MITSUBISHI ELECTRIC REALISES IOT WITH SAP.

On the way to Industry 4.0 and the Internet of Things (IoT), SAP and Mitsubishi Electric aim to close the gap between IT and production technology

OT meets IT

A massive obstacle to Industry 4.0 and the Internet of Things (IoT) is still the historic divide between the world of IT and production technology or Operational Technology (OT). Teaming up with SAP, Mitsubishi Electric aims to close this gap.

The integration of IT and OT is considered the key to the successful implementation of Industry 4.0. Information Technology accords top priority to the protection and confidentiality of data, while data availability is absolutely essential for production. With the connection of previously self-contained production systems to the Internet and with IT's new responsibility for the management and safeguarding of production equipment, the two sides need to come together in order to work productively and efficiently in the age of IoT – a challenge that Mitsubishi Electric and SAP are taking up together.

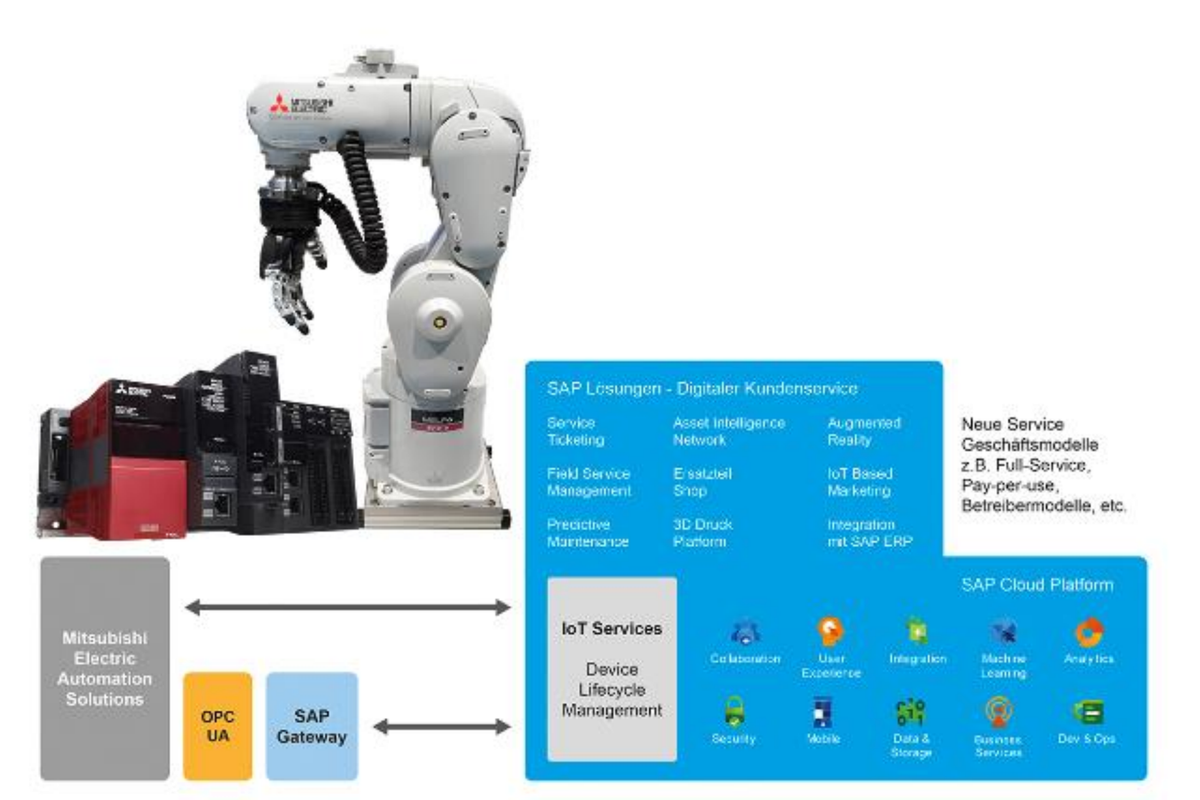
The progress already made in the coordination of production with the world of MES/ERP has been illustrated by a joint showcase at the last Hannover Fair. It consisted of a real robot cell with a 'digital twin' of the physical product in the SAP Cloud Platform. The digital twin enables the extensive analysis and usage of all plant and process data by both the manufacturer and the operator – via user-defined OEE dashboards and with the use of augmented reality for predictive maintenance.

