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# Exploitable Results by Third Parties

## 17041 SMART-PDM (A Smart Predictive Maintenance Approach based on Cyber Physical Systems)

### Project details

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| Website: | https://enforma-tr.com |

| Name: SMART-PDM Arrowhead Cloud | | |
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| Input(s): | Main feature(s) | Output(s): |
| ▪ Sensor data<br>▪ Meta data<br>▪ Service providers<br>▪ Service consumers | ▪ Secure permission-based service, data, and information sharing between partners<br>▪ Global availability<br>▪ Service registration and discovery<br>▪ Increasing amount of open-sourced Arrowhead cloud services are developed<br>▪ REST API and Arrowhead clients<br>▪ Consortium managed data storage and data analytics services | ▪ Partner co-operation<br>▪ Automated service discovery<br>▪ Data and information<br>▪ Robust microservice architecture |

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| Unique Selling Proposition(s): | ▪ Value generation through secure service and data sharing between partners<br>▪ Cloud management and service authentication by SMART-PDM consortium<br>▪ Data storage within the cloud in a standardized MIMOSA database<br>▪ Data analytics services from the VTT O&M Analytics Toolbox |
| Integration constraint(s): | ▪ Web connectivity<br>▪ Arrowhead client or REST client<br>▪ Authentication certificates and access permissions from cloud admin |
| Intended user(s): | ▪ Maintenance engineer, Integration engineer, Application developers |
| Provider: | ▪ SMART-PDM consortium<br>▪ https://github.com/VTT-OM/arrowhead-setup<br>▪ https://github.com/eclipse-arrowhead/core-java-spring |
| Contact point: | ▪ Jani Hietala jani.hietala@vtt.fi, Petri Kaarmila petri.kaarmila@vtt.fi |
| Condition(s) for reuse: | ▪ Arrowhead: Eclipse Public License 2.0<br>▪ Arrowhead-setup: Eclipse Public License 2.0<br>▪ MIMOSA database: Licensing |
| | *Latest update: 15/01/2022* |

| Name: Predictive Maintenance Platform | | |
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| Input(s): | Main feature(s) | Output(s): |
| ▪ Sensor readouts<br>▪ Failure data<br>▪ Service records | ▪ Flow-based programming UI<br>▪ Customisable charts & dashboard<br>▪ Callable RESTful API<br>▪ Ability to define endpoints for IoT, edge device and gateway<br>▪ Cloud based; multi-tenant Web application | ▪ Remaining Useful Life in time unit<br>▪ Probability of Failure in percentage<br>▪ Alerts, self-updating visuals<br>▪ Machine Learning Model results |

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| Unique Selling Proposition(s): | ▪ Completes an end-to-end predictive maintenance once supplied with right inputs (can also be used merely for descriptive purposes, i.e. to collect, organise, and visualise industrial IoT data, without any predictive model)<br>▪ Ability to auto-scale with demand |
| Integration constraint(s): | ▪ Platform requires minimum configuration during set-up<br>▪ Docker-based; also an enabler for local cloud implementation<br>▪ Input data in JSON format |
| Intended user(s): | ▪ Cyber physical system operator; Manufacturing Execution System (MES) vendors; Operation and Maintenance teams; End-user (maintenance engineer) |
| Provider: | ▪ Enforma |
| Contact point: | ▪ sales@enforma-tr.com |
| Condition(s) for reuse: | ▪ Licensing |

*Latest update: 15/01/2022*

| Name: Seed Drill Mobile Gateway (Mobile Gateway for Agricultural [And Forestry] Implementations) | | |
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| Input(s): | Main feature(s) | Output(s): |
| ▪ Implements sensor data (old and new)<br>▪ 4G connection | ▪ Connects implement and mobile phone using Bluetooth<br>▪ Transfer data to the cloud services<br>▪ Shows additional data for user | ▪ Makes predictive maintenance possible<br>▪ Data gathering<br>▪ Data processing in cloud services |

