New production concept for increased efficiency

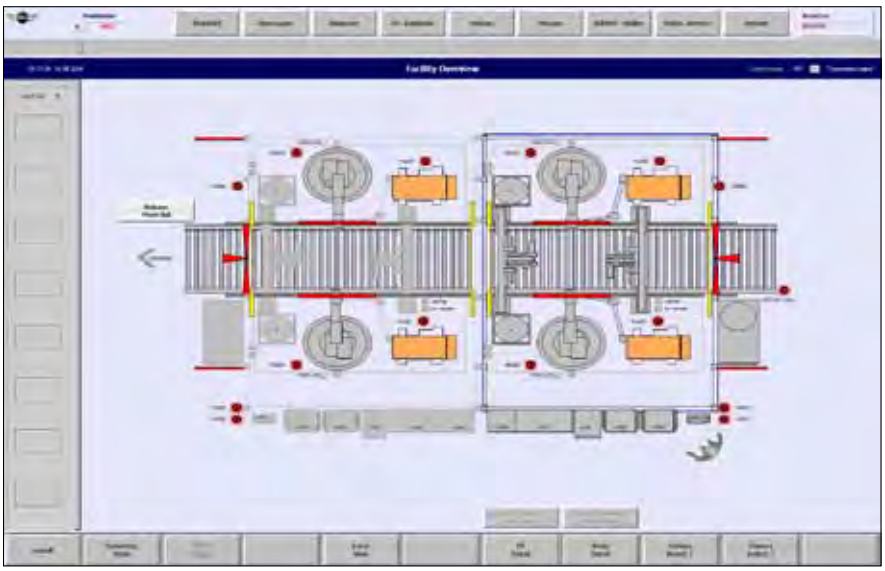
Laser cutting after painting – zenon ensures precision.

Intelligent and well-thought-out production processes ensure that car manufacturers can efficiently master the multitude of body and engine options. An example of this is the MINI Clubman and its optional equipment. zenon is used for the production in Oxford, UK.

Flexibility in automotive production is more important than ever to quickly and efficiently meet every customer's requests and to control the multitude of variants. For this reason, manufacturers are always developing different methods to efficiently integrate optional extras for specific models into the production process. An example of this is the MINI Clubman with spoiler and roof rails. Holes are drilled by laser after painting – without damaging the bodywork paint. What is special about this is that the equipment is on the assembly line and not in the bodyshop. If the pre-painted body is lasered, the number of painted body variants, which currently number 336, would also be needed for the Clubman variant.

NUMBER OF VARIANTS REDUCED

Thanks to laser cutting the bodies on the assembly line, 672 (336+336) additional painted body variants are therefore avoided. This is because a decision can be made as to whether hole drilling is necessary directly before the body is assigned to a customer order. This part of the production is carried out in a sealed manufacturing cell and is visualized with zenon 6.22. Bodies are moved into the cell via a routing bypass. The fully-automated equipment consists of two identical cells each with two lasers. The holes for the roof spoiler and roof rail are made in the manufacturing cells. The holes that the laser makes are freely programmable. The second identical cell, also equipped with a robot on either side, serves as a backup. The operators can set different pre-defined movement patterns for all robots. The focusing unit moves in a circular motion "wobble" before the robots make the hole with the laser. The laser cuts the holes for the roof rails and spoiler



Two identical manufacturing cells with two lasers each drill the holes for the roof rails or roof spoiler into the painted body of the MINI Clubman.

into the painted body during the "wobble" movement. Thanks to the thermo sublimation process, heat does not enter into the bodywork as a result of the laser action; rather solid materials are turned directly into gas and the paint remains unblemished. zenon displays this stage of production in full. Each of the two manufacturing cells and the conveying technology are equipped with a Simatic S7 controller. The conveyor technology is equipped with two direct control panels with 15" displays. In addition, each manufacturing cell has a 19" panel, which is fitted outside the cell. The user therefore always has an overview of the process in the sealed cell. Three cameras are integrated into zenon and observe the laser process – two fixed for observation and one controllable with the highest resolution for initiation and optimization.

