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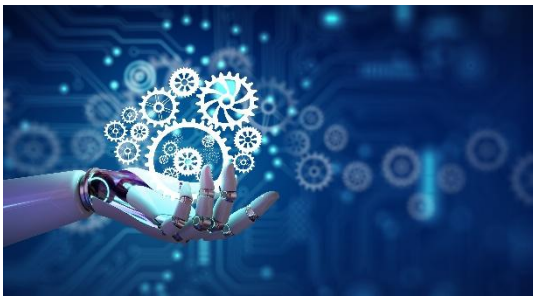
From rocket engines to toys: How 3D printing is powering India's next industrial leap



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Synopsis

Once constrained by cost factors, the 3D printing industry is now taking shape in India, with its applications growing from prototypes to end products. AI is helping further, accelerating its adoption.

Last year, Chennai-based spacetech firm Agnikul made history by successfully launching the world's first rocket powered by a single-piece 3D-printed engine. What made this feat even more impressive is that manufacturing a rocket engine typically takes up to six months, with an overall preparation time of 10-11 months; however, Agnikul achieved this in just three days by employing a 3D-printed rocket engine to reduce time, effort, and money.

In early July, the Mumbai-based firm WOL3D launched India's first 3D-printed flexible toy brand. From rockets to toys, the growing adoption of 3D printing across industries highlights the rapid growth of the 3D printing market in India. According to market research from IMARC Group, the Indian 3D printing market, valued at approximately $707 million in 2024, is expected to grow at a CAGR of 21.7% to reach $4.3 billion in 2033.

With the expansion, India's 3D printing ecosystem has also undergone remarkable transformation. The growth, as per experts, goes beyond just applications to include a more diverse consumer base and a wide range of raw materials. From D2C brands to MSMEs using 3D printers over traditional manufacturing methods to the industry shifting towards alternatives to plastics for raw materials, the evolution of 3D printing in India is both exciting and far-reaching.

Evolution of 3D printing

Over the past decade, 3D printing in India has undergone a striking transformation—from a tool reserved for niche prototyping to a powerful enabler of industrial innovation. “The evolution of 3D printing can be seen from building a prototype a decade ago to complete end products now,” says Rahul Chandalia, CEO of WOL3D, a leader in India’s 3D printing market.

“Initially, the high costs and limited expertise confined it [3D printing] to research labs and design studios, with its early promise centred around rapid prototyping,” says Anuj Budhiraja, VP-Phillips Additive, part of machining manufacturer Phillips Machine Tools India.

“However, expensive technology and limited local expertise did not deter its evolution. Today, 3D printing is no longer experimental; it is helping manufacturers move faster, lighter, and smarter, enabling innovation across key industries,” he adds.

The government’s support, he says, has also been pivotal in this journey. The 2022 National Strategy for Additive Manufacturing promotes innovative manufacturing technologies such as optic chip packaging, optical computing chips, 3D printing, and electronics components, etc. By 2025, it aimed to contribute nearly $1 billion to GDP, create 100 start-ups, develop 50 India-specific machine, material, and software innovations, launch 500 new products, and train 100,000 skilled professionals.

“One of the primary reasons for 3D printing gaining traction in India is because it has become increasingly affordable and accessible. The growth is fuelled by the adoption of advanced manufacturing technologies across sectors like automotive, healthcare, and construction,” says Sameer Jain, MD at Primus Partners.

A key factor driving this trend is the ability of 3D printing to overcome the design constraints associated with traditional manufacturing methods. Ravikiran Pothukuchi, Enterprise Apps, Dassault Systemes India, which makes the software for 3D printing, explains, “You cannot come out with innovative complex shapes because the output of a shape in traditional manufacturing depends on the operation. A hole can be carved, but a complex, weird-looking structure cannot be created because a subtraction operation is still hard to find. With additive printing, or the 3D printing editor manufacturing, it becomes much easier to come up with these innovative parts,” he says.

Artificial Intelligence (AI) is further revolutionising 3D printing by enhancing efficiency, precision, and innovation across various stages of the additive manufacturing process, says Chandalia. “AI-driven generative design for complex geometries is lightweight yet structurally robust, which would be challenging to achieve through traditional methods. AI can help automate slicing processes, adjust print parameters in real time, and predict errors, reducing manual intervention and increasing throughput,” he says. Moreover, ML models analyse data from sensors and cameras to detect defects during the printing process, ensuring higher quality outputs and reducing material waste, he adds.

From healthcare to defence, 3D printers are facilitating a wide range of applications across sectors. “In manufacturing, they support rapid prototyping as well as the production of lightweight, performance-oriented components. In healthcare, they enable cost-effective, patient-specific implants and prosthetics. In aerospace and defence, they are used to produce complex, high-performance parts that must meet strict material and weight requirements,” says Budhiraja.

According to Traxcn, there are about 240 3D printing companies in India currently. WOL3D, which began selling 3D printers in 2016, has seen tremendous growth since then. Chandalia mentioned that they started by selling 10 to 12 printers in a month, and now they sell about 1,000 to 1,500 printers every month. According to him, industries like dental (for dentures, crowns, etc.), jewellery, and education are growing very fast in 3D printing.

“Apart from this, we see people using 3D printers for home decor, table lamps, flower vases, and even customised nameplates,” says Chandalia. These creative applications are gaining popularity among a new wave of makers. “This end application of 3D printing is coming with new entrepreneurs; kids who have passed engineering or are in their last year have started buying 3D printers and started home production and then selling them on Amazon. They are starting their entrepreneurial journey with an investment of hardly Rs 1-2 lakh.”

