Digitally enabled Zero-Defect Manufacturing

Innovations and Experiences from openZDM

openZDM

Open Platform for Realizing **Z**ero **D**efects in Cyber Physical **M**anufacturing

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openZDM in a nutshell

- HORIZON-CL4-2021-TWIN-TRANSITION-01-02
  Zero-defect manufacturing towards zero-waste
- GA ID : 101058673
- Duration : 42 months
- Started : 1 June 2022
- End date : 30 November 2025

No *	Participant organization name	Country
1	University of Patras-Laboratory for Manufacturing Systems & Automation (LMS)	EL
2	Vdl Weweler (VDLWEW)	NL
3	VW Autoeuropa (VWAE)	PT
4	Sonae MC Serviços Partilhados SA (SONAE)	PT
5	Vidrala S.A. (VIDRALA)	ES
6	INTRASOFT International S.A. (INTRA)	LU
7	U-Sense.It s.r.l. (USIT)	IT
8	Asociacion de Investigacion Metalurgica del Noroeste (AIMEN)	ES
9	Induction s.r.l. (INDUCTION)	IT
10	Habber Tec Portugal (HT_PT)	PT
11	Mondragon Sistemas De Información (MSI)	ES
12	F6S Network Ireland Limited (F6S)	IE
13	Fundacion TECNALIA Research and Innovation (TECNALIA)	ES
14	Università Politecnica delle Marche (UNIPVM)	IT
15	Instituto Politécnico De Bragança (IPB)	PT
16	COMAU Spa (COMAU)	IT
17	Universidade do Porto (UPORTO)	PT
18	Aptiv Connection System Service Italia S.p.A. (APTIV)	IT

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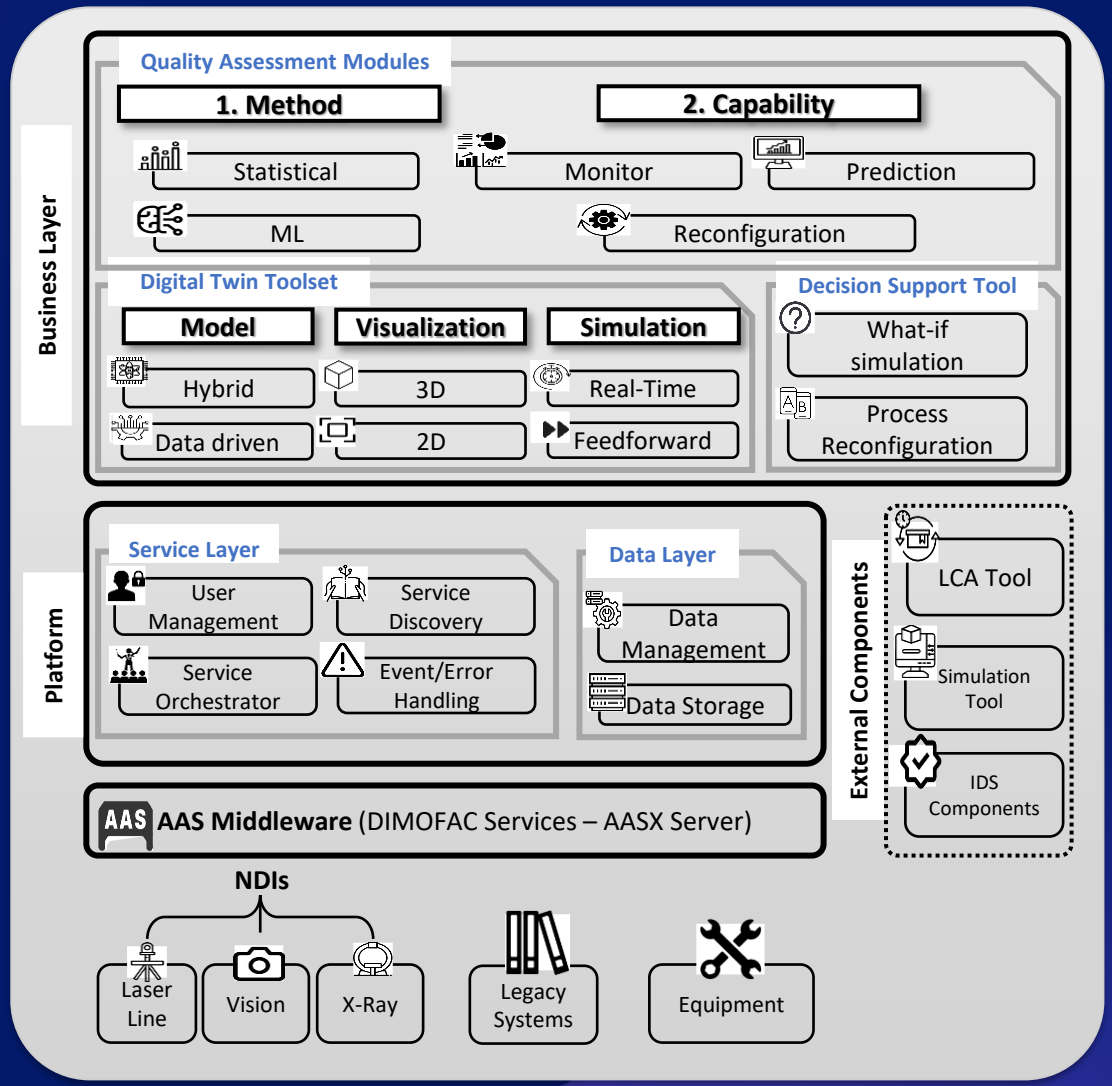
How openZDM is different?

