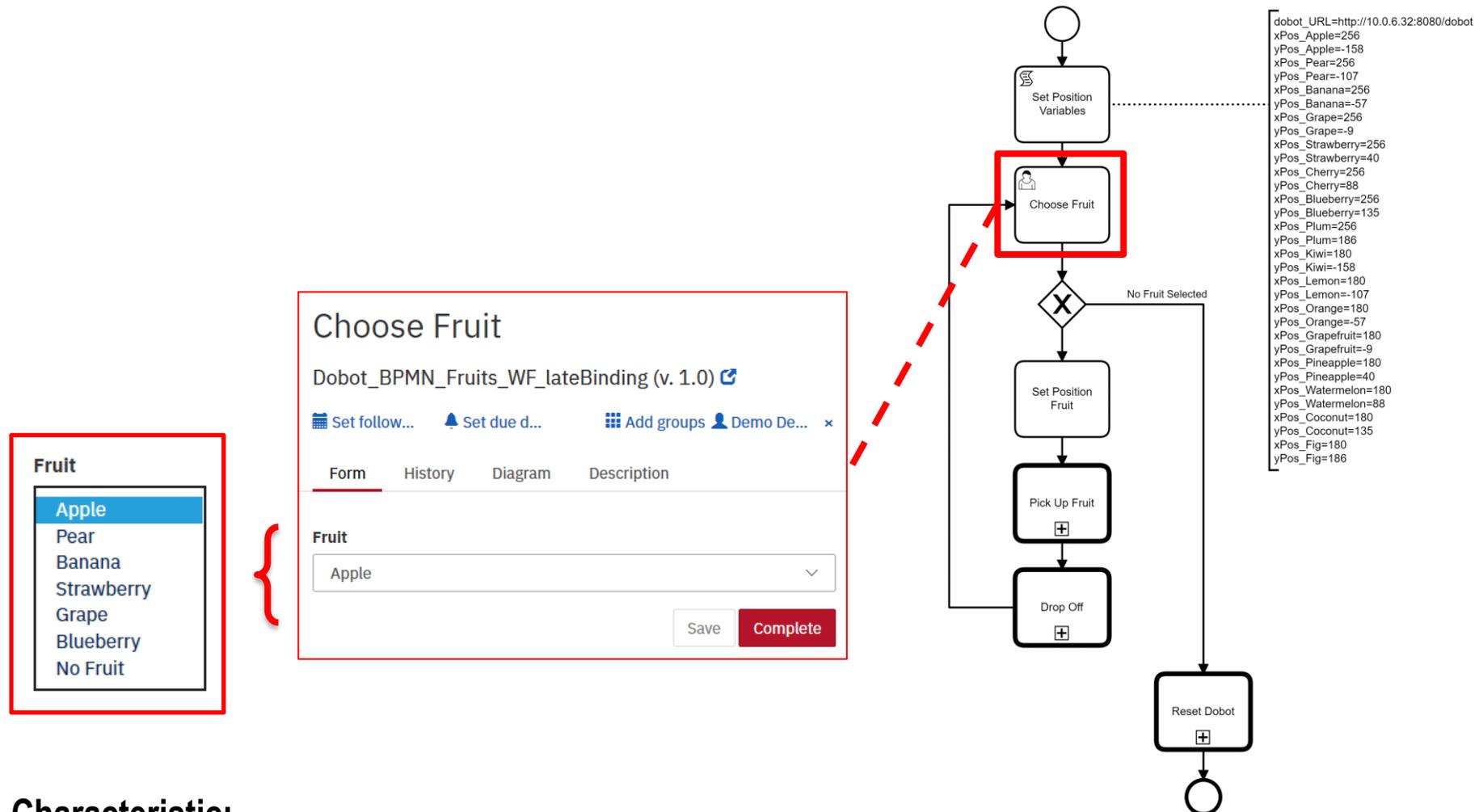
...
