

TAGMA TIMES

NEWSLETTER

(Technical Info. on Die, Moulds & Toolroom)

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July 2023



3D Printing Technology: Prototyping Perfection

IN FOCUS
3D printing: Transforming
Manufacturing

CASE STUDY
Rough saves 35% in costs and meets
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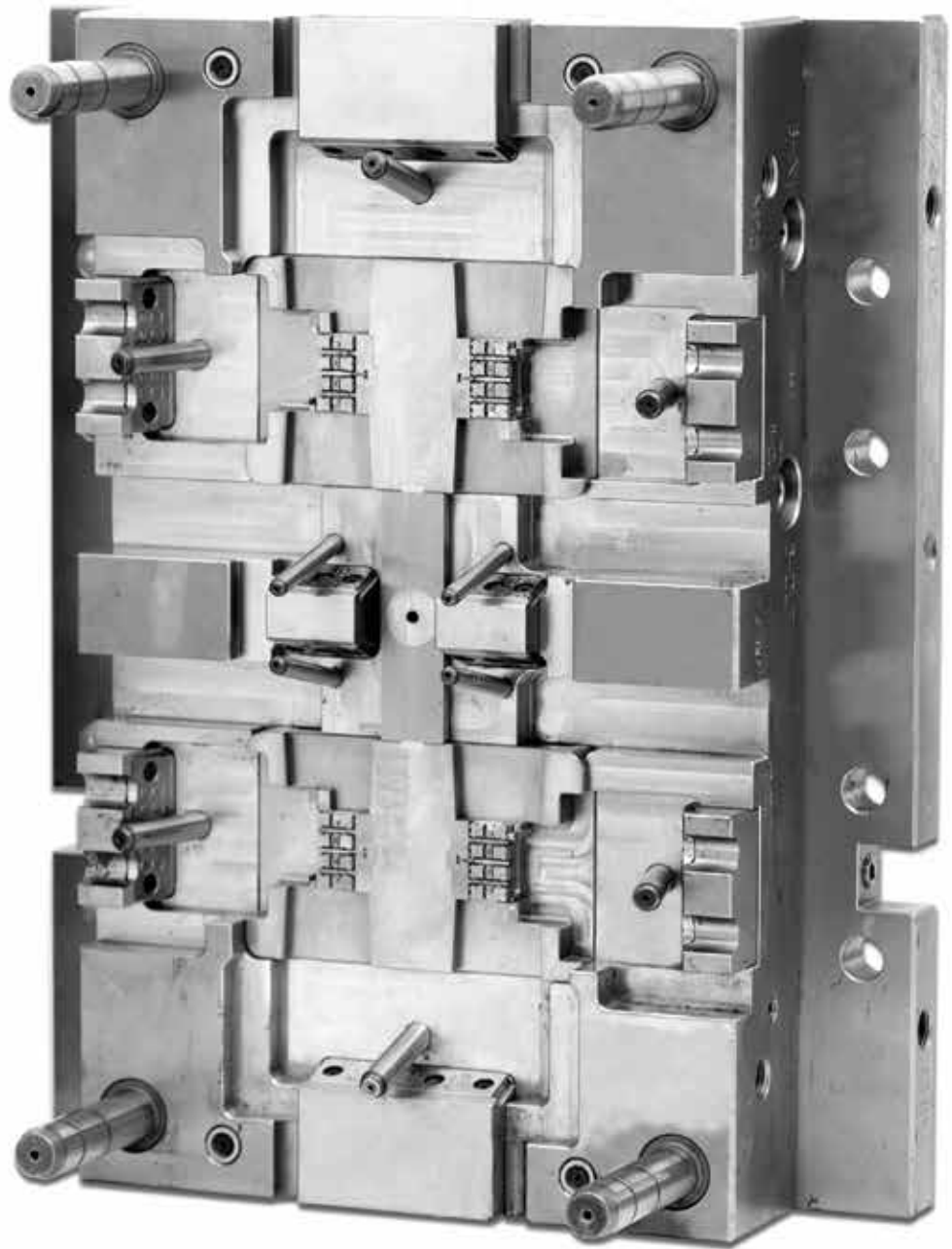
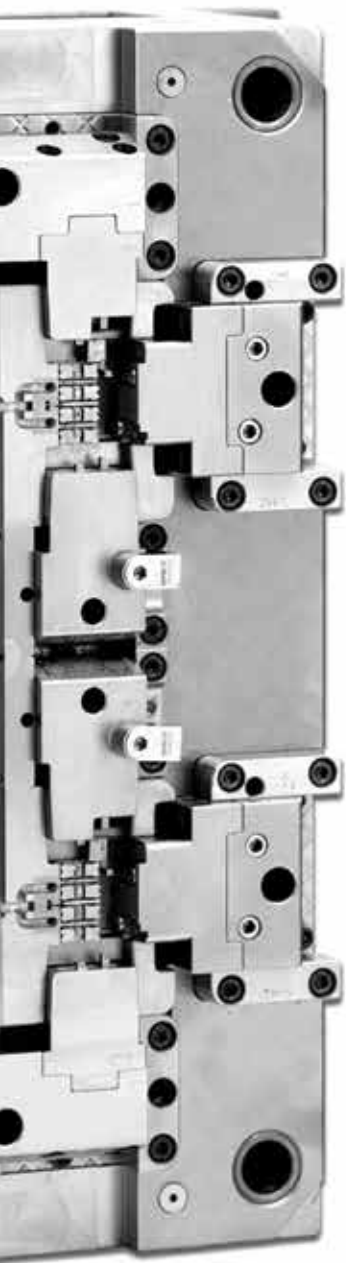


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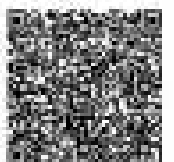


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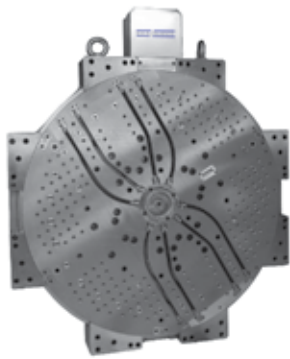


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◀ **THRUHARD SUPREME HH** ▶

"When designers at BMW-Germany are working on the new design for the 7 series, they also know what is the best mold steel that will meet their high quality requirements-THRUHARD SUPREME HH"



Injection molding tool for the Bumper



Injection molded Bumper part



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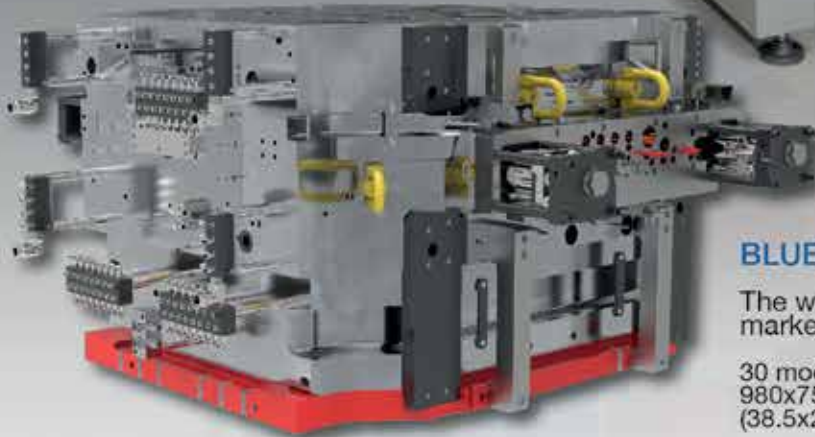
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Dear Readers,

Welcome to this month's edition of TAGMA Times, where we dive deep into the realm of additive manufacturing, more commonly known as 3D printing. As die & mould makers, you are at the forefront of innovation, and it is our privilege to present you with a comprehensive coverage of this revolutionary technology in this special edition.

Additive manufacturing has been transforming industries across the globe, providing unprecedented opportunities for innovation, efficiency, and cost-effectiveness. With its ability to create complex geometries and customise designs, 3D printing has emerged as a game changer for die & mould makers. This technology has proven to be a powerful ally, empowering you to push boundaries and unlock new possibilities.

In this edition, we have curated an assortment of thought-provoking articles, case studies, and interviews with industry leaders who have embraced additive manufacturing. These insights aim to not only inspire you but also equip you with the knowledge needed to navigate this transformative landscape. We believe that understanding the potential of this technology is crucial for staying ahead in today's competitive market.

As die & mould makers, staying informed about these developments is vital for leveraging the full potential of additive manufacturing. However, it is important to acknowledge that additive manufacturing is not a panacea. It is not meant to replace traditional manufacturing techniques but to complement them. The integration of both conventional and additive approaches can lead to unprecedented synergies, allowing die & mould makers to optimise their production capabilities and create superior products.

As you explore this edition, we hope you find inspiration, knowledge, and practical insights that fuel your journey into the world of additive manufacturing.

Happy Reading!

A handwritten signature in black ink that reads "Nishant".

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MAKING TECHNOLOGY AFFORDABLE

GE Aerospace signs MoU with Hindustan Aeronautics Limited to produce fighter jet engines for Indian Air Force

GE Aerospace recently announced that it has signed a Memorandum of Understanding (MoU) with Hindustan Aeronautics Limited (HAL) to produce fighter jet engines for the Indian Air Force. The agreement includes the potential joint production of GE Aerospace's F414 engines in India, and GE Aerospace continues to work with the U.S. government to receive the necessary export authorisation for this. The effort is part of the Indian Air Force's Light Combat Aircraft Mk2 program.

"This is a historic agreement made possible by our longstanding partnership with India and HAL," said H. Lawrence Culp, Jr., Chairman and Chief Executive Officer of GE and CEO of GE Aerospace. "We are proud to play a role in advancing President Biden and Prime Minister Modi's vision of closer coordination between the two nations. Our F414 engines are unmatched and will offer important economic and national security benefits for both countries as we help our customers produce the highest quality engines to meet the needs of their military fleet."



GE Aerospace has operated in India for more than four decades with wide engagement in the industry including engines, avionics, services, engineering, manufacturing, and local sourcing. In addition to potential new work in India, a number of U.S. facilities that currently support work on the F414 engine will see additional volume as a result of this announcement.

In 1986, GE began working with the Aeronautical Development Agency and HAL to support the development of India's Light Combat Aircraft (LCA) with F404 engines. Subsequently GE Aerospace's F404 and F414 have been part of development and production programs of LCA Mk1 and LCA Mk2 programs.

In total, 75 F404 engines have been delivered and another 99 are on order for LCA Mk1A. Eight F414 engines have been delivered as part of an ongoing development program for LCA Mk2.