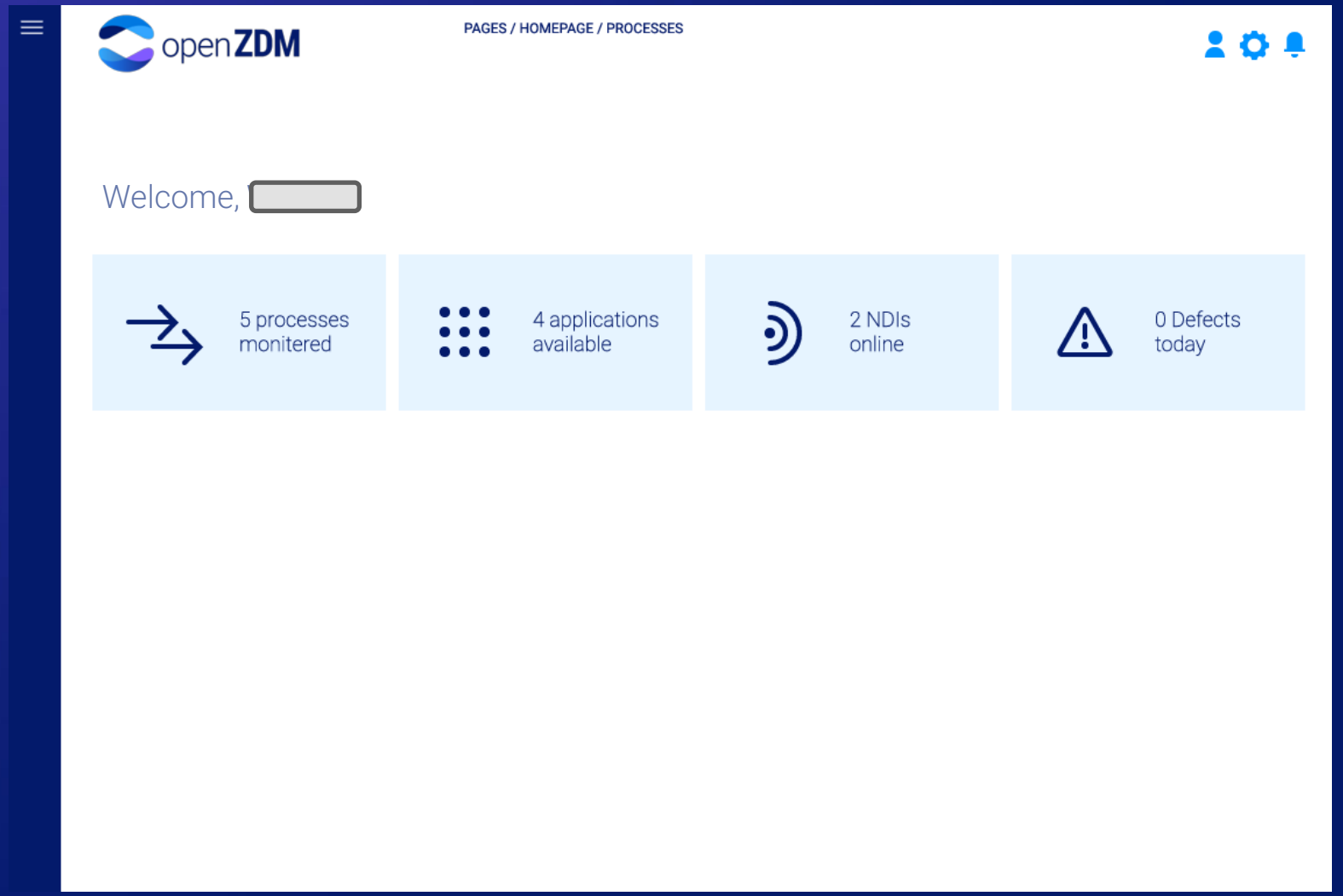
openZDM targets aims to enable proactive quality control:

