AI-based Robotics in the RoX Ecosystem

ERF WS56 - Data Spaces Beyond the Basics: Toward Operational AI and Robotics

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aufgrund eines Beschlusses des Deutschen Bundestages
Finanziert von der Europäischen Union
NextGenerationEU

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We make previously technically infeasible and economically unviable automation a reality.

We enable new ways of collaboration and new business models.

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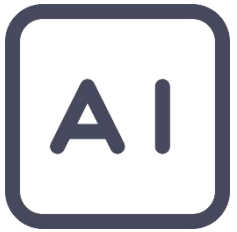
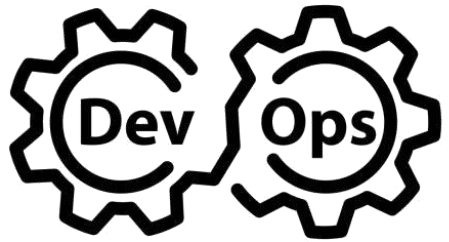
How?

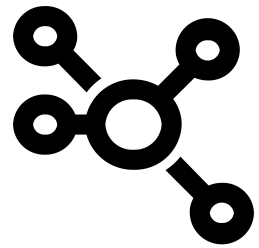
- By using **AI** to **lower the entry barriers** to robot-based automation and **increase the flexibility** of systems.



- By developing the right **development tools and processes** to enable consideration of the **entire lifecycle of automation solutions** and allow for their continuous improvement.



- By building a **decentralized data and service ecosystem** to enable **secure, efficient, and sovereign data exchange** between all stakeholders.



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Enabled by?

- R&D project funded by the BMWE
  (Federal Ministry for Economic Affairs and Energy)
- Project volume: €55m
- Duration: 30 months

ABB
Boehringer Ingelheim
dfki Deutsches Forschungszentrum für Künstliche Intelligenz German Research Center for Artificial Intelligence
DLR Deutsches Zentrum für Luft- und Raumfahrt e.V.
DÜRR
Fraunhofer
Gluth System Technik
intrinsic
invite
Mercedes-Benz
RHEINMETALL
RIF Institut für Forschung und Transfer
roboception
robomotion
SAFELOG
SCHUNK
SIEMENS
SOTEC
T Systems
VDMA
WACKER
WÜRTH
RHEINMETALL YARDSTICK ROBOTICS

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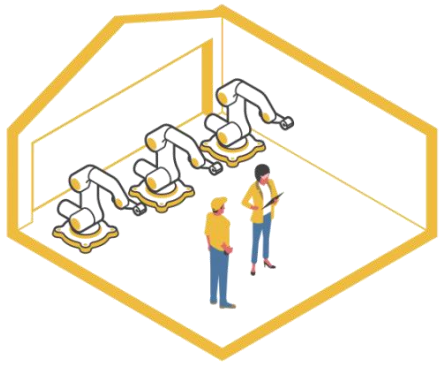
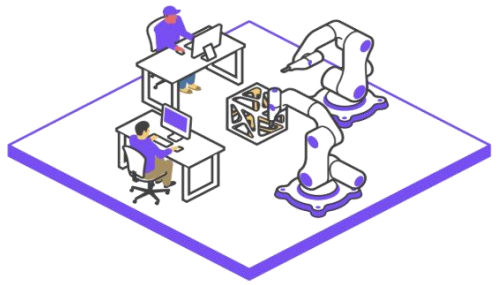
Relevant for whom?

- For companies of all sizes, especially for SMEs, along the entire value chain: component suppliers, solution providers, end-users.



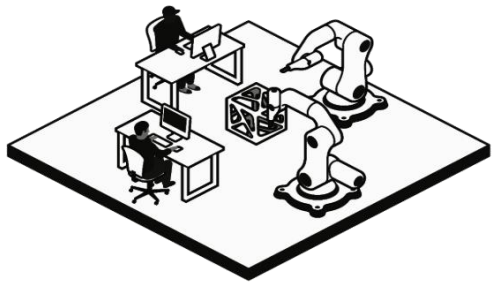
Asset Builders

Develop assets (e.g. hardware, software skills, custom actions, etc.)



