



Towards predictive insights in machining

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Why data extraction is gaining importance

Data extraction has become a recurring theme in production environments in recent years. In the machining industry too, there is growing interest in connecting machinery, making processes transparent and ultimately developing predictive applications.

In practice, however, this process rarely proves easy. The biggest challenge usually lies not in the technology itself, but in the choices companies have to make. What data will you collect? Why is that data relevant? And how do you translate measurement data into actionable insights for your production process?

A well-thought-out data strategy is therefore essential.

Do you want to understand better how to connect machinery and use process data to improve machining processes? Within the COOCK+ project, a technical document has been

developed to help companies make informed choices around data capture, monitoring and predictive applications.

[Download the whitepaper \(in Dutch\)](#)

Why machining requires a specific approach

Machining processes such as milling, turning and drilling are highly dynamic. Small differences in the material, fixture, tooling or temperature can have a major impact on:

- Process stability
- Product quality
- Tool life

Analytical models and CAM simulations help with process design. However, these models are still simplifications of reality; in a real production environment, anomalies often arise that are difficult to predict in advance.

Without measurements, these anomalies remain invisible. They only become apparent when problems occur, such as loss of quality, downtime or tool breakage.

Data extraction can help with gaining a better understanding of these underlying processes and detecting anomalies faster.

Measurement is not an end in itself

A common pitfall in digitisation projects is collecting data without a clear technical requirement.

Modern CNC controls already provide a large amount of information today, for example:

- Machine status
- Cycle times
- Load on shafts and spindles
- Alarms

This data provides valuable context, but also has limitations. Many signals are derived quantities and are filtered for machine control, not process analysis.

Adding extra sensors seems like a logical solution, but often creates new challenges. More data also means more complexity and more interpretation.

When companies collect data without a clear objective, a “data tomb” is created: a large amount of measurements that make little contribution to better decisions.

From business goal to technical demand

An effective data strategy therefore starts from the production process and not from technology.

Companies first formulate their objectives. In machining, for example, these might be:

- Higher machine availability
- Better quality control
- Optimisation of tool management
- Improving process stability

These objectives are then translated into concrete technical questions. Only then are the following determined:

- What process variables need to be measured?
- At what resolution is data needed?
- What measurement strategy is appropriate?

Not every application requires complex predictive models or high-frequency sensor data. In many cases, reliable monitoring is sufficient to detect anomalies in time.

The distinction between monitoring, diagnosis and prediction helps keep expectations realistic.



Architectures rather than isolated solutions

In practice, no single data source proves sufficient on its own.

CNC data, for example, provides context and continuity, while external sensors or smart tooling provide detailed information close to the process.

Successful implementations combine different data sources in a layered architecture, with each layer fulfilling a specific role.

CNC-native data

CNC controls provide basic information about the state of the machine and the production process.

External sensors

Sensors measure process-related signals such as vibrations, forces or temperature.

Smart tooling

Tools with integrated sensors can provide additional information about the machining process.

Industry standards and protocols such as OPC UA or MTConnect and initiatives involving umati support this integration. They become especially relevant when data across multiple machines or production lines needs to be combined.

From data to actionable knowledge

Raw data by itself has little value. Only when data is interpreted does useful knowledge emerge.

This is often done in two steps:

1. Feature extraction: relevant features are extracted from the data
2. Interpretation and modelling: the features are linked to process behaviour

Physically inspired models remain important here. They help to understand causality and maintain confidence in the analysis.

Data-driven techniques can offer additional insights, but are rarely a panacea in machining environments. Variability in processes and limited datasets make generalisation difficult.

Predictive applications can be valuable, for example for maintenance or tool changes. However, they require stable processes and sufficient context.

For many companies, the biggest gains for now lie in better process insight and more robust monitoring.

A realistic growth path to data-driven manufacturing

Data extraction in machining is not an all-or-nothing matter. Companies vary widely in maturity, machinery and scale.

A phased approach lowers the risk and increases the chances of success.

A typical growth path consists of:

1. Basic monitoring of machines and processes
2. Detection of anomalies and process monitoring
3. Analysis and diagnosis of process behaviour
4. Predictive applications when sufficient data is available

By working step by step, companies can build knowledge and create a solid foundation for further digitisation.

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