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SolidAIR

**Solid, rapid and efficient adoption of Data, AI & Robotics
applications in production**

Deliverable D3.2

Implementation Report for all use cases

Primary Author(s)	Hakan Cem Muslu BOS
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Project Coordinator	Andreas Frommknecht Fraunhofer IPA (FHG) (andreas.frommknecht@ipa.fraunhofer.de)

Contributors	
Name	Organisation
Emil Andreas	FHG
Andreas Frommknecht	FHG
Alexander Katzbeck	AUT
Panagiotis Mavridis	THL
Panagiota Morai	THL
Kerman Osoro	CIE
Benjamin Stöcker	UGS
Alexej Zitzer	BRO

Formal Reviewers	
Name	Organisation
Anesa Begovic	I2M
Jean Pierre Allamaa	SISW

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Project Abstract

SoliDAIR aims to accelerate the uptake of Artificial Intelligence (AI) and Robotics in European manufacturing, using Data as an enabler. It will co-develop and demonstrate tailored solutions to digitalise and automate visual inspection and physical testing, enable predictive quality control and process optimisation. The SoliDAIR project tackles the problem of AI & Robotics systems not being extensively used in the production industry, because it is not clear whether they are safe and when or why they will fail, by researching, developing and testing methods that are as solid and trustworthy as possible to be adopted by the European industry, while being cost-efficient to develop and replicate.

New methods and tools will be developed by research and technology providers, which leverage the current state of the art in visual AI, AI for process data, and smart & collaborative Robotics. The developed technologies will be applied and demonstrated in 4 industry use cases to prove their functionality and applicability in real production environments. The objective is to improve production processes through digitalised and automated quality control for high volume, high rate and flexible manufacturing. The developed methods shall be efficiently and easily adaptable and replicable, so they can be easily applied to new use cases outside the consortium.

Public Summary

UC BROSE: The BRO use case demonstrates an AI-based 2D visual inspection system for verifying the Bowden cable routing (slider area) in door modules during production. It detects and classifies defects in critical components, distinguishing between OK parts and various NOK defect types.

The inspection runs in a fully operational demonstrator environment on a dedicated demonstrator PC, enabling validation of AI decisions and providing operators with insights through KPIs and visualizations to ensure transparency and trust in the automated process. Overall, BRO combines real-world image data, expert annotations, and AI deployment in series production, establishing a scalable and reliable foundation for automated visual quality control.

UC CIE: The CIE use case is developing an AI-based visual inspection system for high pressure die casting aluminium parts, together with an AI-based quality predictive model based on the optimization of the production parameters. This visual inspection system is supported on trained and validated AI models and performs defect detection and classification on the machined surfaces of the part.

The inspection system has a full operational approach from the beginning, considering that it should be integrated, in the future, at the end of a machining line, where it should inspect 100% of the parts coming out. The system is currently being trained using real data.

As different part numbers may be machined in the cell, the inspection system must be flexible and trained to inspect more than one geometry. Therefore, the project includes the training of 2 different geometries (now finishing the work on the first one), coming from 2 product families (engine and transmission components).

The overall objectives of this initiative are to optimise line efficiency, reduce material consumption, production and Q-inspection costs, facilitate the work of inspection operators through a full-automatized AI-based inspection system trained for 2 product families, and minimise the risk of sending defective parts to customers.

UC BOSCH: The BOSCH use case focuses on developing a high-accuracy predictive quality algorithm for an end-of-line (EoL) testing station. The core of this initiative is to leverage machine learning models to predict the final quality and performance of manufactured injectors based on data collected throughout the production process. This allows for a significant reduction in the dependency on time- and resource-intensive physical testing for every part.

The system will be trained using historical data from the production line, correlating in-process parameters (e.g., sensor readings, machine settings, and environmental data) with the results from existing EoL quality tests. The AI approach will involve supervised learning models, such as regression or classification algorithms, to accurately predict whether a component meets its required quality specifications.

Initially, this predictive system will be integrated into the existing production lines. By analyzing the data in real-time, the algorithm will predict the EoL testing result. This data-driven approach allows for a dynamic adjustment of the measurement frequency.

The overall objectives of this initiative are to:

- Optimize resource consumption by reducing the frequency of measurements, leading to lower usage of energy and test oil.

- Increase production efficiency by minimizing the time and effort spent on EoL testing bottlenecks.
- Maintain high-quality standards by using a predictive model to ensure product reliability while streamlining the quality assurance process.

UC AUTFORCE: The Use Case AUTFORCE deals with AI- and data-driven predictive quality control for early detection of defective gearboxes, ideally well before end-of-line (EOL) testing, but at the latest before it is carried out. The goal is to eliminate classic EOL testing for a large number of units produced by using reliable, data-based quality predictions to approve products.

In addition, the system continuously optimizes the manufacturing process through AI-supported root cause analysis. Anomalies and causes of errors are evaluated in close collaboration between AI and human experts in order to derive targeted corrective and improvement measures.

The data-driven predictive quality control runs on a line host computer in a real production environment, enabling direct analysis and monitoring on the actual system. Overall, AUTFORCE combines production data and end-of-line data with human knowledge to provide reliable quality prediction.