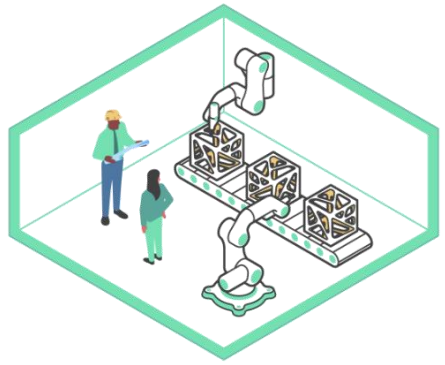
Solution Builders

Create (digital) robotic solution for an end-customer



Solution Installers

Procure, assemble, install, maintain the created solution



End Customers

Use robots in their operations

Digital Ecosystem for AI-based Robotics – Overview

- RoX promotes the use of advanced AI in practically relevant robotic solutions
  - Increasing the flexibility of robotic solutions.
  - Broadening the range of applications for robotic solutions.
- Digital ecosystems foster close cooperation/collaboration between e.g. users, system integrators, IT vendors and manufacturers of robotic components. They also provide the opportunity to realize innovative value-added services
  - Accelerating the design and commissioning of robotic solutions
  - Unlocking new market potential through value added digital services – e.g. predictive maintenance.

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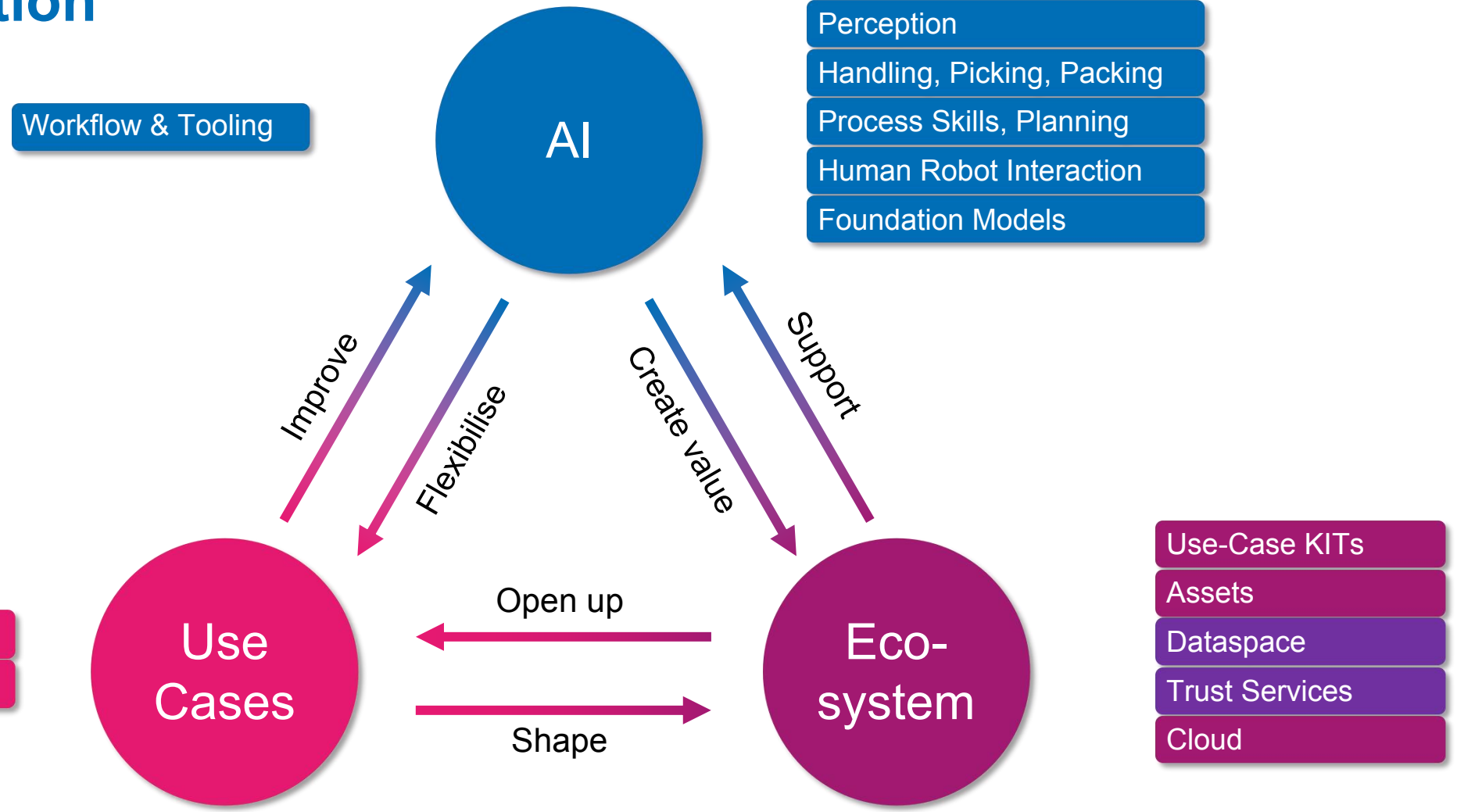
Areas of action



