

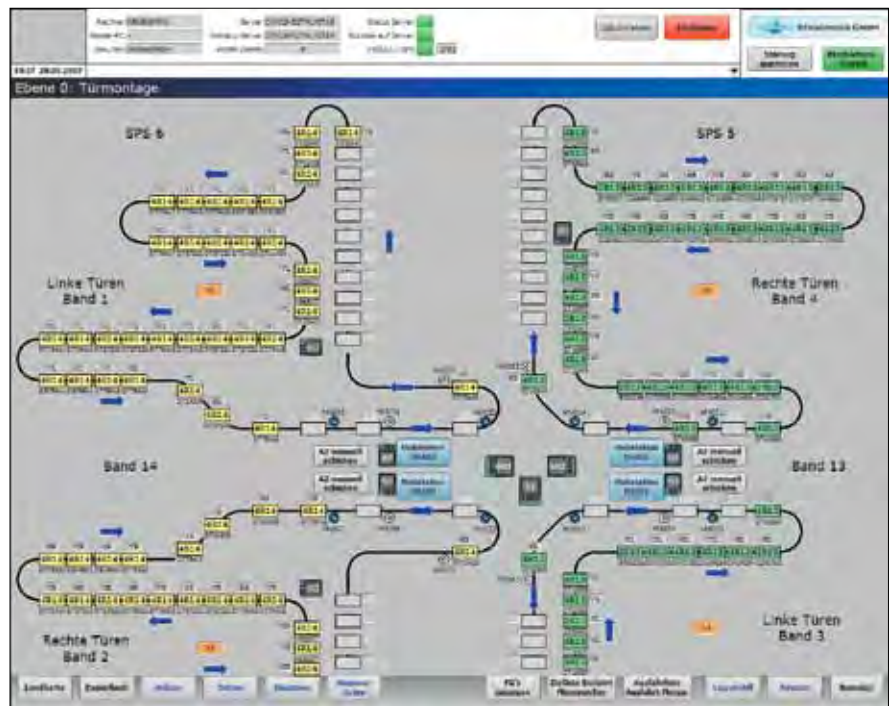
zenon – Greater flexibility in production.

The flexible storage and conveyor system in BMW's Dingolfing plant picks up all the doors from the assembly line and reunites them with the bodies at the right moment. This storage system, whose display requirements are handled by zenon, boasts a minimal space requirement whilst at the same time offering excellent flexibility.



During recent years the automotive industry has been transformed, and the final assembly phase has changed even more than others: the number of different vehicle models has increased, and a vehicle must be delivered to the customer as soon as possible after the order is placed. This is made possible by ensuring that production personnel are highly qualified and that production plants are regularly modernised or replaced. In the assembly section at BMW's Dingolfing plant - the

Group's largest production facility which produces around 1,200 vehicles every day - several thousand components are assembled to create a finished vehicle. zenon also forms part of the assembly facilities. This software is used for automation and visualisation of a conveyor system in the assembly plant. This is a flexible storage and conveyor system comprising electric vehicles, suspended electric trains and lifts. After painting, the doors are removed from body shells, and are then taken in lifts to the storage level; the doors for different vehicle types are all stored together. These electric vehicles then transport the doors for further processing, initially to the flexible store and then, when requested, on to the door fitting station. Once the body shells



have been completed, the doors are brought back to them for final assembly. The purpose of removing and refitting the doors in this way is that it is easier and more convenient for workers to carry out the necessary fitting operations on the doors. The body shells also take longer to assemble than the doors do, and so the latter need to be put into temporary storage in the best space-saving way possible. The new storage and conveyor solution was developed in such a way that it takes up very little shop floor space. At the same time, the overview is ensured: all doors are labelled (model, chassis number, door position, etc.), all load-carrying media are provided with RFID tags, and therefore the location of any particular door is known at all times. At various points in the plant are located distributed read/write stations that control and monitor the suspension gear routes that can be uniquely identified at each point. Users can read out the data, but also change and update it if necessary. To make the doors available at the right time and in the right place presents a particularly large logistical challenge; this is an extremely complex task for the control system to achieve.

