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54



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34

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CONTENTS

VOL 9, ISSUE 6 -MARCH-APRIL 2026



16



18

22



50

58

68

- | | |
|--|--|
| 08 FOREWORD | 44 IMTMA – BEST DESIGN AWARD 2026 |
| 10 PUBLISHER'S NOTE | Electro Pneumatics and Hydraulics (India) Pvt Ltd |
| 12 EDITORIAL | 48 IMTMA – BEST EXPORT PERFORMANCE AWARD 2026 |
| 14 INDUSTRY OUTLOOK | Electronica Mechatronic Systems (India) Pvt Ltd |
| Manufacturing Momentum Drives India's Machine Tool Market | 50 CUTTING TOOLS |
| 16 IMTMA'S DESK | Concentrating Expertise for Tool, Pattern, and Mold Making |
| Technology and Innovation to Drive Growth | 54 STARTUP |
| 18 VIEWPOINT | Localizing Turboprop Aviation in India |
| Engineering India's Energy Transition | 58 EVENT SNAPSHOT |
| 22 TECH TALKS | IMTEX FORMING 2026 |
| Quality as a Mindset | 64 EVENT SNAPSHOT |
| 26 THE CUTTING EDGE | International Seminar on Forming Technology 2026 |
| Unlocking the True Value of Cutting Tools | 66 EVENT SNAPSHOT |
| 28 COVER STORY | Motion Meeting |
| The Precision Renaissance | 68 EVENT PREVIEW |
| 34 BIG INTERVIEW | SIMTOS 2026 |
| Powering Growth in Forging Industry | 70 DIE & MOLD PRODUCTS |
| 38 IMTMA – PREMIER OUTSTANDING ENTREPRENEUR AWARD 2026 | 74 COMPANY INDEX, ADVERTISER INDEX & SUBSCRIPTION |
| Barani Hydraulics India Pvt Ltd | |
| 42 IMTMA – COOPER AWARD FOR OUTSTANDING SUPPLY CHAIN UNIT 2026 | |
| Rajamane Industries Pvt Ltd | |

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MOHINI KELKAR
PRESIDENT
IMTMA

Dear Readers,

Union Budget 2026 was a welcoming one for micro, small, and medium enterprises (MSMEs). The Government of India's efforts to strengthen supply chain, liquidity measures for MSMEs, targeted initiatives to boost industry competitiveness, and focus on skill development can further strengthen the sector.

Higher capital expenditure on transport infrastructure, an SME Growth Fund of INR 10,000 crore, the strengthening of legacy industries, and scaling manufacturing across seven strategic sectors are expected to benefit the manufacturing sector. Semiconductor Mission 2.0, higher allocation for electronics component manufacturing, and promotion of data centers and cloud computing will help advance technological development. Strengthening the momentum is the extension of concessional duty rates from March 31, 2026 to March 31, 2028, providing much-needed policy certainty. Extending the deferred customs duty payment cycle from 15 to 30 days would ease working capital pressures and improve liquidity.

As we move into the financial year 2026-27, I am pleased to note that the industry has shown resilience, supported by steady demand from key sectors and continued investment in technology and capacity. The Indian machine tool industry, backed by policy support and infrastructure investments, will continue its efforts with renewed optimism.

Indian Machine Tool Manufacturers' Association (IMTMA) will remain steadfast in its mission to foster rapid industrial progress while keeping readers of Modern Manufacturing India (MMI) abreast of the latest developments in manufacturing.

"Higher capital expenditure on transport infrastructure, an SME Growth Fund of INR 10,000 crore, the strengthening of legacy industries, and scaling manufacturing across seven strategic sectors are expected to benefit the manufacturing sector."



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JIBAK DASGUPTA
DIRECTOR GENERAL & CEO
INDIAN MACHINE TOOL MANUFACTURERS' ASSOCIATION
BANGALORE INTERNATIONAL EXHIBITION CENTRE

Dear Readers,

IMTEX FORMING 2026 was a defining moment for the Indian Machine Tool Manufacturers' Association (IMTMA). The exhibition, significantly larger than its previous edition, generated palpable excitement as visitors engaged with the latest technologies and trends in metal forming. The focused interactions and valuable knowledge exchanges reflected the curiosity and confidence in Indian-engineered goods across every aisle.

While we celebrate the remarkable success of IMTEX FORMING 2026, the Indian machine tool industry, which has a significant presence of micro, small, and medium enterprises (MSMEs), stands to benefit from the measures announced in the recent budget.

The measures announced in the recent budget will also enhance the machine tool industry's capability to excel in all aspects of manufacturing, supported by better access to funds and the availability of skilled human resources.

This will also enhance the machine tool industry's capability to excel in all aspects of manufacturing, supported by better access to funds and the availability of skilled human resources.

Modern Manufacturing India (MMI) aims to bring together ideas, insights, and perspectives that inspire dialogue and encourage business entities to push boundaries.

This edition of MMI focuses on die and mold manufacturing. IMTMA has authored an article on technology and innovation in manufacturing. As we look to the future, our shared commitment to excellence, capability

building, and continuous transformation will propel manufacturing to new heights.

I extend my sincere appreciation to the contributors, partners, and readers of MMI for being part of this journey. Readers are encouraged to share their feedback and suggestions to further enhance the magazine.



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FROM CONNECTIVITY TO COMPETITIVENESS

The recent inaugurations of the Noida International Airport in Jewar in March 2026 and the Navi Mumbai International Airport in late 2025 mark a paradigm shift from 'city-centric' to 'hub-led' economic growth. By accelerating the movement of goods and seamlessly linking roads to the skies, these new corridors are strengthening the very core of Indian industry.

This infrastructure empowers our manufacturing and machine tool sectors to compete on the world stage, setting a new global benchmark for speed, efficiency, and high-precision engineering. For the manufacturing sector, proximity to these hubs, especially in the Western UP and Mumbai-Pune belt, drastically reduces the order-to-delivery cycle for high-value components.

The most significant impact lies in the Maintenance, Repair, and Overhaul (MRO) sector. With India's aircraft fleet set to double, the demand for domestic servicing is skyrocketing. For the machine tool industry, this translates into a massive requirement for specialized CNC machines, high-precision tooling, and automated ground support equipment.

The symbiotic relationship between the aerospace sector and the machine tool industry serves as the key catalyst in propelling India's manufacturing output toward its ambitious target of contributing 25% to the national GDP. As aviation demands unprecedented levels of precision and material integrity, the machine tool sector has risen to the challenge, evolving from a provider of equipment to a strategic partner in high-tech innovation.

We take pride in presenting this issue, meticulously curated to highlight the resilience and technical brilliance of our indigenous manufacturers. We welcome your valuable feedback as we continue to chronicle India's journey toward manufacturing sovereignty.

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you're halfway there."*

– Theodore Roosevelt



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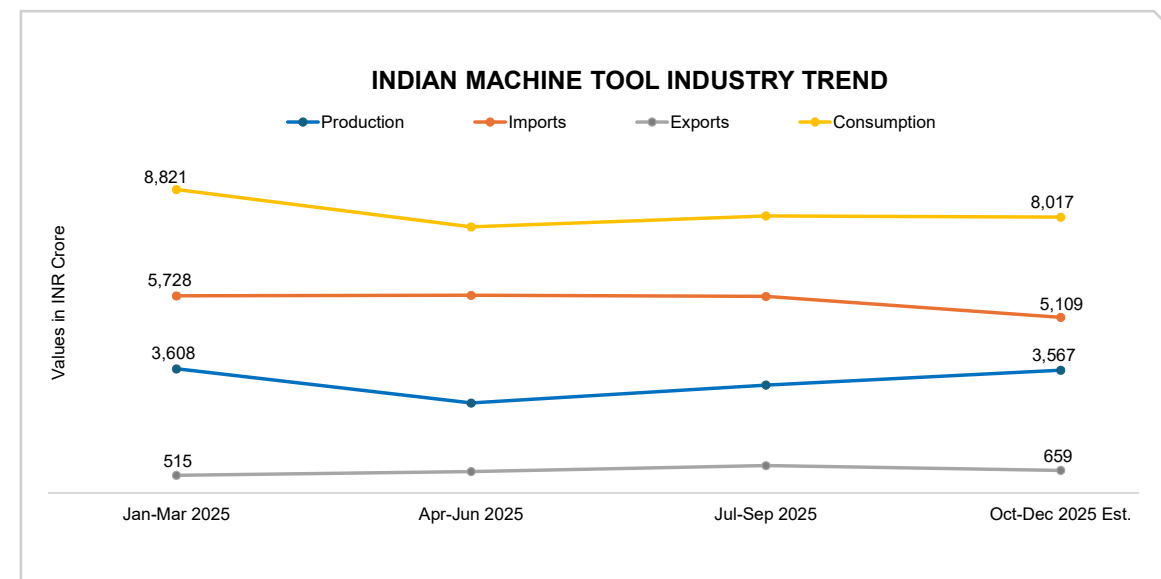
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MANUFACTURING MOMENTUM DRIVES INDIA'S MACHINE TOOL MARKET

India's strong economic growth and manufacturing expansion are driving rising demand for machine tools. Domestic production is improving, while exports shows growth.



India's economic momentum remained strong at the start of 2026. The Manufacturing PMI stood at 55.4, while the Services PMI was 58.5 in January 2026, both remaining well above the 50-mark threshold, indicating continued expansion in private sector activity. Industrial performance also showed notable improvement. The Index of Industrial Production (IIP) rose to a 26-month high of 7.8 percent in December 2025, compared to 7.1 percent in November 2025, reflecting strengthening output across key industrial segments. The Reserve Bank of India retained the repo rate at 5.25 percent in its monetary policy review held on February 6, 2026. CPI inflation stood at 2.8 percent in January 2026 (2024 base), up from 1.2 percent in

December 2025, while core CPI remained moderate at 3.4 percent. Headline WPI inflation (2011-12 series) increased slightly to 1.8 percent from 0.8 percent, though overall price pressures remained contained, supported by low food and manufactured product inflation and continued contraction in mineral oil and crude prices.

Government Spending Supports Industrial Growth

The Government of India's gross tax revenues (GTR) grew by 8.5 percent during April-December FY26. However, as per the FY27 Union Budget, the FY26 Revised Estimates have been lowered from INR 42.7 lakh crore to INR 40.8 lakh crore, reflecting a downward revision of INR 1.9 lakh crore in revenue projections. During

the same period, total expenditure grew by 4.6 percent, with revenue expenditure increasing by 1.8 percent and capital expenditure registering a stronger growth of 15.0 percent, highlighting the continued emphasis on asset creation. Fiscal and revenue deficits stood at 54.9 percent and 21.6 percent of their respective annual revised estimates, while the FY27 Union Budget indicated that the FY26 fiscal deficit target of 4.4 percent of GDP is likely to be achieved.

Trade Dynamics

India's merchandise trade deficit widened sharply to US\$ 34.7 billion in January 2026 from US\$ 25.0 billion in December 2025, as export growth remained subdued at 0.6 percent while imports surged by 19.2 percent

mainly due to a sharp spike in gold and silver imports. Average global crude oil price increased from US\$ 60.9 per barrel in December 2025 to US\$ 63.7 per barrel in January 2026, after falling to its lowest level since February 2021, indicating a modest recovery in international oil prices. The International Monetary Fund (IMF) has projected global growth at 3.3 percent in 2026 and 3.2 percent in 2027, while India's growth is forecast at 6.4 percent for both FY27 and FY28, indicating relatively stronger economic momentum compared to the global average.

Machine Tool Industry Records Strong Growth

The Indian Machine Tool industry's production is estimated to have grown by around 10 per-

cent year-on-year in CY2025, reaching INR 12,930 crore (US\$ 1.48 B). Imports registered a sharper increase of 23 percent, amounting to INR 17,561 crore (US\$ 2.5 B). Exports recorded a significant growth of 83 percent, rising to INR 2,599 crore (US\$ 298 M). Overall consumption is estimated to have expanded by 17 percent year-on-year to INR 32,632 crore (US\$ 3.7 B) in CY2025, reflecting strong domestic demand and increased trade activity.

Import Dependence Remains High

In CY2025, China (27%), Japan (23%), and Germany (12%) emerged as the top countries for imports to India, contributing to 62 percent of the total machine tool imports. Presses

(17%), VMCs (13%) and Turning Centers (9%) were the top machinery types imported, valued at INR 8,764 crore (US\$ 1,008 M), constituting approximately 39 percent of total machine tool imports during the period.

Export Markets Expand

For exports, Russia (33%), UAE (8%), and Vietnam (7%) emerged as the top three export destinations, accounting for 48 percent of total machine tool exports in CY2025, with a total export value of INR 1,249 crore (US\$ 143 M). VMCs (21%), Presses (16%), and Turning Centers (11%) were the top three machinery types exported, valued at INR 1,257 crore (US\$ 144 M), constituting approximately 48 percent of total machine tool exports during CY2025.

For exports, Russia (33%), UAE (8%), and Vietnam (7%) emerged as the top three export destinations, accounting for 48 percent of total machine tool exports in CY2025, with a total export value of INR 1,249 crore (US\$ 143 M).



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Indian Machine Tool
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For more information & Purchase of report, please write to: rakesh@imtma.in

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TECHNOLOGY AND INNOVATION TO DRIVE GROWTH

India's manufacturing sector is at a pivotal stage, where growth is increasingly defined by capability, innovation, and technological depth. Strengthening the machine tool industry and reducing import dependence will be key to sustaining long-term competitiveness.



Source: Magic Wand Media

India, one of the fastest-growing major economies in the world, is projected to grow by around 7.4 percent in real terms in FY 2025-26, making it a bright spot for investment. Currently ranked as the fifth-largest economy globally and aspiring to become a US\$ 5 trillion economy by 2027, India must focus on exports for sustained long-term growth. Achieving this is increasingly about capability, not just scale.

In the current geopolitical landscape, with ongoing tensions in the Gulf region and looming supply disruptions affecting goods and services, we need to brace ourselves for tough times.

Machine Tools at the Core of Industrial Growth

At the center of this conversation is the Machine Tool industry, which forms the backbone of manufacturing and is a key driver of the Capital Goods sector. Major industries—from

Automotive and Aerospace to Electronics, Energy, Railways, and Defence—depend heavily on machine tools. Building self-reliance in CNC controls, ball screws, linear motion systems, laser technologies, and 5-axis and multi-axis machines is vital for manufacturing growth. Strategic mergers and acquisitions can help accelerate innovation and product development. Engaging domain experts can enable knowledge exchange and exposure to global



Source: Magic Wand Media

best practices, a move that may help reduce imports.

India aims to become a 'product nation' with a focus on high-quality, indigenous manufacturing, transitioning from a service-driven economy to one that builds deep-tech capabilities. However, the Machine Tool industry continues to rely heavily on imports, particularly for core technologies, advanced high-precision machinery, and critical subsystems. This dependence poses a long-term strategic risk and can lead to supply disruptions.

India's growth trajectory can become more robust when collective action replaces fragmented efforts. Technology development can be driven by shared learning, coordinated investments, and ecosystem-wide collaboration.

IMTMA's Technology & Innovation Forum

Recognizing this need, the Indian Machine Tool Manufacturers' Association (IMTMA) has launched the Technology & Innovation Forum as a collaborative initiative to promote structured engagement on technology priorities and bring together stakeholders to accelerate innovation. This extends beyond product development to include manufacturing processes, supply chains, financial

models, logistics, and organizational practices.

The Forum aims to serve as a structured platform for systematically identifying and prioritizing emerging and future-shaping technologies that will define the next phase of manufacturing competitiveness. Through focused deliberations, it will map critical technology gaps, assess industry readiness, and develop time-bound action plans aligned with national manufacturing objectives.

Towards a Culture of Innovation

Building such a culture requires participation at every level—from shop-floor teams to senior leadership—supported by strong leadership, openness to experimentation, and the empowerment to contribute ideas. Organizations that remain receptive to external knowledge and adapt it to their context are often able to establish themselves more quickly.

Strengthening the SME Ecosystem

Integrating small and medium enterprises (SMEs) into the innovation value chain is equally critical, as they form the backbone of the supplier ecosystem and contribute significantly to industrial development. A collaborative approach between

industry and academia, through research programs and technical exchanges, will help address end-user needs with speed, agility, and a shared vision. Self-funded and government-supported research and development will further drive product innovation, enabling SMEs to grow and compete effectively. In addition, the Forum will actively engage with government bodies, financial institutions, multilateral agencies, and other funding organizations to facilitate access to financing for technology development initiatives among IMTMA members.

From Dependence to Innovation

Moving forward, India must shift from import dependence to innovation. When innovation becomes ingrained in an organization's DNA, it fosters meaningful change and creates long-term value. For India, the way ahead involves blending growth with capability, developing homegrown products, enhancing collaboration across the ecosystem, and prioritizing strategic self-reliance. This approach could help the Machine Tool industry achieve its goal of developing deep-tech products for both domestic and global markets. 

IMTMA has launched the Technology & Innovation Forum as a collaborative initiative to promote structured engagement on technology priorities and bring together stakeholders to accelerate innovation.

ENGINEERING INDIA'S ENERGY TRANSITION

The global narrative on climate change has shifted from theoretical goals to industrial mandates. For India, the journey toward Net-Zero by 2070 is not merely a policy objective but an industrial evolution. At the center of this shift is the heavy engineering industry—an energy-intensive sector that is now driving efficiency, renewable integration, and next-generation clean technologies at scale.



Source: Isgec Heavy Engineering Ltd

The Heavy Engineering Industry (HEI) is one of the nation's largest energy consumers and its most critical enabler of a low-carbon future. It serves as the backbone for India's core industries, including Steel, Mining, Oil & Gas, Cement, and Shipbuilding. Because industrial processes range from melting and de-coking to high-precision welding and are inherently energy-intensive, the HEI's shift toward sustainability will dictate the pace of India's overall green trajectory.

A Policy-Driven Mandate for Growth

The Indian Government has established a robust framework that aligns industrial expansion with environmental stewardship. By targeting energy efficiency, incentivizing renewable uptake, and fostering cleaner technologies, the current policy landscape ensures that long-term industrial competitiveness is inseparable from sustainability.

The Roadmap: From Efficiency to Innovation

Achieving deep decarbonization

requires a multi-tiered approach that addresses both immediate operational improvements and long-term technological leaps.

Operational Excellence and Energy Efficiency

The first step is the modernization of legacy infrastructure. HEI firms are increasingly optimizing utilities through energy-efficient machinery, advanced heat recovery systems, and tighter process controls.

