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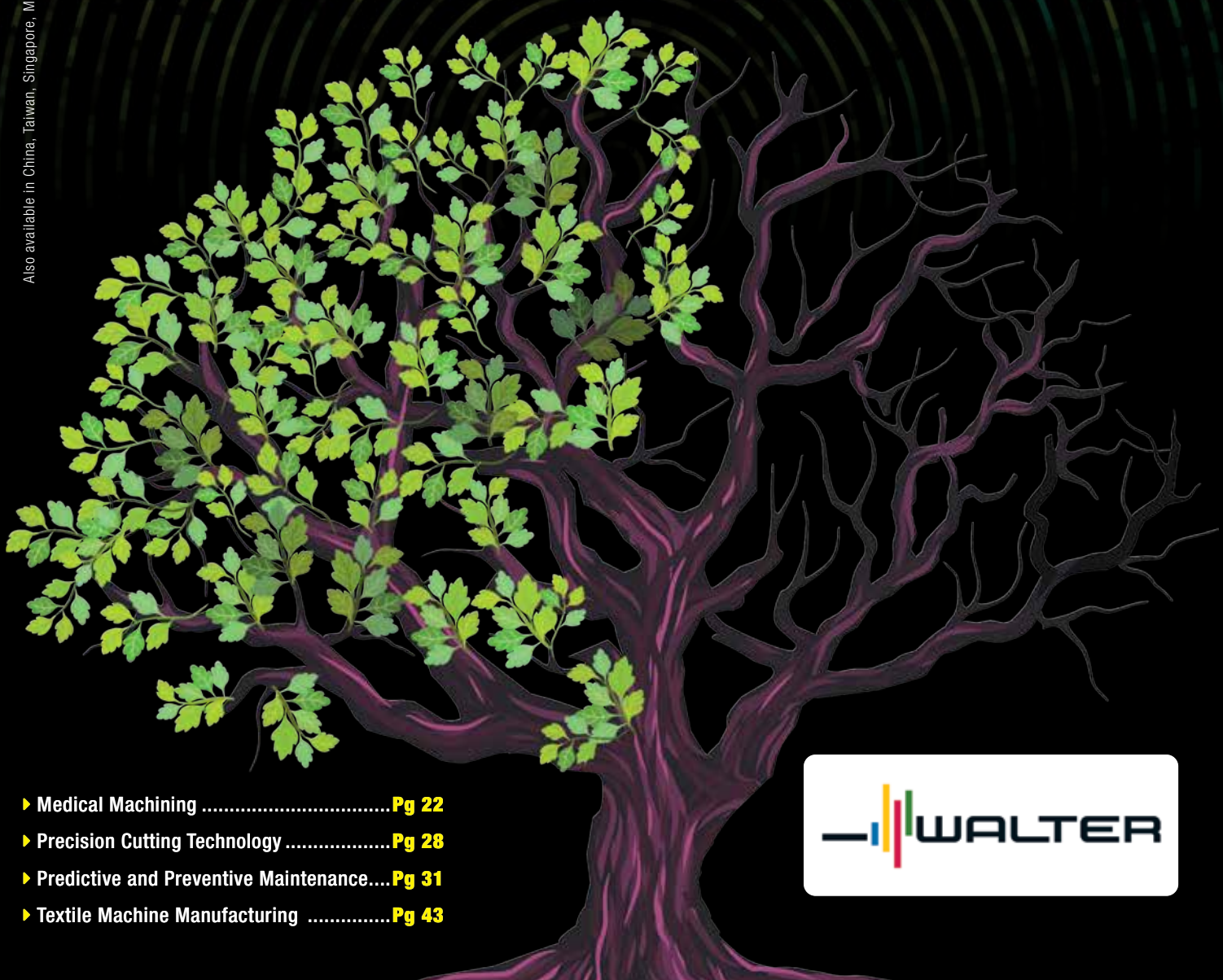

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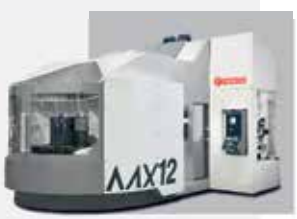

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"The path to progress lies in circularity"

Fast-tracking India's circular economy

India stands at a crucial juncture in its pursuit of economic growth. To mitigate the adverse impacts of rapid urbanisation, industrialisation, population growth and climate change, embracing circularity in our economic development is essential. India's reputation for frugal innovation offers a foundation for this shift. This entails adopting design-thinking strategies throughout product lifecycles and mitigate raw material scarcity risks.

In our Cover Story, we shed light on Navigating the Circular Economy, exploring how this model addresses environmental and societal challenges in India. This issue's Industry Focus delves into Medical Machining, providing insights into India's medical technology sector. Our Technology Focus spotlights Precision Cutting Technology, unveiling its advancements in manufacturing.

Additionally, we examine Predictive and Preventive Maintenance strategies and approaches in rapidly evolving industrial operations. Our Special Feature highlights Textile Machine Manufacturing, showcasing innovative processes and technologies revolutionising textiles.

November marks a special milestone as Efficient Manufacturing magazine completes 14 years in the industry. In our November issue, we will feature insights from manufacturing industry leaders, sharing their thoughts on the sector's progress. Stay tuned for our upcoming issue as we continue to highlight the manufacturing industry's remarkable advancements.

Neha Basudkar Ghate
Joint Editor
neha.basudkar@pi-india.in

MANAGEMENT NOTE

With digital technologies advancing rapidly, the manufacturing landscape is experiencing a profound transformation across sectors. In our upcoming issue, we'll be your guide to these transformative developments. We are thrilled to introduce new digital initiatives that enhance your reading experience. Our interactive comments section enables readers to shape our content, ensuring it meets your needs and expectations.

But that's not all! Our cutting-edge Flip magazine offers an immersive experience, allowing you to watch videos while seamlessly flipping through the pages. Dive into the world of manufacturing innovation like never before. Stay tuned for more exciting updates, including the latest episode of '***Morning Bytes***', our weekly podcast, and engaging video content on our LinkedIn accounts. We are dedicated to keeping you informed and engaged in the ever-evolving manufacturing landscape. Join the conversation and share your insights at www.pi-india.in.

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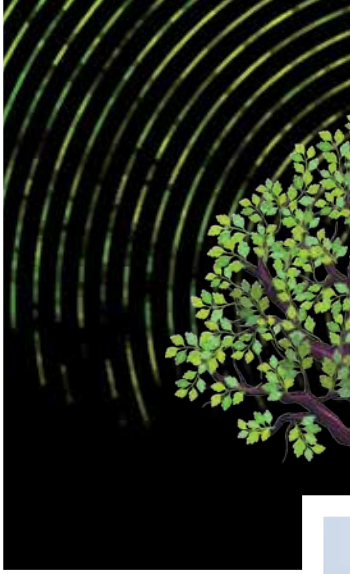

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PREDICTIVE AND PREVENTIVE MAINTENANCE
Proactive maintenance using new-age technology

All images courtesy: *shutterstock*

SPECIAL FEATURE

NEW PRODUCTS

Columns

Arun Bhardwaj
Editor, EM and A&D India

EV battery technologies: **key considerations**

The Electric Vehicle (EV) industry is undergoing a transformative shift, with a focus on sustainability, innovation and global competitiveness.
In continuation from the previous issue, this column explores three pivotal aspects that are shaping the future of EVs and the broader electric mobility landscape.

Talk

"In the race towards a greener future, the evolution of battery technology promises to power a transformative era in e-mobility with accessible and sustainable transportation and energy systems".

- **Rapid charging and infrastructure development**

Charging infrastructure is a critical factor in the widespread adoption of EVs. This section discusses the synergy between battery advancements and the development of fast-charging networks. Innovative charging technologies are facilitating quicker and more convenient charging experiences for EV users, making e-mobility increasingly accessible.

- **Sustainability and circular economy**

As the EV market grows, sustainability considerations are gaining prominence. This section explores efforts to create a sustainable battery ecosystem. It delves into initiatives for environment-friendly battery manufacturing, recycling and repurposing. These endeavours aim to minimise the environmental footprint of batteries, support the circular economy model and ensure that EVs remain a greener choice for transportation in the long run.

- **Global battery race and supply dynamics**

Batteries are central not only to EVs but also to various sectors such as electronics and utilities. The EV industry's rapid growth has spurred demand for batteries, resulting in supply shortfalls and increased material costs.

The future of E-mobility battery tech

The next decade promises a transformative era for battery technology. As automakers aim to electrify their fleets and reduce carbon emissions, advancements in battery technology will be a driving force. With a focus on reducing costs, increasing energy density and improving safety, the battery race is set to reshape the automotive and energy sectors. The future of EV battery technology envisions a transition to cleaner, more efficient and sustainable transportation and energy systems, with batteries playing a central role in this transformation. These advancements aim to make EVs more accessible, practical and environment-friendly, contributing to a greener and more sustainable future.

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Kirloskar Oil Engines launch the largest range of CPCB IV+ Compliant Gensets, Flexi-Fuel and Optiprime Range

Kirloskar Oil Engines (KOEL) recently launched its range of CPCB IV+ compliant gensets. With a focus on delivering high-performance, fuel-efficient and environmentally responsible solutions, the new gensets meet the latest emission norms set by the Central Pollution Control Board (CPCB). These gensets are designed to cater to diverse power requirements across various sectors, ensuring businesses and communities have access to more reliable, cleaner and better power.

Kirloskar gensets are engineered to operate efficiently on multiple fuel options, including diesel, natural gas, biogas and more, providing unmatched flexibility to consumers. Hence, by offering fuel-agnostic gensets, Kirloskar aims to empower businesses and industries to choose the most suitable fuel source based on their needs, location and availability. This initiative reinforces the brand's commitment towards resource optimisation, contributing to a greener and more energy-diverse future.

This new range of Optiprime gensets is based on their patented hybrid technology, which helps expand the range of efficient load, leading to significant savings for their customers by significantly lowering the consumption of fuel and other consumables. This range of gensets provides increased flexibility, even lower emissions, and increased savings for our customers. These new range of Gensets are 'Made in India' and are IoT-enabled, thereby transforming the landscape of power generation and its monitoring. Through advanced connectivity and data analytics, real-time insights, predictive maintenance and remote monitoring capabilities that enhance operational efficiency and uptime are possible.

During the launch, Gauri Kirloskar, Managing Director, emphasised, "Kirloskar Oil Engines Limited has been a leader in the power generation industry since its inception. Our ability to swiftly adapt to change and deliver innovative solutions has established us as India's foremost manufacturer of reliable and fuel-efficient Gensets. We believe that our latest offering, the Optiprime version, will further solidify our leadership in the market. At the core of our operations lies our unwavering commitment to our customers. Backed by an unparalleled product service network of over 3,000 dedicated technicians available round the clock, we ensure the highest level of customer-centricity".

Sterling Generators and Pi Green Innovations launch Retrofit Emission Control Device

Sterling Generators (SGPL), a Sterling and Wilson Group Company, in collaboration with Pi Green Innovations, recently launched an innovative clean air solution, the Retrofit Emission Control Device (RECD). RECD is built on filterless technology and based on Electrostatic Precipitation fundamentals. It captures Particulate Matter (PM) from the engine exhaust with more than 70% efficiency.

Commenting on the product launch, Sanjay Jadhav, CEO, Sterling Generators, said, "The world's sustainable journey to zero emissions is advancing across sectors, and India's 2070 net-zero target spans the entire economy. At Sterling Generators, our commitment to environmental compliance aligns perfectly with this vision. Our collaboration opens doors to enrich our product range. The newly launched RECD offers high-efficiency air quality improvement and aids in meeting PM compliance, following pollution control board norms. Notably, RECD poses no harm to diesel generator sets".

"Together with Pi Green Innovations, we aim to redefine how the industry addresses air pollution, setting a new standard for cleaner energy solutions", Jadhav further added.

Speaking at the launch event, Irfan Pathan, Founder & CEO, Pi Green Innovations, said, "We are honoured and proud to partner with a prestigious brand like Sterling Generators. This partnership not only gives a boost to the DG retrofit (RECD) industry in India but also adds impetus to Pi Green's vision of A Pollution Free Tomorrow".

The RECD is installed after the DG exhaust (muffler or silencer), and no modifications to the engine or DG set are required. What sets this technology apart is its ability to transform the separated particulate matter or byproduct and reuse it as a high-value raw material in paints, dyes and toners for laser printers and copiers, as well as in a vulcanisation process to treat rubber, thus eliminating the need for disposal and secondary contamination. The product is all weatherproof and needs minimal maintenance, with a simple, efficient and sturdy construction that provides constant performance and long operational life.

Renishaw's 'Unveiling Innovation' Open House celebrates 50 years of excellence

Renishaw marked a significant milestone this year, celebrating its 50th anniversary at the Renishaw Technology Centre in Hinjawadi Phase II, Pune, on September 12, 2023. This special occasion was dedicated to unveiling the rejuvenated Pune Technology Centre, setting the stage for their 'Unveiling Innovation' Open House.

The Open House was a momentous event designed to showcase the latest solutions and cutting-edge technologies offered by Renishaw. This state-of-the-art technology hub is outfitted with the most advanced engineering technologies, empowering customers to manufacture exceptional quality components. Strategically located in Pune, Bangalore, Gurgaon, and Chennai, these facilities are intended to benefit customers by enabling them to produce higher-quality parts.