This agreement will advance GE Aerospace's earlier commitment to build 99 engines for the Indian Air Force as part of the LCA Mk2 program. ♦

National Centre for Additive Manufacturing inaugurated at Hyderabad

The National Centre for Additive Manufacturing (NCAM) recently inaugurated its new state-of-the-art facility at the Technology Development Centre at Osmania University in Hyderabad.

The centre has been established by the Ministry of Electronics and Information Technology (MeitY), in partnership with Government of Telangana.

The NCAM is the apex body to build a comprehensive additive manufacturing ecosystem in the country by enabling the adoption of additive manufacturing in the industry, focusing on indigenisation, providing access to state-of-the-art infrastructure, enabling research and development, and promoting skill development activities to generate quality manpower.

Secretary of Ministry of Electronics and Information Technology, Government of India, Alkesh Kumar Sharma; Principal Secretary Industries & Commerce and ITE&C, Jayesh Ranjan; Vice Chancellor of Osmania University, Prof Ravindar, and other senior officials from the Government and leading Additive Manufacturing industry doyens were present at the



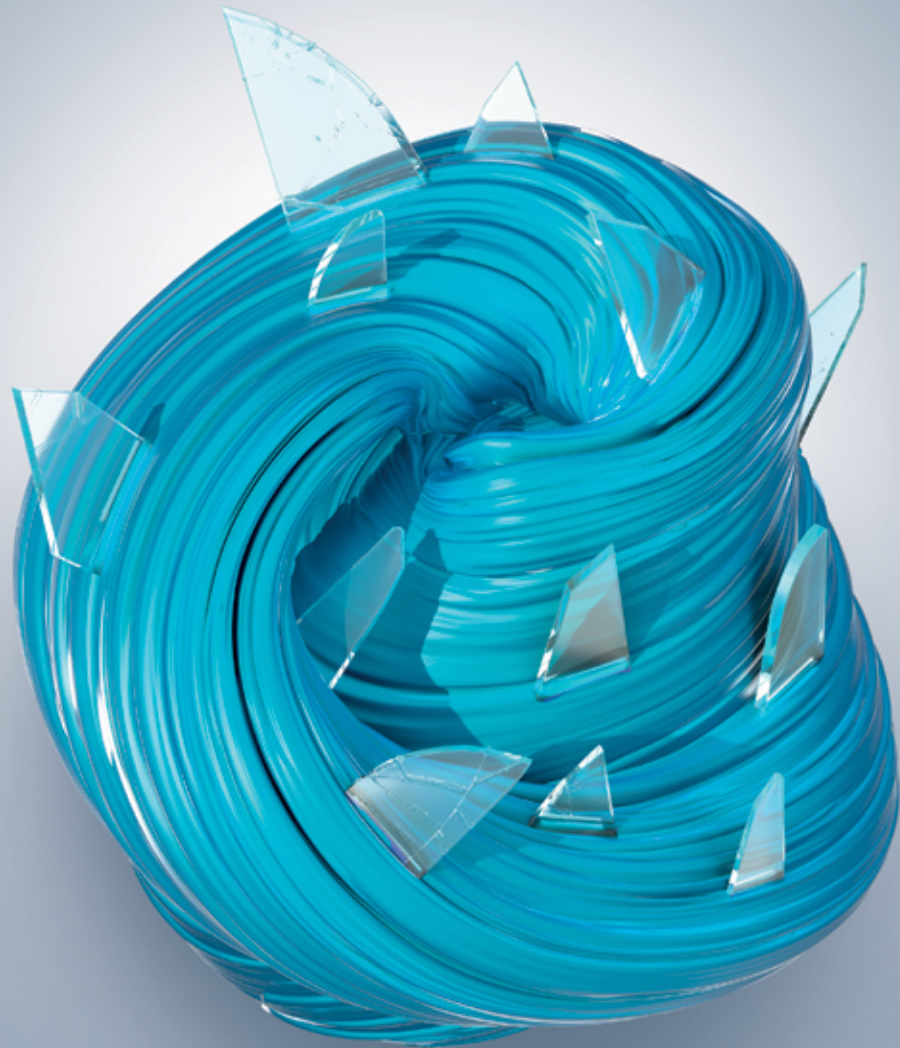
Image courtesy @ DigitalIndia/Twitter

inauguration.

Speaking at the inauguration, Alkesh Kumar Sharma said, "India aims to add US \$1 bn to the GDP through Additive Manufacturing by 2025. There is tremendous scope for further growth in various sectors like electronics and healthcare among others to make India 'aatmanirbhar'. This can be made possible through concerted and collaborative efforts by the industry, academia and government."

"Additive manufacturing, commonly known as 3D printing, has already shown immense potential in transforming traditional manufacturing processes. The NCAM aims to serve as a hub for additive manufacturing by bringing together leading experts, industry partners, and researchers from diverse disciplines to drive innovation, propel economic growth, and shape the future of manufacturing," NCAM CEO Jaspreet Sidhu said. ♦

Courtesy Deccan Chronicle



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Glass and carbon in fiber-reinforced plastics act like a file on injection molds. They are extremely abrasive and cause premature wear. Injection molds made of high-quality BÖHLER tool steels can significantly increase tool life. Because the cost of building the mold itself is always the same, the use of high-end materials is an investment in tool life with tremendous economic potential.

Motherson and Marelli inaugurate the first-ever tool room for automotive lighting in India

Motherson, in collaboration with Marelli, announced the inauguration of Motherson Automotive Lighting Tool Room (MALT), a ground-breaking facility that marks a significant milestone in automotive lighting technology. This is the first-ever tool room in India dedicated to automotive lighting. The plant was inaugurated by Mr. R. C. Bhargava, Chairman of Maruti Suzuki India Ltd., and Mr. Hisashi Takeuchi, Managing Director & CEO of Maruti Suzuki India Ltd., in the august presence of other esteemed guests. The 8700 sq mtr. facility is located in Noida (Delhi-NCR region) in close proximity to OEMs and other tooling locations of Motherson.

MALT is a state-of-the-art facility, set up with an initial capex of INR 600 million approx. by Marelli Motherson Automotive Lighting India Private Limited. (MMLI), a 50:50 JV company between Samvardhana Motherson International Limited (SAMIL) and Marelli Europe SPA.

The new facility embodies Motherson's and Marelli's vision of being a globally preferred sustainable solutions provider to its customers. By leveraging the strengths of Motherson and Marelli, the new facility aims to meet the long-standing demands of the Indian OEMs for the localisation of advanced automotive lighting solutions. It will serve as a platform for collaboration and innovation, bringing together technical experts from both companies to develop cutting-edge tooling solutions for automotive lighting.

Mr. Sylvain Dubois, President of Marelli's Automotive



Lighting & Sensing division, said, "The new facility will allow us to build locally and autonomously all the tools needed for our joint venture, representing a great step forward in terms of speed, competitiveness, and flexibility. This is a real competitive advantage on the Indian market and an outstanding milestone in the history of our joint venture, which enables us once again to best support our customers together."

Mr. Vivek Chaand Sehgal, Chairman, Motherson, said, "The inauguration of this tool room for lighting is a moment of great pride for us. We want to express our gratitude to our customers for their encouragement and support to Motherson. This facility is a testament to our commitment to pushing the boundaries of innovation and delivering advanced solutions on demand of our valued customers. We are also grateful to our partner Marelli for their collaboration in this project." ♦

Schaeffler India expands industrial production capacity

Global leading industrial and automotive supplier, Schaeffler India Limited, recently announced the inauguration of manufacturing hall 2 at its manufacturing facility at Savli, Vadodara, Gujarat. The inauguration ceremony was graced by Dr. Stefan Spindler, CEO Industrial, Schaeffler Group and Executive Board Member, Schaeffler AG, underscoring the significance of this expansion.

The new hall will add the manufacturing capacity for small and medium-sized products, which will further enhance Schaeffler's market competitiveness in this region. Expansion of the Savli plant's production capacity is a vital step towards driving localisation strategy and meeting the growing demands of the market.

Schaeffler will add additional capacities of over 10,000 sq.m. of production space, to the existing state-of-the-art manufacturing plant in Savli. This increased capacity will enable the plant to manufacture spherical roller bearings (SRB) and spherical rollers, while also expanding its heat treatment capabilities. The enhanced production capacity



will support the growing market demand in the wind, heavy industries, and railway sectors now.

Dr. Stefan Spindler, CEO Industrial, Schaeffler AG, said: "Schaeffler is a global company with a local presence, and we continue to invest judiciously in India. We recognise India's strategic importance in the manufacturing space and as a mature industrial market for us in the region. This expansion will enable Schaeffler to meet the market demands and grow with the Indian market." ♦



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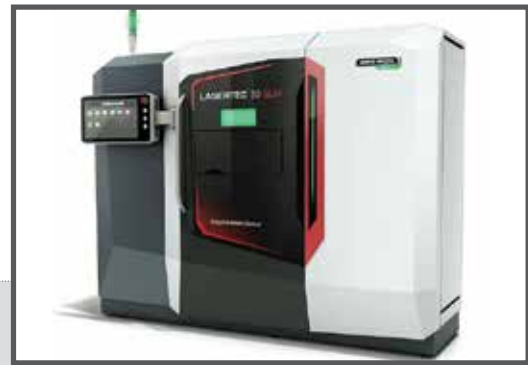
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DMG MORI redefines the footprint of Additive Manufacturing



By launching the new LASERTEC 30 SLM US with Adaptive Beam Control – developed and manufactured domestically – DMG MORI delivers a class-leading machine to address the rising demands of the U.S. market.

The LASERTEC 30 SLM US will start delivery from December 2023, focusing on best-in-class cost per part and complex geometries in an envelope of 11.8 x 11.8 x 11.8 in. Breaking the mould of incumbent technology, the machine features several key advancements – Adaptive Beam Control enabling dynamic changes to Laser Power, Laser Speed, and Laser Beam Profile. Non-contact recoating improves the freedom and independence of powder spreading. Best-in-industry production cost using an optional innovative hybrid toolpath strategy that dynamically changes between laser beam profiles using a 1.2 kW laser.

With R&D and manufacturing for Additive Manufacturing in the U.S., Japan, and Germany, DMG MORI answers the growing demand for additive technologies in the U.S. market and abroad. This contributes to the supply chain resilience and supports export-regulated applications or industries in local markets. The LASERTEC 30 SLM US will be the first additive manufacturing product to fulfill this requirement.