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| Unique Selling Proposition(s): | ▪ Cost effective way to apply predictive maintenance for agricultural implements.<br>▪ Increase overall usability, and minimize downtimes<br>▪ Increases knowledge about product behaviour for the company<br>▪ Easy to update software |
| Integration constraint(s): | ▪ Requires good 4G coverage on the fields<br>▪ Requires 12V power supply<br>▪ Some materials and powerlines block Bluetooth signal |
| Intended user(s): | ▪ Manufacturers<br>▪ Farmers |
| Provider: | ▪ Junkkari<br>▪ Wapice<br>▪ VTT<br>▪ Xedi |
| Contact point: | ▪ Tarmo Kukkola tarmo.kukkola@msk.fi |
| Condition(s) for reuse: | ▪ Licencing |

*Latest update: 15/01/2022*

| Name: Automated RAM Analysis<br>(The Same Method Was Utilised in Both Use Cases Sawmill & Hydro Power Plant) | | |
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| Input(s): | Main feature(s) | Output(s): |
| ▪ Device hierarchy and the logical structure of the system under study<br>▪ Event history (all type of events, resources, failures, repair duration, maintenance data etc.)<br>▪ Cost history (resources, spare parts, break and downtime costs etc.)<br>▪ Expert knowledge | Automated RAM Analysis Prototype<br>▪ Data Input Interfaces<br>▪ Modelling<br>▪ Simulation<br>▪ Analysis results and reports<br>▪ Data Export Interfaces<br><br>RAMS Simulation Gateway Prototype<br>▪ Import Interface<br>▪ Combining IoT data and Automated RAM Analysis model and simulation<br>▪ Dashboard<br><br>*RAM = Reliability, Availability and Maintainability* | ▪ Comprehensive and up-to-date RAM analysis<br>▪ Visualization of history data and simulation results<br>▪ Recognize hot spots for sensors and digital solutions<br>▪ Highlight improvement potentials<br>▪ Visibility into reliability, availability and overall cost risks<br>▪ Improvements to reliability, availability and cost risks |
| Unique Selling Proposition(s): | ▪ Unique solution that combines quick and easy history analysis methods and sophisticated modelling and simulation methods integrated to modern IoT platform.<br>▪ Visibility into overall cost risks. Decision making is based on analysed facts.<br>▪ Payback time for analysis can be proved through the cost savings and benefits that can be achieved.<br>▪ Solution makes RAM analysis a continuous process and results more visible.<br>▪ Fast algorithms, automated analysis, proven methods and making the results visible contribute to sale of analysis tools and solutions. | |
| Integration constraint(s): | ▪ Hardware requirements: a) Memory: 4GB RAM (more than 8GB RAM recommended for large models), b) Hard drive: 100MB, c) Operating system: Windows (7/8/10), macOS (10.7-10.15), Linux<br>▪ The object under study: It has been shown that automatic RAM analysis can be performed in very different processes. Therefore, we do not see any technical constraints to extend the analysis to other processes as well.<br>▪ Data quality: The quality of the data collected from the object under study is important for the outcome. When the data is consistent, | |

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| | available, and reliable, we get correspondingly better results. However, this is also a challenge, and the data can be processed and supplemented by expert knowledge, for example. The analysis also reveals qualitative deficiencies in the data and thus efforts can be made to improve data quality. |
| Intended user(s): | ▪ Maintenance engineer, Reliability expert |
| Provider: | ▪ AFRY Finland Ltd, Caverion Ltd, Wapice Ltd |
| Contact point: | ▪ miikka.tammi@afry.com, tatu.pekkarinen@caverion.com, Veli-Pekka.Salo@wapice.com |
| Condition(s) for reuse: | ▪ licensing, many options |
| | *Latest update: 15/01/2022* |

| Name: Industrial Grinding Machine | | |
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| Input(s): | Main feature(s) | Output(s): |
| ▪ Accelerometers<br>▪ Spindles<br>▪ Controller<br>▪ Gateway<br>▪ CNC<br>▪ Arrowhead compatible interfaces<br>▪ Feature analysis and extraction algorithms<br>▪ Diagnostic and decision algorithms | ▪ Super-efficient proactive maintenance.<br>▪ Increased production efficiency.<br>▪ Ensure better product quality and increased machines health and safety.<br>▪ Making use of data to improve manufacturing efficiency.<br>▪ Smart services such as maintenance based artificial intelligence techniques that subsequently the results of data analysis offers valued-services to companies. | ▪ Self-diagnostic cycle reports<br>▪ Architecture that allows the acquisition and processing of data from the machine to know its current state of health and predict possible failures in system to justify the predictive maintenance.<br>▪ Operating models and behaviour patterns of critical parts of machines.<br>▪ Most suitable analysis techniques to perform an analysis of machine tools focused in a predictive maintenance system. |