The central theme of this Open House revolved around industrial automation and its role in propelling the automotive revolution. Over 150 individuals representing diverse industrial sectors, including automotive, electric vehicle, general engineering and tool and gauge, among others, graced the event.

The Open house displayed Renishaw's extensive product portfolio, including its advanced metrology equipment for process control applications, such as the CMM probes, software and retrofits, Machine tool probes and software, Machine calibration and optimisation, Equator™ gauging systems, fixtures and Raman spectroscopy.

During this occasion, Team EM interviewed, Paul Weaver, Director of Sales & Marketing, Renishaw India. He said, "At the outset, achieving 50 years of success is a remarkable feat for Renishaw, originally a small company that has since expanded to a global presence. Renishaw firmly resides in the realm of technological innovation, providing valuable support to its customers within the manufacturing sector, with a particular focus on the Indian market".

Weaver also stated, that, "The Open House showcased the renovated Renishaw Technology Centre in Pune's Hinjawadi Phase II, uniting local customers to explore our comprehensive solutions, from CMM probes and CNC machine tool scanning systems to 5-axis non-contact CMM inspection. This includes the Equator™ shopfloor gauging systems, fixtures, Raman spectroscopy and our expanding encoder product line, featuring enclosed rotary and linear encoders tailored for machine tool builders".

Paul Weaver, Director of Sales & Marketing, Renishaw India

> "We recently inaugurated a technology centre in Bangalore, our primary sales and marketing hub, given its proximity to the machine tool industry. However, Pune is pivotal, housing demo centres across India to support our customers. The Indian market is experiencing exponential growth, attracting investments across varied sectors, thanks to government support. Our technology centre empowers customers to produce superior, high-quality parts with the right technology, enhancing yields and quality."

"EV last-mile segment grows rapidly in cargo and passenger areas"

…says **Debashish Mitra,** Director, Sales, Service & Marketing, Altigreen. In an interview with Sanjay Jadhav, he shares compelling insights into India's evolving EV market and Altigreen's vision and accomplishments as they continue to shape the future of sustainable mobility. Excerpts from the interview…

Can you share your perspective on the current market trends for EVs in India, particularly in the last-mile segment?

The EV last mile segment has been growing at a very fast pace in both cargo and passenger segments. The penetration of EV in the organised last-mile segment is currently at 24%, which was 18% last year, 6% in 2021–22 and only 1% in 2020–21. Apart from the FAME subsidy and some government initiatives to promote EVs, the economic benefits of using EVs, as compared to their ICE counterparts, are now felt by the user. A diesel three-wheeler has an operating cost of ₹3.5– ₹4/km, while an EV three-wheeler operates at 92p/km.

What growth plans does the company have to expand its market presence both within and beyond India?

Altigreen has grown multi-fold since its phase one investment of ₹300cr, which was garnered from various investors, including Reliance, in February 2022. Apart from building a strong organisation of 900 people and a state-of-the-art plant spread over 3 lakh sq ft that has a production capacity of 55,000 units/year, Altigreen has built a strong dealership network in 31 cities with strong partners having decades of experience in commercial and passenger vehicles with other brands. The company currently wants to focus on the domestic market and would soon want to unveil plans for offshore markets as well.

Can you discuss the company's approach to innovation and research to stay ahead in the evolving market?

Altigreen has always been an innovation-based company. The company conducted strong research for over eight years and acquired 28 patents globally and 93% localisation, displaying Altigreen's high focus on R&D.

How does Altigreen address concerns about charging infrastructure and range anxiety?

Altigreen's batteries can be charged at home with a three-phase power supply. Their large battery capacities of 11kWh, high quality cells and technology ensure high regeneration capacity and address the range anxiety issue. Altigreen vehicles deliver >120-km range with a 550-kg load on road. Altigreen is building an e-Pump network in cities like Hyderabad, Chennai and Delhi, starting from Bangalore.

"EV charging industry uses solar power to reduce carbon footprint"

…says **Ashish Deswal,** Founder, Earthtron EV. In an interview with Neha Basudkar Ghate, he provides insights into their innovative approach towards sustainable transportation. Excerpts from the interview…

What inspired you to enter the EV charging industry? Could you share your journey and how your passion for sustainability influenced your decision?

In the initial years, our prime focus was to gather as much expertise as we could to gain an edge over our competitors in the evolving EV charging market in the country. After gaining significant experience in technology and business, with the aim to develop sustainable EV solutions, the idea of Earthtron EV was conceptualised in 2020. Later, after extensive research and brainstorming sessions, we could finally come up with a dynamic EV charging solution. The company began operations in November 2021 and was launched in 2022. Since then, the company has been growing by leaps and bounds.

What are some of the latest trends you have observed in EV charging? How is Earthtron EV adapting to these trends?

Many players in the EV charging industry are now partnering with EV manufacturers to facilitate the setting up of robust charging infrastructure. Moreover, charging station operators are leveraging renewable energy resources like solar power to power charging stations, thereby contributing towards the reduction of overall carbon footprint. There has been a smooth integration of charging stations with digital platforms to provide users with real-time information on the availability and location of charging stations.

Earthtron EV aims to install over 500 charging stations by Dec'24. What strategies and investments are you planning to achieve in this target?

Our primary strategy is to make EV charging stations available for the masses to make their journey easy and hassle-free. We are aiming to plant our advanced charging stations at popular hubs to cater to the charging needs of a large number of EV users. We have quite a few big things that we will be unveiling soon and many of these initiatives are planned with the leading EV OEMs in the market i.e. our charging stations will be accessible to their customers using their apps.

How do you foresee the future of the EV charging industry? What role do you see Earthtron EV playing in this future landscape?

The year 2022 witnessed more than five times growth in the number of EV charging stations in the country, and the number is further expected to rise exponentially in the coming years. Earthtron is committed to creating a hassle-free service and installing fast EV charging stations along most northern highways. We will keep striving to provide a seamless charging experience by ensuring all their charging stations are well-maintained and the customer service team is accessible round the clock.

"India's rise as the world's second-largest steel producer signifies growth and innovation in construction"

says **Anoop Kumar Trivedi,** MD, Tata BlueScope Steel. In an interview with Sanjay Jadhav, he describes that steel plays a pivotal role in shaping the world that harmoniously balances human advancement with environmental integrity. Excerpts from the interview...

Q How would you define the role of steel in building a durable and sustainable future?

Steel's unique combination of strength, versatility and recyclability positions it as a cornerstone of modern construction and innovation, driving a future that marries durability with sustainability. Its adaptability enables the creation of energy-efficient and eco-friendly structures, reflecting a commitment to both human progress and environmental stewardship. The global attributes of steel transcend its physical properties, transforming it into a catalyst for sustainable development. This holistic vision underscores the essential role of steel in forging a resilient and environmentally conscious future. The continued evolution and responsible utilisation of steel are pivotal in shaping a world that harmoniously balances human advancement with environmental integrity.

Q What are some major developments in the Indian steel construction industry over the past few years?

India's ascent to the position of the world's second-largest crude steel producer, with a production of 120 MT in FY'22, underscores a period of remarkable growth and innovation in the steel construction industry. The anticipated surge in finished steel consumption to 230 MT by 2030–31, coupled with industry consolidation and strategic government initiatives, reflects a robust and resilient sector.

Despite challenges such as the pandemic's impact and labour shortages, the industry has forged ahead with technological advancements, quality enhancements and the exploration of new markets such as metal roofing. With a projected CAGR of 7%–7.5% in steel demand through FY 2024–25, driven by sectors like housing, rural development and automotive, the Indian steel industry's multifaceted growth and commitment to excellence signal a future defined by innovation, sustainability and global competitiveness.

Q Tata BlueScope Steel operates in the APAC region. How does the company's business model adapt to the changing customer demands?

At Tata BlueScope Steel, the customer is central to everything we do, guiding our product and solution development efforts. Our strategically positioned plants and partners facilitate a customer-centric experience by ensuring product availability. Our extensive network, with over 6000 touchpoints, guarantees our presence across the Indian subcontinent. We differentiate ourselves through our service offerings, including an in-house design and engineering team, a construction team that adheres to the highest safety standards, a pool of

certified builders, Annual Maintenance Contracts and specialised Roof Diagnostics. Our robust manufacturing abilities are complemented by technical expertise and research support from BlueScope, Australia. We've been monitoring our products' performance for over three decades across various climatic conditions, using both exposure test sites and infield inspections. Our commitment to cutting-edge technology drives operational efficiency, productivity and growth, while our focus on sustainability is evident in our environmentally friendly and thermally efficient steel products.

The success of Tata BlueScope Steel is rooted in our enduring relationships within the construction community and our ability to provide comprehensive, tailored solutions that cater to our customer's specific needs. We recognise that in today's construction sector, customers require more than just a product; they need a partner who can assist them from the conceptual stage through design, engineering, supplies, installation and beyond.

Q How does Tata BlueScope Steel stay at the forefront of technological advancements in the steel industry, especially in the fields of coated steel and building products?

Tata BlueScope Steel represents a strategic fusion between the trust of the TATA Group and the quality assurance of BlueScope, transcending mere corporate alignment to become a guiding philosophy. Recognising the dynamic growth in the steel industry, particularly in coated steel and building products, TBSL is poised to leverage the surge in construction activities. The market's expansion is driven by coated steel attributes such as durability, hygiene and cost-effectiveness, with the Asia-Pacific region holding a significant market share. Despite challenges from alternatives like aluminium, the demand for colour-coated steel continues to rise, propelled by urbanisation, infrastructure development and the automotive sector. TBSL's focus on innovation, quality and sustainability aligns with these market drivers and anticipates growth in the metallic-coated steel segment. By strategically positioning itself to harness opportunities in emerging economies and renovation activities, TBSL demonstrates a forward-thinking approach, prepared to navigate challenges and contribute to the evolving landscape of the global steel industry.

Q Tata BlueScope Steel is a joint venture between Tata Steel and BlueScope Steel. How has this partnership influenced the company's growth and expansion strategy and how do you foresee the coming years?

Tata BlueScope Steel Limited represents a remarkable collaboration between two globally acclaimed corporations: Tata Steel, one of the largest, geographically diversified steel companies, and BlueScope Steel, Australia, a world leader in coated steel. Both companies, each with a legacy spanning over a century and leaders in their respective fields, foresaw the potential of India's construction landscape well ahead of its time. Established in 2005 and operating within the ASIA PACIFIC regions, Tata BlueScope Steel has positioned itself as a premium supplier of Colour Coated steel, Steel Building Products and Building Solutions. This joint venture has introduced globally recognised and technologically advanced brands to India, such as COLORBOND® steel and ZINCALUME® steel, specifically for architects and consultants.

Additionally, the LYSAGHT® roof and wall cladding solutions have been brought to the market, offering innovative roofing solutions for progressive infrastructural applications, including metros, railways and industrial structures. In the coming years, we would be focusing on expanding our impact by creating innovative learning interventions with strategic alignments to our company's vision. □

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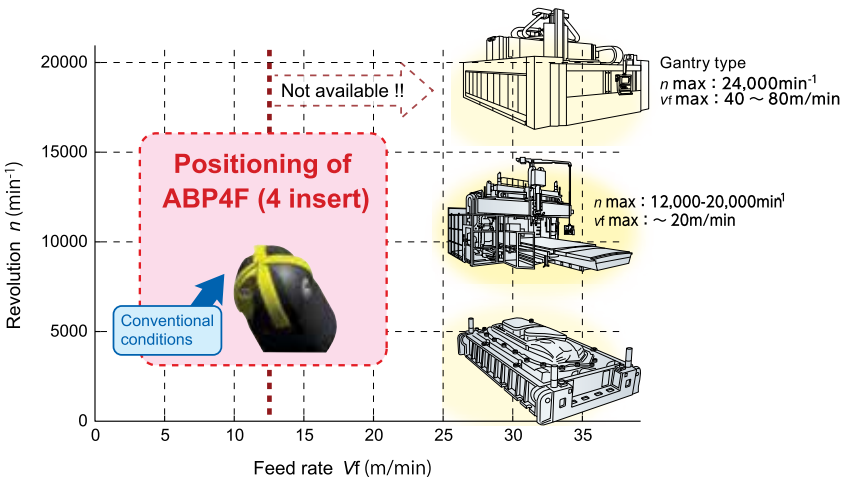
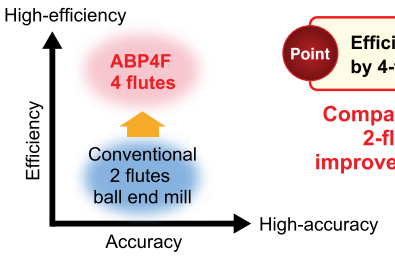
Example of large press die for automotive parts



Processing advantage of 4-flutes end mill

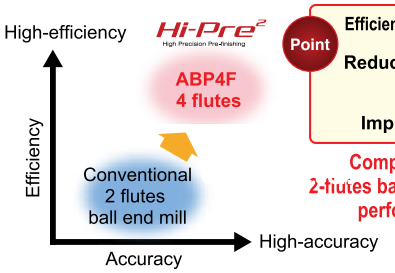
Figure Finishing



Point **Efficiency improves by 4-flutes end mill**

Compared with conventional 2-flutes ball end mill, improves cutting performance.

Figure Semi-Finishing



Point **Efficiency processing with small pitch**
↓
Reduce the processing load on semi-finishing
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Improve finishing accuracy

Compared with conventional 2-flutes ball end mill, improves cutting performance and accuracy.