- **The Switch to LNG:** Recognizing the impact of fuel sources, the industry is transitioning to LNG.

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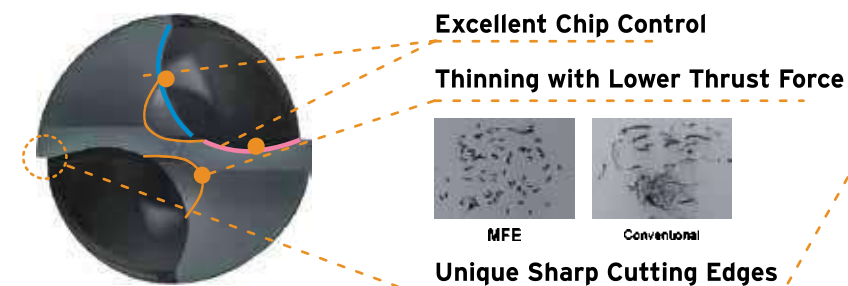
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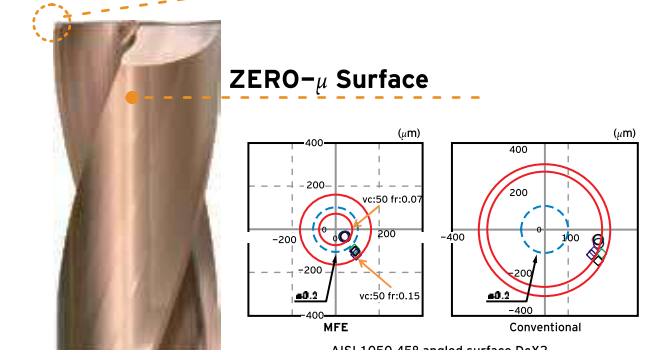
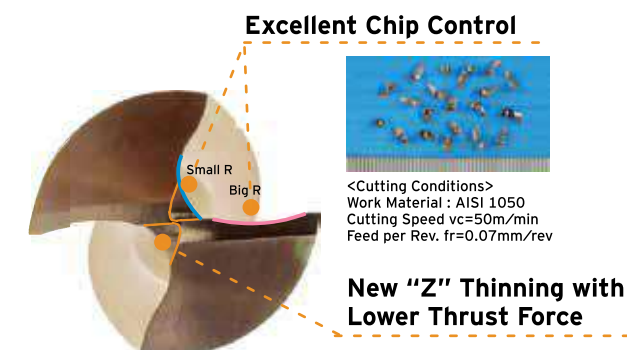
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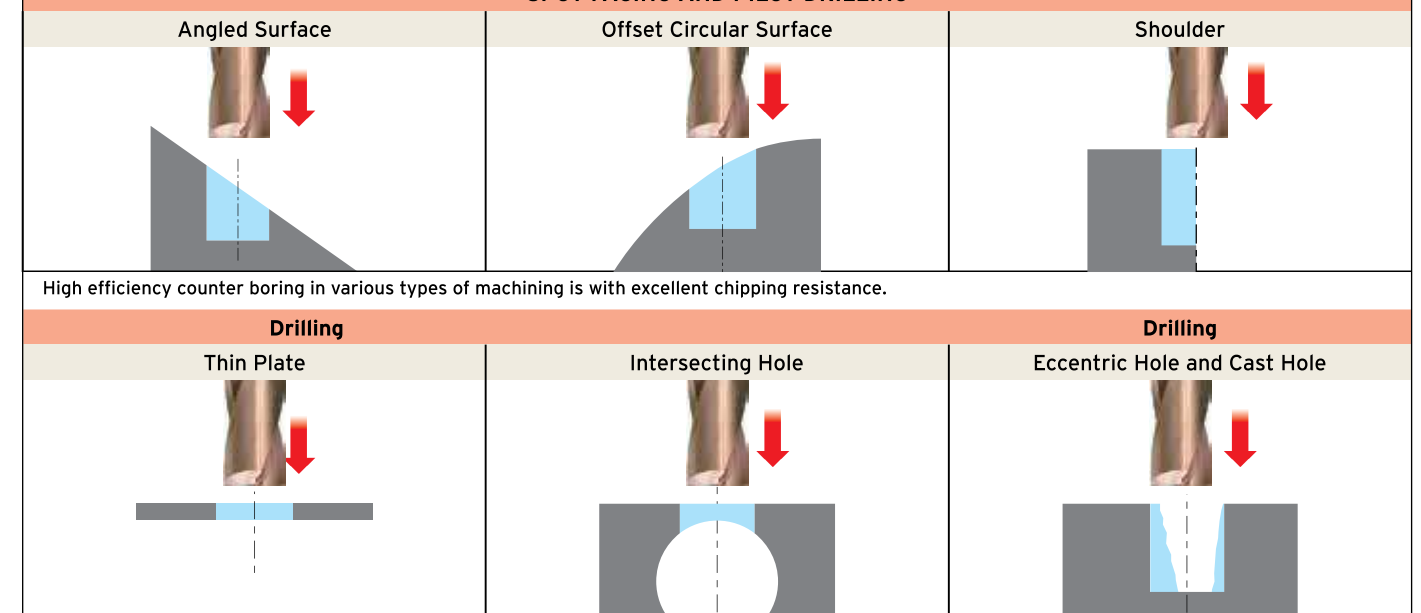
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YOUR GLOBAL CRAFTSMAN STUDIO

The Heavy Engineering sector is not just decarbonizing its own footprint; it is providing the critical infrastructure required for the nation's broader green economy.

sitioning heat treatment furnaces to LNG (Liquefied Natural Gas), a significantly cleaner alternative to conventional Light Diesel Oil.

- **Legacy Upgrades:** Beyond fuel, the systematic replacement of aging equipment with high-efficiency machinery remains a priority. This includes the deployment of Inverter/IGBT-based welding equipment and the integration of Variable Frequency Drives (VFD) and high-efficiency induction motors to optimize power consumption.
- **Precision Monitoring:** Leading firms are implementing energy-saving circuits on rotary machines and utilizing acoustic imager instruments for proactive monitoring and the elimination of industrial gas leaks. At the facility level, the transition to sensor-based and LDR (Light Dependent Resistor) lighting in workshops and offices ensures that no watt is wasted.

Renewable Integration

The transition from fossil-fuel-based power to renewables is already yielding measurable results across the industrial landscape.

- **On-site Solar Generation:** Various facilities are witnessing the tangible impact of aggressive solar adoption, proving that even heavy industrial loads can be partially offset by on-site renewable generation.
- **Electrification:** The adoption of Electric Arc Furnaces (EAF) in upcoming steelmak-

ing plants is a critical step in reducing the grid-dependency of the most energy-intensive processes.

Frontier Technologies: Hydrogen and CCUS

Looking toward 2030 and beyond, the focus is shifting to hard-to-abate sectors.

- **Green Hydrogen & Biomass:** The Steel sector is increasingly integrating green hydrogen and biomass to lower carbon intensity.
- **Circular Economy:** A renewed thrust on higher scrap utilization in casting and steelmaking is further reducing the cradle-to-gate emissions of industrial products.
- **Carbon Capture:** While still maturing, Carbon Capture, Utilization, and Storage (CCUS) will become the ultimate cornerstone of decarbonization once economic viability is achieved through scale.

Enabling the Green Economy Infrastructure

The Heavy Engineering sector is not just decarbonizing its own footprint; it is providing the critical infrastructure required for the nation's broader green economy. The industry is now pivoting toward the manufacturing of specialized components for:

- Green Hydrogen and Green Ammonia production plants.
- Pumped Hydro Energy Storage systems and Long Duration Energy Storage (LDES) solutions to solve renewable intermittency.
- Polysilicon production, the

fundamental building block of the solar panel supply chain.

The Path Ahead: Addressing Structural Challenges

Despite this progress, the road to total decarbonization is fraught with astronomical capital requirements. Updating heavy machinery and achieving more than 60 percent green power integration requires energy storage technologies that are currently cost-prohibitive without state intervention.

To bridge this gap, the industry requires a supportive ecosystem:

- **Financial Incentives:** Government-backed public-private partnerships (PPP) are essential for implementing high Capex green technologies.
- **Demand Side Incentives:** Following the European model, where Green Steel consumption is linked to incentives, India should consider policies that motivate domestic industries to prioritize low-carbon materials.
- **Innovation Support:** Collaborative R&D frameworks are needed to lower the entry barrier for deep decarbonization technologies.

Conclusion

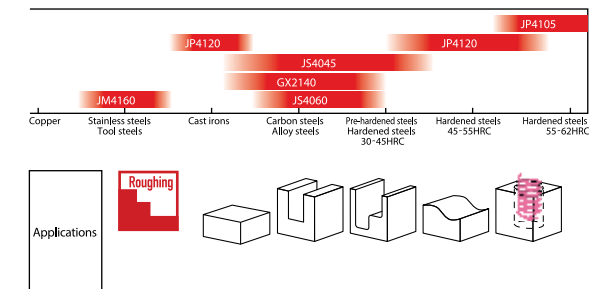
The Heavy Engineering industry is no longer a bystander in the climate conversation; it is the engine of the transition. By blending immediate efficiency gains with bold bets on future technologies, the sector is proving that industrial growth and decarbonization are not just compatible, they are synergistic. 

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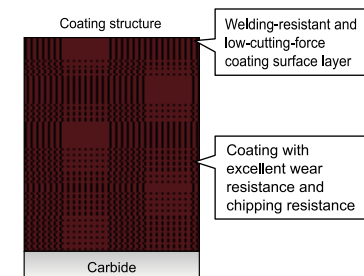
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- Employs a low-friction-effect coating with excellent welding resistance as the top-most surface layer. This reduces welding to the work and decreases cutting force!

Layer structure AJ Coating



PVD Technology

General purpose for steel

JS4045

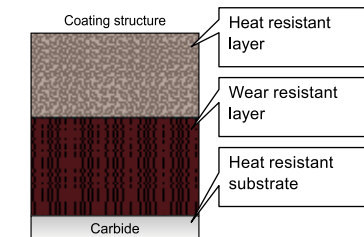
Features

- JS4045 adopts heat resistant layer, reduces the crater wear by high-efficiency cutting.
- JS4045 adopts heat resistant substrate, reduces the wear and improves tool life.
- Especially improves tool life on dry cutting.

Strong fields

- Continuous and light interrupted cutting of less than 35HRC dry cutting.

Layer structure JS Coating



CVD Technology

General purpose for steel

GX2140

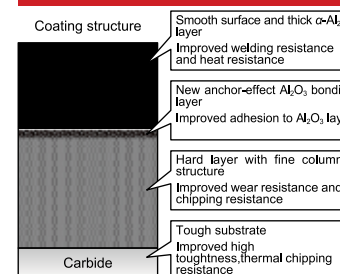
Features

- Smooth surfaced α -Al₂O₃ coating with improved chipping / welding resistance brings less sudden-tool-edge-chipping.
- Machining efficiency is improved for high-speed, high-feed-rate rough machining by using the hard-layer with fine columnar structure.

Strong fields

- Exhibits superior wear resistance when cutting mild steel, carbon steels, alloy steels and tool steel use with hardnesses of less than 35HRC.

Layer structure GX Coating



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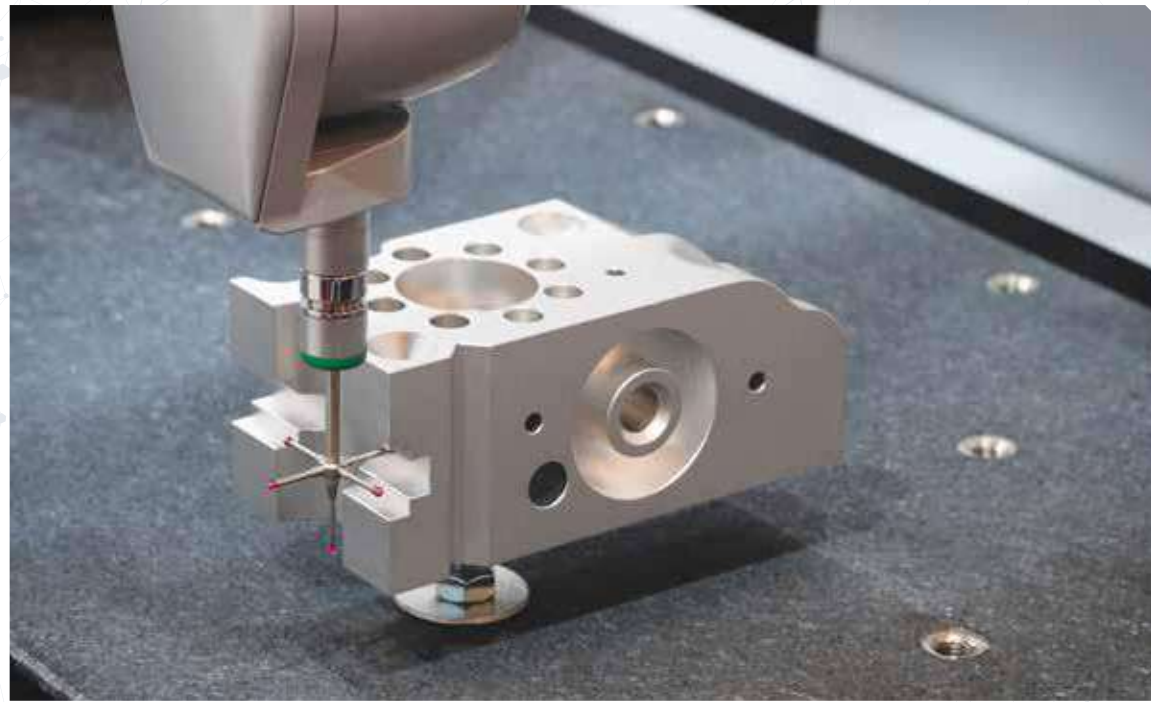
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QUALITY AS A MINDSET

A reflection on why the iconic book 'Zen and the Art of Motorcycle Maintenance' continues to influence engineers and engineering education worldwide, 52 years after it was first published.



Source: Magic Wand Media

In engineering colleges around the world, students spend years learning thermodynamics, materials science, fluid mechanics, and machine design. They learn equations, tolerances, stress limits, and simulation tools.

And then, every so often, they encounter a book that teaches them none of these things, but something equally important.

Robert M Pirsig's 1974 classic 'Zen and the Art of Motorcycle Maintenance' is not a textbook, nor is it a repair manual for motorcycles. It is the story of a journey across America taken by Pirsig and his son on a motorcycle. Along the way, the author pursues a deceptively simple question: What is Quality?

What is Quality?

For engineers accustomed to measurable quantities — microns, Cp/Cpk, efficiency percentages — this question can be unexpectedly unsettling. Yet for more than fifty years, the book has found a place in engineering curricula of colleges such as Princeton, MIT, Stanford, the University of Michigan, and others because it explores issues that are difficult to teach through equations.

These include the meaning of quality, the ethics of engineering decisions, the relationship between craftsmanship and purely analytical thinking, and the connection between technology and human values.

Beyond Equations: Asking 'Why'

Engineering education traditionally focuses on the 'how'. Students are taught how to design a fixture, how to optimize a machine tool, and how to calculate fatigue limits.

But Pirsig asks a different question: why does good engineering matter?

In the book, he describes two ways of understanding the world. The first is the classical view, which is analytical, logical and technical. The second is the romantic view, which is experiential, aesthetic, and intuitive.

Engineers often live comfortably in the classical world. They believe in deterministic laws, logical systems, and the ability to analyze performance with precision.

But technology detached from the web of human purpose inevitably becomes sterile. A machine



"When you are dealing with a fixture that is three metre long and weighs more than three tonne, and the assembled tolerances must be within ten micron, every stage matters. If patience and care are maintained throughout the process, quality takes care of itself."

S Manorajakumar
Vice President
RV Forms and Gears

may function correctly according to calculations yet still lack the care and skill that distinguish great work from mediocre work.

The book reminds engineers that technology and values cannot be separated. Every engineered system reflects human choices, about safety, responsibility, cost, and care. Engineering, in the end, is not just about machines. It is about the people who design, build, operate, and depend on them.

Quality as a Mindset, Not a Metric

In manufacturing, quality is often discussed in numbers — tolerances, rejection rates, Cp and Cpk values, and audit scores. These measures matter. But anyone who has spent time on a shop floor knows that true quality appears before the numbers.

It shows up in the way an expert machinist listens to the cutting sound of a tool. In the way a machine tool designer anticipates problems. In the extra minute taken to clean a datum surface before setup.

On the shop floor, quality is rarely discussed in philosophical terms. It is recognized in quieter ways, through habits, discipline, and the accumulated wisdom of experience.

S Manorajakumar, Vice President, RV Forms and Gears, has spent more than four decades building high-precision fixtures. For him, quality begins not with inspection reports but with mindset.

"Quality is fundamentally a way of thinking," he says. "Our focus has always been on creating a culture of quality in the workplace. One of the ways we do this is through extensive apprenticeship. Young trainees work alongside experienced craftsmen and slowly absorb the discipline, patience, and attention to detail that the work demands."

The scale and precision of the fixtures produced by the company leave little room for error.

"When you are dealing with a fixture that is three metre long and weighs more than three tonne, and the assembled tolerances must be within ten micron, every stage matters," Manorajakumar ex-

plains. "The stack-up tolerances of the individual components can easily affect the final accuracy. If patience and care are maintained throughout the process, quality takes care of itself."

Pirsig's central insight was simple but radical: quality is not something added at the end of a process. It is sensed at the beginning.

A hurried technician can finish the job. But a skilled mechanic listens to the engine, notices subtle changes in vibration or sound, and patiently restores the system to its optimal condition. The difference is not just technical knowledge — it is care.

For engineers and manufacturing professionals, this idea resonates deeply. Quality is not only about inspection or standards. It is also about attention to detail, intellectual honesty, curiosity, and pride in craftsmanship. These qualities cannot be reduced to formulas or procedures. They can only be illustrated.

Where Quality Really Begins

In manufacturing organizations, quality is often treated as the responsibility of the quality department. In reality, quality begins much earlier, at the moment attention is brought to the task.

When work is rushed, fragmented, or treated as a checklist exercise, defects multiply. When attention is steady and thoughtful, problems are caught early, sometimes well before they fully appear.

That philosophy is echoed by CO Abraham, who began his career as a tool-and-die maker at the age of eighteen and today, five decades later, heads the applications, fitting, and assembly divisions at RV Forms and Gears.

