CASE STUDY

Manufacturing Lessons from Space

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How Earth-Bound Manufacturers Can Benefit from Aerospace Manufacturing Methods

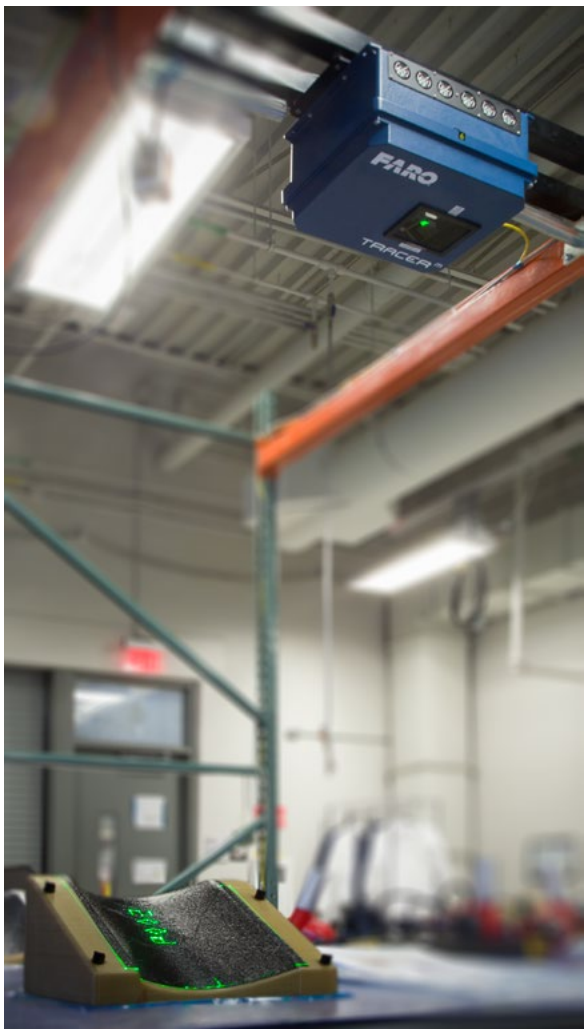


Figure 1. A Tracer™ projecting onto a winglet mold for laser-guided layup in a composites assembly facility.

Building airplanes and spaceships poses some of the most unique engineering and manufacturing challenges mankind has ever encountered. Fortunately, you don't have to build rockets to benefit from rocket science. Manufacturers of most any product can improve their efficiency and profitability by studying some of the approaches the aerospace industry takes to overcome production obstacles such as waste, rework, and engineering changes.

SWaP-C Factors

Organizations who use composites such as Spirit, GKN, Boeing, Airbus, Albany Engineered Composites, and SpaceX do not tend to share proprietary processes, but they do share common hurdles when it comes to engineering and manufacturing. Aerospace – and all other manufacturing verticals — must consider size, weight, power, and cost. And they must factor those elements into the scheme of a complete system or product.

"There's a term used by military and aerospace design called SWaP-C, which stands for size, weight, and power. The remaining C is for cost," explains John Earnshaw, product manager for Laser Projection at FARO®. "Any time you can reduce a size or weight factor while simultaneously maintaining strength and quality, it has a positive effect on the power and/or cost factors of the SWaP-C formula."

In the aerospace industry, the use of composites has become mainstream because of its excellent strength-to-weight ratio. Within the SWaP-C framework, lighter parts mean less power is consumed by an aircraft, which results in multiple benefits such as more time aloft, fuel savings, or increased payload. Basically, the lighter your launch vehicle, the more payload you can carry and use less fuel doing it.

When composites were introduced, their unique properties had wondrous effects on the weight and power aspects of the SWaP-C formula. Unfortunately, the labor-intensive nature of engineering and production with composites certainly did not reduce the cost factor. Laser Projection technology is helping to change that.

*The use of a Laser Projection Solutions typically results in a **50% to 75% labor savings** versus using traditional physical template methods.*

Depending on production volume, payback is typically a year or less.

