ATHANASSIOS KALIUDIS

All aboard for the laser!

The automotive industry has long enjoyed the benefits of lasers and rail vehicle manufacturers could follow suit. This was the thinking behind setting up Photon AG and its latest signature project is proof that this idea was spot on.

Ten or fifteen years ago, the steel age seemed to be coming to an end in the automotive industry as experts heralded a new era of aluminum. But then along came laser welding, tailored blanks, 3D laser cutting, high-strength steels, huge boosts in productivity, and the widespread emergence of light-weight steel construction. Applying these new developments to rail vehicle manufacturing is the recipe for success chosen by Berlin-based Photon AG □ and something of a personal mission for its technical director, Holger Alder.

"In the auto industry, lasers have a proven track record of faster, cheaper and more efficient performance. They've even created entirely new methods of construction," says Alder, who was employed by an automobile manufacturer before joining Photon AG. "In the past few years, we've repeatedly shown that the technologies used to build cars can also be applied to rail vehicle manufacturing. But obviously this isn't a one-to-one transfer □ you need to get people on board and make them rethink what works best."

Strict safety regulations

The know-how gained by Photon AG in its early days suggests that this may be something of an understatement. In fact, the differences between manufacturing automobiles and rail vehicles are substantial. While batch sizes in the auto industry often run into the hundreds of thousands, a decent order in the rail industry could be much smaller, perhaps in the region of several hundred parts.

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Holger Alder | technical director of Photon AG

What's more, the safety standards in rail vehicle manufacturing are sometimes higher than those in the auto industry — especially when it comes to high-speed trains — and that makes the processes involved more complex. Once a company has finally obtained all the necessary stamps and certificates for a product, it can be tempting to stick to the same track rather than reworking designs from scratch. "Copy and paste is the lowest-risk method," says Alder with a smile.

Similar challenges as Automotive industry

Yet at the same time the rail industry is facing similar problems to those besetting carmakers. For example, manufacturers are starting to pay more attention to the weight of their rolling stock. Since many rail cars and loco- motives have a service life of up to 30 years, every unnecessary kilogram will ultimately travel millions of kilometers, dragging down the train's overall energy efficiency year after year.

Efficiency is also becoming a bigger issue on the production side as companies strive to make their rail vehicle manufacturing processes faster and more cost-effective. The challenges that make lasers an appealing option for rail vehicle manufacturers are practically the same as those facing the automotive industry. Photon AG has overcome these challenges hundreds of times in recent years thanks to the advantages of laser machining.

A prestigious large-scale project: ICE 4

"Lasers enable us to save time, costs and materials in component welding while simultaneously boosting quality," says Alder. The industry is increasingly embracing this approach. In 2014, Photon AG was awarded a prestigious large-scale project involving the production of side walls, roof panels and undercarriage components of around 1,600 rail cars for the new ICE 4, which Siemens/Bombardier is building for Deutsche Bahn.

Before assembling the prototype, Photon AG worked with the customer to define the manufacturing strategy for the side walls. These are composed of five modules □ each five meters long □which are almost completely prefabricated by Photon AG before being assembled by Bombardier in its own facility.

Return to Steel

In terms of materials, the ICE 4 marks a return to steel. The rail car bodies of previous incarnations of the ICE were made of aluminum to keep them as light as possible. "That's a material that many people associate with lightweight design, and rightly so," says Alder. "But aluminum generally has a lower tensile strength than steel. So to meet the load-bearing requirements you have to compensate by using thicker materials and large-volume profiles."

Since the width of trains is limited by the track gauge, this increased volume could only be extended into the freight and passenger compartments. The ICE 4 is aiming to regain this lost space for passengers by switching to an outer skin made of lightweight steel □ obviously without upping the weight or making any compromises in regard to rigidity or safety. Photon AG is familiar with these requirements from the automotive industry and can fulfill them using laser technology.

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"To stay within the weight limits, most of the outer steel shell can't be any thicker than two millimeters. Yet, if we were to weld metal that thin by conventional means, the amount of heat applied would make the outer skin look like a rollercoaster track," Alder explains. "But thanks to the very high quality of laser weld seams, we can weld even thin steels like this with virtually no distortion and virtually no need for any postweld work." Additional weight reductions are achieved by using tailored blanks that ensure that all the sections of the outer skin are only ever as thick as they need to be.

Challeging series production

The side wall segments from Photon have already been fitted to seven ICE 4 trains □ some of which are already in on-track testing □ and a further four trains are currently in production. Once series production gets underway in late 2016, the company will be producing ten segments a day, equivalent to the outer skin of one complete rail car. The logistics of dealing with this quantity of components in such large dimensions is another challenge that Photon AG has mastered over the years. In fact, the company has manufactured almost 3,000 side walls for regional trains over the past three years, some of which were as long as 16 meters. Five-meter sections seem fairly easy to manage in comparison.

For Holger Alder, this major order represents another milestone in rail vehicle manufacturing. Picture: Angelika Grossmann

Photon AG manufactures rail car side walls up to 25 meters long in its laser cabin. Picture: Angelika Grossmann

"The big challenge of this project was to find a time-optimized automation method for producing the outer skin segments," says Alder. Photon came up with the idea of producing the segments in two laser cabins that can be loaded from two sides. Each cabin contains a robot that welds the sheet metal parts together and attaches them to the longitudinal and transverse struts to keep them stable. While one auto- mated fixture is leaving the cabin with its welded assembly on board and the next is taking up position, a TruDisk disk laser is busy feeding the welding robot in the other cabin. This ensures optimum use of the laser at all times.

Aviation beckons

Having already tackled both the automotive and rail industries, Photon AG knows a thing or two about tapping into new markets □ and the company already has the next in its sights: "Our experience in designing and producing safety-relevant components and focusing on small and medium production runs makes us the perfect choice for jobs in the aviation industry. We're hoping to secure more orders in that industry over the next few years."

The company is always careful to ensure that customers get the competitive prices they expect. "Nobody buys things any more just because they have a 'made by laser' sticker on them! What customers are ultimately looking for is high quality at a price that is comparable to that of conventional welding, or even lower."

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The Photon AG is specialized on the development and use of industrial laser applications in metalworking.
It focuses on laser welding. Furthermore the company offers products and services for the areas of signal and communications technology, sheet metalworking and housing technology.

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