    
```

Characteristic:

- Fixed Sequence with variable „Picks“
- Robot-Arm API interaction is implemented in sub-processes
- Orchestration is manually performed by user

Pick-and-Place Assembly

Adaptive and Variable Sequence described with BPMN

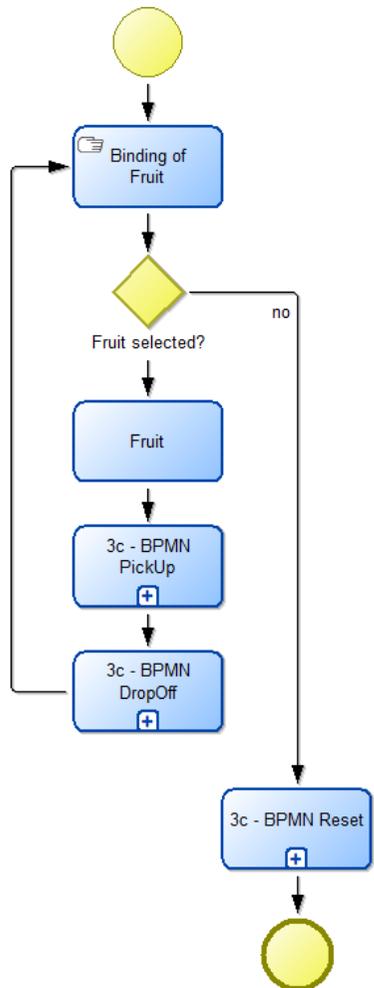


Characteristic:

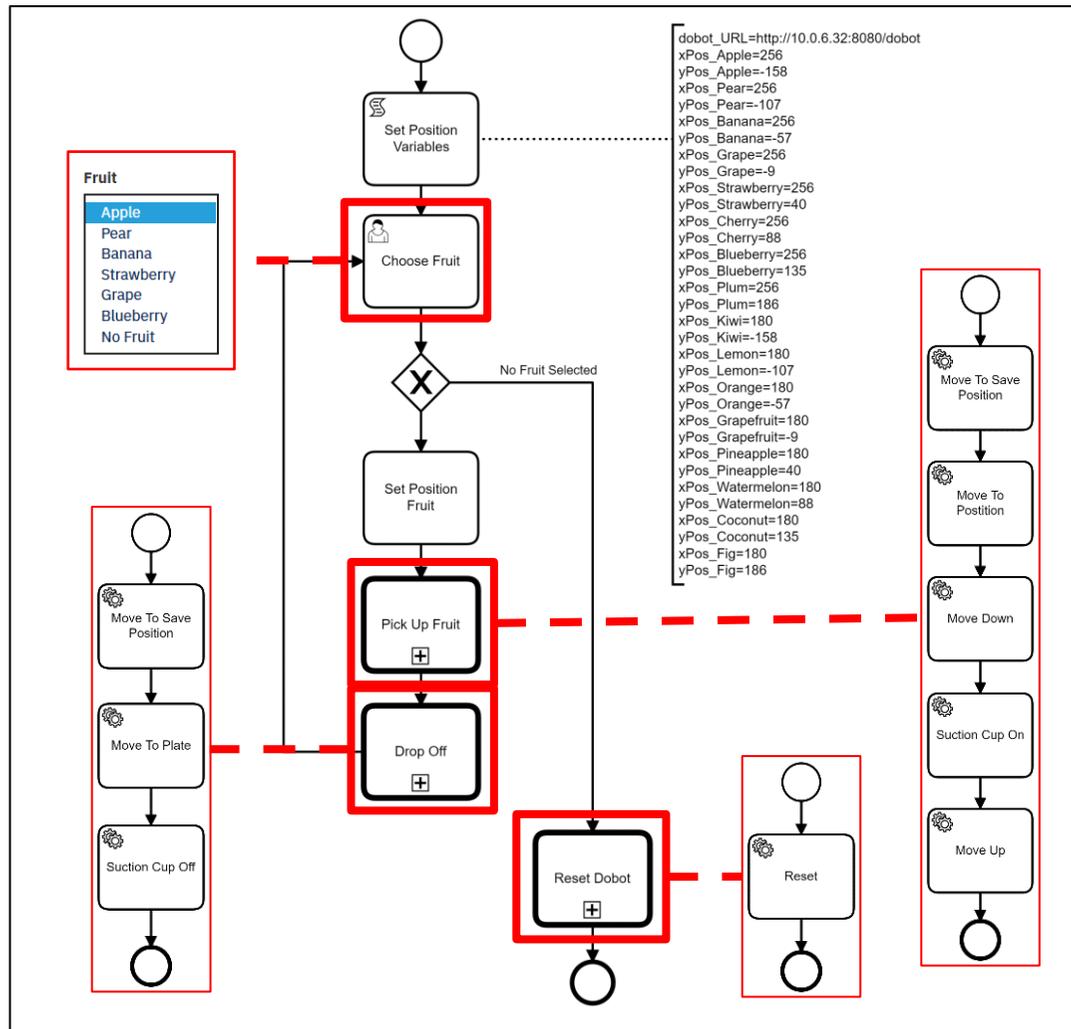
- Adaptive Sequence with variable „Picks“
- Robot-Arm API interaction is implemented in sub-processes
- Orchestration is automatically performed by Workflow Engine

“Smart” Workflows for Robots using BPMN

BPMN



BPMN for Workflow Engine



Robot Arm



OMiLAB Innovation Corner: Project specific Extension

- *Questionnaire Model*
- *Approval of Workflow*
- *Signing Workflow*

Assessing a workflow using questionnaires



2 Select a model



5



Fill the questionnaire

4

Show questionnaire

Questionnaire for "Rest Robot Arm"

Question 1 (*)
