

Hiro Robotics

Circular Technology Award

PoC Description

The Proof-of-Concept proposed by Hiro Robotics aims to validate the application of Hiro Robotics' AI-driven disassembly technology to selected Knorr-Bremse products, with a focus on **enabling scalable circular treatment and recycling of complex industrial components**.

The PoC will begin with the joint selection of one or two representative product categories, such as electronic braking systems, brake discs or entrance systems, based on their relevance in terms of volume, complexity, and recovery potential. A set of end-of-life **units will be collected and analyzed** to capture real-world variability, including different product generations, wear conditions, and assembly configurations.

Based on this input, Hiro will perform a detailed disassembly **mapping to identify key process steps and define the automation strategy**. A pilot robotic cell will then be configured using Hiro's modular platform, integrating computer vision, adaptive tooling, and AI-based control systems. Importantly, if needed, the system can **potentially operate without predefined product-specific programming**, leveraging autonomous interpretation of the components.

This approach builds on Hiro's proven **industrial solutions already deployed** in the disassembly of professional and industrial electronic equipment, as well as on **ongoing R&D activities targeting more complex systems in the field of electric mobility**, including e-mobility components, battery-integrated systems, and advanced electronic assemblies.

During the testing phase, the PoC robotic cell will execute **iterative disassembly cycles**, progressively optimizing handling, unscrewing strategies, and process reliability. **Performance will be measured** against jointly defined KPIs, including throughput, recovery rate, capacity, and system autonomy.

In the final phase, the PoC will **validate the system under realistic operating conditions** by processing a representative batch of components. The results will be used to assess technical feasibility, economic viability, and scalability potential. Based on these outcomes, a **roadmap for industrial deployment will be defined**, including integration into existing recycling or remanufacturing workflows and extension to additional Knorr-Bremse product lines.

PoC Plan

1. **Selection of target product category (July)**
Joint definition of one or two reference products from Knorr-Bremse portfolio (e.g. electronic braking systems, brake discs, entrance systems or others), based on volume, structural complexity, and circularity potential.
2. **Sample collection and characterization (July – early August)**
Collection of representative end-of-life units, capturing variability in wear conditions, product generations, and assembly configurations to reflect real-world scenarios.

3. **Disassembly mapping and task analysis (July – August)**
Detailed analysis of product architecture to identify disassembly sequences, fastening types (screws, clips, welds), and component hierarchies, defining the technical scope for automation.
4. **Definition of PoC KPIs (July – August)**
Alignment on key performance indicators, including e.g.:
 - o disassembly time per unit
 - o recovery rate of valuable components and materials
 - o system uptime, repeatability, and operational stability
5. **Adaptation of Hiro robotic technology (August)**
Configuration of Hiro's modular robotic platform (vision systems, adaptive tooling, AI control) to process selected components, leveraging existing industrial solutions without the need for product-specific programming.
6. **AI training and perception setup (August – September)**
Training and calibration of computer vision models on real samples to enable robust detection of screws, interfaces, and structural features under high variability conditions.
7. **Pilot cell installation (late August – September)**
Deployment of the pilot robotic cell at a Hiro facility.
8. **Iterative testing and optimization (September – October)**
Execution of iterative disassembly cycles to progressively refine:
 - o handling strategies
 - o unscrewing paths and sequencing
 - o force and torque control
 - o error detection and recovery logic
9. **Performance validation under realistic conditions (October)**
Processing of a representative batch of components to validate system performance in terms of throughput, robustness, and recovery efficiency under near-industrial conditions.
10. **PoC evaluation and industrial scale-up roadmap (October)**
Joint evaluation of results and definition of next steps, including:
 - o integration into existing recycling or remanufacturing workflows
 - o extension to additional product categories within the Knorr-Bremse portfolio
 - o preliminary business case and ROI assessment for industrial deployment