



**HAL**  
open science

## Industrial Digital Environments in Action: The OMiLAB Innovation Corner

Robert Woitsch

► **To cite this version:**

Robert Woitsch. Industrial Digital Environments in Action: The OMiLAB Innovation Corner. 13th IFIP WG 8.1 Working Conference on the Practice of Enterprise Modeling (PoEM 2020), Nov 2020, Riga, Latvia. pp.8-22, 10.1007/978-3-030-63479-7\_2 . hal-03434639

**HAL Id: hal-03434639**

**<https://inria.hal.science/hal-03434639v1>**

Submitted on 18 Nov 2021

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

# Industrial Digital Environments in Action: The OMiLAB Innovation Corner

Robert Woitsch

BOC, Vienna, Austria  
robert.woitsch@boc-eu.com

**Abstract.** The digital transformation is a global mega trend that is triggered by the evolution of digital technology, that has the potential for every organisation to either optimize their current business via a digital innovation or by transforming the business via digital disruption. The challenge for every organisation is therefore to select and personalise the appropriate digital innovation. There is a plethora of methods and assessment frameworks, here we introduce the OMiLAB Innovation Corner that assists in (1) creating new business, (2) design the organisational model and (3) engineer proof-of-concept prototypes as a “communication media”. The unique value proposition of OMiLAB Innovation Corner is the model-based foundation that supports decision makers in key phases of the innovation. First, the creation of new business models by providing digital design thinking tools is assisted. Second, the design of the digital organisation by providing extended modelling capabilities is supported. Third, a proof-of-concept engineering providing robots and sensors is enabled. We share our practical experiences by introducing (a) how new business models are created in the H2020 project Change2Twin to help manufacturing SMEs in their digital transformation, (b) how conceptual models are design in the H2020 project BIMERR to create digital twins of renovation processes and (d) how proof-of-concept engineering is performed in the FFG project complAI to analyse different robotic behaviour.

**Keywords:** OMiLAB, Digital Transformation, Digital Innovation in Industry.

## 1 Introduction

Digital transformation has the potential to create additional value of about 100 trillion \$ (in Europe “billion”) in the next decade. Industry aims to capitalize this potential by creating new business and improve existing business by applying digital technology.

The digitalization strategy of LEGO™, demonstrates nicely, how new business can be created. In addition to the traditional production of toy bricks, the 3D Web-design environment that was used to create new designs of toy bricks, was provided openly. The resulting open environment evolved towards a digital ecosystem where video-games, applications and movies had been created by different stakeholders. Films with LEGO™ figures as main characters, that was possible by a co-creation of the LEGO™

development tools together with animation of the film industry, created a revenue of 468 million \$.

The digitalization strategy of Mack-International, demonstrates, how existing business can be improved. The traditional roller coaster producer and operator was confronted with the fact that similar customer experiences can be achieved with Virtual Reality glasses. Therefore, the virtual roller-coaster was realized combining Virtual Reality with physical roller-coaster. This required new skills, as the movement of each head of each customer must be perfectly synchronized with the Virtual Reality images the customer sees. Skill for real-time 3D image rendering using high performance computer where needed to generate not only a unique customer experience, but also to become the worlds first hybrid roller-coaster producer.

Those two samples introduce the need of (a) a digital mindset and digital skills that go beyond a simple usage of a particular digital technology, (b) digital environment that evolves towards an ecosystem, (c) data access management with strong data infrastructure and appropriate analytics and communication capabilities, as well as (d) technological readiness in cloud computing, cybersecurity and interoperability.

The challenge is to keep the momentum of the digital transformation within the organisation and within the whole ecosystem. The start is the process of inventing [1] – “to produce ... for the first time through the use of the imagination or of ingenious thinking and experiment” in form of creative actions. Then the transformation continues with innovation [2] “a new idea, method, or device” that is understood as the process of emerging something. The transformation ends with providing digital offerings.

This transformation process is unique for each digital strategy of an organisation and is influenced by [3] the (a) challenge in question, (b) the organisational culture, skills and capacity, (c) the market situation and innovation pressure, (d) the strategy, principles and approaches of the organisation, the stakeholders and partners. The challenge is therefore to find appropriate methods, instruments and tools that support organisations during the transformation phases.

The OMiLAB Innovation Corner provides concepts, methods and tools that support organizations in their transformation process by providing a conceptual, technical and physical infrastructure. First, the creative innovation space fosters the co-creative generation of new business models by involving the experience from different experts from different fields. Second, the organizational models are designed with concept models to describe, how the digital technology is introduced into the organization. Analysis, simulation and mining tools support decision makers in assessing the impact of the different utilization of digital technologies. Third, the engineering space supports the construction of proof-of-concept prototypes as a “communication media”. The interaction with physical objects - like robots or sensors – introduces new challenges (a) the digitization of physical objects into a virtualised object using IoT Sensors as well as (b) the interaction with the physical object from the virtualised objects using IoT Adaptors.