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Digital Ecosystem for AI-based Robotics – Use-Case Driven

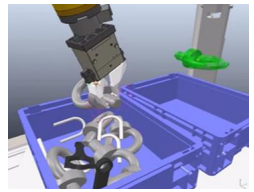
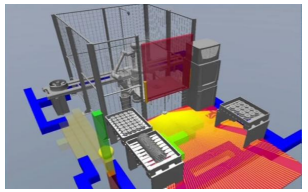
Use Cases

- Loading & Unloading
  … covers truck loading and unloading processes, load carrier stacking tasks and autonomous outdoor transport


- Picking & Kitting
  … relates to single item picking and palletizing in order fulfilment processes in warehouses and in assembly fulfilment in production


- Production
  … addresses the automation of (high-mix, low-volume) production using multifunctional robot assistants for various standard tasks


- Commissioning
  … the focus is on using AI to speed up and reduce costs during the commissioning or reconfiguration of robotic systems and applications

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Details – Loading & Unloading

Use Cases

Loading and unloading pallets on trucks with autonomous mobile robots (AMR) or autonomous forklifts

Challenges:

- Moving pallets in very confined workspaces requires force-feedback control
- Ensuring personal safety

Pallet handling in warehouses and production with autonomous forklifts

- Transportation, storage and stacking of pallets in warehouses and production sites

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Details – Kitting in Production

Use Cases

Description:

- Assembly pre-picking: required parts for an assembly step are compiled from the industrial warehouse
- Goal: establish a generic robotic picking solution for the broad range of parts

Challenges:

- Exceptional generalization requirements for perception and gripping capabilities
- Extreme variety of components and their delivery states, including packaging materials
- Short cycle times for fulfilment
- Simple setup or model-free operation required

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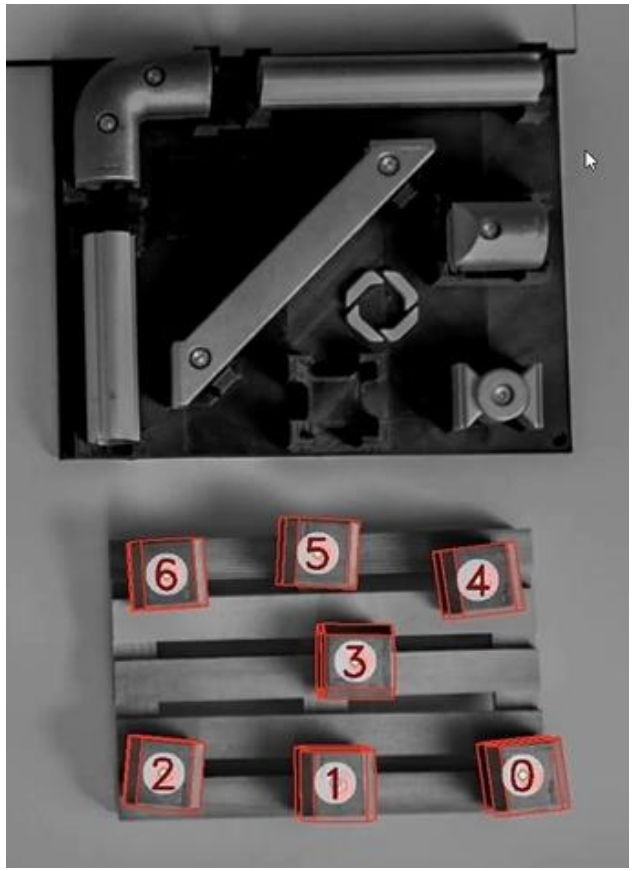
AI

Generic Software Components for Robotics

Example: Pose estimation of known objects.



Technology description:

- Precise 3D pose estimation of objects for which CAD data is available.
- Improvement of accuracy and robustness to handle difficult objects (e.g. highly reflective, elongated, highly perforated).
- Usage of advanced deep learning methods trained with synthetic data
- Estimation of the graspability to increase the success rate when grasping bulk material.

