Interview with Dr. Olaf Sauer

Trends in shopfloor-related ICT systems

Features of shopfloor-related IT or manufacturing execution systems are and will remain indispensable even in Industrie 4.0. Pragmatic persons, however, repeatedly wonder what development trends will appear in the automation pyramid and how shopfloor-related IT systems will be enhanced in the future. Unternehmen & Trends talked to Dr. Olaf Sauer, Head of the Automation Business Unit at Fraunhofer Institute of Optronics, System Technologies and Image Exploitation (IOSB) in Karlsruhe, Germany.

Everybody is talking about options and perspectives of Industrie 4.0. What are the major trends in terms of changes to the ICT architecture of shopfloor-related systems, as reflected in this projection of the future?

Sauer: The existing levels of the well-known automation pyramid are likely to disappear, which is why a new information model for Industrie 4.0 is required. The basic technologies responsible for the disappearance of the automation pyramid include, first of all, the Internet of Things, cyber-physical systems and embedded systems. Generally speaking, these technologies imply that all levels of the existing automation pyramid are consistently supported by internet technologies and the associated standards. This ranges from the applied communication technologies such as TCP/IP, on the one hand, to the level of individual sensors and actuators, which has been made possible by the standardization of IPv6 and globally unambiguous resource identifiers, e.g., the Uniform Resource Identifier (URI) of the world-wide web. Increasingly intelligent devices that have their own communication and data processing capacities ensure that some MES features, e.g., the calculation of key performance indicators, can be shifted to the machine level. IP compliance on embedded systems converts simple devices into internet nodes capable of networking themselves and of communicating and exchanging data with other participants.

Further basic technologies include big data and in-memory databases. In the field of today’s ERP systems, efforts are being made to gain direct access to online data from manufacturing processes, to process it and to generate business-relevant information on this basis. In-memory databases promote this trend by providing the speed required to process large volumes of data.

Last but not least, there is IP-based communication. Real-time ethernet for industrial communication allows ethernet, which is being used in the office environment anyway, to be extended to the field level, thereby creating a consistent physical communication structure for the first time. Real-time ethernet is thus an enabling technology for flexible and consistent data exchange.

Today’s MES systems seem to have a rather monolithic structure. Are there changes to be expected in this area?

Sauer: We can make out a clear shift towards service-oriented architectures. New providers of shopfloor-related IT systems on the market directly follow the paradigm of service orientation when designing their tools. In this context, the following major architectural components can be distinguished: Applications (apps) with their own user interfaces which do not have any or very limited data storage capabilities themselves can be used on mobile devices. MES services are units with a specific function and unambiguous input and output parameters. Services may provide one or a combination of several functions. The Manufacturing Service Bus enables services to communicate with each other. This service bus is one of the core components of the future service-oriented architecture and serves as an integration layer enabling interaction between the services. These components can already be found in today’s MES systems, yet they have been customized to the relevant supplier. As yet, there have been no service buses which allow MES services from various software providers to interact without any manual programming. Integration services are indispensable to connect MES services with machinery, equipment and other components of the factory. The ultimate objective of service orientation has to be the combination of services from multiple suppliers, ensuring that users get a true best-of-breed solution.

What options result from cloud computing?

Sauer: The basic idea behind cloud computing is that processing capacities, ICT systems and their functionalities do not have to be installed locally with the user; rather, they are provided by a remote computer center on demand. To this end, the cloud provider (public or private cloud) maintains a complete cloud infrastructure. On the basis of this infrastructure, MES suppliers provide their services. Relevant studies have shown
that cloud services are already available for PLM and SCM features, for evaluation and reporting functions and, in part, for quality, warehouse and transportation management.

How realistic is the vision of flexible, adaptive production, allowing for the automatic recognition, management and implementation of changes to the factory, for example?

Sauer: Current trends indicate that the process of planning and setting up a factory, its machinery and equipment and the associated components will change substantially in the future: Equipment will be composed of mechatronic components consisting of three-dimensional geometry, kinematics and logic, i.e. parts of control programs. These smart components ‘know’ their capabilities and ‘know’ the equipment to which they can be added. They may even change the configurational settings on their own in order to adapt to the manufacturing task or the production equipment to which they have been added. Against this background, the vision of adaptive production is realistic because physical and logical adaptivity will complement each other.

What are the preconditions for this kind of adaptivity?

Sauer: First of all, one important precondition is security, ensuring, for example, that unauthorized participants or devices cannot be added to the production line. To meet this requirement, the Federal Ministry of Education and Research has approved a research project aimed at developing PLUGandWORK mechanisms with integrated security consistently on the basis of specific demonstrators using standards that are freely available on the market. Another precondition is standardized communication ranging from the embedded system to the MES. In addition, the standardized description of the capabilities of equipment plays a major role. To this end, features and capabilities are stored on the very equipment itself. In parallel to physical integration, they can be accessed by the control system directly using an interface. Equipment suppliers identify the information required for this purpose in advance and include it in the components by means of a standardized description, which can be exported from machine control or a higher-level MES system and interpreted in the correct way. The physical and informal integration results in a considerable reduction in time-consuming manual work during initial set-up, maintenance and changes to production.

Condition Monitoring supports new strategies for maintenance and repair of equipment. What trend can you distinguish and what are the consequences for future MES systems?

Sauer: Instead of simple, corrective maintenance, there is a trend towards systems that anticipate maintenance and propose further action. In the last few years, industry has defined various application scenarios for these new approaches and identified scope for improvement. These new potentials are based on information about the process which is captured by field devices. The increasing availability of “intelligent” field devices results in a trend towards more and more instrumented processes. The existing functionality of machine intelligence suggests that future MES systems will provide features for condition monitoring, diagnose and decision-support, allowing operators of machinery and equipment to ensure availability in a timely and specific way.

What opportunities does the trend triggered by Industrie 4.0 open up for MES suppliers?

Sauer: MES suppliers can extend their know-how to other fields of application. In the area of production and its suppliers, there will be an increasing amount of software-based services. A lot of MES suppliers have many years of experience, allowing them to support providers of production systems to specify and implement software-based services. This is particularly true when suppliers of machinery and equipment wish to offer MES features, e.g. machine intelligence, in addition to the products they provide.

What new technologies will support human-machine interaction in the future?

Sauer: Rather than screens, keyboards and mice, gesture and language recognition and other new technologies will be used on the shop floor in the future. This implies that today’s fixed points in manufacturing will disappear, including the terminals to provide feedback on processes, to report quality results or to visualize machine states, for example. They make room for more natural and intuitive human-machine interfaces that are nevertheless appropriate for the harsh industrial environment.

Thank you very much for your time.