As an innovation leader in machine tool manufacturing, DMG MORI has expanded its broad portfolio of conventional

manufacturing methods with additive technologies since 2013. The LASERTEC DED hybrid and LASERTEC SLM models enable highly productive and reliable manufacture of additive metal components within the holistic DMG MORI ecosystem going from metal powder to high-precision finish machining. In the ADDITIVE INTELLIGENCE consulting unit, DMG MORI also supports beginners and experienced users in fully exploiting the potential of metallic 3D printing.

40 years of innovation and regional engagement

The launch of the LASERTEC 30 SLM US comes in the 40th anniversary year of DMG MORI USA. It marks another growth milestone for the company locally in the USA. With 12 locations in the USA featuring technology centers, showrooms, and the production facility DMG MORI Manufacturing USA in Davis, California.

DMG MORI has built up an outstanding regional presence in the country, supporting local customers like no other. Furthermore, it contributes to developing the skillset in the local workforce, which also serves the local communities. ♦



New VPGT-JP and -JS geometry inserts for precision finish turning of small parts

The proven chip control performance of Tungaloy's -JP and -JS chipbreakers are now available with its VPGT turning inserts designed for finishing of small and miniature parts in Swiss-type automatic sliding-head machines and mini lathes.

The -JP chipbreaker, the first choice for precision finishing processes, provides secure chip control over a wide application area. The chipbreaker also helps eliminate

burr formation and chatter marks effectively over a broad range of depth-of-cut and feed rate combinations.

The -JS chipbreaker is the first choice for finish turning applications, providing free cutting action and good chip control. Featuring a steep inclination angle of the cutting edge and optimised chipbreaker design, the -JS provides effective chip evacuation and light cutting action when used at either light or high depths-of-cut.

A total of seven inserts are introduced in this expansion for improvement of chip control in a wide application area, reduced downtime, and productivity boosts. ♦

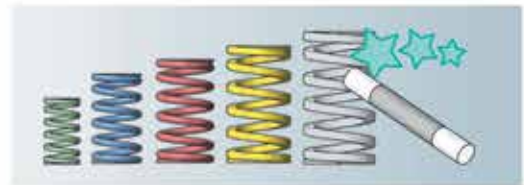


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Kennametal's HARVI end mills recognised in the industry for aerospace tooling excellence

Kennametal Inc. recently announced that its HARVI™ solid carbide end mills will be included as a preferred product in Lockheed Martin's internal machining guide. The resource, produced by Lockheed Martin Aeronautics' Operations Technology group for internal operations and engineering, as well as global supply-chain partners, identifies the most effective parameters and processes for machining material-specific aerospace components.

"We're honored to be a longtime supplier to Lockheed Martin and to have our HARVI III metal cutting end milling portfolio featured in one of its most invaluable machining guides," said Keith Mudge, Kennametal Vice President Metal Cutting Sales, Americas. "We work closely with customers like Lockheed Martin to problem solve and deliver the utmost accuracy in machining. Inclusion of HARVI end mills in this internal resource is a testament to our commitment in the industry and our high standard of excellence."

The Kennametal HARVI solid carbide end mill portfolio is an industry staple because of its ability to outperform other end mill tools when working on hard-to-machine aerospace materials like titanium and Inconel.

A signature Kennametal brand and bestseller, HARVI



end mills have been proven to deliver time and cost savings in aerospace operations with impressive metal removal rates and longer tool life. Users experience maximum productivity from HARVI style end mills with features like:

- HARVI 1 TE's twisted cutting edge for increased corner stability and market leading ramping and helical interpolation operations.
- Proprietary relief from anti-vibration-anti-friction technology.
- Unequal divided flutes including some with variable helix, enabling vibration dampening and unmatched feed rates.
- An innovative flute design with chip gashes to reduce cutting forces and promote more efficient chip evacuation. ♦

Hanita™ introduces VariMill™ Chip Splitters series in metric

Hanita, a WIDIA™ brand, announced the addition of metric VariMill Chip Splitters end mills to its high-performance tooling solutions, increasing the accessibility of efficient dynamic milling tools to customers in the general engineering, automotive and aerospace industries.

The new metric VariMill Chip Splitters feature a design that actively controls chip size, resulting in easier chip evacuation in deep cavities. The end mills include five- and seven-flute configurations from 8mm-20mm metric standard diameters. The five-flute tool maximises performance in steel materials, while the seven-flute tool excels in stainless steel and high-temperature alloys.



"With the new VariMill Chip Splitters end mills, we are giving customers the highest speeds and performance for side milling, shoulder milling and helical milling, and especially for dynamic milling applications," said WIDIA and Hanita Global Portfolio Manager for Solid Carbide Milling Tamir Sherif. "We strive to offer solutions that result in

increased productivity and are proud to broaden access to more efficient dynamic milling for our customers."

The new Chip Splitters end mills are the natural evolution of the successful VariMill II and VariMill III series. The VariMill I, II and III remain available in the Hanita product offering. ♦

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3D printing: Transforming Manufacturing

Increased customisability, reduction in error rates, zero material waste, low development costs, saving on time... the list of factors that have made 3D printing a major market focus in recent years is endless. This articles highlights how 3D printing can become a valuable asset for manufacturers looking to optimise their traditional manufacturing processes.

Ankit Sahu

3D printing technology has come a long way since its inception. Now, it is being combined with Virtual Reality (VR) and Augmented Reality (AR) to create a truly incredible experience. VR and AR are being used to design and model products before they are printed. They also help manufacturers visualise what a product will look like once it's been created. Future directions in 3D printing will be dictated by demand across the various industries in which it has currently found applications. In particular, healthcare will drive innovation

in the sector, given the growing demand for novel drugs for both rare and common diseases and biomedical devices.

Key factors driving its growth

The Indian 3D printing industry has been experiencing growth in recent years, driven by several key factors. Specifically, in the realm of service providers, the following factors have been instrumental:

➔ **Increasing adoption in manufacturing:** The Indian manufacturing sector is recognising the benefits of 3D printing for rapid prototyping, tooling, and

low-volume production. Industries such as automotive, aerospace, consumer goods, and healthcare are increasingly utilising 3D printing services to accelerate product development, reduce lead times, and achieve cost savings.

➔ **Government initiatives and support:** The Indian government has been actively promoting initiatives like 'Make in India' and 'Digital India', which encourage advanced manufacturing technologies, including 3D printing. Various policy measures, incentives, and funding opportunities have been introduced to support the growth of the 3D

printing industry and foster innovation.

➔ **Growing entrepreneurial ecosystem:** India has witnessed a surge in entrepreneurial activity, with many startups focusing on 3D printing services. These startups are leveraging the technology to offer innovative solutions across sectors, such as custom manufacturing, healthcare devices, architectural models, and consumer products. The entrepreneurial ecosystem provides a fertile ground for the growth of 3D printing service providers.

➔ **Customisation and personalisation demands:** With the rise of e-commerce and changing consumer preferences, there is an increasing demand for customised and personalised products. 3D printing enables service providers to offer on-demand manufacturing, allowing customers to get personalised products with unique designs and specifications. This has created new opportunities for service providers in catering to niche markets and fulfilling individual customer requirements.

➔ **Technological advancements:** Advancements in 3D printing technology, including improvements in printer speed, resolution, and material options, have expanded the capabilities of service providers. The availability of a wider range of materials, including biocompatible and high-performance materials, has opened up new applications in sectors like healthcare, jewellery, and industrial manufacturing.

➔ **Cost-effectiveness and sustainability:** 3D printing offers cost advantages in terms of reducing material waste, minimising tooling costs, and enabling on-demand production. Service providers can offer cost-effective solutions to their customers, particularly for low-volume production and complex geometries. Additionally, 3D printing promotes sustainability by reducing material consumption and transportation requirements.

➔ **Collaborations and partnerships:**

Service providers in India are actively collaborating with industries, research institutions, and educational institutions to explore new applications and address specific industry needs. Collaborative efforts help in knowledge sharing, technology adoption, and the development of innovative solutions.

These factors collectively contribute to the growth of the Indian 3D printing industry, enabling service providers to expand their offerings, reach a broader customer base, and contribute to the country's manufacturing and innovation ecosystem.

The major challenges

India has seen increasing adoption of 3D printing technologies with growth rates over 30% year-on-year across materials. The industry has evolved from being a prototyping tech to end-use production, with metal Additive Manufacturing (AM) leading the course. The need for mass customisation in goods has risen significantly. 3D printed applications are seeing a boom in India's automobile, aerospace & defence, and aviation sectors. All these factors will help to fuel the development of the 3D printing market. Furthermore, the growing production base of the robotics, medical prosthesis, and automotive sectors in India will accelerate the market's expansion in



the future.

While 3D printing acts as a catalyst and enables people to research and use creative ways to construct or produce products that solve big problems, the industry faces certain challenges. Let's take a look at some of them:

➔ **Limited awareness and adoption:**

One of the significant challenges is the limited awareness and adoption of 3D printing technology. Many potential customers, especially in sectors like manufacturing and healthcare, are not fully aware of the capabilities and benefits of 3D printing.

➔ **High costs:** 3D printing technology, particularly for industrial-grade printers and materials, can be expensive. The initial setup costs, maintenance, and material costs can pose a financial barrier for service providers and customers.

➔ **Skill gap:** There is a shortage of skilled professionals with expertise in 3D printing technology in India. The lack of trained operators and designers proficient in 3D modeling and printing techniques can hinder the growth and quality of services.

➔ **Quality control and standards:** Maintaining consistent quality and meeting industry standards can be challenging for 3D printing service providers. Ensuring accuracy, surface finish, strength, and reliability of printed parts is essential for various applications.

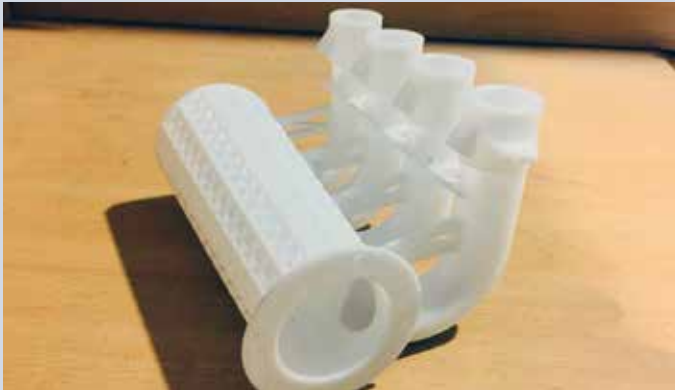
➔ **Intellectual property concerns:** Intellectual property rights and piracy can be a concern in the 3D printing industry. Protecting designs and preventing unauthorised copying or reproduction of objects can be a challenge for service providers.

How is India overcoming the challenges?