Parameter: • Trained template of the object Requirements: • CAD data available	Required developments: • Estimation of graspability • Deep learning models • Pipeline for generation of synthetic data for difficult objects Ressources: • GPU (min NVIDIA A4000) and CPU (i7) for inference
Relevant in Use Case: Kitting and Autonomous truck loading and unloading	

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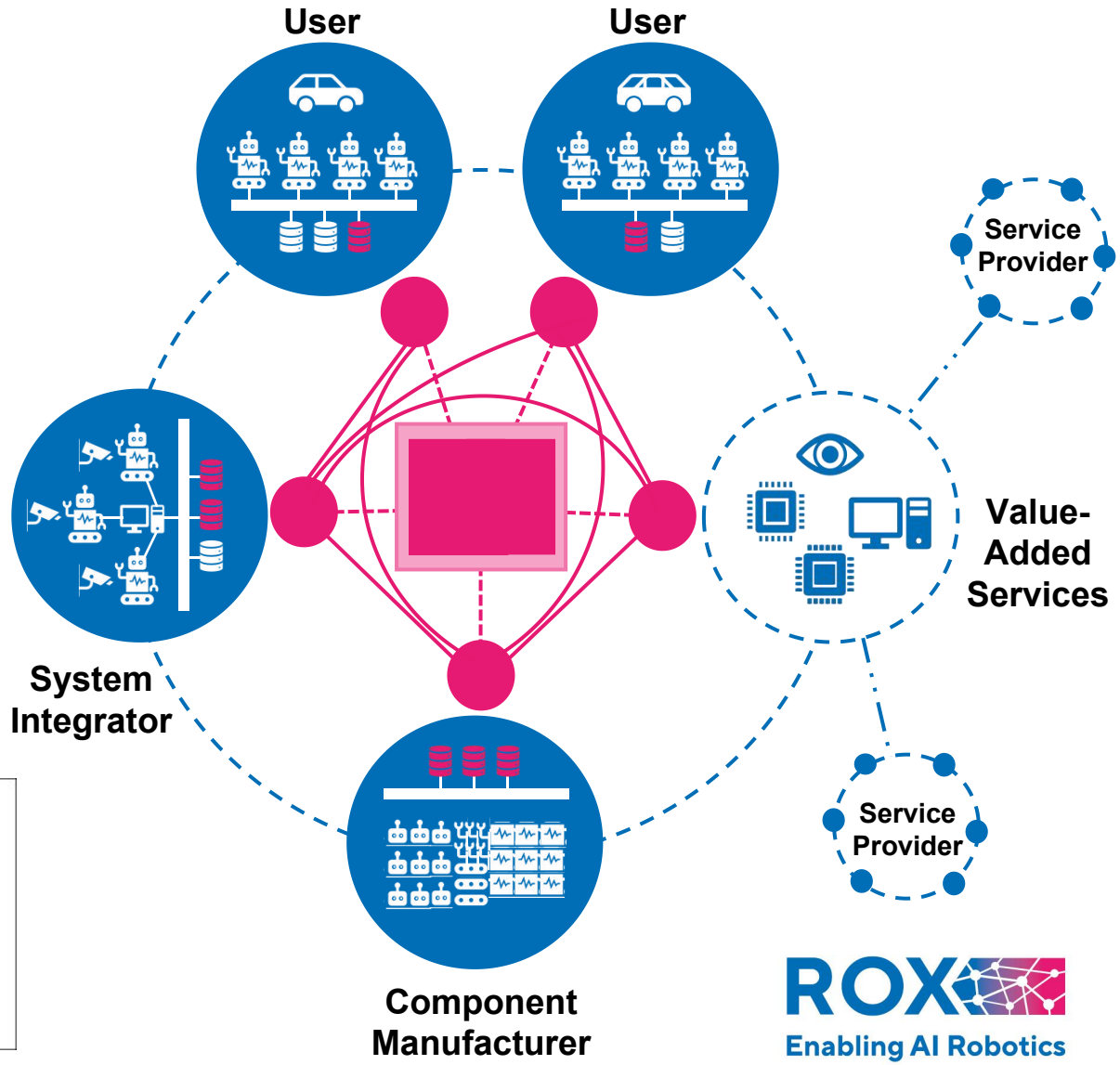
Eco-system

Creating a digital ecosystem for AI based robotics

The RoX digital ecosystem acts as a **connected network** where different parties can work together to **innovate**, **optimize processes**, and **create new value**, within the context of **robotics and automation** services:

- Fostering collaboration (value network)
- Enabling innovative value-added services
- Accelerating robotic solutions development
- Unlocking new market potential



