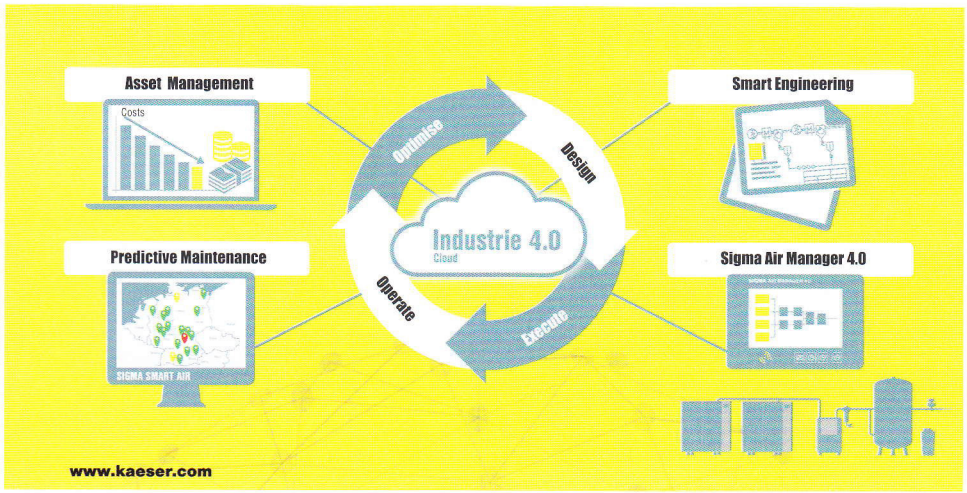
The Engineering of Things

by JOHANNA KIESEL

The topic of Industry 4.0 is now established worldwide: From the German initiative 'Plattform Industrie 4.0' via the Chinese one 'Made in China 2025' to the 'Industrial Internet Consortium' of the Obama-Administration in the US; but it has only been embraced selectively by companies. While increasing numbers of executives are recognising the opportunities of the digitalisation, networked production processes, many of them still need substantial clarification, even in terms of the question as to their consequences for engineering.



Kaeser Kompressoren evaluates Aucotec's EB for holistic predictive maintenance scenarios. ***The diagramme depicts its end-to-end Industry 4.0 approach for the food & beverage sector as to demonstrate at upcoming drinktec fair in Munich, Germany*** *(September 11 to 15)*

Pictures(2): Kaeser

The Internet of Things (IoT) ensures a change in roles for plant designers and operators. The future Industry 4.0 reality will involve autonomous, learning devices and components. Will there be parental instructional instances? Will it involve central controls which query, process, and forward information? This will be a thing of the past to some extent at least if machines and products operate independently with each other.

Thus plant operators are relinquishing responsibility, while developers are obtaining it. They need to design self-sufficient systems which will respond flexibly to changing situations and communicate independently with each other. This requires mechanisms which ensure that a production station operates safely and reliably, but without excessive regulation. This is because it is impossible to anticipate all future situations of all (even self-sufficient) components involved. Control systems are becoming analysis tools. Their effectiveness depends on how well they correlate the incoming information to the correct devices and functions and interpret it.

Reinhard Knapp

Picture: Aucotec

Requirements: Best of both worlds

On the one hand, the plant must be aligned with the analysis system, for example, for predictive maintenance; on the other hand, the requirements for the engineering of devices have greatly increased, especially for those that move freely. The design of increasingly more intelligent subcomponents, with more and more sensors and actuators, places the highest demands on data and change management. Since components are grouped together hierarchically into self-communicating 'organisms', it is also essential to be able to design their engineering in a function-oriented manner in larger contexts.

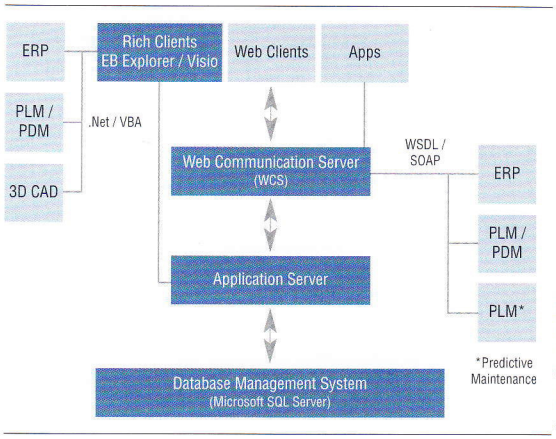
Consistently networked

"As a rule, only really consistent, networked engineering with minimal system disruptions will be able to meet future requirements. Holistic machine and plant models, which include multi-disciplinary metadata throughout the entire lifecycle, are essential," Reinhard Knapp, Senior Product Manager with Aucotec AG (Hanover, Germany) emphasises.

