Quality built-in

Cat Lift Trucks has achieved a remarkable reputation for quality and durability. **eureka visited the plant at Almere,** near Amsterdam in the Netherlands, to find out how it is done.

You can build to low cost and may well succeed in upping sales - for a while, before the problems kick in. Gartner Research published a report in the early 2000s, which found that every cost-cutting drive it examined in an extensive survey had resulted in rising costs and falling market share for the companies concerned. Costs rose because quality fell and rework became commonplace; market share fell because the word got round, pretty quickly, that quality had slipped and cheaper products weren't worth it.

By contrast, the European plant of Cat Lift Trucks has seen its warranty work fall by about 60 per cent over 10 years – but it isn't satisfied. It has a philosophy of 'continuous improvement'; it simply won't accept the best it can do at the moment as the ultimate – it wants to do better. Every aspect of its operation is focused on eliminating waste and driving up quality. It first achieved ISO9001 certification in January 1998; it has held ISO14001 since 2002 and has also been recognised locally for its environmental management.

Quality from the start

The drive for quality started with the creation of the factory in Almere, near Amsterdam, in 1995. It is located with a canal one side and a street on the other. The effect of the lateral restrictions has been that it has adopted a ribbon layout. That, in turn, means that the opportunity for U-shaped work cells – widely adopted in 'Lean Manufacturing' – is very small. Where they exist, they are for relatively small parts of the process. That reality 'on the ground' means that the emphasis on quality and elimination of rework has to be even greater – it isn't as easy to bring people down a long line as it is to bring them across from another part of the operation.

Quality standards begin as components come in. New parts are loaded on to a precision measuring table and are inspected by a highly sensitive needle-tipped machine that compares its dimensions with the specifications in its database. Several measurements are taken and used to compare it with a 3D drawing, which is then overlaid within the computer on the original drawing. The component is either accepted or rejected. Three reports are produced: one for the supplier, one for inspection records and one for communication. There is simply no room for defects...

"We expect everything to be 100 per cent correct – zero ppm (parts per million defects)" said Hans van Maastricht, Senior Technical Trainer with Cat Lift Trucks, and our guide on the factory tour. However, this is real life, rather than an ideal world, and faults will occur. If an error is found, is the entire batch rejected? The answer is yes – to a point. "We will put the entire batch into quarantine, where it will be more intensely inspected. Whenever we find an infected part we will normally inspect a certain percentage more. That's for straightforward components." The ultimate objective is to have no 'infections' arriving at the plant at all, that everything will have been dealt with in the supply chain. "It's a manual operation and time consuming but it has to be done"

Continuous improvement, increased capacity

Inspection is undertaken by representatives of the Quality Department of this factory. The day may come when pre-delivery inspection, within the supply chain, ensures that nothing faulty arrives at the factory. Until that day when inspection is no longer necessary, a second machine is being installed, in order to increase capacity.

Maintenance of quality relies on accurate data and effective management of the production process. Every chassis and mast assembly is 'tattooed' with its identification number and has an electronic tag attached to it, which will record work done and communicate what it needs as it proceeds down the line. The system, devised by the quality department, ensures that incomplete parts or faulty components cannot make progress; they will be stopped and rectified. Customers aren't interested in machines that won't work: nor is Cat Lift Trucks.

There is one production line for all products. Diesel, LPG, three-wheel and four-wheel electric trucks proceed down the same assembly line and are built-to-order, rather than batch manufactured. The masts go down one line on one side of the factory; chassis and power trains go down another line in parallel, on the other side. The system is designed to ensure that the right parts are added to the right 'mainframe' at the right time. Van Maastricht likens the ultimate meeting to an ideal partnership.

