

SmartFactory^{KL} *AI in Manufacturing* *Human-Centric Support:*

Smart factories can touch,
hear, see, and speak



smartFactory^{KL}

Artificial intelligence in manufacturing

People employed in the manufacturing jobs of the future will have an important partner in artificial intelligence (AI). The technology is able to quickly and reliably evaluate large volumes of data and provide filtered, context-related results to the operator. The deployment of AI enables replication of the human senses which allows better cooperation with the machines and improves the support provided to the operator.

"Today we can process complex algorithms and manage huge amounts of data. Enormous computing power at low cost is exactly "the enabler" that AI needs to take off. Whether in pattern recognition for the field of autonomous driving or augmented reality in the manufacturing sector – the market is discovering a technology that is suddenly cheap and available."

Prof. Dr. Detlef Zühlke, Chairman of the Board of **SmartFactory**^{KL}

› *What are the advantages of AI in manufacturing?*

- An important task performed by AI in the production environment is the evaluation of collected data. The collection of machine data like pressure, temperature, or flow provides the supply of information about the system status and enables **Condition Monitoring**.
- The amount of data generated is far more than a human can quickly evaluate and interpret without technical assistance. But once the collected data has been processed by the appropriate mathematical data analytics (**Anomaly Detection**), plant operators can benefit from this data in predicting possible system malfunctions.
- The impending failure can be remedied in advance by **Predictive Maintenance**, which in turn, minimizes plant downtime and repair time.
- **Augmented Reality (AR)** guides the operator, perhaps assisted by data glasses, through the servicing procedures at the unit. In this case, for example, the worker sees information and instructions projected in the smart glasses, leaving both hands free to perform and complete the required work steps. The result is an intuitive and improved issue resolution.

“Predictive maintenance is a good example of how AI supports factory workers. The employee has to interpret the decision support information made possible by AI and initiate the correct work steps.”

Prof. Dr. Martin Ruskowski,
Department Head of Innovative Factory Systems research at **DFKI** and
expert in the use of AI for manufacturing



AI adapts to the characteristics of the human senses: Use Cases at SmartFactory^{KL}

› Touch and Hearing: Condition monitoring, anomaly detection and predictive maintenance – algorithms support the operator

- The early signals of friction-generated wear on a work unit can often be heard, for example, in the form of vibrations or grinding noise. In an actual production setting, this may be caused by abrasion on the conveyor belt as a result of a loose bolt or some imbalance in an engine.
- For demonstration purposes, a malfunction during operations in the form of an unusual vibration is generated at one of the stations of the Industrie 4.0 production plant at **SmartFactory^{KL}**. A sensor on the weighing module records the vibration and transmits the values to the cloud. The anomaly is detected as the signal is analyzed there with the aid of AI algorithms.
- Similarly, a simulated malfunction is generated for a grinding noise. The sound environment within the module is monitored and acoustically recorded to enable evaluation by an AI algorithm. The AI algorithm identifies the unusual noise and assists with anomaly detection.



- The ERP system then creates a maintenance order indicating the type and location of the fault. A service technician receives the information via tablet, smartphone, or even in the display of smart glasses. AR realizes the potential of remote maintenance, for example, by allowing an engineer back at the office to support a technician on site.

› Hear and Speak: The work unit recognizes voice commands

- Another exciting option is the “speech-to-text” application. This AI application translates the operator’s voice commands into text and then performs a database search for the required information.
- In this way, the operator can display the pages of an assembly or operating instruction from the technical documentation in the data glasses as required, or even have the information read out by the integrated speech generating device. Say goodbye to the tedious flipping of pages in a file binder or the annoying computer folder and file searches.



› Sight: Computer Vision – AI “sees” production errors

- Cameras that film the production flow are installed in the production modules (stations) of the Industrie 4.0 production plant at the **SmartFactory^{KL}**. The aim is to have AI evaluate the data that is generated. This task is carried out by an intelligent computer vision service, which recognizes and analyzes the work piece to include its processing status.
- Using this data, the computer vision AI algorithm determines if the processing step was carried out error-free. To specify this adaptive AI process, various well-trained models of the algorithm are used.

Companies participating in the artificial intelligence working group at **SmartFactory^{KL}** are EPLAN Software & Service, Haier, IBM, KIST Europe and METTLER TOLEDO.

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