Integrated assembly process at Volkswagen Emden

zenon – production is dependent on information.

Production that is transparent down to the last detail and a well thought out material and production flow are the factors of success in automobile production – today and in the future. As one of the largest automobile manufacturers, Volkswagen masters these processes perfectly. zenon is part of the modern infrastructure at Volkswagen Emden and makes it possible to provide all process and production data consistently and transparently at any time in order to monitor, visualize and analyze manufacturing.


zenon is used at Volkswagen in Emden for the central monitoring of the whole assembly process. At the same time, the car manufacturer also uses the HMI/SCADA software from COPA-DATA for individual assembly processes. "We therefore looked for an HMI/SCADA solution that could meet our requirements for both visualization and process control, but also guarantee complete integration of all business and production processes. Production is dependent on information. zenon is a solution for all duties", explains Mario

Ewen, project leader for the introduction of the new super-ordinate visualization in the assembly area at Volkswagen Emden. One of the production stage that zenon provides visualization and analysis for is the application of adhesive onto the windows. This stage of the assembly takes place before the parts are assembled. During assembly, the interior – instruments, seats, trim panels, carpets, etc. – are installed, as well as the mounted parts – windows, windshield wipers, lights, wheels, etc.

CONSISTENTLY AUTOMATED

Previously, the windshields were delivered to the adhesion cell manually. Now, the windshield adhesive application facility at Volkswagen is largely automated. The company ATN Hölzel
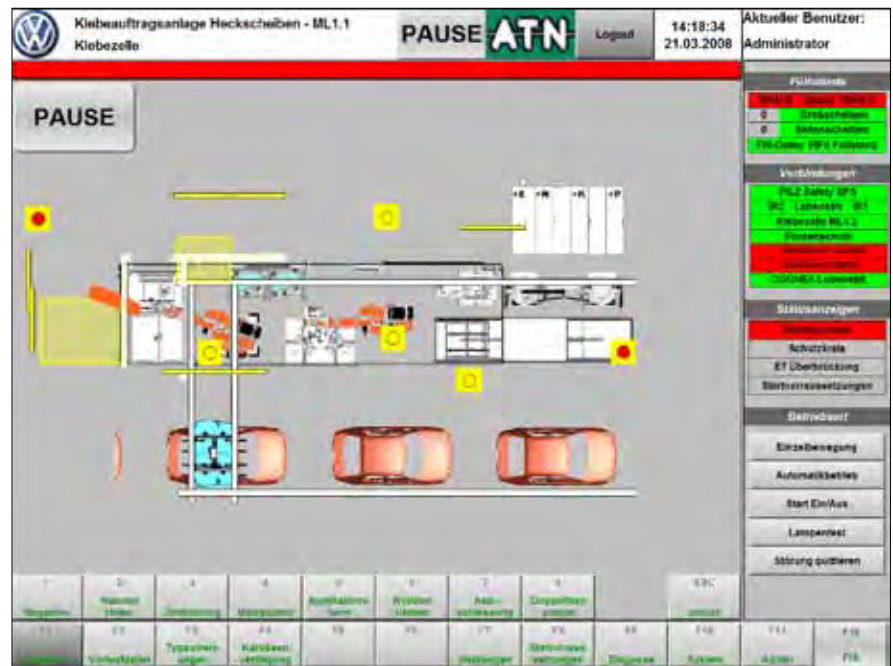
zenon is involved in the global control of material flows at Volkswagen.

GmbH, a specialist for adhesive technology and automation, provided the new equipment for this assembly process and implemented the project in conjunction with COPA-DATA.

Today in the assembly department at Volkswagen Emden, there are a total of four windshield adhesive machines for the front and rear screens and the left and right side windows. In the windshield adhesive application process, the required window is initially brought to the equipment in pre-converted magazines. KUKA robots take the window out of the magazine and, after centering it, automatically guide it to the adhesive application tower, where the adhesive is applied. After this, the robots give the window to the 'manipulator', which transports the window to the installation point. At the installation point, the VW employees take the window using suction grips and place it into the vehicle, which will already have been transported into place by the production line conveyor.