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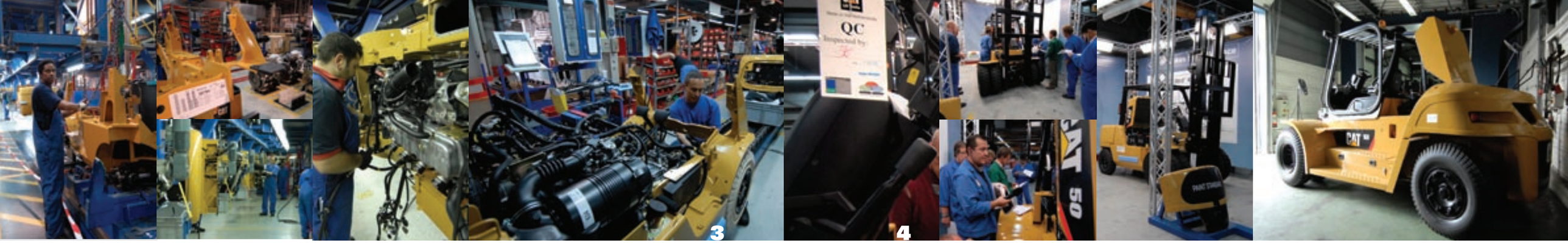
The speed of assembly is dictated by the paint shop – nothing can hurry the drying process along, although Cat Lift Trucks does its best. Before a mast goes into the paint shop, it is cleaned and prepared by shotblasting. The 'paint shop' is actually a tunnel, several metres long, with five nozzles either side spraying electrostatic-charged powder coating onto the roughened surface. They are pre-heated before entering the 220°C oven. This particular section features a U-bend, which gives the masts time to cool down before passing on to the next stage of the process. There is no pause in the line for cooling, no chilled lay-by; things keep moving.

Variety and complexity united

This factory has the capacity to make 70 trucks a day and the variety of options available means that it's rare to have two models that are exactly the same in immediate succession.

"We're talking about over 300 different configurations," van Maastricht said. "We have one to five-and-a-half tonne lift trucks; three-wheel; IC, diesel; and mast height profiles from 2.7 to 7 metre lengths. All the different mast sections are reduced to the 40 we have here, based on tonnage, class and ➔

Main image:
The Cat Lift Trucks plant at Almere, near Amsterdam in the Netherlands.
1. *To ensure quality at every stage, assembly line workers have the right to stop the line if something's wrong. In fact, they have to: if it's wrong, it doesn't go on.*
2. *Marrying the chassis to the services that make the lift truck work.*



3. *The chassis and bodywork are nearly ready to be mated to their engine.*

➔ size. They are supplied to the beginning of the mast line and cut to size on an Omegamada laser cutting machine." The company used to subcontract various components, such as fuel and hydraulic tanks, but it wasn't an effective approach. Decreasing costs is important in Lean Manufacturing but the ultimate focus has to be on quality, so fabrication of components like the tanks was brought in-house.

"We have found we have improved quality, cut faults, reduced inventory in the supply chain and improved our responsiveness and flexibility" he said. After cutting comes welding, a lot of which is performed by two machines working in parallel – one does the left side, the other does the right. This is a revision of the original arrangement and an example of how the company is willing to learn from its operations and act to improve them – the essence of "continuous improvement".

Learning from experience

"We used to split the masts in the middle – one machine did the top and the other did the bottom – but that wasn't as smart as it looked, because most of the welding is at the bottom," he continued. "So we had one machine working flat out and the other spent a lot of time idle, waiting for the next part. What we did was undertake a complete reprogram, for each of the 300-plus variations, to reach the side-by-side arrangement." Line operatives, design department and quality representatives were all involved. Question: why not alternate complete masts between the machines? "The production rate would only be 25 per cent of what it is now. Pairing makes them flow much quicker." After the final weld is in place, there will inevitably have been some heat-induced deformation. Pressure panels align the units before they go to painting. They go in as segments, which has eliminated the need for final pre-treatment and masking before painting.

On the other side of the factory, metal components for the chassis are wet treated with solvent for cleaning and degreasing before being painted. The chassis units are still wet painted, with every drop of liquid recovered, cleaned and reused – none goes into external effluent. The factory has been recognised with a special award from the Mayor of Almere for leadership in environmental planning and control.

