Leuze electronic

the sensor people

FIT FOR INDUSTRY 4.0 WITH SMART SENSOR BUSINESS 4.0

White Paper

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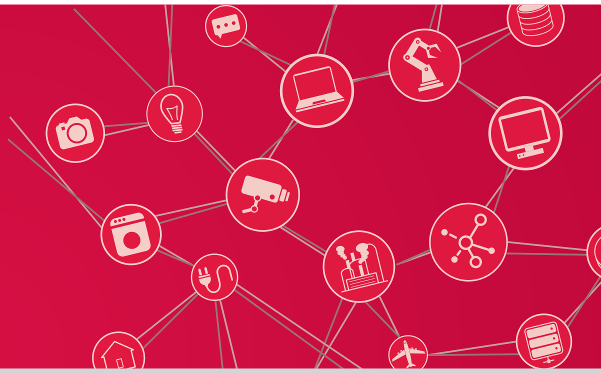
THE I4.0-CAPABLE SENSOR SOLUTION OF THE FUTURE



As leading innovator in optical sensors, Leuze electronic positions itself as the driving force and pioneer for the implementation of Industry 4.0
As sensor system manufacturer and with their connectivity competence, Leuze electronic deals intensively with the possibilities of Industry 4.0 on a daily basis, and considers them as opportunities for new business models. “The fact that process and diagnostic data from the field level is being passed to various levels right up to the control level is nothing new,” says Henning Grönzin, Head of Research & Development. Leuze electronic already offers efficient solutions for this, e.g. the IO-Link interface and integrated connectivity. “However, to achieve a far-reaching Industry 4.0 implementation, in the future we will need to meet the challenge of making data for control also available in the cloud.” The sensor becomes the enabler for Industry 4.0, the sensor system becomes the data source for service and big data applications. This is accompanied by an increase in data transparency, for which Leuze electronic stands with Smart Sensor Business 4.0 in order to achieve greater application utility for its clients.

Data plays a central role in Industry 4.0
With Industry 4.0 or IIoT, focus is primarily on data and the exchange of data across all system boundaries. Most of this data is generated with the help of sensors. For this reason alone, Leuze electronic is working intensively on the topic of Industry 4.0.
The fundamental job of a sensor is to record sensor data and to convey this data to the outside via the interface. With simple binary switching sensors, this is usually just one switching bit; with distance measuring sensors, an analog output is often used as the interface. In the case of absolute value encoders, the position information is generally transferred via serial interfaces, e.g. SSI. All of these interfaces, however, are only suitable for transmitting process data. In the long term, these interfaces will likely also be authorized for the transmission of process data. Additional and new protocols and interfaces via which data other than process data is transmitted will, however, come into play. Important considerations for a path towards Industry 4.0 are the topics of diagnostics, predictive maintenance, recipe changes as well as format changeover during the configuration of machines and systems during production operation. For this purpose, it is necessary to exchange diagnostic and configuration data with the sensor. To this end, the sensor must be equipped with communication interfaces via which the more complex data can be transmitted. Depending on performance requirements and cost, this can be a fieldbus interface (e.g. Profinet) or a standardized serial communication interface (e.g. IO-Link). The process data as well as the diagnostic and configuration data can be exchanged with the control system via these interfaces. The implementation of such an interface is one of the first steps toward greater data transparency and, therefore, is a step toward Industry 4.0 as well.

Is a communication interface already Industry 4.0?
An intelligent and standardized data interface is the prerequisite for high data transparency and thus, a basis for Industry 4.0. The interface alone is not enough yet, however, to be able to realize Industry 4.0 systems. The RAMI 4.0 reference architecture model of the Industry 4.0 platform provides a representation for Industry 4.0.
In this model, the properties of Industry 4.0 components are shown in three dimensions. One direction describes the lifecycle of the product. Data about the product, such as production data, data sheets,