### ZENON – INFORMATION THAT GIVES YOU THE COMPLETE PICTURE

All processes and information that are necessary for the operation and control of the equipment are displayed transparently using zenon – be it process statuses and values, equipment operating types, communication connections or status reports. The equipment and its components are shown in the overview screen. Starting from this screen, the user can switch into the different process stages. In the detail views, operators see, amongst other things, the individual cells – trolley cells or stacking column cells – in the same way that they can also see

individual robots and their status data. In the detail views of the adhesion cells the user can, for example, set values, activate or deactivate sensors and tighten or loosen trolleys.

In the first process stage the robot takes the window out of the magazine and places it on the centering table. The window and its exact positional values are visible in zenon and the window can therefore be re-positioned for a perfect fit. For the adhesion process, zenon offers an overview of all status information and also the positions of the robots. This status information for the adhesive process includes the amount of adhesive applied, the pressure in the dose feeder, target revolutions etc. In this process the twin barrel pump transports the adhesive or sealing mass through pipes in the dose feeder, which supply the nozzles with the adhesive mass for the job. Here, all data on air pressure, temperature and fill level is visible. The manipulator, which travels with the line, takes the corresponding window and brings it to the vehicle. All positional values of the manipulator and robots are always available to the workers. They can not only adapt these values, they can also trigger subsequent actions.

The alarm management always provides the necessary safeguards in the operation of the facility and ensures that the VW employees react immediately where necessary. Equipment down times are therefore a thing of the past.

"zenon has proven itself in use at Volkswagen Emden. We implemented integrated visualization of the equipment which provides central monitoring of all of the assembly lines. In addition to a well thought out implementation of the project,
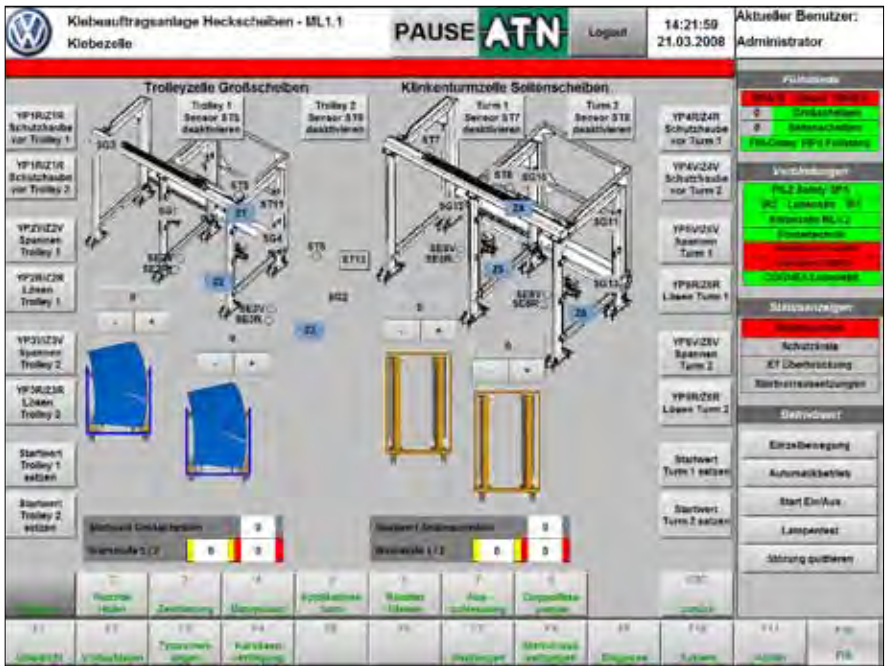
zenon offers a direct connection to the Manufacturing Information and Control system at Volkswagen.

and the well-engineered technical solutions that we use today, COPA-DATA particularly stood out because of the commitment of their employees – be it during the project preparation and implementation or in the support and training they deliver," explains VW project leader Mario Ewen.

