Artificial Intelligence (AI)

Background and Application in the Smart Factory

Artificial intelligence (AI) is the ability of a computer or program to adapt to human behavior or thinking and perform complex tasks.

AI can **find answers and solve problems independently** without having to be programmed for every purpose.

In this slide deck, we look behind the scenes.

What Is Artificial Intelligence?

Weak AI refers to all systems that exist **today**. For example,

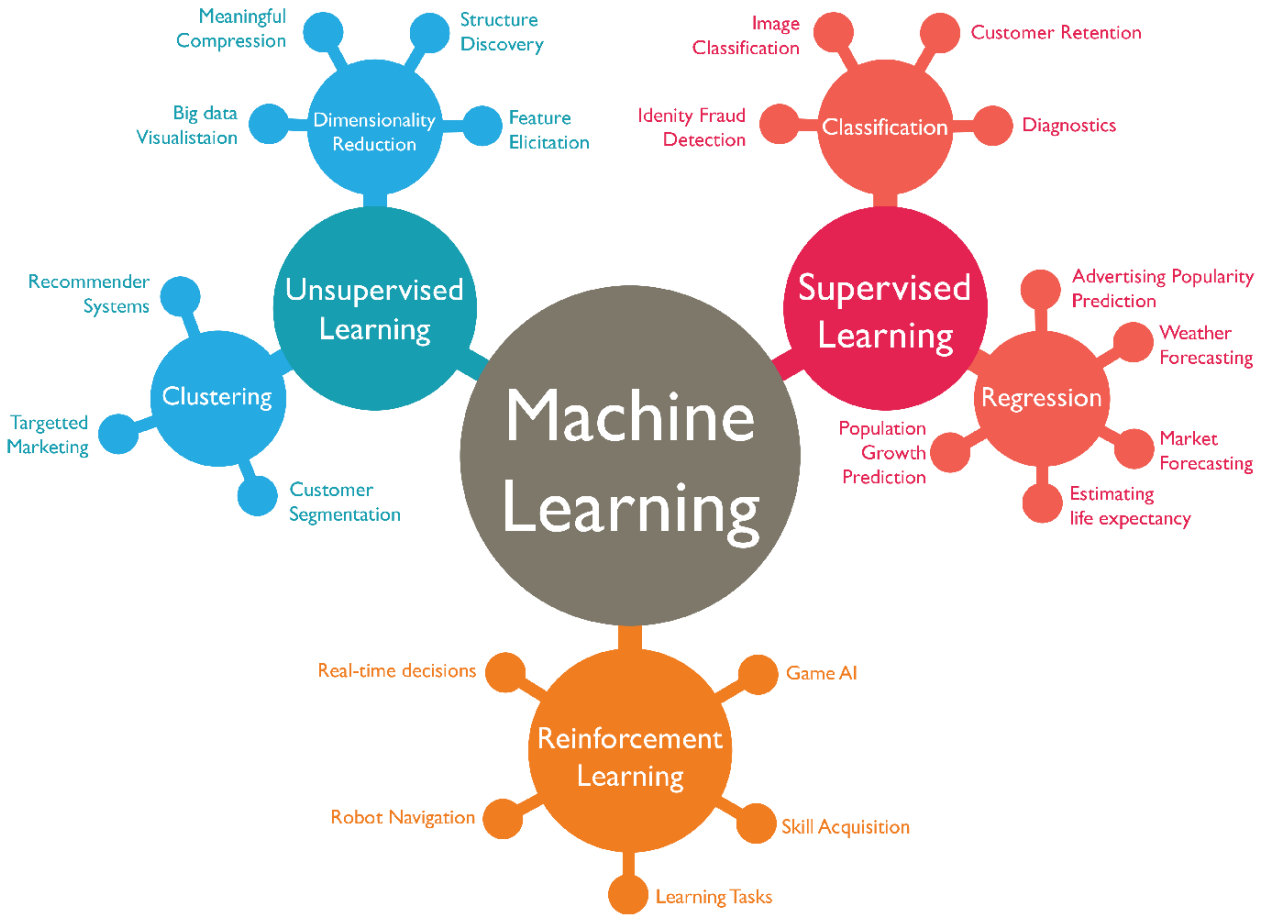
- character, text, image, and speech recognition.
- individual control of advertisement.
- automated translation.
- expert systems (e.g., guidance based on a knowledge base).
- navigation systems.
- autocomplete and suggested corrections for searching.