The vendor has been developing CAE software for over 30 years. The history of one of the first database-driven, function-oriented systems, the Engineering Base (EB) platform, started some twelve years ago. It links design processes in the wire harness design of mass-produced vehicles as well as in the design of satellites, special-purpose machines, power grids, or chemical and other large industrial manufacturing plants.

Mr Knapp knows that, in addition to central data storage, engineering has to meet very specific challenges posed by Industry 4.0. They include the customisation of products and production (theme 'lot size 1') under mass production conditions, networked production processes with central monitoring and handling huge amounts of data that cannot be managed manually ('big data'), for example, from communication between machines and products or IT applications.

Lot size 1 has long been an issue for engineering. "It is almost impossible to find two identical plants in engineering. Of course, their designers also claim to achieve this customisation as efficiently as possible, thus under mass production conditions," the product manager explains. The same applies to mechanical engineers. They want and need to meet individual customer requirements with the highest possible degree of standardisation. "The more In-



System architecture of Aucotec's Engineering Base (EB)

dustry 4.0 is incorporated in the projects, the more necessary standardisation is becoming because the complexity is increasing enormously. This can be accomplished only with sophisticated modularity approaches and easy-to-use modular systems," Mr Knapp says.
With EB, which was developed on the basis of decades of experience both in boosting efficiency in plant and mechanical engineering, the virtually unlimited upward component diversity of plants as well as all variants of the maximum equipment of a machine (entire design space approach) can be easily compiled. Reusable function-based templates – so-called 'typicals' – constitute the efficiency-generating aspect of standardisation. The number of templates is reduced by a unique, centrally managed variant and option management.

Networked mode of working with central changes

Each engineering stage of each user is stored in EB's central database and is visible immediately for all the other project stakeholders. Manual revisions, multiple inputs, and thus multiple sources of error are eliminated. The underlying data model is a decisive advantage for change management in particular as it is edited centrally at one point, but appear immediately in each of the often multiple representations of the objects. "Thus the time-consuming search for object duplicates is eliminated. This accelerates change processes immensely," Mr Knapp says. Sophisticated management of change also ensures easy traceability and comprehensibility throughout the entire documentation chain. "You can safely forget the ever-present risk of forgetting subsequent changes, confusing revision levels or failing to check a new status," the product manager calms down.
Thus IoT-compliant, networked mode of working remains consistent and clear. All users involved can always see the up-to-date status of the ongoing project, and this applies when using EB's Web Communication Server regardless of where and how the user has access.

Engineering with no limits

The vast amounts of data resulting not only from the plant complexity, but also from communicating machines and products or from status analyses for maintenance are regarded as another hallmark of Industry 4.0 – EB's answer: A system architecture with a database underneath that is infinitely expandable in principle and openness providing the ability to embed not only your own engineering data, but also heterogeneous information sources directly connected to the design process or via hyperlinks.

Next generation of predictive maintenance

At Hannover Messe (Hanover Trade Fair) in 2016, Aucotec was the first vendor demonstrating a configured solution for predictive maintenance. In this show case, EB acted as single source of truth by providing both a predictive maintenance and control system including all relevant data. The close connection was only possible because EB can map abstract objects, e.g. subordinate measured variables which are not included at all in circuit diagrams or P & IDs. In order to calculate optimised maintenance intervals based on as-is data and to be able to report an impending breakdown, the predictive management system must first understand that the value x to signal y indicates, let's say a certain pressure on a certain sensor and not a temperature. "Aucotec's solution enables to obtain its engineering knowledge directly from EB. This information previously had to be read in via various interfaces and lists that had to be compiled laboriously – a mammoth task for often 50 000 or more control system signals!" explained Product Manager Knapp.

Conclusion: Data quality pays off

The platform provides universal efficiency which takes into account significantly more aspects of the lifecycle of machines and capital projects than conventional ECAE systems. As the origin of all plant data and also as the source for downstream processes such as for predictive maintenance, investing in data quality pays off in several respects, and is more necessary than ever in the age of Industry 4.0!

Aucotec has over 30 years of experience in developing engineering software for the entire lifecycle of machines, plants, and mobile systems. The portfolio ranges from flow diagram generations via control and electrical engineering support for large-scale plants to modular harness design solutions in the automotive industry.

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