AN INTEGRATED FLOW OF INFORMATION ENSURES COMPLETE INTEGRATION

The outstanding advantage of the zenon application is the direct connection to the Manufacturing Information and Control system. This system is used throughout the Volkswagen factory, in order to control material flows for automobile production and to forward production-related information to the production lines. Worldwide, the Manufacturing Information and Control system automates the supply chain in the Volkswagen factories and controls the supply chain extremely effectively. The solution has been used since the middle of the 1990s and records all necessary data on each individual car that Volkswagen produces. This includes the job, the specification details, the serial numbers of individual components as well as recorded production times or production sequences. In addition, it provides information such as throughput times, adherence to deadlines, utilization of capacity and order status information. The direct connection between zenon and the Manufacturing Information and Control system makes it possible that all relevant product information is available in the window assembly line too. Thanks to the display of the production line that zenon provides, the workers can gain an overview of which vehicle or model – Passat Variant, Passat

CC or Passat Limousine – is the next to arrive on the production line conveyor. The window that is to be installed also arrives, precisely cycled, at the desired time and in the correct sequence.

The connection to the Manufacturing Information and Control system is created as a sub-project in zenon. This makes it possible to use this connection universally for other applications too, at low cost and with only small adaptations.

"When choosing the new solution for the visualization and monitoring of manufacturing, the standard connection to our Manufacturing Information and Control system was decisive", stresses project leader Mario Ewen. Until this development, programmers had created individual applications for each interface and connection to the group-wide Manufacturing Information and Control system. Mario Ewen continues "Today we benefit from the standard connection between zenon and the Manufacturing Information and Control system, which is available to us for use with further applications in Production. This reduces the planning and maintenance costs considerably, just as it does the deployment time and costs." The fact that the person in charge of the project, Mario Ewen, and his colleagues at Volkswagen are satisfied – and that zenon has risen to meet all their requirements in full – is evidenced by the most recent activities at Volkswagen Emden. Building on the facility-wide production monitoring and visualization of the new window equipment, the automotive group is now implementing further projects with COPA-DATA's HMI/SCADA solution: in the future, Volkswagen will also rely on zenon for visualization and control of the tire equipment and the filling of coolant and brake fluid.

Condition monitoring with zenon – all the key figures at the press of a button.

A streamlined production system is based on all the relevant key figures for production and performance always being available, and on production being standardised to the greatest possible extent. At Volkswagen in Emden, zenon is responsible for transparency in assembly, increased productivity and greater plant availability. Thanks to the zenon-based assembly information system, the maintenance engineers benefit from instant access to all production-related information and key figures.

The Volkswagen plant in Emden has a daily capacity of 1,200 vehicles, and has produced more than 9.5 million vehicles since the plant was opened in 1964. The Passat Limousine has been built in Emden since 1977, and the Passat Variant is only built here. The Emden site has been the leading plant in the world for this successful model.