Is the robot arm safe, can people be hurt?
 Yes
 No

Question 2 (*)
Does the customer know the result?
 Yes
 No

Question 3 (*)
Is AI performing any decision the customer is unaware of?
 Yes
 No

(*) Required

Cancel Continue

Model Questionnaire Application

Model Questionnaires

Select the ADOxx model to load: 1.1 Supermarket - Fixed Binding (Business process diagram (BPMN 2.0)) (9 Qu) Open ADOxx Model Open External Model

In process 1.1 Supermarket - Fixed Binding Powered by ADOxx 28.07.2020, 15:16:18

Available questionnaires for the model "1.1 Supermarket - Fixed Binding":

"Start" (Start Event)	Questionnaire "Questionnaire 20200804"	Questionnaire Score: Not filled	<input type="radio"/> Show
"Rest Robot Arm" (Task)	Questionnaire "Safety Questionnaire"	Questionnaire Score: Perfect (Points: 3, Missing: 0)	<input checked="" type="radio"/> Show
"Pick Object 1 from Box 1" (Task)	Questionnaire "Safety Questionnaire"	Questionnaire Score: Sufficient (Points: 2, Missing: 0)	<input checked="" type="radio"/> Show
"Place Object 1 into Shopping Cart" (Task)	Questionnaire "Safety Questionnaire"	Questionnaire Score: Insufficient (Points: 1, Missing: 0)	<input checked="" type="radio"/> Show
"Pick Object 2 from Box 2" (Task)	Questionnaire "Safety Questionnaire"	Questionnaire Score: Insufficient (Points: 0, Missing: 0)	<input checked="" type="radio"/> Show

Olive UI Workbench

Olive Microservice Controller

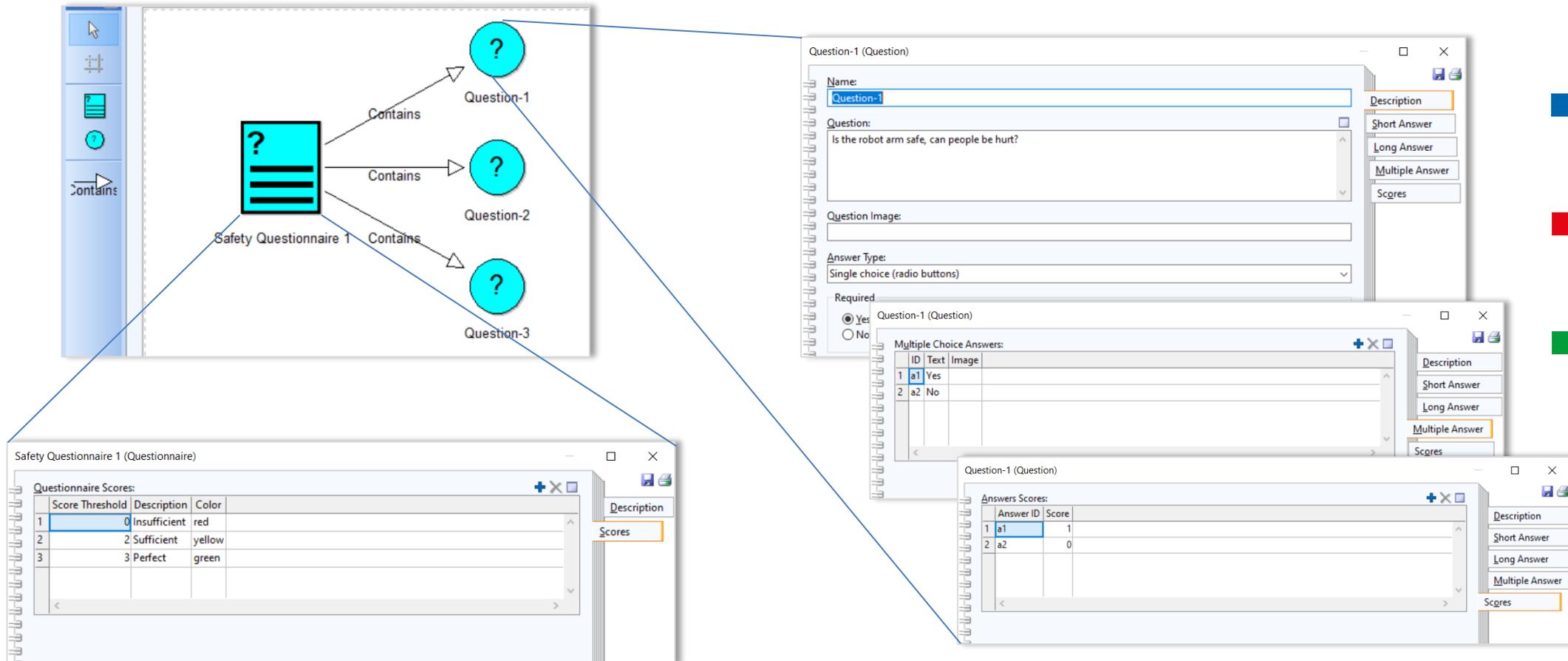
3 Retrieve model details



1 Retrieve model list

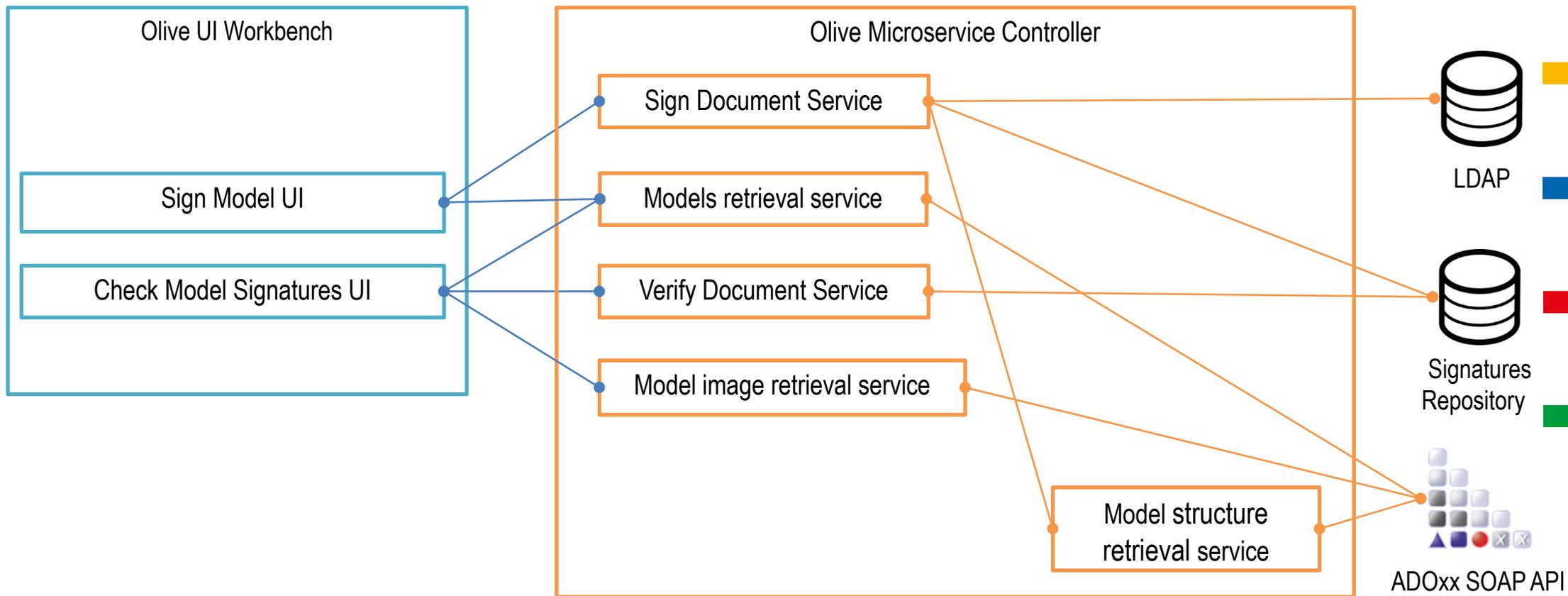
Model a Questionnaire

- Questionnaires are modelled and questions are references
- There are different types of questions, and each answer corresponds with a score
- Finally the score defines if there is a red, yellow, or green flag for the questionnaire