"When I walk through the shop floor, I look at small things," he says. "The way a fitter has stacked the components, the care taken to deburr sharp edges, the neatness of the workbench. These details reveal the mindset of the person doing the work."

For Abraham, craftsmanship lies in how seriously a person relates to the task at hand.

"Quality does not suddenly appear at the inspection stage. It emerges much earlier, in the care, attention, and quiet discipline with which the work itself is approached."

REJI VARGHESE
President
RV Forms & Gears
rfgreji@gmail.com



In many ways, the best engineering is the kind that understands a system so well that once it is properly established, it runs smoothly with minimal intervention.



“A fitter must see himself as a craftsman and take pride in his work, not simply complete tasks. When production schedules leave no room for reflection, people stop thinking and start coping. And when that happens, craftsmanship begins to suffer.”

CO Abraham
Head-Applications, Fitting, and Assembly Divisions
RV Forms and Gears

In many ways, these shop-floor observations echo the central insight of Pirsig's book: quality does not suddenly appear at the inspection stage. It emerges much earlier, in the care, attention, and quiet discipline with which the work itself is approached.

The Lesson of Maintenance

When people think about engineering, they often imagine invention and design. New technologies capture headlines.

Pirsig's story, however, focuses on something more mundane: maintenance.

Understanding how a machine works, how its components interact, how failures arise, requires patience and trial and error. Factories, aircraft, machine tools, and power plants depend less on dramatic breakthroughs than on the steady work of maintenance, monitoring, and repair.

Production systems are complex, dynamic systems. They behave less like static machines and more like living organisms. They must be watched, adjusted, and cared for.

Avoiding the 'Gumption Traps'

One of the most memorable ideas in Pirsig's book is the concept of 'gumption traps'. These are psychological obstacles that technicians encounter while solving problems.

An Engineer debugging a turnkey project on a machine tool may experience frustration, boredom, impatience, and overconfidence. When these traps appear, mistakes multiply.

Abraham says, “Anyone who has worked on a factory floor trying to diagnose a malfunctioning machine knows the feeling. The most effective engineers are often those who recognize when frustration is clouding their thinking, step back, and approach the problem again with patience.”

Reji Varghese is an industry veteran with nearly four decades of experience in high-precision fixture building. He also contributes as a guest writer to several leading national newspapers and magazines.

Technical competence matters, but clarity of mind matters just as much.

Creating Conditions for Quality

Quality cannot be imposed through slogans or audits alone. But certain conditions make it far more likely to emerge.

Respect for time: Not slower production, but realistic production. When schedules leave no room for reflection, people stop thinking and start coping.

Intimacy with the process: Operators who understand why processes work develop judgment rather than mere compliance.

Learning cultures outperform blame cultures: Cultures built entirely on penalties produce compliance, not excellence. Quality improves when mistakes become opportunities to learn.

Integration of logic and intuition: Manufacturing often separates engineering analysis from shop-floor experience. The best results appear when both work with each other. Precision and craftsmanship are not opposites. They are partners.

Why the Book Still Matters

More than fifty years after its publication, 'Zen and the Art of Motorcycle Maintenance' continues to appear on engineering reading lists. The reason is simple. Engineering schools can teach students to solve equations and design systems. But the profession also requires soft skills and qualities that are harder to teach such as intellectual humility, curiosity, patience, respect for systems, and commitment to craftsmanship. Pirsig's book reminds us that engineering is not merely a technical activity; it is a human one. Whether designing a machine tool, maintaining a production line, the best engineers bring something that no equation alone can supply: care for the work itself. And when that care is present, quality tends to follow. 

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Unlocking the True Value of Cutting Tools

Despite rapid advances in cutting tool technology, shop floors may not always fully capitalize on its potential – a tension that resonates across India's precision manufacturing sector.

Zenith Precision, a Bangalore-based manufacturer of precision components and assemblies since 1986, holds AS 9100 Rev. D, IATF 16949:2016, and ISO 9001:2015 certifications. Specializing in high-mix, low-volume machining for Aerospace, Automotive, Locomotive, Energy, and Healthcare industries, the company has developed a deep understanding of metal cutting over nearly four decades.

Yet even at this level of expertise, Deepak Pinto, Managing Director, Zenith Precision, acknowledges that the shop floor may not be fully capitalizing on modern cutting tool technology – a tension that resonates across India's precision manufacturing sector.

The Cost Perception Problem

The primary barrier, Pinto explains, is the perception of high cost. That word – perception – is telling. Across Indian precision manufacturing, the upfront price of premium tooling is routinely compared against less expensive alternatives, rarely accounting for tool life, reduced cycle times, or the downstream cost of scrap and rework. When these factors enter the equation, the economics often look very different.

Zenith does take tooling seriously at the project outset – involving the responsible tooling manager early, assessing technical requirements, and selecting tooling deliberately. In the Aerospace in-

dustry, advanced coatings and geometries have made previously challenging special alloys routine to machine. This is a real competitive advantage, and a demonstration of what thoughtful tooling decisions can achieve.

When the Numbers Don't Add Up

The harder challenge arises on complex tenders. Technical requirements push the cost-per-component above the customer's target, the contract goes to the lowest bid, and Zenith is left wondering how a competitor priced it lower. This is a familiar frustration – but the answer is often not cheaper inputs. Competitors who correctly model total tooling cost – fewer tool changes, tighter tolerances first time, less downtime – can price more aggressively precisely because their tooling spend is better optimized.

The Path Forward

India's cutting tool market is undeniably price sensitive. But it is not price-determined. The manufacturers who consistently meet aggressive cost targets do so through process discipline – choosing the right tool for each operation, optimizing parameters, and understanding where premium tooling pays for itself many times over.

For Zenith – and the wider industry – the opportunity is to close the gap between tooling potential and shop floor reality. This means conducting rigorous cost-per-component analyses, engaging cutting tool suppliers as technical partners, and building internal feedback loops

around what works. Pinto's willingness to acknowledge this gap is itself a mark of maturity. Those who act on it stand to turn a perceived cost burden into one of their sharpest competitive edges. 

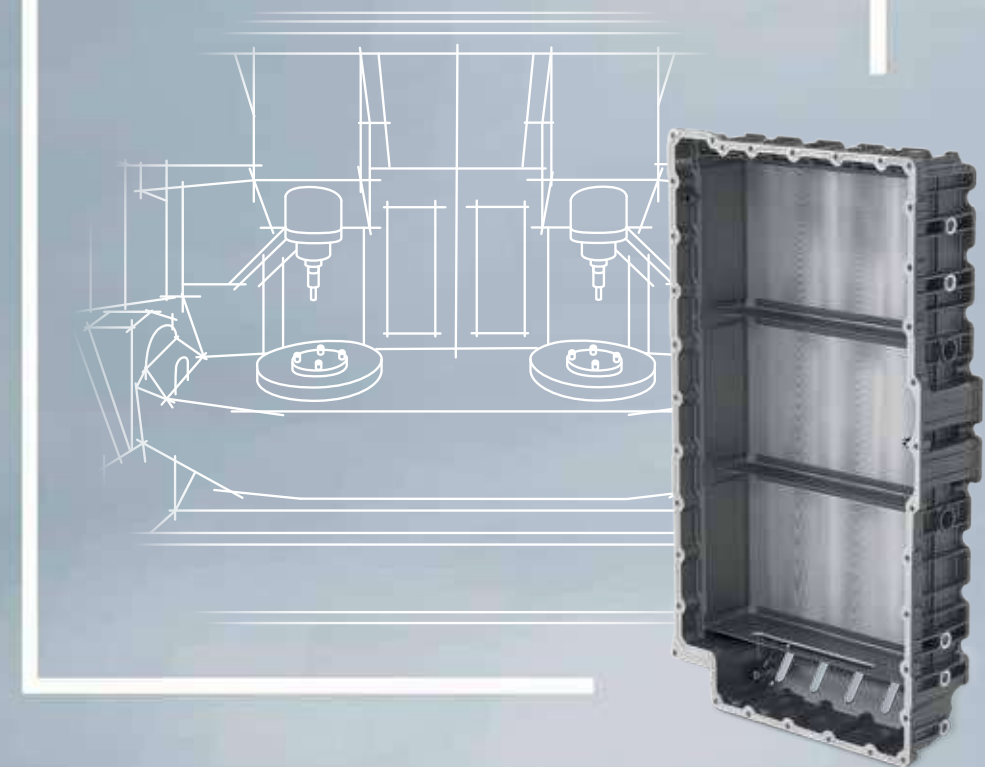
“Competitors who correctly model total tooling cost — fewer tool changes, tighter tolerances first time, less downtime — can price more aggressively precisely because their tooling spend is better optimized.”

NIKHIL NAYAK
Managing Director
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The Precision Renaissance

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The Indian die and mold industry in 2026 stands at a historic crossroads. For decades, the narrative surrounding Indian machine tool manufacturing was one of roughing versus finishing. Domestic machines were often relegated to the heavy, initial removal of material, while the micron-perfect, high-aesthetic finishing work was reserved for expensive imports from other countries.

Driven by the 'Aatmanirbhar Bharat' (Self-Reliant India) mission and a strategic pivot from a brand-heavy to a performance-first mindset, Indian toolrooms are now competing on global terms. The conversation has shifted from mere machine acquisition to total application engineering. Today, the focus is on the Reliability-Value-Knowledge Triangle—a new cornerstone where indigenous engineering, real-time metrology, and sophisticated CAM software converge to create a manufacturing ecosystem that is not just a cost-effective alternative, but also a preferred global partner for high-precision engineering.

Democratization of the 5-Axis Frontier

One of the most significant trends defining the current era is the democratization of 5-axis simultaneous machining. Muralidhara Rao, Director, Ace Designers Ltd – Machining Center Division, AceMicromatic Group (AMG), explains that historically, this technology was the exclusive domain of large Tier-1 aerospace or automotive suppliers due to its high capital costs and the steep learning curve of programming. With the changing times, technology is defined by the application, not the size of the company.

He explains that Ace Designers has engineered its latest models to break the price barrier for Tier-2 and Tier-3 toolrooms through modular versatility. Its flagship GV-60 5C is engineered as a performance-first machine, offering a 'Right-Fit' approach. By providing compatibility across multiple CNC controls—including Siemens, Mitsubishi, Fanuc, and Syntec—it allows toolrooms to select the control environment they are already comfortable with, re-



"The leap from 3-axis to 5-axis is as much about a mindset change as it is about the machine. To lower this hurdle, AMG focuses on an extended support system: advanced digital integration and hands-on training."

Muralidhara Rao
Director
Ace Designers Ltd-
Machining Center Division

ducing training time and capital expenditure.

For MSMEs where 5-axis simultaneous work might still be a future goal, Ace Designers provides solutions such as high-precision 3-axis machines integrated with Rotary Tilting Tables. This enables 4+1 positioning, allowing complex geometries to be machined with the required accuracy without the extreme cost of a full, continuous 5-axis system.

The complexity of 5-axis work, specifically the fear of collisions, is addressed through technology. The company now integrates collision avoidance and AI-driven optimization, making complex parts of 5-axis work automated and safe.

The 'Done-in-One' Philosophy

Jyoti CNC Automation Ltd is catalyzing a similar process-led

transition. To this end, Vikas Taneja, President-Sales, observes that Tier-2 and Tier-3 die makers are increasingly adopting 5-axis technology to achieve setup consolidation and lead-time optimization. By adopting a 'Done-in-One' philosophy, smaller shops eliminate multiple secondary setups, ensuring datum integrity and drastically reducing part-handling time.

The company makes this transition affordable through vertical integration, manufacturing high-precision rotary tables and tilting heads in-house to lower capital entry barriers. Furthermore, its systems utilize AI to automate kinematic calibration, which empowers existing 3-axis operators and reduces the overall cost of operation. This modular, 'Fit-for-Purpose' engineering, backed by a localized service ecosystem, makes high-end 5-axis precision a scalable reality for all toolrooms.

Indigenous Rotary Technology

A critical enabler of this 5-axis shift is the rising confidence in domestic rotary solutions. Varun Dev, CEO, UCAM Pvt Ltd, confirms the steady shift among Tier-1 mold makers toward high-performance indigenous 5-axis rotary technology. UCAM's benchmarking framework against global competitors focuses on dynamic positioning accuracy, torque capability, structural rigidity, and thermal stability. By delivering consistent contouring accuracy and dependable performance under real production conditions, domestic solutions are proving that 'Make in India for the World' is a tangible reality.

Bridging the Imported Grade Finish Gap

The most persistent challenge

Today, the focus is on the reliability-value-knowledge triangle—a new cornerstone where indigenous engineering, real-time metrology, and sophisticated CAM software converge to create a manufacturing ecosystem.

By delivering consistent contouring accuracy and dependable performance under real production conditions, domestic solutions are proving that 'Make in India for the World' is a tangible reality.

for Indian manufacturers has been overcoming the perception of thermal instability. In die and mold making, where a machine may run for 48 hours straight to finish a single cavity component, even a few microns of thermal drift can ruin a multi-million-rupee workpiece. In this context, Shashank V Joshi, Head of Sales, LMW Ltd, shares that the company addresses these fundamentals at the design stage with its J & JV Series (Versatile and Heavy-duty VMCs). "Optimized cast structures, thermally symmetric machine layouts, controlled spindle cooling, and direct-coupled drives significantly reduce thermal drift. Additionally, finite-element-validated ribbing and damping characteristics minimize micro-vibrations during high-speed finishing. Together, these enable consistent micron-level accuracy and surface finishes that meet global mold-making expectations," he elaborates. LMW's focus is on confidence in application execution. By supporting the transition from 3-axis to 5-axis through post-processor optimization and real-part prove-outs, it ensures that the machine's technical capability is fully realized by the end-user.

Eliminating Reversal Error
Achieving high surface finishes also depends on the dynamic accuracy of the rotary table. UCAM's latest generation of Direct Drive (DDR) tables addresses this by eliminating mechanical transmission elements, thereby directly reducing reversal errors. The high-resolution encoder feedback ensures smoother motion during complex contouring. As per Varun, DDR platforms are engineered for balanced ther-



"Achieving a polish-free finish is a function of maximizing structural loop stiffness and eliminating harmonic disturbances. Through the convergence of advanced mechatronics and vibration control, our RDX and VMC nvu series ensures constant surface speeds and minimal tool deflection in complex cavities."

Vikas Taneja
President-Sales
Jyoti CNC Automation Ltd

mal behavior, ensuring minimal thermal drift even during long machining cycles. This results in stable angular positioning and consistent dimensional fidelity throughout the process.

Polish-Free Molds

For Jyoti CNC, the goal is achieving a surface finish so fine that manual bench-polishing is eliminated. Taneja explains that surface roughness (Ra) is a critical cost driver. Its RDX and VMC nvu Series leverage broad-base rigid structures for dynamic stability and thermal-harmonic synchronization. Through the convergence of advanced mechatronics and vibration control, these machines ensure constant surface speeds and minimal tool deflection, allowing

end-users to effectively bypass manual polishing.

EV Pivot and New Mobility Tooling

The rapid shift to Electric Vehicles (EVs) has fundamentally changed tooling requirements, from compact, heavy dies to large, lightweight structural molds and complex battery trays. Joshi shares that LMW has evolved its R&D to emphasize machines with larger work envelopes, high dynamic stiffness, and superior axis acceleration. Special attention is given to spindle responsiveness for thin-wall machining and aluminum-intensive applications like battery trays. Similarly, UCAM's 2026 R&D focus is strengthening torque density and axis rigidity for these demanding mold applications. The industry is moving toward high-speed simultaneous machining where dynamic accuracy is the key differentiator. LMW has also realigned its R&D to cater to these requirements, which often demand larger table sizes, higher dynamics for thin-wall machining, and superior stiffness to handle high-speed milling of aluminum alloys used in battery housings. This shift also necessitates better process control.

Digital Gatekeeping

As India becomes a hub for EV components, Rashmi L Gururajao, Co-Founder & Director, Manleo Designs Pvt Ltd, points out that on-machine inspection acts as a digital gatekeeper. For high-tolerance EV and electronic molds, real-time inspection verifies dimensions before a part is removed, allowing for instant corrective paths and preventing costly rework.

Value of Dual Expertise

D Shanmugasundaram, Man-

aging Director, S&T Machinery Pvt Ltd, brings a unique perspective sharing that the company is in a unique position of manufacturing both the CNC machines that make the molds (VMCs/EDMs) and the Injection Molding machines that use them. This dual expertise allows the company to understand the end-of-life requirements of a mold. For cost-sensitive Tier-2 shops, STM positions its Double Column and VMC series as systems that bring global engineering standards to the Indian shop floor. According to him, it manufactures heavy machine structures in India to leverage local cost advantages but insists on importing critical high-precision components like spindles, precision bearings, linear motion systems, and CNC controls from proven global leaders. This hybrid strategy ensures the performance expected in mold manufacturing at an Indian price point.

Moving Inspection to the Shop Floor

The zero-defect mandate of global OEMs means that inspection can no longer be an afterthought performed in an isolated lab. Renishaw's approach focuses on making precision practical. Its REN-GAGE™ technology (found in probes like the RMP600) uses silicon strain gauges to achieve sub-micron repeatability, even in the harsh, thermally variable environment of a shop floor. Sanjay Sangam, Deputy Director - Sales and Technical, Renishaw Metrology Systems Ltd, says the company champions the move of inspection directly onto the CNC machine using In-Process Probing (MTP). He emphasizes, "Probes establish reliable references and apply offset updates in re-



"Most Indian die and mold shops need practical digital tools, not complex automation. LMW addresses this through modular IoT offerings that scale with customers' needs. The entry-level package focuses on essential machine monitoring such as machine status, and utilization."

Shashank V Joshi
Head - Sales
LMW Ltd

al-time even as temperatures change across long cycles. This makes inspection part of production and prevents late surprises at final inspection." Echoing similar sentiments, Gururajao shares, "Automated probing and tool-setting solutions help smaller shops reduce setup times by up to 70 percent, ensuring machines stay running." Talking of Renishaw's NC4 laser, Sangam shares that it monitors tool wear and breakage, ensuring surface finishes and critical dimensions stay under control. He explains that for Indian toolrooms supplying global OEMs, this makes it easier to demonstrate capability, consistency, and production approval readiness. The outcome is

stable processes, predictable try outs, and fewer last minute corrections.