ZENON SETS NEW STANDARDS

Several generations of Passats have been manufactured here. Half way through 2003 the 12 millionth Passat, and in September 2004 the 13 millionth Passat from any Volkswagen plant was produced. The sixth generation of Passat Variant was launched in August 2005. In November 2007 Volkswagen in Emden produced its 15 millionth Passat worldwide. 2008 was the launch year for the new model, Passat CC, that is produced exclusively
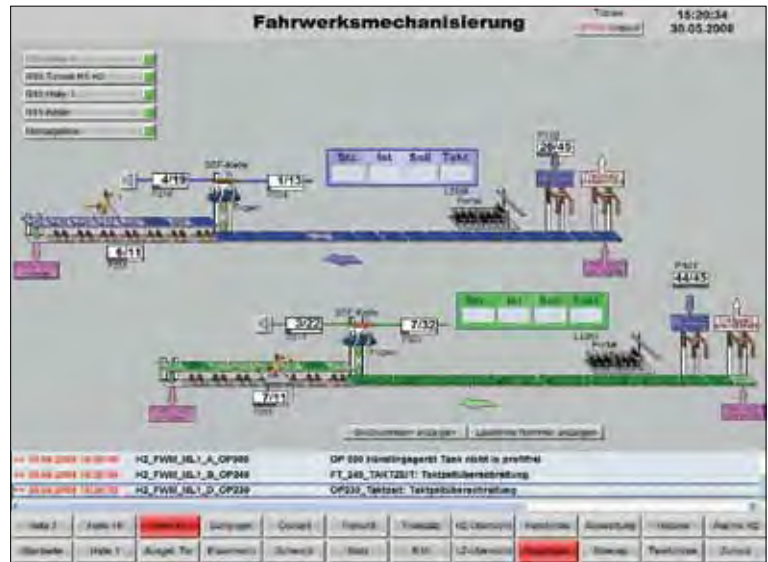
in Emden. The launch of a new model is usually also the event that triggers investment in new machines and software. Volkswagen in Emden took the production of the new series of Passat models as a trigger for modernising the assembly plant and standardising the base software as well as the overlaid visualisation software. Here, the zenon software from COPA-DATA, which is used for the central plant monitoring system, has been setting new standards in production.

CONSISTENCY IN THE VW PASSAT ASSEMBLY PROCESS

In the assembly process at Volkswagen's Emden plant zenon is now responsible for a total of four assembly shops as well as for communication with high level and low level systems, for the entire flow of information in the assembly plant and for preparing all the data for use in a high-performance, effective information system. There was no other system that was capable of satisfying the requirements of Volkswagen's project managers. An important evaluation criterion for zenon was its use of different controllers and its extensive integration ability. "Because of the increased volume of data in modern plants we were not able to capture data from all sections of the plant and to visualise it all. The systems were overloaded and grew considerably slower. A new solution was required", explains Mario Ewen, project leader at Volkswagen in Emden. In this case more than 120 controllers are involved – different models from different manufacturers. zenon visualises and oversees the entire production flow using more than 50,000 variables, which are

transferred to zenon. The entire assembly process is now visualised with 172 displays. Another incentive for developing a new application was the fact that the previous operating system, Windows NT, was to be discontinued. What's more, one of the tools used was no longer supported by the manufacturer. "Overall, the applications from our previous providers were no longer up to the job with the modern, upgraded structure. We compared a number of systems, taking into account our requirements, and reached the conclusion that zenon met all the criteria on our list. We are now using a consistent, standard solution for the entire assembly process", explains Georg-Joachim Loger, maintenance engineer at Volkswagen's Emden plant. This project was implemented by process management staff and production facilities management staff working with staff from COPA-DATA. Volkswagen was especially happy with the efficient direct approach and the readiness of the COPA-DATA team to try to give us everything we wanted as well as to incorporate changes as they presented themselves in the course of the project.

