



HOW MANUFACTURERS SHOULD UTILIZE THE SYNERGY BETWEEN 3D PRINTING AND LEAN TO CONTINUOUSLY PUSH THEIR BOUNDARIES.

THE MANUFACTURING INDUSTRY IS UNDER EVER MORE CONSTANT PRESSURE TO PRODUCE BETTER GOODS MORE QUICKLY AND AT LOWER COST. WITH INCREASING GLOBAL COMPETITION AND THE ECONOMIC CHALLENGES OF THE COVID-19 PANDEMIC, INDUSTRIES MUST TAKE HUGE LEAPS FORWARD IN STREAMLINING OPERATIONS, RE-TOOLING PLANTS, AND INNOVATING HOW THEY DESIGN AND BUILD PRODUCTS IN ORDER TO BOOST OR EVEN SIMPLY MAINTAIN PROFIT MARGINS.

In many industries, the COVID-19 pandemic lockdowns and border closures wreaked havoc with supply chains, requiring many manufacturing companies to rapidly re-evaluate and overhaul their supply chain strategy. One of the winners to emerge from this shakeout was 3D printing, which was called into action when manufacturers faced shortages of spare parts.

“Manufacturers who were forced to turn to local 3D printing service providers when they ran short of needed components now see additive manufacturing as a key part of a future risk-reduction strategy,” says Seif Shieshakly, Co-Founder and Managing Partner of Four Principles.

Lean Manufacturing and the Digital Age

Lean Manufacturing is a production management system introduced by Toyota that was developed to eliminate unnecessary operational steps and reduce waste, in both materials and time. In the past year and a half, as manufacturing companies have needed to adapt at an unprecedented pace, Lean manufacturing has gained even more prominence as an ideal method to solve problems in the supply-demand chain, deal with transport issues, and set up a cycle of continuous performance improvement and cost reduction.

Lean helps manufacturing companies reduce waste by removing from the production system anything that does not add value to the product. According to the principle of continuous flow, Lean manufacturers achieve a stable, continuous production cycle in which the product moves through from initiation to sale without barriers or blocks. Ideally, organizations that undergo a Lean transformation bring products to market utilizing only the necessary - and predicted - amount of resources.

How 3D Printing is taking over the factory floor

Constantly under threat from competitors, manufacturers continually look for ways to produce goods at higher quality and lower prices. By reducing the number of steps required to take a product from concept to store shelves, 3D printing reduces both labor and materials costs.

Frequently described in the industrial sector as additive manufacturing (AM), 3D printing is the process of binding together resins or powders into a three-dimensional object. Additive manufacturing differs from other processes in these ways:

- Creates very little material waste as compared with milling, cutting, and other “subtractive” processes
- Requires little or no custom tooling
- Allows for customization of each component
- Is able to deal with complex shapes and geometries impossible using subtractive techniques
- Allows for more complex three-dimensional designs perfectly tailored to requirements
- Builds inventory on demand, achieving a just-in-time (JIT) manufacturing system

Industrial clients are under constant pressure to manufacture products more quickly and at lower cost to outpace and undercut competitors,” says Shieshakly. “It’s clear that 3D printing is a game-changer in Lean manufacturing, supporting all the key Lean principles of reducing waste and increasing efficiency.”

How Lean and 3D together create greater efficiency

Lean management consultants can help manufacturing companies integrate Lean with 3D printing and other digital tools to optimize production and reorganize operations in ways that transform how companies bring products from concept to consumer.

“We can see the results achieved by manufacturers who utilize 3D printing and other digital tools to speed and simplify production,” says Patrick Wiebusch, Co-Founder and Managing Partner at Four Principles. “Integrated into Lean process improvements, these technologies become part of a larger transformation towards speed and agility. Lean manufacturers using 3D printing need fewer suppliers, require less inventory, produce goods with fewer defects, and develop what the customer wants, when they want it.”

Here are some of the benefits companies can see from the integration of 3D printing and Lean management.

1. Better prototyping

In the industrial sector, prototyping is one of the biggest challenges when it comes to reducing waste. Designing and building a new component or product for the first time poses huge challenges in sourcing materials, drilling, cutting and welding, assembly, inspection and testing.

Not only is prototyping extremely labor and cost intensive, in traditional manufacturing it also typically requires outsourcing, leading to time delays that can affect a product’s ability to get to market quickly. When manufacturers can use 3D printing to make prototypes, they can do so in-house at much lower cost and fewer chances for errors and delays.

2. Increased innovation

If there’s one way in which 3D printing has up-ended manufacturing, it’s in the area of creativity and design flexibility. The ability to make something on-site and design numerous versions of the same part or product for comparison, allows manufacturers much greater flexibility and freedom to experiment and test new products.

The concept stage becomes much more productive with the ability to test multiple new parts and products. While it might appear that the result is more trial and error, this trial and error process takes place upfront, before a great deal of time or money has been invested. True innovation requires taking risks, which was much more difficult under older, more cumbersome methods.

3. Enhanced customization

Unlike traditional manufacturing which relies on molding and cutting, 3D printers can be reconfigured for each new product to allow for variability on the production line. This gives manufacturers greater flexibility to adapt to changes in consumer demand.