The evaluation space enables the demonstration of the proof-of-concept prototypes and integrates the expertise of different fields coming from stakeholders from e.g. legal department, business manager, information technology or engineer.

We use OMiLAB Innovation Corner to focus on different parts of the digital transformation depending on the needs of the projects. In the H2020 EU project

Change2Twin for example, we used the OMiLAB Innovation Corner to support the creation of novel business models for manufacturing SMEs that aim to use digital twin technology. In the H2020 EU project BIMERR, we used the OMiLAB Innovation Corner for designing organizational models that can be used as digital twin for renovation process of buildings. In the Austrian FFG project complAI, we used the OMiLAB Innovation Corner to study the different interaction alternatives between information technology and robots. Finally, we provide an outlook on digital trends in industry and reflect how science could contribute.

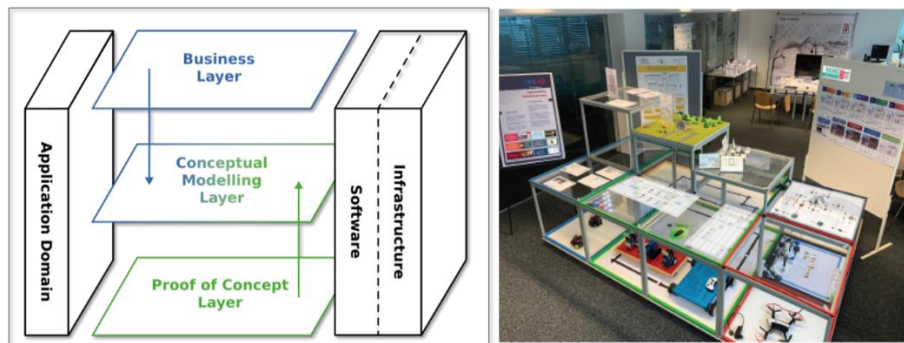
## 2 The OMiLAB Innovation Corner

The OMiLAB Innovation Corner provides a setting of conceptual, technical and physical infrastructure in which different actions can be performed.

### 2.1 Settings of OMiLAB Innovation Corner

#### The Conceptual Framework

The conceptual framework distinguishes between three abstraction layers, (a) business layer that is concerned with creating new business models, (b) the proof-of-concept layer that is concerned with engineering prototypes and (c) the conceptual modelling layer that is concerned with creating organisational models in order to link the business with the proof-of-concept layer.



**Fig. 1.** Introduces the three abstraction layers of the OMiLAB Innovation Corner, whereas the conceptual description is on the left part and the realisation of the industrial OMiLAB Innovation Corner at BOC in Vienna is shown in the right part of the figure.

The OMiLAB Innovation Corner is based on the following principles:

#### 1. Business Layer: Focus on Business Model Creation

A business model describes the “rational of how an organisation creates, delivers, and captures value” [4]. The aim is therefore to either improve existing or to generate

new business models in order to generate added value. This layer therefore provides a high-level overview of the domain, the application scenario as well as the overall eco-system in which the organisation operates. It follows the “Outcome based approach” principle, where digital innovation is always justified by the outcome.

## 2. **Conceptual Model Layer: Focus on Organisational Model**

Conceptual models are successfully applied in enterprise modelling [5] and information systems [6] and hence capable to describe how the digital solution is applied within an organisation. The digital innovation is therefore described in a technology independent way using a knowledge-based approach. The knowledge can be interpreted by computer algorithms or by human experts, depending on its model-representation. Hence, we follow the principle to “Invest on use cases and not technology” as the organisational models can be realised with different technologies.

## 3. **Proof-of-Concept Layer: Focus on Robot Interaction**

Rapid prototyping is “... the idea of quickly assembling a physical part, piece or model of a product. “ [7] We apply rapid prototyping for both the development of a software application as well as for the development of a physical device. The engineering of a rapid prototypes is performed by configuring and integrating pre-packaged features that are provided as services. Instead of full implementing the prototypes, we apply the “Fail Fast, fail cheap” principle by rapidly composing features in form of services that emulate the main behaviour of the intended solution.

### **The Technical Environment:**

The technical environment supports the idea to use “prototypes are communication media”. Haptic elements enable a hands-on experience of involved experts with different background. Those haptic elements are additionally represented in form of conceptual models in order to enable documentation, analysis, simulation and the interaction on different channels to also involve experts that are not physically present during the workshop. For the models we use out-of-the-box modelling tools. OMiLAB provides the tool Bee-Up [8] that realises the most common modelling languages BPMN, EPC, ER, UML and Petri-Net (Bee-Up). Business process models are commonly represented in BPMN [9]. Data models have their origin in the Enhanced Entity Relationship (EER) [10] model. Technical specifications and software interaction is described with the Unified Modelling Language (UML) [11]. Formal state diagrams with a well-developed mathematical theory is commonly described with Petri-Nets (PN) [12]. There are additional 55 other modelling tools based on the meta modelling platform ADOxx. Hence, the modelling tools can be combined for the particular need of the organisation.