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YOUR GLOBAL CRAFTSMAN STUDIO

Sustainability unveiled: Navigating the Circular Economy

Recognising the environmental and societal challenges for our economy, many organisations and governments worldwide are advocating a transition towards maintaining a circular economy. The Cover Story discusses how circular economy model provides tools and methodologies in response to environmental and societal challenges facing our economy.

Rohit Pandey,
Sr Manager, International Business & Lead, ESG, Commtel Networks

What exactly is the circular economy? Simply put, it is an economic model designed to eliminate waste and continually use resources. It emphasises moving from the traditional 'take-make-waste' pattern to a more sustainable 'reduce–reuse–recycle' approach. This shift not only helps alleviate the burden on our planet but also offers new business opportunities and potential for economic growth.

The social and environmental effects of climate change highlight the need for organisations to reconsider their business strategies. The circular economy stands as a beacon in this new landscape, offering tools and methodologies that can reshape our future. ESG (Environmental Social Governance) professionals have an essential role in this transition. Through their influence, they can promote the principles of the circular economy, ensuring businesses adopt sustainable and responsible practices.

The directives given by the international bodies further emphasise the importance of adopting this model. The pivotal message from these directives is clear: businesses should prioritise sustainability. They should not view it as a mere compliance measure but as a strategy for long-term growth and risk mitigation.

Three pillars of the circular economy

(a) Design out waste and pollution: Sustainability's roots lie in the design phase. It is here that products are conceived with an emphasis on durability, recyclability and minimal wastage. This approach mandates businesses to invest heavily in research and development, explore eco-friendly materials and employ digital innovations, such as Artificial Intelligence (AI), to achieve design precision.

(b) Keep products and materials in use: This pillar harmonises with the ethos of product longevity. The evolving market dynamics, where brands increasingly opt for leasing over outright selling, signifies a transition from ownership to usership. Such transformations also facilitate avenues for product refurbishment and re-manufacturing.

(c) Regenerate natural systems: The focus transcends recycling; it's about rejuvenating ecosystems. This vision encompasses initiatives ranging from habitat restoration to afforestation drives and innovative agricultural techniques that bolster soil health and biodiversity.

Real-world case studies

1. **Philips:** The brand has seamlessly transitioned to offering products-as-a-service across diverse sectors. For example, they lease lighting solutions to business clientele, ensuring maintenance and upgrades, when necessary, thus promoting waste reduction and efficiency.
2. **Dell:** Embracing a closed-loop gold recycling program, Dell reclaims gold from used electronics for new computer motherboards and integrates recycled plastics into its products.
3. **Nike:** Through its 'Reuse-A-Shoe' initiative, Nike recycles worn-out athletic shoes, repurposing them for materials in sports surfaces like running tracks. Furthermore, they are spearheading designs using unified, recyclable materials.
4. **H&M:** With its "Conscious Collection", H&M champions sustainable fashion, introducing initiatives to recycle old clothing and produce new garments from the recycled fibres.
5. **TerraCycle:** This ground-breaking company has specialised in recycling traditionally 'unrecyclable' waste. Collaborating with various businesses, they have developed recycling systems for an array of products, from cigarette butts to toothbrushes.
6. **Interface:** As a modular carpet manufacturer, Interface had set forth a mission to reach a zero environmental footprint by 2020, which they were able to achieve even before the set timeline. They continue to make efforts in this direction and influence others across the world to create change within their communities. Their strategy incorporates recycled and bio-based materials in products and introduces programs to reclaim old carpets for recycling.
7. **Ecover:** Renowned for its cleaning and laundry products, Ecover has championed refill stations to curtail plastic bottle usage and is pioneering the adoption of bio-based plastics and other sustainable packaging alternatives.
8. **Loop:** In a strategic partnership with TerraCycle, Loop offers popular products in reusable packaging. Customers return empty containers, which Loop then sanitises and refills, establishing a waste-free system for diverse products.
9. **RentoMojo:** This innovative Indian start-up is at the forefront of the furniture and appliance rental space, advocating the concept of leasing over owning.
10. **Neste:** Hailing from Finland, Neste has emerged as a global leader in crafting renewable diesel and jet fuel derived from waste and residues.

Directives and regulations

1. European Union (EU):

(i) **Circular Economy Action Plan:** As a component of the European Green Deal, this plan was inaugurated in 2020 to address challenges across product lifecycles, ranging from design to consumption and waste management.

(ii) **Waste Framework Directive (2008/98/EC):** This directive provides foundational concepts and definitions pertaining to waste management, such as recycling and recovery.

(iii) **EU Ecodesign Directive (2009/125/EC):** Establishing a framework, this directive sets forth eco-design requirements for energy-related products.

2. Netherlands: **Circular Economy Implementation Program:** Launched in 2016, this programme aspires to transition the Dutch economy to a fully circular model by 2050.

3. China: **Circular Economy Promotion Law (2008):** This legislation serves as China's legal framework, advocating the circular economy across various scales, from individual businesses to entire regions.

4. France: **Anti-Waste for a Circular Economy Law (2020):** Encompassing measures that promote waste reduction, reuse, recycling and combat planned obsolescence.

5. Finland: **Finland's Roadmap to a Circular Economy (2016):** A guiding document emphasising sustainable product design, production and consumption, with the ambition of establishing Finland as a leader in the circular economy by 2025.

6. Chile: **National Strategy for a Circular Economy:** Introduced in 2020, this strategy is dedicated to fostering sustainable consumption and production patterns by 2040.

7. Japan: **Fundamental Law for Establishing a Sound Material-Cycle Society (2000):** This piece of legislation emphasises waste reduction, promotion of recycling and ensuring proper waste treatment processes.

8. South Korea: **Act on the Promotion of Saving and Recycling of Resources (2008):** This act is designed to encourage resource conservation and recycling, with the ultimate goal of minimising waste generation.

9. India: **National Resource Efficiency Policy (Draft, 2019):** This policy framework aims to champion resource efficiency and the principles of the circular economy as avenues to sustainable development.

10. Canada: **Canada-Wide Strategy on Zero Plastic Waste (2018):** While part of a broader initiative to reduce waste and stimulate a circular economy, this strategy focuses particularly on addressing the challenges posed by plastic waste.

The pivotal message from these directives and regulations is the collaborative spirit demonstrated when governments, businesses and communities unite. The examples provided

underscore both the inspiration and a pragmatic blueprint for other nations aspiring to make strides in the realm of the circular economy.

Benefits of the circular economy:

(a) **Environmental:** Imagine a world with diminished landfills and seas free of plastic. Circularity can make this a reality by slashing the need for fresh resource extraction, thereby diminishing the environmental trauma like deforestation and mining. This cascades into reduced carbon footprints, nurturing our planet back to health.

(b) **Economic:** The circular economy can be an elixir for businesses, offering cost predictability against the mercurial nature of raw material prices. Furthermore, models like 'product-as-a-service' guarantee steady revenue flows, bolstering economic tenacity.

(c) **Social:** The alignment of the circular economy with societal wellness is palpable. It heralds the dawn of green employment opportunities, assures equitable economic progression and serves as a buffer against the socio-environmental repercussions of climate change.

Challenges and roadblocks:

- **Scale of transition:** While neoteric ventures can nimbly adapt to circular models, legacy enterprises grapple with revamping entrenched systems.
- **Consumer mindset:** We are entrenched in a culture that idolises the 'brand-new'. To usher in circularity, it's imperative to recalibrate consumer psyche.
- **Regulatory frameworks:** A lacuna exists between existing legal canons and circular principles. The need of the hour is robust advocacy and a legislative facelift to nurture circularity.

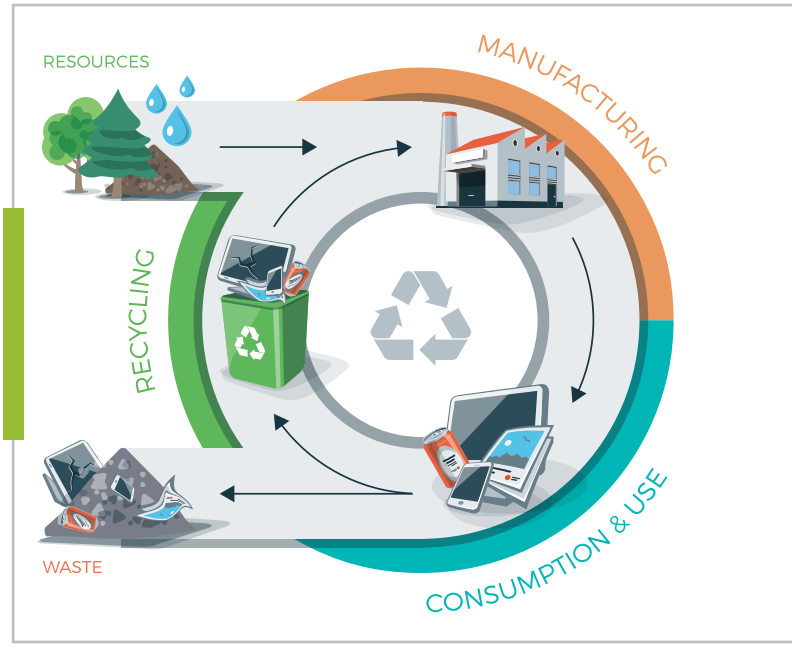
Technology and innovation's roles

Technology acts as a force multiplier. IoT devices can monitor product wear and tear, suggesting timely maintenance, prolonging product life. AI can aid in efficient resource allocation, minimising waste. Blockchain promises transparency, ensuring that every stakeholder in the supply chain adheres to sustainability norms. Biotechnologies are unveiling breakthroughs—from bio-degradable plastics to lab-grown meats, challenging traditional production paradigms. For ESG stakeholders, leveraging these technologies can elevate their sustainability metrics.

Transitioning to a circular model:

The transition from the linear 'take-make-waste' model to a circular economy is pivotal for industries aiming to minimise environmental impact and promote sustainability. Let's delve deeper into the integration of AI, ML, Digitalisation and the '7Rs' in th manufacturing sector:

1. **Rethink:** Before initiating the manufacturing process, companies can use AI and ML algorithms to analyse historical data and forecast demand more accurately. This allows for better allocation of resources, preventing overproduction and subsequent wastage.
2. **Re-design:** Digital twin technology, a virtual replica of a physical product, allows manufacturers to test and optimise designs in a digital space. This reduces material waste and ensures the product is designed for longevity and ease of repair or disassembly.
3. **Re-purpose:** AI can assist in identifying ways to use retired products or parts in new applications, increasing their lifespan and reducing the need for virgin materials.
4. **Repair:** Predictive Maintenance, powered by ML, can alert manufacturers and users to parts that need repairing before they fail. This extends product lifetimes and reduces the waste associated with discarded broken items.
5. **Re-manufacture:** Advanced sensors and IoT devices can provide data on the wear and tear of



products. This data can be analysed to determine the optimal time to remanufacture a product, ensuring that it serves for as long as possible.

6. **Recycle:** ML can aid in sorting recyclables more efficiently. In electronic waste recycling, for example, machine learning algorithms can classify and separate components to recover valuable materials.
7. **Recover:** AI and digitalisation can help in tracking products throughout their lifecycle. This ensures that, at the end of life, materials are recovered efficiently and either reused or disposed of in an environmentally friendly manner.

Additionally, the shift towards a circular economy strengthens the 'Product-as-a-Service' (PaaS) trend. Instead of selling products, companies lease them out, retaining ownership and responsibility for their maintenance, repair and eventual recycling. This model ensures that products are used to their fullest potential and are taken back at the end of their lifecycle for proper recycling or disposal.

Benefits

- **Cost-efficiency:** Properly implemented AI and ML solutions can result in significant cost savings, as they optimise resource allocation, reduce waste and prolong product lifespans.
- **Environmental impact:** A circular approach drastically reduces waste, emissions and the depletion of finite resources.
- **Customer relations:** Cstomers are more likely to support and remain loyal to companies that prioritise sustainability.
- **Regulatory compliance:** Many governments around the world are implementing stricter environmental regulations.
- **Innovation:** The challenges posed by transitioning to a circular economy drive innovation, leading to the development of new business models.

In summary, integrating AI, ML and digitalisation with the principles of the circular economy offers a strategic approach for manufacturers to ensure sustainability, improve efficiency and meet the demands of a changing global landscape. Consumer behaviour is both a challenge and a catalyst. A conscious consumer, by repairing, reusing and recycling, embeds circularity in daily life.

Conclusion

The symbiosis of ESG and the circular economy holds the promise of a sustainable future. Projections indicate an increasing number of businesses transitioning, driven by both environmental necessity and economic viability. Collaborative endeavours, where businesses across sectors share resources, are expected to gain traction. Policymakers, recognising the socio-economic benefits, are likely to introduce regulations promoting circularity.

The circular economy is not just a trend; it is a pressing necessity. ESG professionals have a unique opportunity to pioneer this change, using the circular economy as a tool to enhance their impact across all fronts. By intertwining business success with environmental stewardship and societal well-being, we are charting a path for a balanced and prosperous future. Now is the moment to act, and the circular economy is our roadmap. ☐

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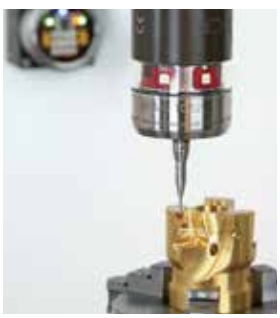

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India's MedTech industry **on the rise**

As the nation strives to enhance its healthcare infrastructure and provide quality medical services to its vast population, the growth trajectory of the medical technology sector is becoming impressive. Here is an overview of the medical technology industry in India.

