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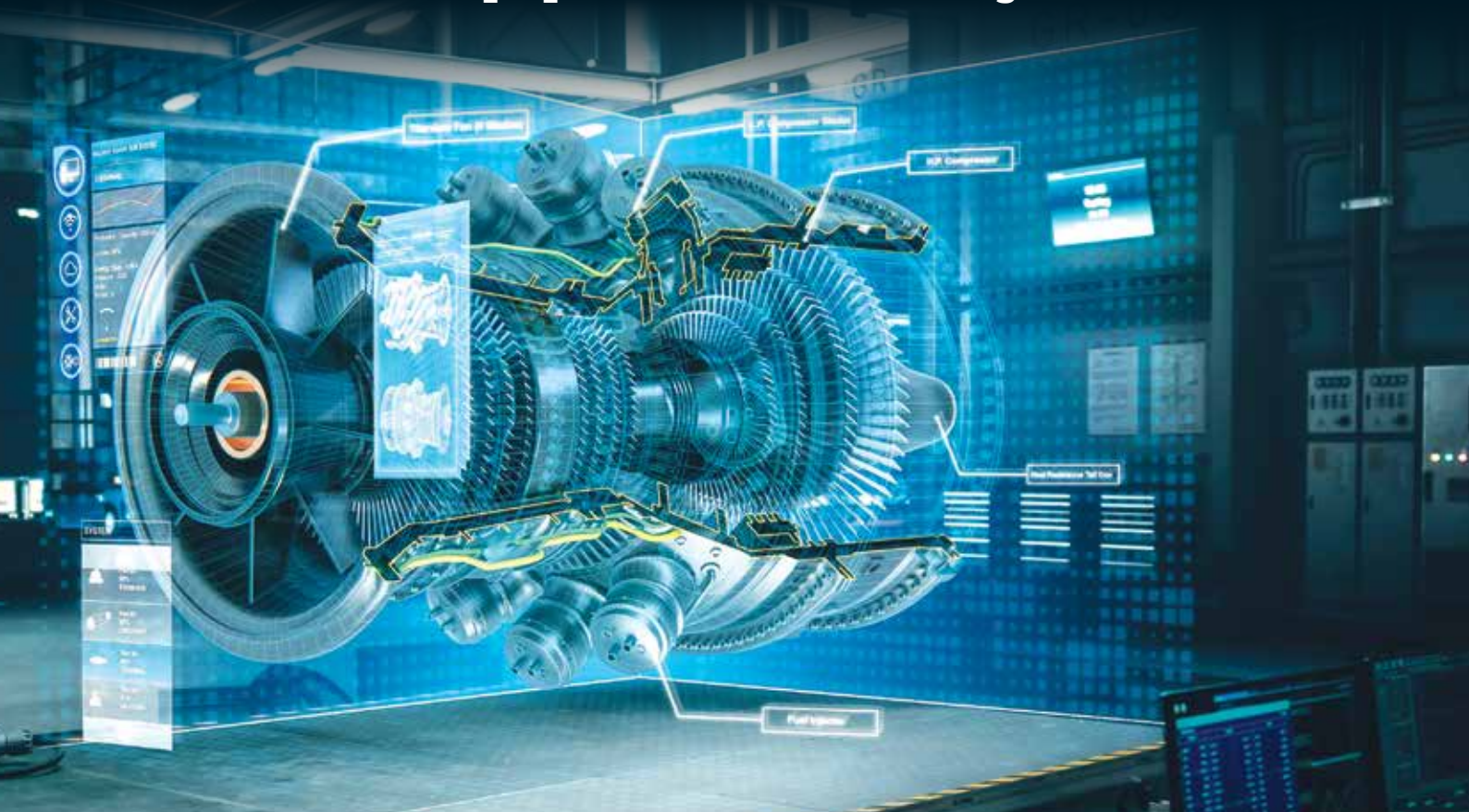
Simulation-driven Hybrid Digital Twin

for Industrial Equipment Manufacturing



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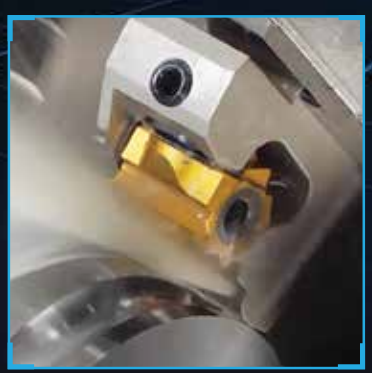

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"Increasing employment opportunities"

Sanjay Jadhav
Assistant Editor, sanjay.jadhav@pi-india.in

Unlocking Potential: Towards stability and growth

The recent few weeks have witnessed a flurry of updates as many companies announced/ inaugurated their manufacturing plants across the length and breadth of the country. This brings some positive news as the workforce across many sectors stands a chance for increased employment opportunities.

According to a recent Deloitte report, the pace of mergers and acquisitions in India is anticipated to maintain its stability throughout 2024 and beyond.

The manufacturing industry, particularly propelled by the automotive sector, is poised to drive merger and acquisition activities, with an anticipated increase in deals within Auto Components and Electric Vehicles (EV) sectors.

The topic for this edition's Cover Story is Simulation-driven Hybrid Digital Twins for Industrial Equipment Manufacturing. Discover how these twins transform design, operation, and maintenance through real-time data and simulation, revolutionising the industry with insights and efficiency, while reducing downtime.

The Industry Focus revolves around the topic of Aerospace Engineering. At the same time, the Technology Focus articles are centred around topics which include Lighter and Stronger Materials for Greener Aircrafts and Robotics & Industrial Automation.

Meanwhile, the Special Feature delves into Supply Chain Disruptions in the Aviation and Defence Industry. Efficient Manufacturing remains dedicated to sharing progressive ideas that empower manufacturing enterprises.

As we navigate towards a future where sustainable development is paramount, we invite you to explore the pioneering strides manufacturing is taking towards a greener and more efficient tomorrow. □

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CONTENTS

43
SPECIAL FEATURE
Navigating Supply Chain Disruptions in India's Aviation and Defence

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SPECIAL FEATURE

NEW PRODUCTS

Columns

Sanjay Jadhav
Assistant Editor, EM

India's Aerospace Industry braces for opportunities and challenges

India's aerospace sector is currently witnessing an extraordinary surge, driven by escalating demand for both commercial and defence aircrafts. This rapid growth trajectory is reshaping the landscape of aerostructures, presenting a plethora of prospects for proficient individuals.

Talk

"Navigating the Soaring Skies"

Aerospace Expansion

The Indian government's substantial investments in military modernisation, particularly in the air force, are creating avenues in defence aircraft manufacturing, maintenance, and upgrades. This strategic focus amplifies the need for a skilled workforce adept at cutting-edge technologies.

Embracing Sustainability

With a heightened emphasis on eco-friendly solutions, there is a burgeoning requirement for professionals specialising in lightweight materials and fuel-efficient designs. This shift towards sustainability underscores the industry's commitment to environmental stewardship and innovation.

Seizing the Future

The Indian aerospace market stands on the brink of an extraordinary journey, promising an exhilarating future for aerostructures. By embracing these transformative changes and prioritising skill enhancement, both individuals and organisations can actively participate in and benefit from this monumental era.

Supply Chain Dynamics

Concurrently, the aerospace and defence supply chain ecosystem is undergoing unprecedented disruption. The resurgence of air travel post-pandemic, expected to escalate by 30 percent over the next five years, coupled with advancements in Sustainable Aviation Fuel (SAF) and NextGen Materials, is propelling demand for new aircrafts. This surge, combined with the retirement of decades-old aircrafts, has resulted in substantial order backlogs, prompting global OEMs to ramp up production capacities by over 70 percent in the next three years. In summary, as India's aerospace industry ascends to new heights, opportunities abound for those prepared to navigate the evolving landscape, while challenges present themselves in the form of supply chain disruptions and heightened demand. Embracing sustainability and innovation will be key to ensuring a prosperous future in this dynamic field. ☐

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Honeywell India partners with IISC to Fund Deep Science Startups

Honeywell Hometown Solutions India Foundation (HHSIF), the philanthropic arm of Honeywell, in partnership with the Foundation for Science, Innovation, and Development (FSID) and the Indian Institute of Science (IISc), renowned for its cutting-edge deep sciences research, has extended research and financial support to 37 Indian start-ups, extending capital worth ₹9 crores over the last four years. With an intensive focus on agri-tech, clean-tech, health-tech, and green-tech, Honeywell has extended funding worth ₹2.4 crores in FY23–24 to eight start-ups and 5 entrepreneurship-in-residence programmes (EIRs), and further plans to onboard ten new start-ups in the current fiscal. Ashish Modi, President, Honeywell India, said, "Honeywell has been at the forefront of automation, digitisation, and sustainability for many decades. Our long-standing partnership with IISc is a testament to our commitment to bolstering local innovation and empowering emerging businesses in India. Our core focus is not just to extend financial support but also to encourage deep science/tech research that fuels the innovative prowess of these businesses."

Remsons Industries forms JV with Aircom Group

Remsons Industries, has entered into a joint venture with Aircom Group AG, Switzerland, to form a company, namely Aircom Remsons Automotive (ARAPL). ARAPL would be engaged in the business of manufacturing and selling tyre mobility kits (new-age puncture kits) and their components. This move will increase the total share of Remsons in the overall products supplied to OEMs. ARAPL would focus on eventually launching these products as B2C products for consumers. These products will go a long way in replacing spare tyres currently provided with almost all cars. Some of the luxury car OEMs have done away with spare tyres and have started providing tyre mobility kits for convenience and a lighter vehicle, which will improve the mileage. Commenting on the development, Rahul Kejriwal, Executive Director, said, "We are aiming to gain a sizable market share in the tyre mobility segment, which includes tyre repair kits and related products, sealants, air compressors, plugs, and other products aimed at repairing and preventing punctures."

TRUMPF cooperates with High-Performance Computing Center Stuttgart

TRUMPF recently signed a co-operation agreement with the High-Performance Computing Center Stuttgart (HLRS) of the University of Stuttgart. The aim of the agreement is to provide TRUMPF employees with the extensive computing capacities of the HLRS. Berthold Schmidt, CTO, TRUMPF said, "This co-operation shows that we in industrial Germany also have a powerful digital ecosystem. With the help of these mainframes, our developers can virtually simulate machine functions even before the prototype is built and train AI solutions for our systems more quickly. This allows us to innovate more sustainably and efficiently," The 'Hawk' supercomputer provided by HLRS has a peak performance of 26 petaflops, which corresponds to 1,000,000 billion computing operations per second. It is one of Europe's most powerful computers for industry and will be supplemented by its even more powerful successor model, Hunter, with around 39 petaflops at the end of 2024. Prof Dr Michael Resch, Director HLRS, said, "With Hawk and Hunter, we can support the further development of technologies at TRUMPF."

StoreDot inks deal with EVE Energy for fast charging battery mass production

StoreDot will secure manufacturing capacity from Eve to produce its XFC batteries. The company will also license its technology to Eve and continue to pursue licensing agreements with other third parties, in conjunction with creating its own global captive capacity. The deal will facilitate StoreDot's cells being produced from Eve's highly advanced production lines in the future, to be delivered directly to the company's customer portfolio of global electric vehicle manufacturers. Amir Tirosh, COO, StoreDot, said, "This newly minted agreement with Eve Energy is a pivotal inflexion point for StoreDot. We now have the agreement for captive capacity, and it gives us the ability to implement our ambition for mass production of our extreme fast charging cell technologies. This will allow us to serve our customers who do not have their own manufacturing capability. I am also pleased, as this agreement fully cements our strong alliance with Eve Energy. We are already utilising its world-beating manufacturing expertise in our R&D efforts."

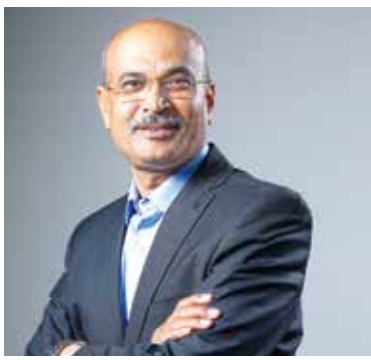
Posco begins derisking rare earth permanent magnet supply chain from China

Posco International has announced that it has bagged large-scale orders through its overseas subsidiaries to de-risk its supply chain for rare earth permanent magnets from China. The company's U.S. subsidiary recently won an order worth about KRW 900 billion for permanent magnets from a global automaker in North America and agreed to supply them from 2026 to 2031. The supplied permanent magnets will be mounted on the drive motors of the company's new mid- to large-sized electric vehicle models. In addition, Posco International's German subsidiary has also signed a contract with a European premium car brand to supply permanent magnets worth approximately KRW 260 billion from 2025 to 2034. According to the company, "The contract to supply permanent magnets through Posco's overseas subsidiaries is not only a means of 'expansion of the stable mobility business through large-scale orders' but also a 'post-China supply chain' in the permanent magnet market, which accounts for more than 90 percent of rare earth elements from China."