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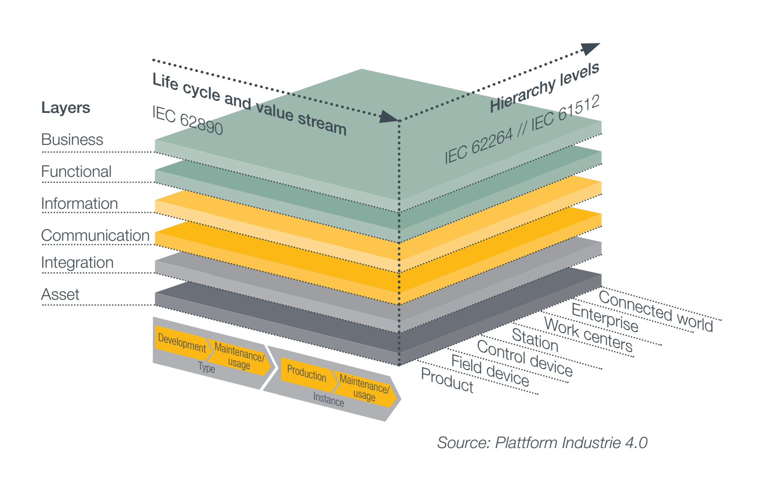
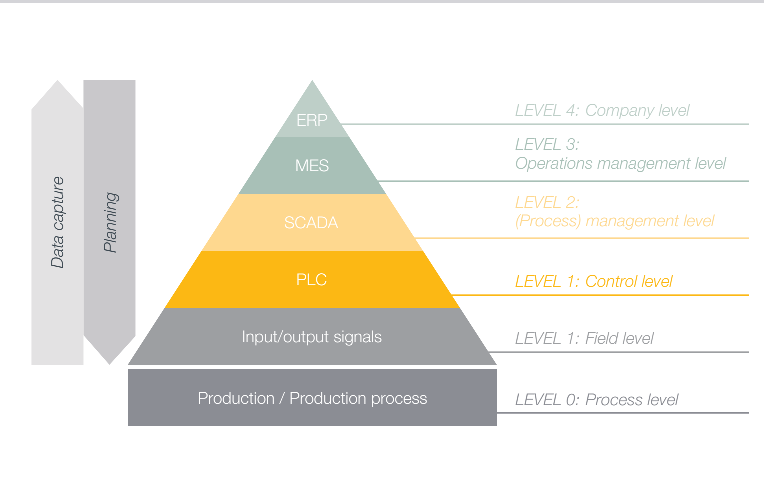


The reference architecture model of the Industry 4.0 (RAMI 4.0)

configuration data, etc., is collected here. Described in the next dimension is the IT representation. In the third dimension, a hierarchy is recorded. This is, in principle, similar to the familiar automation pyramid, expanded with the “product” item below the Field level and the Connected World item above the Company level. Located on the field level are the physical “assets,” such as sensors and actuators. These assets are also frequently referred to as “edge devices,” as – from the perspective of the data stream – they are located at the edge of the connected world.



The standard automation pyramid

Industry 4.0 components must be describable using the RAMI model. This means that a sensor (field device) must be able to exchange data across all levels of the RAMI model if it is to be used as a real Industry 4.0 component. This is something not possible for a sensor which only has an IO-Link interface or integrated fieldbus, since these interfaces communicate exclusively with the control, but cannot pass any data to the upper levels of the automation pyramid. One way to access an asset on the component level of the automation pyramid from outside of the control level is by implementing a web server.

The web server allows simple diagnostics without having to access the control. It also enables global access to the sensor. A web server can at present not yet be integrated in simple sensors, e.g. a contrast sensor. If, however, an edge device is equipped with an IO-Link interface, it is possible to realize this functionality via an IO-Link field master, such as the MD700i from Leuze electronic. The web server is integrated in the master and connects up to 4 IO-Link sensors to the control via a fieldbus, e.g. Profinet. At the same time, the web server allows communication across all IT levels and therefore simple global diagnostics. As a result, the island comprising multiple single sensors at the IO-Link master can again be described as realization of an Industry 4.0 system.

OPC UA as future communication standard

One of the most promising realizations of Industry 4.0 systems at present is certainly the use of the OPC UA protocol. OPC stands for “Open Platform Communications” and is a set of standards for industrial communication. It was developed between 1994 and 1996 under the name “OKE for Process Control” to exchange process data of actuators and sensors from various manufacturers with SCADA and HMI systems. OPC is based on the Microsoft technologies OLE, COM and DCOM. OPC UA – UA stands for “Unified Architecture” and is a significant further development of OPC which was initially made public in 2006 and since then has undergone continuous development. The big advance in the context of Industry 4.0 is that OPC UA was realized as a cross-platform implementation and, as such, is no longer restricted to Windows platforms. Rather, it can even be implemented in embedded systems, as are common in edge devices. Moreover, data based on

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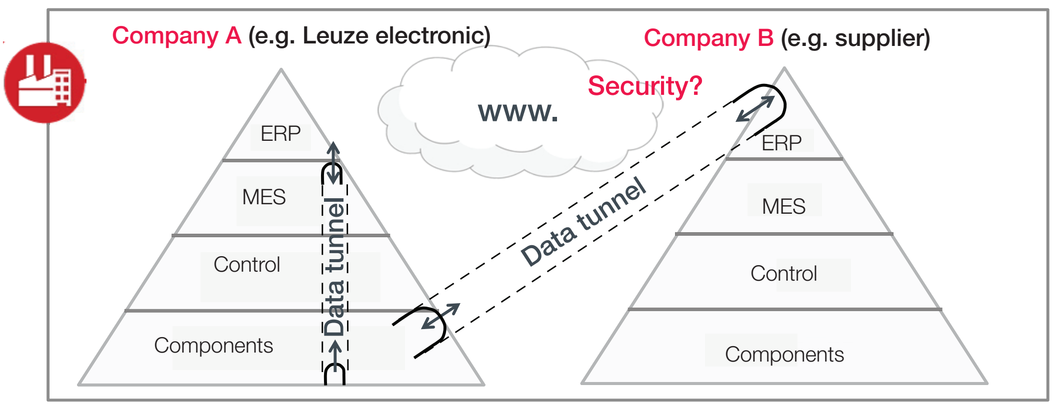
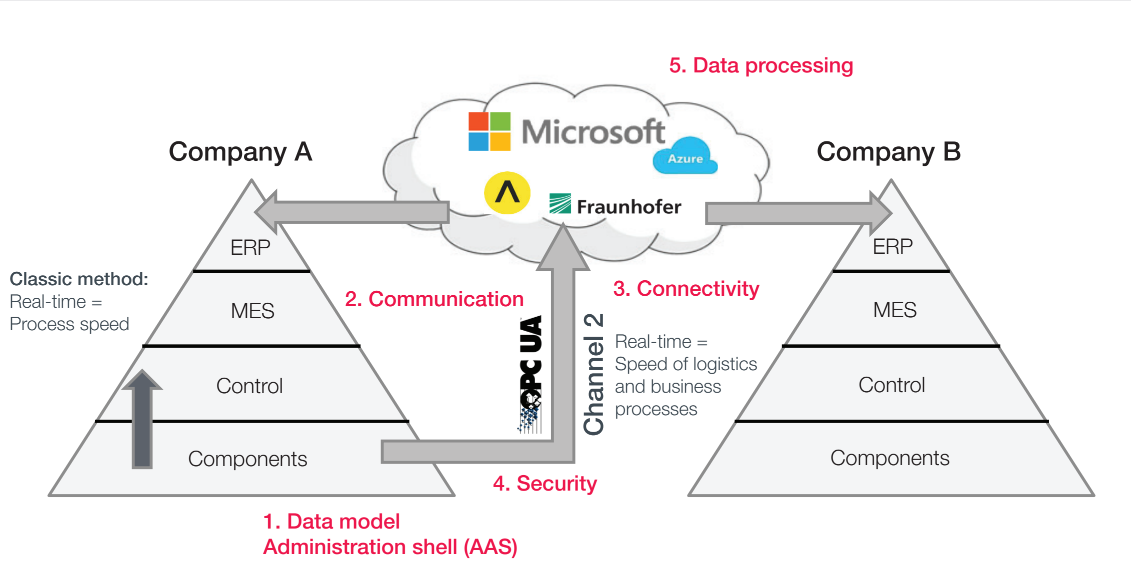
the OPC UA information model can be transferred using the OPC UA protocols via all Ethernet-based bus interfaces such as Profinet or EtherCat.

Furthermore, OPC UA includes a security implementation that consists of authentication, authorization, encryption and data integrity with signatures. As a result, OPC UA allows secure communication, which is not the case with the communication methods typically used in industrial environments. From the field level of the automation pyramid, OPC UA can communicate with higher layers (e.g. the ERP layer) via two different mechanisms. Either via client/server communication or via a publisher method. With client/server communication, an OPC UA server, which can supply data to a data recipient, is integrated in the data source. With the publisher method, an UPC UA publisher is integrated in the data source. This publisher can then make its data available to various data recipients. If there is more than one data source (sensor) in the system, the data recipient can decide which data from which publisher it is interested in. Thus, the recipient does not always need to accept the data from all publishers. Firstly, using this process, communication from m data sources to n data recipients is thereby possible. Moreover, a data cloud can retrieve interesting data directly from the data source. Communication is also possible in the reverse direction (from the cloud to the edge device), e.g. to facilitate software uploads or configurations. As a result, OPC UA can virtually “tunnel through” the layers of the automation pyramid and distribute data in the entire RAMI model. Thanks to the secure communication, even the exchange of data between different systems via public channels is conceivable. Because Industry 4.0 and IIoT stand for the exchange of data between capturing and operating units (sensors and actuators) across all system borders, OPC UA is an important part of Industry 4.0.
With the properties mentioned above, it is – from our perspective – one of the most important candidates for a future standard in machine-to-machine communication (M2M).