Strong AI or **superintelligence** may be possible in 20 to 40 years. Strong AI...

- has a logical intellectual power.
- can also decide in the event of uncertainty.
- combines all skills to achieve an overriding goal.
- has empathy, self-knowledge, memory, and indeed wisdom.
- knows love, hate, fear, or joy.
- may even have its own consciousness.

ChatGPT is also weak AI. It merely arranges learned words based on statistical methods to produce a more or less readable and meaningful text. However, the results suggest that this application is on the borderline of being strong AI but that is debatable.

We Distinguish Between Weak AI and Strong AI

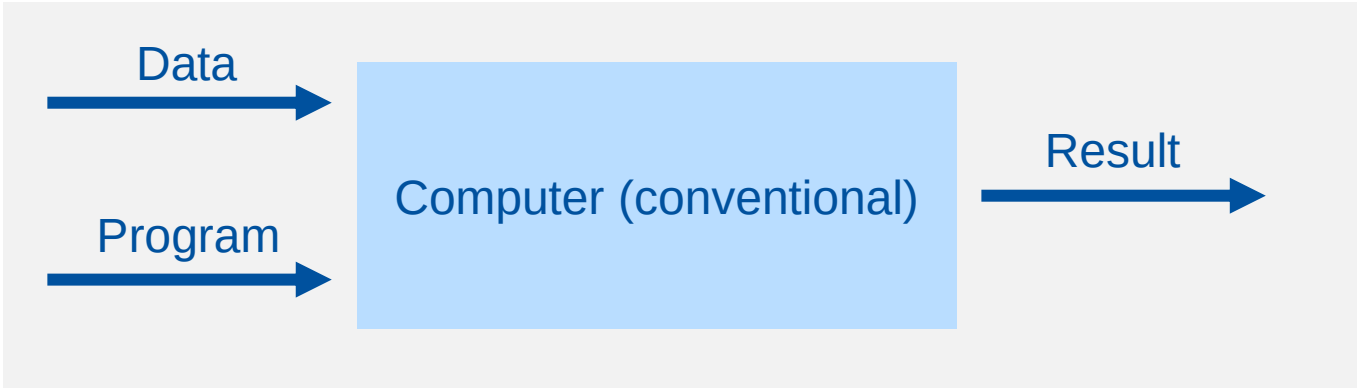


Artificial intelligence (AI) is a topic that has been hyped in recent years.

Terms such as artificial intelligence, machine learning, neural networks, and the like are thrown around at will.

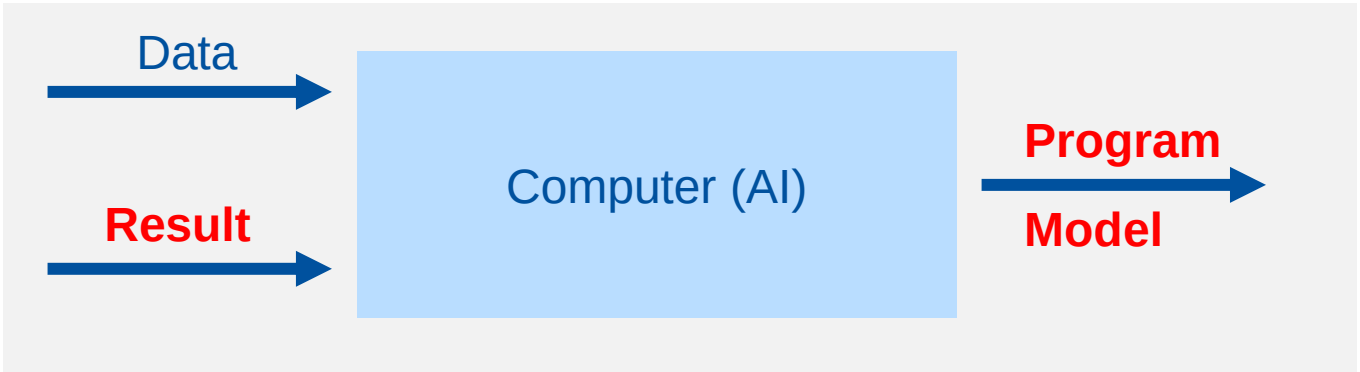
It is generally assumed that machine learning (ML) is a sub-area of AI. ML is the basis for most AI applications.

AI and ML – What is the connection?