FARO®

Bringing Aerospace Ideology Down to Earth

In many cases, established production methods are the consequence of limitations in technology. Advancements in technology bring opportunities for more efficient methods of construction that improve on one or more of the SWaP-C principles. This holds true for all manufacturing verticals, not just aerospace. Some of these industries include ship building, automotive, trucks and trailers, small aircraft, marine and private yachts and boat building, wind turbines, plus any other composites assemblers including aerospace tier 1, 2 and 3 suppliers. Virtually any company in which product strength and weight really matter should be considering composites.

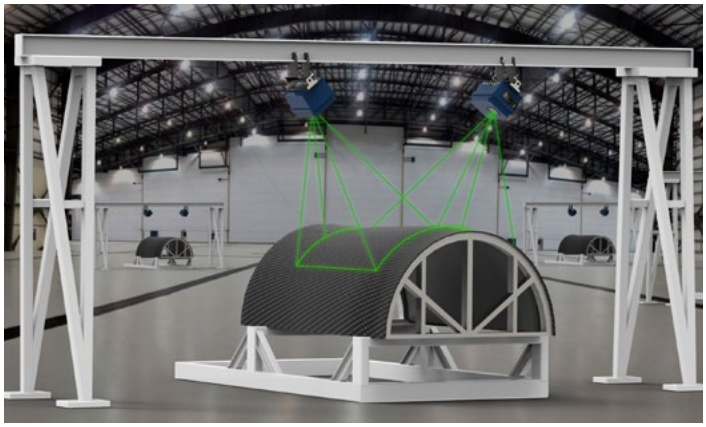


Figure 2. Two Tracer^{M} projectors projecting onto an engine nacelle for ply layup in a composites clean room

If the use of composites is crucial for aerospace to be a viable industry, the use of Laser Projection technology is crucial for composites to be viable as a cost-effective material in the general manufacturing arena.

"If you're utilizing composites to build a racing bicycle, a boat hull, or a wind turbine rotor, something of that nature, you want to minimize weight and maximize strength, which is where detail engineering comes in," says Jerry Reitmayer, composites industry veteran and key account manager at FARO. "You have to decide exactly how many plies go where to reinforce the structure while reducing weight. Laser Projection has become a preeminent tool in composites because you can position small pieces within the lay-up in specific areas."