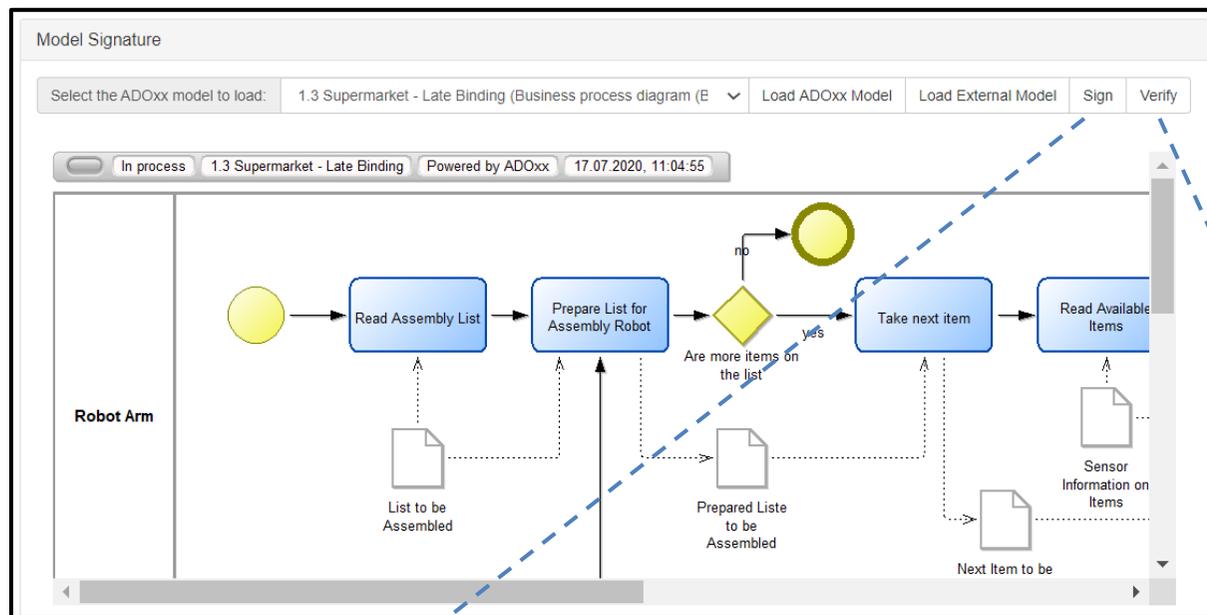
Signing and Verifying Models (1)

An Architecture Overview



Signing and Verifying Models (2)

User Interaction



Log-in

Username: model_owner

Password:

Cancel Continue

Valid signatures for the model "1.1 Supermarket - Fixed Binding":

Users: "domain_advisor"	Applied on "2020-08-10 17:33:49"
Users: "model_owner"	Applied on "2020-08-10 17:33:26"
Users: "technical_advisor"	Applied on "2020-08-10 17:33:37"

Access to Results










Overview Downloads

Groups	Items	Description	Technology	Version	Introduction Video	Technical Explanation Video	Slides & Documentation	Download
2. Sample Models to smartly Operate a Robot Arm		showing different kinds of interaction with the robot arm: (a) manual interaction or (b) interaction via a workflow engine using three different modelling languages: (i) Petri-Net, (ii) Flowchart, (iii) BPMN.						