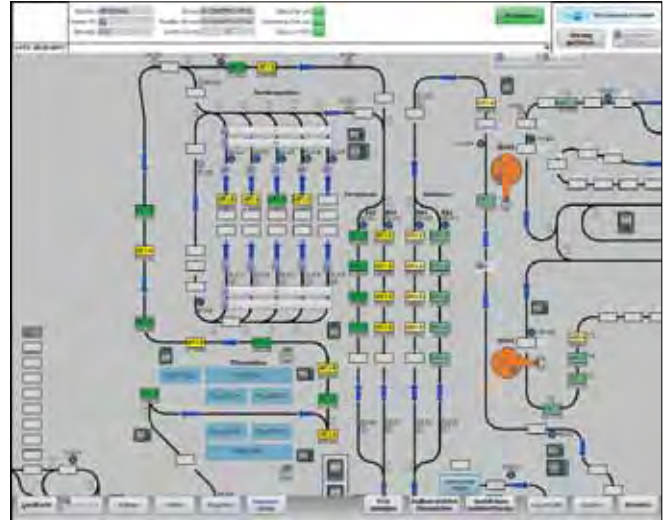
CONVEYOR SYSTEM PROFESSIONALS OPTIMISE THE PLANT'S INTERNAL LOGISTICS

The company Staudinger GmbH supplies the software and the entire control system for the door conveyor system. Staudinger has developed a suitable custom solution for operation and visualisation based on COPA-DATA's zenon. This software depicts the entire system. This company, which is based in Loiching (near Dingolfing) was founded as long ago as 1950, and now

specialises in three fields: control systems, plant and mechanical engineering, and simulation modelling. Staudinger has around 150 employees, and produces solutions for challenging open- and closed-loop control tasks in all types of automation systems. This was the first time that Staudinger had worked on such a large product with zenon from COPA-DATA. Another partner in the project was the company Rofa Rosenheimer Förderanlagen GmbH, which specialises in automated conveyor systems for material flow and manufacturing.

COMPLEX CONTROL PROCESSES IMPLEMENTED WITH CLARITY

The objective for the door conveyor project at BMW's Dingolfing plant was to implement and visually represent the complex control processes necessitated by the storage system so clearly that the plant manager or maintenance engineer can always retain an overview and can see immediately the locations of vehicle bodies and doors. The flexible storage and conveyor system has a full graphical display. The system displays show the operator all the strands of conveying and storage. Each box in a storage strand represents one door or a set of two or four doors. The colour provides information about the vehicle type, and the status of the door's manufacture (unfinished door, fully assembled door, empty vehicle). In order for the doors to be fitted, a robot transfers them to the suspended electric overhead conveyor system for pre-assembly. This process, too, is visualised with zenon. Once the doors have been completed on the production lines they are moved back to storage to await the bodies. A sequence list is maintained to keep track of when cars are ready to have



their doors fitted. Light-grey boxes in the visualisation are unoccupied spaces in the storage and conveyor system. Before doors pass into the lines, a check is carried out automatically to determine whether a line of doors of the same type already exists. If it does, then the door will be stored there in order that separate lines are created for each model. There is likewise a colour to indicate when doors are re-fitted in the vehicle – like door removal, this is a process that is performed manually. When doors are removed from the storage and conveyor system, the empty hangers return to the door removal station – this completes the cycle, and the process starts from the beginning again.

The zenon overview display enables operators and maintenance engineers alike to zoom in on any detail of the plant whilst at the same time keeping the entire plant on the screen. “The overview display is for me one of zenon’s best functions as it hugely increases user-friendliness and enables the plant manager to work efficiently and retain an overview however complex the plant”, says Markus März, a control software designer at Staudinger GmbH who is responsible for visualisation systems.

NETWORKING, CONSISTENCY AND INHERITANCE

The basic idea behind networked visualisation is that operators can perform all the necessary operations at any time and from any position: defining parameters, switching units on and retrieving alarms and trend data. zenon’s consistency, in combination with its unique network technology, opens up all kinds of options for integrating and optimising production and information flows. Staudinger took advantage of this consistency earlier when configuring the visualisation system: The system planners have integrated the standard project specified by BMW and

used only a small part of it (fault reporting system) that they really needed. The cost is thereby greatly reduced, and efficiency increased. Object-oriented parameter definition makes system configuration very simple: as soon as an object has been defined centrally, it is available for use throughout the system. And whenever any item is modified, it is handed on down quickly, securely and accurately without any further input.