Godrej & Boyce introduces Smart Connected Die casting Die for Die Parameter Monitoring

Godrej & Boyce, recently announced that its business, Godrej Tooling, unveiled the Smart Connected Die casting Die, a patented technology that revolutionises the monitoring of real-time die parameters. This innovative solution aims to reduce breakdowns by alerting non-conformance and predicting failures in die-casting production. This milestone in Indian die-casting offers an indigenous solution that boosts efficiency. With a 10 percent increase in die life, a 10 percent cost reduction per piece, and fewer rejections, it signals a significant industry advancement. Pankaj Abhyankar, Senior Vice President & Business Head, Godrej Tooling, said, "By seamlessly integrating real-time monitoring, proactive alerts, and cloud-based accessibility, we are not just optimising die-casting processes, but rather fundamentally reshaping how manufacturers approach production. Alongside improving individual components, this will empower entire industries to embrace smarter, more adaptive methodologies that prioritise quality, reliability, and sustainability. As we continue to bridge the gap between traditional manufacturing and cutting-edge technology, the potential for transformative change across the manufacturing landscape is limitless."

Sterling Generators, Tecnicas Reunidas SA sign agreement for developing Electrolysers



Sterling Generators announced that it has recently signed an agreement with Tecnicas Reunidas, S.A. This agreement is for the joint development of a 1 MWe hydrogen electrolyser, which is planned to be commissioned in the last quarter of 2024 and that would thereafter be scaled up to 10 MW. The agreement was inked at the Embassy of Spain in India before a distinguished audience comprising the Spanish Ambassador, diplomats, government officials, and senior members from both companies. Hydrogen is a universal, light, and highly reactive fuel. Electrolysis is the process of using electricity to split water into hydrogen and oxygen. This reaction takes place in a unit called an electrolyser. Sanjay Jadhav, CEO of Sterling Generators, said, "We are confident that as a versatile energy carrier, green hydrogen holds the potential to strengthen India's energy independence, resilience, and innovation, driving the transition towards a cleaner and greener future. This agreement will therefore strengthen India's adoption of green hydrogen as a key component of its ambitious renewable energy targets."

Schneider Electric launches EasySet MV switchgear

Schneider Electric, recently announced the launch of its new EasySet MV air-insulated indoor switchgear. This innovative and sustainable switchgear offers unparalleled ease of operation, monitoring, and maintenance for meeting electrical distribution needs. Part of the renowned Set series, the EasySet MV is a compact and modular switchgear for MV primary distribution that leverages vacuum circuit breaker technology. Its unique feature is its ability to achieve high performance within an improved footprint. With withdrawable circuit breakers up to 12 kV and up to 2000 A, this medium-voltage air-insulated indoor switchgear assembly is engineered to meet all electrical distribution needs. Speaking on the sidelines of the launch, Udai Singh, Vice President, Power Systems, Greater India, Schneider Electric, said, "The EasySet MV switchgear reflects Schneider Electric's commitment to develop and innovate products for a sustainable future. Designed to elevate the user experience, the EasySet MV is a compact, easy-to-install, monitor, and maintain switchgear to ensure a reliable electricity supply. The addition of this new range of air-insulated switchgear is a testament to Schneider Electric's dedication to scaling sustainable engineering for driving climate impact."

"Meeting market demand with precision"

…says **Sudhir Kumar Chawla**, Managing Director at BorgWarner Emissions Systems India. In an interview with **Neha Basudkar Ghate**, he talks about the market perspective of the EV industry, with a focus on sustainability in the coming years. Excerpts…

How does BorgWarner's contribute to the automotive market, in the context of the recently completed spin-off and the focus on electrification?

BorgWarner has been expanding its electrification portfolio since 2015 through strategic acquisitions and partnerships, such as Delco Remy and Sevcon. The acquisition of Delphi Technologies in 2020 was a significant step towards accelerating the company's move towards electric mobility, providing the necessary scale and technology leadership in electronics and software. Recent acquisitions have further strengthened our vehicle electrification capabilities, supplemented by the internal development of electrification products.

How do you plan to accelerate the electrification strategy, and what specific steps is the company taking to increase revenue from electric vehicles?

We have successfully met or exceeded all the targets set initially in March 2021 when the company introduced the Charging Forward strategy. This includes organic growth, disciplined M&A, and dispositions. As a result, new business goals called Charging Forward 2027 were introduced in June 2023. The company aims to generate more than $10 billion in eProducts revenue by 2027, profitably, with a clear milestone of a 7 percent adjusted operating margin by 2027 and a plan to reach double digits by the end of the decade.

How does the integration of electronics into mechanical systems optimise performance across EV products?

We apply our expertise in combustion product development to develop EV products. For example, High Voltage Coolant Heaters in EV vehicles require the most efficient heat transfer to heat the battery and cabin. Based on our experience and knowledge from EGM Management and power electronics, including the software, we can optimise HVCH for optimal use in heating the battery and cabin and meet customer requirements with precision.

You aim to achieve carbon neutrality by 2035. How is the company working to achieve this goal?

BorgWarner's Charging Forward goals are aligned with its sustainability program. In December 2022, the company set a new goal to reduce Scope 3 emissions by 25 percent by 2031 from its 2021 baseline, building on its previously announced goals to reduce Scope 1 and 2 emissions by 85 percent by 2030 and achieve carbon neutrality by 2035. To meet its Scope 3 target, we are focusing on transitioning its product portfolio to electrification, furthering circular product development, increasing the content of recyclable and remanufactured material, product weight reductions, and sustainable raw material selection. The company has launched different workstreams through five key reduction levers: Supplier Emissions, Aluminum Emissions Reductions, Overall Weight Reduction, Steel and Iron Emission Reductions, and Recycling and Reuse. □

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"Creating transformative business opportunities"

…says **Jigar Vakharia**, Senior Vice President, Global Head – Manufacturing, and CMT, Birlasoft. In an interview with **Sanjay Jadhav**, Vakharia delves into the concept of 'Plants of the Future' to leverage cognitive technologies like Artificial Intelligence and Machine Learning.

Q What are the key components of Birlasoft's current business model in the manufacturing sector?

» Birlasoft's business model in manufacturing focuses on strategic growth initiatives and collaborative partnerships. We prioritise domain-led offerings and utilise key technology partnerships to deliver enterprise solutions, digital and data services, infrastructure, and cloud services. Our focus on themes like Supply Chain Visibility and Plants Of The Future drives our dedication to addressing industry needs.

At the core is our commitment to co-innovate with customers in leading business and technology areas like Industry 5.0, De-carbonisation, Digital Twins, and Generative AI. This creates large transformative opportunities and strengthens existing relationships, ensuring our solutions meet evolving industry needs.

We emphasise talent development through domain training led by SMEs and partner-driven programs on digital technologies like Generative AI, Digital Twin, and Cloud. Our cultural tenets, including organisation-first, customer and people-centricity, say-do ratio, being bold, and quick decision-making, underpin our strong business model, enabling us to drive growth and deliver better value in manufacturing.

Q How is Birlasoft leveraging the concept of 'Plants of the Future' to stay competitive in the market, and what specific features of this concept is the company prioritizing?

» Manufacturers today are at varying levels in terms of maturity spectrum. Most of them are already evaluating and adopting smart manufacturing technologies to improve quality, which ranks as one of the primary drivers for building 'Plants of the Future'.

Considering existing industry challenges ranging from data silos and interoperability to data security risks, we go to market with industry-leading solutions like MDC, ProdLogix, MachineLogix, intelliAsset, etc., to optimise plant operations.

Our consulting toolkit, the TRU Smart Factory Maturity Analyzer, assists clients in evaluating their current maturity level and devising a roadmap for accelerated advancement at scale. Our dedicated attention to OT security, complemented by a centralised risk scoring mechanism, highlights our commitment to tackling emerging cybersecurity threats.

Additionally, our ongoing collaboration with clients on Generative AI applications through Birlasoft Cogito platform exemplifies co-innovation and staying ahead of industry trends.

Q How is the company utilising cognitive technologies such as AI and ML to enhance collaboration between humans and machines, and what specific technological advancements is the company prioritising to facilitate the transition to Manufacturing 5.0?

» For one of our cement manufacturing clients, we responded to the shift towards Manufacturing 5.0 (M5.0) by moving ahead from predictive to prescriptive analytics with recommendations for performance optimisation, productivity improvement, and in-process quality control, thereby assisting the Plant Head, Engineer and Operator in decision making.

An innovative initiative is our Gen AI-powered Digital Thread accelerator, which integrates product lifecycle information from engineering to shop floor to aftermarket processes, enabling closed-loop manufacturing with human monitoring of the controls.

Our industry-ready offerings leveraging both AI, ML and Gen AI in accelerating Smart Manufacturing initiatives include:

- Predictive Maintenance: Real-time process visibility with prescriptive recommendations for proactive or preventive maintenance.
- Virtual Factories with Digital Twins: Developing digital replicas of physical manufacturing assets to simulate and analyse their behaviour in various scenarios.
- Quality Assurance: AI-powered image recognition for quality inspection and defect detection.
- Supply Chain Optimisation: Streamlining supply chain operations, including demand forecasting, inventory management, and logistics planning.
- Employee training and aftermarket collaboration: Smart Glass solutions powered by AR/VR augment remote collaboration in warehouse operations, aftermarket, and employee training.

Q Can you discuss any recent mergers or acquisitions that Birlasoft has undertaken to strengthen its position in the manufacturing technology market?

» Birlasoft has chosen a distinct growth approach, emphasising investing in domain solutions and bolstering partnerships with specialised allies for collaborative solutions and go-to-market strategies. Rather than relying on mergers and acquisitions, we prioritise leveraging partnerships to expand our market presence. We have crafted tailored growth strategies for different regions, teaming up with hyperscalers, ISVs, and niche partners.

Recent collaborations include our engagement with a niche decarbonisation partner, where we are developing an emission accounting framework, and partnerships in the worker safety domain. These alliances allow us to combine our expertise with that of our partners, resulting in innovative solutions.

Q How does Birlasoft leverage its global presence to serve manufacturing clients across different regions?

» Birlasoft leverages its extensive global presence to serve manufacturing clients worldwide with tailored solutions and localised support. With onshore delivery centres in the US, Europe, Australia, Singapore, and Brazil, as well as offshore centres in India and recent expansions in Mexico and Coimbatore, we ensure proximity to clients and efficient service delivery.

In the US, dedicated client partners provide personalised support, building strong relationships. For global accounts, we leverage cross-regional relationships to expand regional business coverage and ensure comprehensive support by global client partners who oversee operations across different regions. In Europe, our focus is on building long-term partnerships, supported by cross-selling initiatives and collaborations with niche technology companies offering end-to-end solutions.

In the Asia-Pacific region, we prioritise operational efficiency and customer centricity, engaging in large-scale programmes such as digital and cloud transformation projects. Collaborations with customers and leading OEMs and CSPs drive co-innovation initiatives with Proof of Concepts to address evolving market needs. Our global footprint allows us to offer localised support, build strong partnerships, and deliver innovative solutions tailored to the unique requirements of manufacturers worldwide. Through strategic expansion and collaborative initiatives, we reinforce our commitment to serving as a trusted partner in the manufacturing technology market. ☐

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TR4F type to meet specific challenges posed by high-efficiency cutting

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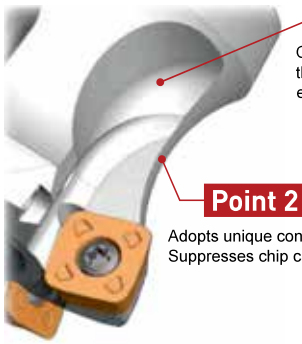
01

Although high-feed cutting is performed for shaping,
resulting severe chip clogging and biting may reduce shaping efficiency.

Proposed solutions

Adopts new body shape to enhance chip removal.
Suppresses chip clogging, even when cutting long overhangs.



Point 1

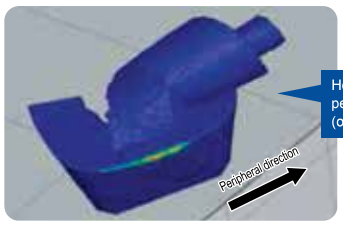
Offers excellent chip removal performance thanks to large open pocket, thereby eliminating clamp pieces.

Point 2

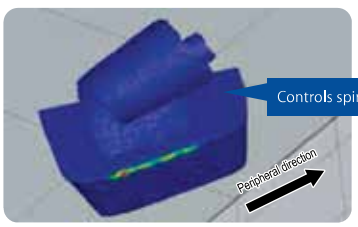
Adopts unique constricted shape.
Suppresses chip clogging between tools and wall surfaces

Point Suppresses chip clogging.

Optimizes cutting edge design to achieve smooth chip removal flow; keeps chips away from wall surfaces.
Suppresses clogging from the time chip generation starts.



