ZERO DEFECTS Manufacturing Platform ZDMP

Newsletter

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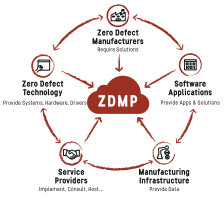
Welcome to the 5th newsletter of the *ZDMP* project – Zero Defects Manufacturing Platform

ZDMP Overview

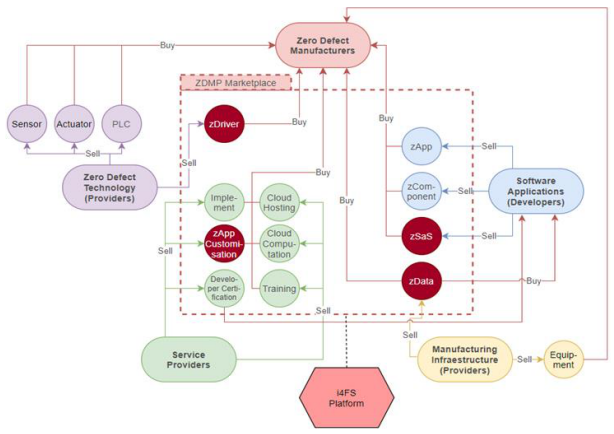


ZDMP is a European project launched in 2019 in the framework of Horizon 2020 and, is in its last period of operation. The project aims at providing an extendable platform for supporting factories with a high interoperability level to cope with the concept of connected factories to reach the zero defects goal. The concept of ZDMP can be simplified to a feedback and control system found in areas of vital importance to the European economy, such as Automotive, Machine Tools, Construction, and Electronics.

The core elements of the ZDMP platform are software modules called zComponents and zApps that are developed by ZDMP itself, and also by sub-projects launched in the framework of the ZDMPs Open Calls. The development process is supported through the ZDMP Studio available for the software engineers to enrich the functionality provided by ZDMP. The final software modules will be available from the ZDMP Marketplace hosted by partner i4FS. That can be used by manufacturing users to acquire required functionality (zApps) as well as software developers utilising functional blocks (zComponents) to rapidly generate their own applications.

ZDMP Value Proposition

The ZDMP project expects to create an industrial ecosystem, where different heterogeneous components and actors can coexist and collaborate. The main collaborative actors are addressed in the image below representing the Value Proposition of ZDMP. One important integrated actor is the i4FS (Industry 4.0 Factory Solutions). i4FS is the company that will maintain the ZDMP marketplace after the completion of the project and where the applications from ZDMP will be offered. As a central element of ZDMP Value Proposition, the Marketplace is where all software functional blocks, such as zComponents, zApps, zDrivers, etc. are available for the industrial customers and software developers that can implement new zApps utilizing the functionality of existing ones. Other important actors are Manufacturing Infrastructure Providers and Zero Defect Technology Providers that are selling physical equipment, as well as drivers required to link to the ZDMP ecosystem. The library of ready-to-use zComponents and zApps are targeting various aspects of zero defects manufacturing and developed within ZDMP project, and Open Call sub-projects. They are available for industrial customers. Furthermore, new zComponents and zApps to satisfy the emerging needs of Zero Defects Manufacturers for the specific customized applications to complement functionality of existing ones will be ensured by the Software Application Providers.



ZDMP Open Calls

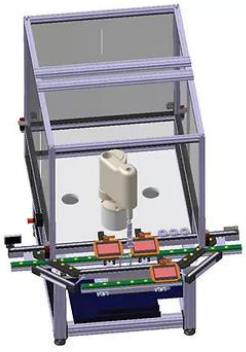
ZDMP launched two Open Calls in 2021 to the value of 3.2M€. This strategy has enabled us to extend the ecosystem provided where external SMEs and start-ups have access to ZDMP Platform and can conduct pilots and/or develop the new zApps and/or zComponents. The sub-project activities fall into 3 broad areas: Development, Integration, and Validation. The 1st Open Call awarded 10 sub-projects focused on utilization of ZDMP platform and zComponents, whereas the 2nd Open Call awarded 18 sub-projects that address the development of the novel zApps based on zComponents and/or 3rd party services, as well as validation activities. The Open Call 1 sub-projects are in a more mature stage, as they were launched in August 2021, while the Open Call 2 sub-projects just started in January 2022. More about each subproject can be read below and also in a series of blogs available/coming at https://www.zdmp.eu/subcall-blogs