Chandra Ganjoo,
Group Chief Executive Officer, Trivitron Healthcare

The medical technology industry is a vital sector that encompasses a wide range of products, devices and equipment used in healthcare to diagnose, treat and monitor patients. It plays a crucial role in improving patient outcomes, enhancing the quality of healthcare and increasing the efficiency of medical procedures.

India's medical technology industry has been growing steadily, driven by factors such as a large and diverse patient population, increasing healthcare awareness and government initiatives to promote the domestic manufacturing of medical devices. In India, the industry is experiencing growth, driven by both domestic manufacturing and technological advancements, although it still faces challenges that need to be addressed for sustainable development.

The medical technology industry in India is experiencing an unprecedented surge, fuelled by a confluence of factors that position the nation as an escalating hub for innovation and production. A comprehensive, valid report underscores this growth, highlighting how the sector rapidly expands and attracts substantial investments. According to the latest information, the medical technology market in India is projected to reach almost $8 billion by 2025, a witness to the sector's remarkable potential.

A closer look at the transformation reveals that technology plays a pivotal role in shaping the future of healthcare in India. Technological advancements are redefining diagnostics, treatment methodologies and patient care, improving outcomes and accessibility. The integration of digital health solutions, Artificial Intelligence (AI) and tele-medicine is ushering in a new era of healthcare delivery that is efficient, precise and patient-centric.

Revolutionising MedTech

The impact of technology on healthcare in India is intensely evident through various dimensions. The advent of tele-medicine has bridged geographical barriers, ensuring that quality healthcare reaches even the remotest corners of the nation. Patients can now be consulted by specialists from the comfort of their homes, significantly reducing the burden on urban healthcare centres and enhancing healthcare equity.

Furthermore, integrating genetic engineering, genomics, metabolomics, AI and Machine Learning (ML) algorithms has revolutionised diagnostics. These technologies enable early detection of diseases, enhance accuracy in medical imaging and facilitate personalised treatment plans. Data-driven AI-powered algorithms can analyse medical images to identify anomalies with a previously unimaginable precision level. This expedites the diagnostic process and reduces the likelihood of human error.

The convergence of medical and information technology has also given rise to Electronic Health Records (EHRs) and tele-health platforms, streamlining patient data management and healthcare delivery. EHRs ensure patient information is readily accessible, enabling seamless coordination among healthcare providers and reducing redundancies. Additionally, wearable devices and health monitoring applications empower individuals to actively participate in their well-being.

Catalysts for indigenous production

A pivotal aspect of India's medical technology journey is the emphasis on indigenous production. The country's leadership recognises that self-reliance in manufacturing medical devices fosters economic growth and enhances national security by reducing dependency on imports. The Make in India initiative has spurred investments in domestic production capabilities, contributing to job creation and technological self-sufficiency.

Conducive policies and regulatory frameworks complement the Indian government's support for indigenous production. The National Health Policy 2017 prioritises the development of medical technology, advocating for a robust ecosystem that nurtures innovation, research and development. Initiatives like the Atmanirbhar Bharat Abhiyan (Self-Reliant India Campaign) further underscore the commitment to bolstering domestic manufacturing and reducing reliance on imports.

Empowerment and self-reliance hereon

The growth of India's medical technology industry heralds a future where the nation not only redefines its

healthcare landscape but also strengthens its position on the global stage. Empowerment through technological innovation and indigenous production is a two-fold advantage. Firstly, it ensures that Indians can access cutting-edge medical solutions, diagnostics and treatments, improving healthcare outcomes and quality of life. Secondly, it reduces the outflow of capital to foreign markets, boosting the nation's economic resilience and fostering a sense of self-reliance.

India's journey towards self-sufficiency in medical technology is instrumental in reducing dependency on other nations for critical healthcare resources. The nation's quest to manufacture medical devices domestically aligns with the vision of a robust, self-reliant, technologically advanced India. It positions the country as a global player in the medical technology sector, fostering partnerships, collaborations and knowledge-sharing, which contribute to a more inter-connected world.

As India's medical technology industry continues towards the curve of growth and development, the nation stands on the edge of a healthcare revolution marked by innovation, accessibility and self-reliance. Integrating technology into healthcare delivery amplifies the reach and impact of medical services, bridges gaps and ensures that quality healthcare is a fundamental right for all citizens. The commitment to indigenous production is not just a strategic economic move but a demonstration of India's determination to chart its course in medical technology.

The MedTech industry in India is not just riding a growth curve; it is forging a path toward a future where healthcare is empowered by innovation and driven by self-reliance. The convergence of technology, policy support and visionary leadership smears a promising depiction of a healthier, more resilient and self-sufficient India that is exalted to make a lasting impact on the global healthcare landscape. ❐

Unveiling the path to India's **Industry 4.0 transformation**

The Confederation of Indian Industry (CII) Manufacturing Innovation Conclave, held in New Delhi, marked a pivotal moment in India's journey towards Industry 4.0. The event, attended by industry luminaries and thought leaders, explored the convergence of innovation and security in the rapidly evolving manufacturing landscape.

The CII conducted a successful manufacturing and innovation conclave to discuss the role of Industry 4.0 and other new-age technologies in manufacturing. On September 26, 2023, the event took place at Hotel Taj Mahal, Mansingh Road, New Delhi, with Efficient Manufacturing Magazine as the media partner. Dignitaries and visionaries attended.

The welcome and opening remarks were given by Kishore Jayaraman, Conclave Chairman and President, India & South Asia, Rolls-Royce. The theme introduction was given by Shridhar Kamath, Partner, Consulting Deloitte India. The address for the event was made by Tarun Mishra Founder, Covacsis India; Salil Gupte, Chairman CII National Committee on Aerospace and President, Boeing India, and Madhav Singhania, Deputy Chairman, CII (Northern Region) and Deputy Managing Director & CEO, J K Cement. The inaugural address was given by the Guest of Honour, G Narendra Nath, Joint Secretary, National Security Council Secretariat Government of India.

In the opening remarks, Nath underscored the imperative role of security as a fundamental requirement for innovation. He set the tone for a day filled with insightful discussions and called for the development of capabilities that drive innovation while ensuring security remains at the forefront.

As a concept, Industry 4.0 witnessed significant growth in India and is becoming mainstream. Although organisations are adopting industry 4.0 practices, such as predictive maintenance, 3D printing and connected operations, progress

varies amongst industries. 'Industry 4.0: Learn and Propel; a whitepaper co-authored by CII and Deloitte India was also released at the Manufacturing Innovation Conclave 2023. This paper explores how organisations can overcome the challenges and fuel growth and advancement.

The manufacturing sector in India is currently at the cusp of a technological renaissance, largely driven by the visionary leadership of Prime Minister Narendra Modi and a steadfast commitment to innovation-led manufacturing. The Government of India's unwavering focus on the technological and digital revolution is steering the nation towards Industry 4.0, promising unparalleled opportunities and growth for manufacturers.

The CII Manufacturing Innovation Conclave served as a platform for industry leaders and thought leaders to deliberate on the roadmap for the future of manufacturing in India. The primary focus of these discussions was harnessing the country's robust digital ecosystem to enhance global competitiveness.

The Conclave also featured Tarun Mishra, Founder, Covacsis Technologies, who passionately advocated for dispelling common misconceptions surrounding Industry 4.0 and Industrial Internet of Things IIoT in the manufacturing sector. He used real-life project examples and live case studies to illustrate the transformative power of these technologies.

Best wishes in the form of video messages from Prof Ajay Kumar Sood, Principal Scientific Adviser to the Government of India; Atul Dinkar Rane, Director General, BrahMos, DRDO, and CEO & MD, BrahMos Aerospace; Commodore Amit Rastogi (Retd), Chairman & Managing Direcotr, NRDC, were also played during the Inaugural Session.

The event served as a congregation of industry leaders and subject matter experts from renowned organisations such as JK Tyre, Adani Group, DiFACTO Robotics & Automation, Infosys, IBM, TCS and more in a panel discussion. Contributing to the event's glory, A K Makkar, Manufacturing Director, JK Tyre & Industries, said, "IoT is not just about the machines, it is about utilising the data and you start visualising it and taking it to the analytical level and predictive level. The fundamental risks involved, which are surmountable, are regarding security".

The Conclave featured a diverse array of topics and dialogue, including Industry 4.0 implementation and the prospects of 5G and Generation AI. It witnessed enthusiastic participation from over 190 attendees, reinforcing the growing importance of Industry 4.0 in shaping India's manufacturing landscape. Contributing to the knowledge base, Geeta Rohra, Global Head, Business Advisory, IoT and Digital Engineering, Tata Consultancy Services, added, "We believe that the ability to predict, simulate and support real-time decision making through digital twins is instrumental for achieving operational excellence across Industry 4.0 initiatives". Furthermore, Sunil David, Digital Technology Consultant and Ex Regional Director, AT&T India, mentioned, "5G has its uses cases in several industries in India. However alone 5G is not a solution, it has to be combined with IOT or AI or AR/VR. Basically the combined technological effect will create much better business impact".

The conclave was a resounding success, shedding light on the critical role of security in the innovation journey and emphasising the transformative potential of Industry 4.0 technologies. It provided a platform for industry leaders to exchange insights and strategies, setting the stage for India's manufacturing sector to embrace a future filled with innovation, sustainability and global competitiveness, one step at a time. This is evident in the words of Vikas Gupta, Associate Vice President & Global Delivery Head, IOT, Infosys, who mentioned that, "You have to have a vision to bring them all together, but you have to start in a small way". Stressing on the technological spectrum, Ramachandran Sundararajan, Principal Consultant, Manufacturing Lead, Infosys Knowledge Institute, emphasised that "Design for new products and systems is one such area according to me where Generative AI can become more advanced".

The event also hosted Ajay Gopalswamy, Chief Executive Officer, DiFACTO Robotics and Automation. Commenting on the current scenario, he said, "The engineering talent that we have in India enables us to develop a lot of innovative and frugal tooling technologies". As the country continues its march towards Industry 4.0, it is poised to unlock unprecedented opportunities for growth and development.

Dr Rishi M Bhatnagar, President, Lava International, emphasized, "Embrace the future with Industry 4.0. It's not just about technology; it's about learning, adapting and propelling ourselves forward. Let's master the tools of the fourth industrial revolution and shape a brighter, more innovative tomorrow".

While answering the Session Moderator, Deepak Sehrawat, Director, Hughes Systique, said, "With 5G speed, Gen AI's intelligence and Industry 4.0 innovation, we're on an unstoppable journey. Let's navigate this exciting landscape together and shape a future that's not just forward but boundless".

While stating the importance of Industry 4.0 revolutionising the manufacturing industry, Ashok Wadhawan, Jt President & Head Land System, Defence & Aerospace, Adani Group, "Industry 4.0 revolutionises manufacturing by integrating technologies like IoT, AI and robotics, enabling smart factories, predictive maintenance and efficient production systems. It paves the way for interconnected machines, real-time data analytics and collaborative processes, leading to increased productivity, cost savings and sustainable growth in the digital era". ☐

G Narendra Nath,
Joint Secretary, National Security Council Secretariat, Government of India

IoT devices can be vectors for attacks. This is where the industry and academia have been working together to come up with the requirements for the security of IoT devices and a certification mechanism.

Kishore Jayaraman,
Conclave Chairman and President - India & South Asia, Rolls-Royce

The interplay of technology, automation and human ingenuity is creating unprecedented technological breakthroughs. There sholud be greater collaboration between humans and machines to enhance operational productivity, also the cross-sector cooperation and knowledge sharing are essential to truly harness the potential of Industry 4.0.

Salil Gupte,
Chairman, CII National Committee on Aerospace and President, Boeing India

Embracing Industry 4.0 is not an option but a necessity as we seek to maximise the efficiency of more resilient supply chains in a post-pandemic world.

Madhav Singhania,
Deputy Chairman, CII (Northern region) and Deputy Managing Director & CEO, J K Cement

The transformative potential of Industry 4.0 technologies in fostering innovation and sustainability. These technologies hold the key to creating a sustainable environment across various industries while substantially reducing manufacturing and research and development costs.

Shridhar Kamath,
Partner, Deloitte India

The tangible benefits reaped by organisations that have successfully implemented Industry 4.0. These benefits include cost savings, improved efficiency, enhanced customer satisfaction and robust growth. The organisations should remain at the forefront of technological advances while navigating the challenges of digital transformation.

Revolutionising industries through **unparalleled accuracy**

As technology advances it is important to delve into the intricacies of precision cutting technology, exploring its various applications, advantages and the future it holds. Here is an article diving into the developments in precision cutting technology and its advantages to manufacturing.

Shivika Singh,
Senior Marketing Manager, WAE

Introduction

Precision cutting technology has emerged as a game-changer across various industries, from manufacturing to healthcare, by offering unparalleled accuracy and efficiency. This innovative technology encompasses a wide range of techniques and tools that enable precise and controlled material removal. The ability to achieve intricate cuts with minimal waste has redefined manufacturing processes and beyond.

Understanding precision cutting technology

Precision cutting technology refers to the set of methodologies and tools that facilitate the accurate removal of material from a workpiece. This process involves achieving fine, intricate cuts with minimal tolerances, ensuring that the resulting components meet the strictest specifications. The technology finds its applications in various sectors, including manufacturing, electronics, automotive, aerospace and healthcare.