Attention to detail

When the hydraulic lift cylinders arrive from suppliers, they are rotated and stored vertically in a buffer zone. It is an example of attention to detail in improving quality. Storing vertically takes pressure off the internal seals and keeps them circular – which reduces the risk of failure in operation. As the masts are assembled, with their chains and belts, hoses and hydraulic cylinders added; each workstation inspects the sub-assembly on arrival, before it passes to the next stage. It's a go/no-go arrangement - if there is any problem, the operator is empowered to stop production and either gets the issue fixed on the spot or pulls the faulty assembly out into a lay-by, where it will be inspected and rectified by a Quality Department representative. "The cause of the fault will be analysed and addressed, so improvement is going on all the time – and not just in the mast assemblies but in the chassis and powertrain assembly, as well" van Maastricht said. "We are continually looking for ways to do things better, to eliminate waste, errors and faults."

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Hoses are supplied in bulk, cut to required length (as identified by the chassis/mast ID number and work order) and fitted. "We use a huge amount of hoses but we only keep a maximum of one week's supply. If we decide to redesign the truck, we don't have to throw away loads of stock – the supplier has time to change."

At the end of the line, the masts are rotated to the vertical, ready to meet the chassis, which has been proceeding down its own line, at the same pace as the mast. Component parts are supplied as 'kits', which can vary from large pieces of steel for the body and counterweight, to the electronic wiring loom.

"Our steering axles used to be assembled and outsourced from a supplier. We now do it in-house," van Maastricht said. Once again, it's an approach that helps to control transportation and inventory costs and delivers improved quality. The line has been designed to be a comfortable environment in which to work – the assembly workers can perform all their tasks standing up. That's nice in itself but it goes further; a comfortable working position leads to fewer mistakes and better results. It also reduces sickness and accidents, because the people aren't trying to perform in cramped or awkward positions. The chassis skeleton will either be lowered from an overhead conveyor onto the powertrain or raised up, so the operatives don't need to kneel, bend down or reach up high. This set-up reduces errors, improves quality and cuts rework.

Perfect matches

Even tyres are matched to their intended vehicle before they arrive just in time (JIT) at lineside. They are all marked with their barcode, part numbers and order numbers, which makes them easy to identify and match up to the right chassis. Fluid filling, again, is controlled by the vehicle's ID tag. The wireless communication enables the equipment to identify where the chassis has to go and what it needs, in what quantities.

The final inspection follows 'cosmetics', which adds customised finishes and makes sure that the truck is in perfect condition.

"We maintain slave batteries here permanently, for testing and transportation of our electric trucks," van Maastricht explained. He wrote the program the company uses for charging and maintaining the factory's battery bank. He believes that an effective maintenance program is an important element – which is demonstrated in practice. These batteries have been running effectively for more than twice as long as the normal specified lifecycle.

"We have our own maintenance team, which is responsible for all our machinery except the welding machines," he explained. "Those are overhauled, serviced and repaired twice a year, during Christmas and summer shutdowns." A preventive maintenance schedule ensures that the rest of the factory's production equipment works reliably throughout the year.

Behind a big white wall is a testing area, which includes a tilting test. If any parts or trucks fail within the warranty period, then they are returned to Almere for detailed analysis and testing. It's all part of the determination of Cat Lift Trucks to ensure that quality is a defining characteristic of the brand.

"The quality processes we have embedded within the system help us on our journey to continually drive down warranty claims," van Maastricht said. "This helps us to reduce the hidden costs of rework – but, more important, it means that our customers have trucks that have a great performance and last a long time". People talk about initial costs, but Cat Lift Trucks looks at the total life time costs, which is a different approach, requiring a high quality product.■

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4. *A safe workplace is a productive workplace. Ergonomics help reduce accidents, faults and failures and make the working environment comfortable for assembly line operatives.*
5. *Inspection, analysis and empowerment combine to drive out waste and eliminate defects, which has helped cut warranty work by over 60 per cent in the past 10 years.*