→ Increased productivity
→ Increased quality
→ Reduced unit costs

by differentiating normal from abnormal variation at a process or system level



Key innovations – open platform



- Multiple User roles
- Authentication
- Data storage
- AAS middleware
- Cloud, local, hybrid deployment

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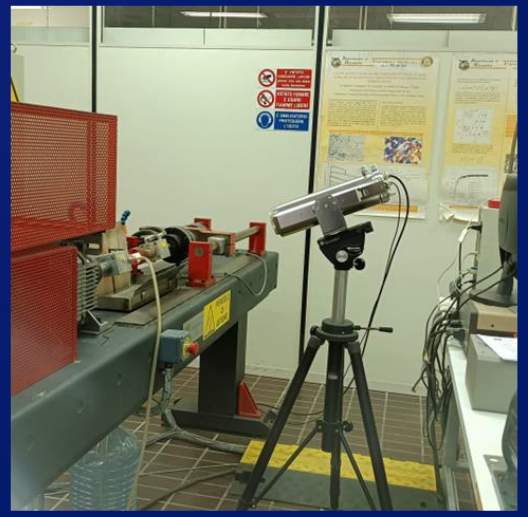
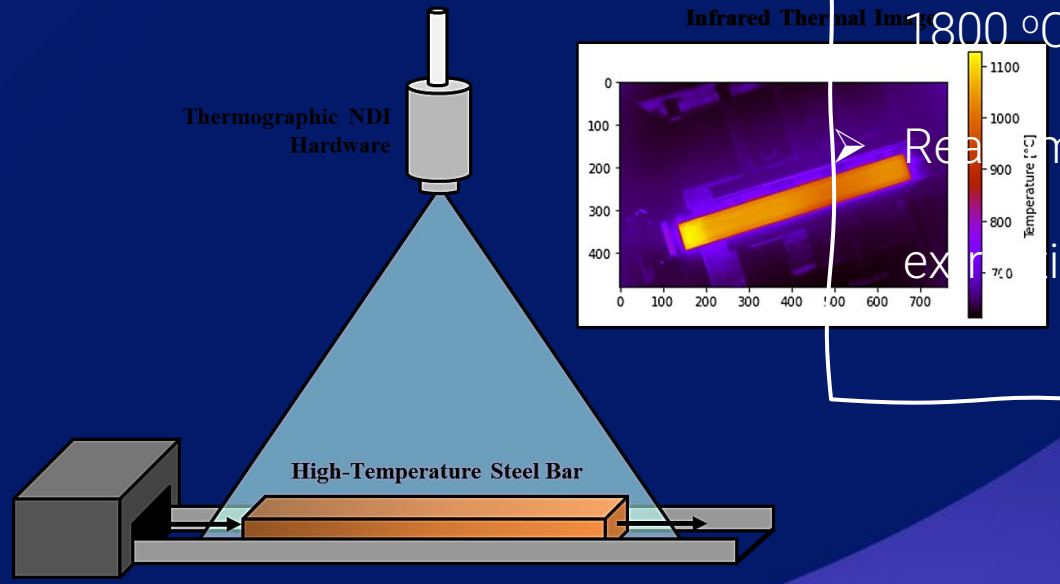
Key innovations – Vision NDIs

