

# THE MACHINIST

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SAMPLE INSIDE



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The industry 4.0 revolution has brought about unprecedented levels of efficiency in manufacturing. But it also comes with its own set of challenges, the biggest one being cyber security and protection of data.

Machining  
Expertise in machining threads

Additive manufacturing  
Innovative 3D printing

Interview  
Rajeev Kapur, MD, Steelbird Hi-tech India

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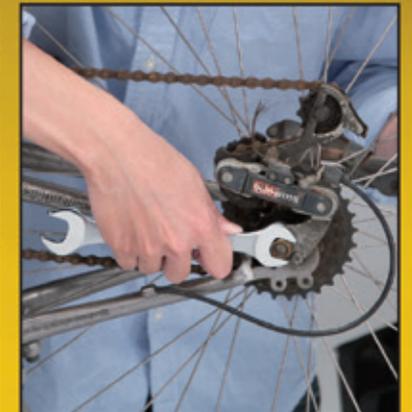
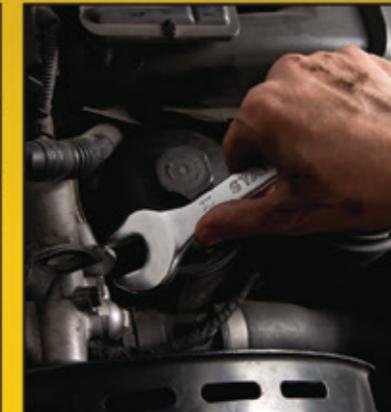
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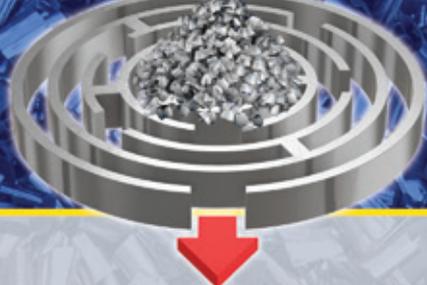
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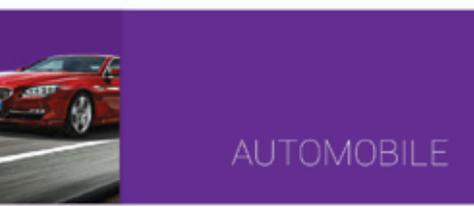
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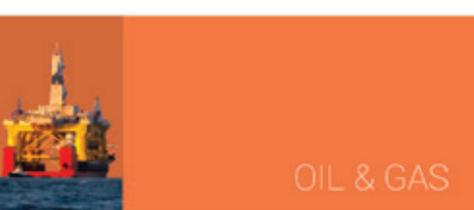
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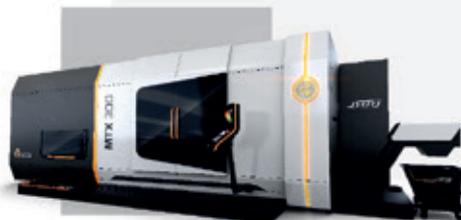
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## CHANGE IS A GOOD THING

**T**here are a ton of maxims on change- change is inevitable, success lies at the end of your comfort zone, change is the only constant...

But these seemingly cliched words do have a world of wisdom imbibed into them – be it business, workplace, our surrounding communities, change is a constant factor and how we deal with it, harness it, employ it and apply it, ultimately decides our success.

From assembly lines to man-made tools to machines to automation, the evolution of modern manufacturing has driven the course of the global economy for centuries. We continue to see innovation and creative ideas change the face of modern manufacturing, with ideologies such as industry 4.0, industrial 5G and digitisation driving the way forward. But evolution comes with its own challenges. We explore this theme in our cover story this

### FROM ASSEMBLY LINES TO MAN-MADE TOOLS TO MACHINES TO AUTOMATION, THE EVOLUTION OF MODERN MANUFACTURING HAS DRIVEN THE COURSE OF THE GLOBAL ECONOMY FOR CENTURIES

month on cyber security and how an increase in the use of technology and automation has left organisations vulnerable to cyber-attacks.