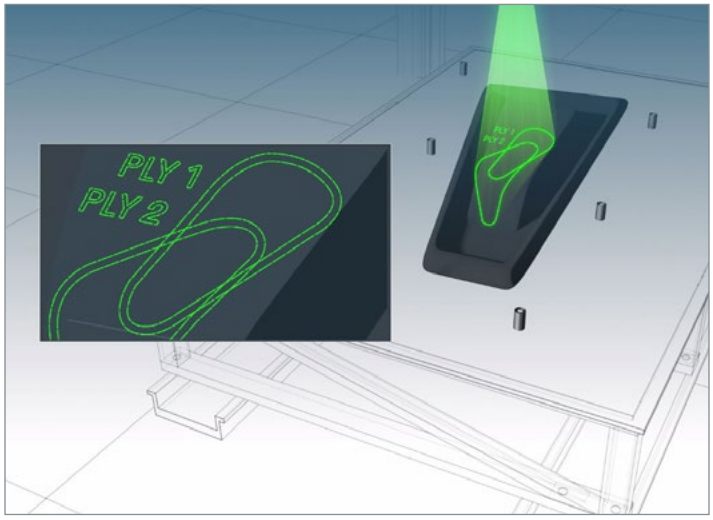


Figure 3. Tracer^{M} projection of multiple plies onto a composites mold

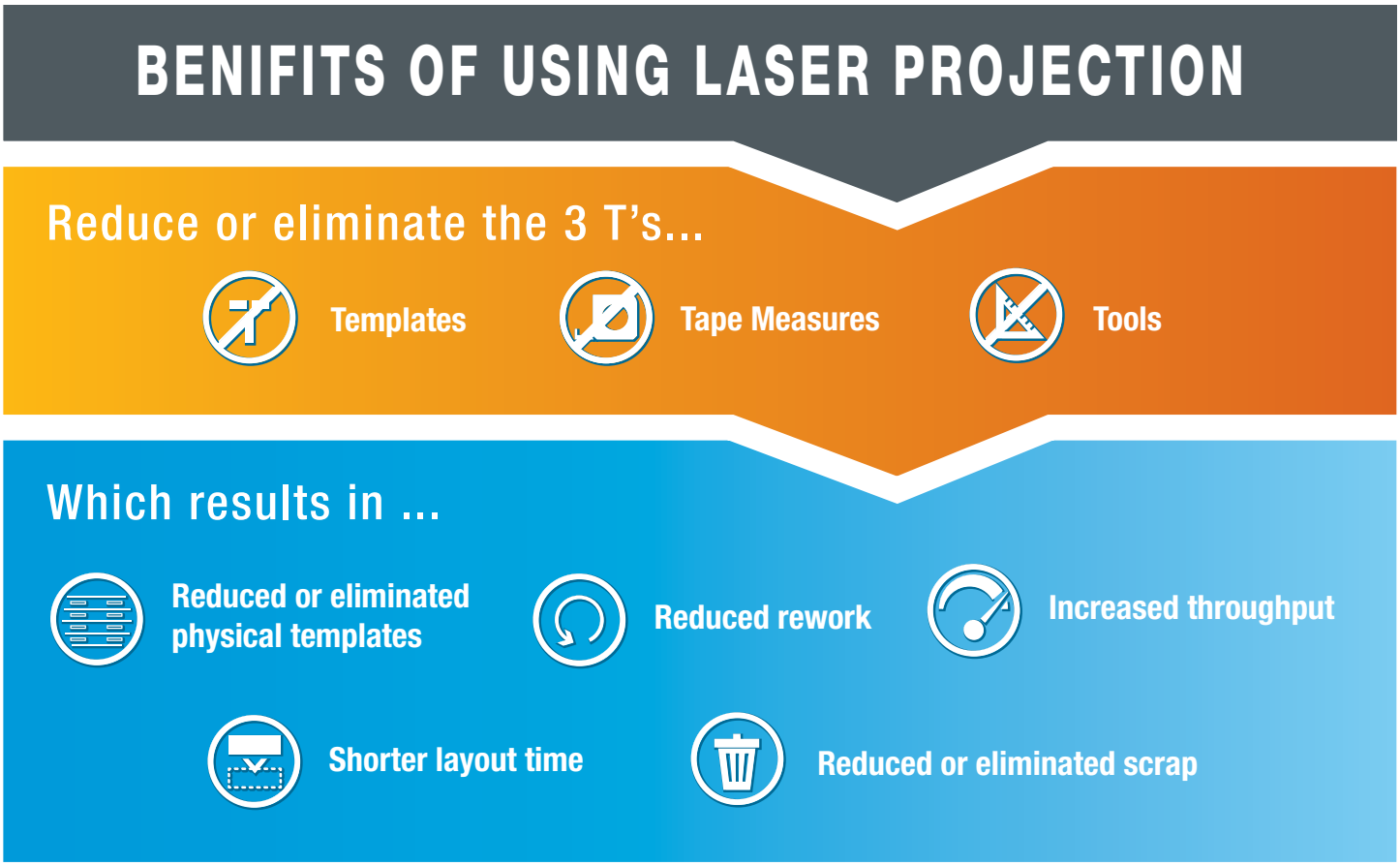
Most composites layups involve multiple plies. Using outdated tools, such as tape measures and Mylar® templates, makes the layup process slow, tedious, and sometimes inaccurate. If you're using Mylar templates, just the process of walking over and finding the right Mylar for the next ply layer (sometimes referred to as non-layup time) slows production and throughput, not to mention that every engineering change necessitates a new template.

Compare this to laser-guided layup where the images of what ply is to be placed where are projected directly onto the surface, step-by-step, as it is being built.

"When developing and launching a new product, the number of Engineering Change Orders (ECOs) are unbelievable," Quips Reitmayer. "If you had to create a new Mylar for every ECO, you'd be wanting to buy stock in a Mylar company."

The ability to make engineering changes on-the-fly, such as adding segmented plies, has opened tremendous opportunities for advancements in engineering design and application simply because this technology has been overlooked as something specific to the aerospace industry.

