Fig. 1: The One-Click Dashboard of TwinCAT Analytics saves valuable engineering time.

TwinCAT Analytics makes engineering more efficient with automatically generated dashboard

Engineering 4.0: One-Click Dashboard eliminates an entire work step

In their quest for new business models, many machine builders and system integrators have identified data to be essential for their future. Based on the process information generated by machines and systems, they can now implement services in the areas of operational data collection, predictive maintenance, energy monitoring and technical support. And since these services are mostly considered add-on business, it is important to provide them very cost-effectively through simplified engineering. By reducing the up to now highly complex generation of such dashboards to a single click, TwinCAT Analytics makes Engineering 4.0 possible.

The aim of TwinCAT Analytics is the machine-oriented, centralized analysis of data from one or more simultaneously running machines or systems (Fig. 2). This is achieved with optimally coordinated and integrated tools that operate in a consistent workflow ranging from the acquisition of data to its communication, analysis and visualization in an analysis dashboard. The engineering tools involved combine a high degree of flexibility with easy and intuitive operation.

The analytics workflow begins as early as in the engineering process for the machine application. As is customary in TwinCAT engineering, all tools are integrated into Microsoft Visual Studio®, and since the TwinCAT Analytics Logger is already embedded into each TwinCAT project, no external configuration tool is required. The logger makes it easy to pick data simply by checking the appropriate box in order to transfer it to a message broker via MQTT or store it locally as a file on the control system. No complex programming is needed. Only the logger's options, such as IP address, data compression and authentication of TLS (Transport Layer Security), must be configured in order to enable communication once a machine project has been activated. In addition to being ideal for high-resolution data, the real-time logger can also be started and stopped with PLC calls via the control program.

Data analytics easily incorporated into IoT concepts

An Internet of Things (IoT) infrastructure can be easily implemented with TwinCAT Analytics to ensure that the various applications are decoupled. All MQTT clients need to connect only to the message broker and not to each other, and it doesn't matter whether the message broker is on the local network or, for example, in the cloud. The outbound client-to-broker connections simplify the IT setup.

This is also reflected in the system's use. For example, a service technician can use the TwinCAT Analytics Service Tool to log onto the message broker and analyze machine data from anywhere as an MQTT client. Users can access live