We also delve deeper into additive manufacturing in this issue, firstly with an end-user story and secondly with a feature on how machining and additive manufacturing can work together in harmony for efficiency. Additive manufacturing today is not just looking at the value propositions like assembly, cost, and cycle, but actual applications. 3D printing may seem very futuristic, but it is fundamentally changing what we can do. It's not 10 years away. It's here

Finally, our tooling feature highlights why sometimes its important not to wait to fix it until its broken but adopt tooling solutions on a proactive basis – for a better tool life and overall efficiency.

Change of any kind doesn't have to be a revolution- adopt it as part of the evolution process, use it as a stepping stone for better things.

Stay Safe!

**Kruti Bharadva**

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# CONTENTS



## COVER STORY

Flip Side of The Coin..... **26**



## INDUSTRY PIONEERS

The Father of Robotics ..... **16**

Editorial .....	4
News .....	8
Event: ExxonMobil is Presenting Partner for ET Promising Plants .....	18
Digital Engineering: Experience @ Speed!.....	20
Interview:	
Steelbird Flies Higher.....	36
Products .....	44



## Additive Manufacturing

A Design Perspective ..... **22**

Printing the Way Through  
Innovation ..... **42**



## Tooling

Fixing What Isn't Broken ..... **30**



## Machining

A High Speed Trochoidal  
Slicer ..... **34**

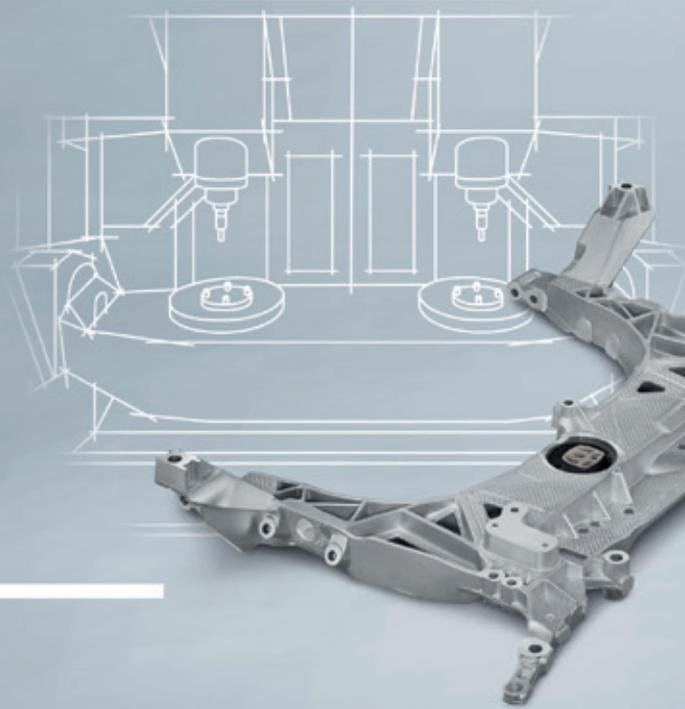
Machining Threads – The  
'Do's & Don'ts'!..... **40**



## HR

Procurement Patterns  
– A Behavioural Study ..... **38**

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## E4Q Energy Chain From Igus Wins Award

**THE E4Q ENERGY CHAIN SERIES** was developed by igus to achieve the best possible solution for unsupported and long travels. In the process, shapes inspired by nature ensure very low weight, while a unique tool-free opening concept reduces installation time by 40 per cent. The E4Q has now received the renowned German Design Award for this pioneering design.

“To optimise the material and thus the weight of the energy chain, our developers have been inspired by nature”, explained Michael Blaß, head of the e-chain systems division at igus. “The rounded design is very organic and is found on the outside of the chain links and the stop-dogs. This reduces the weight by 10 per cent compared to the



previous E4.1 series, and the drive energy.” Despite the material cut-outs, the new development has 20 per cent higher strength and stability. The chain links of this energy chain generation continue to have a completely new crossbar concept with locking straps. These ensure that the

series can be opened and closed in seconds without tools. Filling is therefore particularly easy, and the installation time is reduced by 40 per cent.