Conventional



TR4F type

Breaker type is added to the inserts (1 item, 4 grades)

Lineup of holders are added. (φ32, 40, multi-flutes type total 14 item)

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YOUR GLOBAL CRAFTSMAN STUDIO

Amidst the complexities of industrial equipment manufacturing, simulation-driven hybrid digital twins offer a transformative solution. This article explores how these twins revolutionise design, operation, and maintenance by leveraging real-time data and simulation. Join us as we uncover how this cutting-edge technology reshapes the industry, providing unprecedented insights and enhancing efficiency while minimising downtime.

Simulation-driven Hybrid Digital Twin

for Industrial Equipment Manufacturing

Mike Yeager,
Area Vice President, India and Japan, Ansys Inc

High-value machines are used for various applications like manufacturing automobiles, transportation equipment, power generation, oil and gas production, supplying clean water, packaging, and performing many other key functions. Most of these machines are designed using complex simulation to optimise processes, which include structural, fluid flow, electromagnetic, thermal, and other physical behaviours.

It has been a challenging time for most industries, with tested supply chains, global health crises, shortages of materials, rising costs, unemployment, complex logistics networks, and declining productivity. In addition to these global challenges, several operational challenges exist in industrial equipment manufacturing. Even with all the growth opportunities, the dynamic business landscape and rising global competition will mean that the challenges for industrial machine manufacturers will only increase as the market is very competitive. Manufacturers must be constantly on their toes and ready to deal with this.

For manufacturers, it is crucial to know the health of the machine and identify well in advance if a machine is headed for a breakdown, as this will lead to production loss and, hence, business impact. It is also essential to ensure the machine's optimal operation since suboptimal operation will reduce its life in the long term. It is also pertinent to check if there are opportunities to increase the performance of a machine by changing its operating conditions or advancing its capabilities.

Challenges

Industrial machinery manufacturing is quite complex, with the production of heavy industrial equipment and custom-engineered goods across various industries. Processes change frequently as project requirements are unique, making industrial manufacturing more challenging. There are many engineering challenges in industrial equipment manufacturing, whether for an initial machinery order or if it involves changes to an existing product. Translating project requirements into a production workflow is not only time-consuming but also tricky. In production and planning, managing demand, inventory, and supply chain issues, or taking care of quotation and resource management, IE manufacturers have many aspects to look into. Even after production, service management is key.

The failure of any machinery or critical components means a huge loss for the plant. Any failure often makes it necessary to shut down the equipment controlled until the relay is fixed or replaced. Production lines controlled by relays often produce thousands and lakhs of rupees worth of products every hour, so even a short shutdown can be expensive. Until now, there has been no practical way to predict an impending failure in a safety relay so that it can be replaced before failure when the equipment it protects is not scheduled to operate. This means unplanned plant downtime and high-cost implications. There is a need to optimise maintenance schedules, reduce unplanned asset downtime, and significantly enhance operational performance. Another challenge is predicting these machinery or critical component failures in advance.

The Solution

Addressing the manufacturing sector's challenges to enhance its operational efficiency is essential. First, visualising all the data associated with the in-service physical assets in a particular environment is required. Past data is vital to gain an understanding of critical component failures. The primary focus of ensuring the safety of major equipment

is the structural integrity of these critical components. It is required to be ensured throughout the entire operating cycle. This makes it crucial to have a physics-based understanding of the essential component. Multiphysics that merges physics-based understanding— such as electromechanics, structural, and thermal—with analytics is needed. Physics-based models can help understand all the parameters, determine normative patterns, and make it faster.

Today, the Internet of Things (IoT) makes it possible to get real-time data about an operational product and combine it with digital information about the product, including simulation models, to augment the present state of a machine. A digital twin can incorporate real-time sensor data with simulation results to predict the failure of a component with a digital twin.

Digital Twin

The concept of digital twins is that you have an asset or process in the field, you have models in a virtual world that represent critical elements of these assets, and you have ways to keep those two synchronised. Data flows from an asset running in the field to the digital models. The models then make predictions from that measured data to generate insights you couldn't measure on the field. Finally, operators receive this information from the models in time for adjustments. With that additional data available, you can make decisions more efficiently. This concept has been adopted in the asset management industry for years, even before the term 'Digital Twin' was coined.

The actual worth of the digital twin is understood by integrating physics-based understanding with analytics. Engineers can identify the operational failure modes of the product, advance product performance, avoid unplanned downtime, and create next-generation products with accessible insights. Digital twins can leverage multi-fidelity simulations from detailed 3-D physics to Reduced Order Models (ROMs) to cut simulation times and show key product performance aspects. A digital twin can test predictive maintenance and monitor real-time prescriptive analytics to optimise product performance. Simulation is vital to the accuracy of a digital twin. IoT can provide enough data about equipment, operations, assets, and people to make predictive modelling a reality and to ask much-needed 'what-if' questions.

Simulation and Digital Twin

Modelling and simulation are key tools once we have the data. To innovate, physics-based models must be combined with statistical and machine-learning approaches for the best of both sides. A physics-based model aids in understanding the parameters, discovering normative patterns, and quickening the pace. The volume of data also need not be too high to gain insights; decision-makers can be given the information necessary to operate capital-intensive infrastructures and achieve business value for their operations while making the right decisions.

With a digital twin, manufacturers can see the product in action over time when exposed to the physical environment under actual working conditions. Product development teams can close the loop on their initial simulations, and engineers can make more informed choices for future designs and make their simulations even more accurate. Additionally, the time and cost savings are significant.

Simulation helps us fully realise the tremendous value contained within the digital twin. Engineers can gather daily performance data by placing small, relatively low-cost sensors

on products operating in the field. By combining this new information with the power of physics-based simulation, the engineering team can examine and address any performance issues, foresee the need for product maintenance or repair, and ensure that future product versions are optimised for day-to-day operating conditions.

Simulation can identify and predict any issues before they impact the performance of the physical component. Increasing the interconnectivity means sensors must be placed on each part; some are real-time physical sensors that caution about an event or service. Due to the complexities of operation, placing physical sensors everywhere is impossible. Thus, creating an accurate digital twin of the working tool equipped with a series of virtual sensors is critical, and simulation can help create a digital twin directly connected to a working machine tool.

Engineering simulation aids analysis and optimises product performance in real-world operating conditions when incorporated into a digital twin. Simulation is critical to a digital twin as it answers all the 'what's, how's, and why's.

Key Elements of Digital Twin

With digital twins becoming more integrated across industries, new features and capabilities are constantly added. Here are some critical elements of the digital twin:

- **Hybrid Analytics:** A hybrid digital twin is a virtual representation of a connected physical asset made possible by combining advanced simulation and analytics. The best digital twins adhere as closely as possible to actual physical behaviour, predict behaviour across multiple operating scenarios or product variations, adapt to changing environments and conditions, and come from rapid, automated workflows.
- **Data-Based Analytics:** Using and analysing valuable information and combining it with advanced analytics technology provides deeper perspectives into the system's workings and helps predict its future behaviour using a digital twin.
- **IoT Platform:** IoT allows sensors to capture data and understand and optimise their real-time performance. It makes it possible to build a digital twin with operational data, maintenance records, PLM data, simulation results, analytics, and machine learning. IoT connects simulation to the product in near real-time, just-in-time, or replay mode to aid in operating and maintaining it.
- **Assets and Infrastructure:** First, build a robust, balanced data model for a successful digital twin. Establishing governance and benefit attribution from the start and ensuring cross-team engagement are also critical. Developing an optimised digital twin is labour-intensive and involves high-cost implications. However, physical experiments are even more time-consuming and expensive. Digital twin enables true predictive maintenance for expensive assets, allowing manufacturers to save on warranty and insurance costs and proactively optimise a product's operations.

How does a Digital Twin work?

A multi-technology platform that lets engineers generate simulation-based digital twins of assets with real-world sensor inputs, Ansys Twin Builder combines the power of a multi-domain system modeller with extensive 0D application-specific libraries, reduced-order model or ROM capabilities, and 3D physics solvers. Twin Builder allows the reuse of prevailing components and quickly creates a systems model of the product when combined with embedded software development tools. Twin Builder combines multi-domain system simulation capabilities with swift Human-Machine Interface (HMI) prototyping, XiL validation tools, and systems optimisation to authenticate a system and guarantee expected performance. It easily integrates with Industrial Internet of Things (IIoT) platforms and contains runtime deployment options to connect the twin to test or produce real-time data, allowing predictive maintenance.

ROM interfaces generate accurate, compact models from detailed 2D and 3D physics simulations. It allows the visualisation of 3D fields directly in Twin Builder. With its links to other tools, it can create high-performing models for electromagnetic machines and actuators, circuit parasitics, and cables, excitations for Electromagnetic Interference/ Electromagnetic Compatibility (EMI/EMC), electronics thermal networks, signal integrity, general flow and heat transfer characteristics, and rigid-body dynamics. Multiple ROM generation techniques (including state space, electrical circuit equivalent, Singular Value Decomposition (SVD), and modal response) support a range of analysis requirements (linear or nonlinear, steady-state, or transient).

The model can also be exported as a twin on the IoT platform by configuring a connector to an IIoT platform and sending and receiving operational data. A portable, cloud-deployable twin can be generated by exporting from Twin Builder. Validation and verification of twins with the Twin Deployer significantly reduce deployment time. Twin Builder can export diagrams, plots, and tables to other software in multiple formats.

Use cases of Digital Twin

For applications that require tight control of the flow of raw materials, using a digital twin during the production

process can accurately predict the quality of the end product, enabling manufacturers to make more informed decisions. The digital twin concept is being extended to encompass large and complicated assets such as petroleum refineries, automobile assembly plants, distribution centres, wind farms, large-scale construction projects, etc. In each case, sensors and other devices captured data and fed it into the simulation model to provide a detailed understanding of the current state of the asset. Machine learning algorithms running on the edge or in the cloud access information from the physical asset and the simulation model to optimise the performance of the asset by scheduling maintenance, setting control points, sending alerts to operators, providing reports to management, etc. The information generated by the simulation model can also be communicated by overlaying the flow contours of the fluid flow inside the pump onto an image of the pump, so operating personnel can quickly understand and diagnose problems.

Digital Twin can be used in an assembly line in the manufacturing industry and virtual commissioning, troubleshooting, and system configuration. A simulation-based digital twin can accurately predict equipment stresses and hot spots to prevent unanticipated maintenance needs during a production cycle. As companies work to have a zero-carbon footprint, a digital twin can test and validate carbon reduction options to see the most appealing opportunities to meet their sustainability goals. Providing a precise quote for large equipment can require weeks and multiple customer visits. A digital twin of a proposed installation can accurately quote performance and cost quickly and easily.

In the most common use cases for hybrid digital twins, you typically try to change or kick off a new process. You can use these digital twins offline as part of virtual commissioning. You can try to understand what-ifs and learn how to define set points. Then, you can take it online to receive virtual sensing data. You can start using it for monitoring, then expand through automation and optimisation. Finally, you can also use these virtual sensors for predictive maintenance.

Hybrid digital twin solutions, including Ansys Twin Builder and advanced probabilistic methods, already support our customers' industrial autonomy. It is way beyond pure 3D contextual visualisation—a starting point that enables the visualisation of all the data associated with in-service physical assets in a particular environment. Leading-edge nuclear power plants that can accelerate the creation of renewable energy with unmatched efficiency and unparalleled customer accessibility can also be designed with Twin Builder. By digitally transforming manufacturing processes, emissions can be minimised, maintenance costs can be reduced, and the power generation market share can be maximised while fully complying with strict regulatory standards.

Conclusion

A digital twin enables the creation of new revenue streams through high-value service offerings. Simulation-based hybrid digital twin helps manufacturers evaluate smart machines in everyday conditions and make up-to-date decisions that will improve their performance far beyond what is possible today. A combination of machine connectivity and a data lifecycle management platform powered by engineering simulation empowers organisations to generate insightful data that can be used to improve the next generation of the product. Rather than just selling a piece of machinery, manufacturers can sell the uptime associated with that piece of machinery. Thus, simulation-based digital twins unlock significant value.❑

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The pressure on efficiency and cost-efficiency in aircraft construction remains high even after the pandemic

Machining processes in aircraft construction with potential for optimisation

Aircraft construction figures are on the way up again. However, the demands for production efficiency remain high. This has given rise to challenges for machining companies in particular. High machining volumes must be achieved quickly, reliably, and economically. The machining tool specialists at Walter have developed a range of high-performance tools specifically for aluminium machining, with which the possibilities of modern machine tools can be optimally utilised.

The aviation industry and aircraft construction have been through a difficult few years. The worldwide travel restrictions due to the COVID-19 pandemic have not only led to yawning emptiness at airports, but also to massive slumps in production. The market has now recovered, and passenger numbers are rising again.