- Operate on the:
  - ✓ Visible spectrum
  - ✓ IR spectrum
- Designed to withstand harsh environmental conditions

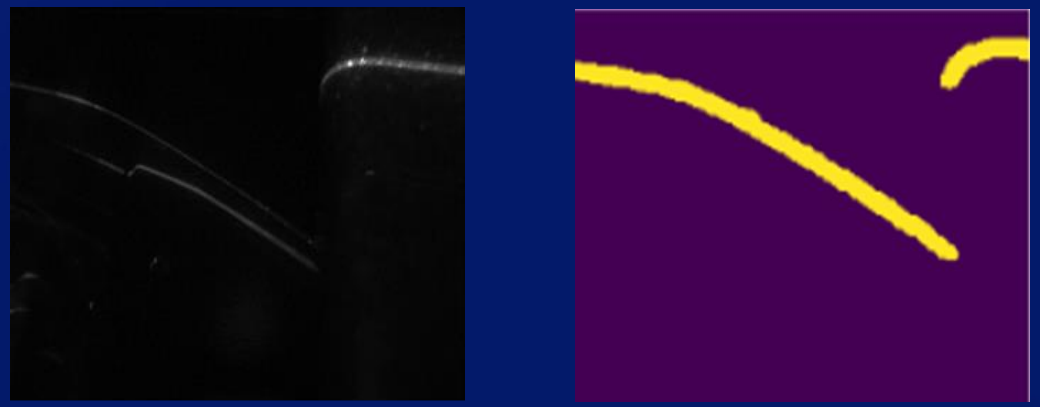


- Inline deployed
- Camera operating in the λ=0.85 μm spectrum
- Temperature range 450 – 1800 ºC
- Real-time temperature profile extraction



Key innovations – Laser line triangulation (LLT) systems

- LLTs developed are either:
  - ✓ Fixed inline systems
  - ✓ Portable inline systems
- Have undergone safety clearance to be inline installed