The Redistribution of Skill

A recurring bottleneck for Indian toolrooms is the shortage of skilled programmers. Vineet Seth, Managing Director, South Asia & Middle East, Mastercam APAC, points out that software intelligence is about the redistribution of skill rather than its removal. He shares that the latest Mastercam 2025 release introduces features like 'Mastercam Deburr', which automates edge finishing—a task that previously required deep multi-axis knowledge. By automating these repetitive tasks, programmers can focus on higher-level problems like tool behavior, machine kinematics, and post-processing. Seth states that software intelligence helps standardize outcomes and shorten learning curves, but it does not replace engineering judgment; rather, it scales capability across teams.

Industry 4.0 for MSMEs

For the typical Indian toolroom, often an MSME, the concept of Digital Twin can seem intimidating. Hence, LMW addresses this through a phased Industry 4.0 approach at the entry level by monitoring essential machine status and utilization. The intermediate level includes predictive maintenance dashboards to track machine health, while the advanced level enables full ERP connectivity for toolrooms ready for global integration. This allows smaller owners to monitor unmanned finishing cycles from their smartphones without heavy upfront investment.

Role of Automation in Die and Mold

Discussing the evolution of the sector, Taneja emphasizes that

Software intelligence is about the redistribution of skill rather than its removal. It helps standardize outcomes and shorten learning curves, but it does not replace engineering judgment; rather, it scales capability across teams.

By implementing structured changes—such as shop floor internships for women, ergonomic workstations, and data-driven hiring, the industry is beginning to leverage a more diverse leadership pool to drive innovation in jig and fixture design.

automation is designed to liberate the craftsman from the repetitive cycle of trial and error rather than replace human expertise. He views automation as a means of flexible orchestration that removes the burden of trial and error from the craftsman. By leveraging the 7th SENSE digital ecosystem alongside Zero-Point workholding, Jyoti CNC converts standard machinery into an intelligent partner. With digital twins to simulate the production journey and real-time sensors to compensate for tool wear, intricate mold-making achieves the reliability of mass production. This 'Smart Shop' strategy facilitates 'lights-out' manufacturing, ensuring even the most complex one-off components are produced with high predictability.

Diversity and Knowledge Capital

The technical transformation is being matched by a cultural one. Gururajaro highlights that



"The skill gap is real, especially in die and mold shops running complex jobs. Our focus is to simplify decision-making on the shop floor. With probing cycles and software, operators don't need deep metrology knowledge to verify parts."

Sanjay Sangam
Deputy Director -
Sales and Technical
Renishaw Metrology
Systems Ltd



"India's manufacturing push has moved well beyond intent—it is now influencing real decisions on capacity, localization, and supply chains. For the die and mold industry, this is expanding the opportunity space, but at the same time accelerating the need for capability upgradation, skill development, and digital maturity."

Vineet Seth
Managing Director -
South Asia & Middle East
Mastercam APAC



"Indian toolroom owners are moving from a 'brand-heavy' mindset to a 'performance-first' approach. By choosing indigenous, high-quality precision tools, they gain equivalent accuracy at a fraction of the cost, with the added advantage of localized, immediate service."

Rashmi L. Gururajaro
Co-Founder & Director
Manleo Designs Pvt Ltd



"For Tier-2 die and mold manufacturers, the key requirement is achieving reliable precision with moderate capital investment. At STM, we position our VMC and Double Column machines as systems that bring global engineering standards to the Indian shop floor."

D. Shanmugasundaram
Managing Director
S&T Machinery Pvt Ltd



"The direction is clear — combining precision engineering with intelligent system integration to support uninterrupted, high-accuracy mold production. In critical tooling environments where downtime impacts delivery commitments, reliability and predictability are essential."

Varun Dev
CEO
UCAM Pvt Ltd

As automotive interiors and consumer electronics become more complex and textured, the need for intricate electrodes is surging. As a result, graphite machining has become a necessity.

the gender gap in toolrooms is often a skills and environment gap. By implementing structured changes—such as shop floor internships for women, ergonomic workstations, and data-driven hiring, the industry is beginning to leverage a more diverse leadership pool to drive innovation in jig and fixture design. Companies like AMG are investing heavily in their training ecosystems. They don't just deliver a machine; they provide dedicated CNC simulators to transform standard operators into 5-axis specialists, ensuring customers see ROI from day one.

Graphite Machining

As automotive interiors and consumer electronics become more complex and textured, the need for intricate electrodes

is surging. Shanmugasundaram points out that graphite machining is evolving from an afterthought on standard VMCs to a dedicated necessity. Dedicated graphite centers require specialized machines designed with high spindle speeds, effective dust management, stable motion control, thermal stability, and precision. "As Indian toolrooms increasingly participate in global aerospace and automotive supply chains, investing in dedicated graphite machining centers will become essential to achieve the precision, repeatability, and productivity demanded by advanced tooling applications," he predicts.

The Road Ahead

As we look toward the future, the Indian toolroom is no longer

defined by the brand of the machine on the floor, but by the intelligence of the process it runs. As Seth rightly points out, "The conversation with global OEMs has shifted from 'Can you make this?' to 'Can you make this consistently, at scale?'. India's edge lies in its ability to offer a total engineering solution. The Indian die and mold industry is becoming a hub of innovation and reliability. Backing this evolution, Varun concludes, "As we move through 2026, our focus in the die and mold vertical is centered on enhancing performance capability and operational reliability." The direction is clear, combining precision engineering with intelligent system integration to support uninterrupted, high-accuracy mold production. 




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POWERING GROWTH IN FORGING INDUSTRY

Yash Munot, President, Association of Indian Forging Industry (AIFI), in the following conversation with MMI's Editor-in-Chief Soumi Mitra, shares insights into the developments unfolding in India's forging industry. He highlights the macro-trends driving growth in the domestic market and explains AIFI's role in guiding the industry's transition from traditional setups to highly automated smart factories.

With the domestic market projected to grow significantly by 2030, what macro-trends are driving this momentum, and how is the Association of Indian Forging Industry (AIFI) steering the industry to capitalize on emerging, high-value sectors like Aerospace, Defence, and EVs?

India's Forging industry is entering a transformative growth phase driven by several macro trends such as rapid industrialization, increasing domestic manufacturing under the 'Make in India' initiative, rising demand from Automotive and Infrastructure sectors, and the strong push toward electric mobility and defence indigenization. At AIFI, we see significant opportunities emerging in high-value sectors such as Aerospace, Defence, and EV Components, where precision, lightweighting, and reliability are critical. Our role is to facilitate this transition by promoting advanced manufacturing practices, encouraging technology adoption, and enabling collaboration between industry, academia, and government. Through skill development initiatives, global partnerships, and technology forums, AIFI is actively preparing Indian forging companies to move up the value chain and become competitive suppliers in global high-performance component markets.



Yash Munot, President, Association of Indian Forging Industry (AIFI)

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As the forging ecosystem transitions from traditional setups to highly automated smart factories, how is AIFI addressing the critical skills gap, and how can the next generation of leaders overcome legacy business models?

The transition toward automated and digitally integrated forging facilities requires a fundamentally new skill set that blends traditional metallurgical expertise with digital and data-driven manufacturing. At AIFI, we are actively addressing this challenge by collaborating with technical institutes, skill development bodies, and industry experts to design specialized training programs for the forging workforce. We also encourage exposure to Industry 4.0 technologies such as robotics, automation, and predictive analytics. For the next generation of leaders, the key lies in embracing innovation while respecting the strong operational foundation built over decades. Moving beyond legacy business models will require a shift toward data-led decision-making, global quality benchmarks, and strategic investments in technology that enhance productivity, traceability, and sustainability.

There is an accelerating demand for lightweight, high-strength components to support electric mobility and aerospace applications. From a technical and processing standpoint, how are Indian forging companies adapting their capabilities to work with advanced materials like titanium and complex aluminum alloys?

The shift toward electric mobility and aerospace applications has accelerated the need for lightweight yet high-strength components. Indian forging companies are increasingly investing in advanced forging technologies capable of process-

"Indian forging companies are increasingly investing in advanced forging technologies capable of processing materials such as titanium alloys and complex aluminum grades. These materials demand precise temperature control, specialized dies, and sophisticated process monitoring to maintain structural integrity and dimensional accuracy."

Yash Munot
President
Association of Indian
Forging Industry (AIFI)

ing materials such as titanium alloys and complex aluminium grades. These materials demand precise temperature control, specialized dies, and sophisticated process monitoring to maintain structural integrity and dimensional accuracy.

Many forging companies are upgrading their presses, adopting isothermal and precision forging techniques, and integrating simulation tools to optimize material flow and reduce defects. At AIFI, we are encouraging knowledge-sharing platforms and international collaborations so that Indian manufacturers can develop deeper expertise in advanced materials processing and position themselves as reliable suppliers for global aerospace and high-performance mobility ecosystems.

While large enterprises are rapidly adopting mechanization, a vast majority of India's forging industry still comprises MSMEs. How practical is the integration of AI-driven process optimization, IoT, and robotics for these

smaller players, and what steps is AIFI taking to make digital transformation accessible to them?

MSMEs form the backbone of India's forging ecosystem, and their participation in the digital transformation journey is essential for the sector's long-term competitiveness. While the adoption of technologies such as AI-driven process optimization, IoT-enabled monitoring, and robotics may initially appear capital-intensive, scalable and modular solutions are making these technologies increasingly accessible to smaller manufacturers.

At AIFI, we are working to bridge this gap by organizing technology awareness programs, facilitating access to shared knowledge platforms, and promoting collaborative models where MSMEs can adopt digital tools in a phased and cost-effective manner. Our objective is to ensure that smaller forging units are not left behind but instead become agile, data-driven manufacturing partners within the broader supply chain.

Sustainability is becoming a strict mandate rather than a choice. With initiatives like circular forging and the integration of solar power gaining traction, what specific technical upgrades must forging plants implement to align with global ESG standards and reduce material waste?

Sustainability has become a central priority for the Forging industry as global customers increasingly demand environmentally responsible manufacturing practices. Forging plants can significantly reduce their environmental footprint through several technical upgrades. These include adopting energy-efficient induction heating systems, integrating renewable energy sources such

AIFI is actively addressing the skill gap challenge by collaborating with technical institutes, skill development bodies, and industry experts to design specialized training programs for the forging workforce.

The association sees significant opportunities emerging in high-value sectors such as Aerospace, Defence, and EV Components, where precision, lightweighting, and reliability are critical.

"Indian machine tool builders have made commendable progress, but continued innovation in high-speed machining, automation compatibility, and customized solutions for forged components will be crucial to fully support the evolving needs of the forging sector."

Yash Munot
President
Association of Indian Forging Industry (AIFI)



Source: Association of Indian Forging Industry

as solar power, and implementing advanced process monitoring to minimize material waste and rework. Circular forging practices, where scrap is systematically recycled within the production loop, are also gaining traction. Additionally, digital process control and simulation tools help optimize billet usage and improve yield. At AIFI, we are actively promoting best practices and knowledge exchange to help Indian forging companies align with global ESG standards while improving operational efficiency.

Forged components rely heavily on high-precision machining to meet tight global tolerances. How would you evaluate the current synergy between the Indian Forging industry and the domestic Machine Tool sector?
The relationship between the Forging industry and the Machine Tool sector is extremely critical, as forged components require high-precision machining to meet stringent global tolerances. Over the past decade, we have seen encouraging progress in the capabilities of Indian machine tool manufacturers, particularly in CNC machining centers and specialized tooling solutions. However, there is

still scope for deeper collaboration between forging companies and machine tool builders to develop solutions tailored specifically for forged components. AIFI strongly advocates stronger industry linkages, joint research and development initiatives, and technology partnerships that can help both sectors grow together. A robust domestic machine tool ecosystem will ultimately strengthen India's position as a competitive global manufacturing hub.

Are there specific technological advancements in multi-axis CNCs or metal-cutting machinery that forging companies urgently need from Indian builders?
As forging companies move toward higher precision and complex geometries, the demand for advanced machining solutions is increasing rapidly. In particular, multi-axis CNC machining centers with higher rigidity, faster tool change systems, and improved thermal stability are becoming essential for machining forged components with tight tolerances. Forging manufacturers also require machines capable of handling difficult-to-machine materials such as titanium and high-strength alloys.

Additionally, integration with digital monitoring systems, predictive maintenance tools, and automated tool management will be critical in enhancing productivity. Indian machine tool builders have made commendable progress, but continued innovation in high-speed machining, automation compatibility, and customized solutions for forged components will be crucial to fully support the evolving needs of the Forging sector.

Die life, precision, and thermal resistance are critical points in closed-die forging. How are modern CAD/CAM software, forging simulation tools, and advanced die-sinking EDM machines transforming forging die design, and what impact is this having on overall production yield and defect reduction?
Advancements in digital engineering tools are significantly transforming the way forging dies are designed and manufactured. Modern CAD/CAM platforms, coupled with advanced forging simulation software, allow engineers to predict material flow, stress distribution, and potential defect zones even before physical production begins. This enables optimized die design, improved thermal

"Circular forging practices, where scrap is systematically recycled within the production loop, are also gaining traction. Additionally, digital process control and simulation tools help optimize billet usage and improve yield."

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President
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Source: Association of Indian Forging Industry

management, and better material utilization. Additionally, high-precision die-sinking EDM machines have enhanced the accuracy and surface finish of complex die cavities, which directly influences the quality of forged components. These technologies collectively contribute to longer die life, reduced trial-and-error during production, and significantly lower defect rates. Ultimately, this results in improved production yield, better consistency, and enhanced competitiveness for Indian forging companies in global markets.

How can the integration of advanced machine tools and automated inspection systems help Indian manufacturers differentiate themselves through superior value-added solutions rather than just cost arbitrage?
For many years, Indian manufacturing gained global traction primarily through cost competitiveness. However, the future lies in delivering superior value through precision, reliability, and innovation. The integration of advanced machine tools with automated inspection systems such as coordinate measuring machines, laser scanning, and AI-enabled

quality analytics allows manufacturers to achieve consistent accuracy and traceability across production batches. This level of process control is particularly important for sectors such as Aerospace, Defence, and Electric Mobility, where component reliability is non-negotiable. By combining precision machining with real-time inspection and data-driven quality assurance, Indian forging companies can position themselves not merely as cost-efficient suppliers but as trusted partners capable of delivering high-value engineered solutions to global customers. 

AIFI is organizing technology awareness programs, facilitating access to shared knowledge platforms, and promoting collaborative models where MSMEs can adopt digital tools in a phased and cost-effective manner.



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THE QUIET RISE OF AN ENGINEERING FORCE

TK Karuppannaswamy, Founder & Chairman, Barani Hydraulics India Pvt Ltd, received the IMTMA-Premier Outstanding Entrepreneur Award at IMTEX FORMING 2026 at BIEC, Bengaluru – a moment that prompted reflection on the company's journey.



Source: Barani Hydraulics India Pvt Ltd

vanced machinery. Over time, it progressed to manufacturing presses that met corporate standards and eventually entered international markets. The company was also honored with the IMTMA Export Performance Award in Memory of Shailesh R. Sheth in the Metal Forming category, recognizing its significant achievements in exports of machine tools and related products. "Though Barani has already received national and international awards, these two prestigious awards from IMTMA are a real honor for us and a recognition of true Indian engineering values. They motivate us to serve our nation even better. We sincerely appreciate IMTMA's contribution and encouragement in promoting Indian engineering successfully in the global arena."

When Opportunity Knocked – Barani Answered

Several defining moments helped the company transition from a small manufacturing unit into a global supplier. One of the first major breakthroughs came in 1997 when a leading motor pump manufacturer in India began exporting. "It chose not to import hydraulic presses and instead entrusted us with developing indigenous machines," he shared. Another important project followed in 2005. "A leading automotive wheel rim manufacturer handed the opportunity for manufacturing the wheel rim

project line with automation," Karuppannaswamy said. The company achieved another milestone in 2008 when it worked with an Indian market leader associated with a Japanese global manufacturer for a joint venture project. "We got the opportunity to develop JIS Grade-1 accuracy level presses that were certified by the Japanese team for their country standards," he said. He noted that these experiences significantly strengthened the company's confidence. "These successful opportunities increased our confidence in providing total solutions to customers and entering the global arena," he added.

Coimbatore's Influence

A substantial part of the company's success is rooted in the Coimbatore ecosystem. The region's entrepreneurial spirit has played a pivotal role in shaping the company's identity. "The geographical area supported our progress and helped us gain the confidence to compete globally with pride as an Indian manufacturer," he shared. "Known as the Manchester of South India, Coimbatore has a long tradition of engineering excellence, innovation, and self-reliance, and hosts nearly 80 percent of India's motor pump



"Though we had a lot of struggles, the ambition to build hydraulic products never deviated. We started by manufacturing hydraulic jacks and small presses for the motor pump industry. We later built presses that met corporate standards and eventually entered global markets."

TK Karuppannaswamy
Founder & Chairman
Barani Hydraulics India
Pvt Ltd

manufacturing industries in and around the region," he noted. He added that collaboration within the local industrial community helped the company continuously improve. "The presence of strong industrial associations, technical institutions, and knowledge sharing among

entrepreneurs helped us learn from peers and continuously raise our standards," he said.

Integrating Artificial Intelligence into Machinery

As manufacturing industries are increasingly adopting digital technologies, the company has also incorporated artificial intelligence into its machine-building processes. "As man-dependent activities are reducing, industries have started focusing on Industry 4.0, industrial safety, and consistent performance in both quality and productivity. Artificial Intelligence support is a must now," he said.

He noted that modern manufacturing increasingly relies on data-driven processes. "Almost all the manufacturing sectors are focusing more on process capability with data science. AI integration has become essential." "As an equipment manufacturer for more than a decade, we have introduced AI and data-driven intelligence wherever possible. To compete globally, it was essential to introduce upgraded technology with modern resources," he added.

Establishing Indian Engineering in Global Markets

Entering global markets was not without challenges. Karuppannaswamy explained that Indian manufacturers initially faced skepticism from international customers. "A decade ago, it was difficult to get leading global manufacturers to accept Indian capital machines," he said. The company addressed this perception by focusing on advanced engineering and global certifications. "Meeting global standards such as JIS, CE, UL, and NR12 was another major challenge," he noted. Persistence and continuous improvement eventually

Barani Hydraulics India Pvt Ltd currently supports customers in more than 20 countries and has expanded its manufacturing footprint with additional facilities.



Source: Barani Hydraulics India Pvt Ltd

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A substantial part of the company's success is rooted in the Coimbatore ecosystem. The region's entrepreneurial spirit has played a pivotal role in shaping the company's identity.