DISTRIBUTED, SECURE AND FUNCTIONAL

zenon features all the modern technology that a car manufacturer could possibly ask for. The Volkswagen software is configured as a client/server system with redundancy, and is therefore fail-safe. The internal network at Volkswagen now incorporates eight zenon clients. As well as the redundant server pair, there is also a database and a web server. The COPA-DATA web server serves 100 web clients simultaneously. The various process displays are brought up according to the specific task or functional
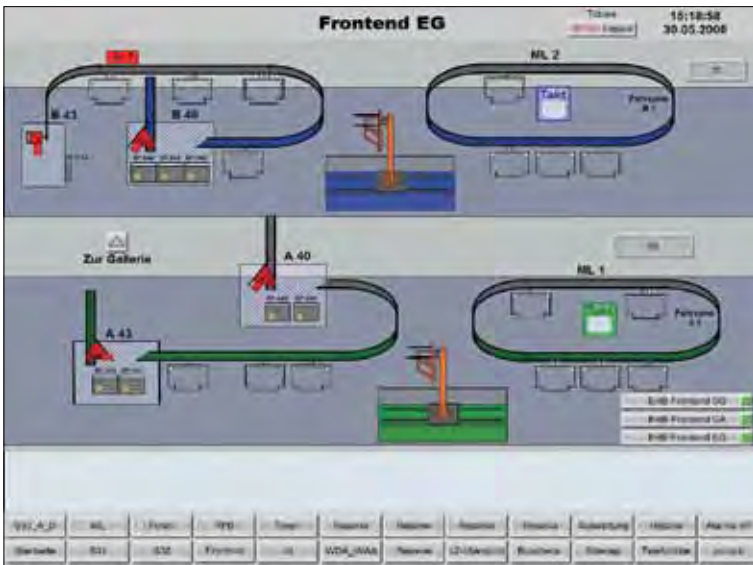
area. For storing and archiving data, the managers at VW decided on a (Microsoft) SQL-Server. The database is automatically populated from the zenon-SQL-Server connector, which also ensures that the data is read back automatically. Also included is a powerful user management module for defining access rights to the project and system. The user management module is used to specify which users are permitted to view or modify which functions – such as the shift schedules.

WELL-THOUGHT-OUT PROJECT STRUCTURE

The umbrella project, which integrates all the systems in the four assembly shops, includes the system overview displays, the industrial performance analysis, the production and facility manager (for the shift models), the higher-level alarm management, the chronological events list, counters and plant downtime, plus the initial project for the web client. The individual sub-projects include the system displays with detailed information, the driver links and control variables, alarm zones and the plant's shift reference.

ZENON – SUCCESSES BECOME MEASURABLE

One of the important goals for the new overall system at Volkswagen was to gain clear and total control over the assembly processes, both for management and for those working in the assembly shop. One of zenon's exceptional strengths is its ability to manipulate large volumes of data and to display them in a useful format to managers or those working in the plant. Volkswagen's main interest for its Emden plant lay in presenting the key figures for the production process and output in the form

of graphs and tables. The car manufacturer can now use these key figures to see how cost-effectively the assembly shop is operating. In other words, results become measurable. The key figures might, for instance, include target and actual values for the overall life of a production line, possible differences, the cycle times, the setting up of events in the plant and their causes, and the number of finished cars. Mario Ewen explains: "Monitoring the key figures ensures that the assembly process is running as efficiently as possible, and at full capacity. This system provides us with an overview of all the important information, allowing us to carry out detailed analyses and react quickly to events as necessary." Volkswagen could also use this data to detect any delays in the course of the assembly process and the causes, allowing an appropriate response. The integrated soft PLC, straton, which complies with the IEC standards, is used to calculate the buffer, unit, and output counters. To ensure that all the key figures reflect the assembly processes exactly, Volkswagen uses an additional zenon module. The production and facility scheduler (PFS) controls the chronological sequence of operations in Emden: at this plant a number of working hours models (shift system, lengths of breaks, etc.) are used. The shift hours entered from the PFS can be classified, grouped and evaluated. They are also fed into the performance calculations. "When all the figures are combined, they tell the story of how many cars we are actually producing. The opportunities for evaluating and monitoring our assembly processes are more detailed and sophisticated than ever before", observes Mario Ewen.