ALL EVENTUALITIES CALCULATED IN

The zenon application also enables data sets to be modified, moved or deleted, and it allows the data system to be accessed directly should the need arise. With the help of the relevant operation the controller can now determine which subsequent processes are necessary. This entire complex, yet flexible storage system is extremely user-friendly. This demonstrates the high level of automation and efficiency that is made possible by this software”, explains Markus März from Staudinger. To implement their solution Markus März and his colleagues had to calculate in all the possible eventualities in order to represent the necessary processes and other resulting processes in the solution: if, for instance, a door has been included in the wrong conveyor line due to a defect in the soft material, then this must be corrected immediately. The visualisation includes a waste-paper basket that the user can use to throw away any records that are not needed. Using drag-and-drop techniques, the responsible person can then move the door data to the correct position in the system. Markus März from Staudinger GmbH continues: “This entire project is visualised using zenon. With all its technically refined hardware and software solutions it is a truly state-of-the-art automation system which not only works extremely reliably, but is also unparalleled in terms of flexibility.

Advanced Conveyor Technology with zenon

A New Dimension of Logistics.

Modern commissioning and storage systems are the basis for quickly supplying a distribution structure with parts and accessories. The BMW Group uses its Dynamics Center in Dingolfing to ensure that all replacement parts are at the right place at the right time. zenon visualizes the materials handling from the receipt of goods through to the high bay warehouse.



The car manufacturer has created one of the largest replacement part warehouses in Europe with its Dynamics Center close to the BMW factory in Dingolfing. The building complex covers 153,400 m². Approximately 2,000 suppliers from around the world supply their goods to the central parts delivery center in Dingolfing. Each individual article is tested for qua-

lity, examined and stored. 3,700 dealers worldwide are supplied from the center. 55,000 transactions are made each day. The receipt and dispatch of goods requires up to 500 trucks and 60 containers each day, which are transported by train. Every year, goods with a total volume of 1.4 million cubic meters are moved. Parts for all types of cars and motorcycles are

kept for 15 years. Around 260,000 articles are stored in the Dynamics Center. The cleverly thought-out logic enables all articles for Germany to be delivered overnight; it takes a maximum of 48 hours for the goods to be delivered to anywhere else in Europe.

HIGH-TECH STORAGE WITH ZENON

In order to be constantly competitive in the automotive industry, the central logistics and parts delivery center must always be as up to date as possible. As part of the most recent expansion, or rather refurbishment, of the Dynamics Center, the computers processing the flow of material were replaced with a Simatic S7-400 master controller. In addition, BMW also requested a new software solution for the process control level and operation of the control panels, of which there are currently 50. zenon came into play here. zenon from COPA-DATA displays all processes – from the receipt of goods, through internal movement, to dispatch.

The solution thus enables the people operating it to know where a replacement part or accessory is at any time.

