1 Publishable summary

Summarised project description

iMain is a European level research project aiming to develop a novel decision support system for predictive maintenance. To that end, a multi-layer solution integrating embedded information devices and artificial intelligence techniques for knowledge extraction and novel reliability & maintainability practices will be developed. The resulting solution will provide extended capabilities compared to those achievable with current state-of-the-art maintenance practices, increasing system lifetime of the production equipment at least 30%, energy efficiency at least 20%, availability of whole process at least 30% while decreasing maintenance costs at least 40%.

The iMain project is strongly committed to deployment issues, including innovation and implementation actions focused on value chains and bridging the gap from research to market. iMain acknowledges the significance of exploitation, puts emphasis on the commercialisation of results, also taking into account the needs of post-project monitoring of the commercialisation process. Monitoring progress after the project end will reveal the results of the funding received and evaluate the effectiveness of the innovation mechanism developed.

As a step towards the Horizon2020 strategy, the iMain project will thus make a contribution in terms of R&D investment, employment and resource efficiency, aiming to assist EU manufacturers, particularly SMEs, to adapt to global competitive pressures by increasing the technological base of EU manufacturing through the development and integration of the enabling technologies of the future, specifically engineering technologies for novel predictive maintenance solutions.

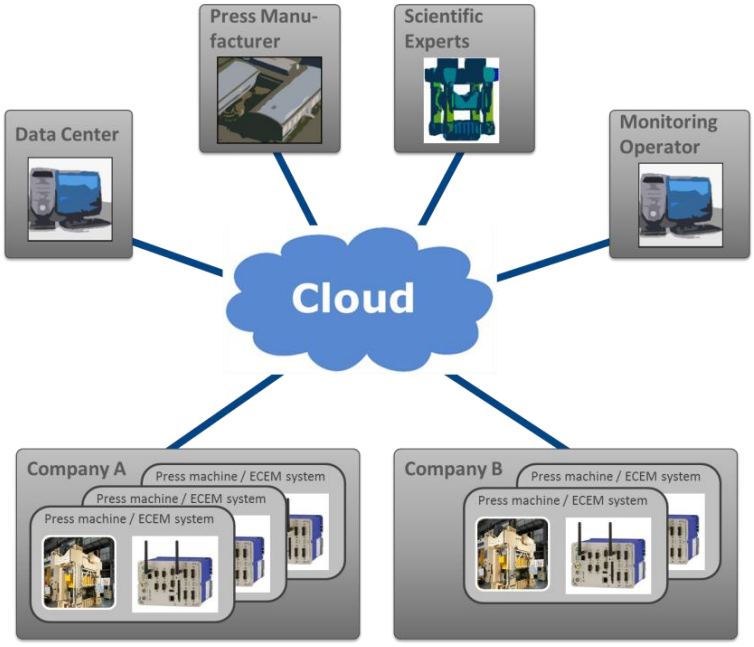

Figure 1: The iMAIN approach

Performed work and main results

In the finalized work package 1, first the production equipment has been analyzed regarding critical components, which are relevant for maintenance, and a condition and energy monitoring strategy has been developed. To increase the efficiency of the monitoring solution and to minimize the number of necessary real sensors, it will be supported by the development and implementation of virtual sensors. Virtual sensors can be considered as one main novelty of the project. For this and to support monitoring planning, varying simulation models has been developed. These models allow the virtual analysis of mechanical strains and stresses as well as the estimation of influences on the energy consumption. Based on the FE models and in combination with strain measurements on both demonstration presses, the parameters for the virtual sensors have been derived.

The embedded condition and energy monitoring system (ECEM) as the main base for maintenance has been developed in WP2. It allows data acquisition and pre-processing in realtime on the ECEM-DA module and comprehensive service life prediction operations on the ECEM PC. The architecture for the acquisition hardware has been defined as a combination of a specialized embedded device with realtime capability and a supporting PC based system for configuration, additional processing and storage. Prototypes for both components have been delivered. The ECEM-DA is actually installed at both presses and is basically connected to the cloud. In the second period this system will be extended to the ECEM PC and optimized.

In work package 3 the theoretical works for the service life prediction system (lifPRED) and an offline prediction system (lifPRED mirror) is in progress that will finally run on the ECEM PC. The development of the needed processing environment is finished and is partly connected to the e-maintenance cloud.

Work package 4 deals with the development of the e-maintenance cloud. A special architecture has been developed and the hard- and software has been specified. The software architecture is comprised from various software services (sql service, virtual desktop service, software development service, alarm service, SEARCH-database service, database management service, post processing service, dashboard service) and describes their dependencies and interaction within the eMaintenance cloud.

Finally, several dissemination activities like (website, publications, flyers, posters, clustering activities) have been done and will be continued in the second period.

Summary of the expected iMAIN results

In order to increase the European industries' competiveness, this project aims to provide a set of artefacts for optimisation of operation and maintenance processes. These artefacts can be utilised to increase the effectiveness and efficiency by e.g. estimation of remaining useful life of forming machines and slow rotating machines. Hence, some the major outcomes from this project are:

- Data acquisition software for management and provision of a common maintenance ontology and e-maintenance services specifically for forming machines and slow rotating machines (this software develops based on e.g. ISA-95, OPC, and SCADA aimed for data acquisition, data structuring and data fusion from different data sources in a heterogeneous environment);
- Data analysis software for intelligent knowledge discovery and data mining using, e.g. support vector machine and fuzzy logic. The software will develop and implement data analysis models for forming machines and slow rotating machines;
- Decision-making support software using service-oriented architecture based on standards such as MIMOSA aimed for establishment of optimal predictive and corrective maintenance strategy.

The result of our project will be a novel advanced concept with a practical verified solution for the described information-based predictive maintenance system as well as all necessary methods. The system will include:

- An Embedded Condition & Energy Monitoring system (ECEM system) (Hard- and Software), which will can nearly operate personal self-sufficient;
- A Smart Service Life Prediction system (SSLP system) (Hard- and Software), that will complement the ECEM system through a number of virtual sensors that will allow:
    - The smart processing of information from different sources;
    - The service life prediction of mechanical components under consideration of real loads and planning data;
    - The detection of energy-relevant component wear.
- A novel e-maintenance strategy using cloud e-maintenance (Hard- and Software).

Project website: www.imain-project.eu