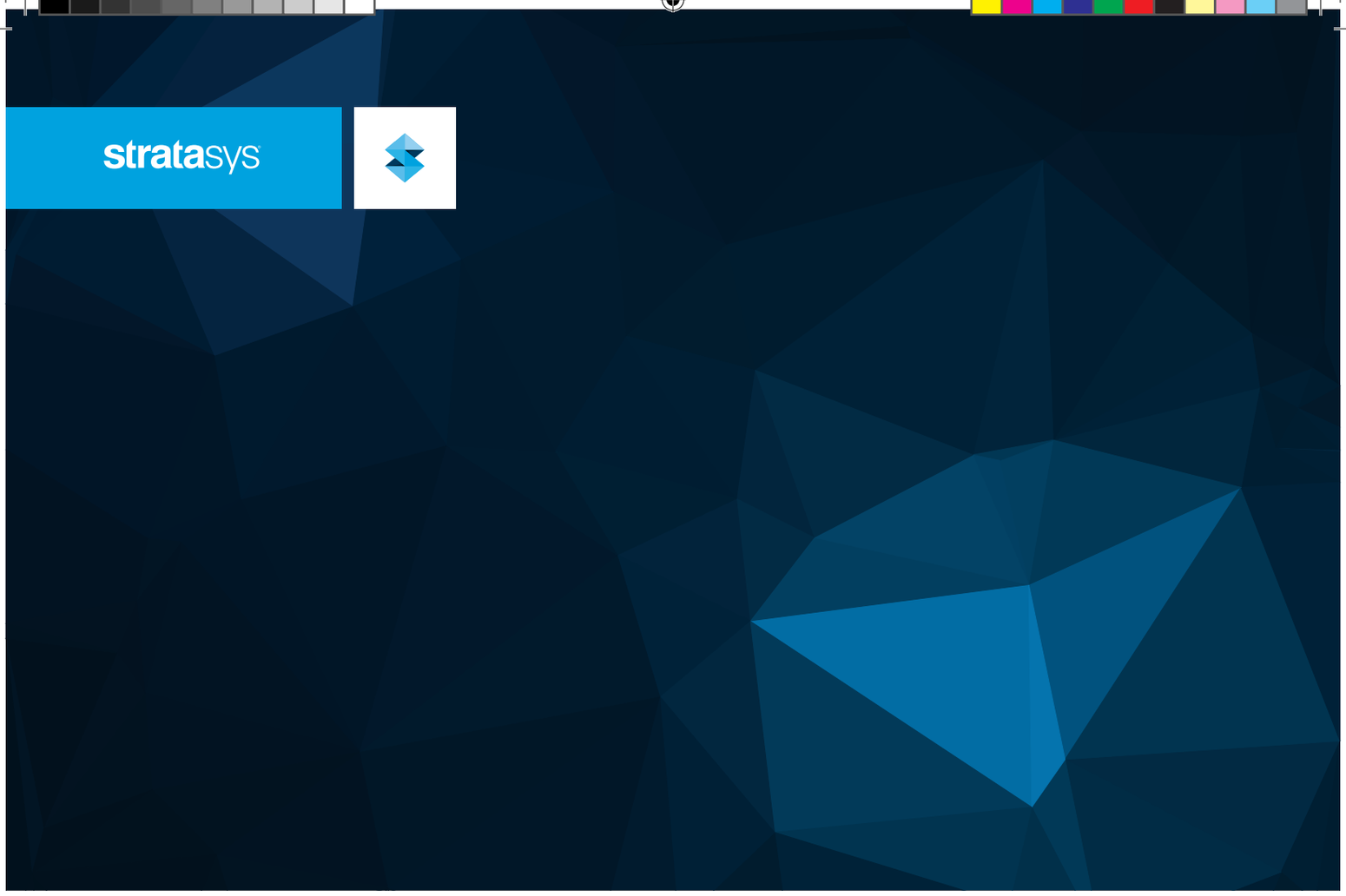

Jigs And Fixtures: More Profitable Production

PRODUCTION TOOLS WITHOUT TOOLING DELIVER REAL VALUE TO MANUFACTURERS WITH 3D PRINTING

3D printing has moved beyond prototyping. The current state of 3D printing systems, materials and parts-ondemand providers makes 3D printing jigs and fixtures and other manufacturing applications practical and accessible to manufacturers. Mainstream manufacturers are wise to seize on the economic and efficiency advantages offered by this technology, as well as the new possibilities it opens.

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NEW POSSIBILITIES

New possibilities are born of new capabilities. The ability to dramatically lower production times and costs on complex, low-volume components, often while increasing functionality, is a game changer.

What's at stake for manufacturers are the prospects to improve current operational efficiencies and reduce costs, as well as capitalize on new product and market opportunities. Ultimately, 3D printing may enable strategic initiatives that change manufacturing and business models, and provide disruptive competitive advantages.

Underlying the operational value of 3D printing are new ways to mitigate risks inherent in traditional manufacturing:

- Product and production risk due to imperfectly designed parts
- Missed opportunities to supply new products to customers due to delays using traditional processes
- Missed opportunities to innovate parts and Products using new design and manufacturing capabilities.