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| Unique Selling Proposition(s): | **Self-diagnostic cycle reports that**:<br>▪ Shows the value and evaluation of the last measurement whether it is in range or not.<br>▪ The evolution of the bearings and analysis capable of detecting imbalances and phenomena that are detected at lower frequencies. |
| Integration constraint(s): | ▪ Hardware requirements:<br>• Windows (7,8,10), macOS (10.7-10.15), Linux, Controller (PLC), A gateway<br>▪ A solution for acquisition of data from sensor deployed in the machine.<br>▪ The quality of the data collection from the machine through sensors. |
| Intended user(s): | ▪ Customers<br>▪ End user |
| Provider: | ▪ Danobat S.Coop |
| Contact point: | ▪ Gorka Unamuno - gunamuno@ideko.es |
| Condition(s) for reuse: | ▪ Licensing |
| | *Latest update: 15/01/2022* |

| Name: Algorithm for Operating Mode Identification | | |
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| Input(s): | Main feature(s) | Output(s): |
| Soldering process values and quality control images | Automatic detection of welding electrode degradation | Predictive maintenance status |

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| Unique Selling Proposition(s): | Unsupervised algorithm to identify operating modes from process and image data |
| Integration constraint(s): | Own python framework |
| Intended user(s): | Process engineers and quality department |
| Provider: | Mondragon Assembly / Lortek |
| Contact point: | Aitor Apraiz / Ander Muniategui |
| Condition(s) for reuse: | Proprietary |

*Latest update: 15/01/2022*

| Name: Home Appliances Predictive Maintenance | | |
|---|---|---|
| Input(s): | Main feature(s) | Output(s): |
| ▪ Algorithms capable of analysing consumption patterns<br>▪ Cloud platform for data acquisition, storage and analysis<br>▪ Know-how on data analysis | ▪ Energy consumption, vibration, and temperature readings<br>▪ Consumption Ratings simulation: transforming raw data into a friendly/well known format<br>▪ Usage readings, focused on ensuring a responsible usage of the appliances<br>▪ Commercial benefits via appliances upgrade/update suggestion: better / more efficient appliances<br>▪ Preventive maintenance alerts<br>o Commercial benefits via Services<br>o Sustainability benefits via extended lifetime of the appliance & malfunction reduction<br>▪ Malfunction detection<br>o Click to repair if the appliance is not working<br>▪ More data could be translated to a better knowledge of the appliance and it´s top defective components<br>o To a better predictive management of spare parts production<br>o To a faster and more efficient repair process | ▪ Predictive maintenance algorithms able to detect and/or predict faults in home appliances<br>▪ A system that can detect and predict home appliance faults by analysing their power consumption patterns, vibration and temperature<br>▪ A tested API/ testbed<br>▪ User Interfaces for end-users (expected final costumers) and maintenance/after-sales professionals<br>▪ Standalone Device (the smart connector) to collect energy consumption, vibration, and temperature data. |
| Unique Selling Proposition(s): | ▪ Innovative after sales predictive maintenance service for home appliances, thus helping consumers extend the life of appliances and its monitoring, in line with circular economy strategies<br>▪ Additionally, the replacement of non-efficient home appliances for updated appliances and much more efficient ones. | |
| Integration constraint(s): | ▪ GDPR<br>▪ Data complexity and size<br>▪ Data readiness | |
| Intended user(s): | ▪ Final consumers and maintenance/after sales professionals | |

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| Provider: | ▪ ISEP / CleanWatts, technological and developer partners (algorithms, Smart Connector and User Interfaces)<br>▪ Sonae/Worten, the end-user along the Smart-PDM project, UC9, Home appliances |
| Contact point: | ▪ ISEP: Luís Lino Ferreira llf@isep.ipp.pt<br>▪ CleanWatts: André Oliveira aoliveira@cleanwatts.energy<br>▪ Sonae/Worten: Nuno Gouveia, nmgouveia@sonaemc.com |
| Condition(s) for reuse: | ▪ To be defined by ISEP and CleanWatts to other projects and initiatives, as the technological and developer partners |
| | *Latest update: 15/01/2022* |