A computer conventionally processes **data** based on a pre-defined **program** to produce **results**.

This **requires** an understanding of all influencing factors.



By contrast, machine learning is trained with **data** and matching **results**. Here, a **program** is produced that is also called a **model**.

In this case, the interaction of all influencing factors is **not** necessarily known.

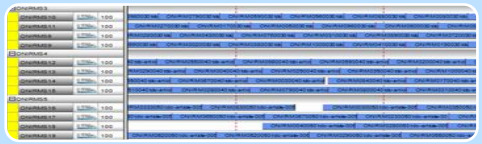
Machine learning (ML) is the basis for many use cases in the Smart Factory.

Changed Approaches by Machine Learning

Classification – detect patterns

Anomaly Detection – detect deviations from the standard

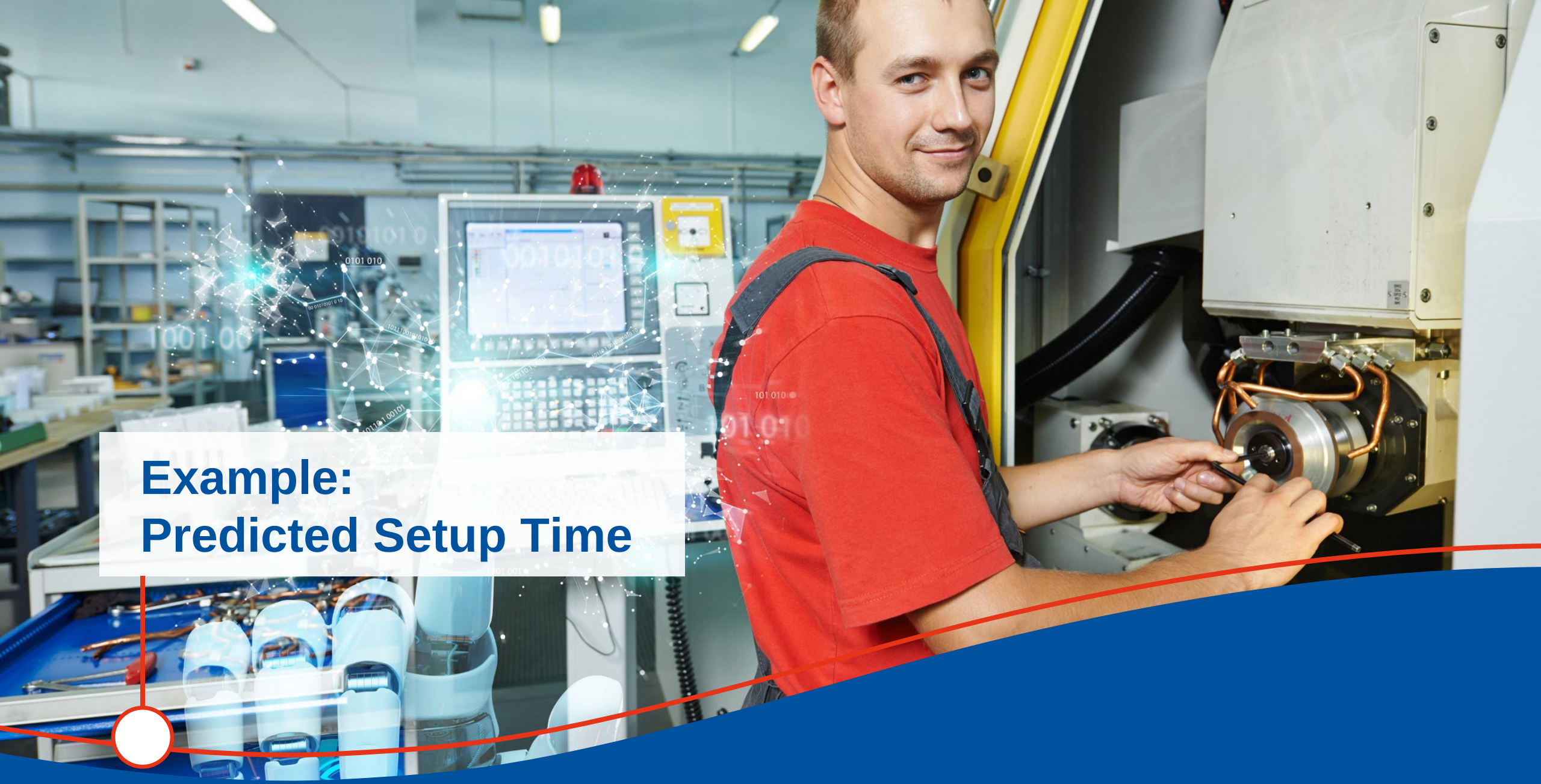
Prediction – derive predictions



Planning – perfect solutions for planning tasks

Find below three examples from the Smart Factory.

