Interview with Dirk Kordtomeikel, Business Manager Wind Energy

The winds of openness blow in all directions

In 2011 the wind energy sector contributed around 14 % to the total turnover at Beckhoff. In an interview with Inge Hübner from the openautomation magazine, Dirk Kordtomeikel refers to the openness of Beckhoff automation solutions – not only with regard to other technologies and manufacturers, but also with regard to system changes – as a recipe for success. The intention is to open up further applications in the wind enrgy sector on this basis.

In the year 2011 Beckhoff generated a turnover of around 65 million euros from the wind energy sector. This amounted to around 14 % of the company's total turnover of 465 million euros. "This is absolutely top performance among providers of automation technology for wind turbines," said Dirk Kordtomeikel and continued: "In 2011 we equipped wind turbines with a total capacity of 11.2 GW with our controllers. This corresponds to an impressive market share of above 25 %." Meanwhile there are around 20,000 wind turbines around the world in which Beckhoff technology is used.

A large proportion of the turnover from the wind energy sector is generated in China. Since the market there went sour last year, Dirk Kordtomeikel expects a reduction in Chinese wind industry turnover of 40 to 50 million euros for 2012. Currently countries such as India, Brazil and Germany are beginning to make up for the sluggishness of the Chinese market. The projects that were successfully implemented in China provide a tail wind. "We look back on a number of good references in China. This has a positive effect on our activities in other countries and regions," said Dirk Kordtomeikel.

However, it isn't just the Chinese wind market that is experiencing difficult times at present, but the wind industry worldwide. Dirk Kordtomeikel describes the current situation as follows: "The market for renewable energies – be it wind or sun – is currently struggling with overcapacity. In addition many countries are heavily indebted, so that subsidies were cut. In the US, for example, the PTC – the law in support of renewable energies – is being phased out. Moreover, wind farms are regarded as large projects, which banks are currently reluctant to finance due to economic uncertainties. An additional obstacle is grid expansion. In this and many other areas politicians have a duty to set the right course for the future."

Notwithstanding the current uncertainty in this segment Dirk Kordtomeikel is convinced that the market will pick up again, because: "In many countries the phase-out of nuclear power is a done deal. Energy generation from fossil fuels, which is associated with high CO_2 emissions, has no future either. One of the main alternatives in the medium to long term is wind energy."

Innovative technology ensures competitiveness

From a technical point of view Dirk Kordtomeikel describes the situation as positive. "Thanks to a range of technical improvements we have reached a point at which wind-generated electricity is no longer more expensive than the purchase price. Further technical innovations will favor this development." Examples from an automation specialist's perspective include optimizations in Condition Monitoring, faster and more cost-effective communication solutions for wind farm networking, pre-wired field solutions and improved load management.

In all these areas Beckhoff uses openness as a recipe for success. At the core is the scalable, PC-based automation solution. Its key elements are TwinCAT on the software side, EtherCAT as the high-speed communication medium and the EtherCAT I/O terminal system, through which different functions can be integrated in the controller. Openness towards other manufacturers is provided through a large number of interfaces. According to Dirk Kordtomeikel this PC-based approach offers cost benefits for wind customers compared with conventional solutions. "In conventional systems dedicated controller units are used for operational management, Condition Monitoring, brake control, obstacle light, etc. PC-based automation technology offers powerful control options for combining all components of a wind turbine on a single platform. In all these cases the EtherCAT I/O system enables further terminals to be integrated in the nacelle without the need for further CPUs. On the software side this is mapped via TwinCAT. The customer benefits in terms of fewer components, simpler infrastructure and lower overall costs. Since the installation has fewer systems, its availability increases and its diagnosability is improved significantly," Dirk Kordtomeikel summarizes.

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For Dirk Kordtomeikel EtherCAT is an absolute highlight. He is convinced that "There is no better bus system for the wind energy sector than EtherCAT." Key features are its speed, impressive transfer characteristics, simple design, and the availability of copper-based and optical cabling media. It offers benefits not only in each individual wind turbine, but also for overall wind farm networking. The industry expert explains the situation in a wider context: "The international grid codes prescribe a number of measures for grid stabilization. The background is that the further expansion of intermittent renewables makes the grids less stable. One of the countermeasures on the converter side is LVRT (Low Voltage Ride Through)," said Dirk Kordtomeikel. However, based on his sales experience he knows that wind farm operators have additional requirements. For example, they demand response times of 200 ms to enable fast responses to voltage drops and the like. "Standard TCP/IP technology is not suitable for this purpose," he said. Real-time Ethernet protocols enable high-performance wind farm networking. "There are solutions based on real-time Ethernet with which response times of 20 ms have been realized. With EtherCAT these values can be improved further," Dirk Kordtomeikel said.