	2.1 Processes with fixed bound resources	A starting setup is provided, introducing the three different modelling languages – (i) Petri-Net, (ii) Flowchart, (iii) BPMN – and how they interact with the robot arm. Those models introduce also the different abstraction layers that can be observed when interacting with a robot.				Process with fixed binding using Petri Net and Process with fixed using Flowchart and Process with fixed binding using BPMN	Processes with Fixed Binding of resources using different Modelling Approaches	Sample Models of Processes with Fixed Binding of Resources (OMILAB internal) and Sample Models of Processes with Fixed Binding of Resources (OMILAB external)
	2.2 Processes with pre binding of resources	In addition to the process with fixed bound resources, those sample models introduce two actions where AI is needed. (1) a sensor identifies which resources are available, (2) a knowledge base decides, which resources to select. Both AI interactions are simulated with manual interactions by the modeller to explain where to interact with AI. Smart sensors or decision making is introduced before the process starts.				Process with pre binding using Petri Net and Process with pre binding using Flowchart and Process with pre binding using BPMN	Processes with Pre Binding of resource using different Modelling Approaches	Sample Models of Processes with Pre Binding of Resources (OMIAB internal) and Sample Models of Processes with Pre Binding of Resources (OMIAB external)
	2.3 Processes with late-binding of resources	In addition to the process with pre-binding of resources, this late-binding introduces now a time issue, where the sensor information and the decision making needs to be performed during execution.				Process with late binding using Petri Net and Process with late binding using Flowchart and Process with late binding using BPMN	Processes of Late Binding of Resources using different Modelling Approaches	Sample Models of Processes with Late Binding of Resources (OMILAB internal) and Sample Models of Processes with Late Binding of Resources (OMILAB external)

<https://adoxx.org/live/web/complai/downloads>



Reflection and Next Steps

Reflection and next Steps



Lessons Learned

- ▶ business model creation can be supported
- ▶ assessment of innovations and the selection of promising innovation to be put into practice is assisted
- ▶ keeping the momentum of innovation within a heterogeneous workforce – including digital natives and digital immigrants is supported via the model-based approach
- ▶ digitizing of real world into a digital world are key challenges when introducing digital innovation.

Open Questions?

- ▶ What is a digital organisation? If everything can be virtual, what are the key components of an organisation, and how can those key elements be configured?
- ▶ Is the digital transformation different from previous changes? Industry is under continues transformation and hence capable to adapt to new circumstances, but is the digital transformation special compared to previous changes?
- ▶ How to transform the current workforce into a digital workforce? Digital natives and digital immigrants are both needed for the benefit of a digital organisation. But how to manage such teams and how to identify the needed capabilities?
- ▶ What is a global digital ecosystem? Organisations know how to act in global ecosystems, but what is different in a digital globalism?



We thank you for your attention!

For further questions please contact:

