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Forging ahead toward Industry 4.0

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Network provider Cisco has predicted that in the year 2020, around 50 billion applications will be connected with the Internet of Things (IoT). One aspect of this IoT is known as Industry 4.0. But Industry 4.0 is not a final destination to be reached. It is more of a process which is constantly developing.

In Germany, it is mainly the research institutions which are focusing on Industry 4.0, including the DFKI, the OWL Technology Centre and RWTH Aachen. The Innovative Factory Systems (IFS) research division at the DFKI (German artificial intelligence research centre) has created the Smart Factory KL demonstration platform, while the Ostwestfalen-Lippe (OWL) technology centre involves more than 170 companies and institutions, among others, on the subject of industry. At RWTH Aachen, more than 20 institutions are researching material and production technologies in conjunction with the Fraunhofer Institute and leading companies from manufacturing industries on the principles of a sustainable production strategy.

Many companies are now active in the field of Industry 4.0 as these days there is virtually no alternative: either you join in or you run the risk of no longer being competitive in the medium to long term. Although companies developing towards Industry 4.0 may need to change their business model, they would probably soon cease to be relevant in the market without this move towards Industry 4.0.

Within the framework of Industry 4.0, EBV Elektronik sees itself as a supporter of SMEs (small and medium-sized enterprises). EBV advises and suggests components or solutions to help these SMEs climb aboard the Industry 4.0 train, which is already travelling at some speed, and focuses on the companies wishing to develop components for use in line with Industry 4.0.

This article provides insight into the development and design of elements used in line with Industry 4.0, for example the design of an innovative new machine controller. In this context, the other side of Industry 4.0, i.e. the use of subsystems such as machine controllers, is not addressed as this is covered by conventional factory automation.

Time to market

In order to launch the final application quickly with a good time to market, the development departments need to be clear on where their core expertise and real know-how lie. There are now lots of hardware and software elements and development services which application developers can acquire off the peg. Efficient work also includes the intelligent use of standard components on both the hardware and software side.

For example, only very few developers would come up with the idea of developing their own standard (embedded) PC, because it is much quicker and cheaper to buy in an appropriate standard PC, processor board, etc. as a complete solution and use this as the basis for their own application. The process is similar in areas such as high-frequency communication (RF), security, etc.

As the relevant resources are not available for all elements in the companies doing the developing, the onset of Industry 4.0 has made cooperating with appropriate partner companies an everyday necessity. EBV Elektronik has a comprehensive network of partners to support its customers in searching for appropriate development partners.

Connectivity and interoperability at the RF level

In principle, Industry 4.0 is distributed intelligence by means of connectivity, and this means either wired or wireless communication is required. There are now various standards for wireless communication which can be developed using cost-effective microcontrollers. The requisite development tools are also available, and selecting the right controller with extremely low power dissipation means that sensors can also be battery-powered.

The many sensors used for recording variables such as pressure, temperature, humidity and mechanical load can sometimes communicate reliably with the higher-level system for several years on one battery charge. However, the battery life also depends on the wireless technology used, such as Bluetooth (low energy), Wi-Fi, etc.

Irrespective of which wireless technology is used, interoperability on the high-frequency side (RF level) must always be guaranteed. With its vertical RF segment, EBV Elektronik is positioned to recommend developers the right technology on a manufacturer-neutral basis, from chips through software to antennas. And the right security technology lays the foundations for a comprehensive security strategy as early as the RF level.

More and more often, wireless connections are being used for control systems, as by no means every machine in the field needs its own industrial display terminal. More and more often, (industrial) tablets are used which can connect to the relevant unit, visualise data and enable input as required.

The relevant communication between the machine and the tablet is mostly via Wi-Fi or Bluetooth, with an app running on the tablet taking on the function of a traditional control terminal. At the same time, the app can utilise the sensors for speed, position, acceleration, etc. integrated into the tablet (or even a smartphone), including the camera sensor.

If the available data is used cleverly, the resulting control systems can be remarkably innovative. EBV Elektronik supports newcomers and existing customers in recognising and utilising the relevant potential in line with Industry 4.0, even when it comes to wireless technology and control units.

Standardised communication using TSN

Essentially, EBV gives its customers all the jigsaw pieces they need to allow them to develop the relevant application. A good example of this is communication at the production level on the factory floor via the future communications standard TSN (Time-Sensitive Networking).

At the lower field level, data exchange has previously been via proprietary buses such as Profibus, Varan or Ethernet options such as Ethernet/IP, Ethercat, Ethernet Powerlink, Safetynet-p or Profinet. Experts are attempting to establish a communication standard for the level above the field level, the control level.

As factories involve multiple machines working in parallel which often come from different suppliers, communication between these proprietary buses was often complicated and involved gateways to enable at least a level of real-time communication. Each individual gateway requires additional work, which costs not only money but also development resources and at the same time involves a certain delay in the real-time communication and increases the complexity of the system. This gateway essentially translates from Profinet to Ethercat and from Ethercat to Sercos, etc.

In order to allow the universal use of different components, a consistent communications standard such as TSN is very desirable, especially as TSN also allows seamless communications in the upper levels where the Manufacturing Execution Systems (MES) work. Typical examples of MES are units such as PLCs (Programmable Logic Controller) and scada systems (Supervision Control and Data Acquisition). TSN is currently in the process of standardisation by the IEEE and has its roots in the automotive industry.

Because of the complexity of TSN, EBV Elektronik works with partners who can help support this standard. In conjunction with these partners, EBV also bundles components such as processors and switches together with the BSPs and the necessary software for its customers. This means EBV customers are able to develop their own TSN-compatible applications for an acceptable cost. In contrast to the high unit numbers for the major automotive OEMs, the production batches in the industrial sector are normally much smaller, so it would not be possible for the vast majority of companies to develop a cost-effective TSN solution without appropriate partnerships and tool kits.

Security, including data security

Of course, this virtually seamless connectivity is not without certain risks. The systems need to do

exactly what they are supposed to do in order to guarantee smooth operation. Security, which covers much more than just data security, is an absolute must to ensure hackers cannot manipulate processes or even take over control.

EBV Elektronik also sometimes gives recommendations when it comes to implementing security using cryptographic chips at a board level. For large-scale security strategies, it works with partners with specialist know-how such as Fraunhofer Institute. These partners then support the developing companies both on security analysis and recognising and removing any potential security loopholes. But one thing should be clear: those who fail to implement appropriate security measures can be pretty certain that malicious hackers will access their systems and create problems.

Five different elements of security are required. These are the fundamental aspects of authentication, data integrity and data security, plus the prevention of tampering and counterfeiting.

Authentication allows clear identification of system components. For example, it means the system can recognise that only authorised components are connected, such as drives, controllers or remote maintenance terminals.

Data integrity means protecting against falsification of data during communications. This aspect is primarily required as security for firmware updates from the Internet but also allows real confidence in the sensor data supplied.

Data security covers encrypted data communication through the use of technologies for encryption and decryption.

Anti-tampering is manipulation protection for a device. In the event of manipulation, the system automatically deletes the relevant security keys so that the manipulation can be detected.

Anti-counterfeiting is no more than protection implemented into the hardware and software which saves specific keys in a cryptographic chip. The device only works when the keys in the crypto-chip and in the software match. Among other things, this keeps a handle on the problem of overbuilding (unauthorised production of additional devices over the agreed sales unit numbers) for made-to-order manufacturers.

Real potential

Industry 4.0 opens up a whole wealth of new potential that companies should capitalise on to develop new business models to enable them to continue to be successful in the global market. Those that fail to tap into this potential will allow other companies to muscle in on their turf. Industry in Europe, in particular, is currently at a crossroads, as Industry 4.0 is not a question of whether, but a question of when and who.

Many small and medium-sized companies do not have the requisite engineering, IT and development resources to cover all aspects of Industry 4.0. As an example, many medium-sized companies admit they have no experience with the programming of apps. Central European companies in particular could achieve a great deal by thinking in a new way, as there is no need to be constantly reinventing the wheel. American and Chinese companies are mostly considerably more flexible in this respect, as they integrate the technologies of different service providers and companies into a new application. This can lead to what are known as disruptive business models.

Achieving targets through partnerships

A company working in automation has its core expertise in automation; this is the company’s specific IP. But communicating via high-frequency wireless connections (RF) is not part of the core expertise in automation. Buying in the relevant standard elements allows high-performance systems to be developed within a short space of time.

It is a strategy chip manufacturers have been pursuing for a long time, using processor cores from ARM, for example. Only a few semiconductor manufacturers can differentiate the processing cores themselves, through the whole system they create around one or more processing cores based on their system know-how. The number of ARM processors installed is now very high and a very attractive market has developed for the manufacturers of the relevant development tools. Users of chips can benefit from this selection of tools available from a technical and pricing perspective.

In the same way as the chip manufacturers do not develop 100% of every element of their chips, there is potential in many other areas to rely on specific external elements to accelerate the completion of the end product. These days, IT resources can be hired or leased so that there is no longer a need for lots

of hardware in-house.

Various companies are now offering secure cloud services. As, for example, data security is a key element of the business models of companies like SAM or IBM in secured cloud services, it would be massively expensive for a medium-sized company to achieve the same level of security that these system providers can offer virtually off the shelf.

One of the secrets of the success of Industry 4.0 is therefore the specific, targeted use of external resources, and EBV plays an active role in brokering these resources, although semiconductor distributors make no revenue from the production of contacts of this kind. EBV sees this added value as a means of customer loyalty as an investment into the future, as it can only be successful if its customers are. The first successful applications often come onto the market just two to three years after the beginning of the project.

EBV's partners include various Fraunhofer Institutes, including Fraunhofer AISEC in Garching which deals with security, or the Fraunhofer IOSB-INA institute in Lengo which covers other issues such as TSN and OPC-UA in line with Smart Factory OWL, or various other partners who write software and BSPs (board support packages) on behalf of the end customers.