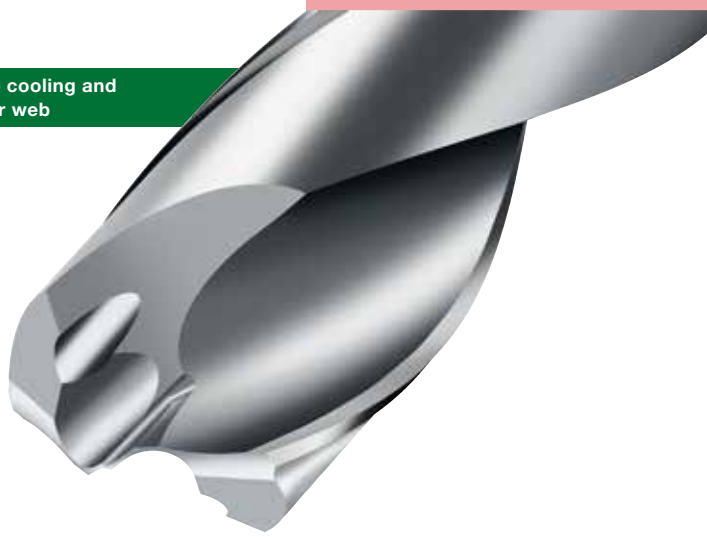
Modernisation push for aircraft fleets is offering opportunities

For aircraft construction, of course, this is good news. The profound transformation that was already underway in the sector before COVID-19 is gathering dynamic momentum with changing passenger demands, energy costs, and CO_2 emissions. Airlines are adapting their existing fleets to these new demands, for example by modifying the cabin area. Many fleets also need to be modernised.

But even if the order situation in aircraft construction is looking up, the production environment and conditions remain challenging for the industry. Economic and political crises around the world are placing entirely new demands on the resilience of our own supply chains. Two other major players – China and India—have firmly established themselves in the market. Production and value chains are shifting. So the pressure on the efficiency and cost-efficiency of processes remains high.

High-performance machining systems are making new demands

Particularly in the complex and demanding field of aluminium machining, process managers are therefore looking for ways to reduce costs per part and increase output. Components such as frames and wing ribs are often milled out of the solid material. Components several metres long also require large and cost-intensive machines. To be able to produce the necessary high machining volumes, mechanical engineers are developing machining centres with increasingly powerful spindles. Today, values above 80 kW are standard – the latest generation of machines has a spindle output of around 130 kW. However, pure power alone has not yet made any machining process fundamentally more efficient. The machining tool that is used is an important factor in offering the component the machine performance that is theoretically possible in reality, too. Only with the appropriate tool and a well-set-up process can the potential of a modern high-performance machining system with spindle outputs of up to 130 kW be used economically and reliably.

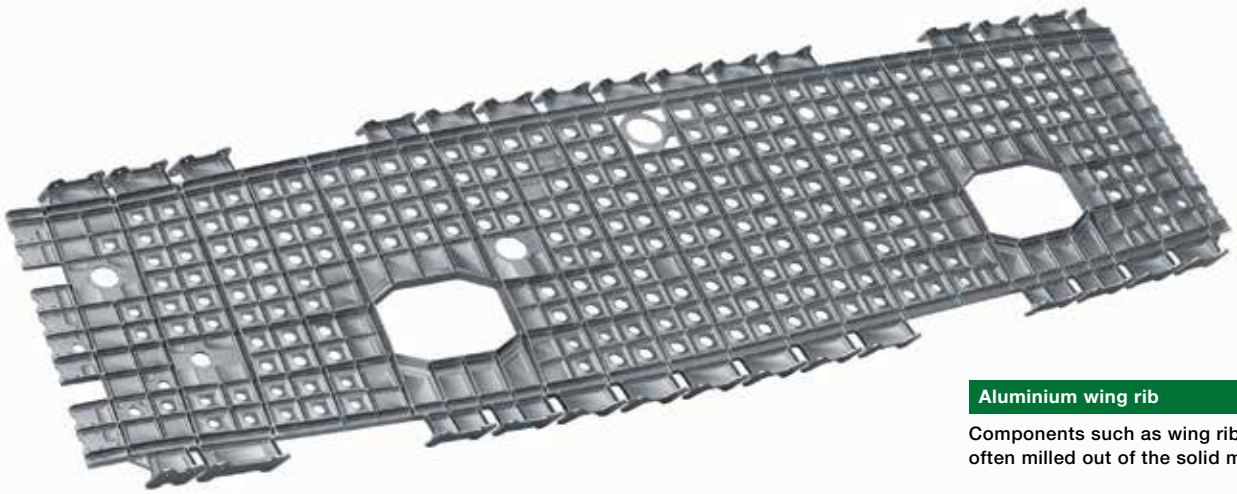


DC166 cooling and thinner web

Designed for mass producers, the DC166 Supreme enables productivity increase of up to 30 percent

Optimal tool solutions for high machining volumes

With a sophisticated range of high-performance tools, machining solutions provider Walter has been helping customers in the aircraft construction industry achieve



Aluminium wing rib

Components such as wing ribs are often milled out of the solid material.

DC166 Supreme solid carbide drill

Designed for mass producers, the DC166 Supreme enables productivity increases of up to 30 per cent

MD265 Supreme

The MD265 Supreme solid carbide milling cutters have been specially developed for high machining volumes when machining aluminium alloys

their efficiency goals for years. The company invests significantly in further developing its existing machining solutions and designing new ones. This is well illustrated by the 'new sales ratio'. At Walter, the proportion of tools that have been on the market for less than five years is currently over 25 percent. The MD265 Supreme and MC268 Advance solid carbide milling cutters have been on the market since October 2022. They were specially developed for high machining volumes when machining ISO N materials such as aluminium alloys, which are frequently machined in aircraft construction.

The developers have placed particular emphasis here on optimising the micro-geometry. The special 'V-shaped centre cutting edge' is typical of both milling cutters—a Walter development that is so far unique on the market. The new cutting-edge technology enables reliable ramping with less thermal input into the workpiece. This prevents structural changes in the material that can occur when using conventional milling tools.

This is because temperatures of up to 480 °C can be achieved here selectively at high machining rates under minimum quantity lubrication. This can affect the electrical conductivity of the material and lead to it being disqualified during quality testing. With the new centre geometry, the temperature remains below 140 °C. In addition, the cutting edges, Kordel or RAPAX profiles, and flutes are finely polished so that hardly any machined material adheres to them. The special micro-geometry enables smooth cutting, resulting in high process reliability. Users can also work with a reduced cutting force, which saves on spindle output and maximises the efficiency of the output used.

With its Kordel profile, the MC268 Advance is designed as a universally applicable roughing tool. The MD265 Supreme with RAPAX profile is designed for the maximum metal removal rate. Its NHC coating is designed for a metal removal rate of up to 9.2 litres per minute in Al7075 in 24/7 operation. This metal removal rate is achieved with a tool with a diameter of 25 mm at 33,000 revolutions per minute and a feed per tooth of 0.15 mm, as well as a depth of cut and width of cut of 25 mm each. The required spindle output is about 120 kW. The maximum value of current machine tools is optimally utilised.

30 percent productivity increase in aluminium: The Walter DC166 solid carbide drill

The DC166 Supreme solid carbide drills have been on the market since April 2023. Designed for mass producers who need to drill many identical holes in an aluminium alloy workpiece, the drills make productivity increases of up to 30 percent possible. Due to the optimised cooling towards the centre and the strong, thinner web as well as the polished flutes, a significantly higher feed rate can be operated with the DC166 drill. In some cases, the machining time can thereby be halved. In addition, tool life is increased due to the reduced built-up edge. This standard tool with coolant is specially designed for minimum quantity lubrication (MQL) and cooling with emulsion. □

To go to the Walter website: www.walter-tools.com

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Diversifying global supply chains for resilience

In the wake of unprecedented challenges like the pandemic, businesses are rethinking supply chain strategies. Explore how diversification fosters resilience, reduces risks, and shapes the future of global commerce.

Suman Nelluri,
Executive Director,
Greaves Technology

Supply chains have become indispensable for global commerce in the rapidly evolving global economy. However, the pandemic has exposed vulnerabilities and risks of concentrated supply chains. Production, transportation, and distribution disruptions have cascading effects on the global economy. Globally, diversifying supply chains have become an urgent imperative to enhance resilience and minimise disruptions caused by unforeseen shocks, such as natural disasters, geopolitical conflicts, and pandemics.

Strategies for building resilient Supply Chains

The primary goal of diversification is to create stronger safety nets, flexibility, and adaptability within supply chains, enabling them to withstand external shocks with minimal disruption. Achieving this involves various approaches, such as expanding the number of suppliers, implementing redundant logistical solutions encompassing multiple modes of transportation, and considering near or re-shoring options to bring operations closer to home.

A survey by Ernst & Young reveals that many industrial companies have taken significant steps to diversify their supplier base, establish operations in new countries, and conduct near- or re-shore operations. Despite the associated costs, businesses prioritise resilience in their supply chains. Challenges arise from the previous focus on efficiency, cost reduction, and globalisation in concentrated supply chains. COVID-19 and other crises have exposed concerns and vulnerabilities related to transportation, shifts in consumer demand, and inventory management procedures. This necessitates shifting towards diversified suppliers, increased supply chain visibility and resilience, adaptability to shifting market conditions, and embracing digital transformation.

While diversifying supply chains enhances resilience, it also introduces complexity and potential challenges, such as increased environmental, social, and governance risks. Despite these challenges, building robust, agile, and resilient supply chains is worthwhile. However, achieving this will require a rare level of visibility in the freight and logistics cycle during supply chain reconfiguration. To foster diversification efforts, companies should actively seek multiple domestic and international suppliers to form strong partnerships that promote resilience and healthy competition. Evaluating regions based on policy stability, infrastructure, labour costs, and market proximity is essential to mitigating concentration risks and expanding operations to new areas.

Digital technologies such as blockchain, Artificial Intelligence, and automation can enhance supply chain visibility, traceability, and efficiency. Collaboration with industry partners, governments, and research institutions is crucial to sharing knowledge and resources, identifying emerging threats, developing innovative solutions, and bolstering societal resilience.

Governmental support for addressing challenges and sustainability

Governments can play a significant role by enacting favourable legislation, offering incentives, promoting innovation, investing in infrastructure, including transportation, logistics, and digital connectivity, developing skills, and facilitating companies' expansion of their supplier base. Initiatives like the PM's Gati Shakti project, focusing on multi-modal connectivity, can expedite the movement of goods and services, reduce travel time, and improve last-mile infrastructure connectivity.

India can leverage its commitment to sustainability and ethical practices to ensure a conducive business environment and attract businesses looking to diversify their supply chains while meeting environmental and social responsibility goals. India can capitalise on its expertise in IT services and technology solutions by integrating digital tools for supply chain management, data analytics, and automation, investing in research and development to foster innovation in manufacturing processes and technologies,

and fostering collaboration between the government, private sector, and academia to address supply chain challenges. By implementing sound strategies, India can position itself as a resilient and attractive destination for global supply chain investments while ensuring its supply chain's stability and adaptability in the face of unforeseen disruptions.

Diversification of supply chains has never been more critical to ensuring resilience. Concentrated supply chains have various risks, and disruptions can have significant consequences. On the contrary, diversification offers stability through increased resilience, risk reduction, and enhanced adaptability. Companies prioritising diversification as a strategic imperative can effectively navigate uncertainty, overcome challenges, and ensure long-term stability for their businesses and the global economy.

Securing the foundation

As businesses adapt to a changing world, the call for diversified supply chains resonates louder than ever. Through strategic partnerships, technological innovation, and government support, companies can navigate uncertainties and secure the foundation for a for a resilient global economy. ❐

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Securing and safeguarding humans, **machines, and robots**

The evolution of robotics and automation in manufacturing is driven by digitalisation and Industry 4.0. The increasing presence of robots beyond traditional factory floors, emphasises collaborative robots' role in safer operations. Pilz as a global leader in safety and automation technology, details its commitment to address the evolving challenges and providing safe automation solutions to manufacturers worldwide, particularly in India.

Manufacturing environments have long relied on robotic systems to streamline processes on the shop floor, aiming to enhance efficiency, output, and product integrity while reducing human intervention. Yet, with the advent of digitalisation, IIoT, and Industry 4.0, the integration of automation and robotics has witnessed a notable increase in recent years. Additionally, robotics and automation are not just limited to the factory floor. Today, they are increasing their presence in warehouses and handling logistics. One big reason for this paradigm shift is the growth of collaborative robots, which can work alongside humans safely. Experts predict that the revenues generated from using robots will exponentially rise in the coming years, with an expected 15 percent growth per year until 2027.