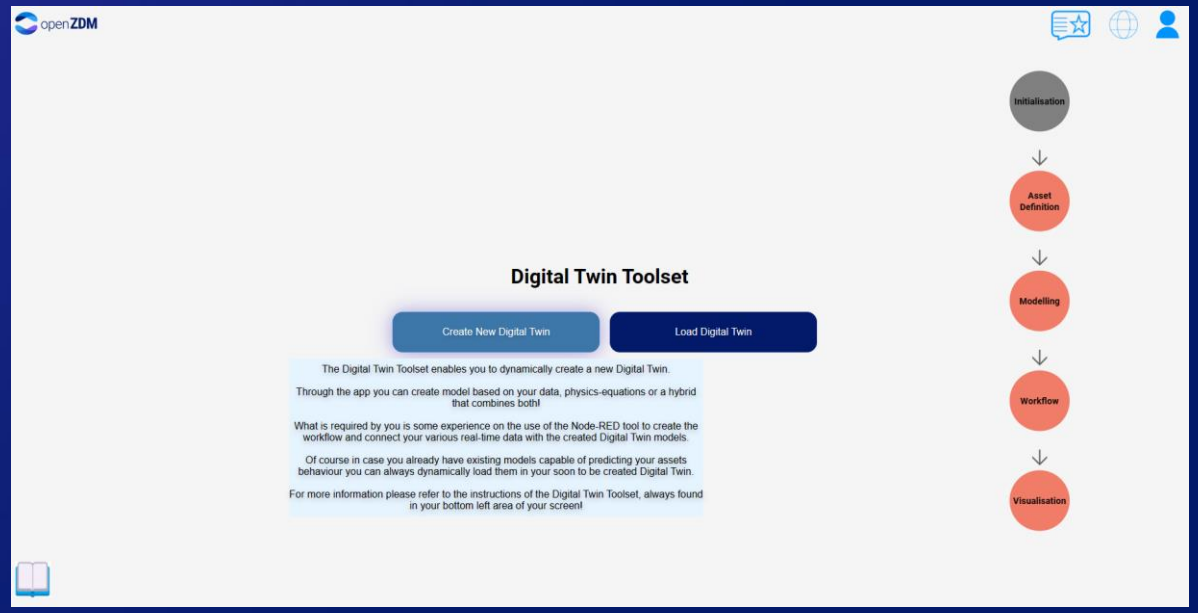


Raw image and output of AI model with gap & flush profile

- Portable miniaturized LLT system
- Coupled with AI for gap & flash measurements and feature extraction
- Ergonomically designed
- Real-time data communication with MQTT

Key innovations – Digital Twin Toolset (DTT)

- Supports:
  - ✓ Data-driven & physics-based
  - ✓ Hybrid
- Allows system and individual asset modelling



- Multilanguage
- Real-time & feedforward simulation
- SQL and NoSQL databases
- 2D/3D/Point cloud visualization
- Synthetic data generation
- High complexity of physics and hybrid modelling

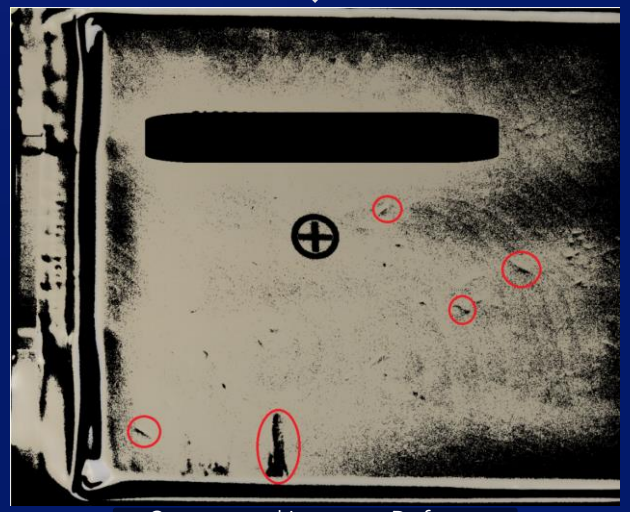
Key innovations – Data-driven quality assessment modules

openZDM

- AI data-driven techniques for proactive quality assessment

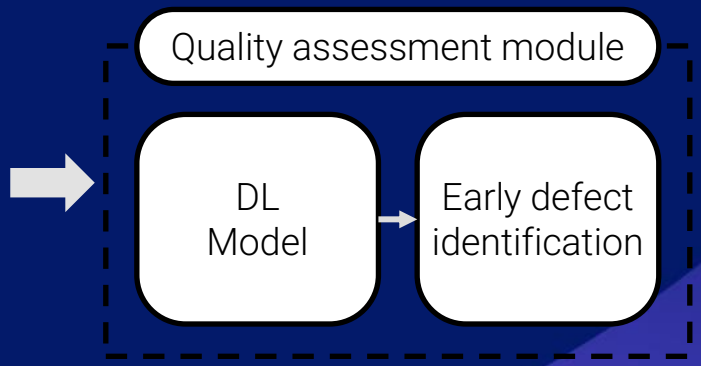
  - ✓ Descriptive and diagnostic analytics
  - ✓ Predictive analytics

Original image – Battery cell



Segmented image – Defects encircled in red for illustration

- Defect identification and prediction
- Early product anomaly detection
- Results communication via MQTT & HTTP
- Use of time-series or vision data
- Potential high computational time