Typical Use Cases for AI

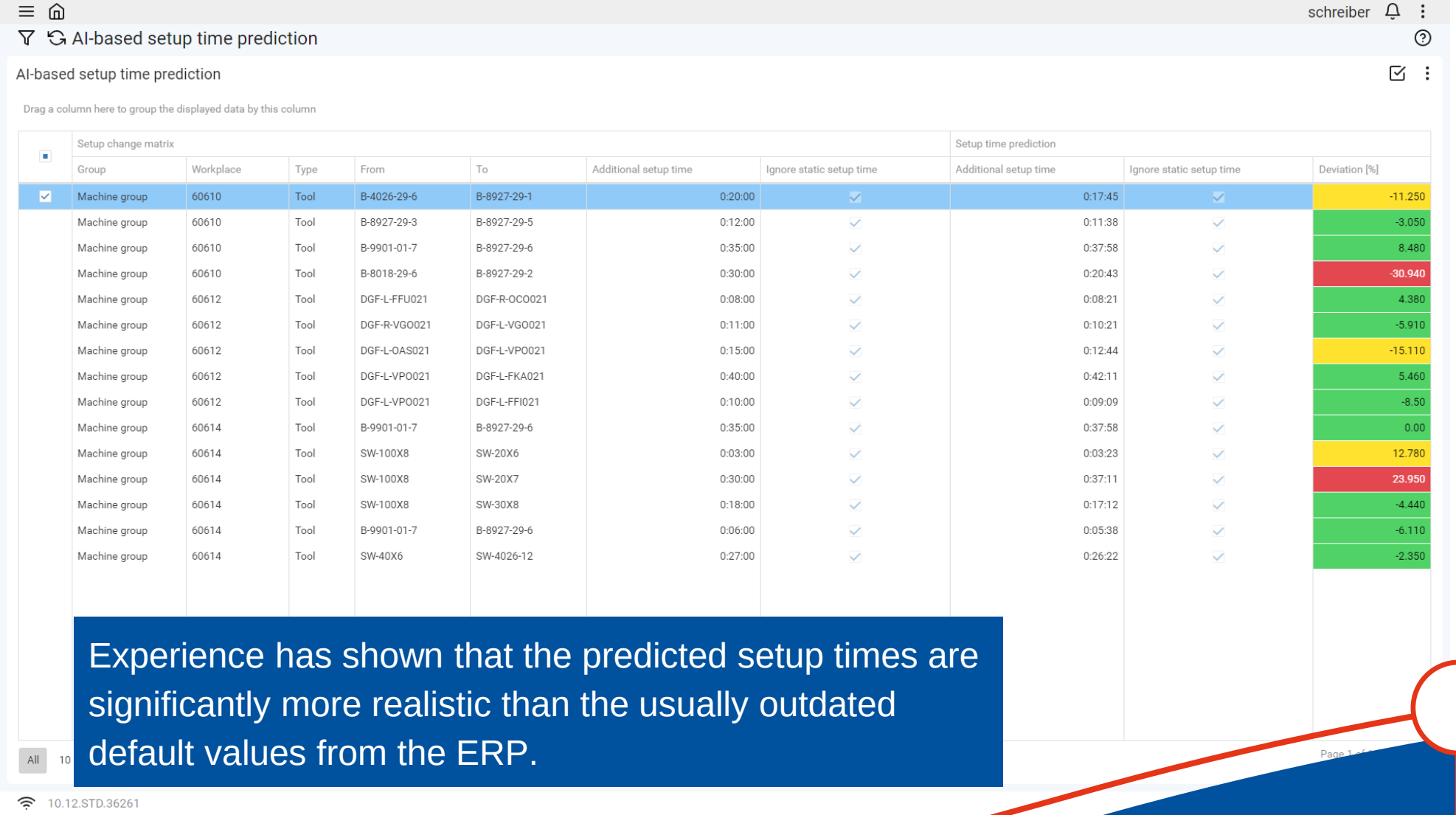


Example:
Predicted Setup Time

AI-based Setup Time prediction provides realistic default values!