This technology is an innovative fusion of laser beam and water jet cutting, centring around precise water control. This approach capitalises on the advantages of both methods. By exploiting total internal reflection within the water jet, the laser beam is confined, enabling meticulous control. This technology facilitates material cutting from varying heights and excels in high-demand cutting scenarios—crafting holes, intricate cut-outs and diverse shapes.

Industries requiring tailored shapes and sizes for manufacturing applications can benefit from this hybrid method. By harmonising laser's accuracy and water jet's adaptability, this system achieves efficient outcomes, particularly for intricate designs in diverse materials. This technology represents a compelling solution for industries necessitating intricate, customised and large-scale cutting tasks, enhancing precision and productivity.

Precision Cutting Technology is driven by key techniques and tools, since in today's fast-paced world precision and accuracy are critical factors that make or break the success of an organisation, especially in the manufacturing industry. Let's delve deeper into these techniques:

- **Laser cutting:** Laser cutting employs a high-energy laser beam to vaporise or melt the material, leaving behind precise cuts. This technique is widely used in industries like automotive manufacturing, electronics and even artistic creations due to its ability to handle a variety of materials with exceptional precision.

- **Waterjet cutting:** Waterjet cutting employs a high-pressure jet of water mixed with abrasive particles to erode

the material. This technique is suitable for a diverse range of materials, including metals, composites and even food products. It is known for its cold-cutting capabilities and is often preferred for materials sensitive to heat.

• **Plasma cutting:** Plasma cutting involves ionising a gas to create a plasma state, which is then used to melt and expel the material. It is commonly used for cutting metal sheets and is especially favoured for its speed and versatility.

• **Electrical Discharge Machining (EDM)**: EDM uses electrical discharges to remove material from a workpiece. It is particularly effective for intricate shapes and hard-to-machine materials, making it a staple in industries such as aerospace and tool manufacturing.

• **Precision Abrasive Cutting:** This technique employs abrasive materials in conjunction with high-precision machinery to achieve accurate cuts. It is often used in the production of small, intricate parts, such as those found in medical devices and electronics.

Advantages for manufacturing

Precision cutting technology has revolutionised manufacturing processes by enabling the production of intricate components with high precision. From the creation of complex gears to the manufacturing of delicate medical implants, precision cutting technology plays a pivotal role in ensuring product quality and consistency.

Possibilities for the future

The evolution of precision cutting technology is far from over. As industries continue to push boundaries, the demand for even greater precision, speed and efficiency will drive the development of advanced techniques and tools. Here are a few areas where precision cutting technology is expected to make significant strides:

• **Nanotechnology:** Precision cutting technology is likely to play a pivotal role in the advancement of nanotechnology, enabling the creation of intricate nanostructures with unprecedented accuracy.

• **Additive Manufacturing:** The integration of precision cutting technology with additive manufacturing processes could revolutionise how complex 3D-printed objects are refined and finished.

• **Artificial Intelligence:** AI-driven algorithms could enhance the precision of cutting processes by optimising parameters based on real-time data, leading to more efficient and accurate cuts.

• **Hybrid techniques:** The combination of various cutting techniques, such as laser and waterjet, could yield hybrid approaches that leverage the strengths of each technique for specific applications.

Precision cutting technology has transformed industries by enabling the creation of complex components and products with unparalleled accuracy. Particularly in manufacturing sector, this technology continues to shape the way products are designed, manufactured and utilised. As advancements in materials, software and machinery continue to evolve, the potential for precision cutting technology to reshape industries and create new possibilities remains boundless. ❐

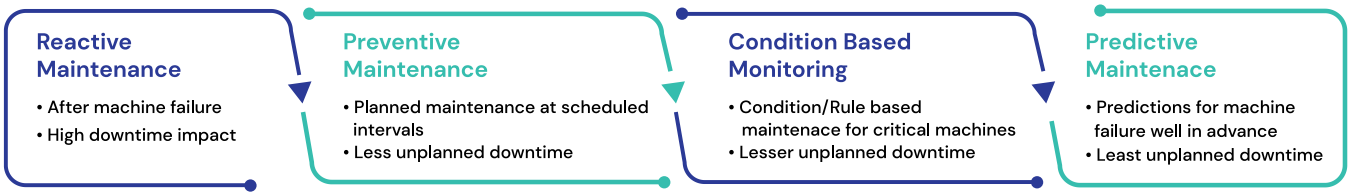
Proactive maintenance using new-age technology

In the fast-evolving landscape of industrial operations, maintenance has emerged as a critical factor in ensuring smooth and uninterrupted production processes. Traditional maintenance methods, often reliant on scheduled inspections and reactive responses, have proven to be inadequate in preventing downtime and optimising asset utilisation. The article delves into predictive and preventive maintenance, their technological underpinnings and profound impact across various sectors.

Ranjit Patil,
CoE Head,
Mfg Ops Management,
Tata Technologies

Predictive Maintenance (PdM) and Preventive Maintenance (PM) are twin pillars that elevate manufacturing operations to an unprecedented level of productivity. While PM entails scheduled inspections and interventions to pre-empt equipment failures, PdM harnesses a sophisticated blend of sensors, data analytics and Machine Learning (ML) to forecast potential issues before they cascade into operational disruptions.

Maintenance maturity



Embracing the technological ecosystem

Central to the success of predictive and preventive maintenance in manufacturing is the intricate web of technologies driving this transformation:

• **Industrial IoT and sensor fusion for condition monitoring:** The convergence of IoT and sensors equips machines with the ability to communicate and share real-time data. Sensors embedded in machinery monitor temperature fluctuations, vibration patterns and energy consumption, offering real-time insights into equipment health. Real-time facility monitoring solutions are proven to play critical role in such scenarios.

• **Data analytics and Big Data over Cloud:** The proliferation of data from sensors and other sources demands expandable storage and robust analytics solutions. Cutting-edge cloud-based data analytics platforms process massive datasets to unveil patterns, anomalies and trends that hint at impending issues.

• **Advanced ML and Artificial Intelligence (AI):** Machine learning algorithms dissect historical data to discern patterns and anomalies, enabling precise predictions. AI-driven systems scrutinise vast datasets, transforming raw information into actionable insights that augment decision-making prowess.

• **Digital Twins for simulated brilliance:** The advent of digital twins creates virtual replicas of physical assets, enabling real-time monitoring and experimentation in a digital realm. These twins simulate various scenarios, aiding in the prediction of equipment failures and in devising optimal maintenance strategies. This approach can also help in virtual commissioning.

• **Augmented Reality (AR):** AR can be used effectively for maintenance training and assistance. Technicians can use AR glasses or devices to receive step-by-step instructions for complex maintenance tasks.

• **Blockchain:** Blockchain can be used for equipment maintenance records and service history, ensuring data integrity and transparency.

Industry specifics

Across various industries, predictive and preventive maintenance solutions are proving to be transformative, optimising operations and bolstering efficiency. Incorporating these strategies across sectors leads to minimising downtime and costs to enhancing product quality.

• **Manufacturing:** Within the manufacturing domain, machinery plays a pivotal role in achieving production targets, with predictive maintenance emerging as a foundational approach to ensure uninterrupted machine functionality. Take the example of automotive assembly lines where sensors discern motor vibrations and deviations, signalling misalignments. Addressing such concerns proactively not only averts defects but also prevents disruptions in production.

• **Aviation:** The aviation industry's paramount concern is aircraft safety, where predictive maintenance shines. Embedded sensors monitor engine performance, airframe health and avionics functionality, providing a comprehensive view of an aircraft's condition. MRO solutions empowered with PdM can help in anticipating such scenarios and maintaining overall LLP traceability.

• **Automotive manufacturing:** In the fiercely competitive automotive manufacturing landscape, even minor disruptions can have far-reaching consequences. By employing sensors to detect motor vibration fluctuations, misalignments are identified before they escalate into production standstills. This proactive strategy not only

ensures product quality but also curtails costly delays.

• **Heavy equipment manufacturing:** Industries reliant on heavy machinery, like construction and mining, are acutely aware of the financial implications of downtime. Sensors embedded in equipment can pinpoint anomalies in components, pre-emptively addressing wear and tear. This approach streamlines maintenance schedules and resource allocation, resulting in reduced operational expenses and unplanned downtimes.

• **Electronics manufacturing:** Precision and reliability are paramount in electronics manufacturing. Utilising data analytics and AI, manufacturers scrutinise intricate machinery involved in circuit board assembly. This meticulous analysis identifies potential issues early on, guaranteeing top-notch output and minimising defects.

• **Healthcare:** Predictive maintenance is employed in healthcare facilities to ensure the reliability of medical equipment, such as MRI machines and X-ray equipment, which are crucial for patient care. Routine check of these equipment helps healthcare institutions as well as patients receive effective treatment.

• **Energy:** According to a report titled Predictive Maintenance in the Energy Market, PdM is expected to grow at a CAGR of 25.77% between 2023–2028. In the energy sector, power plants and wind farms use PdM to maximise the uptime of turbines and generators, ultimately increasing energy production and reducing operational costs.

Challenges

• **Initial Investment:** Implementing PdM can be costly due to the need for sensors, data infrastructure and analytics tools. Preventive maintenance also requires an initial investment in setting up schedules and processes.

• **Data quality and management:** High-quality predictions hinge on impeccable data quality. Robust data collection and management protocols are very important to ensure the integrity and reliability of collected data.

• **Integration complexity:** Introducing advanced technologies into existing manufacturing systems requires meticulous planning and integration to avoid disruptions and ensure seamless operations.

• **Skill enhancement:** The operation and maintenance of these advanced systems necessitate a skilled workforce proficient in both machinery mechanics and data analytics.

• **Cybersecurity:** With the increased use of IoT devices and cloud platforms, there is a greater risk of cybersecurity breaches. Protecting sensitive maintenance data is crucial.

• **Scalability:** As businesses grow, the maintenance needs also expand. Ensuring that predictive and preventive maintenance systems can scale to meet these growing demands is essential.

Blueprint for progress

• **Investment in technology:** Manufacturing enterprises must allocate resources to acquire and implement state-of-the-art technologies like sensors, IoT platforms and analytics tools.

• **Robust data governance:** Establishing data collection and management protocols is crucial to ensuring data accuracy and consistency.

• **Skills empowerment:** Manufacturing leaders must invest in training programmes to up-skill the workforce, equipping them to operate and decipher data from these advanced systems.

The realm of manufacturing stands poised on the cusp of a technological revolution. Predictive and preventive maintenance, fuelled by the convergence of sensors, IoT, data analytics and AI, has metamorphosed maintenance from a reactive chore to a proactive art. As technology advances further, the synergy of human expertise and cutting-edge tools promises to reshape the landscape of manufacturing operations, forging a future where disruptions are minimised, assets are optimised and precision prevails. ☐

How is data analytics transforming the manufacturing space?

With the increasing availability of advanced analytics tools and technologies, manufacturers are better equipped than ever before to harness the power of data and drive their businesses forward. A read on...

Piyush Somani,
Chairman and Managing Director, ESDS Software Solution

The manufacturing sector has seen a blazing expansion recently, mainly due to the increasing adoption of contemporary technology post-pandemic and Industry 4.0. A recent report by Research Dive states that the international smart manufacturing industry will reach $303 billion by 2026, with a CAGR of 6.4%. (researchdive.com). One of the key drivers behind this rising development is Data Analytics. Using the available data and tracking it in real time forms the basis of any automation procedure in manufacturing, and thus holds the utmost value.

Decoding 'Connected Factory'

In this aspect, the term 'Connected Factory' is the buzzword around which the future of manufacturing will revolve. All the devices and elements of a manufacturing unit will be able to communicate clearly the interconnection of sensors and devices with machine software, applications and the Industrial Internet of Things (IIoT). This will ultimately improve the transparency in each process on the factory floor.

Data analytics, an increasingly important tool for manufacturers worldwide

Why has data analytics become an increasingly important tool for manufacturers? The manufacturers are looking to optimise their operations and improve their bottom line. By collecting and analysing data on everything from production processes and equipment performance to supply chain logistics and customer demand, manufacturers can gain valuable insights into their operations and make data-driven decisions that can improve efficiency, reduce costs and increase revenue.

Live monitoring and improved production process

One of the key areas where data analytics is being used in manufacturing is in monitoring and improving production processes. How is this process done? It is done by collecting data on everything from machine downtime and production rates to quality control and scrap rates, manufacturers can gain a comprehensive understanding of their production processes and identify areas for improvement. For example, if a machine is frequently experiencing downtime, data analytics can help manufacturers identify the root cause and take steps to prevent it from happening in the future. Similarly, if production rates are low, data analytics can help manufacturers identify bottlenecks and optimise their processes to improve efficiency.

Discrete event simulation

Discrete simulation is a computerised method for modelling and analysing the performance of manufacturing systems. By analysing data collected from the manufacturing process, such as machine utilisation, production rates and inventory levels, data analytics can provide insights into where bottlenecks occur, where capacity is underutilised and where inefficiencies can be improved. How are these insights helpful? These insights can then be used to optimise the manufacturing process and improve overall performance.

Additionally, discrete simulation can be used to model different scenarios, such as changes in demand or new production methods, allowing manufacturers to test and evaluate different strategies before implementing them in the real world.