ALL THE KEY FIGURES, CLEARLY PRESENTED AND READY FOR USE

VW managers can view all the key assembly figures in either
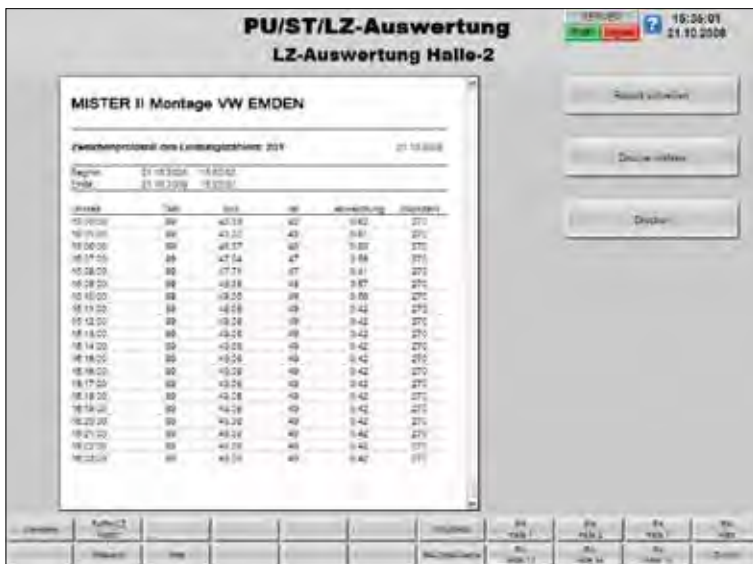
All values displayed in the screenshots in this article are for illustration only.

table or graph form. Individual users can choose how they want the information to be presented. They can also select from many time scales, and different periods of time can be compared with one another. In this way, Volkswagen workers have access to extensive and at the same time highly condensed information that is available at the press of a button in the form of lists and analyses.

The report generator shows the archive entries in table form, and outputs the reports in HTML format - likewise either as a graph or a table. The Extended Trend module is provided for preparing data in graph form. At runtime users can arrange for various graphs to be displayed, and even for more than one graph to be compared. This ensures that all the relevant operators can view and use analyses, reports and graphs. "The central plant monitoring application is a tool for improving availability", explains Mario Ewen.

TOTAL CONTROL

The higher-level visualisation is now also used as a central point for all events in the plant and system messages. Volkswagen used to operate two systems for this purpose, but these have now been replaced by a single standard system. "As well as the system and plant monitoring we also wanted detailed analyses – on the one hand to ensure maximum availability and on the other hand to exploit any potential for optimisation", explains Mario Ewen of Volkswagen. All the operators now know instantly what they should do if they receive a system message, and can respond straight away.

Around 5,500 operating messages and system messages per day are produced by the assembly lines in Shops 1 (engine and gearbox), 2 (main assembly, drive assembly, disks, cockpit, etc.)

7 (headlamps, batteries, seats, wheels, doors, etc.) and 16 (initial assembly following paint). All the information is on hand to enable statistical evaluation and analysis with the industrial performance analyser. This information can also be viewed in the form of bar charts or pie charts. Filtering options enable online alarms, historical alarms, pending alarms or reset alarms to be shown, and to specify their display order: by time, class or priority.

At Volkswagen the alarms are also cleaned up at a break or shift change. This overlaid cleanup process ensures that overlapping messages are not only added, but that the net downtimes are taken into account in calculating the duration of an alarm. Every alarm that has caused a downtime is stored along with the possible discrepancy in unit numbers. The discrepancies are evaluated either individually or in total using the line, time, and shift plan filters, and are displayed on a zenon screen.

OPTIMISING MACHINES ACTIVELY

To ensure that the entire system can be serviced, maintained and upgraded efficiently, Mario Ewen and his colleagues have opted for zenon. It is important to the managers that all future system upgrades as well as all maintenance operations can be carried out without involving a service provider or other external partner. This saves both time and money.

The industrial maintenance manager is responsible for looking after the machinery and maintenance data. Service and maintenance intervals are easy to specify, manage and schedule, as are the detailed instructions. Those employees who are responsible for maintenance can now see at a glance when equipment, plant and machinery is due for maintenance. All maintenance operations are documented in logs.