MSMEs getting crafty with 3D printing

It’s now empowering MSMEs across sectors, driving innovation, and reducing costs. The customer base of 3D printing has broadened significantly, says Jain of Primus Partners. “Indian MSMEs and D2C brands are adopting 3D printing for faster prototyping, cost-effective production, and product customisation. This shift is helping smaller players compete globally by overcoming traditional manufacturing limitations and embracing flexible, on-demand production models.”

In addition to time and cost, the design flexibility offered by 3D printing is a major factor driving MSMEs to adopt this technology. “A primary reason behind the rise in adoption of 3D printing is that advancements in its technology have enabled the manufacturing of things that were not earlier possible. For example, artificial jewellery with intricate designs and toys of various shapes and sizes. As you can customise designs in 3D printing, there is also no wastage,” explains Chandalia.

There has been a notable surge in the adoption of 3D printing by MSMEs, as they increasingly use this technology to tackle challenges related to enhancing quality and reducing delivery timelines, says Phillips’ Budhiraja. What started as a tool for prototyping has now evolved to include applications in tooling, jigs, and fixtures, resulting in cost savings and faster production timelines. “We have seen the tremendous demand for technology by MSMEs. They want to be more competitive by adding value to their proposals with quick prototypes, better production costs, and improved profits; 3D printing is accelerating all of these,” he says.

Between 2022 and 2024, more than 220 SMEs in Chennai's Sriperumbudur Industrial Zone adopted in-house 3D printing for product development, according to a recent report by TechSci Research. "This shift enabled them to reduce their average prototyping cycle time by 55% and prototype outsourcing costs by 48%, helping local manufacturers bring new products to market significantly faster and with greater design control," the report highlights.

Similarly, 45 dental clinics in Delhi-NCR adopted 3D printing technologies between 2023 and 2025 to produce customised implants and orthodontic appliances. "These clinics collectively manufactured over 18,500 devices locally, reducing turnaround time from up to four weeks to less than six days. Production costs for custom parts were cut by nearly 40%, improving affordability and patient care efficiency," the report says.

Pothukuchi of Dassault Systèmes points out that the 3D printing machines have evolved from being bulky to becoming sleeker and lighter, taking less space. "This (evolution) has led to prices going down for the same, making it more affordable for MSMEs and start-ups." More than 60% of WOL3D customers are B2C, the majority of which are MSMEs and start-ups. And it has collaborated with mobility firm Ola Cabs, ISRO, Infosys, and DRDO in terms of B2B, informs CEO Chandalia.

"When Ola bought a 3D printer, the entire design of the Ola bike was first created based on the 3D printed model. They made a mould out of it, and then they manufactured the bike. So bigger companies use it for all the prototypes in their R&D," he says.

One of WOL3D's customers is wearables firm Fire-Boltt, which has been using the former's 3D printers to make prototypes of smartwatches as well as smartwatch cases. Arnav Kishore, Co-founder of Fire-Boltt, says that the company has been trying to identify how 3D printing could benefit their brand for the last 1-2 years. He points out that across the world, the most common way of prototyping is 3D printing.

According to him, the biggest advantage of 3D printing is time. "If we were to make a sample of any new design of a smartwatch, traditionally, it would take more than 45 to 60 days because we would need to first open a mould for injection, and then that mould itself takes about 60-plus days to develop. This would cost us time and money."

"Whereas through 3D printing, we have a prototype in 24 hours. Then, once we are satisfied, we can proceed towards the mould development. So, it helps us in commercialising the product much better. It helps us make the product more accurate before we give it for moulding," he adds.

Another evolution is taking place in the 3D printing space regarding raw materials. It has moved beyond plastic and polymers, with more sustainable options now available, such as corn starch, which is biodegradable and more environmentally friendly. "There is a noticeable global shift towards environmentally responsible alternatives, with India playing an active role in this movement." says Budhiraja.

While the growth of 3D printing companies like WOL3D looks promising, challenges persist.

Challenges

Entry-level machines are affordable; however, scaling up to high-precision or production-grade applications remains capital-intensive, Budhiraja notes. “A shortage of skilled professionals is another major limitation. Running and maintaining 3D printers, designing for additive manufacturing, and managing end-to-end workflows require specialised training, something that India’s current technical education ecosystem is still catching up on,” he says.

Budhiraja also laments low awareness and limited adoption among traditional manufacturers, many of whom remain unfamiliar with 3D printing’s practical use. “While some reliable components are still being made using conventional methods, additive technologies can extend product life and improve output quality when applied correctly.”

However, the trial phase of validating additive models is not always preferred, and this hesitation, according to Budhiraja, continues to hold back wider experimentation. He also points out the lack of regulatory standards and quality control frameworks, which creates uncertainty for manufacturers exploring applications in safety-critical sectors like medical devices and aviation.

3D printing is tightly linked with technology. But the additional software and applications required for additive manufacturing add further costs, making it a bit cost prohibitive, especially for MSMEs.

Additionally, there is another limitation. Although 3D printing of prototypes can be faster than traditional manufacturing, it is limited in terms of scalability. Chandalia points out that traditional manufacturing would be faster for those needing to produce more than 50,000 products, whereas 3D printing would be efficient for those with requirements of 1,000-5,000 products. “However, the speed of the printers is increasing, which is a positive sign, but then many people are not really aware of these specifics. People don’t know this technology exists. But, with time, we are trying to find ways where we can cope with that,” he says.

India is still at a nascent stage of 3D printing, but it is growing rapidly. In China, there are farms with 3,000-6,000 printers. “I feel such farms will also come to India,” says Chandalia. “We are the ones who are getting the first farm of about 150-200 printers. But I think with time, we may increase the farm from 200 to 300 printers next year. I believe there will be a time when every household in India will have at least one product that is 3D printed,” says a highly optimistic Chandalia.