ADOxx.org is an open community consisting of about 4.300 developer who implement their own modelling tools on top of the meta modelling platform ADOxx. It offers tutorials, documentation and FAQ interaction and development tools for realising own modelling tool, like the 55 modelling tools from OMiLAB. 14 building blocks and code snippets that provide additional features such as monitoring dashboard or simulation services, and 17 development spaces of projects.

OLIVE is a Microservice Framework that provides several modelling-features that can be used when engineering a proof-of-concept prototype. It provides a connection to ADOxx, hence any modelling tool that is built on ADOxx can use the OLIVE

Microservices or one of the connectors that access third-party applications. This technical integration of an OLIVE Microservice and an ADOxx-based modelling tool requires also a conceptual integration which depends on the modelling language and the service in use. The Model Wiki for example is generic and can be used by any modelling language, whereas the monitoring dashboard for example requires the semantic of goals, KPIs and measures.

### **The physical Infrastructure**

The physical environment is provided in form of spaces, chairs, large and small tables that can be flexibly arranged to divide participants. All aforementioned layers are supported with the corresponding physical infrastructure. The business model creation is supported with SAP Scenes paper figures, cameras and corresponding Scene2Model toolkit that generate models automatically. The proof-of-concept engineering is supported with tools, laptops and working places to sold, screw and programme the robots and IoT sensors. The consolidated evaluation and demonstration of the solution is supported by Plexi-glass tables that represent each layer and laptops with corresponding modelling tools. The OMiLAB Innovation corner provides physical devices like training robots and IoT sensors that provide the basics for the prototype engineering. The focus is thereby on the generation of a “prototype as a communication and assessment media” to encourage the co-operative evaluation of simplified proof-of-concept realisations. It provides a simplified setup using IoT Adapters that enable the emulatoin of different software behaviour. The robot behaviour can either be implemented on IoT-Adapter, with the benefit of the availability of smarter algorithms, but with the drawback that the reactions are slow. Alternative, the robot behaviour is implemented on the platform of the robot, which has the benefit that the robot acts fast and secure but in order to change the behaviour, the algorithm needs to be re-implemented on the platform level. Different robotic behaviour can be demonstrated in different configurations.

## **2.2 Actions within the OMiLAB Innovation Corner**

The OMiLAB Innovation corner provides an environment for design thinking and conceptual modelling and supports therefore a wide range of methods and tools that can be applied to work on different organizational challenges. We consider “Design Thinking as a systematic, human-centred approach to solving complex problems ... [where] ... user needs and requirements as well as user-oriented invention are central ...” [13]. We follow a co-creation approach where human experts with different backgrounds - like business, legal, engineering or software engineering – are co-creatively working on ideas for digital solutions.

We stress the observation that “making ideas tangible facility communication”, hence “prototypes are communication media” [14] and extend this with our experience that business process modelling can complement and assist the communication of such prototypes. The domain-specific graphical documentation of the context, purpose, aim, requirements or challenges has proven to support the collaboration between stakeholders with different backgrounds. In addition to the documentation of the workshop

results or prototypes, the models can be analysed, simulated and distributed in order to share models and collect feedback from stakeholders. Business process modelling can complement the design thinking workshops by providing additional explanation.

In the business model creation phase, we design a new business model by applying the SAP Scenes approach and complemented it with Business Process Modelling. In order to elicit creative ideas, and innovations the workshop moderate may use instruments like User Motivation Analysis, Persona, Value Proposition Chain, Research Mind Map, Stakeholder Map, User Journey, Hypothesis Generation, Collective Notebook or similar instruments to gain new ideas from the workshop participants.

In the conceptual modelling phase, we model the Company Map to indicate where and how the innovation is foreseen in the organisation. Innovations are described as new capabilities that either improve existing or enable new business processes. Different alternatives are modelled to simulate them with different assumptions. Simulations results can be merged with test data or historical data in order to assess the different alternatives. Data mining, data analysis or the collection of expert opinions can complement this phase to support decision making.

In the engineering phase, we combine prototyping of software and digital devices with Wizard of Oz experiments. In the Wizard of Oz experiments the user interaction is actually performed by a human person that acts like a full fledged computer programme to emulate the – yet not implemented - system behaviour. We extend this approach with robots and sensors in form of simplified demonstrations, like a robot arm is only picking-up cards with images of objects instead of picking up the real objects. The demonstration scenario in form of a proof-of-concept prototype, combines therefore human interactions, software prototypes and robots and sensors to emulate the possible behaviour of future systems.