But before the project could get off the ground, SAP on the IT side and Mitsubishi Electric on the OT side first had to agree on shared concept definitions in order to facilitate the merger of the world of automation with its PLCs, robots, motion controllers, and CNC controls with SAP's cloud.

Thomas Lantermann, Senior Solution Consultant at Mitsubishi Electric, cites an example: "When IT users wanted to read off the power consumption of the axes in 'their' real time, i.e. every second, the OT people couldn't help chuckling, because for them 'real time' means milliseconds. With scanning in seconds, the axis could theoretically always be at a standstill. The solution ultimately involved calculating a mean value in the OT environment."

Another key precondition for trouble-free integration is centralised data transfer to the IoT services of SAP's Cloud Platform. This prerequisite is satisfied by plant-wide transparency, i.e. all Mitsubishi Electric equipment as well as various other automation devices can be linked up from a single point in the network. This means that all data can be accessed from a central position in production, and data can also be easily exchanged with other components such as RFID readers, sensors and other control systems.

The special feature and a major simplification of the collective solution from Mitsubishi Electric and SAP is the direct link-up of production without further gateways. Mitsubishi Electric consequently uses a proprietary technology that bypasses Windows-based systems, which ensures, among other things, a high degree of cyber security for the plant. Alternatively, as practised by other manufacturers, the link-up is affected with a software gateway via OPC UA. Lantermann explains: "Like the web-service-based link straight from the Mitsubishi Electric platform, the OPC UA link comprises numerous certification, encryption and authentication options. However, further gateways are also an additional source of error, particularly if they are Windows-based."



Finally, the SAP Cloud Platform handles the efficient storage of very large volumes of data in a big data 'lake'. This memory then makes the data available to all applications and services in the cloud environment. Short-term data, such as the time series of the last four weeks, are deposited in an in-memory database to permit rapid access. Historical data, on the other hand, are managed in less expensive classical big data memories. Since SAP provides this as a service (PaaS), the user does not have to establish and operate any big data architecture in his own computer centre.

How production's IT link works

For connection to SAP, a structure is defined on Mitsubishi Electric's IQ Works programming platform for the data (Structured Data Type (SDT) conforming to IEC 61131-3) destined for the SAP Cloud Platform. For the showcase, 1000 readings were predefined; the size of the data structure, however, is freely selectable. Then all that has to be done is to parametrise the IP address of the IoT services and the login data (name, password) at the C Application Server communication interface. After this, data are continuously exchanged, typically every 500 ms. In principle, other data structures with different transmission intervals can be defined, with the event-controlled parallel transmission of single data being possible.

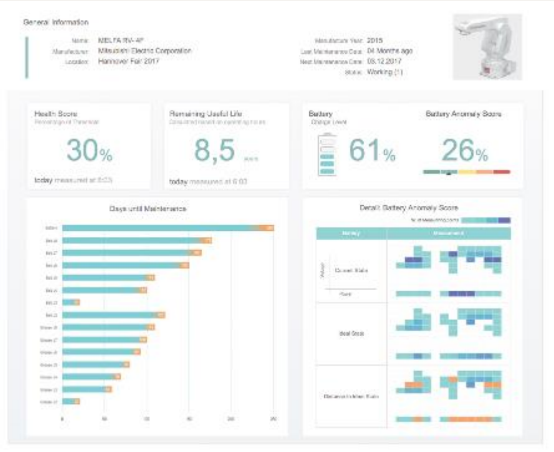
In the cloud this information is distributed among the various applications. The services available here comprise, among other things, analytical tools for the evaluation of error codes, machine learning services, development services for the cross-device development of one's own applications and integration services for local ERP systems. In the final step, the evaluated data are transmitted back in a predefined data structure to the automation environment.

The structures for sending and receiving data were specified jointly by the IT and OT teams. After this, the data structures from the various robot values, such as the position, energy consumption or SAP ticket number, were edited in the OT programming tool. The values can now be checked and visualised directly with the tools of the IoT services and distributed to the immediately usable applications.

The digital twin is finally the point at which all information on an asset– anything from the CAD data to life-cycle information – come together. This is where parameters, programs and libraries on the automation equipment can be stored as well. This way, automated data interchange from design through to simulation can be achieved. “Actually, the digital twin is old hat,” says Adrian Langlouis, Solution Architect, Discrete Industries at SAP. “Some manufacturers of intelligent devices have been managing the digital twin in their service modules for some time now, and plant operators use their maintenance module to define the maintenance intervals. Until now, however, manufacturers and operators have had a one-sided view of the processes in their own modules.” A modern digital twin, on the other hand, comes into being, says Langlouis, when information on the physical product is exchanged by all participants on a cloud platform such as SAP Asset Intelligence. This way, manufacturers, service providers and plant operators each obtain an individualised view of the plant.