As the first manufacturer of edge devices, Leuze electronic, in cooperation with Microsoft, has shown that the complete technical implementation of the possibilities afforded by OPC UA is already possible today. With the BLC348i, Leuze electronic has presented a sensor that transports complex data directly to the Microsoft Azure Cloud parallel to a fieldbus interface for process data and a web server for diagnostic data. In the Azure Cloud, data can be analyzed and distributed for the purpose of, e.g. visualizing it on a mobile device. The reverse is possible as well: one can address a BCL348i from anywhere in the world, e.g. from a mobile device via the Azure Cloud.

What data is suitable for transfer via OPC UA?
In an Industry 4.0 environment, data from sensors can be divided into different categories. Particularly noteworthy are the aforementioned categories “process data”, “diagnostic data”, “configuration data” and “statistical data.” The categories vary considerably with respect to their real-time requirements: process data in highly automated processes, in which, for example, contrast sensors are used,





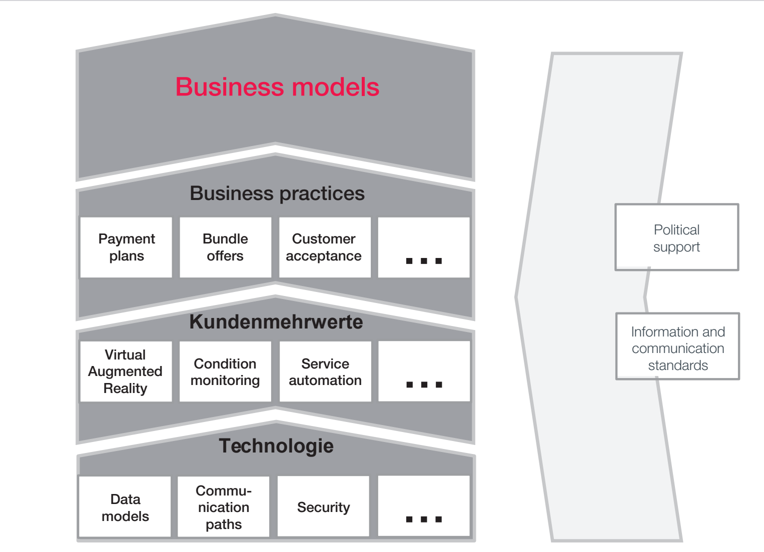
have real-time requirements in the sub-millisecond range. In contrast, process data in partially automated production, diagnostic data and configuration data have considerably less restrictive time-related requirements. On the other hand, statistical data cannot usually be captured quickly because data aggregation occurs, e.g. when drifting average values are captured.

Predictive maintenance

The latter is commonly implemented in "predictive maintenance" – one of the most frequent examples of potential business cases in the Industry 4.0 environment. The run-on of a turning lathe after it has been switched off could be used as an example: if the run-on becomes shorter, this may indicate bearing damage at the turning lathe. As a result, statistical evaluation of the run-on when the turning lathe is switched off can provide information on its condition. The type of data collection should not be confused with diagnostic data in the field level. With diagnostic data preimplemented diagnostic functionalities are addressed by machine components, e.g. self-diagnostics of a sensor. Owing to the strict time-related requirements which are necessary for logical decisions, fast process data will until further notice be collected and processed in the control environment. The passing of configuration and diagnostic data usually involves communication between a specific machine component (e.g. a sensor) and a machine setter or service personnel – i.e. very individual and direct communication. Access via a web server is recommended in this case. However, direct capture in an ERP system is recommended for statistical data and slow process data, e.g. the capture of a slowly changing fill level. Further Industry 4.0 actions, such as reordering or placing a service order, can then be triggered immediately from the ERP system. As OPC UA can directly transfer sensor and actuator data data to the ERP cloud, OPC UA is predestined for the transfer of such statistical data.

From the technical implementation to business models

The heart of Industry 4.0 is the expectation that new business models will arise from new technical possibilities. The provision of data within the overall RAMI model alone is not yet a business model. Above and beyond the technical implementation, it will be necessary to give consideration to the added values that thereby arise for customers. Many of these added values for customers will be industry- and application-dependent – others will be very general in nature. Among these is the often-cited "predictive maintenance." These vary greatly in term of use as well, however. The added value for customers alone is likewise not yet a business model. A business model involves considerations of which customers are willing to pay what amount for what added value. Also included here are considerations of what payment methods are offered and how the associated monetary transactions can be automated.



In most cases, the willingness to cooperate between various companies is very limited. It is therefore even more important for us to cooperate with similar-minded companies on the technology and customer-benefit levels and to generate additional and new added value by aggregating data from a wide range of sources.

Many companies fear a disruptive change of existing business models through Industry 4.0 – Leuze electronic views Industry 4.0 and IIoT much more as an opportunity and openly welcomes the new challenges.

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