Although the aforementioned phases of the OMiLAB Innovation Corner can be mapped to the three phases of design thinking, “Ideate”, “Prototype”, and “Test” [15], we explicitly allow that projects wither focus in only one or two phases, that phases are visited in no particular order as well as the phases are worked out in a sequence.

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

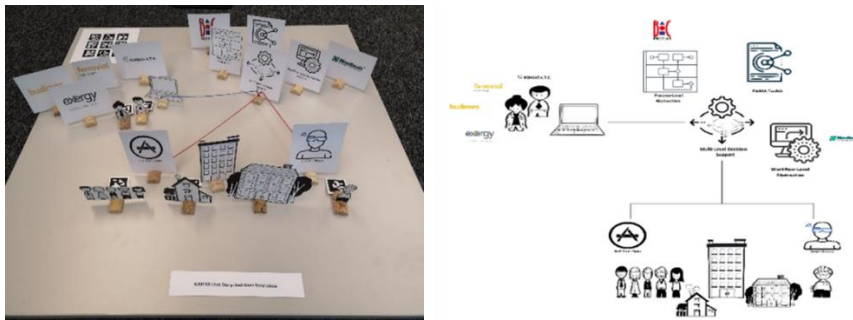
The main goal of the H2020 EU Project Change2Twin is to ensure that 100% of manufacturing companies in Europe have access to 100% of technologies needed to deploy a digital twin. This is addressed by a series of initiatives, where so-called Digital Innovation Hubs help manufacturer in assessing, selecting and applying Digital Twin technology that is provided at marketplaces. We are using the OMiLAB Innovation Corner to analyse the current business model and work-out future solutions using Digital Twin technology. So-called exploitation items that are either market-ready offerings on a marketplaces or contributions with a lower technology readiness level like prototypes, approaches or ideas are proposed to the manufacturer in a creative workshop. The manufacturer needs are matched using expert knowledge and smart algorithms to offer

appropriate available items. Different alternatives are worked out and with the help of analysis and simulation algorithms the most appropriate alternative is elaborated.

### 3.1 Co-Creation Approach

The different interests between technology provider, end users and research partner are externalized using the design thinking method called SAP Scenes [16]. Different stakeholders with different background and expertise are contributing in a co-creative manner to generate a scene of the new business model. We represent both, the consumer viewpoint as well as the vendor viewpoint in form of separate design thinking workshops. The result is an agreed set of so-called scenes that describe the main actors, actions, elements or locations. This method enables the individual extension of the figures. The physical workshop is extended by capturing the scene with a camera and automatically generating a graphical model out of it.

This model can be used for documentation, for distribution to experts that are not physically present at the model as well as the starting point to detail the scene and evolve a business model and the corresponding business processes.



**Fig. 2.** shows a scene as a result of a design thinking workshop [17] explaining a technological ecosystem on the left. The transformation of the original workshop into a scene model using the OMiLAB Scene2Model Toolkit is shown on the right.

### 3.2 Usage of the OMiLAB Innovation Corner

#### Usage of OMiLAB Innovation Corner Default Setting

The Scene2Model infrastructure is used to support the design thinking workshop consisting of: paper figure with QR codes, camera reading QR codes, Raspberry-Pi and corresponding tag-recognition software, and the Scene2Model toolkit that retrieves the QR code and maps them to modelling objects within the scene model. ADOxx with the BPMN modelling library was used to model the business processes. The marketplace model [18] specifies the exploitation items that describe the different digital twin offerings that can be used by the manufacturer. A key challenge is to find, select and propose relevant digital twin technology for the manufacturer during the workshop. The introduction of appropriate samples, ideas or best practices has massive influence in the creativity and the resulting outcome of the workshop. This is currently performed by



the moderator who knows the available solutions and proposes the most appropriate one.

### **Extending the OMiLAB Innovation Corner**

In order to support the moderator of the workshop, we implement an extension to the Scene2Model toolkit that searches for appropriate ideas and solutions, so that experiences from several moderators can be used by automatic matching the demand and the available innovation items using intelligent algorithms. We rely on the experiences we gained during the H2020 EU Project CloudSocket [19], where we apply a matching mechanism [20] that reflects the requirements of a business process on the one side and the service description on the other side in order to find the appropriate service for a business process. In order to match the business requirements against available ideas, we create a so-called innovation shop based on the experience of the H2020 EU-Project CaxMan, where innovation results are listed in form of items. The notation “innovation item” allows us to act flexibly and also include early ideas, software prototypes or consulting instruments that are not yet market ready. The difference between an innovation shop and a marketplace is the fact that the marketplace provides technology readiness level 9 items only, whereas the innovation shop has no restriction in the technological readiness. The “Innovation Shop” or “Marketplace” modelling is used to describe the corresponding offerings. The Annotation-Matcher loads the ontologies that were used when annotating both the requirements and the innovation items and match the innovations to business needs. Hence, during the creative workshop of business model creation, the design thinking workshop is enriched with appropriate offerings coming from innovation shops or marketplaces. We implemented the extension using the OLIVE Microservice framework and extensions in the ADOxx based Scene2Model toolkit.

