BMW GROUP
Corporate Communications

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From press shop to validation: BMW Group Plant Munich builds on artificial intelligence and smart use of data

- Artificial intelligence supports quality assurance
- Smart data analytics saves maintenance time
- Innovations take the strain off production workers and enhance efficiency

Munich. BMW Group Plant Munich is making increasing use of applications with artificial intelligence (AI). AI is fast, reliable and easy to integrate into the various production processes and, coupled with smart data analytics and cutting-edge measurement technologies, it opens up new opportunities for more efficient vehicle production.

Robert Engelhorn, Director of BMW Group Plant Munich, is working to advance the application of these technologies: “At Plant Munich, it takes about 30 hours to manufacture a vehicle. During that time, each car we make generates massive amounts of data. With the help of artificial intelligence and smart data analytics, we can use this data to manage and analyse our production intelligently. AI is helping us to streamline our manufacturing even further and ensure premium quality for every customer. It also saves our employees from having to do monotonous, repetitive tasks.” As with any innovation, the key factor is effectiveness: “Our team in production are highly experienced specialists, so they are the best judges of whether an AI application can boost quality and efficiency at any given stage of production,” says Robert Engelhorn.

The options for using AI and smart data analytics are currently being tested in various areas of BMW Group Plant Munich. In some areas, the technologies are already in use in series production, such as the press shop and function validation.

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Smart Data and AI in the press shop

The press shop at the BMW Group's home plant in Munich turns more than 30,000 blanks a day into vehicle body parts. Since 2019 each blank has been given a laser code at the start of production so the body part can be clearly identified throughout. This code is picked up by the iQ Press system, which records material and process parameters – such as the thickness of the metal and oil layer, and the temperature and speed of the presses. The parameters are then related to the quality of the parts produced.

Uploaded to the cloud in real time, the data is immediately available in its entirety for the production team to gain a clearer picture of the manufacturing process. iQ Press data is an important tool for them, as it eliminates the need for each body part to be checked in minute detail, in quality control for example, and picks out only irregularities that require action.

Artificial intelligence also offers potential to identify recurring patterns in a process, based on the data collected, to support continuous optimisation. So, as well as improving the efficiency of production systems, iQ Press helps to further increase hourly output from the press shop.

Predictive maintenance in the body shop

Body shop robots are fitted with a combined total of over 600 welding tongs. If the tongs ever need replacing unexpectedly, it costs significant time and money. Moreover, many of the robots are difficult to access, so dismantling and replacing their tongs can take hours.

Until now, the condition of tongs has been monitored by eye, by a member of the production team. But in recent months, the maintenance specialists at Plant Munich have been fitting sensors to all the tongs to measure friction levels three times per shift and report any abnormalities. The data they produce is constantly evaluated by software, allowing potential machine failures to be predicted. Martin Hilt, Innovation

and Digitalisation Officer at Plant Munich, explains: “Because we have the sensors and collect their data in a cloud, we can now monitor round-the-clock whether any maintenance work is needed. So, we can plan any replacements better and potentially schedule them for a production break.”

Dust particle analysis in the paint shop

Despite comprehensive cleansing systems, vehicle bodies can pick up dust particles as they make their way to the paint line. Though invisible to the human eye, the particles can affect the quality of the finish. Until now, potential defects have gone undiscovered after the painting process, revealed only by the automatic surface inspection. They then had to be reworked, or the bodies repainted completely.

Now, however, every paint shop system incorporates sensors that measure dust levels and allow the quality of paintwork to be predicted. “We can now tell quickly if the environmental parameters are not quite right at some point, either within the paint shop or in one of the buffer areas. It takes a lot of data to do this, which we collect throughout the process, evaluate historically and analyse in real time,” explains Martin Hilt.

Over the last few months, a further special sensor developed by Plant Munich has been measuring dust levels on body parts at the beginning of the painting process, before and after the emu feather rollers. In the future, when dust levels are too high, car bodies will pass through the paint shop untreated and be sent for further cleansing.

AI-based image recognition in assembly

AI projects in assembly mainly focus on automated image recognition. Here, the technology is used to evaluate images of a component and compare them in milliseconds with hundreds of other images from the same sequence. The system then identifies any deviations from the norm, such as parts that are incorrectly positioned or fitted, or absent.

At Plant Munich, automated image recognition allows the production team to identify whether the hazard warning triangle, wiper caps and door sills have all been correctly fitted to each car. Previously, small bubbles in the foil cover of a door sill were often enough to prevent the conventional camera gates from seeing if the logo on the door sill was correct. But now an associate photographs each part concerned in turn and can even use the mobile equipment to check parts that are more difficult to access. Distance, angle and light hardly have any effect on AI evaluations, which reveal within fractions of a second whether everything is in place or not.