- Record setup times that occur during production – e.g., with MES HYDRA.
- AI analyzes various factors influencing the setup time and creates a prediction model.
- The model is used to calculate setup time predictions that match actual influencing factors.
- Use these realistic predictions for your (automatic) detailed planning.

AI-based Setup Time Prediction



HYDRA X
BUILD YOUR FACTORY SMART

AI calculates additional setup times for each setup change and compares the times with current default values.

Experience has shown that the predicted setup times are significantly more realistic than the usually outdated default values from the ERP.

AI-based Setup Time Prediction At Work

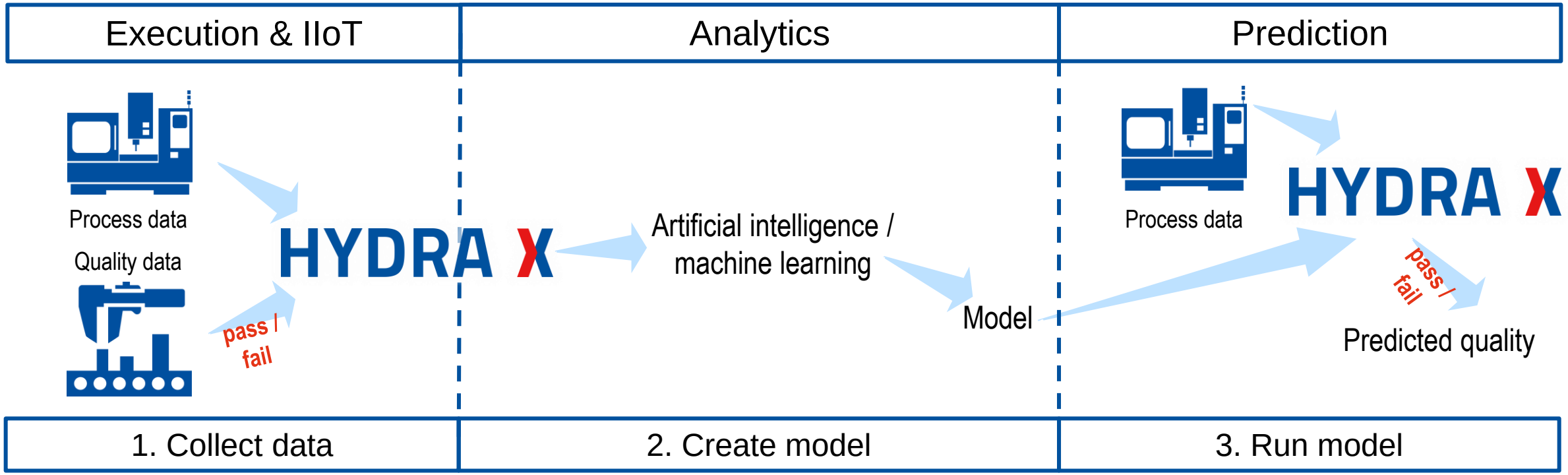
Example: Predictive Quality

Predictive Quality enables the prediction of product quality (**pass** / **fail**) based on currently recorded process data.

The **aim** is to detect scrap at an early stage and avoid further processing of these parts.