To address these challenges, several steps are being taken in India. They include:

➔ **Awareness campaigns:**

Organisations, government agencies, and industry associations are



3D printing benefits for die & mould makers

3D printing offers several advantages to die & mould makers, particularly in terms of conformal cooling. Conformal cooling refers to the use of cooling channels that follow the shape of the mould cavity or core, allowing for efficient and uniform cooling of the part during the moulding process. Here are the main advantages of 3D printing for die & mould makers in terms of conformal cooling:

➤ **Complex geometries:** 3D printing enables the creation of highly complex and intricate cooling channel designs that are otherwise challenging or impossible to achieve with traditional manufacturing methods. The freedom of design offered by 3D printing allows for the creation of conformal cooling channels that can follow the contours of the part precisely, maximising cooling efficiency.

➤ **Improved cooling efficiency:** Conformal cooling channels designed using 3D printing can be strategically positioned closer to the mould surface, resulting in improved heat transfer and faster cooling. This leads to reduced cycle times and enhanced productivity in the injection moulding process.

➤ **Enhanced part quality:** Efficient cooling provided by conformal cooling channels helps in reducing part defects such as warpage, sink marks, and residual stresses. It enables better control over the cooling rate, resulting in improved dimensional accuracy, surface finish, and overall part quality.

➤ **Uniform cooling:** Conventional cooling channels in dies and moulds often have limitations in delivering uniform cooling across the part, leading to variations in cooling rates and potential quality issues. With 3D printing, conformal cooling channels can be designed to provide more uniform cooling, reducing part distortion and improving consistency.

➤ **Reduction in production costs:** Conformal cooling, enabled by 3D printing, can help reduce production costs in several ways. By optimising cooling efficiency, cycle times can be reduced, leading to increased production output. Improved part quality also reduces scrap rates and the need for post-processing, resulting in cost savings.

➤ **Design iterations and optimisation:** 3D printing allows for rapid design iterations and prototyping of conformal cooling channels. Designers can quickly modify and test different cooling configurations, evaluate their impact on part quality and cycle times, and optimise the cooling system before committing to expensive tooling.

conducting awareness campaigns and educational programs to promote the benefits and applications of 3D printing. This includes workshops, seminars, and exhibitions to showcase the technology and its potential.

➤ **Skill development initiatives:** Various training programs and courses are being offered to bridge the skill gap in the 3D printing industry. Institutes and organisations are providing training on 3D modeling, printing techniques, and machine operation to enhance the pool of skilled professionals.

➤ **Research and development:** Efforts are being made to promote research and development in 3D printing technology in India. Academic institutions and research centers are collaborating with industry players to develop innovative solutions, improve materials, and optimise the printing process.

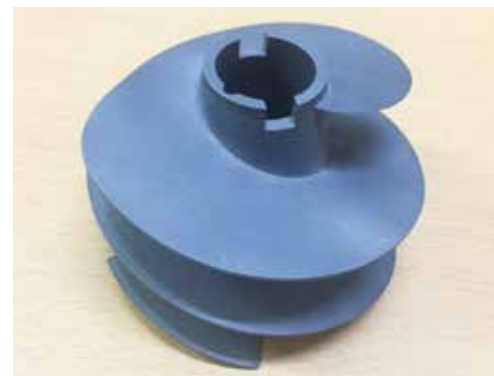
➤ **Industry collaboration:** Service providers are partnering with customers from different sectors to understand their specific needs and develop customised solutions. Collaboration with material suppliers, equipment manufacturers, and software developers helps in addressing challenges and improving the overall ecosystem.

➤ **Policy support:** The Indian government has shown interest in promoting the adoption of advanced manufacturing technologies, including 3D printing. Policy initiatives such as the 'Make in India' campaign and the establishment of technology-focused innovation hubs aim to support the growth of the 3D printing industry.

3D printing and die & mould industry

As adoption of 3D printing spreads, the value of the technology, as more than just a rapid prototyping tool, is becoming increasingly evident.

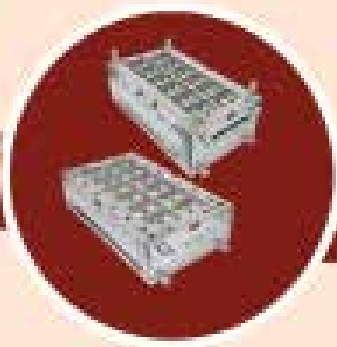
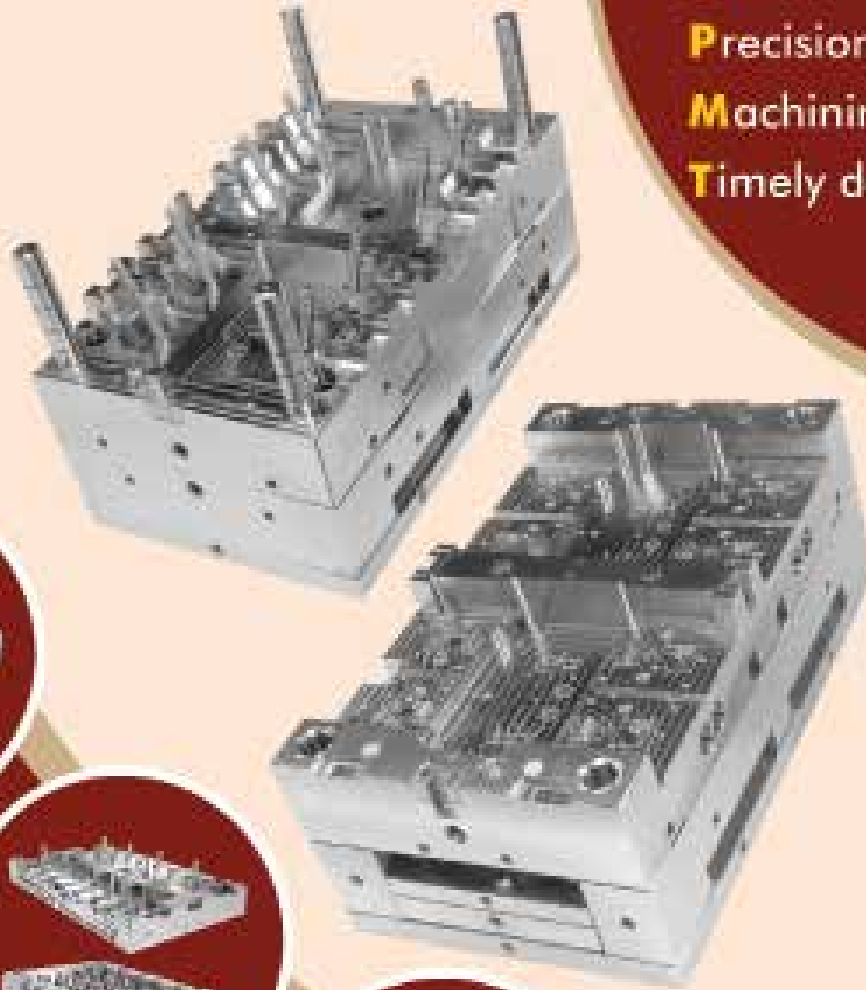
Even when AM isn't being used to produce end parts, businesses are learning that it can be used for the fabrication of tooling for their traditional production processes. In particular, 3D printing moulds & dies for injection moulding and die



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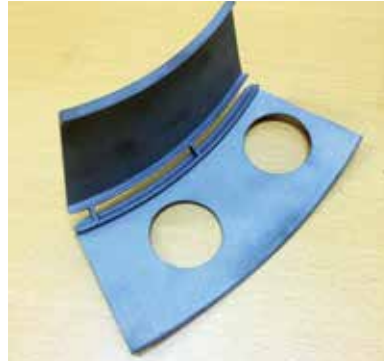
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casting holds a lot of potential due to the various benefits that AM offers in terms of making custom, on-demand and complex parts.

AM can be more cost-effective for small batches of parts. However, in some cases, the technology can provide benefits that are unique to 3D printing, regardless of batch size. This is particularly true of 3D-printed metal moulds & dies that are more durable than plastic moulds.

In many instances, however, different technologies are used for different stages of manufacturing. 3D printing, for example, is frequently preferred for prototyping, since it is simple, transportable and comes with incredibly low start-up costs. Injection moulding, meanwhile, is often the go-to process for huge volumes of end-use parts, since it is fast and highly repeatable. One technology serves the research and development phase; the other takes care of production.

Overall, the use of 3D printing for conformal cooling in die & mould making offers significant advantages in terms of design flexibility, cooling efficiency, part quality, and cost reduction. It empowers mould makers



to create complex cooling systems that optimise the injection moulding process and improve the overall performance of the moulds.

Conclusion

Much of the early success for metal AM came from tool and die applications. This sector continues to offer significant growth potential for the industry. 3D printing can become a valuable asset for manufacturers looking to optimise their traditional manufacturing processes. The technology can be used to produce higher-performing moulds and complex casting patterns, as well as increase the efficiency of machining tools. Furthermore, hybrid machines can offer companies increased

freedom and flexibility in design and manufacturing. Therefore, instead of viewing AM as a competing technology, manufacturers should embrace it as another tool in the toolbox and step forward to embrace the benefits it provides. ♦

Images courtesy: Objectify Technologies



About the Author

Ankit Sahu is the Director of Objectify Technologies Pvt. Ltd. He

completed his Bachelor of Engineering, 2010, in Mechanical Engineering from RV College of Engineering, Bangalore, and his Master of Science in Manufacturing Technology Engineering, 2012, from Warwick University, UK. After returning from the UK in 2013, he founded Objectify Technologies at IIT Kanpur's SIIC Incubation Centre. He now aspires to inform industries and individuals about the value 3D printing can provide manufacturing in the future.

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'The versatility of 3D printing technology is steadily revolutionising die & mould making'

“Facilitating a healthy discussion and fostering collaboration between die makers and 3D printing service providers is of utmost importance. Die makers possess valuable knowledge about the moulding process, while 3D printing service providers have expertise in navigating the limitations associated with the technology,” says **Aditya Kumar**, Managing Director, Marcopolo Products P Ltd.



Nishant Kashyap

Q What are the latest advancements in 3D printing technology and their potential impact on various industries?

Over the years, significant progress has been made in the field of 3D printing technology. This advancement is evident in terms of operational speed, precision, and the expanding range of available materials. While 3D printing technology continues to play a crucial role in the prototyping phase of new product development, it has also found limited applications for end-use parts through the emergence of certain technologies.

Witnessing its rapid adoption, the construction industry has quickly embraced the use of 3D printing technology. Additionally,

metal 3D printing is being widely utilised in the die & mould industry, as well as in sectors such as aerospace, medical, and defence.