Source: Barani Hydraulics India Pvt Ltd

paid off. "With a lot of struggle and learnings, Barani machines have been certified with almost all the global standards, capable of exporting anywhere in the world," he emphasized. He also pointed out that the company's ability to offer customized solutions helped it stand apart. "Some hydraulic press manufacturers restrict their product range to specific segments and produce standard catalogue products in large volumes," he said. "But Barani is more focused on customized solutions and providing total solutions to customers." He added that the company now serves more than 100 industrial segments, which has become a key strength.

Balancing Heavy Engineering with Digital Technology

Shedding light on global customers' expectations for strong structural design and advanced monitoring systems, the Chairman said, "Construction rigidity with adequate safety factors in our designs, structural analysis for every product, the introduction of digital inspection procedures, and the capture of functional and process data are essential." The company therefore integrates digital tools with traditional heavy engineering. "We are deliberate in adopting digitalization

and advanced technologies to achieve higher uptime, improved quality, enhanced safety, and longer machine life," he said. He added that the company designs machines so that "software enhances hardware, real-time monitoring improves consistency, data analytics reduce downtime, and smart controls make machines less operator-dependent."

Expanding Global Reach and Future Plans

"Barani Hydraulics always focused on introducing new technology. With every decade of our journey, we have adopted modern techniques at par with global manufacturers," Karuppannaswamy explained with pride, hinting at the company's expansion of its technology base and manufacturing capabilities. He noted that the company now offers complete project lines along with hydraulic presses. "As an Indian capital machine manufacturer, our product range is not only hydraulic press but also other related machines in the total project line with automation as a total solution," he said. Barani currently supports customers in more than 30 countries and has expanded its manufacturing footprint with additional facilities and spread

the wings in its product manufacturing divisions, associating with the world's top MNCs as a strategic supply partner. "Now we have opened a new facility that is ready to serve as a strategic supply partner for a multinational corporation to cater to its global needs," he said. Karuppannaswamy established a charitable trust in 2009 and went on to found Jai Shriram Engineering College near his hometown, with the aim of providing quality higher education to the rural community. The institution has since nurtured over 4,500 engineering graduates and professionals. Complementing this initiative, the Barani Technology Training Centre focuses on imparting hands-on experience, helping students enhance their practical skills and evolve into industry-ready, creative engineers. He also revealed that the company is involved in a major project aimed at reducing India's dependence on imported machinery. Reflecting on the broader transformation of the country's manufacturing sector, he said, "India is no longer just a low-cost manufacturing country. We have grown significantly, and Indian manufacturers are proudly carrying the Indian engineering banner across international markets, and Barani Hydraulics is one among them."



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GOLDEN JUBILEE GLORY: WINNING THE IMTMA-COOPER AWARD

During IMTEX FORMING 2026, Rajamane Industries Pvt Ltd, a 50-year-old manufacturer, was bestowed the prestigious IMTMA-Cooper Award for Outstanding Supply Chain Unit, instituted in memory of Sir DB Cooper, on January 21, 2026, at Bangalore International Exhibition Centre, Bengaluru. The award recognizes the vital contribution of supply chain units to India's machine tool industry.



Source: Magic Wand Media

Established in 1975 at Bengaluru, Rajamane Industries is one of India's leading manufacturers of coolant pumps and has made significant strides in electric motors, auto components, castings, and other products for the machine tool and allied industries. Rooted in a strong focus on research and development, continuous innovation, and a customer-centric approach, Rajamane Industries has earned the trust of leading machine tool manufacturers and global OEMs.

"Winning the IMTMA-Cooper Award means a lot, not just personally but also for the entire team. It feels like all the hard work, late nights, and relentless focus on excellence have paid off," Rajendra Rajamane, Managing Director, Rajamane Industries Pvt Ltd, expressed. "This award represents recognition of our efforts in building a robust and efficient supply chain that drives innovation and growth in the machine tool industry," Rajamane said. "It validates our behind-the-scenes

work, showing that our focus on streamlining processes, building strong partnerships, and driving continuous improvement is making a real impact."

A Golden Jubilee Milestone

As it marks 50 years of excellence, the company continues to strengthen India's manufacturing ecosystem as a dependable supply chain partner. The award, according to Rajamane, validates the company's efforts in building a robust supply chain, driving technological

advancements, and delivering exceptional value to customers. "We are proud to have this recognition as part of our milestone celebrations," he added.

Ensuring Zero Disruption in a Volatile Market

In today's uncertain market conditions, reliability is critical for supply chain partners. He vividly recalled a recent challenge when a key supplier faced a sudden production halt due to raw material shortages. "Our team quickly assessed the impact and collaborated with the supplier to expedite alternative sourcing. We also leveraged our network to identify backup suppliers and adjusted production schedules to minimize delays," he said.

To prevent any disruption to OEM customers, the company maintained transparent communication and strategic planning. "We kept our OEMs informed about the situation and our mitigation plans. We managed inventory buffers strategically and expedited logistics to meet urgent demands," he explained. He noted that this proactive approach helped the company maintain supply continuity and build stronger partnerships with its OEMs. With regards to on-time delivery, the company has so far achieved 100 percent, never missing a delivery deadline. Its fully integrated manufacturing setup, including the in-house foundry, winding unit, and machine shop, has supported this performance.

Digitizing the Supply Chain

Rajamane Industries has been leveraging technology to modernize its traditional supply chain by integrating Industry 4.0 and smart manufacturing solutions. One such implementation is its ERP system that streamlines operations and enhances supply



"This award is a fantastic way to cap off our 50 years of excellence. The IMTMA-Cooper Award recognizes our relentless pursuit of innovation and excellence in the machine tool industry and motivates us to continue pushing boundaries."

Rajendra Rajamane
Managing Director
Rajamane Industries Pvt Ltd
Past President-IMTMA

chain efficiency. "This system enables real-time tracking and management of production, inventory, and logistics, allowing for faster response times and better decision-making," he said. He added, "Industry 4.0 is being implemented across stages starting from our foundry to assembly." Adopting these smart manufacturing solutions has resulted in stark improvements in terms of operational efficiency, reduced costs, and enhanced customer satisfaction.

Innovation Begins with Listening

A customer-centric approach has directly influenced product improvements. The company actively engages with OEMs to understand their pain points and gather structured feedback. One major improvement came from switching to electrophoretic deposition (ED) coating for pumps. "Switching to ED coating

was a game changer. ED coating offers superior precision, uniformity, and corrosion resistance compared to conventional painting. It also improves precision and enables faster turnaround times," he explained.

Addressing this issue helped the company reduce delivery times and supported customers in improving their own production schedules. The move was implemented based on direct OEM feedback.

Evolution with Core Values Intact

Looking back on the company's journey from 1975 to 2026, Rajamane described a major transformation. In its early years, the focus was on establishing a strong manufacturing foundation. Today, the company has evolved into a technology-driven organization with a growing global footprint.

"We have embraced Industry 4.0, automation, and digitalization. We have expanded from local to global markets and diversified our product portfolio with customer-centric solutions," he said. Despite these changes, he stressed, the company has a set of non-negotiable values. "Quality is non-negotiable. We have an uncompromising commitment to delivering high-quality products. Customer focus and innovation have been our guiding forces for 50 years," he said.

Scaling New Heights

The company already exports to markets including the United States, the Middle East, Germany, Japan, and China. The plans now are to expand its presence in global markets, particularly within the machine tool industry and emerging sectors such as electric vehicles. "We are looking at global market expansion, especially in regions like Europe, the US, and Southeast Asia," he shared. 

Celebrating its Golden Jubilee, Rajamane Industries maintains 100 percent on-time delivery, advances Industry 4.0 integration, and continues expanding into global markets and emerging sectors.

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INDIA-BUILT, WORLD-RECOGNIZED

Electro Pneumatics & Hydraulics (India) Pvt Ltd (EPHL) is one of the few companies with a strong legacy and deep technological expertise in India's metal forming industry. The recent IMTMA Best Design Award 2026 for the 32CNC11X6-LR rotating head tube bender marks a defining moment in the company's journey, reinforcing its position as a leading force in the sector.



Source: Magic Wand Media

Electro Pneumatics & Hydraulics, located in Chakan, Pune, has always believed that India can build world-class machines through indigenous engineering. Right from the 1970s, the company has been a forerunner in developing technologies such as India's first CNC tube bender, 6-axis electric and hydraulic robots, hydro-forming technology, the first hydraulic compacting press,

servo-mechanical presses—many of which have successfully served as import substitutes.

A Validation of Engineering Excellence

Winning the IMTMA (Indian Machine Tool Manufacturers' Association) Best Design Award 2026 at IMTEX FORMING 2026 for the 32CNC11X6-LR rotating head tube bender is a significant achievement for the company. The recognition

is the result of focused engineering work, detailed simulations, thorough prototyping, and close collaboration among the design, simulation, electronics, and controls teams. "This award reinforces that our design philosophy—Forming tomorrow, today—delivers real value to the industry," shared Ingrid Rasquinha, Joint Managing Director, Electro Pneumatics & Hydraulics (I) Pvt Ltd. "For our teams, it boosts confidence,

encourages deeper experimentation with advanced technologies, and strengthens our commitment to building world-class machines from India for India and the global market." The 32CNC11X6-LR is entirely designed, engineered, and manufactured in India using homegrown ingenuity—from servo-electric axes to intelligent control software.

Precision Engineered Performance

During design and prototyping, managing collision risk, especially during complex multi-plane bending, presented a significant challenge. The bend head needs to be rotated from CW to CCW and vice versa, adding complexity in optimal cable routing, as the continuous rotation demands secure, fatigue-resistant pathways without hindering movement. Another major hurdle was the heavy rotating mass, which affects responsiveness and control. "We resolved this by designing the bend head and clamp arm into a compact, lightweight assembly, improving dynamic performance," pointed out Rasquinha. "Advanced simulation and motion-planning software (BendSIM) further ensured safe, interference-free operation." Efficiency, precision, and minimizing material thinning/ovality are critical in tube bending. The 32CNC11X6-LR uses a high-speed rotating head with synchronized servo axes, significantly reducing idle time between bends and improving overall cycle speed. Its intelligent motion-control algorithms ensure smooth transitions and consistent bending performance. The use of reduced-backlash gearboxes across critical axes further enhances repeatability,



"The 32CNC11X6-LR is entirely designed, engineered, and manufactured in India using homegrown ingenuity—from servo-electric axes to intelligent control software. This recognition demonstrates that Indian innovation can stand shoulder-to-shoulder with global competitors."

Ingrid Rasquinha
Joint Managing Director
Electro Pneumatics &
Hydraulics (India) Pvt Ltd

especially during long production runs where precision drift is common. Automated compensation for spring-back and optimized motion sequencing help operators achieve uniform bend quality with minimal manual intervention, resulting in faster throughput and highly reliable dimensional accuracy.

From Shop Floor to Global Stage

The machine is particularly advantageous for the Furniture and Aerospace industries. In the Furniture sector, most components require CW-CCW bending, which the rotating head performs seamlessly in a single setting, eliminating re-clamping and dramatically reducing handling time.

For Aerospace applications, production typically happens in varied batches. The machine's capability to mount six sets of tools simultaneously gives manufacturers the flexibility to switch between components without frequent tool changes. This reduces setup time and enhances productivity and consistency across highly specialized tube geometries across Furniture, Aerospace, Automotive, and other Engineering sectors.

"Machines like the 32CNC11X6-LR strengthen our credibility in global markets by showcasing India's ability to deliver advanced tube-forming solutions," stated Rasquinha on expanding the company's global footprint. "Such recognition provides international visibility, helping us build trust with OEMs in Europe, the Middle East, and Southeast Asia." By demonstrating proven performance through award-winning innovations, Electro Pneumatics positions itself as a competitive alternative to established global brands. "With cost-efficient engineering, we aim to accelerate export growth across emerging markets," she added.

The Next Technological Frontier

The company's R&D focus is aligned with the industry demand for forming high-strength, lightweight, and complex parts at lower energy consumption and reduced CO₂ emissions. To reduce energy consumption, EPHL is moving toward electric-based systems not only in tube benders but also in presses—mechanical, servo-mechanical, and hydraulic, manufactured for various applications as per customer needs. Future focus areas include deeper integration of embed-

The IMTMA Best Design Award 2026-winning 32CNC11X6-LR rotating head tube bender reinforces India's growing capability to design and manufacture advanced, world-class forming systems for domestic and global markets.

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Source: EPHL

ded intelligence, predictive and prescriptive maintenance, vision-based online measurement, AR/VR, and digital twins for complex form-

ing applications. "With Industry 4.0 adoption growing, our goal is to create intelligent forming systems that self-learn, optimize pa-

rameters, reduce trial time, and enhance productivity across all manufacturing environments," concluded EPHL's Joint Managing Director.



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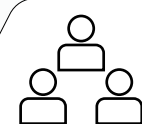
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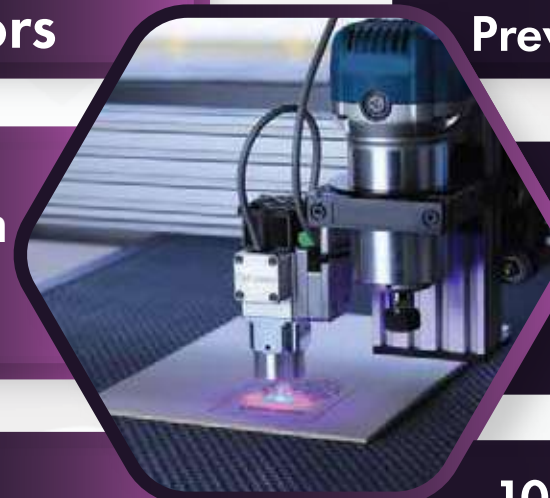


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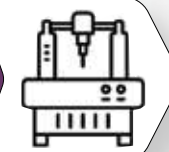


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PERFORMANCE THAT EARNS ITS WINGS

Electronica Mechatronic Systems India Pvt Ltd earned industry recognition for its growing international presence. The company received the IMTMA – Best Export Performance Award during IMTEX FORMING 2026, adding to a notable list of accolades.



Source: Magic Wand Media

“Our export growth has been driven by a long-term commitment to innovation, quality, and strong global partnerships,” said Radhika Madgulkar, Managing Director, Electronica Mechatronic Systems India Pvt Ltd. She described the award as an important milestone for the company’s engineering and manufacturing teams. “Winning the IMTMA – Best Export Performance Award is a proud recognition for the entire Electronica Mechatronic Systems team.”

Award with a Global Message

“This recognition highlights the

growing global confidence in India’s engineering and manufacturing capabilities,” she said. The company plans to use the momentum to strengthen its international partnerships and expand its distribution network. The award serves as a reminder of the company’s belief that Indian companies can design and manufacture advanced industrial technologies that compete globally on quality and innovation. The Managing Director noted that the company’s long-term vision goes beyond its own growth. “Our broader vision is to help position India as a trusted hub for high-precision engineering and manufacturing technologies

that support modern industrial growth worldwide.”

Built in Pune, Calibrated for the World

According to Madgulkar the company’s export growth over the past year was supported by various factors. “We have focused on strengthening our global footprint by deepening engagement with international OEMs, distributors, and machine tool manufacturers,” she said. Participation in international exhibitions and technology forums also helped the company connect with new customers and markets. “We have consistently delivered precision measurement technol-

ogies trusted by global industries,” she shared. The company takes pride in building its global presence on an engineering legacy of over four decades and a strong Pune-based manufacturing foundation.

“By combining quality, reliability, application-focused solutions, and after-sales support, we have positioned Indian-developed technology as a competitive and dependable choice for manufacturers across global markets,” she added.

Building Quality into the Manufacturing Process

“In precision engineering, export success begins with uncompromising quality and process discipline,” she emphasized. The company has developed a vertically integrated ecosystem where design, research and development, manufacturing, testing, and calibration operate within the same facility.

It has strengthened its quality systems by enhancing traceability across production, and implementing rigorous testing and calibration protocols to meet diverse international standards. “Every product undergoes extensive validation before it reaches the customer,” she explained.

Close collaboration with global customers also plays an important role. “Our engineering teams collaborate closely with global clients to adapt solutions for different industrial environments,” she said. The purpose of this collaboration is to ensure the company’s technologies maintain consistent precision and compliance across international markets.

Around the Clock, Around the World

Technology alone is not enough to support international customers, particularly when operations run



“By combining quality, reliability, application-focused solutions, and after-sales support, we have positioned Indian-developed technology as a competitive and dependable choice for manufacturers across global markets.”

Radhika Madgulkar
Managing Director
Electronica Mechatronic
Systems India Pvt Ltd

across multiple time zones. Reliable service support has therefore become a central element of the company’s export strategy. “For industrial customers, reliability is measured not only by technology but also by the strength of service support,” she highlighted.

The company has built a structured global service framework that combines in-house technical specialists with trained partners and distributors to support customers. “After-sales support is central to our value proposition,” she noted. Operator training and spare parts availability are also prioritized to reduce downtime. “Our objective is simple—customers anywhere in the world should experience the same reliability, responsiveness, and engineering support that define our brand,” she shared.

In-House, On Point, On Time

The company’s ability to design and manufacture core technologies internally has also strengthened its competitiveness in global markets. “Our strength lies in delivering precision engineering with flexibility, responsiveness, and value,” she said.

Key technologies are developed in-house so that the company can maintain control over innovation and customization. “From encoders and digital readout systems to advanced metrology solutions, our core technologies are designed and manufactured in-house,” she outlined.

With this integrated approach, the company can respond quickly to application-specific requirements across sectors such as machine tools, automotive, and electronics manufacturing, while maintaining a competitive cost-to-performance ratio.

Future-Proofed and Factory-Ready

As global manufacturing evolves, the company is preparing to expand both its technology platforms and its international presence. “Our focus is to evolve alongside the future of global manufacturing,” she stated.

Electronica Mechatronic Systems India is currently developing next-generation metrology systems and AI-enabled customized inspection solutions. “We are integrating digital technologies and data-driven measurement capabilities aligned with Industry 4.0 environments,” she highlighted. These developments aim to support manufacturers worldwide with higher levels of accuracy and efficiency. “Our objective is to deliver solutions that help manufacturers worldwide achieve higher accuracy, productivity, and efficiency, while reinforcing our role as a trusted global technology partner,” shared Madgulkar.

From Pune to the world: Electronica Mechatronic Systems India Pvt Ltd won the IMTMA – Best Export Performance Award, proving Indian precision engineering can deliver high-tech, reliable, and AI-powered solutions to manufacturers across the globe.