## **4 The H2020 EU-Project BIMERR: Focus on Organisational Model**

The aim of BIMERR is to design and develop a Renovation 4.0 toolkit which will comprise tools to support renovation stakeholders throughout the renovation process of existing buildings, from project conception to delivery. Our focus is the development of a business process and workflow modelling toolkit that has the capability to design, execute, monitor and evaluate through mining the renovation processes. The renovation processes are designed in BPMN, whereas we realise different level of details. On the template level, the different renovation processes are modelled in a generic way in order to be applied by any renovation initiative. On the instance level, the renovation process is modelled in accordance with the concrete project plan of the particular construction site. On the workflow level, the renovation process is modelled in accordance of the applications, mobile apps, smart glasses, data repositories and legacy applications that are used by the workers on the particular construction site.

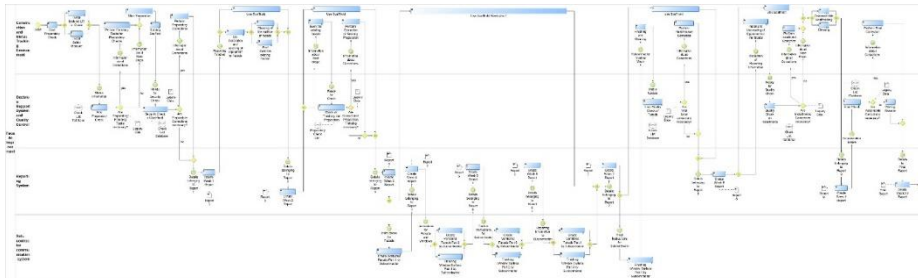
#### 4.1 Knowledge Based Approach

The aim is to create a digital twin of the renovation process on different levels in order to serve different purpose. In the template level, the digital twin is very generic and is therefore only used to assess the prize and the duration of a renovation project. This estimation is on very high level and must therefore be interpreted by experts who can correct the results according their knowledge to make good offers. On the instance level, the digital twin is concrete in terms of weekly deadlines at the construction site, the used material, the manpower and the machinery. Hence, the status of the renovation process consists on the data received by the various project management and monitoring tools, the exert opinion when visiting the site and additional information that is provided by the residents who use the offered mobile apps during the renovation period as well as the smart glasses who is offered for subcontractors.



**Fig. 3.** shows the template of renovating a facade form the outside. The different possibilities like if a re-arrangement of telephone cables is necessary, or which type of facade is added are expressed as decisions in this template.

This template is then instantiated for a concrete project, and each task is split according the sub-contractor and the time slot in which task has to be finished.



**Fig. 4.** indicates the abstract workflow of the facade improvement process outside by using the swim lanes to express different IT-systems - construction onsite environment, management environment, reporting and sub-contractor environment.

Both models can be viewed in full size and downloaded at the development space of BIMERR [21] on ADOxx.org. The digital twin of the renovation process is used to monitor the status of the construction site, to execute the workflow and interact with the stakeholder and to simulate how the future work progress is estimated based on expert opinions. An evaluation of the renovation process by performing a process mining and reflecting the results by a human evaluation via collaboration<sup>1</sup> enables iterative learning cycles.

<sup>1</sup> Deliverable D6.3, D6.4, D6.6, D6.8 and D6.10 of BIMERR

## 4.2 Usage of OMiLAB Innovation Corner

### Usage of OMiLAB Innovation Corner Default Setting

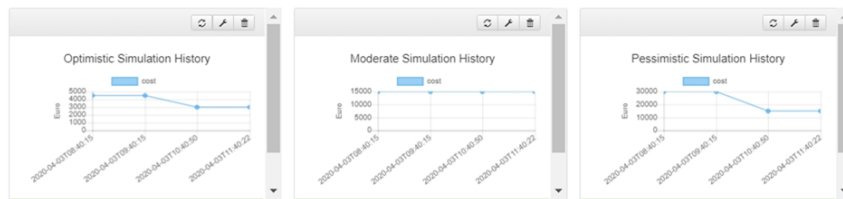
The OMiLAB Innovation Corner provides the ADOxx meta modelling platform and the OLIVE Microservice Framework.

- 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.