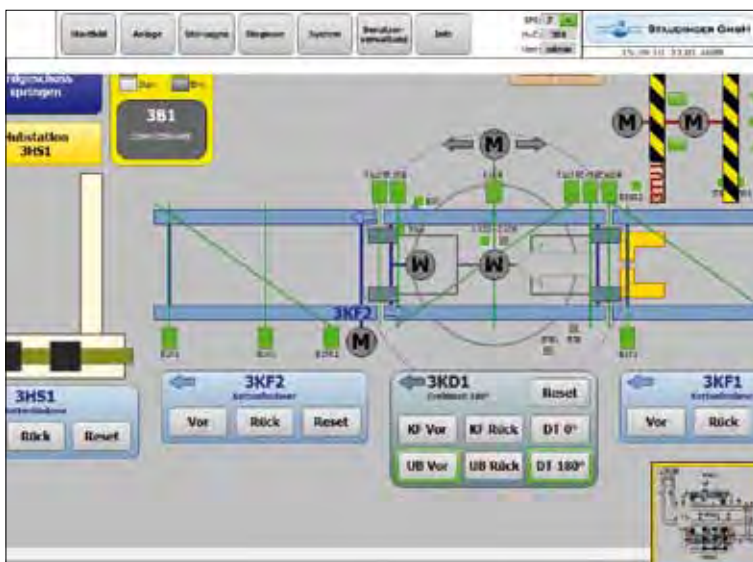
TWO METHODS OF TRANSPORT, ONE SOLUTION

There are a total of 325 chain conveyors on the ground floor. The containers to be transported are placed on or transferred to defined locations on the chain conveyor by means of fork lift trucks. 11 lifting stations, 16 lifting tables, 6 rotary tables and 19 telescopic inverters connect the chain conveyor with the elements of the electric pallet conveyor. They also form the interface between the two levels and methods of transport. The telescopic inverters and lifter bring the skeleton containers with the objects being transported to the upper level, where they are transported by the electric pallet conveyor passed up to 63 four-way points and 7 rotary points to their destination. The electric pallet conveyor is the heart of the internal transport system and serves to bridge the very

long distances in the Dynamics Center. It connects the areas for receipt of goods with pre-packaging, storage, order consolidation and final packaging. The electric pallet conveyor is approximately 6 meters above the facility floor. The conveyor system is 2,650 meters long in total. zenon visualizes the complete conveyor technology on both levels.

FOCUS ON SAFETY AND FLEXIBLE ACCESS

Visualization and master control and therefore the overall flow of material are set up as a client/server system (web server) with a server and a redundant stand-by server. Reliable industrial computers with four 19" monitors and a RAID storage system provide additional security and also make a comfortable control room. This is because the employees particularly benefit from one of zenon's features; during operation, the display resolution dynamically adapts to the respective monitor size completely automatically; in this way, the master control visualization is currently displayed on different systems with 2560 x 2048, 1024 x 768 and 1680 x 1050 pixels. For safety, and to be highly accessible, zenon also has alarm management. Thanks to the reports from alarms and reports of events in the system, users are immediately made aware of all critical activity in the process. zenon comprehensively supports BMW maintenance staff in localization and rectifying



The conveyor technology in one of the largest replacement parts warehouses in Europe is fully-visualized with zenon.



Thanks to complex storage and conveying technology, goods with a value of 1.4 million cubic meters are moved each year in this logistics and distribution center.

any possible problems. “High availability and safety were important requirements for BMW. Just as important was flexibility and ease of access to all information at any location in this giant logistics center”, explained the software engineers at Staudinger GmbH.

A WELL THOUGHT-OUT FLOW OF INFORMATION

The master control, as well as the seven group controls, ensures that there is a continuous flow of information. The 50 control panels are not connected directly to the master control but instead they are connected to the seven group controls. These move the conveyor technology parts – lifters, invertors, chain conveyors and receive instructions for the respective switch settings, which are determined by means of routing tables, from the master control. The exchange of data between the master controls and group controls is recorded and stored in a database (Microsoft SQL Server). The database also runs on an industrial computer with high availability. zenon ensures that, thanks to the web client, the respective employees can

access not only information from group controls but also information from the process control level.

EASY PROCESS CONTROL

The SCADA solution records the flow of goods and prepares the data for statistics. In this way, the operators always have an overview of stock levels and can estimate and analyze trends using previously recorded data. The information is saved in Microsoft’s SQL database. “Thanks to the easy to use VBA integration in zenon, it is easy to access objects, variables and functions and also to set up user defined analyses – one of the many advantages which this software offers”, adds Markus März from Staudinger.

SIMPLE PLANNING, TIME-SAVING MANAGEMENT

The previous solution had a deficiency that has now been put rectified: a separate, independent project was installed on each direct control panel. Each addition and each change to an object therefore had to be carried out 50 times. Thanks to

the integrated multi-project administration in zenon, it is possible to define projects centrally and to consistently generate or change all defined objects from one place; once defined, or changed, objects are available quickly and are error free. The possibilities for reusing these objects increase and the effort needed to maintain these is drastically reduced as a result. Markus März also confirms this: “Planning is exceptionally efficient with this. This also means that the customer enjoys an enormous saving in time and cost during the commissioning phase and in particular thereafter, for instance when expanding or making changes to the facilities. I particularly liked the possibility in zenon to activate or deactivate the drivers for the different controls during operation. As a result, the data traffic on the network was reduced considerably for the customer.”