ZDMP Experimentation Facility

The Open Call winners have the opportunity to use the experimentation facility, based at Finland's Tampere University, which provides a physical environment to study and freely experiment with zComponents and zApps to ascertain their functionalities and capability to ensure zero defects in manufacturing. The facility is an industrial environment with the focus on factory automation systems, intelligent manufacturing systems, and human-robot collaboration - thereby supporting the industry 4.0 concept. It will facilitate the testing, validation, and integration of ZDMP components and applications. It provides ZDMP stakeholders, both project beneficiaries and sub-call partners, the opportunity to validate ZDMP component requirements that provide solutions to integration problems at an early stage before applying them on the actual industrial use cases.

The experimentation facility is made of up industrial equipment, machines, and devices, which include:

- FESTO MPS Assembly Line.
- EMCO Milling Machine.
- Portable Air Pressure Box.
- Mobile Industrial Robot (MiR100).
- Omron Quattro Robot (4-axis parallel Robot).
- ABB Yumi (Dual-Arm) Collaborative Robot.
- Industrial Communication Devices (Fieldbuses) eg EtherCAT, CANopen, Profibus, and Interbus



A part of the experimentation facility (The FASTory line) was previously used in a real factory for the assembly of mobile phone components. The FASTory line was retrofitted to simulate its original operations (assembly of Frame, Keyboard and Screen components). It comprises ten workstations, one static buffer cell, and one loading / unloading station. Each workstation includes one main conveyor (main CNV), one bypass conveyor (bypass CNV), and one robot e.g. SCARA robot (SONY SRX-611).

Open Call 1 Winners

zAR: Empowering ZDMP with an Augmented Reality based maintenance service towards a zero-defect manufacturing.

Augmented Reality (AR) has the potential to completely transform the areas of training and maintenance contributing to the zero-defect objective achievement. The main goal of this sub-project is to bring an AR service into the ZDMP platform. A new zComponent (and a companion AR application - zApp) will serve as the middleware between the ZDMP platform and external AR applications for Industry 4.0.

Robot Kinematics Component Development

This component will allow to model and validate robot's trajectories preventing faults, increasing robustness, and optimizing the production process in zero-defects applications. A new zComponent (Robot Kinematics Component) will be developed to offer a way for robot basic mathematical modelling and motion planning validation other components as for instance Machine Learning algorithms.

DM3DEP

Modern industrial defect recognition systems based on cameras can easily take advantage of machine learning techniques for classification due to availability of many standardized features to describe objects represented in video streams. On the contrary no such a standardized feature-based description of structural 3D objects is currently available. The goal of the proposed project is to support developing defect classifiers based on both 3D design-time models (CAD) and 3D object data, computing and exposing a complete set of well-defined and manufacturing-oriented 3D object descriptors.

Universal Calibration for Robotic Additive Manufacturing

The research focuses on developing a solution to address consistency problems in robotic AM to achieve zero-defect additive manufacturing. Universal Calibration Tool for Robotic Additive Manufacturing (UCRAM) will be a tool that monitors the layer build-up, either to measure and calibrate the material build-up beforehand or during a calibration procedure, or monitoring it layer-by-layer as the print progresses. The tool will create a digital twin of the printed part, by scanning each layer using a 2D-laser scanner, thus building up a 3D-image that can be used for review or to overlay with other available data sets.

RAIZED - Approach for smooth integration of advanced Zero Defect Manufacturing

Optimize processes through new technological approaches, valuing information and transforming reactive systems into predictive systems. This project aims to integrate RAILES platform responsible for making some functionalities on the shop floor with ZDMP. RAILES can be used to extract data and send it to ZDMP.

Cognition-driven ZDM for early detection and understanding of unusual process behavior

Multivariate data analytics and cognition-driven systems are important research areas for the process quality analysis. The project proposes a novel approach for ZDM driven by a proactive detection of complex variations in processes, their understanding (root-causes) and impact analysis, with the goal to spot unusual behaviour of a process and validate it, before it starts producing defect products. The outcome is an innovative ZDMP-enabled solution, cognition-driven ZDM (CogniZDM), based on existing ZDM components and integrated in the ZDMP Platform.