Better supply chain management

So, how does data analytics help with supply chain management in manufacturing? By tracking data on everything from inventory levels and delivery times to supplier performance and logistics costs, manufacturers can gain a comprehensive understanding of their supply chain and identify areas for improvement. For example, if delivery times are consistently longer than expected, data analytics can help manufacturers identify the root cause and take steps to improve delivery times in the future. Similarly, if logistics costs are high, data analytics can help manufacturers identify opportunities to reduce costs through better logistics planning and optimisation.

How do you achieve improved product quality?

Data analytics are also being used in manufacturing to improve product quality. By collecting data on everything from raw materials and production processes to finished products and customer feedback, manufacturers can gain a comprehensive understanding of their products and identify areas for improvement. For example, if customers are

consistently reporting problems with a particular product, data analytics can help manufacturers identify the root cause and take steps to improve the product in the future. Similarly, if raw materials are consistently causing quality issues, data analytics can help manufacturers identify the source of the problem and take steps to improve the quality of the materials they use.

Better customer engagement

Finally, data analytics are being used in manufacturing to improve customer engagement and increase sales. By analysing data on customer demographics, purchase history and preferences, manufacturers can gain a comprehensive understanding of their customer base and identify areas for improvement.

For example, if a particular product is not selling well, data analytics can help manufacturers identify the root cause and take steps to improve the product in the future. Similarly,

if a particular demographic is not purchasing a product, data analytics can help manufacturers identify the reason why and take steps to increase sales to that demographic.

Predictive maintenance and improving productivity

Data analytics can help with predictive maintenance by allowing manufacturers to analyse data from equipment sensors and usage patterns to predict when maintenance will be needed. This can help to prevent equipment failures and reduce downtime. Predictive maintenance can also improve productivity by allowing manufacturers to schedule maintenance during periods of low usage rather than waiting for equipment to fail. Additionally, by identifying patterns in equipment usage and failure, manufacturers can improve the efficiency and lifespan of their equipment. Overall, data analytics can help manufacturers optimise their maintenance schedules and improve the overall performance of their equipment, leading to increased productivity.

Production yield improvement

How is the production yield improvement done? The portion of inputs in a process that are effectively converted into high-quality finished goods is known as the manufacturing yield. Variations in the raw materials used in production can change the result. Industries like mining, pharmaceutical and chemical industry are particularly vulnerable to changes in production yield. Although the modern manufacturing plant has access to hundreds of production parameters, it is not always obvious how to modify them to improve product yield. The platform uses causal inference techniques to recommend the production variables that are believed to have the greatest influence. The tool can examine all input data from machines around the facility and inform operators on how altering each of the input parameters will impact the overall performance of the machine.

Better throughput optimisation

Throughput optimisation refers to the process of maximising the amount of product that can be produced within a specific time period while minimising costs and maximising efficiency.

For example, data analytics can be used to identify patterns in production data, such as machine downtime, high rejection rates or long lead times, and then use that information to identify and prioritise areas for improvement. Additionally, data analytics can be used to predict future demand, allowing manufacturers to plan and schedule production more effectively.

In conclusion, data analytics are playing an increasingly important role in the manufacturing industry. By collecting and analysing data on everything from production processes and equipment performance to supply chain logistics and customer demand, manufacturers can gain valuable insights into their operations and make data-driven decisions that can improve efficiency, reduce costs and increase revenue. □

By collecting data, manufacturers can gain a comprehensive understanding of their products and identify areas for improvement

Sustainability in tyre manufacturing: **The material angle**

In an era where environmental consciousness is paramount, the tyre industry is undergoing a profound transformation. The article explores the promising developments in natural and other rubber types and components and learn how tyre manufacturers are uniting to achieve the ambitious goal of 100% sustainability by 2050.

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Transition to sustainable materials

Tyres have historically relied on substantial amounts of raw materials sourced from fossil fuels. As the global community increasingly prioritises sustainability and minimising environmental impact, the tyre industry is also embracing various endeavours to align with eco-friendly practices. Scientists specialising in material research within tyre company research and development centres are dedicating their efforts to creating alternative, renewable and sustainable materials to replace traditional crude-derived resources.

The industry is actively embracing the principles of Reuse, Regenerate and Recycle, driving a wave of innovative initiatives aimed at creating a more environmentally positive world to inhabit. Natural rubber stands as a prominent component in the production of tyres. As an inherently renewable resource sourced from nature, natural rubber plays a pivotal role in promoting sustainability. Nonetheless, the rate of natural rubber's availability does not parallel the accelerating demand, raising concerns about potential future imbalances between supply and demand. To address this, scientists have diligently pursued the development of alternative sources for natural rubber, such as Guayule and Dandelion.

Challenges and solutions in rubber production

Simultaneously, as the demand for natural rubber continues to surge, there arises a risk of resorting to unsustainable practices that could detrimentally impact tropical rainforests and biodiversity. Acknowledging these challenges, global tyre companies have united in their dedication to establish the sector as both environmentally responsible and beneficial to society. Their collaborative efforts reflect a steadfast commitment to fostering a sustainable and eco-friendly tyre industry.

To fulfil specific performance criteria such as traction, low rolling resistance, crack resistance and gas impermeability, the tyre industry employs various types of synthetic rubbers. Among these synthetic rubbers, the most commonly utilised are Styrene Butadiene Rubber and Poly Butadiene Rubber. Both of these rubber varieties rely on monomeric components, namely Styrene and Butadiene, derived from crude oil. Currently, research endeavours are actively exploring the feasibility of producing butadiene using ethanol sourced from biomass materials like wood, rice husks and corn stover. Additionally, efforts are underway to establish industrial processes for generating regenerated Styrene from discarded Polystyrene items such as food containers and packaging waste. These initiatives reflect a commitment to advancing sustainable practices within the tyre industry by reducing its reliance on fossil-derived resources and promoting the repurposing of waste materials.

Following the rubber components, which make up approximately 40%–45% of tyre weight, the subsequent

significant ingredient in tyres is Carbon Black, accounting for about 20%–25% of the total tyre weight. Carbon Black is also sourced from crude oil, and its production entails notable emissions of CO_2. To address the growing imperative of reducing tyre rolling resistance—a key determinant of vehicle fuel efficiency—extensive efforts have transpired over the past two decades to formulate rubber compounds that utilise Precipitated Silica as a reinforcing filler in lieu of Carbon Black.

A parallel development gaining traction involves the retrieval of Carbon Black from end-of-life tyres through an advanced pyrolysis process. The resultant Recovered Carbon Black, now commonly referred to as rCB, can be incorporated into rubber compounds in specific proportions. This innovation has paved the way for a robust circular economy approach. Notably, incorporating rCB significantly reduces CO_2 emissions by more than 80% compared to the conventional process of producing virgin Carbon Black.

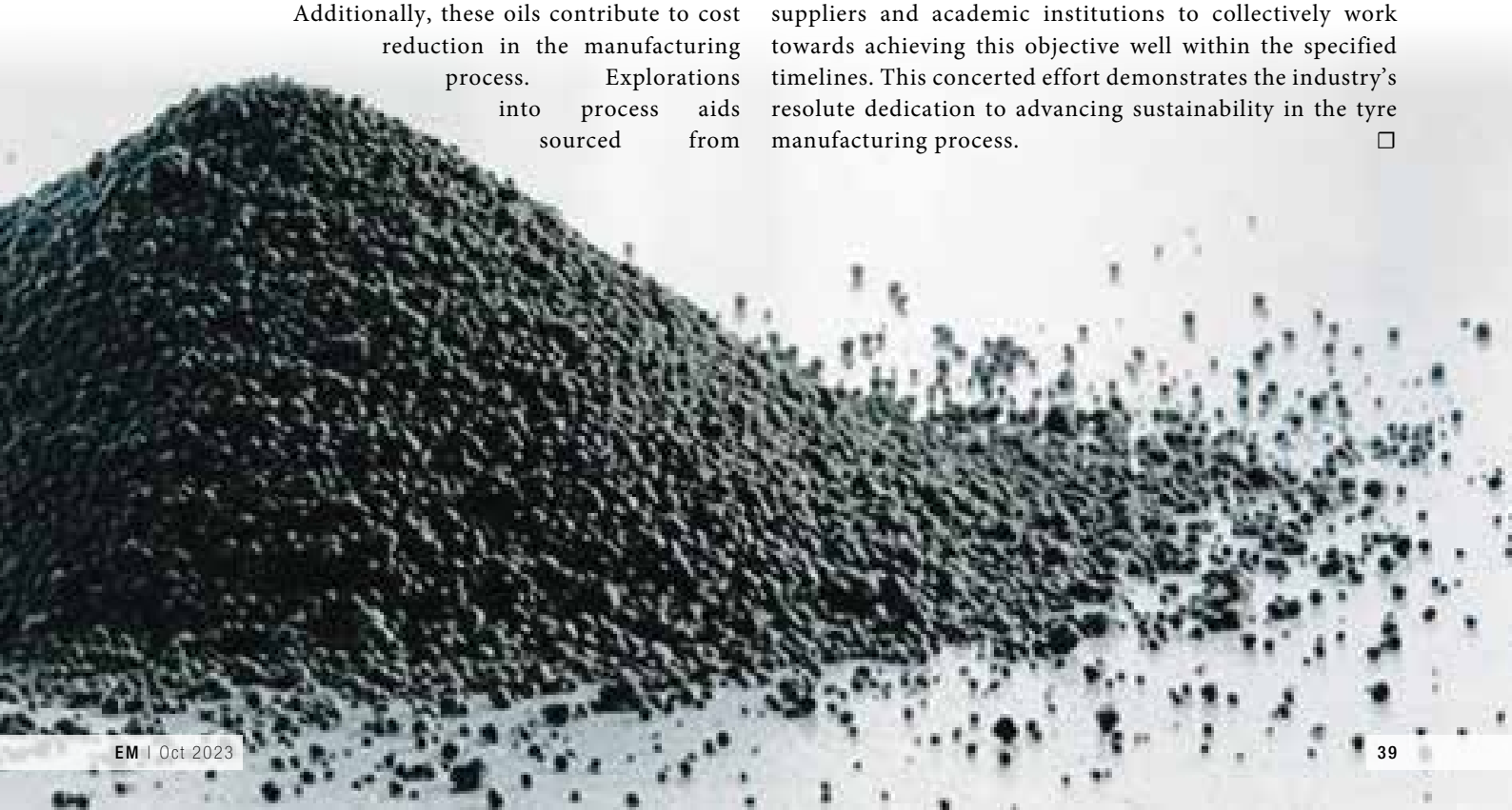
These endeavours underscore a significant shift in the tyre industry's approach, striving for enhanced sustainability by minimising reliance on fossil-derived materials and promoting the efficient utilisation of resources. Another critical raw material employed in tyre manufacturing is Rubber Process Oil (RPO), which encompasses varieties such as Aromatic Oil, TDAE, RAE, MES and paraffinic oil. All of these oils are derived from crude oil. Within tyre production, these oils serve as essential process aids during the rigorous mixing of rubber compounds in internal mixers, while also playing a crucial role in engineering the desired stress-strain behaviour of the final compound. Additionally, these oils contribute to cost reduction in the manufacturing process. Explorations into process aids sourced from non-petroleum origins, such as orange peel, soybean, canola and neem, are underway at various stages of research and development for potential tyre applications.

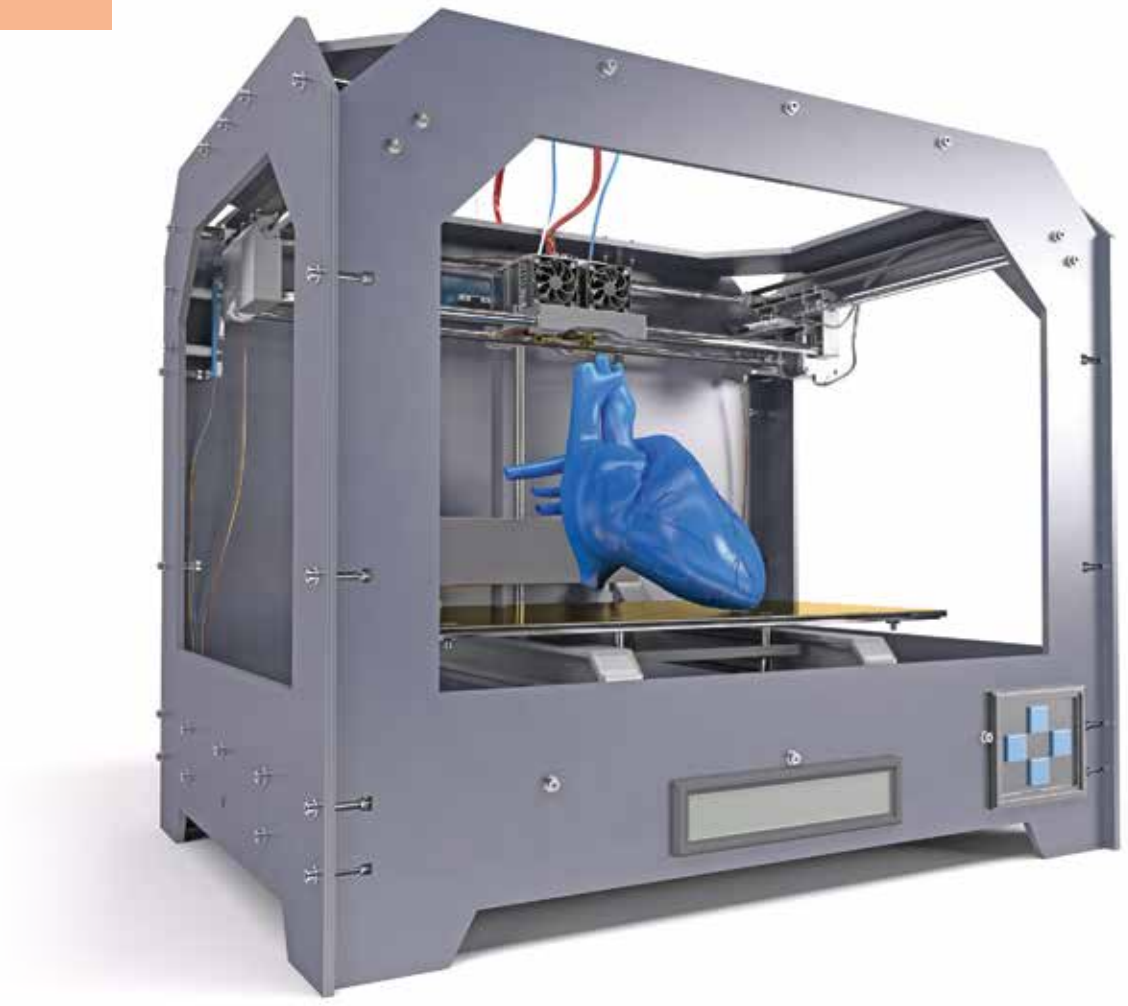
Although Silica is generally considered a more environmentally friendly material, the energy consumption associated with conventional methods for producing Precipitated Silica from quartz sand is notably high. A burgeoning industry centred around Silica extraction from Rice Husk Ash has emerged as a promising solution, substantially curbing CO_2 emissions. This innovation also presents a viable answer to the challenge of managing ash disposal and its associated pollution issues.

