

WAND: Digital Twin based Multi-sensor Data Analysis Platform for Near-Zero Defect Manufacturing

Abstract:

The WAND project aims to develop a platform for achieving near-zero defect manufacturing in plastic injection molding. This platform will analyze data from different sources and will use data-driven prediction and optimization technologies to increase equipment productivity and product quality, reduce ramp-up time and manufacturing defects, and lower energy costs. Project will involve the following activities: 1) Designing a modular framework with an interface to multiple data sources. 2) Providing users with tools for data exploration, optimization, what-if scenarios, and changes in KPIs. 3) Developing software that interfaces with target machines and sensors, with both backend-frontend components.



Countries involved



Application sectors

Automotive / Consumer goods / Capital goods

Research and innovation domains

Advanced manufacturing processes / Smart & adaptive manufacturing systems / Digital, virtual and efficient companies / Sustainable manufacturing

Total cost in M€ (millions)

1.36 M€

Starting date

1/01/2024

Duration (in months)

24 months

Project lider

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Tekkan Plastik Sanayi ve Ticaret A.Ş. [TR]

Project participans

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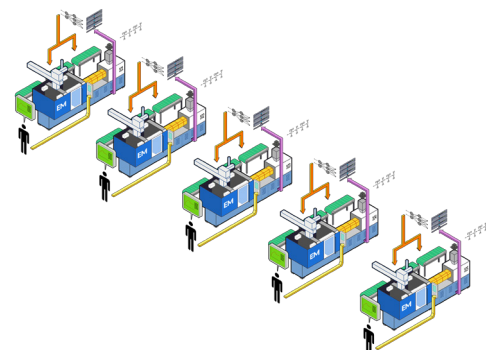
Cavity Eye [HU], Rossaker [SE]

RATIONALE OF THE PROJECT

Plastic components are crucial in industries such as automotive, home appliances, and medical devices due to their reliability and performance. Plastic injection molding, which produces over one-third of all thermoplastics, is essential for mass production. However, the process conditions, controlled by experts, significantly impact product quality. Deviations from optimal conditions lead to defects and reduced quality.

In 2022, Tekkan, a plastic injection part manufacturer, used approximately 6,000 tons of plastic raw materials but incurred a loss of ~223,000 EUR due to defective parts. Analysis showed that 80% of these defects were due to injection process errors. Early error detection is vital for sustainable growth. Tekkan's quality team halts production upon detecting errors, examines past lots to determine the error duration, and quarantines affected products for rework or scrapping. In 2022, 282,062 parts were checked in the quarantine area.

The WAND project aims to optimize plastic injection production through digital twin-based real-time monitoring systems to predict errors and achieve near-zero defect manufacturing. This will enhance equipment and product quality, reduce ramp-up and defects, shorten time-to-market, lower costs, and ensure a reliable production process.



TECHNOLOGICAL INNOVATION, ACHIEVEMENTS AND RESULTS

The WAND project advances the state-of-the-art in plastic injection molding with digital twin-based real-time monitoring systems. This innovation enhances predictive quality management by enabling early detection and correction of errors, targeting near-zero defect manufacturing.

Technological innovations include integrating multiple data sources, creating an interactive platform for data gathering, pattern recognition, and developing robust models for optimization and scenario analysis. The project utilizes Domain Aware Machine Learning (DAML) to incorporate problem-specific characteristics, achieving high accuracy with smaller data volumes.

MARKET POTENTIAL

The global injection molding market, valued at USD 261.8 billion in 2021, is expected to grow at a CAGR of 4.8% through 2030. This growth reflects the increasing demand for efficient, optimized, and automated production processes. The Industry 4.0 market, worth USD 65.53 billion in 2021, is anticipated to expand at a CAGR of 20.8%, driven by advances in AI, IoT, and digitalization in manufacturing. The WAND project targets this expanding market by offering advanced software that integrates sensing, modeling, and IoT technologies. This positions WAND to meet the industry's need for improved efficiency, reduced waste, and higher quality. The consortium, including Tekkan, Rotorbit, AMiquam, Cavity Eye, and Rossaker, offers a comprehensive approach to these demands. By integrating advanced technologies and fostering collaboration, WAND enhances market access and competitiveness across industries relying on plastic injection molding.

IMPACT POTENTIAL

The WAND project aligns with SMART goals by enhancing Europe's leadership in injection molding, improving economic performance, and addressing sustainability. By optimizing manufacturing processes, reducing life-cycle costs, and complying with EU environmental regulations, WAND advances Europe's competitive edge in industries like automotive and medical devices. It also bridges gaps in the European value chain by integrating advanced technologies and fostering collaboration among technology providers and end users. WAND promotes the adoption of Industry 4.0/5.0 and IoT, contributing to increased efficiency and competitiveness in the sector.

