

Examining the manufacturing processes of two recent automotive models - the new Mercedes-Benz Actros semi-tractor trailer truck and the Toyota Hybrid Camry - provides many illustrations of effective implementation of management techniques designed to improve manufacturing practices.

The Actros truck is manufactured at the Daimler factory in Worth an Rein in Germany and the Hybrid Camry car at the Toyota factory in Melbourne, Australia.

**[1]** Both factories are set up to produce over 400 units per day so manufacturing efficiency is essential to ensure that productivity can be maintained without any drop in the quality of vehicle produced.

**[2]** At the Worth factory the process of delivering the finished truck to the customer begins by establishing and confirming the final needs and specific requests. Care is taken to establish how the driver will use it - will it be a truck that will be driven for long periods of time? What size of cabin will be required? Dozens of features can be altered to suit the individual needs – meaning that each truck produced is unique.

**[3]** From the time the order of an Actros truck is confirmed by the customer the manufacturing plant has only six weeks to order and bring together all of the required parts for that specific truck.

**[4]** The truck manufacture involves two main body parts – the chassis, which is the backbone of the truck, and the cab unit in which the driver sits. In the Worth factory both follow separate assembly routes. The chassis comes together following a straight path down one assembly line and the cab takes a roundabout path to the spot when the two come together for the final stages of the process. By the end of the assembly journey approximately 4000 different parts produced by around 1000 different suppliers will have come together to form the final product. In line with current 'lean manufacturing' practice about half of these parts arrive 'just in sequence' – a term which equates to the Toyota 'just-in-time' concept of parts management.

**[5]** The assembly process for the chassis begins with the arrival of the side members in pairs. They have been pre-drilled with pilot holes positioned to each truck's specific requirements. These holes act as guides for the dozens of bolts and fittings that will hold the frame together. Access to new technology allows assembly information to be written directly onto the frames with automatic laser chassis labelling - for example the length and the positioning of a particularly critical screw. In this way the worker gets easy access to all information necessary for the chassis assembly.

**[6]** The chassis assembly lines total 600m in length and it takes six and a half hours to move from set up to the finish. Each piece is secured in place with industrial sized bolts before being moved on to the next stage with the brakes and core wiring requiring particular safety consideration and attention to detail because of the need to install lots of tubes and wires in a very small space .



**[7]** With the backbone of the chassis assembled, the limbs are added with the installation of the axles, springs and drive shaft. The completed chassis moves on to the chassis turning area where it can be finally flipped 'right-side-up'. All heavy lifting is carefully controlled and carried out using specialised lifting gear to ensure worker safety.

**[8]** While the chassis is being hand assembled, 350 robot workers are putting the body panels for the cab together. All cabs are custom assembled with each robotic production cell able to be pre-programmed to build any style of cab in any sequence.

**[9]** In the factory the assembly of an entire truck is scheduled to take just six days. Keeping track of the 4000 parts that have to be ordered and delivered to the correct position on the lines and keeping track of all parts requires complex planning and computerised monitoring systems. Unlike the Toyota plant, this planning is further complicated by the fact that a number of different models are being assembled on the same lines at the same time.

**[10]** Mercedes-Benz used to assemble its trucks at two different plants nearby. The site of the present Worth plant was originally purchased as an engine manufacturing facility. However in its drive to improve productivity the company decided to concentrate all truck production under one roof. The ability to assemble different models on the same lines produced economies of scale from volume production proved financially beneficial but the management systems have had to respond to successfully meet the logistical challenges.

**[11]** In both plants the increasing use of robots has been a key component in improving productivity. Robots can work quickly and reliably - assembling an entire cab in just nine hours. At the end of the assembly process cabs are directed through a cab-testing area. At this quality control point eight cabs are pulled from the assembly line for a concentrated series of tests to check the accuracy of the robot programming. Panels, rivets and glue must all be applied with perfect precision. To verify accuracy, 400 measurements are taken around the entire cab using automated spatial measuring devices.

**[12]** In the factory transport of components is managed by a driverless electronic transportation system being one of the first automation construction factories in the world to use this process to streamline production for maximum efficiency.

**[13]** The Actros cab shell then moves on to the paint shop for full immersion in a large electro-deposition tank followed by robot spraying with the final colour - selected from a palette of nearly 300 custom colours. Use of available automation technology means that the whole painting process can be completed in about 19 hours - including drying time.

**[14]** The quality of the final paint finish is critical so detailed checking then takes place. The colour shade is machine-analysed to match it to the standard specifications. Then the efficiency of the paint robots' work goes through a series of systematic checks for evenness and texture and to make sure there are no blemishes on the painted surface due to paint runs, gaps or dirt spots. All flaws are marked for immediate remedial attention.

**[15]** With the cab assembled and painted its ready for more components to be fitted. Doors, windscreens and interiors are attached to the cab. Then the bumpers and the dashboard follow their own path through the factory to meet up with their specified cab and the new fuel-efficient engine is finally fitted.

**[16]** Next the interior fitting of the cab takes place. The dashboard is installed within the two minutes allocated to the task and the cab is outfitted with glass. An array of windscreen styles can be provided and when fully assembled the robots take over to do the lifting and placing in position.



**[17]** After the cab seats are fitted the doors can finally be attached.

**[18]** The new truck design incorporates many additional safety features including LED lights which are stronger than conventional lights but more energy efficient. Electronic stability control and emergency brake assistance are standard fixtures and the radical new lane alert system caters for situations when driver attention may start to drift.

**[19]** With the outfitting completed the cab moves to the welding station to join up with its chassis.

**[20]** From there it's on to the start-up station where all the fluids are added and the lights, steering, engine and brakes are tested. Last on the quality control checklist is a roller-bed test to verify the truck's maximum speed. To check for efficient wet weather sealing of the cabin a sample of cabs are taken off the production line and soaked with water for 15 minutes. Finally all cabs move off the factory floor for storage ready for delivery.

**[21]** About two thirds of the trucks are shipped direct to their new owners and, with access to both the nearby river and national rail network, the manufacturing plant is ideally positioned for speedy and cost-efficient transportation.

**[22]** Many customers are able to pick up their new customised truck from the factory's customer centre where they can be introduced to the special features of their individual truck and take advantage of a full day driver training programme.

**[23]** This attention to detail and individual customisation has ensured the position of Mercedes-Benz in the forefront of the truck marketplace.