Reducing environmental impact

The utilisation of de-vulcanised rubber derived from end-of-life tyres in tyre manufacturing has been a practiced approach for decades. However, the reclaimed rubber obtained through conventional reclamation processes tends to exhibit significant degradation compared to the original rubber compounds used in tyres. Consequently, extensive research efforts are on-going to develop alternative methods for de-vulcanising cured rubber with minimal degradation. Several of these technologies have already transitioned into commercialisation, opening up opportunities to enhance the incorporation of de-vulcanised rubber in tyre production.

Many prominent players in the tyre industry have firmly committed to achieving the ambitious goal of making their tyres 100% sustainable by the year 2050, setting intermediate milestones for incremental progress. A robust collaboration is taking place among tyre manufacturers, raw material suppliers and academic institutions to collectively work towards achieving this objective well within the specified timelines. This concerted effort demonstrates the industry's resolute dedication to advancing sustainability in the tyre manufacturing process. □





Leaner, lighter and agile manufacturing with 3D Printing

Global businesses have already been able to effectively incorporate 3D Printing into their workflow to support current manufacturing techniques. This trend will increase rapidly as more and more businesses are impacted by 3D Printing technology. A read on…

Prof Vijay Kumar Singh

Dean and Head, School of Mechanical Engineering, Lovely Professional University

Over the past few years, 3D Printing technology has witnessed tremendous growth. From 7.5% growth in 2020 to 19.5% growth in 2021, technology continues to expand. The market is anticipated to increase because of intense three-dimensional printing research and development as well as rising demand for prototype applications from different industrial verticals, particularly healthcare, automotive, aerospace and military.

The overall 3D Printing market is predicted to grow by 24% to reach $44.5 billion by 2026. The space, medical, automotive and even consumer goods industries have all been influenced by this expansion. As the 3D Printing industry is growing, more businesses have started using this technology for production purposes.

Defining 3D Printing

Previously called rapid prototyping, the technology has evolved over the last three decades and is now popularly known as 3D Printing. It is established as one of the major contenders in the manufacturing sector. 3D Printing is generally referred to as Additive Manufacturing (AM) in industrial applications. AM is a group of technologies that are based on additive shaping principle and thereby build physical three-dimensional (3D) geometries by successive addition of material (as per ASTM ISO/ASTM52900-21).

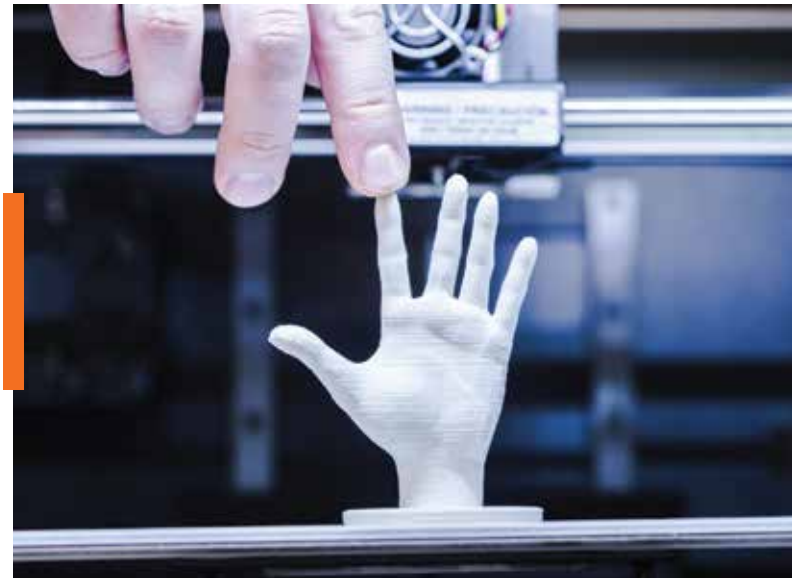
Different 3D Printing technologies have been developed, each with a specific purpose. As per ASTM Standard F2792, seven categories of 3D Printing technologies are binding jetting, directed energy deposition, material extrusion, material jetting, powder bed fusion, sheet lamination and vat photopolymerisation. All of these work on layer-by-layer manufacturing; however, the principles involved in each technology differ from one another. These 3D Printing technologies are increasingly employed for a wide range of applications.

The 3D Printing technology is a layer-by-layer manufacturing technique in which the material is deposited one layer at a time to build a three-dimensional structure. Any complex and intricate feature can be easily fabricated with this technique. This is an added advantage to designing complex yet effective products, which gives designers a lot of design freedom. Moreover, the technology provides significant time compression in manufacturing lead time, which reduces time required to launch new products in the market.

Low costs and faster operations

The speed at which parts can be produced is one of the key benefits of 3D Printing. Traditional technologies frequently lag Additive Manufacturing techniques. The quick verification and development of design concepts is a benefit in this situation.

Prototyping is accelerated by 3D Printing, which may produce parts in a matter of hours. Every stage can finish quicker as a result. In comparison to machining prototypes, 3D Printing is less expensive and faster at generating components because the part may be produced in a short period of time. This makes it possible to complete each design alteration considerably more quickly. The speed of 3D Printing is substantially faster even when compared with the moulded parts, as no design and manufacturing of tools is required. Any changes in the design at later stages can be easily implemented in CAD files and do not affect the production time as much.



When compared to other subtractive technologies, which remove a great amount of non-recyclable materials, the manufacture of components by 3D Printing uses only materials required for the part itself, with little to no waste. The method not only conserves resources but also lowers price of the materials used.

Low waste and less time

Because 3D Printing is a one-step manufacturing method, it reduces time and expenses involved with using various machines for production. As stated earlier, this manufacturing method can also save on material costs because it only uses material needed for the part itself with little to no waste. Low cost of labour is one of the key benefits of 3D Printing. Apart from post-processing, most 3D printers only need a user to submit a CAD file and start the print. The part is subsequently produced by the machine using a fully automated procedure. There is no requirement for operators to always be present

when using 3D printers; they can set up the process and allow to complete the task by itself. Many times, 3D Printing doesn't need highly qualified machinists or specialist operators, which lowers labour costs significantly compared to traditional production.

The financial risk associated with prototyping is eliminated since it is possible to test a design by printing a finished prototype before spending money on expensive manufacturing tools (such as moulds, tooling, and jigs). Even minor adjustments to a mould or manufacturing technique will result in a sizable financial loss.

Another benefit of 3D Printing is print-on-demand, which, in contrast to conventional production procedures, requires less room to store inventories. As no bulk printing is necessary unless absolutely necessary, this saves both space and money.

Aiding manufacturing procedures

As the parts are produced using a 3D model as either a CAD or STL file, all 3D design files are kept in a virtual library so they can be found and printed as needed. Without wasting outdated inventory or spending money on tools, changes to designs can be made for very little money by altering individual files.

Mass production using 3D Printing can be achieved indirectly, which involves creating tools that can aid in other manufacturing procedures. For instance, it can be used to create 3D printed injection moulds, which aid injection moulding for large production.

In roughly 20 minutes, Adidas is printing a sole with a lattice-like pattern using 3D Printing technology. This technology gives the soles flexible, pleasant, and lightweight properties. A better cushioning and stabilising effect are produced by the structure, which also improves the shoe's response to a user's leg movement.

To create customised aligners, Align Technology has combined mass production and customisation using 3D Printing. Formlabs used 3D Printing to create an autoclavable and biocompatible nasal swab at the outset of the Coronavirus pandemic. They were able to manufacture at a rate that satisfied needs of the nation thanks to 3D Printing.

During the coronavirus outbreak, Photocentric used 3D Printing to produce valves for breathing apparatus in large quantities. They were able to produce 40,000 valves each week and more than 600 in a single night. This demonstrates the speedy performance of 3D printers. The medical industry might save money by using 3D-printed metal implants, which could also be more durable and survive longer than conventional implants.

Tremendous time and cost reductions were achieved by Ariane Group as the future upper-stage propulsion module's injector head of a rocket engine was reduced to just one component as opposed to 248 by using 3D Printing.

Airbus, Defence and Space has utilised 3D Printing to produce satellite parts. In addition to the technical benefits, significant cost savings were made: manufacturing savings alone amount to more than 20%.

Accelerating product launches

Electronics manufacturers are turning to 3D Printing to increase throughput and speed up the launch of new products because of mounting demand to shorten product cycle times, satisfy evolving customer needs, and manage fluctuating market conditions. In this view, 3D Printing technology is being used for printed electronics. In future, this seems like a viable solution, as the electronics industry has started to utilise benefits of 3D Printing.

The shift to a sustainable and resource-efficient civilisation will be aided by additive manufacturing in the coming years. Many businesses are looking to benefit from additive manufacturing's capacity to achieve mass customisation.

Through weight reduction, localised carbon footprint reduction, reduced energy use, waste reduction, and the use of plant-based materials, 3D Printing will be crucial in reversing global warming. An advantage over conventional technologies is undoubtedly the fact that 3D Printing is already a leaner, 'lighter', and more agile technique of manufacturing. ☐

Industrial Revolution and the Textile Industry

Step into the fascinating world of textile machinery, where innovation meets tradition to craft the fabrics that shape our lives. This article explores the intricate processes and cutting-edge technologies that have revolutionised textile production, ushering in a new era of efficiency and quality.

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New industrial procedures were introduced during the Industrial Revolution, which lasted from the 1760s through some point between 1820 and 1840. As a result of this transformation, new chemical manufacturing processes, automated production methods and iron production were implemented. The Industrial Revolution was primarily driven by the textile industry. The textile business uses varied machines to stitch fabrics and create clothing, carpets and other textile products. These sewing machines, which range in size from enormous heavy-duty industrial machines to tiny consumer-sized machines, are employed by individuals for their projects, in factories and only by insignificant textile manufacturers.

Machines involving fibre/yarn/thread production

• **Thread winding machines:** The fundamental purpose of winding is to move the yarn from one appropriate container to another. Winding is also required for packing, clearing and checking the yarn to enhance quality and eliminate flaws. The purpose of these devices is to wind thread onto spools.

• **Spinning machines:** Before a thread can be stitched together, it must first be created through the process of spinning. These spinning machines are used to spin materials like cotton into a thread or yarn. The thread or yarn can be knitted or woven together to make a piece of cloth.

• **Carding machines:** Since carding performs all of the primary duties, it is sometimes referred to as the beating heart of spinning. The dust and grime are removed here after the fibres have been opened up to more or less single strands.

• **Bleaching/dyeing machines:** One of the most crucial components in the textile business is dyeing. Different forms of cloth colouring are carried out in the dyeing area according to the buyer's demands and specifications. To provide an even shade with a fastness suited and performance to its end usage, the dyeing procedure is utilised. In contrast, bleaching is used to take out pigments and natural colours that are present in the . It is a chemical process used to remove the substrate's natural coloration, which can be used on yarn, knitted fabric and woven fabrics.

Textile machinery

Some of the major machines that are used in textile manufacturing are:

Fig 1

• **Air jet loom machines:** Air jet weaving machines are one type of contemporary weaving equipment with the highest weft insertion performance and are thought to be the most productive in the production of light to medium-weight fabrics, preferably made of cotton and certain synthetic fibres (sheets, shirting fabrics, linings, taffetas and satins in staple yarns of synthetic fibres); it must be noted, however, that technically positive results are currently also obtained with heavy weight fabrics (denim, leather etc.). For individuals who wish to make large numbers of bespoke fabric styles, these machines are the best option. Generally speaking, the weaving widths range from 190 to 400 cm. There are up to eight distinct colours on the multi-colour weft carrier. The JAT910 AIR JET LOOM (Fig 1) by Toyota has embraced the goal to continue growing with its consumers while understanding their changing demands.