The realisation is provided in the development space of BIMERR on ADOxx.org.

### Extending the OMiLAB Innovation Corner

One knowledge-intensive task that is performed with the help of the digital twin is the prediction if there will be a delay or additional costs. We demonstrate this with the rent of the scaffold, as a delay has a direct impact on the rental costs of an equipment that has to stay onsite. A dashboard monitors the Key Performance Indicators (KPI) “*Scaffold Cost*”, which consists of (a) the construction, (b) the de-construction and (c) the rental costs for the duration. For the prediction of the rental costs, we introduce the process-simulation that forecasts the most likely duration by continuously calculating three scenarios: (1) the optimistic, (2) the moderate and (3) the pessimistic scenario.



**Fig. 5.** shows a representation of KPIs including: (a) actual scaffold costs as well as (b) optimistic, (c) moderate and (d) pessimistic scenarios of the simulated duration

In order to fine-grain the simulation and to introduce expert knowledge in combination with historical data, we introduce the so-called “knowledge-based” simulation. A precondition is, that each simulation run has its own probabilities for decisions, waiting or execution time. This enables the introduction of a context, that defines the probabilities concerning the likelihood for weather extremes, quality issues by some sub-

contracture or unexpected other issues. We externalise expert knowledge through the concept of “weighted net sum” to define the simulation input.

In our sample case, the “rental time of the scaffold” is the parameter which we simulate. To calculate the respective weighted net sum the following inputs are used: (1) is historical data that provides the base distribution for the expected time; (2) is an estimation on the weather conditions causing a delay in the facade renovation; (3) quantifies the potential risk that the customer does not pay and therefore the construction site needs to pause – where the rental costs of the scaffold continues; (4) refers to the potential risk that the subcontractor does not perform according the contract, hence a substitute needs to be put in place – with the rental costs of the scaffold continues; (5) indicates the likelihood of unexpected risks that may cause a delay.

Each of the input is the result of the calculation of the probability and the weighted net summary that calculates the various inputs. The expert input consists of (a) the mathematical distribution and (b) the different weights for the net summary.

## **5 The FFG-Project complAI: Focus on Robot Interaction**

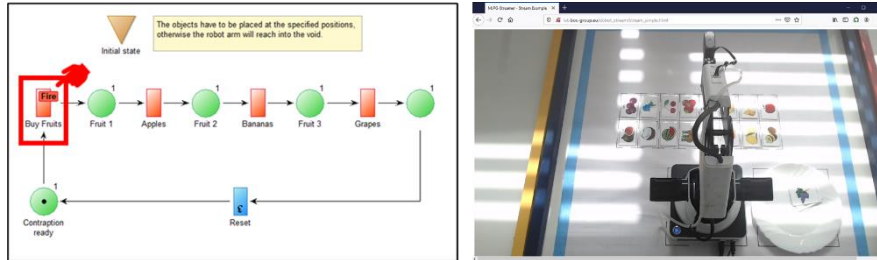
The complAI project develops an assistance system, which is to guide organisations in using AI. Relevant ethical, legal, safety and security issues will be assessed in a model-based risk management software tool. For this investigation, we choose compliant execution of processes on industrial robotic platform. Workflow engines are used for the execution of processes on industrial robotic platforms. The challenge is to assess such workflows by domain experts i.e. layers who are not familiar with the technical details of workflows or artificial intelligence (AI). BOC uses different modelling languages, to separate the concerns and enable also non-technical experts the assessment, if a certain process can be executed on an industrial robotic platform or not. The OMiLAB Innovation Corner is use to engineer a proof-of-concept prototype that demonstrates the different behaviour of a robot arm.

### **5.1 Robot Interaction**

The digital supermarket has been chosen as a sandbox-scenario, as the three challenges in complAI (a) “Pick-and-Place”, (b) “Mobile robots” and (c) “Human and robotic collaboration” can be demonstrated. Although the use case of the digital supermarket is abstract and considered as a sandbox scenario, the worked-out mechanisms can be applied on concrete industrial use cases. In order to enable an open discussion on legal and ethical issues, we selected a hypothetical and abstract scenario being more flexible when discussion sensible issues.

