3D PRINTING

ADDITIVE VALUE

A manufacturing revolution is gaining steam, accelerating innovation.

BY SARAH FISTER GALE

3D printing is going to reshape the manufacturing world—that is the prediction, at least. The technology, also referred to as additive manufacturing, uses precision hardware (and often computer-aided-design software) to build a complete 3D object layer by layer. The emerging industry is taking off, with forecasts of $15.8 billion in revenue worldwide this year, before climbing to $35.6 billion by 2024.

Since the very first 3D printer came on the market in the late 1980s, the technology's applications have grown in complexity: Printers can now make customized, complex objects out of plastic, metal, resins, graphene, carbon fiber and even lab-grown human tissue. Designers and engineers are free to dream up new innovations on the fly, accelerating time-to-market for many products and sparking breakthrough applications that could disrupt industries from aerospace to health care.

"Additive manufacturing allows a level of creativity in design that is not possible with traditional methods," says Melissa Orme, vice president of Boeing Additive Manufacturing. "When exploited, it can bring tremendous benefit in terms of structure, weight, functionality and cost."

Proof of this has become easy to find. Last year, Lockheed Martin created a 3D-printed titanium dome for its high-pressure satellite fuel tanks, cutting production time for that project from two years to three months. In partnership with 3D-printing company Unyq, Ikea is bringing ergonomic video-gaming accessories to market in 2020, such as wrist supports custom-printed for each customer. In the automotive world, BMW's i8 Roadster now includes a 3D-printed aluminum alloy fixture both lighter and stiffer than a traditionally used injection-molded plastic part.

PHOTO COURTESY OF LOCKHEED MARTIN

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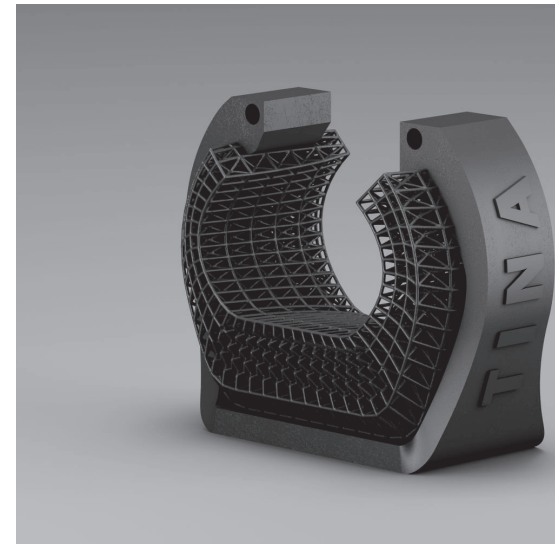
BMW is producing 3D-printed parts for prototypes. Below, a wrist support from the Ikea partnership with 3D printing company Unyq.



THE TAKEAWAY

3D printing is magnifying creativity and boosting efficiency in everything from fashion to aviation. Yet for C-suite leaders to realize the ROI on this groundbreaking technology, they must first bridge a skills gap. As university curricula continue to lag behind, organizations must establish a clear training strategy as well as forge partnerships across industry and academia.

Boeing has steadily invested in cutting-edge, additive manufacturing technology in more than 20 Boeing sites around the globe, as well as 3D printing startup companies as a way to accelerate development of its metal parts and to close gaps in its supply chain. Today, its commercial and defense products use more than 70,000 parts created through additive manufacturing, Ms. Orme says.

3D printing technologies are also revolutionizing how equipment is maintained and products are tested, she adds. "Behind the scenes we are focusing on tooling, shop aids and prototyping to drive company efficiency and innovation," she explains. "Last year alone we released almost 1,000 unique tool designs and fabricated 7,000."

Still Early Days

But for all the benefits, businesses are still in the process of scaling up this emerging technology. "Right now, 3D printing brings the most value for small-volume, high-value elements," says Jérôme Rascol, vice president and head of additive manufacturing platform for Airbus. "Airbus, like many other businesses industry-wide, is progressively scaling up."

He said the best uses for the technology today are low-volume applications such as prototyping, as well as highly customized and out-of-series production parts.

Jens Ertel, head of the Additive Manufacturing Center at BMW Group in Munich, Germany, says BMW primarily uses additive manufacturing for prototyping and small-batch custom components. "This is particularly the case in areas that are driven by innovations, like with concept and show cars," Mr. Ertel says. By 3D printing pieces for testing, they can rapidly iterate designs and make changes without incurring the added time and cost of purchasing one-off pieces, materials or tools.

While BMW is producing a few 3D parts at scale, including a window guide rail for the i8 Roadster, it may take a while before 3D printers are a staple on the assembly line. "Especially at large-scale production, additive manufacturing is less economical than conventional production methods due to higher raw material cost and a relatively slow production speed," Mr. Ertel says.

The Skills Gap

Another challenge is that businesses are struggling to find the right talent to drive adoption at their organizations. As with many rapidly evolving technologies, higher education has been slow to keep up with industry demand.

PHOTOS COURTESY OF BMW GROUP (TOP) AND IKEA (BOTTOM)

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"With few exceptions, most universities are not teaching design for additive manufacturing, requiring the incumbent workforce to learn on the job," Ms. Orme explains.

For companies that want to leverage these tools at scale, training employees has become a top priority, she says. In response, Boeing has partnered with the Massachusetts Institute of Technology to create a series of additive manufacturing education programs. Boeing has also opened more than 190 "innovation cells" to develop best practices and help employees deploy 3D printing in their projects.

Airbus is embarking on a similar effort in support of its long-term strategy to leverage 3D-printing-based manufacturing across the organization, Mr. Rascol says. The company is developing internal know-how, and employees are able to pursue training courses and on-the-job tasks to further develop their skills.

Greater industry collaboration is also part of the solution to these challenges, Mr. Ertel adds. Last year, for example, BMW announced the Industrialization and Digitization of Additive Manufacturing project, which brings together companies, universities and specialists to evolve metal additive manufacturing for the automotive industry. "Additive manufacturing represents a major production method for the future," Mr. Ertel says. "We see great potential. There's nothing to be afraid of." **IQ**

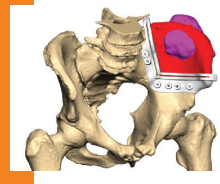
3D PANACEA

In the health care sector, 3D printing is already transforming the treatment landscape. "Medical devices and implants need to be customized to meet individual needs," says Melissa Orme, vice president of Boeing Additive Manufacturing. "Additive manufacturing allows for customized one-offs."

The sector saw several groundbreaking applications in 2019, including:

- **Johnson & Johnson's** Medical Devices Companies debuted a 3D-printed titanium spinal implant for degenerative spine disease. The porous design, meant to mimic natural bone, helps to facilitate bone fusion.

- **3D Systems** received clearance from the U.S. Food and Drug Administration for its VSP Orthopedics solution—a 3D-printed model of a patient's anatomy that allows surgeons to develop a customized surgery plan before entering the operating room.



- Scientists from **Tel Aviv University** 3D-printed a human heart, with cells originally harvested from a human donor's fat tissue. In less than four hours, the printer rendered a half-scale human heart.

PHOTO BY AMIR LEVY/ GETTY IMAGE