Q In your opinion, what are the key factors driving the growth of the 3D printing industry in India, specifically in the realm of service providers?

The rapid pace of new product development has created a strong demand for the 3D printing industry. Service providers play a pivotal role in the prototyping sector by offering solutions for diverse applications and addressing critical requirements. The entry of prominent global players in the aviation industry has further fueled the growth of metal 3D printing technology. Moreover,

the emphasis on manufacturing medical devices in India and promoting import substitution has created opportunities for innovative product development, consequently driving the utilisation of 3D printing technology.

Q What are the major challenges faced by 3D printing service providers in India? What steps are being taken to address them?

In the Indian market, cost sensitivity poses a significant challenge in meeting the quality standards for 3D-printed parts at present cost levels. The reliance on imported materials and machines from Europe, China, and the USA further escalates the overall cost of the final components. Consequently,

Indian companies face decreased competitiveness in the global landscape. Additionally, limited knowledge and awareness about the technology remain obstacles, but efforts are underway to gradually address this issue by incorporating 3D printing technology into the undergraduate curriculum.

Q How do you envision 3D printing technology transforming the die & mould making industry, particularly in terms of efficiency and design capabilities?

The versatility of 3D printing technology is steadily revolutionising die & mould making, enhancing both speed and quality. With the advent of various hybrid technologies, it is now possible to add material and machine components within the same systems, optimising material utilisation. While these technologies find extensive applications in large-scale projects, 3D printing is also driving innovations in the development of intricate sand cores for the sand casting process used in producing sizable aluminium/steel castings.

Q What are the main advantages that 3D printing

The emphasis on manufacturing medical devices in India and promoting import substitution has created opportunities for innovative product development, consequently driving the utilisation of 3D printing technology.

offers to die & mould makers in terms of conformal cooling?

Conformal cooling is one of the biggest revolutions in the die & mould industry. This technique involves the creation of cooling channels in close proximity to the impression area of an injection moulding tool. By utilising these conformal cooling channels, highly efficient heat transfer can be achieved during the moulding process, leading to improved component quality. Significantly, this method also reduces the overall cycle time, resulting in cost savings for the production of components.

Q Are there any specific materials or technologies that are particularly suitable for achieving effective conformal cooling using 3D printing?

Currently, there are multiple metal

3D printing technologies capable of direct metal sintering, making them suitable for the creation of conformal cooling channels. To achieve optimal results, tooling inserts for these channels are commonly manufactured using steel or aluminium materials.

Q How important is collaboration and knowledge sharing among 3D printing service providers and die & mould makers to fully exploit the potential of conformal cooling and advance the industry as a whole?

Facilitating a healthy discussion and fostering collaboration between die makers and 3D printing service providers is of utmost importance. Die makers possess valuable knowledge about the moulding process, while 3D printing service providers have expertise in navigating the limitations associated with the technology. Therefore, organising industry seminars on this topic, well-attended by professionals from both the fields, can significantly contribute to the advancement of the industry. Such forums will encourage knowledge exchange, promote understanding of each other's perspectives, and drive innovation within the sector. ♦

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'To reap the benefits of 3D printing in die and mould making, training and skill development are crucial'

"3D printing technology requires a different skill set... To maximise the benefits of AM, we need to use DfAM [Design for Additive Manufacturing] in our design aspects, which will help us utilise the technology to the fullest," says Anuj Budhiraja, Vice President - Phillips Additive - India, Middle East, Malaysia, Phillips Machine Tools.



Nishant Kashyap

Q How would you describe the recent advancements in 3D printing technology and their potential impact on various industries?

There have been several advancements in 3D printing. Some of the key ones include the development of new materials, and improved software & hardware capabilities such as multi-material printing and high-resolution printing. These have not only helped resolve the challenges related to batch production of various industries like tooling, aerospace, and healthcare, but have also improved the productivity of tools and end-use parts. 3D printing is also helping industries overcome challenges surrounding supply change and increased cost of raw materials. It is making them capable of

printing parts as and when needed, thereby improving productivity and performance.

Q In your opinion, what are the key factors driving the growth of the 3D printing industry in India?

The Indian manufacturing industry is undergoing a transformation. It is mainly focusing on implementing industry 4.0, and smart manufacturing to cater to the global market with best-in-class infrastructure. To improve its manufacturing infrastructure, the industry is looking at Additive Manufacturing (AM) as one of the key technologies to better their products with:

- Freedom of design
- Functional integration
- Customisation
- Shortening lead times

- Improvements in functionality and quality
- Improved ergonomics.

The industry is also moving towards mass customisation and needs AM technology to support the low-volume production with shortened product development cycle. The key factors driving the growth of AM adoption in India are:

- Focus on the global market
- Manufacturing infrastructure improvement
- Shortening product development cycle
- 'Make in India' initiative to develop products.

Q How do you see the adoption of 3D printing technology evolving in India in the next few years?

Innovation in 3D printing in India will continue to grow. Factors



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such as expanding interest in customised products and new-age technology companies developing products using the latest technologies like drone, IoT devices, healthcare, and custom accessories in automotive will further its growth.

Additionally, government initiatives to promote AM technologies and the development of a skilled workforce also contribute to the growth of the 3D printing industry in India. Recently, the government set up the National Centre for Additive Manufacturing (NCAM), an organisation to devise the framework around AM, and its path and future in the country. This shows the government's commitment to promote and establish AM in India.

Q How do you envision 3D printing technology transforming the die and mould making industry in India?

Mould and die manufacturing faces a unique combination of challenges, including working with tough alloys, achieving repeatable micron-level precision, creating complex part geometries, and meeting the ever-growing demands for faster production at lower costs. 3D printing can solve these challenges using various approaches such as hybrid printing, conformal cooling channels and support-less printing.

Q What points should die and mould makers keep in mind when incorporating 3D printing into their manufacturing processes?

Mould makers need to consider

the following points while incorporating 3D printing into their manufacturing process:

- Material selection
- Quality control
- Maintenance and repair
- Intellectual property
- Regulatory compliance.

Q Are there any specific materials or technologies that are particularly suitable for die and mould production using 3D printing?

Several materials and technologies are particularly used in die and mould production using 3D printing. The most used materials include metal powders (such as stainless steel, titanium, and aluminium), thermoplastics (such as ABS and nylon), and photopolymers (such as acrylics and epoxies), which are available in AM.

The materials and technologies used will depend on the requirements of the application and the capabilities of the 3D printing equipment. However, most of the challenges faced by the die and mould industry can now be addressed using the available technologies and materials.

Q How important is training and skill development in order to fully leverage the benefits of 3D printing in die and mould making?

To reap the benefits of 3D printing in die and mould making, training and skill development are crucial. The current education system mostly teaches the traditional way of manufacturing and barely focuses on Design for Additive Manufacturing (DfAM) techniques.

Q What are the main advantages that 3D printing offers die and mould makers in terms of efficiency, cost savings and design possibilities?

The main advantages that 3D printing offers die and mould makers include:

- In terms of efficiency, AM can reduce the time and cost involved in traditional die and mould making processes, allowing for faster and more efficient production.
- In terms of cost savings, die and mould makers can produce customised dies and moulds on demand, eliminating the need for large inventories and reducing waste, which can help companies optimise their supply chain and reduce costs.
- In terms of design possibilities, 3D printing enables the production of highly complex and intricate designs that are difficult or impossible to achieve using traditional manufacturing methods, allowing for more innovative and unique designs that meet the specific needs of customers.

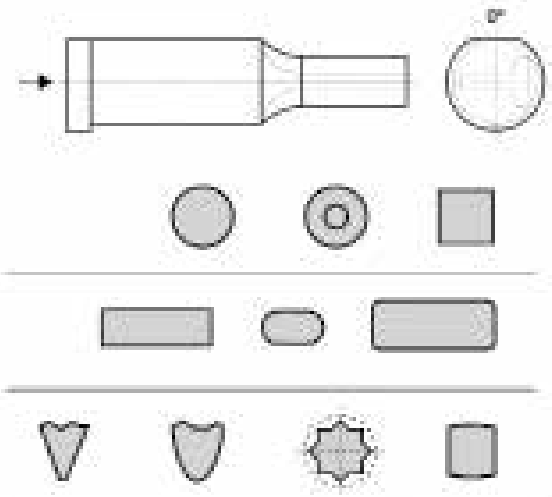
3D printing technology requires a different skill set. And so, educating students about 3D printing technology will prove to be beneficial, especially with regard to DfAM concepts. To maximise the benefits of AM, we need to use DfAM in our design aspects, which will help us utilise the technology to the fullest. ♦

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'The adoption of 3D printing technology in India is poised for significant growth in the coming years'



“Increased awareness and understanding of the benefits of 3D printing, such as design freedom, cost savings, and reduced time to market, will lead to broader adoption in the automotive, aerospace, healthcare, and consumer goods sectors,” says Vishwanath Harpanahalli, Country Manager, Formlabs India.

Nishant Kashyap

Q How would you describe the recent advancements in 3D printing technology and their potential impact on various industries?

3D printing has revolutionised traditional manufacturing processes. It offers die and mould makers in India a new frontier to explore, enabling enhanced efficiency, cost savings, and unparalleled design possibilities.

The recent advancements in 3D printing technology have been transformative, opening up a world of possibilities for various industries. Additionally, Additive Manufacturing (AM) has evolved significantly, enabling the production of complex geometries, functional prototypes, and end-use parts with exceptional precision and speed. These advancements have had a profound impact on industries such as automotive, aerospace, healthcare, and consumer goods, among others.

Q What are the key factors driving the growth of the 3D printing industry in India?

Firstly, new-age industries like drones, robotics, and Electric Vehicles (EVs) are adopting 3D printing technology

to leverage its advantages in design complexity, customisation, and rapid prototyping. This has created demand for advanced 3D printing solutions in India.

Secondly, the Indian government's initiatives, like the 'Make in India' campaign, have created a favourable environment for innovation and manufacturing. The government's focus on promoting indigenous manufacturing and the establishment of technology and innovation hubs have encouraged the adoption of 3D printing technology.

Thirdly, the availability of advanced 3D printers, materials, and software solutions has played a significant role in the growth of the 3D printing industry in India. With ease of access to these technologies, more industries and businesses are recognising the potential of 3D printing and embracing it to enhance their manufacturing processes.

Q How do you see the adoption of 3D printing technology evolving in India in the next few years?

The adoption of 3D printing technology in India is poised for significant growth in the coming

years. Increased awareness and understanding of the benefits of 3D printing, such as design freedom, cost savings, and reduced time to market, will lead to broader adoption in the automotive, aerospace, healthcare, and consumer goods sectors. Small and medium enterprises (SMEs) will also increasingly embrace 3D printing technology to enhance their competitiveness and accelerate product development.