This expansion extends beyond traditional manufacturing spaces, including warehouses and intra-logistics operations, where global enterprises increasingly embrace robotic technologies. Collaborative robots have played an important role in fostering this widespread adoption, facilitating safer shop floor operations. But as factories get more digital, automated, and autonomous, there is a new worry: safety and security. There have been reports of accidents caused by robots malfunctioning and causing damage to humans and machines. Moreover, today, factories are increasingly connected to the IT infrastructure and are more at risk from hackers. Since the pandemic, cybercrime has shot up by 600 percent. Pilz India is stepping in to tackle these challenges, providing solutions to ensure factories and shop floors are not only connected and efficient but also safe and secure from cyber threats. Pilz ensures the safety of machines, humans, and the environment, even with rapidly evolving technology.

Ensuring safety for automated systems

Ensuring safe access to automation systems is not just important, but crucial. Machine malfunctions can pose risks to operators, and human errors may damage machines and robots, leading to further complications. Therefore, it is not just essential but a necessity to protect these systems from unauthorised access. Automation systems often operate continuously to meet demand but may require maintenance or changes. Safe operation during these processes is not just important; it's a matter of safety. Today's automation systems can adapt to various manufacturing needs, allowing the production of multiple products with software and tool changes. Access to these systems should be restricted to trained personnel to minimise risks. Implementing robust access management systems in manufacturing environments is not just crucial; it's a safety imperative. The increasing threat from cyberattacks endangers not only the safety of industrial environments but also their productivity. In addition, there are normative and legal security specifications that present new challenges to manufacturers, integrators and operators. To build up the relevant knowledge within companies, with CESA, Pilz is expanding its training offer to include concise further training for specialists to become security experts.

Safeguarding robots with safety gates

Robots bound by fences or safeguards are common on manufacturing shop floors to safeguard humans during robot and machine operations. These safeguards have doors to enable access for handling various operations, such as tool changeover and maintenance. These doors need to be equipped with appropriate safety mechanisms for safe operations. With robot operations, there should not be direct access to the robot when the machine and robot are moving, ensuring ultimate human protection. The operator needs to stop robot and machine operations before the safety door can be opened and any maintenance activity is undertaken. Moreover, the operator needs to ensure proper lockout-tagout (LOTO) before entering the safeguard.

Thus, safety gate systems for guard protection, safety gates, position monitoring through safety switches, and light curtains for safe intervention in production processes are essential safety elements that safeguard operators from injury. Pilz India offers complete safe controls, relays, and sensor portfolios that enable safe automation efficiently and economically. Pilz safety gate systems such as PSENmech with guard locking, PSENslock, PSENmlock, and PSENsgate are used for guard protection to monitor doors in safety fences, covers, and flaps. These devices meet the EN ISO 14119 requirements. Pilz safety light curtains, PSENopt and

PSENopt II, enable machines to protect staff and capital goods, enabling optimum access protection.

Pilz India: Protecting your valuable data from unauthorised access

Many accidents are caused by unauthorised personnel entering forbidden areas and making changes or maintenance. These events can be avoided by having an access management system in place. With Identification and Access Management, Pilz offers a wide range of products and software, as well as tailor-made solutions for access management challenges faced by manufacturing setups. Pilz offers safety and security functions in one system, with the operating mode selection and access permission system PITmode that controls access permissions to machines and robots. Pilz prevents shop floor operators from incorrect operation, and tampering, thereby protecting humans, machines, and robots. Pilz helps manufacturing units organise machine access and employee permissions, from simple authentication to complex access management, from functionally safe operating mode selection to electronic maintenance safeguarding. Furthermore, these devices and solutions also protect valuable plant data from unauthorised access by hackers.

Transponder keys with RFID technology are available in freely writable versions as well as with fixed, stored permissions. The options range from simple enable and user authentication to a complex permission matrix and company-specific coding. Thus, the operators cannot access tool changes or maintenance features, whereas these rights are reserved for the production in charge and the maintenance manager. Manufacturing units can guarantee safe and secure machine operation with a defined access management mechanism. Some PITmode devices offer integration with the OPC UA standard, which increases the security of communication between server and client. It expands the connection options to other manufacturers' systems using OPC UA, thereby promising greater security and usability for access permission. These reader keys are available in multiple colours to help a factory determine different machine types, functions, zones, or operating modes.

The PITmode device for operating mode selection and access permission systems enables functional, safe operating mode switching through self-monitoring up to PL d. It offers company-specific coding, resulting in tamperproof operations. The PITreader and transponder can be configured via an integrated web server and pre-installed with group-based permission management. With integrated user management, these devices are essential for a manufacturing unit's safe and secure operation.

Pilz India: Your reliable source for automation safety solutions

With innovative solutions and decades of expertise, Pilz is globally recognised as a complete solution provider for safety and automation technology. Its solutions empower manufacturing facilities to embrace digitalization, connectivity, flexibility, efficiency, safety, and security. As a partner, Pilz addresses the evolving safety automation challenges of tomorrow, championing a digital, connected, flexible, efficient, safe, and secure world through its solutions and products. With a rich seven-decade legacy in industrial automation, Pilz actively participates in over 50 standards committees worldwide, shaping industry standards. Since 2011, Pilz India has provided safe automation solutions to Indian manufacturers, distinguished by a team of certified machine safety experts skilled at handling diverse applications, training initiatives, and consulting projects. With a robust nationwide network of certified professionals, Pilz India stands ready to meet the full spectrum of manufacturing units' safe and secure automation requirements. ☐

Courtesy- Pilz India

Advancing Aviation: The quest for Lighter, Stronger Materials

This article delves into the pivotal role of advanced materials in shaping the future of aviation. From innovative designs to emerging propulsion technologies, it explores key specifications, necessity for new materials, and ongoing efforts driving material innovation.

Shantanu Gangakhedkar,
Senior Consultant,
Frost & Sullivan

The aerospace industry has been continuously evolving, especially since the last decade, as efficiency and sustainability have taken centre stage. Industry stakeholders have been working on innovations that can support this need.

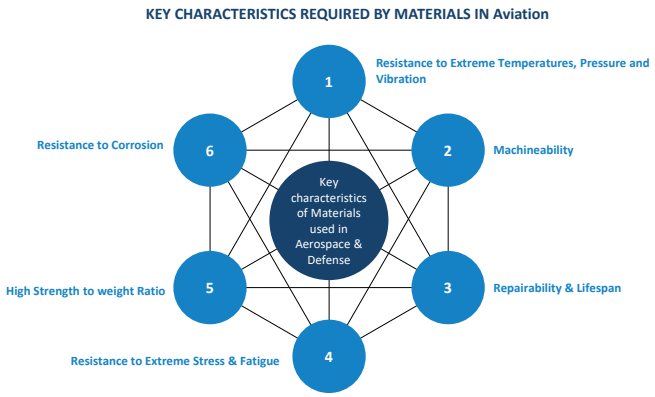
Multiple technological elements need to be developed to support the development and deployment of next-generation aircraft. Technology elements such as battery technology, propulsion systems, avionics, communications systems, and, most importantly, materials that can support the requirements of advanced and innovative aircraft/engine platforms.

Prerequisites of materials used in aviation:

The aviation industry is one of the most regulated industries, and for the right reasons, given the speeds and altitude at which aircraft operate while carrying hundreds of passengers onboard. Materials that can be used on an aircraft need to fulfil certain basic criteria to be certified for use.

Key specification requirements for materials

- **Resistance to Extreme Temperatures, Pressure, and Vibration:** Equipment needs to be able to handle wide variations in temperature and pressure during flight.
- **Machineability:** The materials should be able to be machined to odd and varied shapes and sizes without losing their characteristics.
- **Repairability and Lifespan:** The materials should be able to be repaired to their original form without losing their inherent qualities and specifications.
- **Resistance to Extreme Stress and Fatigue:** Materials need to be able to withstand high degrees of stress and fatigue to maintain the safety of the payload.
- **High Strength-to-Weight Ratio:** Using higher-strength materials that are lightweight aids in increasing the operating performance of the equipment.
- **Resistance to Corrosion:** Materials with high corrosion resistance are key to reducing failures as well as downtime.



Need for new and advanced materials

As aircraft and engine design and technology continue to evolve, conventional materials no longer meet the requirements to support the production and operations of these new technologies, leading to the need for new and advanced materials to be developed that suit future technology requirements.

1. New aircraft and engine designs are being developed by large established manufacturers as well as newly established specialised companies, with one key element defining the success of these developments being the viability of the required supporting technology, including materials and other components. There are a few key innovations that are emerging as the industry moves towards becoming more sustainable:
   - **Blended Wing Body:** A BWB aircraft is one where the entire aircraft is in a singular wing form as the fuselage and wings are blended to make up the airframe. Unlike the conventional aircraft design, which has a tube with wings attached to it, in the BWB design, the entire aircraft resembles a large wing of an aircraft, which encompasses the space for passengers as well as the engines and the fuel tanks. This design will make the surface area of the aircraft much larger, and using conventional materials will make the aircraft extremely heavy, so there is a need for new materials that are lighter but offer the required characteristics such as strength and others.
   - **Truss-Braced Wings:** An aircraft that has high aspect ratio wings mounted from the top of the aircraft body and supported by diagonal trusses, which are connected to the bottom of the aircraft, can be described as a Truss Braced Wing aircraft. The top-mounted wings, which are thin while having a larger wingspan, offer increased lift without an increase in weight while making it possible to fit larger engines into them. These wings and truces, to be able to support the tremendous lift pressures and engine weight, need to be extremely strong and lightweight while also having the ability to withstand the forces the wing usually goes through during the various stages of a flight.
   - **Open rotor engine:** An iteration of the conventional high-bypass-ratio engine that does away with the use of fan ducts or casings and has two sets of propellers placed one behind the other, rotating in opposite directions, with potentially one or both sets of propellers having variable pitch. Each set of propellers will have a separate hub. These blades will be required to be made up of extremely high-strength materials while being lightweight and having the capacity to withstand extreme pressures and temperatures during the flight.

2. **Advanced Propulsion Systems:** Along with aircraft designs, the propulsion systems are also witnessing innovations and developments to support future fuels. To support deploying these propulsion systems, it will require changes to the way aircraft are built, including the materials that are used to manufacture the required components.
   - **Electric:** Electrification is a key factor in the evolution of aviation and in achieving sustainability in the

industry. To have aircraft run on electric power for longer distances with a higher number of passengers, new battery technologies will be required, which will reduce the weight of the batteries and increase their capacity. New and advanced materials aid in developing new battery technologies and electric propulsion systems.

- **Hydrogen:** Hydrogen is quickly becoming a key component in the long-term goal of having net-zero flights. Hydrogen requires large tanks to be stored on board, and to have large tanks without adding on too much weight, need materials that are extremely lightweight to make these tanks.

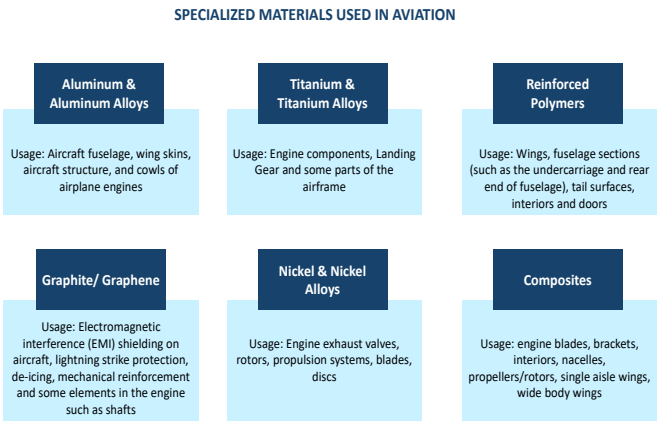
3. **Increasing Fuel Cost:** The cost of conventional jet fuel continues to rise, and manufacturers of both aircraft and engines aim to make the aircraft or engine as light as possible, which requires using new and advanced materials.

4. **Minimising Energy Consumption:** Manufacturers continue to make the aircraft or engine highly efficient and to do so, components need to be able to run at higher temperatures, resulting in lower requirements for power to support cooling and components required for cooling. Using materials that can operate efficiently at high temperatures while continuing to have other required properties aids in operating the equipment much more efficiently.

Key materials used in aviation

To support this evolving aviation landscape, especially from a technology standpoint, there are a few key materials that are gaining prominence and are crucial to this advancement. These materials individually address the specific requirements.

- **Aluminium and Aluminium Alloys:** Aluminium and aluminium alloys are the most widely used materials in the A&D industry, primarily due to their strong weight-to-strength ratio coupled with their high resistance to corrosion and heat. The most commonly used alloys include Al-Cu, Al-Zn, and Al-Li.
- **Titanium and Titanium Alloys:** Titanium and titanium alloys are being increasingly used in the A&D industry. They have a much higher weight-to-strength ratio while also being heavily corrosion-resistant and able to withstand extreme temperatures.
- **Reinforced Polymers:** In the recent few years, advanced reinforced polymers such as carbon-fibre reinforced polymers and glass-fibre reinforced polymers have been used in the aerospace industry primarily because of their strength, lightweight, and high resistance to fatigue and heat.
- **Graphite/Graphene:** Graphite and graphene are known for their lightweight self-lubrication, fire resistance, and high thermal and electrical conductivity.
- **Nickel & Nickel Alloy:** Nickel and nickel alloys are used in the A&D industry primarily for their resistance to extreme temperatures without being prone to cracking or deformation. They also have high mechanical strength and are readily formed, machined, and welded.
- **Composites:** Composites such as carbon, ceramic, and glass fibre-reinforced plastic, which are made up of two or more different materials with varying properties, are becoming more popular and crucial in the aviation industry as they are often stronger and lighter materials.