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Magnetic clamping technology offers distortion-free clamping of the workpiece.

CONCENTRATING EXPERTISE FOR TOOL, PATTERN, AND MOLD MAKING

A collaborative project between SCHUNK, OPEN MIND, and Horn demonstrates how coordinated engineering delivers precision, productivity, and process reliability in tool and mold making. Proven technologies were combined with innovative approaches—from deformation-free magnetic workpiece clamping and high-performance milling tools to advanced CAM strategies for economical programming.

“When Uwe Weil from SCHUNK called me and told me about the idea for the project, it immediately piqued my interest. Shortly afterwards, I agreed,” says Andreas Jenter, Product Manager, Horn, whose specialty is milling with solid carbide tools. “Clemens Bangert from the CAD/CAM manufacturer OPEN MIND also immediately agreed to the

project. The hyperMILL® expert developed and programmed the 3D model of the challenging shape,” shares Weil, who is responsible for product training and technology training at SCHUNK. “The machining process was completed in four days of intensive cooperation. One or two things may be manufactured differently in practice, but we wanted to use different approaches to

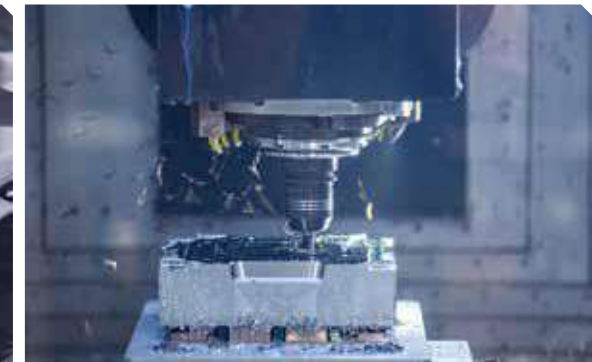
demonstrate the cost-effective processing of such a demanding component,” he adds.

Magnetic Workpiece Clamping

Magnetic clamping technology is widely known in surface grinding, but it is increasingly proving its capabilities in milling applications. “There are still reservations about magnetic



The component itself is not magnetic after clamping.



Roughing the inner mold with the Horn HPC cutter.

workpiece clamping during milling, but we wanted to use this example to demonstrate that this technology can be used and implemented reliably in production environments,” says Weil.

The magnetic clamping plate is connected to the SCHUNK zero-point clamping system on the machine table by means of an aluminum base plate and correspondingly arranged zero-point clamping bolts.

The magnetic tension of the blank is deformation-free. This is achieved on the one hand by fixed pole extensions for height positioning of the workpiece and on the other hand by mobile pole extensions. The mobile pole extensions adapt to the unevenness of the surface of the component. This means that the blank is not warped during clamping.

After face milling the external dimensions, the workpiece is clamped on fixed pole extensions. “The field line height, i.e. the depth of penetration of the magnetic field into the component, is around 10 mm at the maximum magnetic level. One concern about magnetic clamping is that the workpiece might remain magnetized after clamping. However, this is not the case. Due to the low penetration depth of the magnetic field, we have no problems with chips adhering to the

surface even when milling the deep mold,” explains Weil.

For face milling of the outer surfaces, Horn's DAH84 high-feed milling system was used. “The eight usable cutting edges of the indexable insert offer a low cutting price and high cost-effectiveness. Despite the negative installation position, the positive cutting edge geometry ensures a soft and quiet cut as well as good chip drainage,” explains Jenter.

The large radius on the main cutting edge of the insert creates a soft cut, ensures an even distribution of cutting forces and thus ensures a long service life. Surface finishing was carried out using the Type 409 tangential milling system.



The Tendo Zero clamping system offers precise adjustment of the concentricity.

Know-how in Programming

For roughing, Bangert used a function from the hyperMILL® MAXX Machining performance package. “In order to make the machining dynamic and efficient at the same time, I relied on 3D-optimized roughing. Machining is carried out in trochoidal tool paths and the milling cutter is immersed in the component via a helical ramp,” Bangert explains. “It is particularly important that we can program a separate speed, the cutting speed, and a dwell time after immersion during immersion. This ensures a stable process throughout the entire process,” he adds.

The dwell time is necessary to give the spindle sufficient time to reach the correct speed so that the milling of the mold can start in trochoidal movements. The roughing of the mold is carried out as far as possible in a helix movement. This ensures that the tool is always gently cutting in sync without retraction movements and never engages in full cut.

To roughen the inner mold, Jenter relies on the Horn solid carbide end mills of the DS system. “We have developed HPC milling cutters especially for milling high-strength steels with a high metal removal rate,” he explains.

The system shows its strengths especially in dynamic roughing

The machining process was completed in four days of intensive cooperation. Different approaches were implemented to demonstrate the cost-effective processing of such a demanding component.

There are still reservations about magnetic workpiece clamping during milling, but the project demonstrated that this technology can be used and implemented reliably in production environments.



Precisely fitting thread machining with the Horn milling system DC.

operations as well as in classic roughing cycles. For the first roughing operation, an HPC milling cutter with a diameter of 12 mm and four cutting edges was used. "Due to the contour, we did not choose a larger diameter to reduce the processing of residual material," he adds. The immersion angle is 5 degrees in a helix when retracting into the workpiece. The cutting depth is $a_p = 20$ mm. The other cutting data are: $vc = 140$ m/min, $fz = 0.08$, and the lateral infeed $a_e = 3$ mm. The unequal twist angles and the resulting uneven tooth pitch enable very smooth running in use. The optimized face geometry of the tools reduces the cutting pressure when immersed in a helix or in the ramp. The improved chip spaces offer a high level of process reliability in chip forming and chip evacuation during operation. For roughing the free-form surfaces, a high-feed milling cutter with a diameter of 12 mm is used. The milling cutters have a double radius geometry. This favors the flow of force in the axial direction of the spindle and low radial forces. "Thanks to this geometry, high feed rates can be applied even with long tool protrusions without vibrations occurring in the tool," explains Jenter.

TENDO E Compact Hydraulic Expansion Chuck

The roughing tools are clamped in SCHUNK Hydro expansion chucks. For roughing, Weil relies on the TENDO E compact series. The short design is well suited for machining. "I am often asked with what torque I have to tighten the feed. At SCHUNK, it's very simple: All you have to do is turn the clamping screw all the way to the stop and this gives you the optimum concentricity and the best possible torque transmission of the tool," describes Weil.

To accommodate the guide bolts of the later tool, four holes must be drilled at the



The DR.

corners of the workpiece. To clamp the reaming tools, Schunk relies on the TENDO Zero hydraulic expansion chuck. Four opposing Torx screws on the collar of the chuck allow the concentricity to be precisely adjusted. The user can measure the reaming tool on a presetting device and the final setting is then made directly in the machine using a dial gauge. This enables μ -precise adjustment of the concentricity. "With a clamping length of the reaming tool of over 100 mm, we have a concentricity of less than $2 \mu\text{m}$. That's a very decent value," says Weil.

High-performance DR Friction System

The reaming of the four bores was carried out by Horn's DR friction system. With internal coolant supply, the cutting speed was $vc = 110$ m/min and a feed rate of 0.84 mm/rev. The retraction feed was programmed at 4000 mm/min. "It is important that no more than 2 mm emerge from the bore in the case of a long overhang length and a through hole. Otherwise, there is a risk of the tool swinging open," explains Jenter. The Horn friction system has a modular design and can be combined with numerous interfaces. The changing accuracy of the inserts is less than $4 \mu\text{m}$. The system's standard cutting edges can be used to machine materials up to a hardness of 58 HRC.

"We machined the four external threads with three lateral infeeds to ensure the exact fit of the thread. For machining, I used the hyperMILL® 'thread milling' function. This automatically calculates the value of the lateral infeed based on the tool and thread. The function supports both single-edged and multi-edged tools," says the hyperMILL® expert.



The ball milling cutters of the Horn DS system enable a high achievable surface quality due to their high precision.

The DC Horn thread milling cutter milled the threads at a cutting speed of $vc = 80$ m/min and a feed rate of $fz = 0.02$ mm/min. The tensioning system is not based on oil but on PU elements. This enables high vibration damping and thus a stable overall system for thread milling.

High Surface Quality Finishing

"When finishing a mold with different ball milling cutters, there are three crucial factors to achieve the required surface quality: the precision of the tool, a powerful CAM software for precise machining, and the accuracy of the clamping device. We manufacture the radii of the

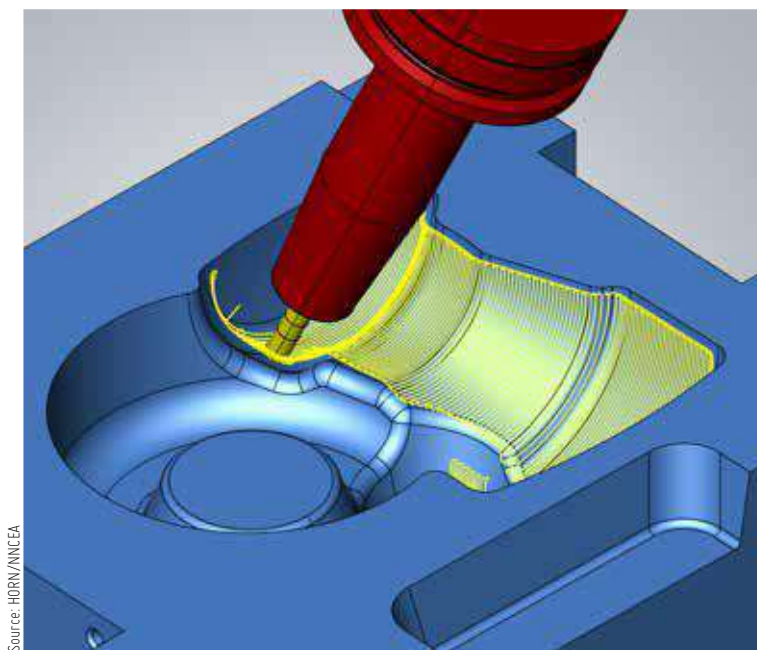
milling cutters with a maximum shape deviation of ± 0.005 mm," says Jenter. The importance of this precision can be seen when different milling cutters are applied to a shape to be finished. Bangert programmed the mold with a 6 mm and a 4 mm ball milling cutter. "Before programming freeforms, we always check the requirements for the component first. These include, above all, the required surface qualities, the shape tolerances and the transitions during finishing," he shares. Machine kinematics and the interaction between clamping devices, tools, and machine control also play a decisive role. For high-precision machining, the hyperMILL® CAM software

already contains numerous strategies in the standard version. For example, the 'High-precision surface mode' option provides an increase in surface quality. This was also used in the machining of the mold. Bangert explains: "The calculation of the tool paths takes place on the real CAD component surfaces and not on a calculation model. This allows tolerances in the μm range to be maintained. In addition, I used the 'Soft Overlap' function to grind the transitions between different surfaces, even if it was processed with a different tool or infeed. In this way, transition-free surfaces can be efficiently realized." In addition, Bangert used the 5-axis radial machining function: "With this strategy, the best possible surface qualities can be achieved. A radial projection method allows tool paths for bottle shapes, for example, to be calculated much faster. In addition, the user is able to respond flexibly to the existing component conditions."

HORN in India

Precision Tooling Solutions for the Die & Mould Industry from Paul Horn GmbH are available in India via NN Combined Engineering Agencies Pvt Ltd (NNCEA) in cooperation with select OEM partners. NNCEA provides complete technical support, logistics and supply chain management solutions for the Indian market.

When finishing a mold with different ball milling cutters, there are three crucial factors to achieve the required surface quality: the precision of the tool, a powerful CAM software for precise machining, and the accuracy of the clamping device.



hyperMILL® 5-axis radial machining: High surface qualities, e.g. for bottle shapes.

LOCALIZING TURBOPROP AVIATION IN INDIA

India's regional aviation landscape is expanding rapidly, driven by policy initiatives and rising demand for connectivity across smaller cities. However, domestic capability to support aircraft operations, maintenance, and production in the turboprop segment remains limited. Hyderabad-based Flamingo Aerospace aims to bridge this gap by building a self-reliant aviation ecosystem in India.



Source: Flamingo Aerospace

When Flamingo Aerospace looked at the Indian aviation landscape, the structural gap was very clear. Demand is growing in the 60-70-seat turboprop segment, especially across Tier-II and Tier-III cities, but indigenous capability to support that demand sustainably remains limited. "Under the Government's regional connectivity push through UDAN, many shorter

and underserved routes have opened," outlines Subhakar Papula, Founder & CEO, Flamingo Aerospace. "However, domestic manufacturing, assembly, and lifecycle support for aircraft operating in this segment remain underdeveloped." Flamingo Aerospace was never conceived as just an aircraft acquisition company. "From day one, our vision has been to build an integrated aviation ecosys-

tem in India," shares Subhakar. That includes operations support, Maintenance, Repair, and Overhaul (MRO) capability, and a long-term ambition of manufacturing and localization. This broader strategy is reflected in the company's agreement at Wings India 2026, Asia's largest civil aviation event, held from January 28-31, at Begumpet Airport in Hyderabad. "It is not simply about flying aircraft,"



Source: Flamingo Aerospace

he stresses. "It is about building capability aligned with 'Make in India' and 'Aatmanirbhar Bharat' objectives."

Building Credibility

Aerospace is one of the most capital-intensive and compliance-driven industries in the world. Every conversation, whether with regulators or OEMs, requires deep technical and financial credibility. "One of the early defining moments for us was engaging with United Aircraft Corporation," Subhakar notes. "Before any agreement is signed, there is extensive due diligence, technical alignment, and long-term industrial planning. Establishing credibility with a global OEM is a significant milestone for a young company."

Another critical aspect is regulatory alignment. Introducing a new aircraft type in India requires close coordination with the Directorate General of Civil Aviation and adherence to certification pathways. "Even before deliveries begin, planning for in-

duction, training, maintenance capability, and operational readiness must be mapped out in detail," he explains. "In aerospace, there are no shortcuts. Every milestone is earned."

At Wings India 2026, Flamingo Aerospace signed a landmark agreement with United Aircraft Corporation for six Ilyushin IL-114-300 aircraft, with deliveries scheduled from 2028. The IL-114-300 precisely fits into the 60-70-seat category required for India's re-

gional connectivity ecosystem. Designed for short- to medium-haul operations, it also has the operational flexibility to serve smaller or less developed airfields, which is critical for many emerging regional routes. "However, the decision was not based solely on operational performance. It was also about industrial strategy. The program includes a phased roadmap for technology transfer and eventual localization," explains Subhakar. "That makes



Source: Flamingo Aerospace

Flamingo Aerospace signed an agreement with United Aircraft Corporation for six Ilyushin IL-114-300 turboprop aircraft with deliveries from 2028. The partnership includes a phased roadmap for technology transfer, localization, and final aircraft assembly in India by 2030.

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this partnership fundamentally different from a pure aircraft purchase. It aligns with our ambition to build capability within India rather than remaining dependent on imports."

Beyond Aircraft Acquisition

A licensing and technology transfer arrangement signals long-term industrial trust. It means the partnership goes beyond operating aircraft to progressively building assembly and possibly component manufacturing capability in India. In aerospace, licensed assembly rights are not granted lightly. They require evaluation of industrial infrastructure, quality systems, compliance standards, and long-term commitment. "Our roadmap for phased localization and final assembly by 2029 reflects a structured partnership rather than a transactional sale," Subhakar points out. This transition positions Flamingo Aerospace as a future integrator within the aerospace value chain.

The next two years are foundational as the company prepares for committed deliveries and eventual final assembly. "First, regulatory and certification planning for the induction of the IL-114-300 into Indian operations must be completed in coordination with aviation authorities," he elaborates. "Second, we are working on developing initial MRO capability within India so that lifecycle support is integrated from the outset. Third, groundwork for supplier identification and qualification is essential for phased localization." Aerospace supply chains require rigorous standards, and early ecosystem development is critical. "Fourth, workforce development and technical training aligned with technol-



"By developing domestic MRO capability aligned with the IL-114-300 program, we aim to reduce turnaround times and improve aircraft availability. Our goal is to integrate lifecycle support within India so that regional connectivity is not just launched but sustained," he adds.

Subhakar Pappula
Founder & CEO
Flamingo Aerospace

ogy transfer provisions will determine how smoothly we transition from operations to assembly," he adds. "These milestones are interconnected. Progress in one area reinforces progress in the others."

Economics of Regional Connectivity

In India, MRO costs have historically been high because many aircraft types rely on overseas maintenance facilities. This increases ferry costs, downtime, and foreign exchange outflows. "By developing domestic MRO capability aligned with the IL-114-300 program, we aim to reduce turnaround times and improve aircraft availability," says Subhakar.

For regional airlines operating in smaller cities, aircraft utilization rates are critical. Higher aircraft availability and faster maintenance cycles directly support route economics. "Our goal is to integrate lifecycle support within India so that regional connectivity is not just launched but sustained," he adds.

The Road to Aerospace Capability

Aerospace manufacturing requires precision machining, composite manufacturing capability, strict traceability systems, and globally benchmarked quality standards. Such capabilities cannot be built overnight.

"Our phased localization roadmap acknowledges that capability development is a journey," Subhakar notes. "We believe India has a strong engineering base and a growing advanced manufacturing sector."

The key is structured collaboration, skill development, and adherence to certification standards. Rather than assuming immediate readiness at scale, Flamingo Aerospace is approaching this through phased capability development aligned with the 2030 assembly objective. "If we execute our roadmap as planned, I would like Flamingo Aerospace to be recognized as a company that has positioned India as a regional assembly and lifecycle support hub for turbo-prop aircraft in the 60-70-seat category," he says.

Beyond aircraft, the real contribution would lie in ecosystem development—skill development, strengthening supplier networks, reducing import dependence, and integrating into the global aerospace value chain. "Aatmanirbhar Bharat is not about isolation," Subhakar concludes. "It is about building competitive capability. That is the journey we have embarked on."



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Source: IMTMA

POSITIONING INDIA'S MACHINE TOOL SECTOR ON THE GLOBAL MAP

IMTEX FORMING 2026, along with its concurrent shows Tooltech, Digital Manufacturing, and Weldexpo, concluded on a highly optimistic note, reinforcing its position as Asia's leading exhibition for metal forming and manufacturing technologies. Organized by Indian Machine Tool Manufacturers' Association, the five-day event was a vibrant showcase of the growing momentum of India's manufacturing sector.