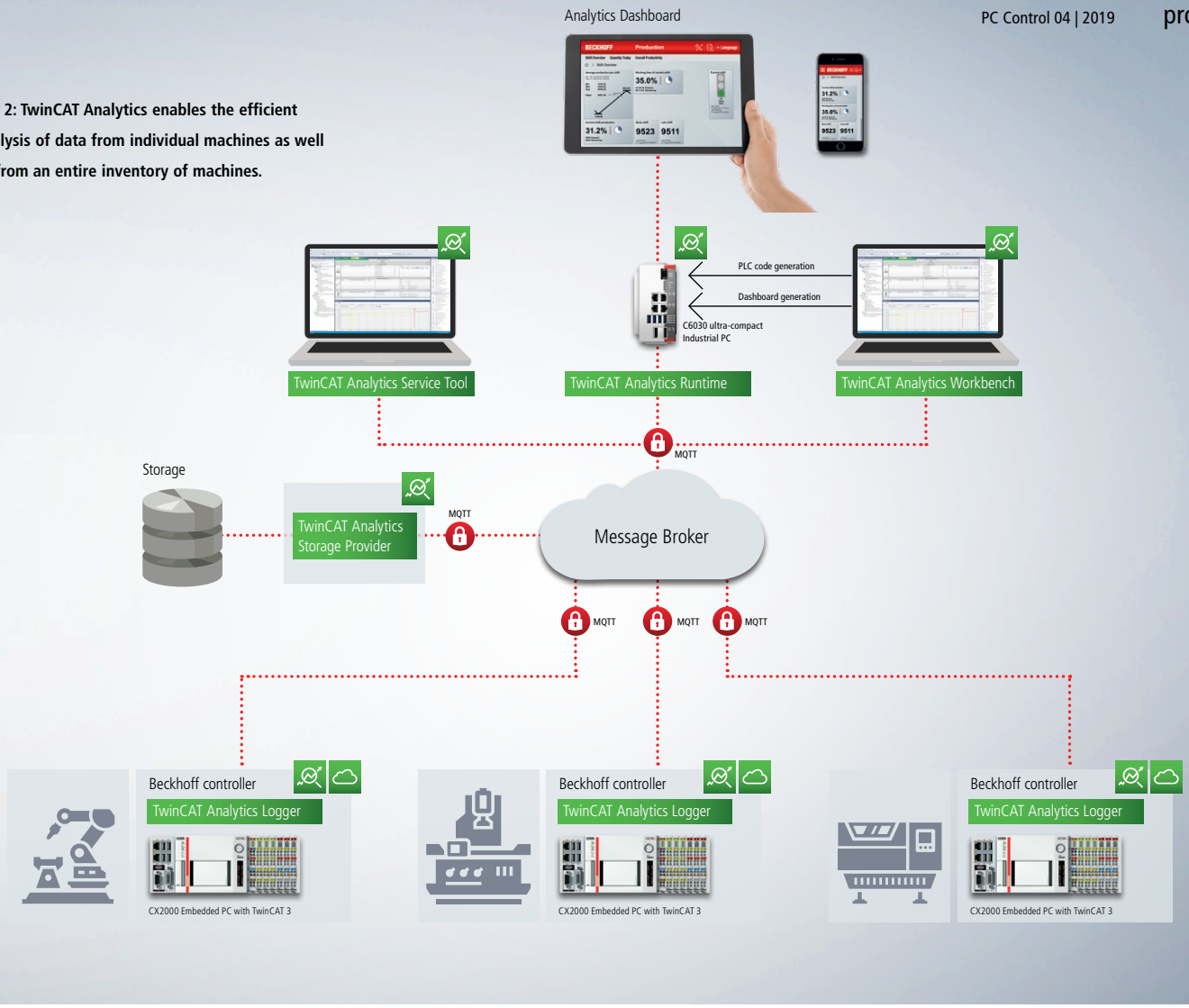

Fig. 2: TwinCAT Analytics enables the efficient analysis of data from individual machines as well as from an entire inventory of machines.

data from the machine as well as historical data supplied by the TwinCAT Analytics Storage Provider. For the analysis itself, TwinCAT Analytics provides many algorithms in the form of modules. These include simple flank counters with and without hysteresis, functions for chronological analysis of machine processes, logical operators, envelope control and productivity diagnostics, as well as a wide variety of classifiers and comparators.

The service technician can then use these algorithms in the TwinCAT Analytics project within Visual Studio® without having to leave the familiar TwinCAT environment. Operation is graphical and intuitive. Especially useful is the automatic TwinCAT Scope configuration, which can be generated by clicking a button. While the proven charting tool from the TwinCAT world can be individually supplemented, it already contains all important variables of the configured analysis. With the link thus created, results from the analysis can be dragged and dropped into the TwinCAT Scope View tool to easily visualize them and highlight significant events in the data stream (Fig. 3).

Services as a new business model

This is where the engineering process ends for the service technician or the person commissioning the system, who can also access the machine data via the ADS communication protocol, i.e. without using IoT infrastructure. If a machine builder or system integrator wants to offer their customers additional services, the engineering process enters another phase. This approach also offers significant potential for new business models that can be monetized with a one-time payment or a subscription. In return, customers receive a customized visualization interface, i.e. a dashboard that perfectly meets their specific information needs. In the spirit of Engineering 4.0, it is crucial for this business model that such a dashboard be implemented as easily and cost-effectively as possible.

To maximize the customer benefit, the goal is to deliver a 24/7 application that runs for the entire life cycle of the machine and analyzes machine data non-stop. The best conditions for such a permanent application are provided by the PLC, which is designed exactly for scenarios with a focus on continuity and longevity. The only thing that's complex in such a scenario is the programming of mathematical algorithms, which are often easier to realize in script languages or in graphical configurators, albeit with a different focus: Instead of analyzing a stream of live data, they often take the easy way out and look at historical data within the engineering process. But since the end customer does not want to and is often not able to work within an engineering tool, the goal is to combine the simplicity of data analysis with the PLC.

Workbench reduces engineering complexity

This combination is delivered by the TwinCAT Analytics Workbench, which supplements the functions of the Service Tool. Like the service technician, the data analyst – who is often the application engineer – uses the Analytics Configurator in Visual Studio® for data analysis, providing the ability to create