Validating ZDMP in Offset Printing embracing Circular Economy principles

The present proposal falls into the scope of validation-centric sub-projects, intending to demonstrate the usefulness of 14 ZDMP components. The ZDMP open call comprises a unique opportunity for Pressious to establish the principles of Industry 4.0 under the circular economy paradigm, in terms of proactive resource management, zero-defect manufacturing, and environmental footprint minimization, by exploiting already available datasets across the production chain. The output of this project will be a thorough examination, testing and validation of these components in the industrial domain of offset printing and the potential adoption of ZDMP platform after the project lifetime.

Zero contamination on sterile medical materials

In the proposers ours study on 100 dental implants (80 producers), they found 30% of the products contaminated with particles, hazardous to human health and not compliant to requirements in clean production. The solution in a ZDMP context is a standardized examination method based on electron microscopy and fluorescence imaging. A UI and toolsets are provided for image analysis on the local machine, referencing verified data catalogue of dental implant contaminants. Utilising AI and ML analysis, the user will receive a cleanliness evaluation and a trusted quality seal for each product under examination at his premise.

zComponent "Unstructured Data Acquisition" - An API and user interface for the acquisition and processing of unstructured data in manufacturing

Factories in the transformation process to I4.0 require to involve employees in production processes who thus are a crucial factor for reaching zero-defect. In this sub-project, a new zComponent will enable the collection of unstructured data in manufacturing. The proposed zComponent provides an API allowing requests from external systems, as well as the manual creation of checklists. Thus, dynamically created user input forms are provided in a mobile app. Results are converted into a semantic structure and returned to the requesting system and platform by means of smart processing algorithms.

ISN4ZDM

Data that captures the knowledge and experience of people working in manufacturing are used to address and analyse quality issues and can be combined with typical machine analytics data. Industrial Social Network (ISN) solutions can be very efficient for knowledge sharing in manufacturing. The objective of ISN4ZDM is the integration of RAPpID ISN solution to ZDMP. RAPpID complements existing ZDMP functionalities with new capabilities that are geared towards management of collaborative ZDM knowledge and IIoT data.

Open Call 2 Winners

dynaVR – dynamic Twin for milling optimization and VR visualization

In the metalwork industry, machinery vibration (eg. milling process) can lead to semi finished products that must be discarded in many cases. The quality of the manufactured products may drop or cannot be guaranteed. dynaVR aims at providing a IIoT cloud-based data storage, processing and analysis application for process vibrations and a Virtual Reality (VR) visualization application to better understand the effects of vibrations, anticipate potential machinery malfunctions and take the preventive decisions to deliver Zero-Defect quality products, significantly increasing product quality and lowering costs at the plant. Pilots are foreseen (aerospace sector).

Development of an AR based zero defect factory planner – z_AR_FactoryPlanner

The project will develop a Zero Defect Factory Layout Planner that will allow manufacturers to quicker adapt to market changes with modified factory layouts. The project is led by Ainak who has built innovative technologies leveraging augmented reality in factory planning and the work is complemented by PTW from Technical University of Darmstadt with experience in the production of the future and factory planning specifically with its EU wide partners with VR learning factories.

SYLENT SYstem LEvel quality policy aNalyser and opTimizer

The SYLENT project aims to develop a novel system-level quality and productivity optimizer tool (zPolicyManager). The tool interacts with the ZDMP components to exchange information about process and product quality. The tool will provide the ZDMP platform users with additional decision-making capabilities allowing choosing the best defect prevention policies at a system level, by avoiding local-optimal solutions, jointly optimising quality and productivity performances of the entire production system.

Smart Jigs

The cooling and shrinkage phases after plastic hot forging make it particularly challenging to correctly measure the molded parts and identify any deviations and defects. The future application allows on the one hand collecting measurements quickly and reliably, on the other hand having a series of specific indicators available to intervene as promptly as possible in case of deviations from the required quality specifications. As a result the sub-project will provide a zApp managing part measurement data.