COMPLETELY AUTOMATED MANUFACTURING CELLS

The installation of the pilot equipment was demanding for the BMW team not only in terms of technical issues but also in terms of logistical issues: the equipment had to be constructed directly above the conveyor, which was only possible when production was not taking place. With this laser equipment, the team also introduced a new standard for control technology throughout the factory in Oxford, which is being used throughout the BMW Group. "RPA" stands for "Referenz-Prozessanlage" (Reference Process Equipment). This control standard describes the hardware and software construction of automated equipment, but also the screen projection defined by the zenon software including the necessary interfaces. This includes pre-defined standard functions selecting the type of operation, information systems or diagnosis tools. The standard is used for conveyor and process equipment of all types. Employees of the BMW Group from Munich, Regensburg, Dingolfing and Leipzig developed this standard for use throughout their factories. The new standard enables unified, cross-factory support of equipment control and simplifies its operation and maintenance. The facility has now been in operation in production since September 2008 and has increased the standard of production and the process stability required from the start. FFT EDAG developed the manufacturing cells, the laser comes from Rofin and the screen editing solution comes from Perceptron. Autotech supplies the conveying equipment.

WELL THOUGHT-OUT, HOMOGENOUS OVERALL SYSTEM

An overview of both manufacturing cells is displayed clearly in the application's start screen. The menus provide the option of checking or changing the different types of operation or to look at the body, conveyor line or individual manufacturing cells in detail. All necessary information such as type of vehicle, body data, manufacturing parameters and the choice of program are sent to zenon when the painted body enters the manufacturing cell, in order to operate the equipment safely and to monitor the processes. As the painted body goes into the cell, it is positioned and the exact position is measured. The cell is then completely closed, the robots position the lasers on the programmed positions and then the laser can carry out its work. When all desired holes have been made, the body is transported out of the manufacturing cell. This process can also be carried out by the backup cell if the first cell needs to be reconditioned or has a fault.

ZENON – THE EXCELLENT SOFTWARE BASIS

Commencing from the starting screen, the user can choose be-

The uniform design of the user interface and intuitive operation ensure that 800 MINIs a day are produced in Oxford efficiently and safely.

tween the Startup, Messages, Diagnosis or Function group status menu items. A functions group is, for example, a conveyor route or a robot that can also be displayed on the main screen. Here, the user can request details of the function groups as well as the status of the processes and interfaces. All functions and information that the user needs to monitor and check the overall system is in the Equipment, Process, Interfaces, Technical Service and System menu items. For example, the system provides information about the distances between the types of bodies, the speeds on the conveyor belts, order data, the TCP/IP connection status, and alarms etc. The operator also has diagnosis option available, be it PLC, Profinet/Profibus or equipment components such as Movidrive traction inverters or Movimot geared motors. Diagnosis and monitoring are also available as web services, accessed via zenon.

SEQUENCERS: DISPLAY AND DIAGNOSIS

zenon also enables sequencers to be displayed clearly and diagnosed. Using the PLC Diagnosis module, the necessary information from the Simatic software's S7 Graph can be displayed directly in zenon Runtime. The projection is easily made with the data being acquired directly from the Simatic S7 Manager. Operators of the equipment can monitor and diagnose all stages (actions) and relaying conditions (transitions) independently of the programming system. During runtime, zenon graphically displays the stages of the PLC currently active and their status. All information can subsequently be analyzed and evaluated. Alarm information is directly transferred into zenon alarm management. In the event of an error, zenon carries out a heuristic evaluation of the erroneous step in question and provides the probable cause of the error in plain text form.

EASE OF USE FOR THE OPERATOR

Overview screens are available at the direct control units, which visualize both manufacturing cells. Required information on body data can be accessed in the overview screen of the cells. In this display, for example, both the rolling shutters of both cells and the robots are visible. Values displayed for the laser robots enable these to be positioned exactly. The user can request all required status or process information via the menus for system info, language switching (German/English), connection status, and interfaces. The bodies are also displayed graphically, so that the user also has a picture of the planned holes. Not only are the different statuses displayed graphically, it is also possible to instigate subsequent actions. For example, the user sees if the body has been blocked, if the rolling shutters are closed and if the filters are clean, and can act or react accordingly. For instance, the robots can be reset; rolling shutters opened, or a body can be transported out. Information about the robots such as operating type or system status can be seen on detailed screens. The basic position and automatic operation can also be read here, as well as the motion system axis values and therefore the positioning of the robot.

USER-FRIENDLINESS GUARANTEES HIGH ACCEPTANCE

For the equipment as a whole, it was important to create a uniform design for the user interface in order to make work as easy as possible for the people operating and maintaining the system. All (bilingual) texts and all illustrations in the zenon application are created in a uniform manner. The user interface is very intuitive and can also be understood without special training. Due to the high degree of user friendliness and the ease of operation, zenon users have accepted the new solution very positively.