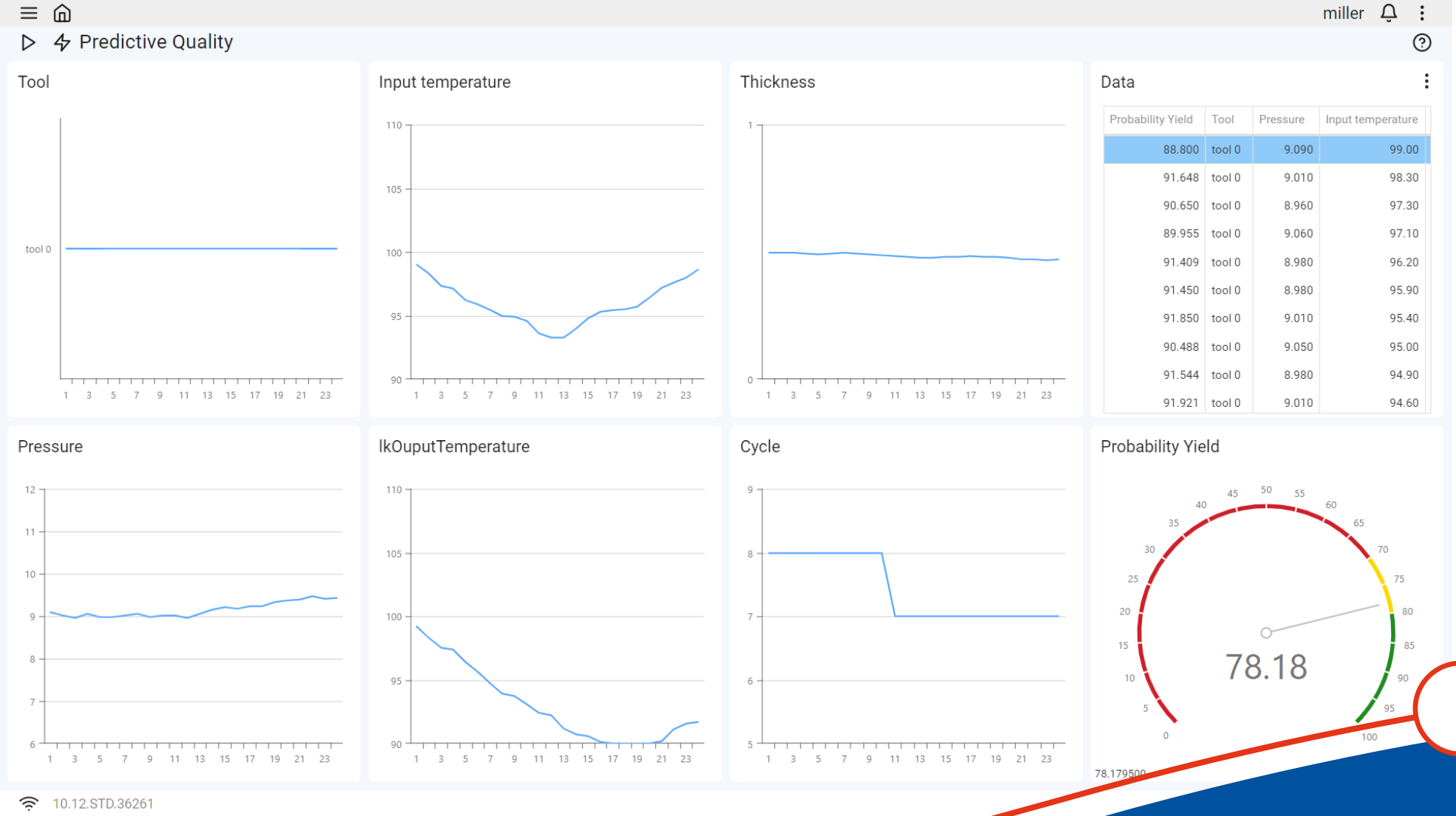
The prediction is based on machine learning.

Example
Predictive Quality



Predictive Quality can forecast product quality during manufacturing based on current process values and an AI model.

Predictive Quality Workflow



HYDRA X
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Current process values are displayed in six diagrams. Based on these process values, AI calculates the probability of the current part resulting in a pass (tachometer chart bottom right).

Predictive Quality
How It Is Used

Example:
Production Planning with AI

Planning facts

Even 500 operations in detailed planning result in 10 to the power of 1000 possible planning options.

That's more planning options than there are atoms in the universe.

Restrictions and dependencies must also be considered, which makes for a high complexity.

Automatic detailed planning is therefore a perfect match for AI.