Lottery: Lot-size one manufacturing defects mitigation via agile quality control and digital-driven dynamic and adaptive metrology

Specialization makes quality control a non-deterministic task. Due to the high variance among different orders, it is almost a lottery to reach a performance and quality level that does not put the sustainability and profitability of a manufacturing SME at risk. This ZDMP platform validation sub-project will foster a zero-defects manufacturing process based on agile and automatized quality control with in-line data inspection of the item calibration and test, built over a digital-driven adaptative and dynamic metrology, verification of orders compliance, end-to-end annotations and stock optimization; to boost effectiveness.

zPasteurAIzer: AI-enabled quality control in tunnel pasteurizers

In the food and beverage industry many foods, beers and soft drinks need to get pasteurized. This is a process that holds a significant role in the quality and taste of the final product but is difficult to monitor due to the process nature. zPasteurAIzer will be a tool for pasteurization process monitoring, early detecting quality issues, and preventing batches of defective products. INDUST will develop an AI-enabled zApp that upgrades the typical tunnel pasteurizers giving the ability to monitor the key process parameters and estimate live the pasteurization units of final products, through AI models being compatible with various pasteurizers, via easy setup from shop floor operators.

PIQ-ME-NOW: Product-Oriented Inline Quality Control for Maximum Efficiency and No Waste

PIQ-ME-NOW will integrate existing components of ZDMP with an enhanced version of the participants scheduler, develop new components related to inline quality control, and demonstrate the complete system in a new domain of custom metal fabrication. To improve interoperability of the system we will develop Asset Administration Shell models describing the quality requirements of production operations.

Smart Manufacturing by Adaptive Robotic Toolpath Generation

MX3D proposes a solution to address consistency problems in robotic additive manufacturing. Using the scanning results of the UCRAM system (ZDMP open call 1), the proposed tool will adaptively control robotic AM processes. This is done by generating an optimal toolpath layer by layer correcting for layer height variations in previous layers. To enable SMARTGen a brand agnostic robotic control interface will be developed. MX3D's generic 3D slicer will be made available in the ZDMP marketplace and expanded to generate the toolpaths adaptively in a layer by layer manner.

Validation of zApps in a Multicursor Zero Defects System

If furniture surfaces are not sufficiently well cured, consumers and end-users may be exposed to unhealthy volatile organic compounds and the lifetime of the products is diminished. The ZDMP call enables Multicursor to test a wood coating curing quality control system using the provided zApps in a new type of setup that includes the principles of zero defects, Industry 4.0 and IoT in a currently outdated sector. This sub-project will result in a tested and validated zApps with the real-world data from the industrial environment, and also the preparation of software to be applied in other zero defects scenarios. This sub-project is aimed towards the validation of zApps and ZComponents.

SmartTwin4ZDM

SmartTwin4ZDM proposes a novel quality control and monitoring system based on smart Digital Twins (DTs) that are able to predict the evolution of the product along the manufacturing line in the most efficient and effective way to ensure product quality and reduce the appearance and propagation of defects. The smart DT will predict the values of the critical product KPIs. In this way, not only the generation of defects will be prevented but also at system level, it will prevent the propagation of the defects to downstream processes and products.

AI-enabled zero defect zero waste production

This proposal paves the way for revolutionizing process & quality control for manufacturing SMEs. The main challenge is that this must be affordable, i.e. smoothly integrated in the existing automation of processes and quality control. The main novelty is using unsupervised deep learning methods for discovering change points in complex multidimensional spaces and understanding their impact on the instability in the process as a whole. The outcome is an innovative ZDMP-enabled solution, for monitoring zero defect zero waste production, integrated in the ZDMP Platform and offered through ZDMP Marketplace.

CELL-OS – Robotic Cell Operative System

Robotic cells have great potential to improve quality, interoperability and intelligence within factories. CELL-OS aims to enhance robotic cells with AI and analysis of new features, to perform predictive maintenance, so the cell performance can be assessed in real-time, obtaining zero-defect processes with maximum reliability for high-demand environments. CELL-OS aims to 1) validate ZDMP platform and zComponents, and 2) add new functionalities to robotic cells, turning them into self-controlled and self-assessed units.

