ZERO DEFECTS Manufacturing Platform ZDMP

ZDMP Blog

Machine tools in Industry 4.0

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Some questions for you

- Can you imagine your workshop running remotely?
- Can your machine work safely without the operator on-site?
- Can your machine tools do real-time self-diagnosis?
- Do you wait for failures to happen, or can you schedule maintenance efficiently?

Introduction

Industry 4.0 allows for improvement of the production process thanks to modern technologies such as IOT, cloud storage, digital twin and other innovations that characterise this historical moment.

State-of-the-art equipment can rely on a large variety of sensors installed and can deal with all types of signals to raise alarms or perform specific manufacturing tasks. Despite the significant amount of the sensorial data available, it is unusual for the machines to store or post-process this amount of data. This is due to, on one hand the lack of IT instruments that the manufacturing companies, especially SMEs, have and, on the other hand, to the difficulty to see the investments return of Industry 4.0-based solutions in the short term. The ZDMP project aims to target both problems. ZDMP offers a set of basic functionalities in a “building block” format, to allow companies to develop customised applications without re-implementing the same functions over and over, and a variety of applications’ examples to see the advantages of inclusion of these technologies in the manufacturing process.

By using it, for example, to implement predictive and diagnostic technologies it will be possible to anticipate problem identification, schedule maintenance activities, avoid unplanned production interruptions and for some activities work on the machine remotely.

Moreover, it will also reduce the need for the physical presence of the operator near the machine tool, optimising the working time and empowering the operator, who can be dedicated to higher level tasks.

What will ZDMP achieve

ZDMP provides a database of tools and resources to quickly and easily achieve enhanced management, such as:

- Capability to monitor the machines remotely
- Automated analysis of component deterioration
- Easier integration of external instruments, such as cameras and scanners for anti-collision system or measuring instruments for deterioration analysis or quality optimisation
- Secure data communication
- Enable technical assistance to check the equipment status remotely
- Automatic project’s workflow re-scheduling considering any delays, both incidental or notified
- Quick interface between the existing equipment and additional modules

These technologies can be applied in specific areas, to have a significant impact in the machine tool usage:

- Collection and management of CNC and PLC data
- Monitoring and analysis of complex sub-systems
- Interfacing with external tools

CNC and PLC data

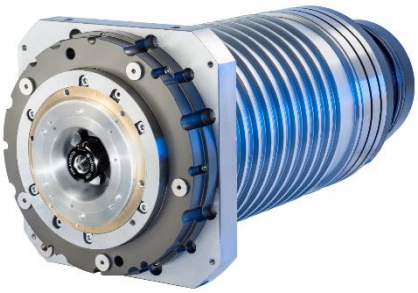
In a machine tool there are many parameters for system's health analysis such as current, torque, velocity, accelerations, vibrations, temperatures, pressures, levels, etc.

In ZDMP this information will be available for high level machine monitoring and predictive analysis on a remote site.

Appropriate algorithms and databases can be developed according to machine type and deterioration analysis to be done.

Complex sub-systems: spindle

ZDMP tools allow isolation of all signals relative to specific sub-systems of the machine. In the case of complex systems, like the spindle, this specific data collection allows analysis of the individual components.

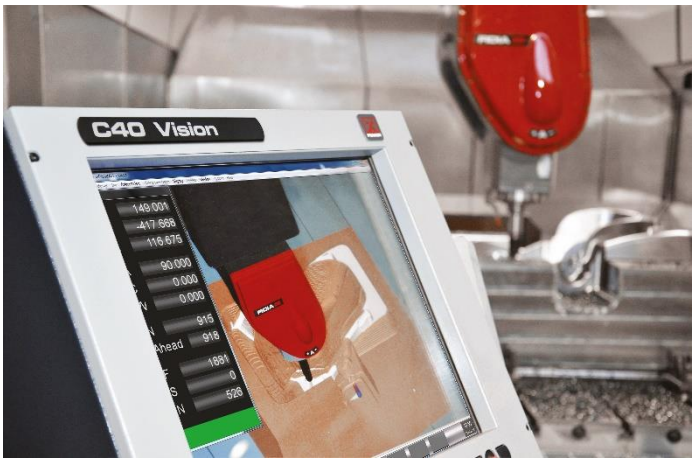


In ZDMP project a tool is developed to analyse the warmup phase of the spindle, comparing it to the historical data of the same procedure, to highlight any drift in the machine performances. In addition, a spindle sensor will be developed and installed to provide appropriate data.

A remote application will perform a high level spindle deterioration analysis that represents one of the most common maintenance situations.

Additionally, spindle data and plc parameters databases will be developed to assess with real-time measurement performed on the machine, by means of an algorithm who decide if and what maintenance action has to be done.

External tools: scanner to improve anti-collision detection capabilities



Possible collisions between machine tool and the workpiece are the main reason why the operator has to be in close proximity to the machine tool. Anti-collision systems exist but have several limitations. They usually use models of the workpiece that need to be prepared with a CAD, which requires a long and expensive modelling time. Moreover, CAD modelling does not cover all collision situations. The clamping systems, for example, cannot be modelled as their set up is made by the operator. It is therefore impossible for an anti-collision software to prevent a crash with those (eg) clamps.

External scanners can be used to replace the CAD model, but their usability is limited by the conversion of the scanned surface into a CAD model.

ZDMP provides a specific application to quickly convert the 3D scanner data into a CAD model.

Benefits for suppliers and users

All these features delivered by ZDMP enable the supplier of machine tools to improve the equipment performance. This has other positive impacts on the supplier, such as, reduction of repair time through the remote maintenance and the maintenance time minimisation spent at the customer's premises. In fact, by having the data available remotely, technicians are able to identify the fault before arriving on site.

From the machines' user perspective, ZDMP allows utilisation of the available data to minimise the production interruptions, to have less waste, a quick identification of the damage, a better product quality and a more efficient and manageable production line overall.

The expected impacts on production are:

- 90% reduction in workpiece rework time due to defective surface quality or due to "hidden" malfunctions
- Reduced servicing time by 20%
- Reduction of scrap production
- Reduced set-up time by 20%
- Optimised production of single items and small-batches

ZDMP Links

• **Architecture Component(s)**	N/A – Pilot Domain
• **Work Package**	WP9 – Traditional Sector Use Cases: Automotive and Machine Tools
• **Tasks**	All Tasks

References/Acknowledgements

None