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Held from January 21-25, 2026, at the Bangalore International Exhibition Centre (BIEC), IMTEX FORMING 2026 witnessed a significant expansion over its previous edition. Spanning 48,000 sq mt, the show brought together 714 exhibitors from 24 countries, including

country pavilions from Germany, Italy, Japan, and Taiwan. Parallel events: i2 Academia Pavilion featuring 32 colleges and around 70 participants from 24 cities; Manufacturing Technology Quiz Contest featuring around 50 participants from 11 colleges; and Jagruti-IMTMA Youth Programme, to encour-

age students to pursue a career in machine tool and manufacturing technology, also generated a good response. Around 1,200 delegates from 272 organizations visited the exhibition as trade delegations. Moldex India and Fastenex, organized by Messe Stuttgart, and the Symposium on Welding for



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Concurrent shows Tooltech, Digital Manufacturing, and Weldexpo, received positive responses from visitors. With digital manufacturing becoming an integral part of the forming and tooling industries, companies had much to offer at the Digital Manufacturing show.

a Greener Tomorrow, organized by the Indian Institute of Welding, were co-located with IMTEX FORMING 2026.

Setting the Right Tone

The event was inaugurated by Dr S Rajkumar, President - Engine Component Division, Rane (Madras) Ltd, and Tarun Mehta, Co-founder & CEO, Ather Energy in the presence of Jamshyd N Godrej, Chairman - Exhibitions, IMTMA; Mohini Kelkar, President, IMTMA; and Vikram Salunke, Vice President, IMTMA, and Jibak Dasgupta, Director General & CEO, IMTMA & BIEC.

Delivering the welcome address, Godrej pointed to the growing recognition of the Machine Tool industry by the Government of India through various schemes and the role of IMTEX in strengthening trade and industrial growth.

Commenting on India's global position, he added, "Our Ma-

chine Tool sector will need to import specific machine tools, but we also need to count on our machines being exported to other regions in Europe, USA and so on. As far as technological competence is concerned, we are now at par with other global machine tool manufacturers."

Reinforcing this outlook, Dasgupta said, "The Indian Machine Tool Manufacturing industry is growing at a rapid pace. Although all nations understand the need for manufacturing, hardly 20 countries maintain a separate Machine Tool sector. India sits in the top 10 in this list."

He added, "IMTEX creates a platform to harness our Machine Tool industry's capability and present the best and latest technology from abroad."

Speaking on the relevance of IMTEX for end users, Dr Rajkumar said, "We have been visiting IMTEX continuously and

consider it a stage to validate our technologies and source machines," he said.

Mehta emphasized the importance of advanced manufacturing, material innovation, and sustained R&D in strengthening India's manufacturing capabilities.

Kelkar highlighted the growth of the metal forming segment, noting its increasing share in the Indian machine tool market and its strong potential for future expansion. "The world is looking for Indian machine tools, and these machines have become an integral part of supply chains around the world. While it is true that we are importing several machine tools, we are also exporting machinery to other countries," she noted.

International Seminar on Forming Technology 2026

Held alongside IMTEX FORMING 2026, the 9th edition of the International Seminar on Forming Technology (ISFT) 2026 brought together around 210 delegates from across the manufacturing ecosystem, including production heads, plant managers, tooling specialists, and R&D professionals.

Powering India's Hi-Tech Manufacturing

IMTMA and the Society of Indian Defence Manufacturers (SIDM) jointly organized the 'IMTMA-SIDM CXO Round Table on Hi-Tech Manufacturing for Defence & Aerospace', during IMTEX FORMING 2026, bringing together senior leaders from the Defence industry, DPSUs, Tier-1 integrators, and machine tool manufacturers to discuss and align on key manufacturing requirements, capability expectations, and the future roadmap for collaboration. This initiative aimed to enable

IMTEX FORMING, Tooltech, Digital Manufacturing, & Weldexpo 2026: A Snapshot

- No. of participant countries: 24
- No. of exhibitors: 714
- No. of foreign exhibitors: 182 (around 25% of the total exhibitors)
- No. of visitors: 52,337
- No. of trade delegations across industry segments: 200
- Exhibition space: 48,000 sq mt
- Country pavilions: Germany, Italy, Japan, and Taiwan
- Enquiries: INR 5,973 crore (estimated 22% growth in enquiries compared to the previous edition)
- Orders: INR 589 crore (estimated 12% growth in orders compared to the previous edition)



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IMTMA reinforced its commitment to building industry-ready talent through a series of focused programs that provided students and academic institutions with direct exposure to industry practices, emerging technologies, and real-world applications.

co-development, pilot projects, and long-term supplier partnerships as well as support India's goals of self-reliance, cost competitiveness, and export readiness.

Awards & Accolades

IMTEX FORMING 2026 also celebrated excellence across the machine tool and manufacturing ecosystem, with IMTMA conferring a series of prestigious awards. The IMTMA-Cooper Award for Outstanding Supply Chain Unit, instituted in memory of Sir D. B. Cooper, was presented to Rajamane Industries Pvt Ltd.

The IMTMA-Premier Outstanding Entrepreneur Award, instituted in memory of Vinod Doshi, was conferred on TK Karuppannaswamy, Founder & Chairman of Barani Hydraulics India Pvt Ltd.

The IMTMA Best Design Award 2026 recognized excellence in indigenous product development. Electro Pneumatics and Hydraulics (India) Pvt Ltd was awarded for its rotary draw tube bender and ISGEC Heavy Engineering Ltd for its 3000T mechanical transfer press.

In the area of global outreach, the IMTMA Export Performance Award, instituted in memory of Shailesh R. Sheth, was awarded to Ace Designers Ltd (Metal Cutting), Barani Hydraulics India Pvt Ltd (Metal Forming), and Electronica Mechatronic Systems (India) Pvt Ltd (Accessories), underscoring their strong contribution to India's export growth.

Manufacturing Technology Quiz: The Manufacturing Technology Quiz Contest saw participation from 50 students representing 11 colleges, testing their knowledge across manufacturing processes, forging, industry terminology, and technical concepts. NMAM Institute of Technology, Udupi, emerged as the overall winner, followed by SSN College of Engineering, Chennai.



Source: IMTMA

i2 Academia Awards: The i2 Academia Awards recognized innovation-led research presented by participating institutions. IIT Tirupati won the top jury-decided i2 Academia Award, followed by KLS Gogte Institute of Technology, Belagavi, while SSN College of Engineering, Chennai, secured third place and also won the audience-voted Popular Choice Award.

Strong Footfall, Quality Engagement Signal Positive Industry Momentum

Industry participants at IMTEX FORMING 2026 described the edition as highly encouraging, citing strong visitor turnout, meaningful engagement, and a clear shift toward advanced manufacturing technologies. Davide Della Bella, General Manager, UCIMU - SISTEMI PER PRODURRE, called the show 'a great opportunity' for Italian machine tool builders to deepen their presence in India, adding, Harmeet Chawla, CEO & R&D Head, Singhal Power Presses Pvt Ltd, said the experience was overwhelmingly positive. "We received a strong footfall and meaningful engagement with a high-quality visitor profile," he noted.

Nishikant Ahire, Chairman & Managing Director, Ahire Machine Tools Pvt Ltd, noted that the exhibition enables companies to meet a wide cross-section of customers under one

roof, with consistently strong engagement across days.

A notable takeaway this year was the increase in both volume and seriousness of enquiries. Sunil Khosla, Managing Director, Hindustan Hydraulics Pvt Ltd, observed a 30-40 percent rise in footfall compared to the previous edition, alongside more focused customer discussions. Echoing this, Davide Andreoli, Senior Technical Sales Manager, Faccin Group, described the response as exceptionally strong, with continuous customer interactions throughout the show.

Participants also highlighted a clear technology shift, with automation, AI, and robotics taking center stage. Sameer Kelkar, CEO, Grind Master Machines Pvt Ltd, pointed to the growing presence of AI- and machine learning-based solutions, alongside increased automation in material handling and production processes, while also noting the need for further development of core technologies in India.

Marking its debut, Kawasaki Robotics India Pvt Ltd underscored the expanding adoption of industrial robotics beyond automotive applications into broader manufacturing sectors.

Overall, participants viewed IMTEX FORMING 2026 as a barometer of India's manufacturing momentum—reinforcing the exhibition's role as a platform for complete manufacturing ecosystems rather than stand-alone technologies. 



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ISFT 2026: USHERING IN CUTTING-EDGE FORMING TECHNOLOGIES

International Seminar on Forming Technology 2026, organized by Indian Machine Tool Manufacturers' Association (IMTMA), held from January 22-23 2026, at Bangalore International Exhibition Centre (BIEC), Bengaluru, concluded successfully, bringing together manufacturing industry leaders, technology providers, academia, and policymakers to deliberate upon the future of sheet metal forming and smart manufacturing.



Source: Magic Wand Media

Held in conjunction with IMTEX FORMING 2026, the 9th edition of the International Seminar on Forming Technologies (ISFT) 2026, garnered significant interest from the industry, with around 210 delegates participating in the event. The attendees included manufacturing and production heads, plant managers, tooling and die professionals, design and R&D specialists, and experts in quality, metrology, and process improvement.

Emphasizing Advanced Forming

The seminar was inaugurated by FR Singhvi, Joint Managing Director, Sansera Engineering Ltd; Dr Karthik Krishnamurthy, Di-

rector-Operations & COO, Mahindra Aerostructures Pvt Ltd; and Ingrid Rasquinha, Joint Managing Director, Electro Pneumatics & Hydraulics (India) Pvt Ltd. Vikram Salunke, Vice President, IMTMA, and Guru Prasath KR, Executive Director, IMTMA, shared the dais. Delivering his keynote address, 'Innovation, Collaboration, and Skill - The Trifecta for India's Manufacturing Future', Singhvi stressed that transformation doesn't happen by accident but through innovation, collaboration, and skill.

Dr Krishnamurthy, in his keynote address, 'Building momentum and driving competitiveness in the global aerospace industry', highlighted the evolving global aerospace landscape

and India's growing capabilities in advanced manufacturing. He cited projections such as 500 million air travellers by 2030, a fivefold increase in airports by 2047, a CAGR of 6.8 percent between 2024 and 2032, and India's potential emergence as the world's largest aviation market. "We have moved the needle from being a low-cost source to a best-cost source," he noted. Rasquinha in her opening address, 'IMTMA INITIATIVE ISFT 2026 Focuses on Advanced Forming and Digital Manufacturing', highlighted the importance of large-scale platforms such as ISFT in fostering collaboration across the manufacturing ecosystem. "This edition of ISFT has been designed to reflect the

transformative challenges shaping modern manufacturing processes," she said.

She also spoke about the growing need for closer collaboration between industry and technology providers to keep pace with rapid advancements in manufacturing.

Forming Processes and Industrial Applications

Over two days, the seminar featured two keynote sessions, 12 technical presentations, and a high-level panel discussion addressing the most disruptive trends in metal forming.

The seminar opened with a strong focus on core forming processes, featuring presentations from key industry players. Electro Pneumatics (India) Pvt Ltd presented on tube hydro-forming of next-generation automotive exhaust parts, highlighting advancements in forming complex geometries for lightweight and high-performance automotive applications.

From the forging perspective, FICEP discussed high-performance presses for aerospace and defence applications, focusing on initiatives to reduce weight and material scrap through cell-based work configurations, thereby improving efficiency and material utilization. Material innovation emerged as a critical area. JBM Group shared insights on ultra-high strength steel (UHSS ~1180 MPa) sheet metal parts development strategies, focusing on the challenges of forming high-strength materials.

AP&T provided perspectives on the evolution of press hardening technologies and their growing relevance. Fronius India addressed joining dissimilar metals, demonstrating how advanced welding solutions are enabling the integration of mixed materials in modern manufacturing.

Future-Ready Forming Technologies

RV Machine Tools highlighted friction-assisted forming technologies, which enhance formability, reduce energy consumption, and enable innovative part designs for both production and research applications.

Digitalization and Intelligent Manufacturing

The seminar also underscored the growing convergence of digital technologies with forming processes.

IIT Bombay presented on agentic digital twins, demonstrating how multiple AI-driven systems can work together to optimize and streamline forming operations. YASKAWA India discussed automation and robotics for press lines, highlighting how advanced robotic systems are enhancing productivity, precision, and operational efficiency. Automation is playing an increasingly important role in streamlining material handling, reducing cycle times, and enabling consistent, high-quality production.

Additive Manufacturing in Aerospace

Objectify Technologies presented on the current implementation of additive manufacturing in the Indian aerospace sector, emphasizing its growing adoption for complex, high-performance components and the importance of meeting stringent qualification standards.

Engineering Intelligence and Tooling

Voestalpine High Performance Metals India discussed engineering intelligence in forming, highlighting how optimized tool material selection and PVD coatings can reduce friction, enhance tool life, and enable efficient forming of high-tensile materials with minimal lubrication.

Advanced Materials for Automotive Applications

Hindalco Industries presented on high-strength aluminium (7000 series) sheet metal, outlining demand drivers, manufacturing challenges, and the roadmap for indigenous production—particularly significant for the automotive sector's lightweighting goals.

Energy Efficiency in Metal Forming

The seminar also had its focus on sustainability, with ISGEC Heavy Engineering presenting on improving energy efficiency in metal forming through advanced press design and automation, highlighting approaches to reduce energy consumption while enhancing productivity.

On the Role of Advanced Forming Technologies

ISFT 2026 also featured a panel discussion on 'Driving India's Manufacturing Competitiveness: Role of Advanced Forming Technologies in the Era of Smart Manufacturing'. The session brought together leading voices from across the manufacturing ecosystem, who shared perspectives on emerging industry challenges and the strategies required to address them.

Learning Beyond the Seminar

A key highlight for delegates was an exclusive access to IMTEX FORMING 2026, held from January 21-25, 2026. This allowed participants to witness live demonstrations of machinery and technologies discussed during the seminar, bridging the gap between theory and practice. ISFT 2026 reinforced IMTMA's role as a catalyst for industry growth, combining strategic insight, technical depth, and real-world exposure. 

The premier Forming Technology seminar featured presentations, keynotes, and a panel discussion focused on innovation and aerospace, uniting industry leaders to explore digitalization, additive manufacturing, advanced materials, and critical industrial energy efficiency.

ADVANCING CYLINDRICAL GRINDING

Woven around the theme ‘Swiss Made’, Fritz Studer AG held this year’s Motion Meeting in Steffisburg, Switzerland. Detailing how the company successfully strengthened its market position and expanded its innovative portfolio. Driven by a robust year-end performance, it achieved a high proportion of new customers, reaching 44 percent of total machine orders.

At the annual press conference, Sandro Bottazzo, CEO, Fritz Studer AG, emphasized that while 2025 was marked by challenging markets and geopolitical uncertainties, the company exceeded expectations and emerged from this phase stronger than ever, due to a powerful year-end performance. North America and Asia stood out as major revenue spinners. This commercial resilience was bolstered by the aerospace segment, which closed as the company’s largest single market for the first time, representing nearly a third of all orders. He shared that the company’s broad portfolio remains a pillar of success across universal cylindrical grinding applications. The best-selling machine was the S33, followed by the S31 and the S41. Both external machines and machines for internal cylindrical grinding also performed well. The S141 even achieved one of the best sales results of the last ten years.

Regarding STUDER’s fiscal momentum, Bottazzo elaborated that although overall turnover finished marginally behind the prior year’s figures, the results surpassed internal projections. He highlighted a record-breaking year for the service sector, stating, “Thanks to our global, customer-focused service organization, we were able to set new



Fritz Studer AG facility in Steffisburg, Switzerland

sales records in the service and maintenance business areas”. Currently, over 70 percent of the active installed base is covered by a maintenance contract.

Operational and Digital Evolution

With the acquisition of GF

Machining Solutions by the United Grinding Group, which now operates under the name, United Machining Solutions, the group is one of the largest machine tool manufacturers in the world. As part of the acquisition, the Studer Competence Center for internal cylindrical



Source: Fritz Studer AG

L-R: Stephan Stoll, COO; Sandro Bottazzo, CEO; and Daniel Huber, CTO from Fritz Studer AG

grinding moved to the modern premises of United Machining in Biel, Switzerland. Adding to this, Stephan Stoll, COO, Fritz Studer AG, stressed, “In 2025, we took our production and logistics processes to a new level”. The new fully automated small parts warehouse with 32 autonomous robots and 16,000 containers is consequently increasing efficiency for both machine and spare parts logistics. Additionally, the company made progress in digitalization on the way to becoming a paperless factory.

Introducing the past year’s technical milestones, Daniel Huber, CTO, Fritz Studer AG, cited the world premiere of the S23 universal cylindrical grinding machine as a primary highlight as the machine received a highly positive market response. Huber mentioned that customers also benefit from a new axis system for the S31 and S33, which allows automatic adjustment to different workpiece lengths. On a concluding note, Huber shared, “The year also brought important new digital features like the C.O.R.E. Release 5.0, which enables access to Transaction Network’s

manufacturer-independent customer portal directly from the machine operating panel and visualizes live status updates of the machine park, among other things.”

Engineering Philosophy of 50 Years of Granitan®

A central theme of the company’s consistent precision is the 50th anniversary of its proprietary mineral casting material, Granitan®. This material remains the bedrock of STUDER’s technological advantage. Granitan® is cast at room temperature. The material’s primary advantage is its vibration damping, which is 15 times better than gray cast iron. The contact surfaces between the rock grains and the binder matrix efficiently destroy the vibration energy, preventing surface marks on workpieces. Five decades after its market launch, Granitan® has become synonymous with a stable machine base that continues to set standards in the industry today. In view of the growing demands for precision, sustainability, and flexibility, it remains an indispensable basis in machining, whether for

machine tools, aerospace, electronics, or medical technology. In this context, Rolf Grossenbacher, Sales Director, Far East, Fritz Studer, pointing to the material as a strategic asset, stated, “Granitan® is more than just a material; it is a technology kit and a platform for future innovations”. He shared that the material would continue to help customers perform grinding at the cutting edge of technological feasibility. Going forward, the company plans to utilize the cold casting process to integrate sensor technology and electronics directly into the machine base.

Roadmap for 2026

Fritz Studer AG enters 2026 with a positive economic outlook, expecting a further increase in demand. On this optimistic note, Bottazzo concluded that the company will continue to invest in innovation, infrastructure, and workforce, supported by an apprentice program that accounts for 10 percent of their staff. This blend of 114 years of tradition and 50 years of Granitan® innovation ensures STUDER remains a global leader in precision. 

A central theme of the company’s consistent precision is the 50th anniversary of its proprietary mineral casting material, Granitan®. This material remains the bedrock of STUDER’s technological advantage.