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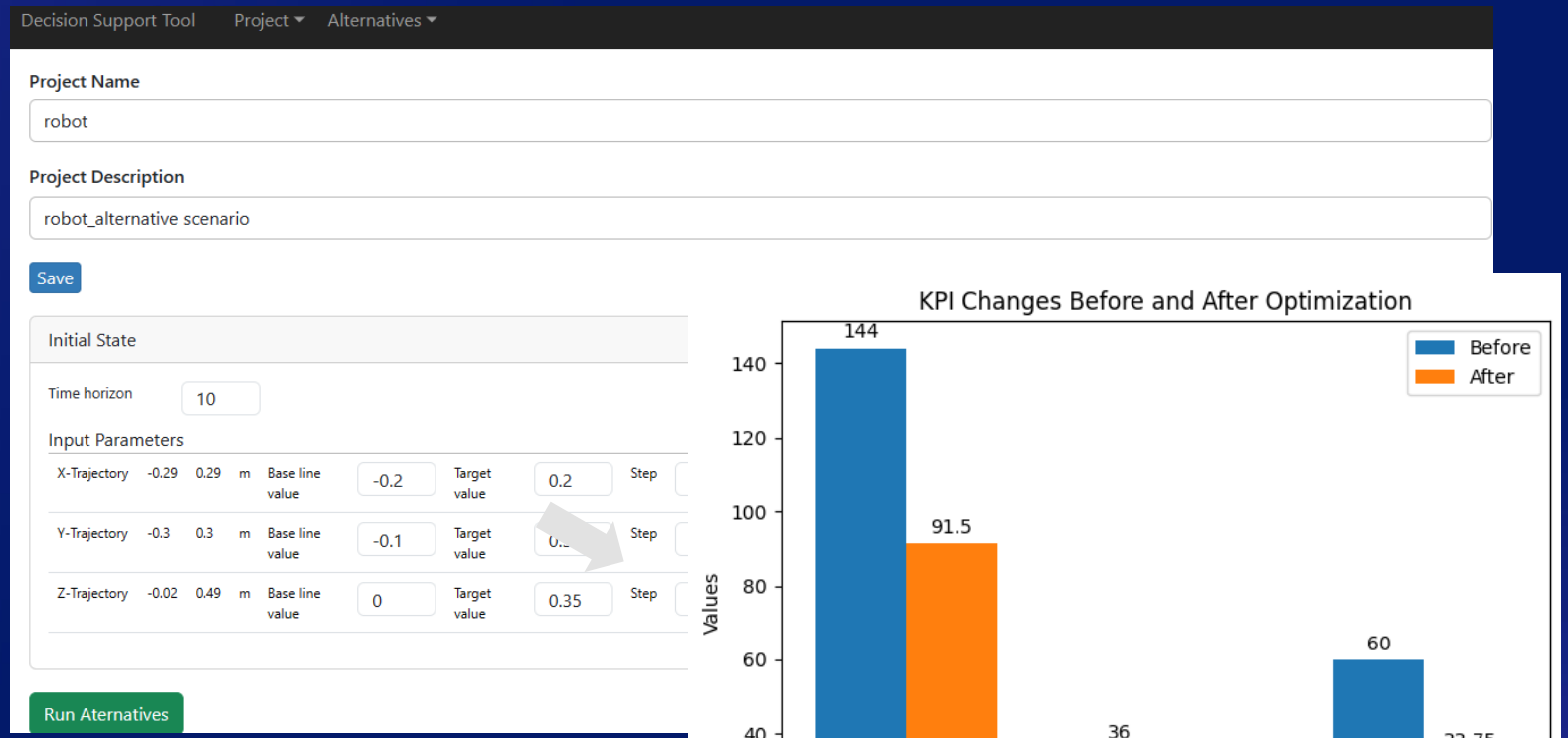
Key innovations – Decision Support Tool (DST)

- The DST leverages:
  - ✓ Cost-benefit analysis
  - ✓ Optimisation algorithms
- Provides optimal alternative process configuration



Experiences of openZDM

- The creation of a DT can be highly complex
- In cases of manual operations in the process data correlation can be challenging
- The implementation approach of AAS Type 3 is unclear
- AI approaches can enable proactive quality control but can be computationally expensive
- Deployment of NDIs can improve environmental & economic sustainability
  - ✓ A vision-based NDI has improved the cost of poor quality on revenue

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Future directions of openZDM

- Inline deployment and full integration of additional NDI systems in pilot lines
- Implement and test AAS Type 3 capabilities
- Adoption of a dynamic user feedback mechanism
- Automatic reconfiguration of production asset
- Extend the openZDM system with the IDS connector

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and discover the latest insights from the manufacturing ecosystem!

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Stay tuned!

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Contact information

If you have any doubts or questions,
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