Future growth outlook

As the industry continues to evolve and new technology/designs are developed, equally advanced materials will be needed to build them. This will lead to constant development in ever-so-advanced materials, which, with each iteration, improve their capabilities and reduce their limitations. This need for innovation will bring in multiple stakeholders—private organisations, governments, education and research institutes, start-ups, and financial institutions, amongst others—to partner and collaborate at various levels. This will also lead to the formation of new companies with a focus on specialised parts of the value chain while the government ramps up support, both financial and non-financial, to ramp up R&D efforts.

There remain a few hurdles in developing and adopting new and advanced materials in the aviation industry, but the potential benefits of deploying them far outweigh the hurdles, making it even more lucrative for the industry to work towards achieving the desired output that can aid in making the aviation industry sustainable and achieve net zero by 2050. ☐

Helping the industry be competitive through efficient manufacturing

Exciting advancements lie ahead in the realm of machining technologies. This article delves into how recent developments in laser cutting technology are not only setting new standards but also pushing boundaries of what is achievable in the industry.

Aditya Goyal,
Founder & Director,
Modern Automotive

Precision-cutting technology is the foundation of the engineering industry and plays a direct or indirect role in every modern product. The demand for efficient products that offer optimum output, minimum downtime, low energy consumption, and less environmental impact is continually growing. This requires precise component manufacturing using the best raw materials, advanced machinery, and state-of-the-art tools and methods.

Benefits and challenges:

- Precision is crucial in manufacturing industries, requiring sophisticated machines and cutting-edge technology.
- Flexibility should be balanced with rigidity for optimum precision and productivity.
- Trained application engineers can enhance part accuracy and tool life through CNC programming.
- Machine tool features, such as electronic feedback and cooling systems, play a vital role in maintaining precision.
- Part designers must consider the cost implications of increasing precision for specific applications.
- Precision is essential in industries like automotive, aerospace, electronics, and more.
- Workforce shortages pose a challenge to sustaining production setups.

Precision cutting tool types and significance

Depending on the application of the end product as well as the surface roughness, machines and tools are selected. The goal is to achieve accurate, high-quality, and efficient manufacturing at a competitive cost.Today, a wide range of cutting tools, including HSS, carbide, ceramics, UCON, cubic boron nitride, and diamond tools, are available for diverse applications.

Techniques and types of precision cutting operations, applications, and tools used in industries

- **Milling:** Milling involves the use of cutters with replaceable elements like inserts, shims, screws, and clamps. These cutters are selected based on the material being worked on. Tool materials range from tungsten carbide to advanced coatings like PVD, PCD, CBN, and DLC.
- **Making holes:** Drilling, milling, and reaming- Tools such as twist drills, core drills, and trepanning tools are employed for drilling applications in materials like ferrous metals, non-ferrous materials, and stone.
- **Turning:** For making round parts CNC turning centres have taken the place of conventional lathes for plain soft turning, hard turning, grooving, threading, and boring.
- **Tapping and Threading:** Tapping and threading operations are critical for creating threaded holes or shafts. CNC machines with rigid tapping features, ensure high accuracy.
- **Splines:** External Spline can be made using machining as well as cold forming. Most automotive designs call for forming due to their high strength. Spline rolling is performed using a set of HSS rollers or racks.
- **Gear Cutting:** Gears play a pivotal role in power transmission. Gear hobbing with cold forming with carbide dies is gaining traction due to its consistency and productivity benefits.
- **Boring / Hole Enlarge:** Boring is a precise machining operation crucial for various applications like engine components and gearbox housings.
- **Grinding / Honing / Super finishing:** These finishing operations are where micro-level material is removed using abrasive tools on hardened or

non-hardened surfaces.

Other latest trending methods

- Plasma arc machining involves removing material using a high-velocity, high-temperature jet in various materials. The tool comprises plasma gas ions like nitrogen/hydrogen or argon/hydrogen mix. Laser cutting/machining employs a powerful, monochromatic light beam or laser that melts and vaporises materials. Laser machining can be cost-effective, but it isn't highly precise, typically achieving accuracies up to 0.1mm for profiles and holes. Notably, there's no tool wear, but safety measures are crucial.
- Water Jet / Abrasive jet machining involves removing metal using a high-speed stream of abrasive powder in a gas or water medium. It's a non-precise method typically guided by cams or pantographs, free from chatter and vibrations. Pollution control measures are essential.

Innovations in Precision Manufacturing:

- MASTERCAM offers enhanced flexibility, speed, and automation for machining with 2D high-speed toolpaths, 3D enhancements, and multiaxis features.
- Smart Cam introduces updated software with a hierarchical tree structure for CAD/CAM data, allowing for precise toolpath creation for high-speed milling.
- AMT Innovations revolutionises work holding with a triangular dovetail design that ensures superior gripping for multi-axis CNC machining.
- Big Kaiser's Air Power Spindle enables high-speed micro-machining, with variable rotational speeds, reduced thermal displacement, and minimal tool runout.
- Universal Milling tools from various manufacturers offer long tool life and versatility for different applications.
- KME CNC's Wireless 5-Axis Workholding simplifies five-axis machining on four-axis machines, connecting wirelessly to CNC controls.
- Tracer's Automatic Bar Feeder features an LED light bar for at-a-glance position checks and alerts.

Popular technological trends

Process Automation and Virtualization:

- Automation through robotics, additive manufacturing, and 3D printing.
- Increased reliance on AI for pattern recognition and

decision-making.
- Improved Programming Techniques:

Advancements in software applications and coding processes.
- Standardisation and automation of existing software.

Smart Cutting Tools:
- Sensor-equipped tools for predictive maintenance and real-time control.
- Machine learning for adaptability and enhanced accuracy.

Tool Holding and Part Holding Techniques:
- Precision tool holders like HSK spindle taper adaptors.
- Innovative part-holding methods with features like vacuum sensors and adjustable clamping pressures.

Tool Reshaping/Resharpening/Coating:
- Utilisation of CNC multi-axis tool resharpening machines with advanced abrasive wheels.

Cutting Fluid:
- Choice of cutting fluids, including petroleum-based and non-petroleum-based options.

Industrial Flooring:
- Durable and functional flooring for industrial settings.
- Resistant to heavy machinery, chemicals, extreme conditions, and improving overall efficiency.

How Industry 4.0 is helping

Industry 4.0 revolutionises manufacturing with smart sensors, devices, and data-driven decision-making. It fuses IT and operational technology for a cyber-physical environment, offering benefits like:
- Enhanced assembly-line efficiency through data analytics.
- Improved customer experiences with personalisation and tailored value propositions.
- Inventory management with real-time insights, optimised deliveries, and reduced errors.
- Predictive maintenance for prolonged asset lifespan, increased availability, and reduced downtime.
- Supply chain visibility through location-based IoT services.

In India, initiatives like SAMARTH and UDYOG Bharath 4.0 aim to integrate cutting-edge technologies to address workforce and productivity challenges in the industry.

Advancements in technology

Some recent technological advancements, practices, and popular trends in the precision machining industry include:
- Use of artificial intelligence and computer science to provide superior quality products. AI and machine learning can also be used to minimise manufacturing downtime, leading to higher production and profitability.
- The use of Robotics / Autonomous mobile robots has enhanced automation systems and does repetitive jobs precisely and at a lower cost.

The intelligent factories of tomorrow will rely on modern computer models. Industrial robotics is revolutionising manufacturing as they become noticeably more sophisticated, faster, and less costly and are being asked to do more to compete with more human skills and qualities such as detection, experience, memory, picking, packing, and trainability, and a wide range of industrial applications where human presence is not considered safe.

Future outlook

The future outlook for machining technologies holds exciting advancements. Ultrahigh-power fibre lasers and all-silicon lasers are revolutionising laser cutting, offering increased cutting speed, advanced applications, precision, and cost savings over traditional CO^2 systems. Nanotechnology opens new horizons, enabling nanoscale precision in CNC manufacturing. In-process quality control enhances product quality. Cloud computing is poised to transform CNC machining, providing real-time data analysis and efficiency.

However, adopting these advancements presents challenges like interfacing with existing equipment and ensuring quality output with trained personnel. Nonetheless, developments in laser cutting technology are setting new standards, and pushing the boundaries of what's possible in the industry. ☐

Turbines and manufacturing **transform with technology**

Steam turbines offer reliability, produce minimal vibrations and require fewer resources, making them ideal for various industrial applications. This technology aligns with India's goal of achieving a more sustainable and eco-friendly manufacturing landscape. The article emphasises the importance of technological advancements and the role of steam turbines in meeting energy needs in the manufacturing sector.

Nikhil Sawhney,
Vice Chairman and Managing Director, Triveni Turbines

In the past few years, India has undertaken a significant and dynamic effort to position itself as a prominent global manufacturing hub. The 'Make in India' campaign has emerged as a driving force in strengthening the nation's manufacturing sector. This catapulted the expansion of the manufacturing sector into new geographies and segments. A noteworthy catalyst for this expansion has been the implementation of the Production Linked Incentive (PLI) program, which has drawn in investments, totalling ₹ 62,500 Cr as of March 2023, fostering inventive strides within the manufacturing sector.

As a result of these policy measures, India has experienced an unparalleled revolution within the manufacturing sector over recent years. In 2022, this sector contributes approximately 17 percent to the nation's GDP and offers employment opportunities to a workforce exceeding 27.3 million individuals. The government's anticipation is to achieve a quarter of the economic output from this sector by 2025. Furthermore, it is expected that the sector will generate export commodities valued at $1 trillion by the year 2030.

Nevertheless, the sector has encountered several obstacles that have impeded its expansion and output. These challenges stem predominantly from a significant dependence on labour-intensive operations and a preference for moderately automated practices. The power supply emerges as a paramount concern in this context. Manufacturers not only require a consistent and adequate power supply but also the reduction of energy costs, which inevitably impacts the pricing of goods in the market. Concurrently, the sector is anticipated to align with India's global commitment to achieving a net-zero economy by 2070, necessitating a swift shift toward eco-friendly manufacturing practices.

In pursuit of this objective, alongside other measures, it becomes imperative to curtail energy consumption. This can be realised by enhancing machinery efficiency and fulfilling energy needs through alternative sources. Clean technologies, including renewable energy systems such as Bagasse, Biomass and Process Waste Heat can play a pivotal role in facilitating the manufacturing sector's transition towards a sustainable environment. This underscores the environmentally conscious solutions in steering the trajectory towards a sustainable future.

Manufacturing tech advancement in power sourcing

With the growing population and increasing business activities, the country is witnessing a continuous surge in energy demand. The reliance on traditional sources of energy is not a viable option today. The manufacturing industry must scout for ways to mitigate energy requirements and meet the same sustainably.

The advancement of technology in the manufacturing sector holds immense significance for several critical reasons in the on-going IR-4.0. Firstly, it allows manufacturers to meet their power requirements sustainably. Traditional manufacturing processes often rely heavily on fossil fuels, which not only deplete finite resources but also contribute significantly to greenhouse gas emissions. With technological innovations such as renewable energy sources, energy-efficient machinery and smart grid systems, manufacturers can transition towards greener, more sustainable power solutions. This not only reduces their environmental impact but also ensures a stable and reliable energy supply, reducing the vulnerability of production processes to energy shortages or price fluctuations.

Secondly, technological advancements in manufacturing are vital for reducing the sector's carbon footprint. Cutting-edge technologies enable manufacturers to optimise processes, minimise waste and use resources more efficiently. This translates into lower emissions, decreased energy consumption and reduced environmental harm.

The need to embrace energy-efficient technologies has spurred organisations to increase their investments in in-house Research and Development (R&D) efforts, as well as to enhance collaborations with universities for technological advancements. For entities within the manufacturing sector that are backed by in-house R&D and design teams, this enables quicker development cycles from concept to market-ready products. The Indian market, characterised by its demand for rapid technology adoption and prompt returns on investment, underscores the urgency for this approach.

Leaders in the manufacturing industry, equipped with in-house R&D capabilities, have effectively showcased that product development can be both expedited and capable of delivering enduring value. By adopting this innovative R&D strategy of tailoring product development to align with market demands such as efficiency, cost-effectiveness and

serviceability, prominent Indian capital goods manufacturers like Triveni Turbines have expanded their product footprint globally. The incorporation of efficient technologies and tools has genuinely unlocked new business prospects.