Real-time wind farm networking based on real-time Ethernet basically enables data exchange between the individual wind turbines. The data points of substation, transformer station and weather mast are integrated in the wind farm network. Alternatively, the communication with the higher-level wind farm master computer takes place based on EtherCAT and has redundant networking via standard components.

"Compared with traditional wind farm networking EtherCAT offers considerable cost and speed benefits," said Dirk Kordtomeikel, summarizing the benefits. "Modern wind farm networking is based on optical fiber technology. The lines

are Ethernet-compliant and are therefore also suitable for EtherCAT so that the existing line network can be used without additional cost and effort. In addition, EtherCAT also meets the demand for cable redundancy. Here too, interfaces to other bus systems ensure openness. All these benefits are available to the operator at a lower price than with alternative real-time Ethernet protocols," the sales expert concluded. The first wind farm networking projects using EtherCAT have already been implemented, for example with Dewind.

Fast wind farm networking

EtherCAT also provides the basis for fast data communication within a wind farm. To this end an additional power measurement terminal and a network monitoring oversampling terminal are available. The EL3413 power measurement terminal has voltage inputs for up to 690 V AC and electrically isolated current inputs. It is designed for direct monitoring of high-performance generators, such as the devices used in wind turbines. "For voltages up to 690 V the upstream connection of a voltage transformer is no longer required, which saves additional costs," said Dirk Kordtomeikel.

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The mains monitoring terminal EL3773 is used to monitor the state of a three-phase AC voltage system. For each phase, voltages up to 288 V eff. and currents up to 1 A eff. are sampled as instantaneous values with a resolution of 16 bit. "The six channels are measured simultaneously based on the EtherCAT oversampling principle with a temporal resolution of up to 100 µs and passed on to the controller. The controller has sufficient computing power for true RMS or performance calculations and complex custom algorithms for the calculation of voltage and current curves," said Dirk Kordtomeikel. "Through the oversampling principle the terminal is able to measure at significantly shorter intervals than the cycle time of the controller. The EL3773 supports distributed clocks and can therefore measure synchronously with other EtherCAT devices."

These terminals, which are integrated in the modular automation system, enable the detection of voltage drops at the feed-in point at an early stage so that appropriate action can be taken more quickly. A voltage drop at the feed-in point can be reported in the whole wind farm network within less than 1 ms. "EtherCAT utilizes the distributed clocks which are integrated in each device. In a wind farm networked with EtherCAT it is possible to synchronize all measuring values and control settings within a timeframe of less than 1 µs," said Dirk Kordtomeikel and explained: "The fast transmission characteristics of EtherCAT enable voltage and frequency control across the whole wind farm." There are further benefits, such as LVRT: "LVRT has to do with pulsing of IGBTs in individual converters. The question is: Why not pulse all IGBTs for a whole wind farm from a central location?" This would be feasible in principle, although it would require all frequency converter manufacturers to cooperate. "The fact that many frequency converter manufacturers who are active in the wind energy sector are members of the EtherCAT Technology Group means that their products already feature an EtherCAT interface, which is advantageous for us," he said.

Openness in practice with Condition Monitoring

In addition to the terminals already mentioned, the EL3632 EtherCAT Terminal is also of great significance for the wind energy sector. It is used to integrate Condition Monitoring functionality in the control solution. The corresponding data are preprocessed with TwinCAT. The data can then be transferred to higher-level diagnostic software for further analysis via an open communication interface such as OPC UA or ADS. This is another example of Beckhoff's openness towards providers outside the company's core competence. Customers benefit from integrated solutions. "However, we don't intend to offer customers from the wind energy sector an all-in-one solution," said Dirk Kordtomeikel. Instead, our strategy is to offer automation technology that provides the data required for comprehensive CM. Specialized monitoring and diagnostics of the relevant parameters in the wind turbine is left to dedicated CMS providers."