Organizations realize that short-term opportunities are real, but the implications of not developing proficiency with this new capability could be even more significant.

JIGS AND FIXTURES: A VALUABLE STARTING POINT

As 3D printing grows beyond just prototyping, manufacturers are finding a valuable asset in the production of jigs and fixtures. 3D printing jigs and fixtures typically yields lead-time reductions of 40 to 90 percent and cost savings of 70 to 90 percent.

The fundamental objectives of manufacturing — quality improvement, decreased cycle time and reduced costs — are the primary reasons that jigs and fixtures are so ubiquitous. It doesn't matter if an operation is fully automated or entirely manual: jigs and fixtures are deployed throughout manufacturing operations.

Going beyond jigs and fixtures, manufacturing tools that serve as operational aids further broaden the opportunities. They range from organizational bins and tool holders for 5S (a workplace organizational methodology) to templates, guides and gauges. They include sophisticated robotic end-effectors (grippers)

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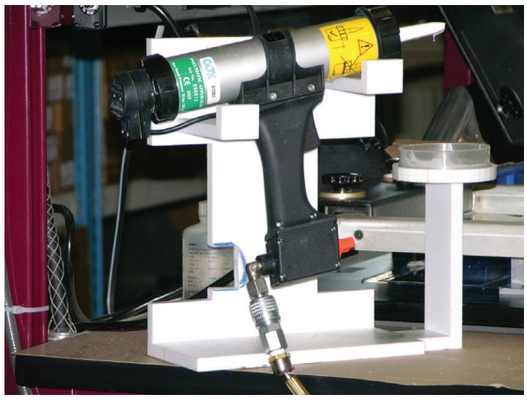

When machined fixtures were quoted at $12,000 and seven days, Thermal Dynamics opted to make them with FDM to save $10,000 and several days.

and rudimentary trays, bins and sorters for conveyance and transportation. No matter the name, description or application, manufacturing aids increase profit and efficiency while maintaining quality.

How Did FDM Compare to TraditionalMethods for Thermal Dynamics?

METHOD	COST ESTIMATE	TIME ESTIMATE
Conventional machining and fabricating (6 fixtures)	$12,000	7 Days
Direct digital manufacturing with FDM (6 fixtures)	$2,040	4 Days
SAVINGS	**$9,960 (83%)**	**3 Days (42%)**

Even though manufacturing tools like jigs and fixtures are widespread, many manufacturing facilities don't use these tools to their fullest: Making them takes time, labor and money.

However, 3D printing stretches limited resources. It provides a simple, automated, fast and inexpensive methodto fabricate customized parts and products.

SMASHING BARRIERS

Substituting 3D printing for traditional methods of making jigs and fixtures can reduce their cost and accelerate delivery. In these terms alone, 3D printing systems are justified with short payback periods.

But this ignores the larger impact on the bottom line: 3D printing lowers the threshold for justifying a new tool. It does this by simplifying the process, lowering the cost and decreasing lead time. This allows you to potentially address unmet needs throughout the production process.

How Does FDM Compare to Alternative Methods at Thogus?

PART/TOOL	FDM	ALTERNATIVE METHOD
End-of-arm robot	$618 24 hours	$10,000 4 weeks
Steel plates	$21/ 2 hours	$200 2 weeks

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With 3D printing you have the power to:

- improve process throughput;
- lower inventories by producing on demand instead of inventorying;
- re-apply skilled workers more productively; and
- reduce scrap and rework.

PRACTICAL EXAMPLES

Thogus Products is an injection molder that specializes in low-volume manufacturing and highly engineered materials. According to Natalie Williams, quality manager at Thogus, “It is so much easier for me to model a fixture and print it myself than it is to design it and work through an outside machine shop.”

For Thogus, 3D printing is easy and fast. “For one 12-cavity CMM fixture the lead time, if outsourced, was seven to 10 days. I built it overnight [with 3D printing],” Williams says. Manufacturers using FDM®-based 3D printers and 3D production systems to create custom manufacturing tools often experience lead-time reduction of 40 to 90 percent. In many cases, jigs and fixtures are manufactured with only 15 minutes of hands-on labor.

3D printing increases return on investment by reducing the cost of a jig or fixture. Typically, companies realize savings of 70 to 90 percent when compared to outsourced fixtures that are machined or fabricated. Thogus saved 87 percent on its 12-cavity fixture. “The machine shop wanted $1,500 for the fixture. I made it for less than $200 in materials,” says Williams.

BETTER DESIGNS, BETTER PERFORMANCE

3D printing also optimizes tool performance. Previously, designs for jigs and fixtures rarely improved past what was sufficient to do the job. Due to the expense and effort to redesign and remanufacture them, only malfunctioning tools

BMW's jigs and fixtures department used a Fortus® 3D Production System to manufacture assembly tools. This tool is used to affix the rear name badge.

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received revisions. This “good enough” thought process may have added a few seconds to an operation or increased the scrap rate by a small percentage, but the savings might not have warranted further investment in the tool.

