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Technical article

Intelligent asset management in the field and in the cloud

While the tracking and tracing of high-value assets such as machining tools is not new, it can still present us with new challenges. More and more machinery and plant manufacturers want to send data to the cloud – but why actually and how? A holistic concept from sensor to data transport to cloud application helps to identify opportunities and to tackle new tasks quickly and safely.

The data-linked tracking and tracing of high-value assets subject to wear characteristics allows for the timely refurbishment or replacement after the specified period of use has expired. A classic example of this are tools in a machine or plant of discrete or continuous manufacturing or process technology. After a number of usage cycles N, the tool must be refurbished, and after a number of uses M > N, the tool reached the end of its service life and must be removed from circulation.

If a machine utilizes multiple tools in parallel and the exchangeable tool stock amounts to a few hundred tools, it quickly becomes clear that the manual recording of the uses is not only very time-consuming and therefore costly, but also potentially prone to errors. Here, the application of contactless and automatable identification technology such as optical identification of QR codes or electronic identification by means of RFID (radio waves) is recommended. The optical readers or RFID readers and antennas are installed at the appropriate points in the machine and fully automatically recognize which tools are installed. Further data in the form of useful life or wear-characteristic metrics such as forces, pressures, or temperatures can likewise be recorded.

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Identification technology from SIMATIC Ident offers the right solution for almost any application. The SIMATIC RF200 and RF300 RFID systems for short to medium reading ranges with especially small and rugged transponders are especially suitable for tool identification. If the distance between the tool and the reading point is long, the SIMATIC RF600 RFID system with its long reading range is appropriate. Heat-resistant transponders for use on metallic surfaces or in potentially explosive atmospheres are available for all systems. For sensitive tools, an optical marking, e.g., lasered on QR code, and reading with an optical reader such as SIMATIC MV500 is recommended.

All data is initially collected in the local enterprise IT; a storing in the cloud appears unnecessary at first glance.

The digital transformation

However, if you ask yourself the question of who has a legitimate interest in the data, a differentiated picture emerges:

machine operators need a virtual image of their tool stock at all times with the total number of uses that have already taken place and the number of uses since the last refurbishment as well as other sensor values. Ideally, a mathematical model describes the load-dependent threshold values for refurbishment and exclusion. For traceability and quality assurance, it is also recorded which product was machined with which tool.
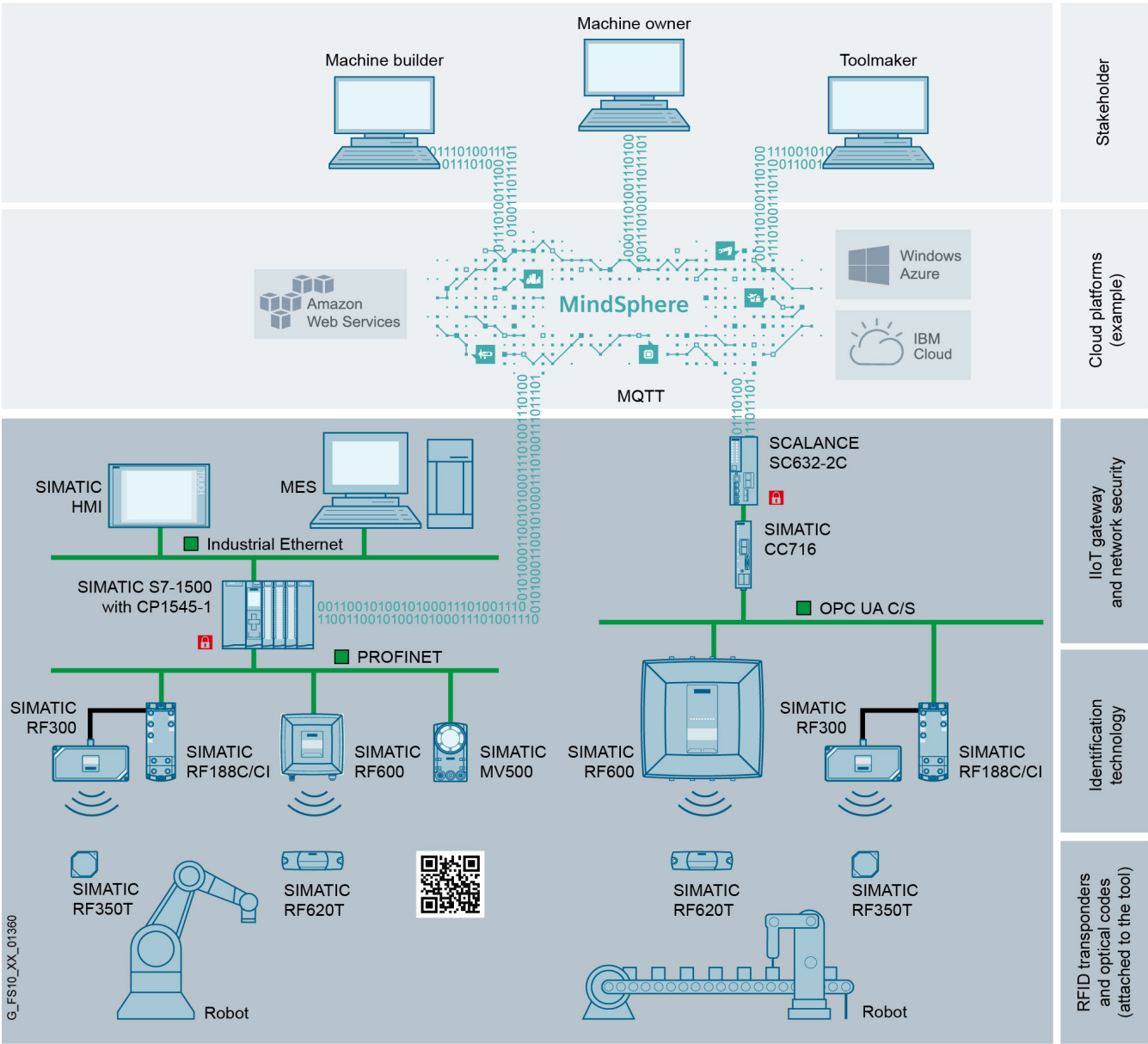
The transmission of the tool identification to the cloud enables the data to be shared.