The advantages of the E4Q have now been recognised by the international jury of the German Design Award. In the Excellent Product Design category, the E4Q was awarded as well as the innovative Module Connect Adapter, with which energy chains including cables can be connected to the machine using a click system. The German Design Award is the international prize of the German Design Council. Its objective is to discover, present and award prizes for unique design trends. 5,000 products/projects from 60 countries were submitted this year.

## Inovance Announces New Facility



**INOVANCE TECHNOLOGY INDIA**, a subsidiary of global industrial automation group Inovance, has announced that it has begun operating a new additional facility at their Chennai HQ. The facility will significantly improve a range of the company’s customer-facing operations, including product storage, stock management, product updates, PIMM product assembly, and product grading and packing. The decision to build this facility was taken due to strong business growth, and also to ensure that Inovance is well placed to manage the expected business upturn as the country finally begins to emerge from COVID-19.

Anil Kumar, Director, Inovance Technology India, commented, “In nine short years, we have shown exceptional

growth in our business as well as massive improvement in our standards of customer service and product delivery times. At Inovance India we are truly proud of the business we have built, which is now pan-India in scale, and this expansion is testimony to our commitment to the Indian market.”

“As of now, our Inovance India HQ covers 22,500 sq. ft., and that’s up from the 1,850 sq. ft. we started with back in 2012. It’s my passion to build this company to greater heights. We’ve already become a big brand in the Indian market, and my goal is to continue to grow by continually building on our reputation for top quality products backed up by the strongest engineering expertise and customer support,” he added.

## FMC Raises COVID-19 Awareness in Rural India

**AS PART OF** its commitment to stand with the people of India as they continue to fight a devastating second wave of COVID-19, FMC India, one of the leading agricultural sciences companies in India, has begun to run a multi-channel educational campaign in the countryside to raise overall awareness of the coronavirus and to help curb the spread among rural communities.

FMC has partnered with the AR-DEA (Agriculture Rural Development & Environment Awareness) Foundation and digital media channel GreenTV, to stream a series of daily episodes over 20 days. Each interactive episode will feature a medical expert, who will educate viewers on different aspects of the disease and answer questions during the live stream.

Ravi Annavarapu, FMC India’s National Sales and Marketing Director, said, “Limited knowledge of COVID-19 symptoms and reluctance towards testing and treatment in remote rural areas has made the village population more susceptible. There is an urgent need to educate and safeguard Indian hinterlands from the coronavirus. In line with our community empowerment initiative Project Samarth, FMC India has opted for a preventive approach to help people take steps to protect themselves against getting infected.”

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## The Chiron Group Open House Online 2021

**AFTER THE CHIRON GROUP'S** traditional in-house exhibition was held online last year for the first time, drawing in crowds of interested visitors, the machine tool manufacturer is building on this success in 2021. The OPEN HOUSE ONLINE will take place from 15th to 18th June, featuring several machine premieres, a 360° tour and exciting innovation talks.

The virtual doors will open on 15th June and remain open around the clock for four days, welcoming visitors from all over the world. One new feature of this year's OPEN HOUSE ONLINE is a 360° tour that offers exclusive peeks at the CHIRON Group's different areas of expertise. Visitors can be accompanied on their tour by their own personal CHIRON Group contact partner, adding the personal touch that visitors to the traditional exhibition will recognise, and offering them the opportunity to discover the exhibition highlights together and



dive into expert discussions. Another novelty: The Innovation Talks. Experts from the CHIRON Group will present information about the latest developments and trending topics in live streams. Some of the company's cooperation partners will also present their innovative solutions.

The new MT 715 series, designed for autonomous and multi-functional machining of bars and feed parts, will make its debut on the global stage. The DZ 28 double-spindle machine will also premiere at this event. With a spindle clearance of 1,200 mm, it is particularly suited for machining structural parts

with large volumes such as those found in the e-mobility and aviation industries. Visitors from the micro-machining sector will be excited to see the CHIRON Group's Micro5, an extremely compact and dynamic manufacturing centre for highly precise machining of small components. Finally, the STAMA MT 733 and the AM Cube, the first 3D metal

printer from the CHIRON Group, are also among the product highlights.