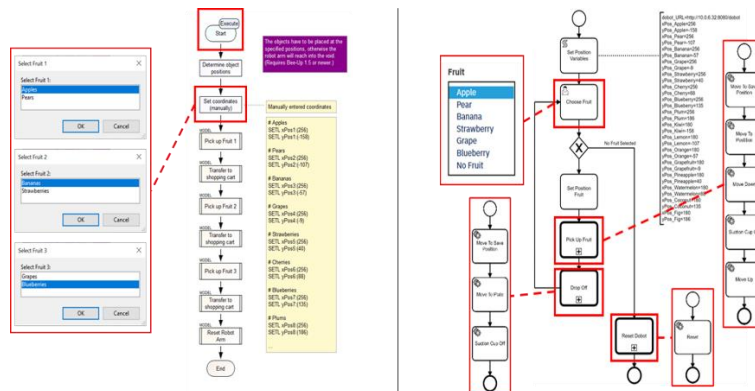
For the “Pick-and-Place” scenario we consider a robotic arm that configures a basket of fruits for the customer. The idea is that the customer can choose the fruits from a mobile app, enter the shop and pick up the prepared basket of fruits. The challenge is to describe not only the process of picking fruits and placing them in a basket, but also on the decisions which fruit to pick and how to deal with the situation that fruits have

been run out of stock. The simple sequence of picking up three fruits was modelled with a Petri-Net.



**Fig. 6.** shows a petri-net describing a simple pick-and-place procedure for a robot arm. Each transition invokes an action from the robot that is shown as a life stream picture on the right.

The target platform is the representation of the pick-and-place workflow in form of a flexible BPMN workflow that runs within a workflow engine. In order to transform the simple pick-and-place sequence, we switched to a flow chart representation, introducing sub-processes for certain robot movements and display user interfaces in form of selection boxes. This enables to explicitly demonstrate, how an intelligent interpretation is performed. In our case the sensor information if the selected fruit is available and the interpretation to select an alternative instead. This sensor-based inference is demonstrated in form of the human interaction using the selection boxes. The flow-chart representation therefore enabled a mock-up of the workflow and the intelligent interaction. The resulting BPMN workflow was implemented on a workflow engine combining the sub-workflows for movements, the orchestration of the movements and the indication of intelligent interaction.



**Fig. 7.** introduces the same simple pick-and-place procedure that picks up some cards with fruit-symbols but introduces a user interaction and sub-processes in form of a Flow Chart on the left and in form of a BPMN workflow on the right.

## 5.2 Usage of OMiLAB Innovation Corner

### Usage of OMiLAB Innovation Corner Default Setting

The proof-of-concept engineering of intelligent robot interaction using workflows used the following default setting:

- The pre-packaged Dobot Magician [22] 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.

The configurations can be downloaded from the complAI ADOxx.org developer space [23].

### Extending the OMiLAB Innovation Corner

In order to assess, if a process can be executed on the robotic platform or not, we extended the OMiLAB Innovation Corner in a two-step approach:

First-Step: We implemented an assessment services that applies a pre-defined questionnaire on the process in order to find out, if the answer result in a (i) “green-light” to indicate that there is no risk when the workflow is operating, (ii) “yellow-light” that there are risks but they can be sufficiently handled following certain conditions or (iii) “red-light”, where additional corrections are required.

The Microservice Framework OLIVE was used to realise this questionnaire services. Models from ADOxx-based tools can be visualised in the assessment service by displaying the model image, and the color-coded icons are laid over the model image. The colour-code item refers to a questionnaire that is displayed and the answers are summarized according its calculation algorithm.

Details on how to use the assessment service, the questionnaire modelling within ADOxx, the JSON format of the questionnaire and the construction of questions and answers is provided in the complAI development space on ADOx.org.

Second-Step: When a workflow model passes the assessment, the model is signed to ensure that only the signed workflows are executed on the robotic platform. The Microservice verifies the role or the person who signed the model. This is performed by creating a hashkey of the model to ensures that no changes have been performed. The haskey is stored in a separate database which is used for verification.

In case a workflow has to be executed, it is first verified, if the signed workflow has not been changed.

## 6 Reflection and Next Steps

We observed that (a) business model creation, (b) the assessment of innovations and the selection of the most promising innovation to be put into practice, (c) keeping the momentum of innovation within a heterogeneous workforce – including digital natives

and digital immigrants as well as (d) the digitizing of real world into a digital world are key challenges when introducing digital innovations.

With the OMiLAB Innovation Corner we apply an instrument, consisting of conceptual framework, technical environment and physical infrastructure, in order to support organizations to solve aforementioned challenges.

Business model creation is supported with a co-creative approach using design thinking to harvest creative ideas from different domain experts with different backgrounds and viewpoints. Assessment of innovations and decision making is supported by a knowledge-based approach using conceptual models, where the expertise of different stakeholders is incorporated into a hybrid knowledge base. Activities to keep the momentum of innovation is assisted by organizational models that are generated within the OMiLAB Innovation Corner. In contrast to other innovation workshop approaches, the models can be used within the organizational during the entire lifecycle of the innovation process. The digitization of real-world objects into digitized objects is supported by a proof-of-concept environment using robots and IoT sensors to enable prototypes as “communication media”. Hence, those prototypes focus on making physical issues explicit and challenges that only engineers are aware of, can be elaborated also to other domain experts within a consolidated proof-of-concept prototype.

