WHITE PAPER

How to Collect Machine Data with Edge Computing

The Essential Guide to Machine Data Collection

We Deliver Results In Productivity.

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We Deliver Results In Productivity.

FORCAM develops solutions and concepts for Intelligent Manufacturing. Recognized as the pioneer of the “Smart Factory”, we have the courage to create new technologies and thereby define standards for the future. We help manufacturers to remain competitive by achieving sustainable gains in productivity and optimize resource efficiency.

Every factory needs solid foundations

The Smart Factory needs a high performance IT infrastructure: Increasingly large data masses (Big Data) from heterogeneous machine controls, sensors and further embedded systems need to be collected and processed efficiently. They need to be accessible in real-time and available worldwide, in all languages on any smart devices.

Every factory needs solid foundations: The foundation of the Smart Factory is seam free machine data collection. Only precise machine data can be used for shop floor optimization: You can only improve what you can measure. The following white paper offers an essential guide to automated collection of machine data.

System architecture of the Shop Floor Management solution FORCAM FORCE™

Integration of production data in 3 main steps

Machine Data Collection should involve as little manual input as possible. Then the more automated data generated, the higher the data quality. Effort for manual data collection is obviously also reduced. Regardless of the machine control in question, there are generally 3 main steps to understanding machine data from the controls:

1. **Capturing Data**
2. **Importing data with specific software plug-ins**
3. **Interpreting and analyzing data**

Step 1: Collecting Data

To connect heterogeneous controls, FORCAM uses three methods for machine data acquisition. The selected method for connection depends on the machinery and the desired amount of information to be captured. The machine data connection (MDC) can be fully adapted as there is little room for error; the more data collected automatically, the better the data integrity and the less resources wasted for manual reporting:

1. **Signal recording with Ethernet convertor**

2. **Signal recording with advanced protocols**

3. **Signal recording with server**

Step 1: Capturing Data

1.1. Basic signal recording from legacy controls

Even machines with legacy controls can generate meaningful data. To achieve this, the installation of an “I/O- Ethernet converter” in the control cabinet of the machine is necessary.

The required analogue signals are output from the machine controller and converted into digital signals that are then output to the network via Ethernet. FORCAM connects to legacy controls via a fieldbus controller (I/O-Set). It is worth mentioning however that the amount of available signals is limited: “Machine on/off”, “Production / Stoppage”, “Quantity” and “Error”.

FORCAM / WAGO-Fieldbus Controller

Step 1: Capturing Data
1.2. Signal recording via advanced protocols

Newer machines come from the manufacturer equipped with communication processors and standardized communication software. Examples are Heidenhain's TNC, Siemens RPC or Fanuc FOCAS. With these controls, the data can be read directly from the machine and additional information and functionality can be provided. The collection of machine alarms, transfer of NC programs or queries on the current tool assignment are just a few examples of the various expanded capabilities. Plug-ins for most providers are available from FORCAM.

SIEMENS HEIDENHAIN FANUC

TRUMPF MAKINO TARUS

OMRON MORI SEIKI THE MACHINE TOOL COMPANY OKUMA

And more…

Step 1: Capturing Data
1.3. Signal recording with server

With modern machine connections, the data preparation can be completed within the facility. Each machine has an additional computer, usually a PC, which is able to run programs for data preparation, providing consistent data formatting. The data forwarding is now completed via Ethernet.
The system is universal, which is important, especially for international companies. IT managers are trained to organize integrated and efficient manufacturing systems, with open communication protocols.

Embedded processor in the controls

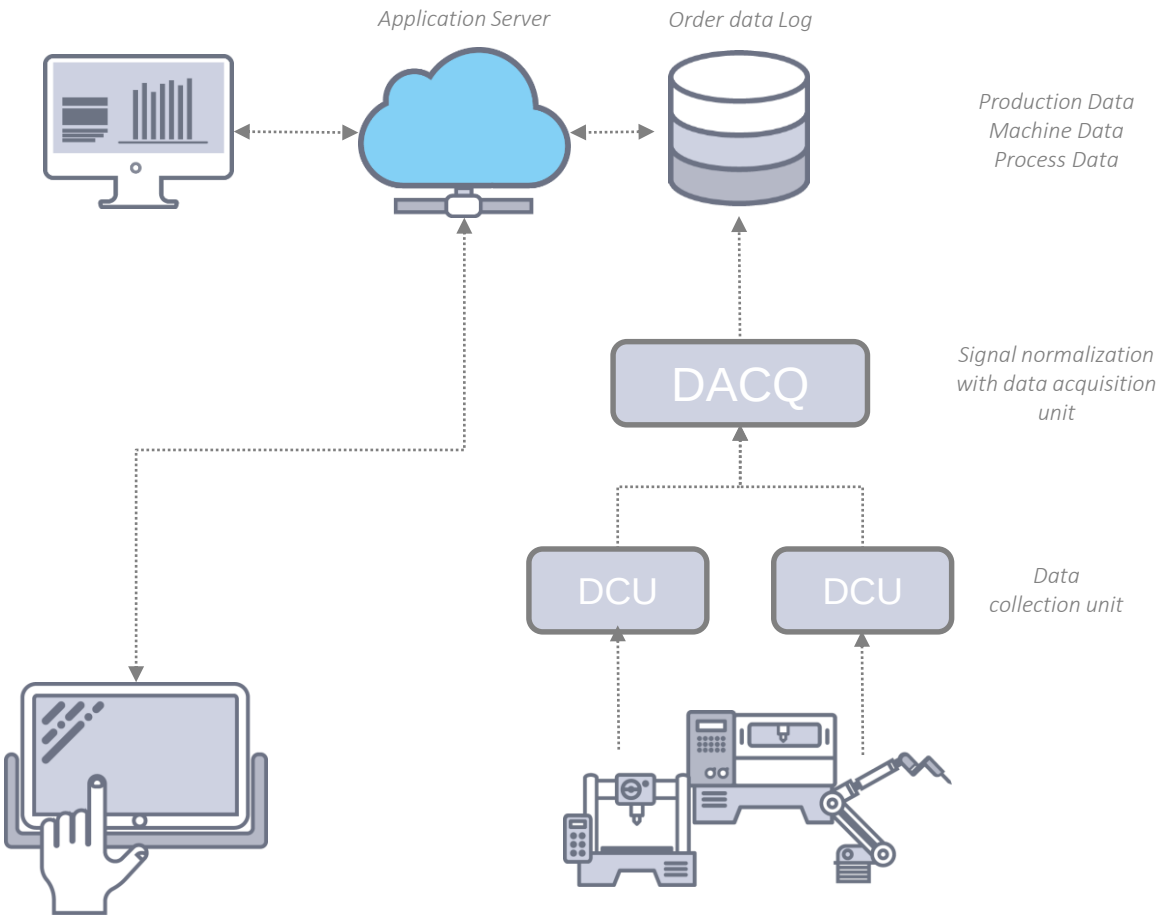
Serial Connection If the machine has a serial (RS232) port, a data exchange (DNC) can be completed using a COM server.