Additionally, the availability of funding and support for startups and research institutions in the 3D printing space will contribute to the growth of the industry. Collaborations between academia, industry players, and government bodies will foster innovation and drive the adoption of 3D printing in India.

Q How do you envision 3D printing technology transforming the die and mould making industry in India?

Traditionally, die and mould production involved time-consuming processes, intricate tooling, and skilled craftsmanship. However, with the advent of 3D printing, manufacturers can significantly reduce lead times, improve design

iterations, and achieve complex geometries with ease.

Formlabs offers advanced technologies such as stereolithography (SLA) and selective laser sintering (SLS) that are particularly suitable for die and mould production. These technologies provide high precision, a smooth surface finish, and excellent dimensional accuracy, enabling die and mould makers to create intricate and customised moulds.

Furthermore, 3D printing offers design flexibility, allowing for the production of lightweight and optimised dies and moulds, reducing material waste and enhancing overall efficiency. With the ability to produce complex cooling channels and conformal cooling, 3D printing enhances the performance and quality of dies and moulds.

By leveraging 3D printing technology, die and mould makers in India can accelerate their production cycles, achieve cost savings, and unlock new design possibilities, ultimately enhancing their competitiveness in the market.

Q What are the main advantages that 3D printing offers die and mould makers in terms of efficiency, cost savings and design possibilities?

Firstly, it enables significant efficiency gains by reducing lead times. Traditional die and mould production involves multiple iterations and manual tooling, leading to longer production cycles. With 3D printing, die and mould makers can rapidly produce prototypes and functional moulds, allowing for quicker design iterations and faster time to market.

Moreover, 3D printing eliminates the need for complex tooling setups, reducing costs associated with tooling maintenance and modifications. It also enables die and mould makers to consolidate multiple parts into a single printed component, reducing assembly time and costs.

In terms of design possibilities, 3D printing offers unprecedented freedom to create complex geometries and internal features that are challenging to achieve using traditional manufacturing methods. Die and mould makers can incorporate intricate cooling channels, conformal cooling, and lightweight designs, resulting in improved part quality and performance.

Q What points should die and mould makers keep in mind when incorporating 3D printing into their manufacturing processes?

Die and mould makers should consider several factors when incorporating 3D printing into their manufacturing processes. Firstly, they should evaluate the suitability of 3D printing for their specific applications and understand the limitations and capabilities of the technology. This assessment will help them identify the most appropriate projects for AM and optimise the integration of 3D printing into their existing workflows.

Additionally, die and mould makers should invest in reliable and high-quality 3D printing equipment and software solutions. Collaborating with experienced 3D printing service providers or experts can also facilitate a smoother transition and ensure optimal outcomes.

Furthermore, it is crucial to educate and upskill the workforce on 3D printing technologies, materials, and design principles. Training and skill development programs will empower the workforce to fully leverage the benefits of 3D printing and effectively operate and maintain the equipment.

Die and mould makers should also consider the selection of materials suitable for their specific die and mould applications. Working closely with material manufacturers, such as Formlabs, can help them choose the right materials with the desired mechanical properties, heat resistance, and durability.

By considering these factors, die

and mould makers can successfully incorporate 3D printing into their manufacturing processes and unlock the full potential of this transformative technology.

Q How important is training and skill development in order to fully leverage the benefits of 3D printing in die and mould making?

Training and skill development are crucial for fully leveraging the benefits of 3D printing in die and mould making. While 3D printing offers tremendous potential, understanding the technology, materials, and design principles is essential to achieve optimal results.

Die and mould makers should invest in comprehensive training programs that cover various aspects of 3D printing, including equipment operation, software utilisation, material selection, and post-processing techniques. Training programs can be tailored to the specific needs of die and mould makers, addressing their unique challenges and requirements.

Moreover, upskilling the workforce with knowledge of 3D printing technologies empowers them to identify suitable applications, optimise designs for AM, and troubleshoot potential issues. Skilled operators can ensure proper machine maintenance, calibrations, and perform the necessary adjustments to achieve accurate and consistent 3D printed dies and moulds.

Continuous skill development and staying updated with the latest advancements in 3D printing technology are also important for die and mould makers to explore new opportunities and stay competitive in the rapidly evolving manufacturing landscape.

By prioritising training and skill development, die and mould makers can maximise the benefits of 3D printing, enhance productivity, and drive innovation in their die and mould manufacturing processes. ♦

'The die and mould industry has been an early adopter of 3D printing'

"In the near future, an increasing number of die manufacturers in India are expected to realise the immense potential of this technology in addressing productivity and quality challenges in end part production," says Vishwas Puttige, Business Head, amace solutions Pvt. Ltd.



Nishant Kashyap

Q How would you describe the recent advancements in 3D printing technology and their potential impact on various industries?

In recent times, there have been remarkable advancements in 3D printing technology, particularly in the field of metal printing. These advancements have primarily focused on three key areas: the development of new materials, the enhancement of process quality, and the improvement of productivity. We are pleased to report that the industry has made significant progress in all three aspects. As a result, there has been a notable increase in the adoption of this technology, leading to a growing number of emerging applications.

The continuous development of new materials has played a vital role in the advancement of 3D printing. These materials are specifically designed to cater to various applications and are

compatible with highly productive printing machines. As a result, manufacturers are increasingly choosing 3D printing as their preferred manufacturing method.

Q In your opinion, what are the key factors driving the growth of the 3D printing industry in India?

In recent years, India has undergone a significant paradigm shift, with a strong emphasis on developing indigenous capabilities in various sectors such as aerospace, defence, electronics, and more. One technology that has shown immense potential in aiding new product development and R&D efforts, particularly from a manufacturing standpoint, is 3D printing. This technology has played a pivotal role in driving the growth of 3D printing in the country.

Q How do you see the adoption of 3D printing

technology evolving in India in the next few years?

India has positioned itself as a prominent global manufacturing hub, attracting numerous foreign investments and nurturing the development of homegrown entities. As the country's needs continue to expand, it becomes increasingly vital for industries to embrace advanced manufacturing technologies like 3D printing. The rise of key sectors such as defence, space, and aviation has further amplified the demand for 3D printing, and this demand is expected to grow exponentially. With increased adoption, the overall cost of manufacturing also drops thereby fuelling further growth.

Q How do you envision 3D printing technology transforming the die & mould making industry in India?

The die and mould industry has been an early adopter of 3D

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printing, recognising its clear use case in the form of conformal cooled dies and inserts for plastic injection moulding and die casting applications. This particular strength of 3D printing has the potential to make a significant impact by reducing cycle time and minimising rejection rates of end parts. In the near future, an increasing number of die manufacturers in India are expected to realise the immense potential of this technology in addressing productivity and quality challenges in end part production. Previously, the lack of awareness within the Indian die & mould fraternity about 3D printing hindered its adoption. However, in recent years, this scenario has changed as more and more die and mould makers, ranging from corporate to MSME segments, are opting to explore the benefits of conformally cooled inserts for their applications.

Q What are the main advantages that 3D printing offers die and mould makers in terms of efficiency, cost savings, and design possibilities?

In the majority of plastic injection moulding cases, we have observed a remarkable increase in productivity of the injection moulding process, ranging from 30% to 60%, as a direct result of minimising cooling time. From a cost perspective, customers benefit from longer-lasting dies, reduced costs associated with poor quality, and quicker availability of dies. The utilisation of 3D printing enables the design of complex geometries with relative ease, facilitating the creation of intricate conformally cooled channels. Additionally, the technology allows for the validation of different designs before proceeding with mass production.

Q What points should die and mould makers keep in mind when incorporating 3D printing into their manufacturing processes?

Similar to any other industry, it is crucial for manufacturers in the die and mould sector to comprehend the value addition that 3D printing can bring to their dies or inserts. Nowadays, with the advancements in simulation software, customers who opt for conformally cooled dies or inserts have the opportunity to simulate the benefits in a virtual environment. This enables them to make informed decisions regarding the necessity of implementing 3D printing technology.

Moreover, die and mould makers should be well-informed about certain limitations associated with 3D printing. These limitations include considerations such as the size of the parts, availability of suitable materials, dimensional tolerances of the printed part, surface finish, and the requirement for post-processing. Additionally, the design of conformal cooling channels plays a crucial role in determining the level of productivity improvement that can be achieved.

Q Are there any specific materials or technologies that are particularly suitable for die and mould production using 3D printing?

Maraging steel (18Ni300) has emerged as the most popular 3D printed material for the die and mould industry, showcasing remarkable performance and superior durability compared to conventional tool steels. In addition to Maraging steel, we have also introduced H13 as an alternative option for our die and mould customers, providing them with a wider range of material choices to suit their specific

requirements.

In terms of technology, Laser Powder Bed Fusion (LPBF) stands as the preferred choice for the die and mould sector. LPBF offers several advantages, including high density, exceptional strength, intricate detailing capabilities, and minimal shrinkage. The dimensional accuracy achieved through LPBF surpasses that of other metal 3D printing technologies, making it highly favoured among manufacturers in the die and mould industry.

Q How important is training and skill development in order to fully leverage the benefits of 3D printing in die and mould making?

In spite of significant improvements in the adoption of 3D printing in the country, we are still at a relatively early stage when we look at its implementation. To propel this technology to the next level, training and skill development will undoubtedly play a crucial role. All stakeholders in the 3D printing field are actively contributing to the training and development of a skilled workforce. However, it is important to acknowledge that this endeavour cannot be achieved in isolation. Industry bodies such as TAGMA must collaborate closely with the additive manufacturing community to bring this technology to a wider audience.

Creating awareness about 3D printing needs to start from the top management level within organisations. Building this awareness is vital to foster a long-term vision for the technology and to harness its sustained benefits. It requires a collective effort from industry leaders, professionals, and organisations to promote the understanding and utilisation of 3D printing across various sectors. ♦

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Reverse-engineering automotive parts using metal 3D printing technology

RPG Industries is a full-service manufacturer working with automotive, aerospace, and oil industry clients. Started in 1995, the company primarily offers EDM, CNC machining, waterjet cutting, and additive manufacturing services.

The challenge

Robert Ginsburg, President of RPG Industries, continuously looks for ways to stay at the cutting edge in a saturated industry, expand the business, and bring new capabilities in-house for his customers. One such customer — D&D Classic Automotive Restoration — was restoring a 1930s classic car when they found that one of the original carburetors was broken. They conducted a worldwide search for a replacement part but were unable to locate one. D&D then attempted to repair the existing part; however, the original could not be welded or brazed due to the need for an air- and watertight seal. "If you

When I saw the technology and the price point, I knew that the Metal X would be a good fit for our company.