How steam turbines can help meet energy needs

Steam turbines offer several advantages in various industrial applications, primarily due to their high reliability. These machines excel in cases requiring sustained high-power output. Unlike some other forms of power generation, steam turbines can operate continuously without significant wear and tear, making them ideal for applications like power plants. A reliable supply of power is crucial for industries where power disruptions can lead to substantial financial losses. In addition to their reliability, steam turbines also have the advantage of generating less vibration compared to reciprocating engines. This characteristic is essential in many industrial processes where excessive vibration can lead to equipment damage, reduced efficiency or compromised product quality. The smoother operation of steam turbines minimises these issues, contributing to their suitability for a wide range of applications.

Steam turbines require lower mass flow rates compared to gas turbines, which means they can produce the same power with fewer input resources. This efficiency is advantageous for both cost savings and environmental considerations, as it reduces fuel consumption and emissions. Furthermore, steam turbines boast a very high power-to-weight ratio when compared to reciprocating engines, making them more compact and space-efficient while delivering substantial power outputs.

Another key advantage of steam turbines is their high thermal efficiency, especially when compared to reciprocating engines. Finally, steam turbines' rotary design makes them particularly well-suited for driving electricity generators. Their continuous, rotational motion aligns perfectly with the requirements of electricity generation, ensuring stable and efficient power production in various applications, from power plants to marine propulsion systems.

Utilising CO_2 as a working fluid

As outlined in the IEA report on energy utilisation, the world faces a 'cold crunch'. Cooling needs are set to increase energy demand by three-fold, from 12TW in 2016, to 36TW in 2050. This surge in energy demand has the potential to double CO_2 emissions by 2050, leading to a substantial increase in global warming. To address the heating necessities and to achieve Net Zero by 2050, 50 percent of heating demand has to be met by Heat Pumps.

As the world progresses in its efforts to address the energy trilemma, there is an immediate requirement to have alternative technologies to address the heating and cooling needs. The existing cooling requirements predominantly depend on refrigerants with a considerably higher Global Warming Potential than that of CO_2. CO_2 presents itself as both an ecologically friendly and cost-effective substitute for synthetic refrigerants. In light of these benefits, prominent Indian research and development entities have undertaken the development of Transcritical CO_2 (tCO_2) Cooling Skid and Heat Pump technology.

The supercritical CO_2 (sCO_2) technology presents itself as a more efficient and compact replacement to the steam Rankine cycle. Additional benefits include operational flexibility in terms of quick start/stop and improved overall lifecycle cost. A significant reduction in size, up to a factor of four (4), is anticipated with the implementation of sCO_2 power blocks compared to steam power blocks. With these essential factors in mind, Indian research and development centres are actively engaged in advancing sCO_2 technology, and the manufacturing sector is embracing this challenge. The industry is eagerly anticipating governmental support, such as subsidies, to accelerate the swift adoption of these advanced technologies.

Conclusion

Amidst India's on-going drive towards sustainability and clean energy, it is evident that manufacturing companies must adopt technological advancements to guarantee energy-efficient and eco-friendly production processes. This transition will not only contribute to curtailing the carbon footprint but also holds a pivotal position in propelling India's industrial landscape towards a cleaner and more sustainable trajectory. In this era of transformation, the fusion of technology and sustainability stands as the cornerstone for manufacturing's continued relevance and prosperity. ☐

Strategies for adapting Aviation & Defence **industries to disrupt Supply Chains**

Disruptions in the supply chain caused by global events, particularly the COVID-19 pandemic and geopolitical tensions, in the aerospace and defence industries' have caused delays, scrapped deliveries, and difficulties for OEMs in managing investments in production scale-ups amidst supply chain unpredictability. This article elaborates on the industry's trials and tribulations, pondering the potential for resolution amidst ongoing chaos.

Mudit Yadav,
Consultant,
Avalon Consulting

In the wake of a global pandemic, the once-stable supply chains of the aerospace and defence industries are now besieged by unprecedented disruptions. The post-Covid era has ushered in a new reality where managing delays and shortages has become the norm for Original Equipment Manufacturers (OEMs). But what are the catalysts of this persistent turmoil, and is there an end in sight?

The stability that defined aerospace and defence supply chains post-World War II has been upended. A confluence of rising global trade tensions and conflicts in Ukraine and Gaza has fragmented these critical networks, posing significant hurdles across sectors. The Red Sea crisis exemplifies the latest challenge, with US-Iran tensions prompting a massive rerouting of shipping lines—a detour adding 3,500 miles to reach European shores.

Manufacturers face the brunt of this instability, grappling with soaring commodity prices and erratic costs. The scarcity of skilled workers post-pandemic, coupled with a titanium shortage—stemming largely from Russian suppliers—has placed immense strain on supply chains. The repercussions are palpable: manufacturers delay timelines and scrap deliveries, while OEMs struggle to reconcile hefty investments in production scale-ups with the erratic nature of supply continuity.

The soaring demand keeps challenging the Aviation and Defence Supply Chain

The aviation sector is currently experiencing remarkable growth in demand, driven by projections of increased air passenger traffic in 2024. The International Air Transport Association (IATA) anticipates a surge to over 4.7 billion passengers, surpassing pre-pandemic levels of 4.5 billion. India, specifically, foresees domestic air traffic exceeding 150 million passengers, reflecting its status as one of the world's fastest-growing civil aviation markets.

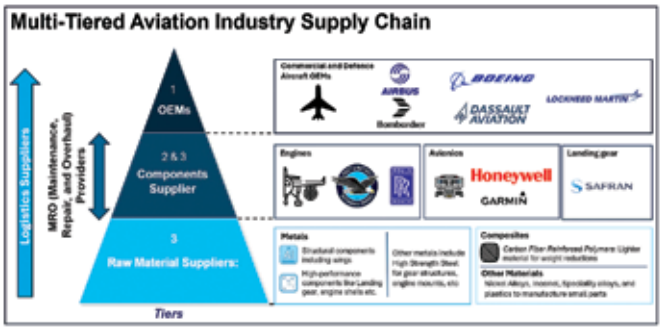
The defence sector has witnessed a surge in demand, largely driven by Russia's invasion of Ukraine and escalating tensions in the Middle East. Initiatives like the Global Combat Air Program (GCAP) and the AUKUS agreement highlight a growing emphasis on military capabilities worldwide.

India, aiming for self-reliance and bolstering its global geopolitical standing, has prioritised expanding its defence arsenal.

Challenges for Aviation and Defence Industries

Both the aviation and defence industry supply chains have a multi-tiered structure, with various players contributing to the final product as suppliers or contractors (figure 1 and figure 3)

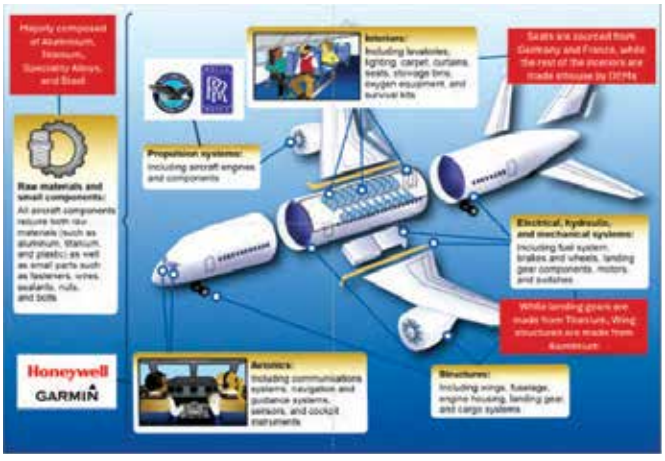
Figure 1: Multi-Tiered Aviation Industry Supply Chain (Avalon Consulting Research)



Considering the parts are sourced globally by T1 Suppliers (refer to above figure), they have been subject to delays from Tier 2 and 3 suppliers, and other key supply chain members face the following challenges,

1. **Shortage of Skilled Workforce:** Post-pandemic, the industry faces a skilled labour shortage. Resuming operations has spiked labour demand and costs, intensified worker competition, and the need for hazardous condition work further complicates resource attraction. The industry also faces competition from other specialized industries for skilled workforce.

Figure 2: Breakdown of components of an Aircraft (Source: Avalon Consulting and Research)



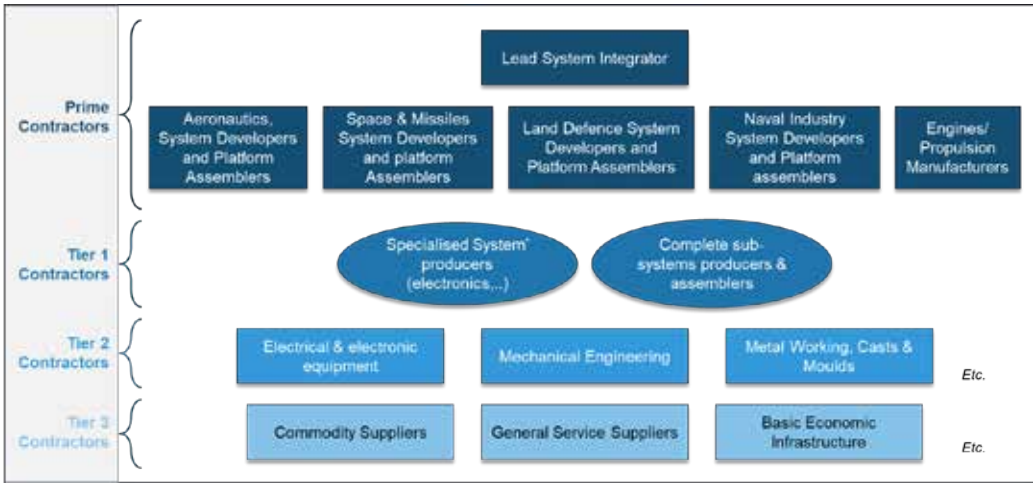
2. **Long Delays in lead times:** Global supplier networks sustain aviation; however, geopolitical strife, particularly the Russia-Ukraine conflict, has hindered titanium and aluminium supplies, l eading to critical part shortages and significant assembly line disruptions.
3. **Semi-conductor shortages:** Semiconductor shortages, driven by consumer demand, pandemic impacts, and political issues, persistently disrupt Aviation and Defence industries.

4. **Rising cost of raw materials continue to affect defence contracts and Aircraft orders:** Supply chain issues have escalated costs for key materials like aluminum and titanium, with a significant reliance on China and Russia's prioritization of domestic needs over international markets, highlighting a stark imbalance in global supply.
5. **Components shortage for MRO (figure 1) of Existing Fleet of Aviation Companies**: Due to the disrupted supply chains, the management of fleets has become difficult, as many suppliers at tier 2 and 3 of the supply chain have been facing delays. Amid Sanctions, the MRO supplies are blocked for Russia, making it even more difficult for Russian Carriers to operate.

Escalating global instability has propelled commodity prices to record highs, leading to significant cost fluctuations for manufacturers. Post-pandemic skills shortages and a global titanium scarcity, predominantly sourced from Russia, further burden aerospace and defence supply chains. Safety concerns surrounding Boeing aircraft exacerbate uncertainties, contributing to demand fluctuations and price hikes.

This extensive supply chain fragmentation is rooted in globalisation trends predating 2020, where manufacturers prioritised low-cost country sourcing. Now, amidst ongoing disruptions, companies are pivoting towards localised or regionalized production to enhance resilience against supply chain vulnerabilities.

Figure 3: Supply Chain of Defence Industry (Source: BIPE)



Seizing opportunities in Aerospace and Defence Supply Chains

Amidst geopolitical uncertainty and cost volatility, aerospace and defence manufacturers face both risks and growth prospects. To capitalise on rapid defence sector expansion:

- **Embrace Innovation and Collaboration:** Original Equipment Manufacturers (OEMs) and sub-tier supply chains should foster innovation and remain open to fresh ideas. Industry collaboration, especially in supply chain inventory management and new product design, is crucial. Leverage digital technologies like AI systems and digital twins for faster innovation and seamless integration.
- **Effective Product Lifecycle Management (PLM):** PLM streamlines innovation from design to production, distribution, and end-of-life planning. Agile design methods, akin to software industry practices, allow for in-life upgrades and mitigate technology obsolescence risks.
- **Position as Innovation Leaders:** OEMs serving the global defence industry can establish collaborations and develop innovative products. These innovations may also benefit civil aircraft designers, creating a unique opportunity.
- **Boost Resilience and Efficiency:** Strengthen supply chain resilience and operational efficiency. Leverage AI, automation, and digital tools to gain a competitive edge.
- **Strategic Investment Decisions:** When evaluating tech transfer opportunities, challenge customer demands and prioritise long-term benefits. Facilitate end-to-end supply chain integration and positive industry collaborations for commercial success.