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Supported by:
Federal Ministry for Economic Affairs and Energy
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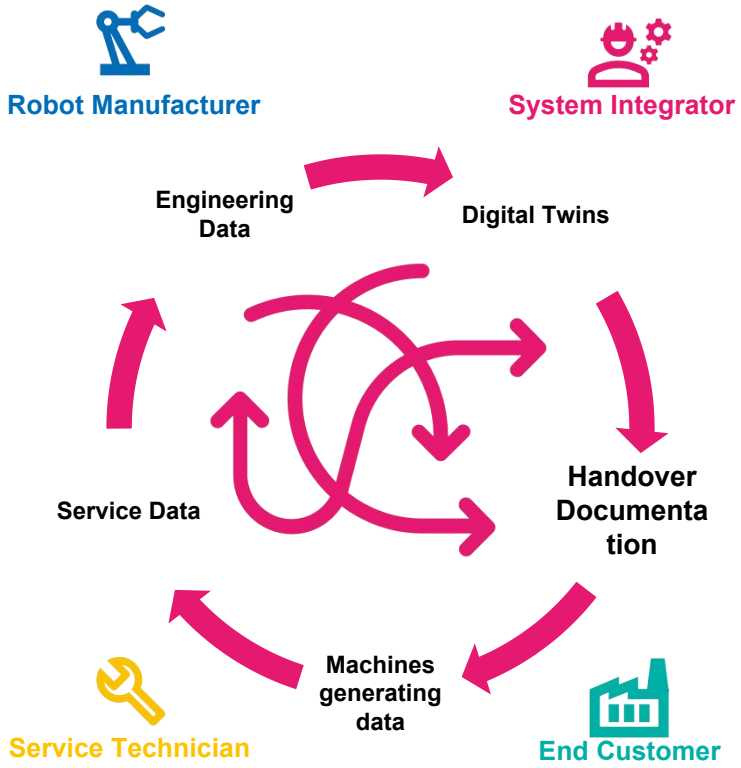
on the basis of a decision by the German Bundestag

Interoperability and why semantics matter…

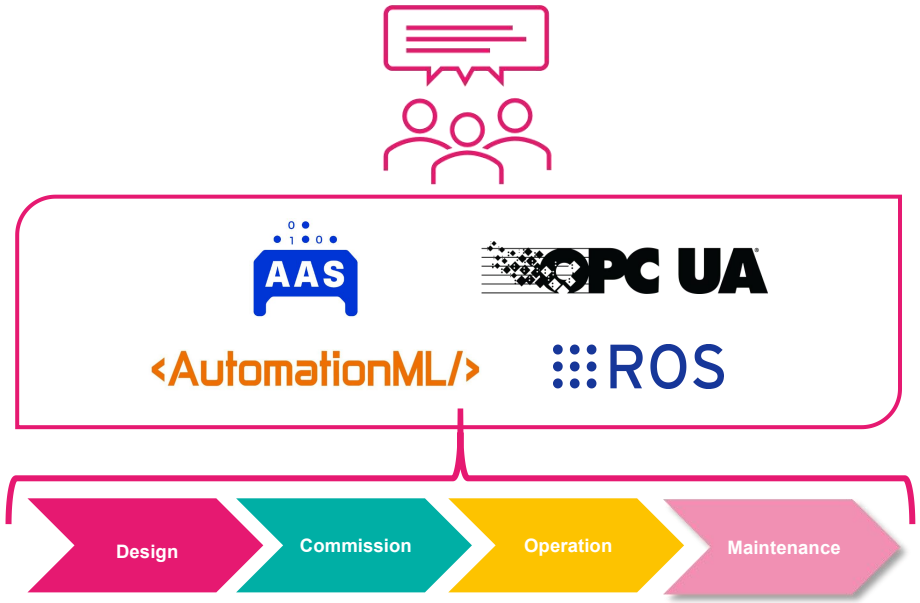
Eco-system

Challenge



Solution

A common language based on existing standards across each phase of the lifecycle



Benefits

Semantic Alignment can …

- … simplify exchange of engineering data
- … enable AI-based Services
- … simplify integration
- … unlock the potential of machine data
- … help avoid vendor lock-in

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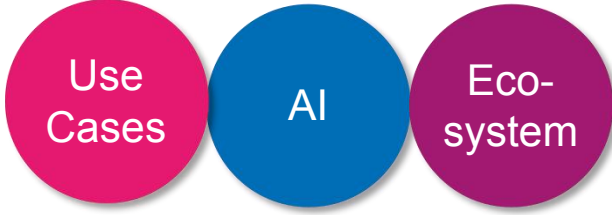
Use Cases in the Ecosystem