- Robert Ginsburg,
President,
RPG Industries, Inc.



were to try to machine this part from scratch, it would be cost prohibitive," says Ginsburg. "The detail, intricacy, and the internals of the component make it nearly impossible, and the machine part will never look as good as the original."

The solution

Robert had been considering adding a metal 3D printer to his business for quite some time; however, he was only familiar with powder-based printers, which did not make economic sense and are prone to workplace hazards. When he realised the Markforged Metal X 3D printer met his price point and was a safer option than other powder-based metal printers, Robert knew he had found his solution. He purchased the Metal X system and a Mark Two 3D printer, and immediately put them to use. Robert initially used his Markforged Mark Two 3D printer to print the reverse-engineered carburetor cap using Markforged Onyx material (chopped carbon fiber-filled thermoplastic). He then 3D printed the same part in 17-4 PH Stainless Steel on his Metal X printer and presented it to the team at D&D as the final part, who were



Having the capability to quickly scan a broken part, make the repairs, and print it out on the Metal X has changed things for us.

- **Robert Ginsburg,**
President,
RPG Industries, Inc.

delighted with the result. "Having the capability to quickly scan a broken part, make the repairs, and print it out has changed things for us,"

says Robert. "And the capability of changing materials in Eiger with little-to-no fuss is just one of the reasons we love Markforged." The car was fully restored and is now back with its owner, boasting a fully functional metal 3D printed part under the hood.

The future

Robert is extremely pleased with the addition of his Metal X system, and has put it front and center in his shop. "The Metal X is the first thing you see when you walk into the shop," says Robert. "People are pretty amazed — it's definitely given us a competitive advantage over other EDM competitors." He hopes some of the smaller moulds and tools that they fabricate traditionally can be printed on either the Mark Two 3D printer or Metal X before being put straight to use. "I think a lot of our workforce is, or was, indifferent to 3D printing. They didn't really understand why I was investing in this technology. Once they saw the results, I think pretty much everybody understood that it's a good fit." ♦

Article and images courtesy Markforged



Roush saves 35% in costs and meets delivery schedule with **3D printing** from Stratasy Direct

Roush Performance Products is an American automotive company that develops and manufactures high-performance components for street and competitive racing applications. The company develops a wide range of vehicles for customers, from Ford F150s to Mustangs.



The challenge

Due to an issue with the Advanced Driver Assistance System (ADAS), a late-stage design change became necessary for the front grill camera on the Roush F-150 pick-up truck. To address the problem, Roush needed to either redesign the grille or redesign the camera mount.

Roush's traditional approach to this issue would have been to create an injection-moulded tool, adding up to an additional 16 weeks, plus time for testing, painting, and assembly trials. However, with trucks already in the facility waiting to be built, Roush needed a faster solution and approached Stratasy.

Roush turns to Stratasy

Roush needed the camera mounts

to be dimensionally accurate, high-impact resistant, and ductile so they could be mounted with multiple parts together. Stratasy recommended using PA11 material using Selective Absorption Fusion (SAF™) technology on the H350 printer. Designed specifically for production projects, SAF is a powder bed fusion technology that provides enough throughput to make several thousand parts for the entire production run of F-150 vehicles.

After prototyping a new design using SAF, Roush engineers discovered the parts performed exceptionally well during rigorous testing, were more effective than injection moulding, and could be produced with a much faster turnaround.

Roush contracts Stratasy Direct for production

With a newly designed camera mount in hand, Roush still faced the challenge of manufacturing enough

On the F150 project, we had a late issue that we had to quickly pivot on. We had to reposition the front cameras on the trucks and in doing so, we prototyped a design that actually became the production solution for the program.

- **Luke MacInnes**,
Product & Development
Engineer

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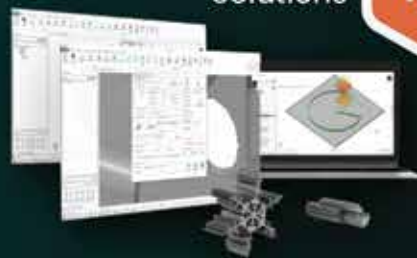
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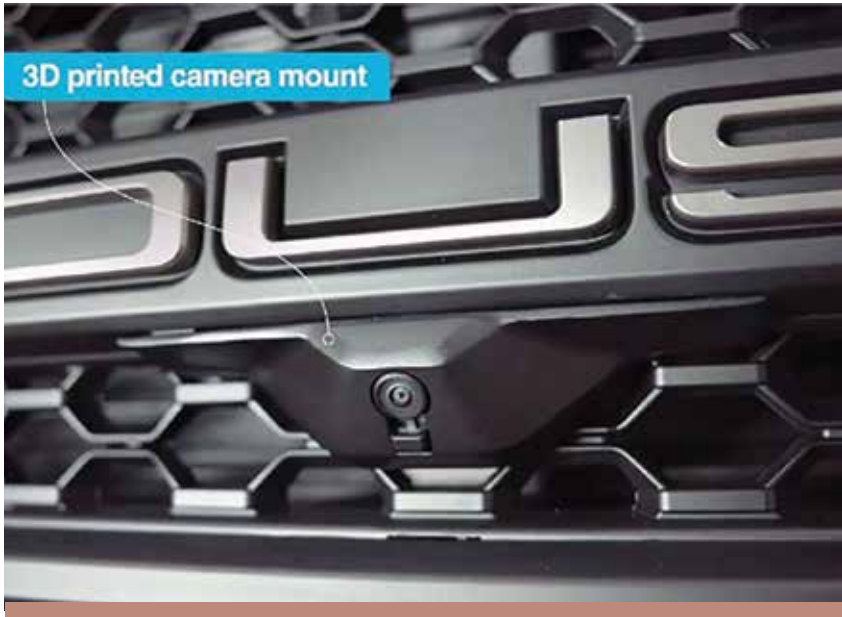
components to equip an entire fleet of F150 trucks. Although Roush had been using 3D printing for several years, they had never utilised additive manufacturing for end-use parts. Until recently, 3D-printed parts for automotive companies focused primarily on low-volume components – jigs, fixtures, tooling, and other prototypes. With the introduction of SAF technology, a production solution was available to manufacture end-use components quickly, efficiently, and affordably.

As a high-performance Original Equipment Manufacturer (OEM) Roush had rigorous testing and quality requirements that every part had to meet. Roush needed to ensure their components would be consistent, repeatable, and meet PPAP standards. Stratasys Direct delivered on that challenge.

Since the beginning of the project, Stratasys Direct has manufactured more than 850 components for Roush, with more scheduled for production through the end of the year. By the end of 2023, Stratasys Direct will have fabricated

Stratasys Direct is fulfilling all of our production orders, as well as our initial PPAP requirements for our quality needs. It [PPAP] makes sure that all of our parts are consistently accurate to our design, so it was great to incorporate Stratasys Direct into our production process.

- **Chad Anderson,**
Product & Development
Engineer



approximately 1500 3D-printed parts for the automaker.

The growing need for PPAP expertise

Roush's requirement for Production Part Approval Process (PPAP)-certified parts was not new. As a leader in advanced manufacturing solutions, Stratasys has been producing

additively manufactured parts for automakers for decades. However, in recent years, Stratasys Direct has seen a significant increase in PPAP parts.

Just two years ago, 3D printed projects for automotive mainly consisted of prototypes, jigs and fixtures, and other low-volume projects. But as AM for production



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projects has gained more validation and acceptance, Stratasys Direct has received numerous requests in the past year.

A standard in the industry, PPAP is a standard automotive companies use to establish confidence in suppliers that their manufacturing process meets quality requirements and standards. PPAP ensures parts conform to customer requirements; provides evidence of process stability; controls product and process changes; and documents that the manufacturer is adhering to a control plan and approval process.

Stratasys Direct delivers PPAP-approved parts

Stratasys Direct collaborated with Roush to deliver camera mounts that met the highest standards of quality and reliability. To ensure compliance with the meticulous Production Part Approval Process (PPAP) required for commercial vehicles, Stratasys Direct not only manufactured durable and long-lasting parts, but also prepared a comprehensive package of documentation that outlined the entire manufacturing workflow.

As part of its robust quality management system, Stratasys Direct created controlled work instructions that ensured reliable human input. Using the Stratasys H350 printer's multipage build report capabilities, manufacturing engineers validated each build for repeatable printing configurations in critical parameters, such as bed temperature, scaling factors, and nesting densities. The entire manufacturing process was reviewed using Process Failure Mode and Effects Analysis (PFMEA) to identify potential risks and control methods.



This comprehensive approach was synthesised into a control plan that mapped how quality would be ensured at every step of the process. Stratasys Direct then verified that the defined workflow was correctly executed and that the final components met all the requirements. The camera mount and cover were 3D-scanned, and a full-dimensional report of each geometry was provided along with a final group of documents outlining and validating each step of the manufacturing workflow to Roush.

After reviewing the data package, Roush approved Stratasys Direct for the production of the components. Once in full

production, a simplified quality process was implemented to ensure part success without over-inspection.

3D Printing – A major win for Roush

By 3D printing the camera mount, Roush was able to achieve a significant reduction in cycle time – by at least 50% compared to injection moulding. This allowed Roush to meet its production schedule and fulfill its commitment to customers, avoiding the typical three to four-month wait and a \$30K expense of injection moulding.

In addition, by using additive manufacturing technology, Roush was able to create a better design with greater performance and efficiency. With the help of Stratasys Direct's huge production capacity, automotive expertise, and manufacturing experience, Roush was able to meet its production schedule, save money, and stay competitive in the market. ♦

*Article and images courtesy
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Additive manufacturing market size is forecast to reach ~\$35 billion by 2026.

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10 Key Skills for Industrial 3D Printing

Additive Manufacturing (AM) has been around for 35+ years, continuously growing adoption in major industries. The AM industry is ready to dominate and bring its futuristic and innovative manufacturing solutions to every business, but first, education and enablement must catch up.

The Levels of 3D Printing Expertise

Industrial 3D printing can have an extensive learning curve, but can be broken down into levels or phases of AM technology throughout your 3D printing education journey:

Level 1: The additive manufacturing basics

Level 2: How to select the right applications for your production

Level 3: AM design and engineering

Level 4: Scaling and validating production

Key Skills

1 Understanding the process

AM is a process, not a button. As much as we admire our 3D printer's abilities to start and build on command, the educational portion of industrial 3D printing is

not that simple. A few of the phases throughout the AM production journey are explained in Figure 1.