USER-FRIENDLY SOLUTION, IMMEDIATE IMPLEMENTATION

With zenon, Staudinger has developed an application that is very intuitive and



easy to understand. With the previous solution, the employees in the Dynamics Center worked for over four years on the changeover; however the transition to the new solution was made with relatively little effort involved in training and also went very smoothly, despite the fact that the software was fundamentally different to the existing software. zenon offers a wide range of design possibilities for intuitive and yet demanding process images. One of the functions which made the quick transition to the zenon solution possible is the zenon worldview: the zenon worldview makes it possible to pan across very large images of facilities with the mouse or by using the touch panel. In addition, it is possible to zoom, and add or remove detailed information into the image at any zoom level – comfortably, clearly, efficiently.

ZENON IN THE BMW DYNAMICS CENTER

- ▶ simple and time-saving planning
- ▶ intuitive user interface and well thought-out functions such as zenon worldview
- ▶ high availability thanks to a redundant server structure
- ▶ flexible access to all information in the whole facility



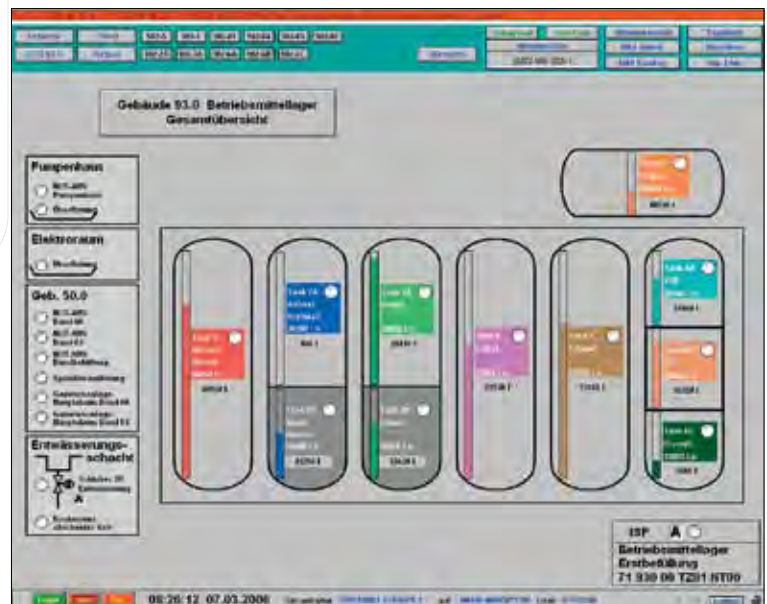
Operating technical facilities efficiently and safely.

From the very start of the planning process, BMW decided to use only the most modern building automation technology for optimal operation of the technical facilities and buildings - with minimum personnel expenses. The project implementation was entrusted to Cegelec, while zenon by COPA-DATA GmbH was chosen as the software for building automation.

If the facilities of a company are not operated and managed efficiently, costs will rise and resources will be wasted. BMW Leipzig therefore decided to strike a new path. Already in the design phase, BMW Leipzig aimed at creating an efficient, reliable and secure system with the new building automation technology; a system that would monitor, control and direct the technical facilities. In cooperation with Cegelec, facility and automation technology GmbH & Co. KG, from Frankfurt, BMW designed an integrated control system for the complete technical and electrical facility equipment. All relevant subsystems are connected with standardized, open and mostly non-proprietary protocols. The communication between these components takes place via TCP/IP in the network of BMW.

ANALYSIS AND OPTIMIZATION

Building automation technology displays the operating conditions and technical parameters with clearly structured facility pictures: altogether, it processes about 53,000 real data points



(sensors, actuators and readings) and 70,000 virtual data points from different information sources (data collection points, control cabinet with PLC) of the whole plant and it visualizes operating conditions with over 1,500 facility pictures. With zenon software by COPA-DATA and the project implementation by Cegelec, BMW can now get a clear overview of all cost-relevant processes concerning their technical facilities and buildings. This allows for professional facility management and plant control. The data collected in building automation is based on a newly developed equipment identification system (AEI). This system identifies all the components of the technical and electrical building equipment, even the passive components of the IT, across different assembly sections.