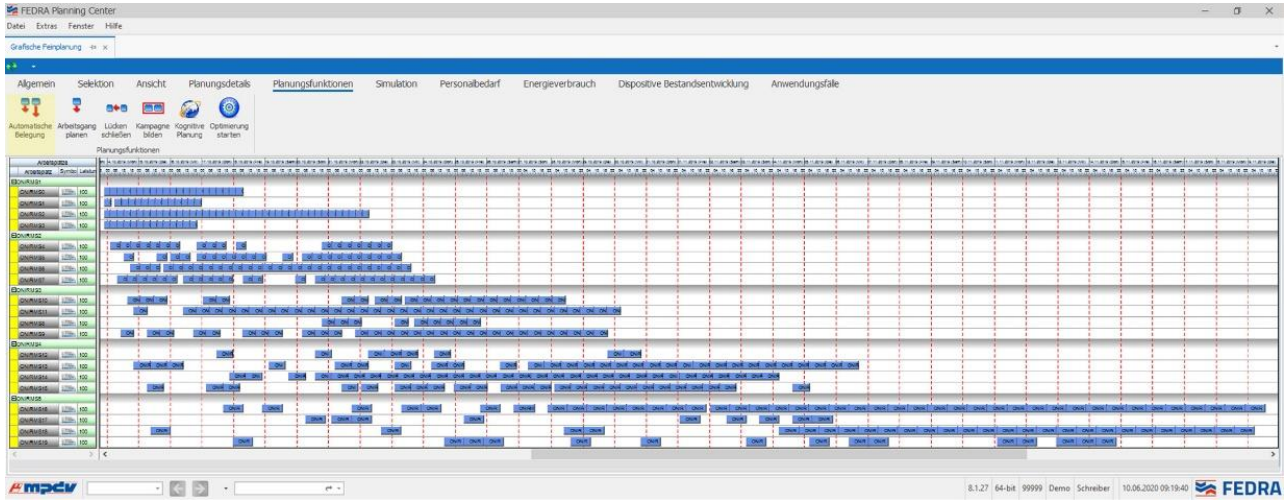
Approaches for Artificial Intelligence

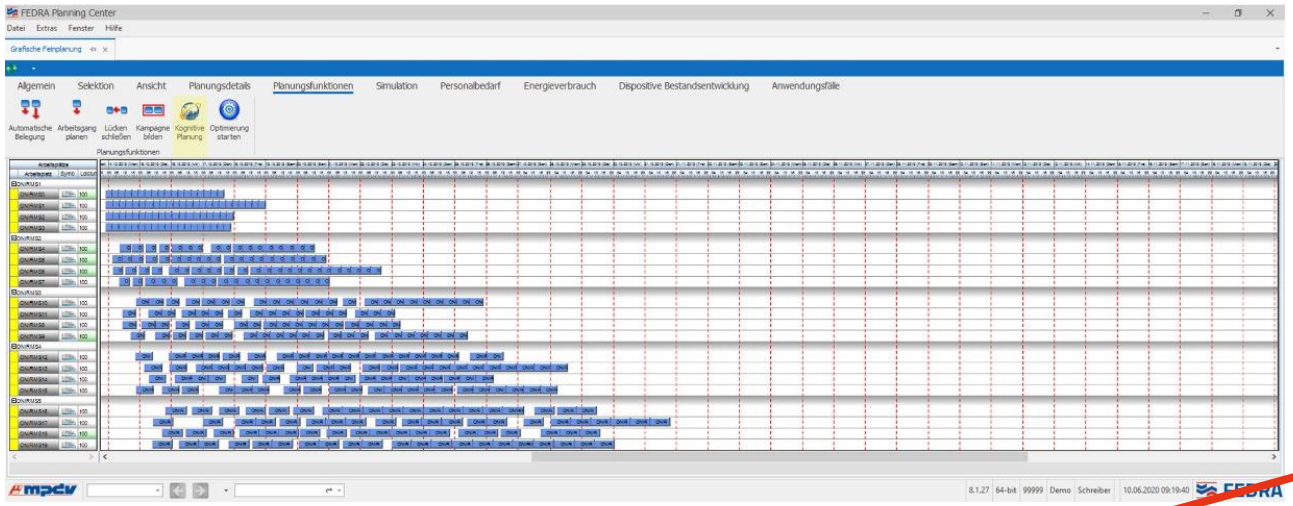
Until now, automatic production planning was based on heuristic methods. **Heuristics** only ever include the current step and make the **next best decision** based on this, which results that the supposedly worse options are not even considered.

Automatic production planning with artificial intelligence is a new feature. The AI method **Reinforcement Learning** takes a long-term view of planning scenarios, finds existing bottlenecks as part of several planning runs, and decides on the **best, overall option**. Once a decision has been made, it may also be changed again.

Benefits are apparent!

Heuristics vs. Reinforcement Learning





Heuristic planning (above) becomes gradually less efficient if there is a large amount of dependencies, because once a decision has been made, it can no longer be changed. This quickly leads to many gaps in planning.

AI-based Planning (below) takes a comprehensive view of planning scenarios and searches for a global best-case solution. The result is more efficient: orders are processed faster and with fewer gaps.