• **Air jet spinning machines:** Contra-rotating twin jets are used in Murata's Vortex Jet Spinning (MJS) to improve the wrapping of edge fibres. The research has demonstrated that the cross-sectional number of fibres affects jet spinning. Given that the number of wrapper fibres is capped by the number of edge fibres on the surface and that the strength is directly

correlated with the wrapper fibres. When the yarn's fibre count rises, the proportion of wrapper fibres decreases and the tenacity drops. Additionally, the wrapping length decreases with increasing count coarseness, which lowers tenacity. As a result, two difficulties required attention: a greater quantity of wrapper fibres and a longer extent of wrapper fibres. The Murata Vortex Spinning (MVS) technology resolves some of the problems with prior iterations of air-jet spinning systems by using more than two air jets to form a 3D air vortex. By producing more edge fibres, switching from a 2D to a 3D system enables a considerable increase in the number of wrapper fibres.

Fig 2

• **Fabric finishing machine**

The Automatic Textile Calendaring Machine (Fig 2) has attached rollers that guarantee crease-free travel. The machine's top advantages include trouble-free operation, smooth performance and low maintenance requirements. They have designed models specifically to meet the needs of the textile industry, providing dimensional stability to all types of materials. As implied by the name, calendaring is the process of treating cotton with a strong caustic alkaline solution to enhance its shine, stability, tensile strength, water sorption and other qualities. For all wholesale orders, this machine is provided to the clients at prices that are at the top of the market.

Fig 3

• **Jet dyeing machine**

India's Surat-based Apex Engineers (Fig 3), the most advanced machine for dispersing colouring polyester fabric is the jet dyeing machine. These machines allow for a speedier and more consistent dying process because the cloth and dye fluid are both in motion. There is no fabric driving reel to move the cloth in a jet dyeing machine. The force of the water helps the cloth move. It is affordable because of the low alcohol percentage. In contrast to a long tube dyeing machine, only four valves are needed to regulate the movement of the cloth, making it more user-friendly. There is only one valve in jet dyeing equipment and fabric dyeing machines.

Conclusion

These are some of the highly automated, effective machines that are now utilised in the textile manufacturing sectors and that will also alter the course of production in the future. The textile industry is not only evolving but also revolutionising itself. It is on the cusp of a new era, promising textiles that are not just functional but also environmentally conscious. With each advancement, the fabric of our future becomes brighter and more technologically advanced than ever before. ☐

Metal Additive Manufacturing machine with innovative technology

Defiant3D, an Additive Manufacturing machine maker, recently launched its first metal AM machine, the Defiant200. Based upon a novel Cold Deposit and Sinter technology, the new machine is marketed as an affordable entry into metal Additive Manufacturing. The Defiant200 machine features a 200 x 200 x 200 mm furnace utilising dual-powder printhead technology. One powder (316L stainless steel) serves as the build material, while the other, with a higher melting point, acts as support. The tool head deposits both powders along the XY axis, while the Z axis gradually descends into the furnace. After filling the furnace, the lid seals it, and internal thermal elements heat it to the metal's sintering temperature. The support material remains as powder, while the build material solidifies. Afterward, the support material is easily removed, and the parts undergo necessary post-processing like sandblasting or machining.

Defiant200

Defiant3D | Scotland

A new coupler equipped with state-of-the-art technology

Engcon, a manufacturer of tilt rotators, quick couplers and accessories for excavators, has launched the new machine coupler S60 for excavators sized 12–19 tonnes. In addition to making the machine hitch stronger, retrofitting with EC-Oil blocks will be easier as the new machine hitch contains almost no hoses and minimises the risk of leaks. Furthermore, the new bolt-on EC-Oil block has an increased hydraulic flow. Additionally, the coupler is reinforced laterally and in the digging direction and has increased stability around attachment points to the excavator.

New Machine Coupler S60

Advantages with the improved machine coupler S60: EC-Oil block without hoses, this means a longer service life, easier for repairs, maintenance and retrofitting; Reinforced construction both laterally and in the digging direction; Increased stability around attachment points to the machine that contributes to a better operating experience; Improved and more flexible hose routing between excavator and machine hitch; Bolted lifting hook and possibility with lifting eye.

Engcon | Germany

Robust air suspension system for Vocational Trucks

Hendrickson Truck Commercial Vehicle Systems has teamed up with Peterbilt to introduce the PRIMAAX® EX, a robust vocational air suspension system, as part of chassis upgrades for Peterbilt's 567, 579 and 589 models. This suspension system is available in 46,000 and 52,000-pound capacities with a 10" ride height, compatible with both drum and air disc brakes. Designed for demanding vocational and severe-service applications like construction, refuse, mixer, logging, and heavy haul, PRIMAAX® EX features a durable structural design, optimising durability, reliability and handling. Its suspension geometry minimises driveline vibrations and controls suspension windup and frame rise. Maintenance-free, heavy-duty rubber bushings provide an extended service life. The PRIMAAX® EX suspension enhances vehicle stability and handling, allowing heavy loads and high-centre-of-gravity vehicles to navigate tight turns with minimal sway. It offers scalability, ranging from 23,000-pound single axle configurations to 78,000-pound tridem setups, providing flexibility for various transport needs.

HAULMAAX EX

Hendrickson Truck Commercial Vehicle Systems | USA

Precision grinding for both worms and gears

PTG Holroyd's new HG350-WG worm and gear grinding centre offers unprecedented efficiency and precision. It combines two traditionally separate tasks into a single machine, streamlining specialised gear and tooth form production. The machine integrates an advanced version of the HPMS (Holroyd Profile Management System) for swift programming and seamless background calculations for both worms and gears. The HG350-WG handles deep grinding operations effectively. Its extended machine bed accommodates screws and worm shafts up to one metre in length. Specialised software compensates for helical twist, ensuring topological accuracy. These machines utilise Sinumerik ONE CNC's Profinet capabilities and incorporate IO-Link communication technology. Additionally, RFID scanning enhances functionality, especially in production cells, by guaranteeing accurate component or tooling item changes between manufacturing cycles during gear grinding operations. The HG350-WG marks a significant advancement in precision grinding for worms and gears, offering efficiency and accuracy in a single package.

HG350-WG worm and gear grinding centre

PTG Holroyd | UK

Frequency inverter for horizontal conveyor technology

Nord Drivesystems recently introduced the NORDAC ON frequency inverter, specially designed for the requirements of horizontal conveyor technology. The NORDAC ON PURE in wash-down design features the nsd tupH surface treatment and is the right choice for applications in the food and beverage industry, especially when it comes to high hygiene requirements. The inverter is characterised by an integrated multi-protocol Ethernet interface, IIoT capability, full pluggability and a compact design. Being part of the NORD modular system, they can be ideally combined with the manufacturer's gear motor portfolio. The series comprises three variants: NORDAC ON for operation with IE3 asynchronous motors, NORDAC ON+ for combination with the highly efficient IE5+ synchronous motor, and NORDAC ON PURE in wash-down design. The NORDAC ON PURE SK 35xP has been specially designed for conveyor applications in the food and beverage industry requiring power up to 1.5 kW. The wash-down design with round and smooth surfaces allows for quick and easy cleaning; thanks to protection class IP69, this is also valid for demanding requirements.

NORDAC ON frequency inverter

Nord Drivesystems | Pune

Innovative solutions for optimised part processing

Seco recently introduced new toolholders, PCBN inserts, round carbide inserts and extra-long solid carbide drills with enhanced versatility and tool life. These innovative products are aimed at applications ranging from general ISO turning to high-volume hard turning and deep hole drilling.

Seco new product solutions

Cost-saving X-tra Long Solid Carbide Drills: 40xD-60xD: Seco X-tra Long Solid Carbide Drills deliver results in various materials with steel, stainless steel, cast iron, Inconel®, titanium and hardened steel using standard machining centres. **CH1050 and CH2581 PCBN inserts for process stability:** CH1050 enhances tool life and cost efficiency, promoting high output and less scrap. CH2581 provides process stability and is tailored for semi-interrupted cuts. **MF2 chipbreaker on RCMT/RCGT round, positive-style ISO-turning carbide inserts with chip control:** MF2 chipbreaker on RCGT/RCMT inserts maintain favourable chip control at higher speeds and feeds, especially with dynamic turning. **Better surface finishes with Seco-Capto MTM JETI Toolholders for general ISO turning:** Seco-Capto MTM JETI Toolholders enhance tool reach, reduce overhang, minimise collisions, optimise production and enable multi-spindle tool usage.

Seco Tools | Pune

Mini-scissor for better drive motors

Snorkel recently revealed the new S3013 Mini. It is developed to address specific needs in the low-level scissor lift market. The S3013E mini-scissor offers the versatility of a compact scissor. This innovative model was also designed to be environmentally friendly, with an electric drive for zero emissions and reduced noise. Snorkel's S3013 Mini fits between the S3215E slab scissor and the lightweight S3010E in terms of size and features. The S3013 Mini offers the compact dimensions of the S3010E while adding an extending deck, which is common on all larger models. This new model features a maximum working height of 19' and a platform size of 29.5' x 52" stowed and 29.5' x 76" extended, with a 600-lb maximum platform capacity. The S3013E also shares the fixed control box design with all Snorkel scissors, which is proven to reduce damage costs and save downtime on the job site. The component layout is designed for ease of maintenance, reducing service time to a minimum.

Snorkel | USA

Better surfaces thanks to new internal coolant

Walter is presenting a new profile milling cutter of the Xtra·tec® XT generation in the form of the M5460. The milling cutter (dia. 8–32 mm or 3/8–1") has an internal coolant supply which can be used with compressed air MQL (minimum quantity lubrication) or emulsion depending on the material and application. This optimises chip removal and therefore surface quality and process reliability. The Xtra·tec® XT milling cutter, designed for finishing, semi-finishing and hard milling, is suitable for profile milling of complex freeform surfaces (for example those on blisks) as well as for deep cavities in steel, stainless steels, cast iron, materials with difficult cutting properties and for hard machining up to 63 HRC. The double-edged, precision-ground indexable inserts combine proven geometries with Walter's universal, wear-resistant cutting tool materials for ISO P, K, M and S and with the WHH15X high-performance grade for machining ISO H.

Xtra·tec® XT M5460 profile milling cutter

Walter Tools India | Pune

Highlights – November 2023

» Coolants and Lubricants

Coolants and lubricants are pivotal components of modern manufacturing, ensuring the smooth operation and longevity of machinery across diverse sectors. This sector has witnessed significant advancements in recent years, with the emergence of eco-friendly formulations and the application of nanotechnology to enhance lubrication efficiency. In our upcoming issue, we will delve deep into these manufacturing developments with an insightful exploration of the latest trends, technologies and their impact on industrial processes.

» Welding Technology

Welding industry plays a pivotal roles in various sectors as the technology continually evolves, with advancements in equipment and techniques enhancing precision and efficiency. This section serves as a comprehensive resource for both professionals and enthusiasts seeking to stay informed about the dynamic world of welding technology.

» CNC Machining Centres

CNC machining centres have revolutionised precision manufacturing, offering unparalleled accuracy and efficiency in producing intricate components for a wide range of industries. The integration of cutting-edge technologies like AI-driven automation and advanced tooling has further cemented CNC machining as a cornerstone of modern manufacturing. The industry continues to push boundaries, making this section a must-read for those eager to explore the forefront of machining technology and practices.

» Design for Manufacturing

The manufacturing design industry is undergoing a digital transformation, where cutting-edge software and 3D modelling tools are redefining product development and prototyping. Innovations such as generative design and additive manufacturing are streamlining production processes and enabling unparalleled customisation. This section explores the convergence of design and technology, offering readers a glimpse into the creative and technical marvels shaping the future of manufacturing.

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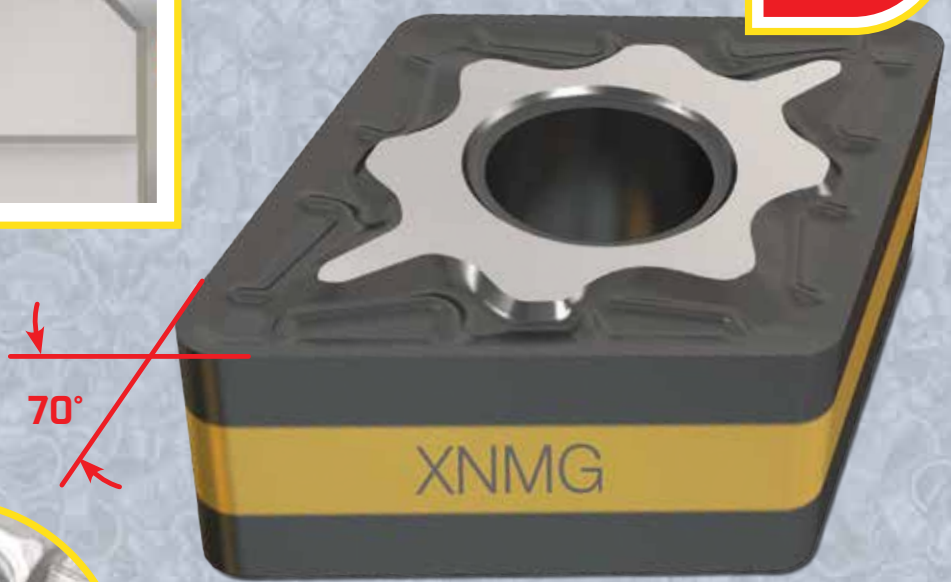

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