THE LOGICAL STRUCTURE OF THE AEI SUPPORTS AN EFFICIENT ALARM MANAGEMENT

Process management by operating personnel makes it possible to run all technical facilities in the Leipzig plant in an efficient, energy-saving and cost-efficient way. Required parameters that are not generated on field level (like performance data) are calculated in the building automation system. The solution saves all parameters in archives and provides reports for individually configurable trends. The powerful zenon SQL interface stores relevant values in an Oracle database for a long-term plant optimization. These values include meter readings or detailed consumption data. Collecting this data makes it possible to optimize control loops. BMW, for instance, calculates the NET value (Normal Effective Temperature = temperature as perceived by employees) from temperature, humidity and air speed and displays it online. Kurt Fingerhut, manager at Cegelec and

responsible service provider for this project at BMW Leipzig, explains: "BMW has created the foundation for efficient energy and cost management, because all information about all buildings and technical facilities are available for analysis at all times." Building automation with zenon® makes it possible today to change all relevant target values either manually at the work place or automatically through an interval timer program.

For this purpose, the convenient Production and Facility Scheduler of zenon is employed. This allows, for example, for the flexible operation of ventilation facilities in different operating and load conditions. A further example: The responsible employees can control all lighting systems (manually through the user interface or automatically depending on lighting and time conditions) and therefore adjust them to the changing requirements of the production flow.

WORKING EFFICIENTLY WITH MINIMAL RESOURCES

It was very important for BMW to combine flexible workplaces with relatively low license costs. The integration of all technical systems administered by Facility Management into a superior building automation system makes it possible to control the whole plant from a relatively small control room with two redundant zenon workplaces. The operator can watch, control and direct the facility processes here. An additional stand-alone server is used as an engineering workplace for future maintenance and optimization processes of the system. Apart from the two fixed workplaces in the control room, there are only about ten laptops that are used as additional zenon operating stations. On these laptops, employees of Facility Management can watch and test technical facilities. Because of the system concept and



the high availability of the GLT, BMW Leipzig decided against fixed on-site operating stations and saved costs for hardware and software.

SECURE SERVERS CONTROL THE FACILITIES

The system concept of building automation consists of two redundant zenon servers, which are installed in the two computer centers of the plant. They form the central element of the building automation system and they control the entire communication with the underlying information sources of the automation level and the connected operating stations. Furthermore, those two servers handle data administration, data archiving and many other additional functions of the control system software.

These functions include performance calculations and interval timer programs. With these functions, all the relevant target values and operation modes of the building-specific systems can be adjusted according to the different operating, load and time conditions. If production is active in a hall, the temperature is automatically lowered if it is getting too hot in the production halls. The IT department is in charge of server operation and data backup. The two servers for building automation, which are running Windows 2000 Advanced Server, are on the same level of availability as the servers in vehicle production. The plant's Facility Management is responsible for the operation and maintenance of the application software zenon.

ALARM MANAGEMENT FOR SECURITY

Alarm message handling and failure resolution is another important process in building automation. BMW Leipzig decided

against the installation of permanently recording alarm printers because of the high availability of the complete system and the possibility of access from every spot of the plant via mobile computers. Instead, powerful color laser systems deliver all the lists, hardcopies and protocols, in color and in sizes up to A3. Two separate alarm systems were designed and implemented, in preparation for running the control room with reduced personnel. The most important alarm groups of the building-specific facilities can be transferred to the permanently occupied work places of the factory security offices of the Leipzig plant.

Failures of the plant-wide infrastructure (e.g. compressed air, heat and power supply) are reported additionally via SMS to the stand-by duty of the Facility Management Provider outside of the plant. For this, the project team at Cegelec has developed an interface for the automatic transmission of alarm data to an SMS server, which was installed for the whole plant.

COMPLETE MONITORING AND CONTROL

The new system for building automation was tested thoroughly over several months – under the most demanding conditions: The system survived a plant-wide blackout of the power supply without problems. Kurt Fingerhut summarizes “We were able to reach all the goals that we had in this project: Complete monitoring and control of the facilities with minimal use of personnel and resources.” Professional building automation creates possibilities for cost reduction and delivers a significant boost of effectiveness. BMW was able to tap those possibilities for cost reduction thanks to the technical possibilities of the zenon software.