This means EBV Elektronik positions itself as not just a supplier, but a valuable partner at the concept and design phase. If a company is working with a third party which cannot deliver a planned project despite prior consultation because they do not have the know-how and/or the necessary manpower or financial stability, projects can be massively delayed. At the same time, customers often talk to EBV about what business models to consider for the future solution, as there are often various options in line with Industry 4.0.

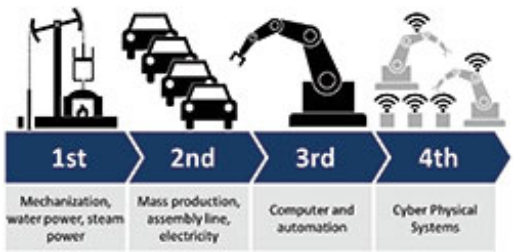
On the other hand, EBV and its development boards often provide a good introduction to the subject. A good example is the Sokrates board which demonstrates the capabilities of FPGAs from Altera. Sokrates is more than just a development board, it is a complete reference design which enables, for example, security functionality to be implemented for the individual application quickly if specific software is used from EBV's partner Wibu Systems.

Interesting for small companies too

Earlier, companies needed to be a certain size and have a certain number of employees in order to play an active and decisive role in the industrial market. In line with the IoT and Industry 4.0, the Internet and the new tools can also be used to help small companies with, for example, 15 employees to launch highly attractive products which would previously have required a company with around a thousand employees. The communication tools and apps make it possible to get a very fast footing in the global market with a great product.

Industry 4.0 – What is it about?

It was at the Hannover Industrial Fair in 2011 when the term 'Industry 4.0' entered the public domain for the first time, and just two years later the government of Germany presented a final report to the Hannover Fair entitled 'Implementation Recommendations for the Future Industry 4.0 Project'. In principle, Industry 4.0 is about the digitalisation in three key areas of German industry: production, mechanical engineering and automation.



The four industrial revolutions. Credit: Christoph Roser, www.allaboutlean.com

Fourth Industrial Revolution

Industry 4.0 is essentially the fourth Industrial Revolution: after mechanisation came electrification (introduction of conveyor belts) and the introduction of the computer, and now the Internet is moving into factories in line with Industry 4.0. It is all about Cyber-Physical Systems (CPS), which are physical

systems that work mechanically, electromechanically or however, and also utilise new potential thanks to the Internet.

Remote maintenance

A classic application of Industry 4.0 is remote maintenance, which makes it possible, for example, to maintain a massive printer in Australia from Germany. The subject becomes more concrete in conjunction with augmented reality. This means that the engineer on-site puts on special glasses (e.g. Google Glass) and the system projects images onto the glasses to show him exactly which screws to open in which order to repair the machine.

Down to batch sizes of 1

At the end of the day, the aim of Industry 4.0 is to combine the Internet and CPS to make manufacturing more efficient and more flexible to enable even batch sizes of 1 at affordable prices. It will be possible to manufacture machines individually, in the same way consumers can now mix their own muesli online.

Cost savings

This means massive cost savings as experts do not need to be sent on expensive long-haul flights for every little detail. If, for example, a machine delivered from Germany to New Zealand can monitor itself and notice that, for example, a particular element could fail within the next three months, there is the option to ship the relevant spare part economically by sea and save on the massive air freight costs for heavy machine components.

Networked delivery processes

In line with Industry 4.0, not only maintenance and production but also delivery processes can be interlinked with one another via the Internet so that the manufacturers can communicate transparently with their suppliers and their suppliers' suppliers. If the above machine in New Zealand indicates a defect which may occur in the medium term, the manufacturer can automatically order or commission the relevant component from its supplier or supplier's supplier.

Increased quality

The variety of sensor data available in line with remote monitoring/remote maintenance means that manufacturers are also able to evaluate the data on various similar machines systematically in order to draw conclusions about the causes of any failures or interruptions. After a comprehensive analysis, constructive measures can be taken to improve the quality and longevity of future products.

Industry 4.0 platform

The government of the Federal Republic of Germany has even set up an Industry 4.0 platform whose members include the VDMA, the VDE and industrial companies. This platform primarily deals with standardisation issues.

Jobs

There are various claims that Industry 4.0 could potentially lead to job losses. Exactly the opposite is the case, as without Industry 4.0, there is the very real risk that industry in Europe would lose touch, as without Industry 4.0 new players from Asia and America could take over the current core markets of German and European industry. However, there will be movement in terms of the quality of jobs, as Industry 4.0 requires more highly qualified personnel and fewer with no skills or on the job training.

In consumer electronics and telecommunications, Europe has already had the painful experience of the consequences of a whole industry moving away. So it is particularly important that industry in Europe actively grabs the opportunities available, and EBV Elektronik supports its customers to get its products going along the route to Industry 4.0 in order to preserve and expand (highly) qualified jobs.

Global activities

Activities relating to Industry 4.0 are not only in Germany, but all over the world. Similar initiatives include Smart Factory (the Netherlands), Usine du Futur (France), High Value Manufacturing Catapult (Great Britain), Fabbrica del Futuro (Italy), Made in China 2025 (China), Basque Industry 4.0 (Spain), Smart Manufacturing Leadership Coalition (USA) and Industrial Internet Consortium (USA).

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