Dirk Kordtomeikel regards Condition Monitoring for wind turbines as an important issue that will become even more important in the future. "The first large 'CMS-boom' was triggered when condition monitoring systems became obligatory for offshore systems. Further impetus was provided by the enhanced Chinese quality requirements, which came into force in 2012. They stipulate that each Chinese wind turbine above a certain size must have a CMS," he said. However, he points out that currently there is no common understanding of this term in the market. "Condition Monitoring is often equated to monitoring of the gear unit. Almost all traditional CMS suppliers also include the main bearing and the generator in monitoring," he said, based on his experience. However, Beckhoff takes a more comprehensive approach, based on which, each CMS would increase the overall availability of a wind turbine and not just that of

the individual components. In terms of the automation solution with integrated CMS, for Dirk Kordtomeikel this means: "The signals for Condition Monitoring should be monitored synchronously with all other signals. In this way a much larger data pool becomes available that can be used for Condition Monitoring of the whole wind turbine." He is convinced that this approach and the Beckhoff components provide unique selling points in the marketplace.

According to the wind industry expert there are currently around 15 to 20 relevant CMS suppliers in the wind energy sector worldwide. Beckhoff has already had fruitful discussions with some of these specialists to drive developments based on Beckhoff technology. "For system operators such an integrated CMS results in cost reductions of up to 80%," he said. The associated overhead is low. The benefits for system operators are clear, but why should a CMS supplier, whose solutions also tend to include hardware, be interested? Dirk Kordtomeikel: "Approx. 70% to 80% of the turnover associated with a CMS is generated by software and related services. The hardware only accounts for 20 % to 30 %, although it offers differentiation potential, resulting in a certain price war." Many smaller CMS suppliers see the open Beckhoff solution as a business opportunity. "The CMS manufacturer tailors its software to the Beckhoff hardware and continues to earn money by offering associated services. The prospects of the company increase thanks to the benefits which the integrated solution offers to the operator," Dirk Kordtomeikel said.

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Openness in practice for Scada

When it comes to Scada systems, the automation specialists take a similar approach towards manufacturer openness. TwinCAT essentially provides a software tool for convenient creation of individual visualization solutions. Openness towards suitable providers is offered for advanced Scada solutions. "Here too we have contacts to the relevant manufacturers, with whom we generate optimum solutions for the customer," said Dirk Kordtomeikel.

He summarizes the overall strategy as follows: "In all areas where we don't have the required specialist expertise, we invite manufacturers to join in our success by offering solutions based on our technology."

The unique selling points

These examples illustrate the attitude from Beckhoff regarding openness. "This approach was and continues to be our recipe for success with machine builders. We transferred this to the wind energy sector, where it is equally successful," said Dirk Kordtomeikel.

As a further Beckhoff USP in the wind energy sector he mentions realization of the complete application, including circuit diagrams for the control cabinets, control cabinet prototyping and subsequent commissioning. "Once implemented, we transfer the project to the customer complete with all documentation and application source code, etc.," he said.

Application-specific IP 67 EtherCAT Box

As a further EtherCAT system innovation Beckhoff presents an application-specific EtherCAT Box in protection class IP 67. Dirk Kordtomeikel commented on the background to this development: "Each wind turbine has brakes, a hydraulic system, a generator and usually a gear unit. These components are generally provided by subcontractors. After delivery they are installed in the nacelle on-site, and the sensors and actuators are subsequently connected in the control cabinet. Our idea is based on offering a pre-wired IP 67 EtherCAT Box for each of these subcontractors." In addition he explains that each of these components supplies between 8 and 15 sensor and actuator signals which have to be collected in the field. "This is now achieved via the new EtherCAT Box. The gear unit manufacturer, for example, can install it directly in the gear unit and deliver it as an integrated unit to the turbine manufacturer. All the turbine manufacturer has to do locally is establish the fieldbus connection and connect the power supply," said the industry manager. Advantages include reduced errors, transfer of liability to the specialist component suppliers, clearer responsibilities and reduced on-site efforts.

Conclusions

The course for Beckhoff's future in the wind energy market has been set. The automation specialists intend to expand their focus with new approaches and open up further fields of application. "This won't compensate the current slump in the wind sector, but it will leave us in a good position, not least for gaining new customers," said Dirk Kordtomeikel. As a result of the 'wind crisis' the specialist expects increased willingness to analyze and test new technologies. In parallel he expects new technologies to make renewable energies more controllable and to take them another step forward.

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