If the operator runs other plants and it is worth to exchange tools between them, a joint stock and status overview across all plants is beneficial.

The machinery and plant manufacturers can have different interests in participating in the data exchange: together with tool making, they can provide the mathematical wear model. There is also an interest in the data to improve their own products. In this case, the data history is of value.

If informed in a timely manner about upcoming refurbishment inquiries, toolmaking and refurbishment staff – often the same company or the same in-house department – have the opportunity to optimize their processes and offer their services on better terms.

If you expand the circle of interested parties beyond the machine operator, it quickly becomes apparent that data retention in the local IT is reaching its limits. Storing and processing the data in the cloud lends itself here and allows data to be made available to different users. And there already seems to be a trend emerging here – according to the current market study Industrielle Kommunikation / Industrie 4.0 2020 by Michaela Rothhöft, created with the support of the German VDMA trade association for electrical automation, the use of the cloud is becoming more relevant: while currently only 15% of machine builders connect their machinery and plants to a cloud, 39% of machine builders intend to do so in the future.

But how does the data from the field level of a manufacturing machine get to the cloud via the local enterprise network and the internet? Which communication protocols have to be used for this? And who takes care of the necessary cloud application?

For the communication model, an architecture is being developed that is termed "digital connectivity." From a communication perspective, all devices are assembled into a network, the "Industrial Internet of Things (IIoT)".

Data transfer from the field to the cloud

As a reminder, the unique identification (ID) of the tool, time and place of use, and, if necessary, other values such as useful life, quality assurance data, or wear-determining metrics such as pressures, forces, or temperatures are captured. This data record must be transmitted reliably and securely from an OT (operational technology) network to the internet via an IT network and from there to the cloud.

Essential for the data transport are so-called IIoT gateways. In network technology, gateways are used for protocol conversion, in our case from a fieldbus protocol to a cloud protocol. The industrial gateway variant is especially adapted to the conditions in the industrial sector and convinces with its long-lasting and reliable operation. To meet the different customer requirements for cloud provider, the use of an IIoT gateway from the SIMATIC CloudConnect 7 series (CC712, CC716) is recommended which offers default settings for the most popular cloud providers during configuration. The product is also available as CP1545-1 communications processor for SIMATIC S7-1500. Mobile wireless routers, such as those from the SCALANCE M series, are suitable for points on company premises that cannot be reached by the LAN infrastructure.

The figure depicts the complete communication chain from left to right: SIMATIC S7-1500 controller, SIMATIC CP1545-1 cloud-capable communications processor, SIMATIC PM 1507 regulated power supply, SIMATIC CC716 cloud-capable IIoT gateway, SCALANCE M876-4 LTE / 4G mobile wireless router.

Let us assume that the fieldbus is an Industrial Ethernet distributed within the machine via Ethernet switches, e.g., from the SCALANCE family. In addition to a programmable logic controller, e.g., SIMATIC S7, identification devices, i.e., optical or RFID readers, here from the wide SIMATIC Ident product range, are also attached to it. Via a free switch port, the IIoT gateway can be integrated directly into the communication. From the data stream of the fieldbus protocol (e.g., OPC UA or S7 communication), the available data is filtered out and made available for selection in the configuration screen of the IIoT gateway. For retrofitting old plants, SIMATIC CC716 also provides a PROFIBUS interface. After just a few minutes, the desired data is marked and the transmission conditions (cyclically or upon value change) are configured. The cloud protocol – today usually MQTT – is provided preconfigured for different cloud providers and can be quickly adapted to your own cloud application.

According to the study, the amount of machine builders in Germany utilizing OPC UA has also increased considerably by more than 60% in the past three years. Many other companies are also planning to do so in the future. It is thus recommended to make sure to use devices that already support OPC UA – such as SIMATIC Ident and SIMATIC CloudConnect 7.

The cloud application

The question remaining is what happens to the data in the cloud. How is data collected, further processed, reported, and visualized? And above all: who creates the app?

Smaller companies may not have the resources or skills in their IT department to develop cloud applications using high-level, script, or design languages. Cost-effective "low code" options are available here – such as Visual Flow Creator and Visual Explorer for MindSphere, which are based on NodeRED or Tableau and make applications and dashboards from simple to medium complexity possible. Also interesting is Mendix, a "no code" tool that can also be used for complex applications with user interaction.

The "MINDBoard" cloud app by focus Industrieautomation GmbH can be adapted to the customer's application.

If you do not want to deal with cloud development at all, assigning this task to specialists is a good choice. One example is the "MINDBoard" app by focus Industrieautomation GmbH of Merenberg (Germany), a Solution Partner of Siemens Digital Industries. This company offers customer-specific apps for MindSphere and other cloud environments for the aforementioned and similar positioned use cases. The list of tools shown uses color high-lighting to indicate required mainte-nance or the exclusion of individual tools.

Conclusion

Siemens and partner companies deliver industrial-grade components for the networking of the field level with the cloud. Whether sensor, communi-cation infrastructure, or cloud application, suitable products and services are available. Only then can applications such as intelligent tool management be implemented in the first place.

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