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PRECISION MEETS PURPOSE

Organized by Korea Machine Tool Manufacturers' Association (KOMMA), SIMTOS 2026 (Seoul International Manufacturing Technology Show) will take place from April 13-17, 2026, at KINTEX Exhibition Halls 1 and 2 in Goyang, Korea. Held under the theme 'AI Autonomous Manufacturing Meets Talent', the event will showcase robotics, automation, AI, digital twins, and smart factory technologies.

Hailed as Korea's largest manufacturing technology exhibition, SIMTOS has built a four-decade legacy since its inaugural edition in 1984. The event has grown into a central industry hub where global manufacturers, buyers, industry experts, and policy stakeholders gather to exchange insights, explore advanced tech-

nologies, and develop meaningful business connections. In its 21st edition, SIMTOS is expected to host more than 1,300 exhibitors from 35 countries, occupying nearly 6,000 booths. Over the five-day exhibition period, the show is projected to attract around 100,000 visitors, including over 5,000 overseas buyers, re-

inforcing its position as one of Asia's most influential manufacturing business platforms.

Specialized Technology Pavilions

SIMTOS 2026 is organized into five specialized, product-focused pavilions, encompassing the entire manufacturing value chain right from

upstream materials to downstream processing, alongside a special exhibition on robotics and digital manufacturing, M.A.D.E. in SIMTOS.

A defining strength of the event is its ability to present a comprehensive end-to-end view of manufacturing technologies within a single exhibition, allowing visitors to compare, evaluate, and validate solutions across materials, machining, assembly, quality control, automation, and digital transformation.

Mold Technology Pavilion — Positioned at the core of precision manufacturing, this Pavilion will feature intelligent, smart, and hybrid cutting and mold-making equipment together with advanced metalworking solutions.

Materials, Components & Control Technology Pavilion — Focused on core components and control technologies, this pavilion presents solutions essential to the performance and reliability of machine tools and automation systems.

Tooling & Measurement Technology Pavilion — Dedicated to process optimization and quality innovation, this pavilion brings together cutting tools and metrology technologies that support stable and efficient production.

Cutting & Welding Technology Pavilion — This pavilion is centered on advanced fabrication and joining processes supporting modern manufacturing operations, presenting innovations in smart sheet-metal processing and automated welding solutions.

Press & Forming Technology Pavilion — Addressing both mass production and high-precision forming requirements, this pavilion is slated to offer a comprehensive view of contemporary press and forming manufacturing capabilities.

M.A.D.E. in SIMTOS

A major highlight of SIMTOS 2026 will be M.A.D.E. in SIMTOS (Manufacturing Automation & Digital Engineering), a future-oriented platform bringing together smart manufacturing technologies shaping next-generation production paradigms. Launched in 2024, it returns with expanded scale and enriched content, located in Halls 7 and 8 of KINTEX Exhibition Center 2. Through application-focused demonstrations, it will showcase technologies such as AI-based process control, digital twins, IIoT, cloud & edge computing, smart logistics, 3D printing, engineering software, MES, CPS, machine learning, deep learning, and digital energy management systems. Theme zones such as the 3D Printing Pavilion and Die Casting Pavilion will feature real-world implementation cases of digital manufacturing technologies currently applied across industrial sites. Moving beyond conventional automation, visitors will be able to explore the future of AI-driven autonomous manufacturing, where production systems can independently make decisions and optimize processes.

Korea: A Strategic Hub

Korea is widely recognized as a global manufacturing powerhouse, with advanced industries spanning semiconductors, displays, batteries, shipbuilding, automotive, aerospace, and defence. This industrial landscape provides an ideal testbed for global manufacturers to validate technological performance and quality competitiveness under demanding production environments. SIMTOS, therefore, serves not only as a technology showcase but also as a strategic gateway for global manufacturers seek-

ing to enter and expand in the Korean market.

The exhibition will also host the Global Digital Manufacturing Innovation Conference, where industry leaders and experts will convene to share insights into global manufacturing developments, AI-driven smart factory strategies, and practical cases of industrial digital transformation. Additional initiatives such as Career Connect and the Women Engineers Network Forum further strengthen its role as a comprehensive industrial ecosystem.

Industry Networking

Held in Korea—the strategic hub connecting China, Japan, and Southeast Asia within the Asian manufacturing belt—SIMTOS offers a strong platform for international business networking. SIMTOS's proprietary business matching program Matchmaking4U (MM4U) facilitates targeted business connections between exhibitors and buyers by sharing product interests and technical requirements in advance. Tailored one-on-one meetings enable in-depth consultations and support tangible business outcomes.

In addition, the Overseas Buyer Invitation Program provides support for airfare and accommodation to qualified overseas buyers with strong purchasing authority, including existing overseas clients invited by exhibitors. These initiatives help exhibitors expand global networks while enabling buyers to explore concrete market opportunities in Korea.

As manufacturing continues to evolve toward AI-driven autonomous production, SIMTOS 2026 offers global companies a practical reference for understanding industry direction, emerging technologies, and new business opportunities. 

SIMTOS 2026 will feature five specialized pavilions plus M.A.D.E. platform showcasing robotics, AI, and smart manufacturing. It is slated to host around 1,300 exhibitors and attract nearly 100,000 visitors.

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Source: KOMMA



INNOVATION TAKES CENTER STAGE AT DIE & MOULD INDIA 2026

The 14th DIE & MOULD INDIA International Exhibition will witness participation from key industry players such as STM, AceMicromatic Group, Mastercam, LMW, Renishaw, and Jyoti CNC Automation. Taking place from April 21–24, 2026, at the Bombay Exhibition Centre, Mumbai, the event will serve as a platform for these companies to present cutting-edge solutions in die and mold manufacturing, reinforcing the sector's shift toward high-precision, digitally enabled production.

AceMicromatic Group | www.acemicromatic.net | Hall & Stall: 6/C-01

VERTICAL MACHINING CENTERS

AMG'S 740G-30 GRAPHITE MACHINING CENTER

The 740G-30 is a specialized Vertical Machining Center from the ADL-MCD G-Series, engineered specifically to handle the unique challenges of graphite and non-metal applications. While standard CNC machines often struggle with the abrasive and invasive nature of graphite dust, the 740G-30 is built with specialized protection systems to ensure both high productivity and long-term machine reliability.

Key Performance Specifications

The 740G-30 offers a balanced work envelope and high-speed capabilities tailored for precision electrode manufacturing and aerospace components. The machine features a work envelope with 760 X 425 X 460 mm travel (X/Y/Z) and a table size of 900 X 400 mm. It is equipped with a BBT-30 direct drive spindle that offers a standard speed of 10,000 rpm, with optional upgrades available up to 20,000 rpm. The machine delivers a positioning accuracy of 0.010 mm and repeatability of ± 0.003 mm, as per ISO 230-2 standards. It is capable of rapid traverse rates of 24/24/24 m/min and cutting feed rates of up to 20,000 mm/min.

Specialized Graphite Protection & Features

To combat the ingress of fine graphite powder, the 740G-30 includes several dedicated "Graphite-Ready" features. The machine incorporates dust protection features such as a spindle air curtain, special double-protection telescopic covers, and specialized LM guideways and ball screws designed to withstand graphite powder. For efficient tool management, it is equipped with a 20-tool Twin Arm ATC featuring a magazine isolation door that prevents dust contamination of the tool holders.

For wet machining applications, the unit utilizes a Compact Paper Band Filtration System (CPBF) along with a multi-stage coolant tank. The machine can be configured for wet, dry, or hybrid machining modes depending on specific process requirements.

Versatile Applications

Beyond graphite EDM electrodes, the 740G-30 is an ideal solution for machining a wide range of advanced materials, including ceramics, silicon carbide, carbon and glass fiber, and composite materials. It is well-suited for industries such as battery cell manufacturing, nuclear reactor components, furnace parts, and defence equipment. The machine also supports advanced geometries, including 4th- and 5th-axis applications, through optional rotary and tilting tables.



Mastercam India
www.mastercamindia.com
Hall & Stall: 2/H-21



CAM PLATFORMS

MASTERCAM EVERPATH TECHNOLOGY: A NEW ERA IN CAM PROGRAMMING

Mastercam's newly introduced EverPath Technology represents a fundamental rethinking of how CNC toolpaths are created, edited, and validated. Rather than evolving incrementally, EverPath has been built from the ground up as a next-generation CAM platform designed to simplify complexity while enhancing control. At its core, EverPath addresses long-standing challenges in manufacturing—rising part complexity, shrinking lead times, and a widening gap between experienced programmers and new talent. Traditional CAM systems often require users to navigate different interfaces for each toolpath type, leading to inefficiencies and extended training cycles. EverPath eliminates this fragmentation through a unified, color-coded workflow that remains consistent across 2D, 3D, and multi-axis strategies. One of the defining aspects of EverPath is its 'automatic-first, but not automatic-only' philosophy. Routine decisions such as cutting parameters and linking moves are intelligently handled by the system, allowing programmers to focus on higher-value decisions. At the same time, complete transparency ensures that experienced users retain full control to refine and optimize toolpaths based on their expertise. The platform also introduces real-time toolpath regeneration, eliminating the traditional cycle of edit-rebuild-validate. Programmers can instantly see the impact of changes, enabling faster iteration and more confident decision-making. Combined with seamless transitions between 3- and 5-axis workflows and a built-in user assistance system, EverPath significantly reduces cognitive load while improving productivity and consistency.

Renishaw Metrology Systems India Ltd
www.renishaw.com
Hall & Stall: 2/H-16

MACHINE TOOL PROBING & TOOL SETTING SOLUTIONS

RENISHAW ENABLES SIMPLE AUTOMATION WITH MACHINE TOOL PROBING

In manufacturing, productivity losses rarely occur at the cutter; they arise when issues are detected at the end of the process. Long machining cycles, multiple setups, and fluctuating shop floor temperatures can turn minor variations into late-stage defects, rework, and missed delivery timelines. The practical solution lies in moving alignment, measurement, and correction onto the CNC machine, ensuring that quality is controlled during machining rather than inspected afterward. This is the core objective of Renishaw's machine tool probing (MTP) and tool setting solutions.

Across Indian toolrooms—ranging from large captive facilities to smaller contract toolrooms—the operational challenges remain the same: dependency on skilled operators, thermal drift over extended machining periods, and the cost implications of unloading heavy dies only to identify setup or wear-related issues.

On-machine probes such as the RMP600 and OMP400 automate die alignment, establish accurate work offsets, and verify critical features during machining. Integrated compensation routines further manage temperature variations in real time. When paired with tool setting systems such as the NC4, which monitor tool length, diameter, runout, and wear, cutting conditions remain stable from roughing to finish. The result is straightforward: fewer cuts, shorter try outs, and predictable deliveries without adding operational complexity.

It is also important to address a common misconception: automation need not be complex, expensive, or disruptive. Simple automation is about a disciplined process control loop—Measure, Verify, and Correct—implemented directly on the machine. While coordinate measuring machines (CMMs) continue to play a role, their function shifts from defect detection to validation. This shift turns long-cycle, complex machining processes into first-time-right outcomes, enhancing delivery reliability.



Jyoti CNC Automation Ltd | www.jyoti.co.in | Hall & Stall: 6/B-03

5-AXIS MACHINING CENTERS

GU5 FIVE: HIGH-PERFORMANCE 5-AXIS GANTRY MACHINING CENTER

The GU5 FIVE is a gantry-moving 5-axis machining center engineered by Huron Graffenstaden, a brand known for its precision engineering capabilities for designing high accuracy and high-speed 5-axis machines that cater to defence, aerospace, automotive, healthcare, and other precision machining sectors.

In today's manufacturing environment, machinists demand machines that offer superior dynamics along with accuracy and reliability in the 5-axis machining segment. The GU series provides an optimal balance of advanced technology and return on investment, enabling the efficient handling of complex machining tasks with precision and versatility. Its gantry-moving structure ensures a combination of stability and high dynamic performance.

This gantry-type 5-axis machine offers stability, precision, versatility, and efficiency, making it suitable for demanding applications across multiple industries. It is designed with special attention to ease of access for preventive maintenance, including lubrication, pneumatics, and proximity systems, thereby enhancing operator convenience.

The electro spindle combines speed, torque, and power to achieve high chip removal rates, improving productivity while maintaining high accuracy. The cradle-type rotary tilting table offers indexing accuracy of up to 0.001°. A mill-turn table is available as an optional feature to suit specific application requirements. Additionally, the specially designed pick-up type ATC with a 40-tool capacity enables faster tool changes, with a tool-to-tool change time of just 3 seconds.



LMW Ltd | www.lmwcnc.com | Hall & Stall: 6/A-02

COMPACT TURNMILL CENTERS

LMW'S S TURN 2M FOR VERSATILE MACHINING

The S Turn 2M Turnmill Center is a versatile machining solution, offering a maximum turning length of 400 mm, a turning diameter of 320 mm, and a chuck size of 200 mm. It is equipped with a 12-station live tool turret, delivering a rotary tool speed of up to 6,000 rpm and a rapid tool change time of 0.7 seconds.

The machine is well-suited for a wide range of industries, including automotive, electronics, aerospace, energy, and pump and valve manufacturing.



S&T Machinery Pvt Ltd
www.stmcnc.com
Hall & Stall: 6/A-06

DOUBLE COLUMN MACHINING CENTERS

STM HIGH-RIGIDITY SOLUTIONS FOR LARGE-SCALE TOOLING

As industries such as automotive, white goods, large television panels, and composite manufacturing move toward larger and more complex products, the demand for large-format mold and die manufacturing continues to grow. To address this need, STM offers a comprehensive range of double column machining centers designed for high-precision machining of large tooling and structural components, with machine capacities ranging from 2 m to 12 m in bed length. These machines are equipped with angular head spindle configurations, enabling flexible multi-surface machining for complex tooling applications.

The STM double column platform is engineered with high structural rigidity, a wide-span column design, and a thermally stable machine architecture, ensuring consistent machining accuracy even during extended cycles. These machines are particularly suited for large automotive molds, compression molds, RTM tooling, and heavy die applications, where dimensional stability and surface quality are critical.

With advanced motion control, high-torque spindle options, and optimized cutting dynamics, STM double column machining centers enable Indian manufacturers to produce large-scale, high-precision tooling aligned with global engineering standards for the Indian shop floor.



UCAM Pvt Ltd
www.ucamind.com
Hall & Stall: 3/K-05



CNC TILTING ROTARY TABLES

UCAM USSR 200Q TN FOR MULTI-AXIS MACHINING

The USSR-250q TN is a compact and lightweight CNC tilting table designed for multi-axis machining. It features a robust tilt axis that ensures stable performance, allows for easy installation, and supports both pneumatic and hydraulic clamping. The table is supplied ready to fit with a rotary union, enabling seamless fluid integration. Ideal for precision die and mold as well as complex part machining, it delivers high accuracy, reliability, and enhanced operational flexibility.



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Company Index

Ace Designers Ltd-Machining Center Division-AceMicromatic Group	28, 58, 70	Objectify Technologies	64
Ahire Machine Tools Pvt Ltd	58	OPEN MIND	50
AP&T	64	Mahindra Aerostructures Pvt Ltd	64
Barani Hydraulics India Pvt Ltd	38, 58	Manleo Designs Pvt Ltd	28
Electronica Mechatronic Systems India Pvt Ltd	48, 58	Mastercam India	28, 70
Electro Pneumatics & Hydraulics (India) Pvt Ltd (EPHL)	44, 58, 64	Messe Stuttgart	58
Faccin Group	58	NN Combined Engineering Agencies Pvt Ltd	26, 50
FICEP	64	Rajamane Industries Pvt Ltd	42, 58
Flamingo Aerospace	54	Renishaw Metrology Systems India Ltd	28, 70
Fritz Studer AG	66	RV Forms & Gears	22
Fronius India	64	RV Machine Tools	64
Grind Master Machines Pvt Ltd	58	S&T Machinery Pvt Ltd	28, 70
Hindalco Industries	64	Sansera Engineering Ltd	64
Hindustan Hydraulics Pvt Ltd	58	SCHUNK	50
IIT Bombay	64	Singhal Power Presses Pvt Ltd	58
IMTMA	8, 10, 14, 16, 38, 42, 44, 48, 58, 64	The Association of Indian Forging Industry (AIFI)	34
Isgec Heavy Engineering Ltd	18, 58, 64	The Society of Indian Defence Manufacturers (SIDM)	58
JBM Group	64	UCAM Pvt Ltd	28
Jyoti CNC Automation Ltd	28, 70	UCIMU – SISTEMI PER PRODURRE	58
Kawasaki Robotics India Pvt Ltd	58	Voestalpine High Performance Metals India	64
Korea Machine Tool Manufacturers' Association (KOMMA)	68	YASKAWA India	64
LMW Ltd	28, 70		

Advertiser Index

AceMicromatic Group – Ace Designers Ltd – Machining Center Division – www.acemicromatic.net	09
Addison & Co., Ltd – www.addison.co.in	41
CHIRON India Machine Tools Pvt Ltd - www.chiron-group.com	27
Eplan Software Pvt Ltd - www.eplan.in	11
HIMTEX 2026 - www.himtex.in	47
IMTMA – FACTEQ 2026 - www.facteq.in	61
IMTMA – IMTEX 2027 - www.imtex.in	63
IMTMA – PMTX 2026 - www.mtx.co.in	59
IMTMA Reference Book for Indian Machine Tool Industry - www.imtma.in	15
Jyoti CNC Automation Ltd - www.jyoti.co.in / www.huron.fr	05
LMW Ltd - Machine Tool Division - www.lmwnc.com	02
MARPOSS INDIA Pvt Ltd - www.marposs.com	25
MF India 2026 – www.mfindia.net	04
Mitsubishi Materials India Pvt Ltd - www.mitsubishicarbide.com	19
MOLDINO Tool Engineering Ltd - Mitsubishi Materials India Pvt Ltd - www.moldino.com/en	21
NN Combined Engineering Agencies Pvt Ltd - www.nncea.com	76
Rajamane Industries Pvt Ltd - www.rajamane.com	12
Royal Precision Tools Corporation - www.royal-spindles.com	57
RV Forms & Gears LLP - www.rvformsandgears.com	75
Tien Ding Industrial Co., Ltd - www.tdcover.com	07
WIDIA – Kennametal India Ltd - www.widia.com	13
Yamazaki Mazak India Pvt Ltd - www.mazakindia.in	01



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74 | March-April 2026

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