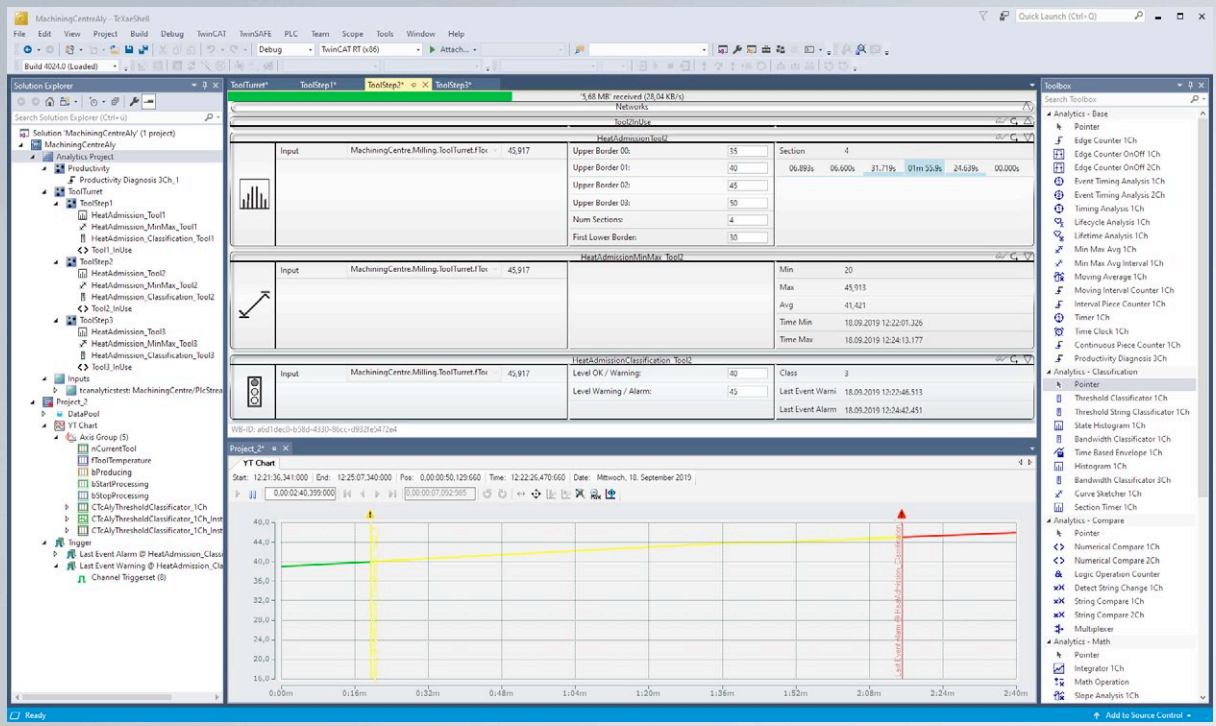

Fig. 3: During the engineering process with the TwinCAT Service Tool or the Workbench, analysis results can be visualized in a clear and detailed manner in TwinCAT Scope View.

complex analyses graphically, broken down into various networks that represent machines, machine components and machine tasks. The algorithms can also be combined with each other, which further increases complexity.

The Workbench's key function in reducing complexity is therefore the complete and automatic conversion of the configuration into readable and executable PLC code with the simple click of a button. This includes connectivity options as well as all network and/or algorithm names. At the same time, a complete HTML-5-based analysis dashboard – the so-called One-Click Dashboard – is generated and loaded into the selected Analytics runtime program. When the code and dashboard generation is completed, users receive the corresponding network address at which they can access the dashboard via a web browser – without having to write a single line of code or design any graphics.

Automatic dashboard generation saves significant time

Simple dashboard generation saves a substantial amount of time within the engineering process. The functionality is based on TwinCAT 3 HMI and for each TwinCAT Analytics algorithm offers a separate HMI control that is based on modern web standards and features a modern tile design. The available controls can be selected within the respective algorithm properties with a corresponding control preview. Combining multiple algorithms in a single control element is also possible.

Automatic dashboard generation can take many individual user requirements into account (Fig. 4). You can specify header colors and logos or optionally display a world map on the start page that shows the locations of all machines being analyzed (Fig. 5). In addition, several languages are available for the controls. The application designer can also select from various layouts and themes. For example, there are layouts with fixed controls that can be fixed left-aligned or right-aligned on each dashboard page. That way, the user – whether the end customer or the machine builder's service technician – has an overview of the entire machine status at all times (Fig. 6). Depending on the surrounding conditions, the user can even switch between light and dark themes. In addition, the reset methods for the algorithms are linked automatically in the dashboard.

Despite its high degree of flexibility, the automatic dashboard generation will not always be able to meet all needs directly, which is why the system integrates as a rule the complete Analytics PLC project and TwinCAT 3 HMI project in Visual Studio®. That way, the application engineer can freely modify the generated dashboard in the graphical editor and add standard or custom controls. Even when the dashboard is customized to a great extent subsequently, this approach still saves more than a thousand clicks and thus considerable time and costs compared to the conventional approach. In addition, individually designed HMI controls can be integrated into the Analytics workflow and also into the One-Click Dashboard.