Eliminating the time it takes to build physical templates is crucial to reducing innovation and manufacturing costs. Using Laser Projection greatly reduces the pain points of the ECO process. When the CAD model is changed, Laser Projection changes are uploaded to the computer that controls the projector and the change is immediately implemented on the next production unit.



Laser Projection on the Production Floor

For most composites manufacturers, effective risk management can make the difference between break-even and profitability.

Depending on the size and complexity of a part, and how far down the production line it may have gotten, a single scrap event can cost in the tens to hundreds of thousands of dollars range, sometimes into the millions of dollars. However, the issue is more than "just" the cost of the scrap event. While the cost of the labor and carbon fiber components are high, there is sometimes a schedule impact which ripples through the entire production process. Delays in production sometimes result in contractual penalties which might be even more significant than the cost of the material scrapped.

With computer and laser-guided assembly, the possibility of having defects during the layup process is greatly reduced. In aerospace, as with other industries, the most skilled workers are often put on the main shift. When there is a second or third shift, there may be "shift creep" or lower skill and productivity levels. Laser-guided assembly solutions such as the FARO Tracer[M] help to solve this problem.

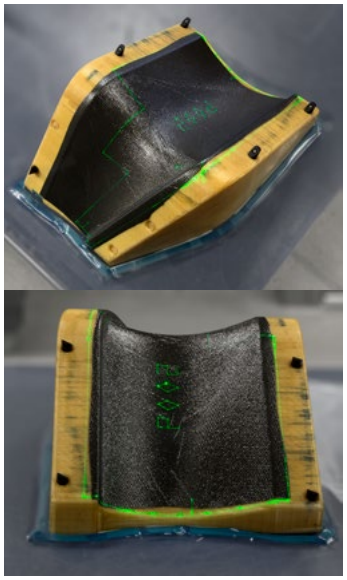


Figure 4. Projection onto a composite winglet mold.

Return on Investment

The proliferation of rapid prototyping as an outsourced service is evidence of the value of technology that can reduce time to product launch. Even manufacturers outside of aerospace are discovering that in many cases, having Laser Projection in their own facilities makes good business sense.

The use of a Laser Projection solution typically results in a 50% to 75% labor savings versus using traditional physical template methods.

For some companies, FARO's Tracer^{M} solutions have resulted in an ROI, or payback period, of just a month. Depending on production volume, payback is typically a year or less. When you consider that a Tracer^{M} typically has a ten-year useful life, the long-term ROI is outstanding.

It's not rocket science; faster assembly and layup time, improved quality and accuracy, reduced or eliminated scrap and rework, all add up to ROI for any organization or industry.

Conclusion

There's an old axiom in manufacturing that looks like this;

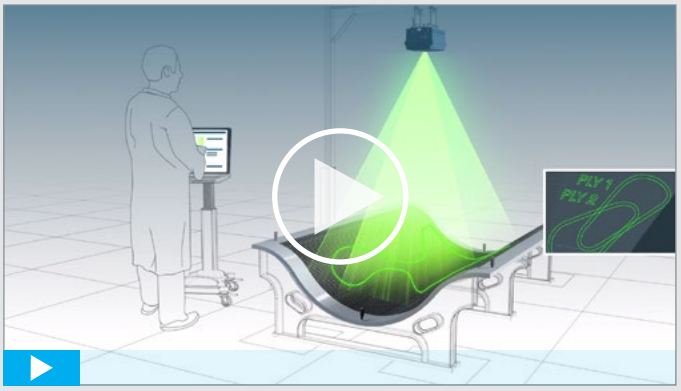
Today's menu:

- High quality
- Fast turnaround
- Low price

... Choose any two.

Technology like Laser Projection may be making inroads on that axiom. It's just basic business math. More efficient production plus less rework equals lower production costs. Lower production cost equals increased profit margin. Increased profit margin allows you to sell your high-quality products for less and still increase revenue.

From aerospace to automotive to custom bicycles, if you're not using the best technology, you're not creating the most value.



Click above to watch a video on the Tracer^{M} in composites applications.

Click above to watch a three-minute demo video on FARO's Tracer^{M} Laser Projection System.

View more of FARO's case studies at ***www.faro.com***