The AI system is trained by associates. They start by photographing the component concerned from various perspectives and marking potential deviations on the images. This allows them to develop an image database that can be used to build up a neural network for evaluating the images. Evaluations are carried out fully automatically, and the machine decides by itself whether or not a part meets all the specifications.

RFID identifies components in the vehicle

Radio Frequency Identification (RFID) allows components to be identified automatically and contactlessly throughout the value chain. “Our goal is to save production workers from having to scan components manually, and simultaneously to streamline manufacturing even further by ensuring the right components are fitted to the right vehicles,” says Martin Hilt. RFID is currently being used in seat production at Plant Munich but will soon be used throughout the vehicle assembly as well.

Smart RFID labels required for the system are applied before the component leaves the supplier. They remain in place throughout production, allowing line-side antennae to pick up every labelled component within each car as it passes.

Function validation with the Comfort Access robot

Comfort Access was first introduced in the current BMW 3 Series. A small team from Electrics/Electronics Validation in Munich has now developed a special robot to validate its integration.

Vehicles with Comfort Access use three exterior antennae to generate a three-dimensional electromagnetic field around the car. When the driver enters the field, the system recognises the car key. At about 3 metres from the car, it switches the Welcome Light on to illuminate the area outside the driver's door. At about 1.5 m, the doors unlock – and relock automatically if the driver walks away.

Until now, this special feature has been validated manually, with parameterisation in development alone taking two days per vehicle. The Comfort Access zones and the influence of production processes on them are then checked manually again in the plant, before production begins, taking into account the various country-specific requirements and equipment features, such as trailer couplings. All in all, it is a lengthy process and not always entirely accurate, given the multitude of different functions.

To solve the problem, the BMW Group and the University of Applied Sciences (HTW) in Dresden have developed a measurement robot that autonomously circles the vehicle several times in a pre-defined pattern to determine the strength of the magnetic field at various required points. Attached to the robot is a box containing the car key. The box can be set at different heights to reflect the different ways a driver might carry it: in their hand, their sports bag or a breast pocket, perhaps. As soon as the robot detects the vehicle electronics locking or unlocking the doors, its inbuilt Lidar scanner measures the distance between the key and the vehicle, and surveys the vehicle's surroundings. The data that is generates goes straight to a central computer, where it is portrayed as a graphic.

The advantages of the system are obvious: "This robot is not only much faster, it's also more precise. The results we obtain are highly detailed and, most importantly, objective. So we can even start validating the function before the car has its first test-drive," explains Martin Hilt.

Vehicle location in the production system

The specialists responsible for product integration at Plant Munich ensure stable processes to deliver defect-free vehicles throughout. They are also responsible for integrating pre-series vehicles into production to allow a smooth official production launch with series quality right from the start.

“Since the start of this year, our specialists have been using a new app that notifies them as soon as the pre-series vehicle they are tracking reaches a specified point in assembly. It allows them to locate any car they want – so they can check, say, a particular combination of equipment features,” says Martin Hilt.

The new app not only replaces the manual process but also improves validation. In the future, it can also be used on series vehicles.

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The BMW Group production network

In 2019, strong customer demand and new models kept capacity utilisation high across the BMW Group production network. Production volumes for the BMW, MINI and Rolls-Royce brands reached record levels, with output totalling 2,564,025 units. Of those, 2,205,841 were BMW vehicles, 325,729 MINI, and 5,455 Rolls-Royce Motor Cars. Approximately 1 million vehicles were manufactured by the German plants.

Uniquely flexible and highly efficient, the BMW Group production network is able to respond quickly to changing markets and regional sales fluctuations. Expertise in manufacturing is a key contributor to the BMW Group's profitability.

The BMW Group production network uses a range of innovative digital and Industry 4.0 (IoT) technologies, including virtual reality, artificial intelligence and 3D printing applications. Standardised processes and structures across the production system ensure consistent premium quality and allow a high degree of customisation.

The BMW Group

With its four brands BMW, MINI, Rolls-Royce and BMW Motorrad, the BMW Group is the world's leading premium manufacturer of automobiles and motorcycles and also provides premium financial and mobility services. The BMW Group production network comprises 31 production and assembly facilities in 15 countries; the company has a global sales network in more than 140 countries.

In 2019, the BMW Group sold over 2,520,000 passenger vehicles and more than 175,000 motorcycles worldwide. The profit before tax in the financial year 2018 was € 9.815 billion on revenues amounting to € 97.480 billion. As of 31 December 2018, the BMW Group had a workforce of 134,682 employees.

The success of the BMW Group has always been based on long-term thinking and responsible action. The company has therefore established ecological and social sustainability throughout the value chain, comprehensive product responsibility and a clear commitment to conserving resources as an integral part of its strategy.

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