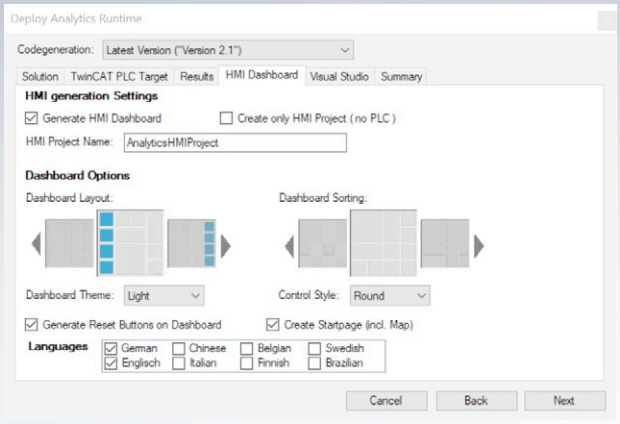

Fig. 4: If you select more than one language in the Analytics Runtime Deploy Wizard, the system automatically generates a language selection menu.

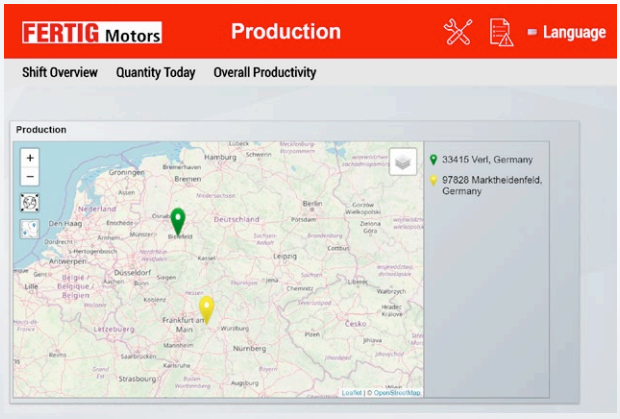

Fig. 5: To localize the analyzed machines – in this case from Schirmer Maschinen GmbH – on a optional world map, the Analytics Logger delivers the corresponding geographical data directly from the machine application in the field.

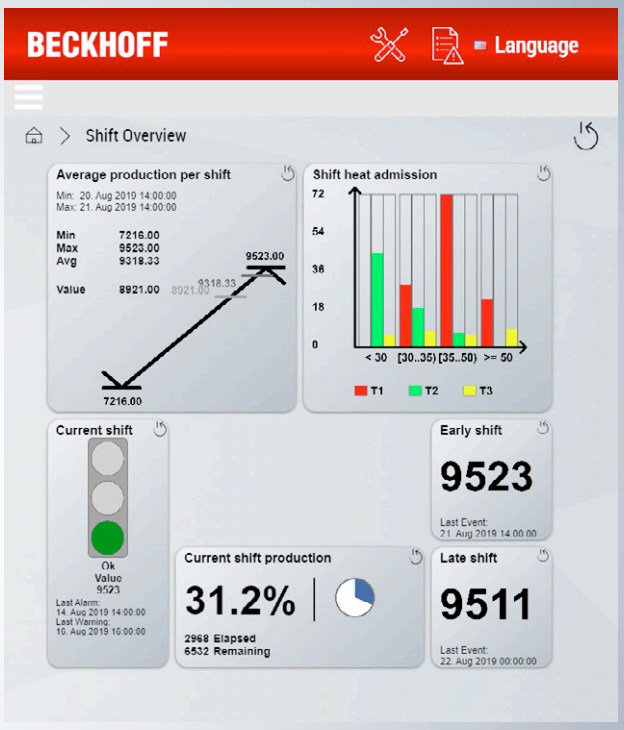

Fig. 6: Automatically generated dashboards can be based on a broad selection of layouts and themes.

Conclusion

Easy, proven and familiar engineering as well as a complete workflow for the ad-hoc and/or continuous analysis of machine data are the outstanding attributes of TwinCAT Analytics. Many automatic functions make the machine builder's or system integrator's work quick and easy while maintaining the openness and flexibility of TwinCAT at all times. Everything from the analysis PLC to the analysis dashboard can be customized as needed. While the end customer is able to enter the new world of the Internet of Things and service-based business models, the application designer can operate in the familiar world of TwinCAT Engineering and make use of its many synergies. There is no way to access new business models and machine options that are based on data analytics with greater ease and cost-effectiveness.

Published in
elektro Automation 11/2019,
Konradin Mediengruppe,
www.konradin.de

Pascal Dresselhaus, Product Manager TwinCAT, Beckhoff Automation

More information:
www.beckhoff.com/analytics