3D printing changes that thinking. The cost is so low, it can deliver the next-generation manufacturing tool in time to have it in service the next day. A simple tool like this requires only a little time and initiative to redesign. While a redesign may only drive out a few seconds from an assembly operation, that time adds up. If the fixture is used to make 500 items per day per worker, a two-second savings reduces direct labor by 70 hours per person per year. For the same part, a onepercent reduction in scrap would save 1,250 parts per year. The bottom line: more jigs and fixtures with optimized designs in service mean more money to your company’s bottom line.

How did FDM compare to traditional CNC machining for BMW?

METHOD	COST ESTIMATE	TIME ESTIMATE
Traditional CNCMachining (Aluminum)	$420	18 days
Fortus System (ABS-M30™ Thermoplastic)	$176	1.5 days
SAVINGS	**$244 (58%)**	**16.5 days (92%)**

PRINT ON DEMAND

Stop thinking of your jigs, fixtures and other manufacturing tools as assets. Instead, think of them as expenses, and disposable. As assets, jigs and fixtures are stored (inventoried) between uses. They remain in inventory until the product line is retired or they are worn beyond repair. With the time, cost and effort of making manufacturing tools through conventional methods, they are too valuable to be discarded.

This approach carries many indirect costs, however. There is cost for the shelf space (warehousing expense), cost to manage and track the inventory, and cost to locate a jig or fixture when needed. For sporadically used tools, these costs can be quite significant.

The opposite can be true with 3D printing. Often, it takes more resources to inventory jigs and fixtures than it does to remake them. So, companies adopt a management approach called digital warehousing where only the digital file is carried in inventory. It may seem unthinkable to scrap a perfectly good manufacturing tool, but for those with infrequent use, this approach reduces cost and labor.

Now companies make a fixture when it’s needed, and then digitally warehouse its design for future

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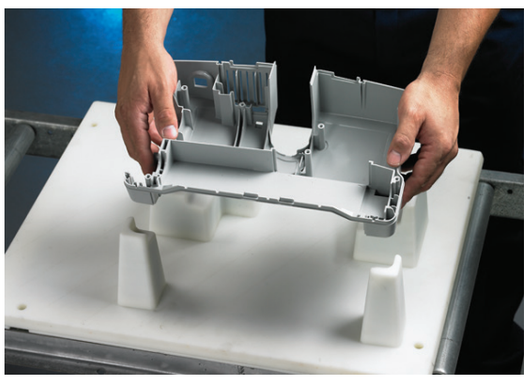
uses. This print-ondemand approach is also handy when a replacement is needed for a broken manufacturing tool or duplicates are needed for increased production to meet an unexpected surge in sales.

Additionally, parts-on-demand providers deliver a simple, lowcost, service-assisted method of starting for new adopters of 3D printing. These providers bring expertise, flexibility and finishing services that accelerate results. Organizations with internal systems that experience capacity constraints, or projects

that require special materials, benefit from 3D printed parts on demand as well.



Oreck uses this jig during assembly of its vacuum cleaners. Here a vacuum top cover is placed into the pallet upside down.

How Did FDM Compare with Traditional Methods for Oreck?

METHOD	TOOL PRODUCTION	COST	TOOL PRODUCTION TIME
Traditional CMC	1 days	$250	30 days
FDM Tooling	3.5 Hours	$55	1 day
SAVINGS	**3.5 days**	**$195 (78%)**	**29 days (97%)**

An operator at Xerox modified 350 connectors in about an hour on this toggle press.

How did FDM compare with traditional tooling methods for Xerox?

METHOD (TO MAKE 350 PARTS)	COST	LEAD TIME
Building by hand	$7,200	120 hours
Punching with steel rule dies	$11,450	200 hours
Punching with FDM tooling	$268	5.5 hours
SAVINGS	**$11,182 (98%)**	**194.5 hrs (97%)**

CONCLUSION

3D printing can lead to big changes that maximize profits by driving out every wasted second and penny from the manufacturing process. Rather than replacing traditional manufacturing methods, it should be viewed as a complementary technology that adds value and opens new possibilities. Savings on the manufacturing floor and in jig and fixture production will be substantial.

If you have a 3D CAD file and access to a 3D printing system, you are ready to start fabricating manufacturing tools with as little as 15 minutes of hands-on labor. Combine the simplicity with typical time and cost reductions of 40 to 90 percent, and you will understand why 3D printing spurs companies to make more jigs, fixtures and other manufacturing tools than ever before. Perhaps most importantly, starting now with jigs and fixtures and other tools puts you and your manufacturing team on the path to rethinking your production process and even business model.

info@stratasys.com

STRATASYS.COM

HEADQUARTERS
7665 Commerce Way, Eden Prairie, MN 55344
+1 888 480 3548 (US Toll Free)
+1 952 937 3000 (Intl)
+1 952 937 0070 (Fax)

2 Holtzman St., Science Park, PO Box 2496
Rehovot 76124, Israel
+972 74 745-4000
+972 74 745-5000 (Fax)

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