For the manufacturer, the use of the digital twin is recommended in the asset network as a service portal where he can make available documentation, 3D models and maintenance instructions for the plant and establish self-service functions for the customer, e.g. the direct ordering of replacement parts by selection on the 3D model. For their part, plant operators obtain a unified view of the digital machine file and, if required, can create a service ticket directly in the customer portal and order replacement parts from the OEM or, for example, via an affiliated 3D printing marketplace from SAP. Optimisation potential from the manufacturer is also available via the latter channel – by dispensing with stockpiling and managing printable replacement parts, which are only rarely ordered.

Optimisation with predictive maintenance



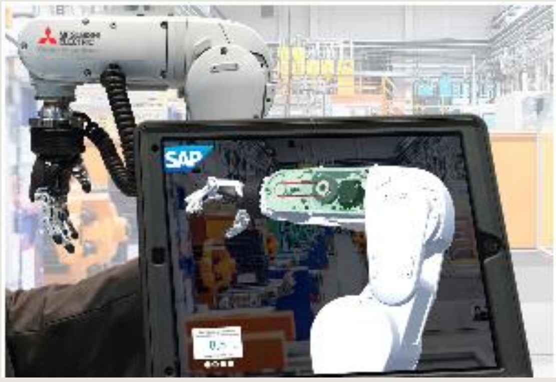
A central task in connection with Industry 4.0 is the analysis of historical machine data from the control and sensors in order to spot deviations and error patterns and exploit the acquired findings to monitor plant and to optimise maintenance cycles. The SAP Predictive Maintenance and Service solution firstly supplies the necessary data models and algorithms for training the models and secondly lays the foundations for the monitoring of plant with regularly calculated and visualised 'health scores' from which it is possible to deduce a plant's 'state of health'. Furthermore, integration in SAP's maintenance and service solutions is safeguarded.

Manufacturers with a multitude of machines of identical design in use on the customer site can create a particularly solid data basis for health scores by having a statistically relevant number of similar devices and either offer monitoring and predictive maintenance as a service, or make maintenance easier for the operator by making this externally available to him via the service portal.

In each case, this is a way to optimise maintenance cycles and cut costs considerably. As far as the data basis is concerned, maintenance for the operator and service for the manufacturer are nothing other than two sides of the same coin.

Augmented reality in maintenance

In view of the shortage of skilled staff in industry, service organisations or maintenance departments are hit hard when experienced employees retire or leave the company. A solution to this thorny problem is offered by the use of augmented reality (AR) for maintenance assignments. Visualising maintenance instructions step-by-step on a head-mounted display using a 3D model makes it possible to assign more complex maintenance tasks even to inexperienced employees. If support is nevertheless needed, an experienced technician can be consulted by video to assist the maintenance employee in his work on site.



SAP and Mitsubishi Electric have also addressed this subject in their joint showcase and implemented a suitable solution: the technician can point a mobile device, e.g. an industrial tablet computer, at the robot and sees the 3D model displayed in front of the physical object. The 3D model shows him which part has to be replaced and how he should proceed. A conceivable scenario would be for the robot to report autonomously when it needs maintenance. In SAP, measures are then initiated so that servicing can be carried out as efficiently as possible by a technician.

Equipment as a Service (EaaS)

Thanks to complete access to device data via the cloud and the use of newly created scope for remote monitoring, plant manufacturers can now position themselves as full service providers and ultimately handle the complete responsibility for plant maintenance and availability. While production companies can farm out unproductive activities in this way and thus concentrate on value generation proper, the manufacturer also benefits from customer loyalty and from the improved continuity and sustainability of its sales flows.
Taking the line of thought further, new business models can be developed on the basis of universal data transparency, i.e. abandoning the conventional sale of equipment. “I can see a definite business model where the operator perhaps no long purchases the plant because the investment is too high. Instead, he makes use of a service that is charged on a pay-per-use basis,” says Lantermann describing his vision. In other words, the customer receives a complete no-risk package with availability guaranteed under Service Level Agreements (SLAs).

The manufacturer retains the ownership of and responsibility for the machine or plant and charges his customers for performance or output on the basis of a metric. Already existing examples in industry are the number of printed pages on printing presses, hours of service of construction equipment and the quantity of compressed air consumed by compressors.

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