2 Designing for 3D printing

Design is one of the most important parts of the AM process. Without useful design, every other stage is unpredictable. An educated and creative AM designer can decrease the amount of wasted powder, longer build times, and lower overall cost-per-part, making them a vital part of the team.

3 Managing the system and application engineering software

To create a great application, you need to master both the system and software at play. To select the right quality part parameters for each case, you need to understand what these part parameters mean for your

application performance, and what results will come from changing process parameters like up-skin, core, down-skin, overlapping, and contours.

4 Selecting the right material

Each material has its unique properties and will behave differently throughout the AM process. Therefore, you need material-specific parameter training to understand the values and implications of different material selections. Exposure settings for hatch, contour, and edge effects are vital to a successful application as well.

Material selection also applies to your application performance, finding the right material to fit your desired application capabilities. It is important to know which materials shrink, warp, or deviate when processed and exposed to varying environments.



Figure 1

5 Preparing for the build

Understanding the data preparation process will enable you to optimise job preparation and reduce failed builds, saving you both time and money on the production floor. Learning how to design successful support structures, how to choose appropriate materials, and how to select the most beneficial parameters for each application type does not come naturally – no matter how easy AM experts may make it seem from an outside perspective.

6 Operating the AM system

Before you can operate a system, you need extensive training on the safe and efficient operation of the machine itself and its peripherals. This includes the handling of the processing software, the set-up, job start, and observation of the process.

7 Post-processing and surface finishing

Additive manufacturing is not only about designing and preparing your project for 3D printing, but knowing how to make it shine after the build

is successful as well. A distinguished, professional feature of an AM application is the level of post-processing used to smooth, shine, and finalise the part.

8 Defining the desired quality

Recognising the definition of quality within the 3D printing industry and how to measure it throughout the AM process is another element of becoming an established 3D printing engineer. To truly benefit from the use of industrial 3D printing, you should be able to identify the quality criteria such as dimensional accuracy, tensile strength, hardness, density, and electrical conductivity in your application.

9 Developing skills for business

Finally, learning how to properly carry out a business case analysis is a key step of the AM journey. This presents the opportunity to show off your knowledge of the entire process chain, and successfully guide your organisation while leveraging AM. Getting to know

the impact of key cost levers and how to reduce overall cost-per-part is an integral part of preparing yourself and your business for future AM projects, as well as understanding both the quantitative and qualitative types of business models.

10 Distributing production

Before you start serial production, you should simulate your production using a digital twin. As a result, you can forecast the throughput and output of your production site based on the machine parking equipment, operator shifts, machine maintenance procedures, etc.

Since the entire process chain from procurement to production is digitally synchronised and all machines are connected and communicate via IIoT platforms, you can easily align your production with local demands while significantly reducing transportation and storage costs. ♦

Article & images courtesy: EOS GmbH



Industrial 3D printer with a digital twin

Using Sinumerik One, Ingersoll Machine Tools has designed its giant industrial 3D printer MasterPrint™, the world's largest device that prints with thermoplastics. Large parts are printed and then machined to their final shape with the same machine. By making use of Additive Manufacturing (AM), production costs were reduced by 75 percent and lead times shortened from months to days.



An industrial 3D printer that can also perform milling, fiber placement, tape laying, inspection, and trimming: the MasterPrint™ series from Ingersoll Machine Tools is a true all-rounder. "At one minute the machine could be adding material, the next subtracting it with the milling head," says Jason Melcher, Vice President Sales at Ingersoll. All the while, the machine maintains highly precise tolerances. No wonder Ingersoll has earned a reputation for excellence in the aerospace, defence, energy, and other heavy industry sectors.

To handle complex machining applications, Ingersoll depends on cutting-edge technologies in hardware and software from Siemens. In regard to the latter, Ingersoll chose the modular, scalable and open Sinumerik 840D sl CNC system from Siemens for its portfolio. Sinumerik 840D sl is considered the control

of choice in high-end machining segments, like those Ingersoll Machine Tools serves.

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Aside from counting on Sinumerik for control, Ingersoll engineered this mega MasterPrint machine using the digitally native Sinumerik One. With its digital twin, it helps to simulate and test work processes entirely in a virtual environment.

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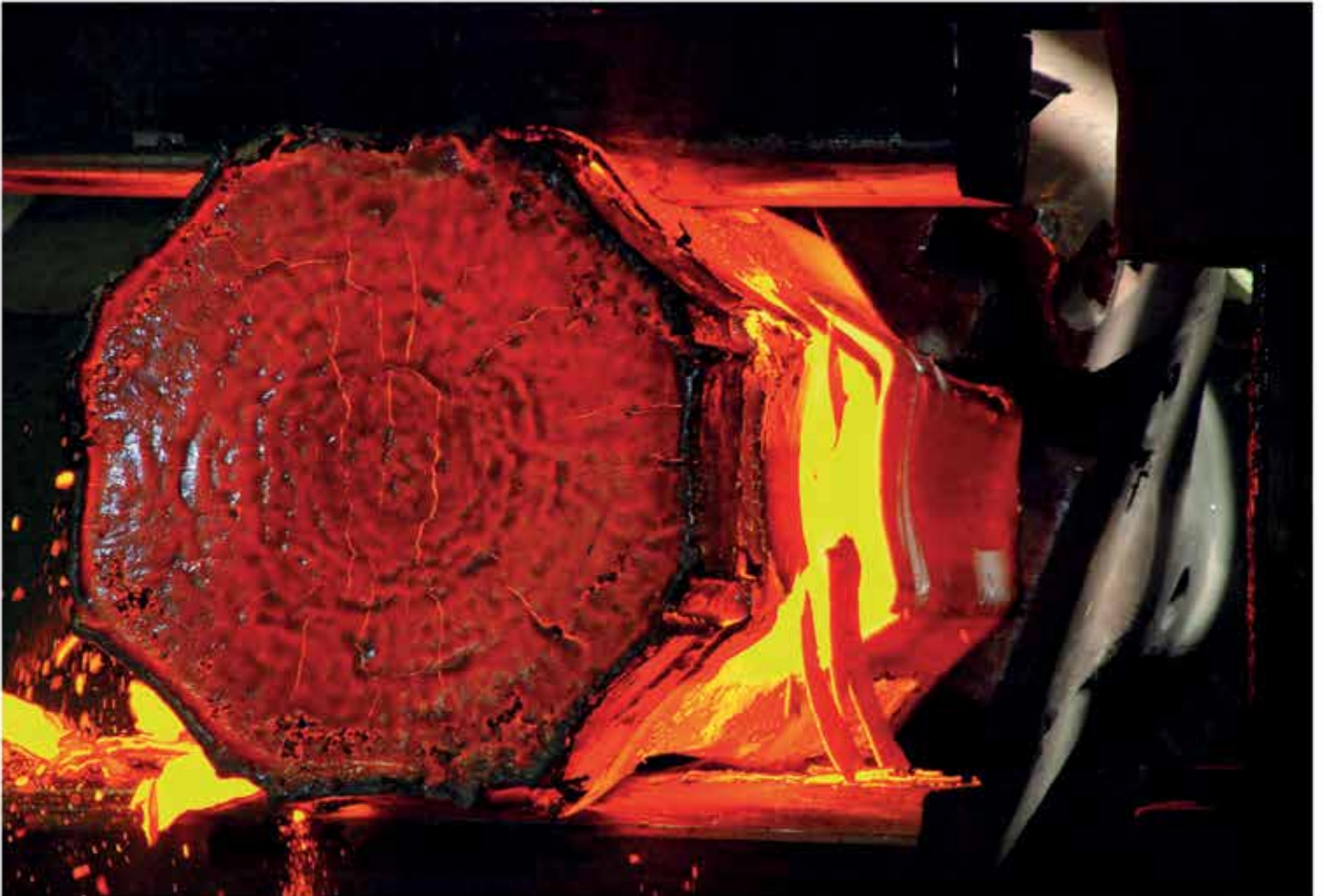
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robotic platforms MasterPrint Robotic™ and MasterPrint Continuous Filament™ – as well as for its gigantic industrial 3D printer MasterPrint™, the world's largest device that prints with thermoplastics. Large parts are printed and then machined to their final shape with the same machine. Manufacturing costs can be reduced by 75 percent and lead times shortened from months to days.

Aside from counting on Sinumerik for control, Ingersoll engineered this mega MasterPrint machine using the digitally native Sinumerik One. With its digital twin, it helps to simulate and test work processes entirely in a virtual environment.

An important aspect here is the Siemens Virtual NC Kernel (VNCK). Ingersoll uses it to embed the real CNC kernel into a virtual machine, allowing it to completely emulate real machine tool control and directly import the commissioning archive of

We have found a CNC hardware and software partner in Siemens, who is willing to develop and encompass advanced capabilities into their products and enable us to achieve our strategic goals and serve the needs of our customers by shortening their time-to-market and increasing their profitability.

**- Piergiorgio Assandri,
Business Director,
Ingersoll Machine Tools**

the actual machine. Doing so saves time through faster commissioning and helps Ingersoll get the machine to its customers faster. End-customers benefit too with the

ability to simulate the manufacturing of their product and shorten their time-to-market while increasing production quality.

Digital twin to meet ROI targets

By offering digital twins of its products, Ingersoll is better able to serve its clients. "Our customers value our capability to create a digital twin in the design phase, because it gives them reassurance in terms of feasibility and the ROI targets they have set for themselves," explains Jason Melcher. Perhaps most importantly, by including software and digital tools from Siemens in its processes, Ingersoll is able to expand into new markets. Plus, the company can even more quickly adapt to market changes. With digitalisation technologies from Siemens, Ingersoll is well equipped for the future. ♦

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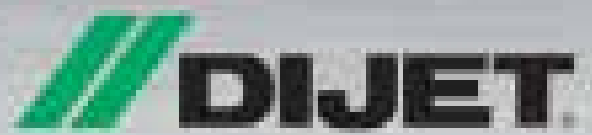
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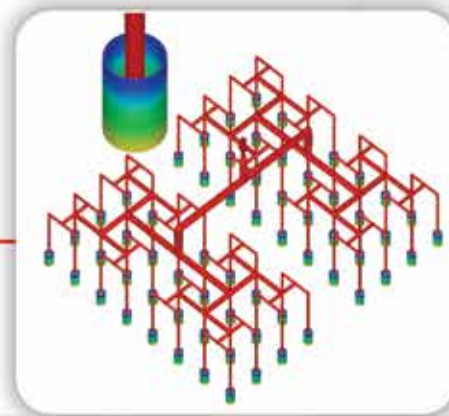
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