4. Improved inspection and defect reduction

Quality control is one of the key areas where 3D printing is boosting efficiency. Manufacturers are using 3D printing to create individually designed measurement tools and gauges, to aid in the inspection process. These go/no-go measurement tools enable manufacturers to identify and eliminate defects, decreasing a major source of waste.

“By creating cost-effective measurement gauges, manufacturers improve their inspection processes and speed up go/no-go decision making,” says James Ryan, Principal at Four Principles. The ability to check more parts and make inspections at more frequent intervals, leads to fewer parts being scrapped due to defects” he notes. “It’s much easier to identify tooling or machining issues when manufacturers can check parts at different points in the manufacturing process.”

5. Improved workspace efficiency

In the manufacturing environment, how tools are stored and equipment is laid out, has a major effect on the movement required from workers. The closer tools are to hand and the better organized they are, the less time a worker spends accessing or worse, looking for, the correct tools.

Many manufacturers now use 3D printing to make custom-designed and built, bins, racks, and other tool holders. Drawer organizers, cabinets and other storage units can also be custom-built to streamline workflow.

6. More consistency

With the control provided by programming, 3D printers can produce the identical product in the identical timeframe again and again. This predictability greatly enables planning and risk reduction.

Case studies: Lean + 3D = Success

Around the world, leading-edge industrial companies are increasingly attributing their success to the use of additive manufacturing and Lean management systems. [A 2020 Deloitte Insights report](#) on Industry 4.0 describes how digital technologies and Lean principles are intersecting to create “digital Lean,” a “powerful combination of timeless Lean principles and constantly evolving digital technologies to decrease waste and variability in processes.”

Aerospace, medical technology and devices, automotive and electronics industries, are among the sectors in the forefront of this adoption, with many other industries following in their wake.

In the Middle East, manufacturers and industrial companies are investing in 3D printing and other smart technologies to imagine, design, build, and test products with less capital investment, fewer workforce hours and less material cost. A few examples:

Knowledge sharing. The Mubadala Development Company, GE Additive, and the Dubai Future Foundation have combined their expertise to create a micro-factory intended to accelerate additive design and digital manufacturing technologies in the UAE. Engineering experts from GE Additive will work with companies from numerous industrial sectors, instructing in best design practices for additive manufacture of components. By supporting small-batch manufacturing, [the project](#) aims to diversify production, increase localization and unlock new growth sectors.

Invention and innovation. Wärtsilä, a Finland-based global company with factories in Finland and Italy, manufactures large engines for more than a third of the world’s largest cargo ships. Working with industrial 3D printer Markforged, Wärtsilä used carbon fiber printing to produce a new lifting tool, formerly made of heavy steel.

In under eight months, the company saved more than \$117,000 USD in tooling alone. [Production time was reduced from between 4 to 6 weeks to a matter of days.](#) Going forward, the company plans to introduce carbon fiber printers, metal printers and other additive manufacturing technologies, across the engineering floor.

Greater localization. Saudi Aramco, the Saudi Arabian Oil Company, is collaborating with companies such as the Chinese 3D printer, Suzhou XDM, to develop additive manufacturing production facilities for use in the oil and chemical industries [with a goal of diversifying the country’s industrial sector and increasing local employment.](#)

Faster prototyping. Sylatech, a UK-based machining and casting firm, serves customers in aerospace, defense, radar, automotive, medical and construction. Prior to introducing 3D printing, Sylatech's customers had to invest in specific tooling for metal parts and components, each time they prototyped a new product. The use of 3D printers enables Sylatech to rapidly prototype new parts without investing in tooling for large-scale production.

Lower cost customization. Anatomics, an Australian maker of customized surgical implants, made headlines in 2015 when they successfully implanted a titanium sternum and ribcage in a living patient, having designed and manufactured the bones using additive technology. At the same time, Anatomics slashed the cost of their patient-specific products by 30 to 50 percent by reducing material waste and tooling costs.

The Problem of Incomplete Adoption

With the accelerating pace of technological change, comes the problem that many companies lack the capacity to identify their needs, select from the rapidly expanding array of technological solutions, and replace or integrate old components and processes, with the new.

According to McKinsey's report, Factory of the Future: Advanced Manufacturing Technologies, only 20 percent of the companies surveyed reported that their manufacturing strategies were effectively aligned with their business strategies. Fewer than 10 percent said their processes for identifying new technologies were successful and fewer than 10 percent felt that the technologies they did identify, were analyzed as thoroughly as they should be. Finally, less than 10 percent of businesses surveyed described their implementation of new technologies to be quick and effective.

For all these reasons, manufacturers seeking to modernize would be wise to work with a management consultant with deep and proven experience in Lean transformation and the selection and integration of the latest 3D printing technologies.

"Recent trends show widespread adoption of Lean by manufacturers and industries, but many stumble in the implementation," says James Ryan, Principal at Four Principles. "Similarly with 3D printing - many companies invest in the equipment, but fewer realize the full potential. At Four Principles, we help companies map value streams, create flow, and establish demand-driven production and a process of continuous improvement, to realize their future vision rather than just short-term gains."

GET IN TOUCH

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