The OMiLAB Innovation Corner has been successfully applied in a series of H2020-EU projects, national FFG-Projects and bilateral industrial co-operations.

However, we see the need that science supports industry by investigating the following challenges:

1. 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?
2. Is the digital transformation different from previous changes? Industry is under continuous transformation and hence capable to adapt to new circumstances, but is the digital transformation special compared to previous changes?
3. 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?
4. What is a global digital ecosystem? Organisations know how to act in global ecosystems, but what is different in a digital globalism?

We are convinced that the upcoming challenges to deal with digital transformation can be supported with model-based approaches acting as documentation, mediator environment, and as a knowledge base for intelligent approaches.

## References

1. Merriam-Webster, <https://www.merriam-webster.com/dictionary/inventing>, last access: 2020/09/16
2. Merriam-Webster, <https://www.merriam-webster.com/dictionary/innovation>, last access: 2020/09/16

3. cmp. World Economic Forum, <http://reports.weforum.org/digital-transformation/wp-content/blogs.dir/94/mp/files/pages/files/dti-executive-summary-20180510.pdf>, slide 20, last access: 2020/09/16
4. Osterwalder, Alexander; Pigneur, Yves; Clark, Tim (2010). *Business Model Generation: A Handbook For Visionaries, Game Changers, and Challengers*. Strategyzer series. Hoboken, NJ: John Wiley & Sons. ISBN 9780470876411. OCLC 648031756.
5. Sandkuhl, K., Fill, H. G., Hoppenbrouwers, S., Krogstie, J., Matthes, F., Opdahl, A., Schwabe, G., Uludag, Ö., & Winter, R. (2018). From expert discipline to common practice: A vision and research agenda for extending the reach of enterprise modeling. *Business & Information Systems Engineering*, 60(1), 69-80.
6. Frank, U., Strecker, S., Fettke, P., vom Brocke, J., Becker, J., & Sinz, E. J. (2014). The research field modeling business information systems. *Business & Information Systems Engineering*, 6(1), 39-43.
7. Techopedia, <https://www.techopedia.com/definition/9093/rapid-prototyping>, last access: 2020/09/16
8. OMiLAB Bee-Up, <https://www.omilab.org/activities/bee-up.html>, last access: 2020/09/16
9. OMG BPMN, 2009, *Business Process Modelling Notation. Version 1.2* Available at: <http://www.omg.org/docs/formal/09-01-03.pdf>, Retrieved: 14.05.2009.
10. Chen, P.P.: *The Entity-Relationship Model – Towards a Unified View of Data*, *ACM Trans. Database System*. 9-36, (1976)
11. OMG UML, <https://www.omg.org/spec/UML/About-UML/>, last access: 2020/09/16
12. Petri, Carl Adam; Reisig, Wolfgang (2008). "Petri net". *Scholarpedia*. 3 (4): 6477. doi:10.4249/scholarpedia.6477.[http://www.scholarpedia.org/article/Petri\\_net](http://www.scholarpedia.org/article/Petri_net)
13. Hasso-Plattner Institut, <https://hpi-academy.de/en/design-thinking/what-is-design-thinking.html>, last access: 2020/09/16
14. Meinl C., Leifer L, *Design Thinking: Understand – Improve – Apply*, Hasso Plattner, Berlin Heidelberg, Springer 2011
15. cmp. Malamed C., *Learning Solutions*, <https://learningsolutionsmag.com/articles/a-designer-addresses-criticism-of-design-thinking>, last access: 2020/09/16
16. SAP, <https://experience.sap.com/designservices/resource/scenes>, last access: 2020/09/16
17. BIMERR Consortium, D3.1 Stakeholder Requirement for the BIMERR system, [www.bimerr.eu](http://www.bimerr.eu), last access: 2020/09/16
18. ADOxx.org, *Change2Twin Development Space*: <https://adoxx.org/live/web/change2twin/downloads>, last access: 2020/09/16
19. ADOxx.org, *CloudSocket Development Space*, <https://www.adoxx.org/live/web/cloud-socket-developer-space/bpaas-design-environment-prototype-research>, last access: 2020/09/16
20. Knut Hinkelmann: *Business Process Flexibility and Decision-Aware Modeling - The Knowledge Work Designer. Domain-Specific Conceptual Modeling 2016*: 397-414
21. ADOxx.org, *BIMERR Development Space*, <https://adoxx.org/live/web/bimerr/downloads>, last access: 2020/09/16
22. Dobot, <https://www.dobot.de/produkte/dobot-magician-4-achsen-roboter/>, last access: 2020/09/16
23. ADOxx.org, *complAI Development Space*, <https://adoxx.org/live/web/complai/downloads>, last access: 2020/09/16