Teach & Assemble

Kitting application

Dynamic Pick &Place

Picking & placing, packaging

Quality Inspection

Inspection application

Data Exchange – Trusted Insights

AI Exchange - Continuous AI Model Improvement

Asset Explore – Seamless Digital Onboarding

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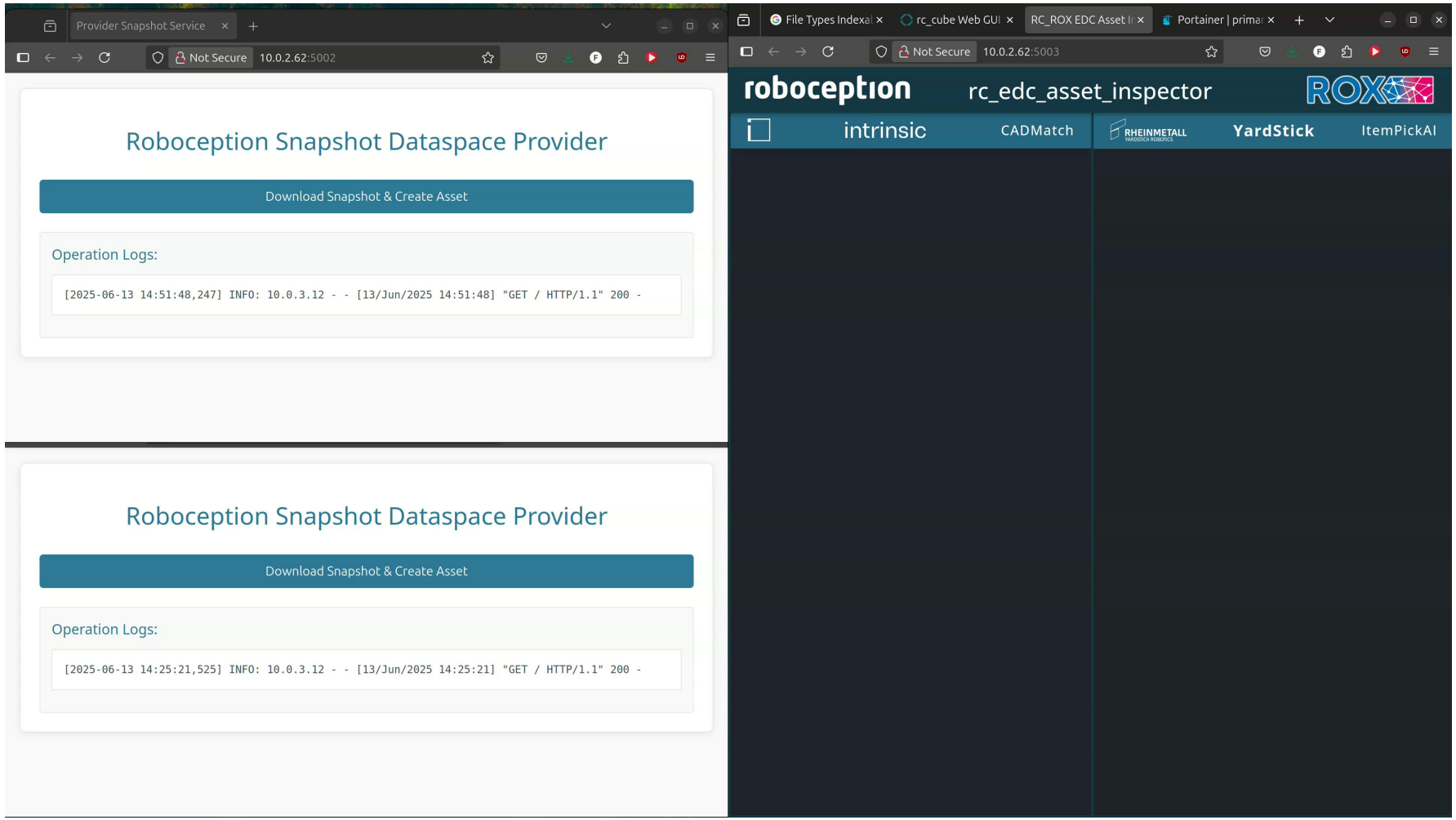
AI Exchange – Continuous AI Model Improvement

Use Cases | AI | Eco-system



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Thank you! – Questions?

https://www.project-rox.ai/

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