AI in Automatic Planning

FEDRA

APS FEDRA For AI in Planning

There are plenty of use cases in the **Smart Factory** for artificial intelligence.

With the **AI Suite**, MPDV offers a set of **standard applications** that can be **used straight away** without much effort.

AI stands for **Artificial Intelligence**

AI Out Of The Box

Manufacturing IT provides transparency in production today …

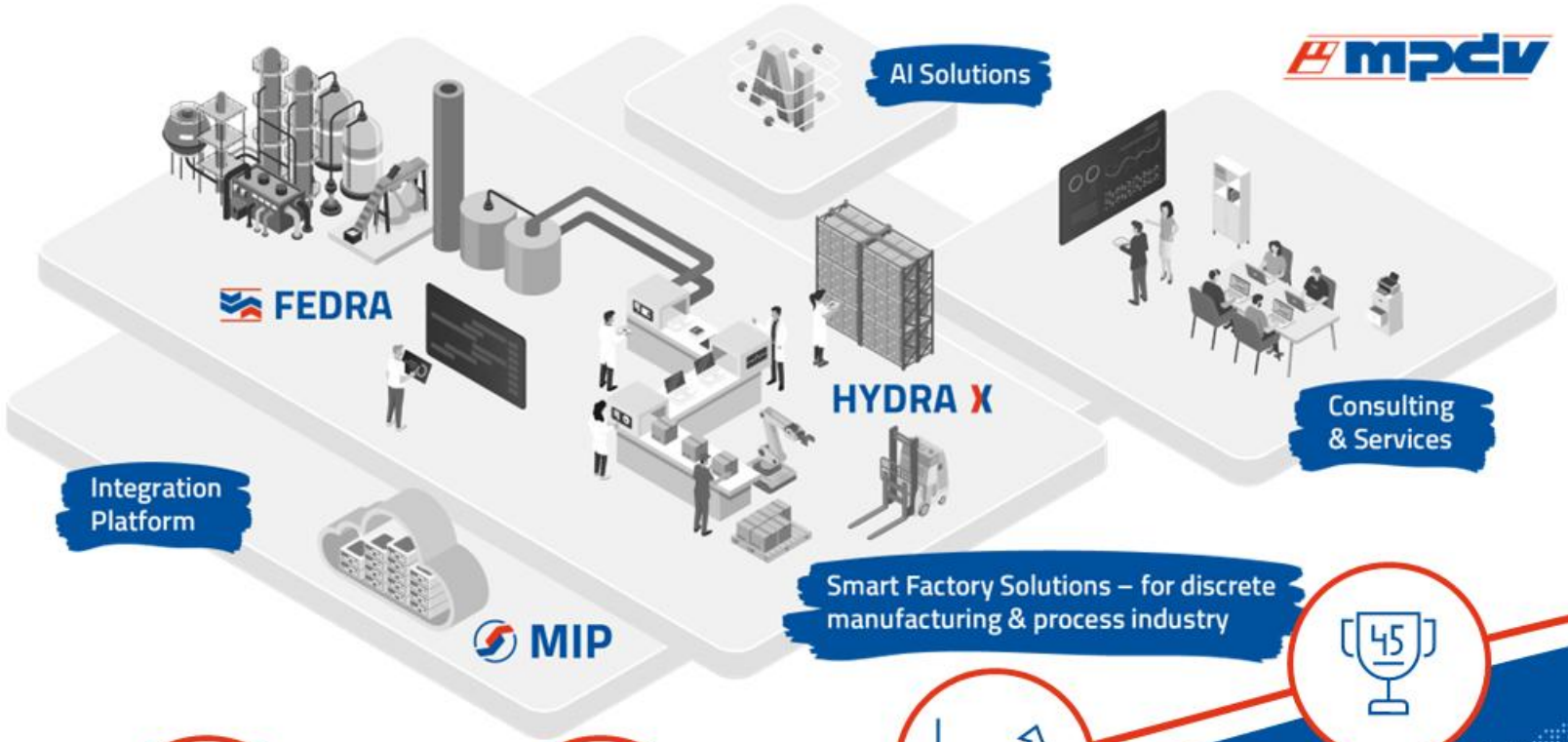
… **AI** will propose optimizations tomorrow …

… and the day after tomorrow **AI** decides autonomously.

Find out more about AI on our website.

Our Vision for the Smart Factory

About MPDV



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euros group turnover

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Would you like to find out more about artificial intelligence in the Smart Factory?

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