In this dynamic landscape, forward-thinking decisions can yield substantial rewards for aerospace and defence manufacturers. ☐

BLUEMARK ID and BLUEMARK ID COLOUR by Phoenix Contact

BLUEMARK ID and BLUEMARK ID COLOUR printing systems

Phoenix Contact recently released, the BLUEMARK ID and BLUEMARK ID COLOUR printing systems, which are both based on established UV-LED printing technology. The main feature distinguishing the two printing systems is the fact that the BLUEMARK ID COLOUR is Phoenix Contact's first printing system to be equipped with fully integrated color management (CMYK). Operation is either with the CLIP PROJECT software or the full-featured marking software via the 7-inch touch display. With the new BLUEMARK ID COLOUR, rating plates, that feature company logos or plant markings with warning symbols in contrasting colors can easily be created without compromising on speed or quality. A key feature is that the BLUEMARK ID & Color can now also process the entire US sheet material range. As a result, there is no desktop printing system on the market that can measure up to the application depth of the new BLUEMARK ID generation.

Major features and benefits:

- **Software onboard:** Quick, easy visual help in the event of a fault, thanks to integrated fault videos. No further PC is required to control the printer. The customer saves time, through direct entry of printing data. Via filters in the search wizard, a quick compressed display of the item, including technical data
- **High print speed:**

BLUEMARK ID: 60min = 21,000 markers

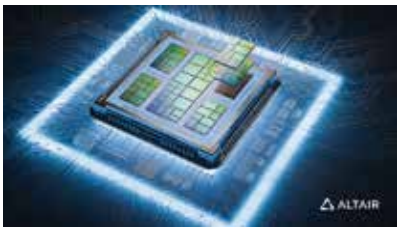
BLUEMARK ID COLOUR: 60min = 14,000 markers

- **Scalable print image resolution:** Due to the scalability, the use of fluid and the speed can be adjusted depending on the application. This saves time and money.
- **Automatic material detection:** Incorrect printing due to integrated material detection for UCT and US materials
- **Wide range of materials:** With more than 1350 marking materials, on 8 different base materials, offers enormous flexibility. Our customers always have the right material to choose from, regardless of the application. There is no larger material selection on the market.

Phoenix Contact India | New Delhi

Multi-disciplinary solver for PCB, IC

Altair recently announced the upcoming release of Altair SimSolid for electronics, bringing game-changing fast, easy, and precise multi-physics scenario exploration for electronics, from chips, PCBs, and ICs to full system design. Altair SimSolid has revolutionised conventional analysis in its ability to accurately predict complex structural problems with blazing-fast speed while eliminating the complexity of laborious hours of modelling. It eliminates geometry simplification and meshing, the two most time-consuming and expertise-intensive tasks done in traditional finite element analysis. As a result, it delivers results in seconds to minutes—up to 25x faster than traditional finite element solvers—and effortlessly handles complex assemblies. Having experienced fast adoption in the aerospace and automotive industries, two sectors that typically experience challenges associated with massive structures, Altair SimSolid is poised to play a significant role in the electronics market. The initial release, expected in Q2 2024, will support structural and thermal analysis for PCBs and ICs, with full electromagnetic analysis coming in a future release.



Altair SimSolid

Altair | Pune

Optimise chip control to eliminate scrapped parts

Seco Tools India's Seco Nanojet Solid Carbide Reamers enhance chip control with an innovative through coolant outlet for optimal chip evacuation. This design eliminates costly scrapped parts, jamming, and edge damage to increase safety, part quality, and tool life. Better coolant flow for better parts Critical reaming operations require stable, secure, and predictable tools. On blind and through bores, Seco Nanojet Solid Carbide Reamers extend the proven performance of Seco Nanofix products with innovative through-coolant outlets that stop chip jamming and enhance application stability. The unique design of these new tools delivers a powerful, precise stream of lubrication directly to the cut zone for optimal chip evacuation and tool life. Along with production stability, shops can rely on Seco Nanojet Solid Carbide Reamers to maintain cutting speeds as well as part quality. This versatile range of multi-flute reamers comes in eight grades and more than 10 geometries, along with custom sizes and tolerances. The tools work with any precision tool holder.

Nanojet Reamers

Seco Tools India | Pune

Why your business needs thermal condition based monitoring?

FLIR Systems India recently showcased their products, which include a range of thermal cameras, with products such as the FLIR E8 Pro having seamless cloud-based backup and file transfer through the FLIR Thermal Studio reporting software. If regular thermal inspections are undertaken, thermal signatures can be identified for every electrical connection, electric motor, other electric component, or moving equipment in a facility. While equipment operates as intended, temperatures will remain reasonably consistent, and the insights gained will be no more than regular reassurance. However, if suddenly a temperature reading begins to unusually increase, then this may be indicative of a developing fault.

Product quality is high on the priority list of any reputable manufacturer. Whether your business manufactures finished articles or components for other businesses to incorporate into their products, the risks are the same: if your production equipment fails, your business quickly transitions from a profitable organisation to a loss-making company.

Many businesses used to keep a healthy level of reserve stock in the warehouse to ensure their customers were never let down in the event of an unplanned break in production. But as competition increases and margins erode, most businesses choose to tie up as little cash in stockholding as possible, making reserve stock a less efficient way to operate in today's highly competitive environment.

As businesses hold less stock, the effect of disruption to production is quickly compounded, deliveries are more likely to be missed, and customers are let down. This not only impacts revenue from lost business, but it also damages the reputation of a business.

Industries, such as the automotive industry, face severe supply fines if they fail to deliver on time. Many modern car production lines can produce a car every 90 seconds, so a one-hour shut-down results in 40 cars not being produced. If the average price of a car is €35,000, then this type of incident would result in a loss of €1.4 million. As a result, it is not difficult to understand the high fines associated with missed delivery deadlines.

But can these issues be avoided in the first place? We believe the answer is yes. Carefully monitoring the condition of your production equipment regularly has shown that many supply chain problems can be eliminated.

For example, if your business uses an electric motor at any stage during the production process, when was it last checked for cleanliness? Electric motors can overheat due to a buildup of dirt and debris blocking airflow holes that are designed to help cool the motor. The motor may not be old or have any obvious issues – in fact, it may appear to be working perfectly well until it suddenly fails.

Other examples might be electrical connections, fuse boxes, contactor plates, or other components found in electrical cabinets. Over time, tiny vibrations and heat cycles can cause crimpe connections to loosen, along with nuts and bolts on connective wiring, which give rise to elevated temperatures as the electrical resistance increases. This type of common fault has no visual clues and can happen at any time during the production process, yet in most cases, it can be prevented using predictive condition monitoring techniques.

FLIR E8 Pro

As mentioned earlier in this article, correcting faults may be as simple as tightening a connection or cleaning cooling fins or airways, but faults may be more severe and require more detailed maintenance or component replacement.

In the example of an electric motor exhibiting higher temperatures due to a buildup of dust and dirt, the fix may take 5 minutes when the motor has been turned off to clean it thoroughly. If the issue isn't identified early, the motor may fail to deteriorate and require a replacement motor to be installed, potentially resulting in a shutdown over several days while waiting for a new motor to be delivered.

Thermal cameras require little training to use in the hands of an operator, and the investment in a camera, operator training, and associated reporting software may cost less than you think. The one certainty is that the overall cost will be less than an unplanned production shutdown.

FLIR Systems India | Delhi

Highlights: June 2024

» Textile Machine Industry

The textile machine industry stands as a cornerstone of modern manufacturing, continually evolving to meet the ever-growing demands of global markets. From advanced weaving looms to state-of-the-art knitting machines, the sector thrives on innovation, driving productivity and quality to unprecedented levels. This section revolves around the intricate world of textile machinery, where every thread counts towards revolutionising the way fabrics are produced.

» Cobots/ Expansion of Collaborative Robotics

Cobots represent the forefront of automation technology, emphasising safe and seamless interaction between humans and machines. With the expansion of collaborative robotics, industries are witnessing a revolution in productivity, efficiency, and workplace safety. This section will explore how cobots are reshaping industries, driving innovation, and paving the way for a more collaborative future.

» Additive Manufacturing/ Rapid Prototyping

Additive Manufacturing, or Rapid Prototyping, redefines production with unparalleled efficiency and innovation. In this feature, we explore its cutting-edge applications and transformative impact across industries. Join us as we uncover the future of manufacturing, one layer at a time.

» Smart Automation and Blockchain used in the EV industry

The convergence of smart automation and blockchain technology is revolutionising the EV Industry. The Special Feature, deep dives into the dynamic synergy between smart automation solutions and blockchain applications, catalyzing efficiency, transparency, and sustainability across the EV supply chain. Join us as we explore how these cutting-edge technologies are reshaping manufacturing processes, enhancing operational excellence, and fostering trust in the B2B realm of electric mobility.

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Subscription
Cover Price: ₹ 100
Annual Subscription Price: ₹ 1200
em.magazine@pi-india.in
Tel: +91-7410009435/36

Printing
United Multicolour Printers Private Limited,
264/4, Riverview Apartment,
Shaniwar Peth, Pune 411 030, India

Internet http://pi-india.in/

Digital edition http://pi-india.in/magazine

Mastering Complexity

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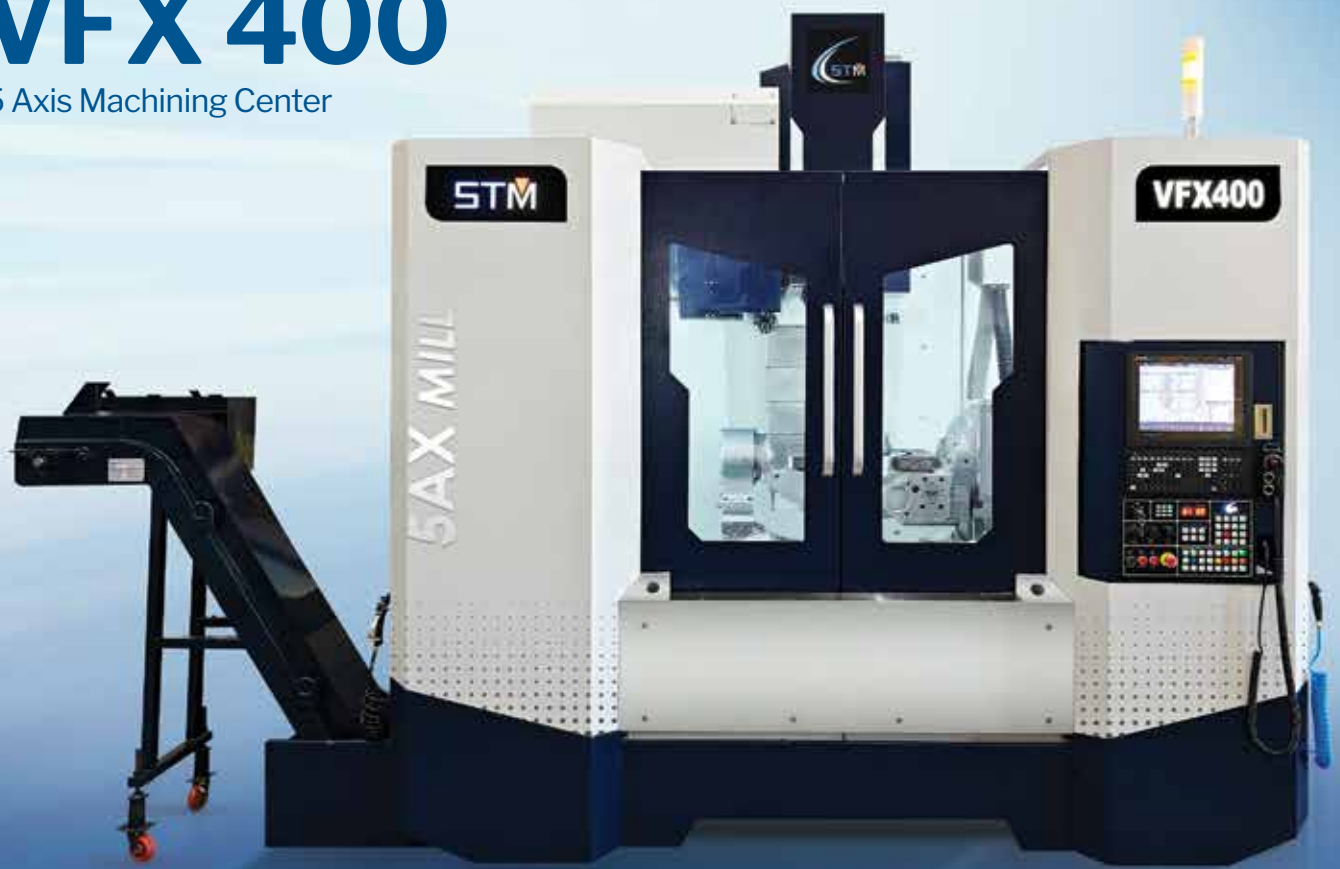
New Launch

VFX 400

5 Axis Machining Center



Streamlining the manufacturing process, the VFX 400 significantly reduces setup times and excels in multi-sided machining for diverse surfaces. Its advanced capabilities include handling complex geometries, consolidating multiple machining steps into a single operation.

INDUSTRY SECTORS

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