Continuous behavioural analysis towards Zero-Defects Manufacturing

Zero-defects concept focuses on minimising the mistakes both due to humans and machines. Mental and physical states such as stress and fatigue as well as human mistakes such as account sharing, forgetting to log out are a few of the sources of human error. CALM will tackle these sources of human error by introducing continuous behavioural analysis into the Zero-defects concept. Continuous behavioural authentication combined with a higher level of behavioural analysis and anomaly detection will automatically and in real-time prevent potential defects in the production line. CALM will predict and reduce defects, increase safety and productivity as well as reduce costs and waste.

Zero defect Smart Flow monitoring and control solution for process industries – SF-Zero

SF-Zero extends the existing 'smart-Flow', a novel fume hood based on a patented push-pull high-capturing technology, manufactured by Osmose. SF-Zero will improve the currently commercialised smart-Flow with IoT and AI, to enable defect detection and safety features, hands-free control and analysis of real time and historical information to detect errors and improve the decision making. SF-Zero will leverage components from ZDMP and integrate, develop, and demonstrate an efficient toxic vapour monitoring and control system for zero-defect in process industries (e.g., cosmetics, pharma).

AI for Robotic Welding Parametrization and Inspection - AI4R.WELD

The application of welding industrial robots to flexible automated productions is still limited. The main reasons are the limitations in robot programming and parameterization. The AI4R.WELD pilot combines automatic robot collision free program generation with advance sensing and machine learning for welding parameterization. The approach is human-centric and innovative promoting its usage and standardisation for welding application in a wide range of application areas. Fast and intuitive welding parameterization is the missing link for truly effective robotized welding.

Explainable AI for NDT

Visual-based Non-Destructive Testing (NDT) represents the largest share of manufacturing quality inspection methods. Recent advances in AI and Computer Vision (CV) increased the ability to automate these methods to detect defects, but widespread reliance on "black box" Deep Learning solutions makes it impossible to fully audit, trust, and therefore comply with always more demanding regulation around the explainability of industrial AI solutions. In this context, XAINDT will demonstrate a novel explainable AI method for visual-based NDT, based on zMachineAnalytics, applied to radiographic inspection in aerospace foundries to spot 100% of welding, surface and precision constraints defects.

zExplAIn – AI explainability applied to the manufacturing industry

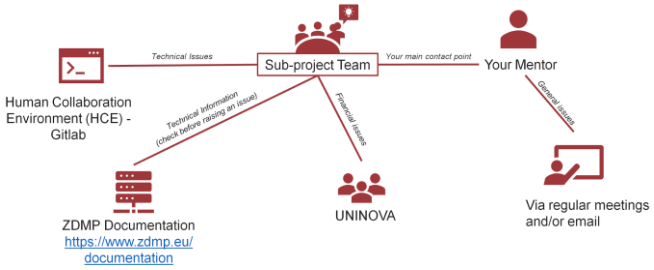
zExplAIn is a new explainable-based zApp to improve Predictive Maintenance AI models in the ZDMP platform. zExplAIn provides rational and insights on the origin and root causes of the anomalies detected within ZDMP, acting as an analytical layer that expands the results already provided by existing AI-based zApps. zExplAIn complements ZDMP black-box models with an additional dedicated surrogate model (hybrid approach) to provide understandability metadata. It will be fully integrated in the ZDMP platform at its three levels (design, use, run-time), and validated in machining processes, plastic injectors and glass-melting processes.

The Enterprise Integration for Zero Defect Manufacturing (EZD)

The Enterprise Integration for Zero Defect Manufacturing (EZD) project proposes to develop an intuitive, efficient, and bi-directional integration component between Enterprise Information Systems (EIS), such as Enterprise Resource Planning (ERP) systems, with the ZDMP ecosystem. The sub-project will focus on the development of interoperability with the leading brand of ERP systems, SAP S/4HANA, and validate the developed assets in the context of their integration with the existing ZDMP infrastructure.

ZDMP Call Support Scheme

All the Open Call projects receive comprehensive support from the ZDMP partners concerning technical, organisational and financial aspects. Additionally, every Open Call winning project is assigned a mentor to support in each phase of the project. There is also another source to connect directly to the technical representatives, namely through the Human Collaboration Environment (HCE), where issues such as discovered bugs or related technical matters can be discussed and reported. Moreover, the technical documentation concerning all zComponents is already available and can be accessed at the official web page of ZDMP.



ZDMP Partners