Step 1: Collecting Data
1.3.1 OPC, OPC/UA and MTConnect

OPC (Open Protocol Communication) has emerged as a standard machine interface protocol. OPC is freely configurable and solely regulates how two machines talk to each other (the syntax). Selecting which information needs to be communicated, is managed separately.

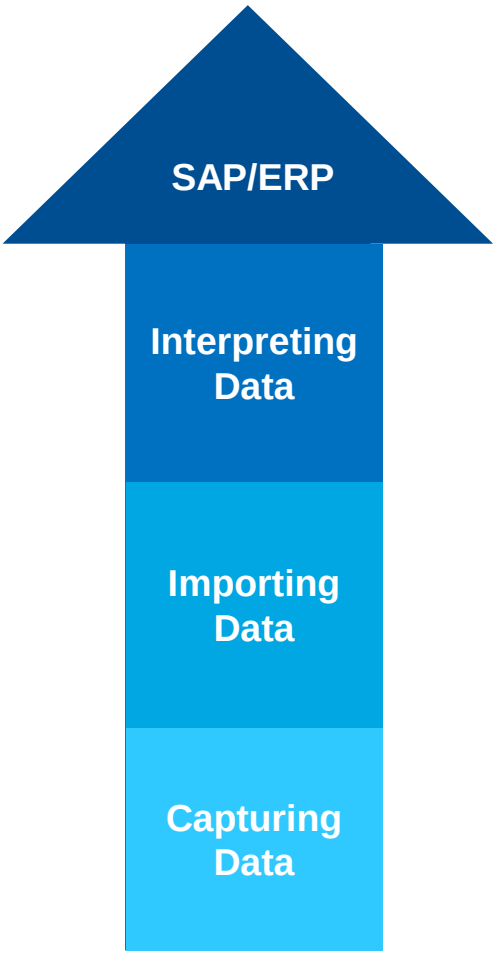
In terms of technology, MTConnect is comparable with OPC, however it is focused on “Communication with Machine Tools”. This solution has been widely distributed in North America and some industry leaders in Europe, including FORCAM as a technology provider, have begun using this royalty free standard. MTConnect links systems, applications, and entire factories with each other to provide an integrated overall manufacturing system. MTConnect was introduced by the Association of the U.S. manufacturing industry AMT - Association for Manufacturing Technology), which also sponsors an MTConnect Institute.

Step 2: Importing Data



Once signals are collected from the controls by data collection units, they are then processed and standardized in the data acquisition unit. Together these make up FORCAM Bridge. Bridge is similar to middleware between the machine and the server, and contains a library of plug-ins for specific CNCs and PLCs. Bridge ensures that only meaningful states are passed on to the server. FORCAM Bridge can process data from different machine controls simultaneously without having excessive requirements on PC or server hardware. It also contains a contingency function in case of data loss.

Step 3: Interpreting Data



Now, the collected data needs to be standardized to guarantee effective performance analysis. Logic blocks in the FORCAM rule engine combine various signals and additional information to generate operating states such as “Production”, “Set-up”, “Stoppage” etc. The collected data is thus independent per machine control type and can be compared with any other machine. The data can now be processed for further analysis.

We have created the foundation for shop floor management: Real-time data, in a standardized format, that can be compared and used for performance benchmarking.

What‘s next:
Data visualization and defining key performance indicators (KPIs)

This new transparency of standardized data alone is only the first step. The next step is to define company-specific performance indicators that can be used for analysis and performance optimization. The most common manufacturing KPI is Overall Equipment Effectiveness (OEE). In simple terms, the OEE figure needs to be feed with utilization, performance and quality data, and then used as a benchmark – a starting point for optimization. Now we can start identifying areas where we can optimize production, and then constantly track our improvements against the OEE figure, to ensure that we are making progress. Constant visualization of machine status and shop floor performance will keep the optimization process ever-present on the shop floor.

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FORCAM
we speak machine

If you cannot measure it,
you cannot improve it.
Lord Kelvin