"These days, many exhibitions and events are taking place virtually, but our OPEN HOUSE ONLINE 2021 is sure to be something very special. No matter where in the world they may be, whether they're joining us from their workplace or their home office, our visitors will be at the very heart of the action – from the digital tour of our actual factory to the exciting live discussions. Everything that drives their production process is waiting to be discovered," says Bernd Hilgarth, Chief Sales Officer, CHIRON Group.

## Alstom Delivers 100th Electric Locomotive To Indian Railways



**ALSTOM** has successfully manufactured and delivered the 100th electric locomotive to Indian Railways. As part of the contract worth €3.5 billion in 2015, the company will be supplying 800 fully electric high-powered double-section locomotives of 12,000 HP (9 MW) for freight service, capable of hauling ~6,000 tonnes at a top speed of 120

km/hr. This is the largest Foreign Direct

Speaking on this milestone, Alain SPOHR, Managing Director, Alstom India said, "I am pleased to mention that despite challenges posed by COVID-19, we have been able to successfully manufacture and deliver 100 e-Locos to the Indian Railways in less than a year. Due to the intricacy of the project, it is an honour to work on a first-of-its-kind 'Make in India' project that resulted in a technology breakthrough for the nation. Our successful collaboration with Indian Railways is paving the way for bringing advanced innovation and technology to the Country. Alstom is committed to delivering safe, reliable, and efficient solutions for IR's evolutionary journey towards becoming the world's first 100 per cent green railways."

## Quaker Houghton Enters Joint Venture with Grindaix

**QUAKER HOUGHTON**, a leader in industrial process fluids, has entered into an exclusive joint venture with Grindaix GmbH, a German-based, high-tech provider of coolant control and delivery systems.

Grindaix's solutions apply to a wide range of machining processes, including grinding applications in the metalworking sector. The technology the company provides helps customers precisely measure and optimize parameters such as coolant flow, velocity, temperature, nozzle angles, and pressures; significantly increasing the success of coolant application.

"This partnership is an excellent strategic fit with broad application. We see several advantages for our customers investing in system automation and optimization trends evolving from Industry 4.0," said Joe Berquist, SVP & Chief Strategy Officer for Quaker Houghton. "Grindaix's advanced capabilities enable us to deliver on our promise to make our customers more competitive, as we combine advanced product chemistry with equipment solutions to deliver an optimal package for performance, cost, and quality. We call this powerful combination 'Fluid Intelligence'. Grindaix's data-based approach to coolant system operation has been growing steadily in the German market, and we see an opportunity to leverage their technology across our broader solutions portfolio."



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## Digital Driving Experience From Continental

**CONTINENTAL** has received its first major order for a pillar-to-pillar display in a production vehicle from a German vehicle manufacturer. By developing a display solution that extends across the entire width of the cockpit, the technology company systematically continues the trend toward larger displays, which has been ongoing for many years. The integrated display solution from one A-pillar to another provides space for a growing number of vehicle functions, digital services, as well as communication and infotainment applications. It is scheduled to go into volume production in 2024. The solution makes the display the central visual interface between the driver, front passenger and digital driving experience. Its launch in a high-volume production vehicle marks another



milestone in the evolution of the car into a smart device as part of the internet of things. Whether it is navigation, warning signs, movies, news, social networks, office applications or booking apps to plan the route: Displayed across the entire width of the cockpit, the content is fully immersive and offers drivers and passengers a completely new user experience.

“A driving experience that is digital and safe is becoming the most distinctive feature of modern cars. The size of the displays and their intuitive operation play a central role here. In short, what used to be horsepower is now screen diagonals and user experience,” said Dr Frank Rabe, Head of the Human Machine Interface business unit at Continental. “With the user experience, we already create value today. Each

year, we supply a total of around 120 million products for human-machine interaction, equipping one in four cars worldwide. With the increasing significance of automated driving, how we spend our time in cars is becoming even more important. As a result, there is also a growing need for solutions and services for the in-vehicle user experience.”

## Coventry University and L&T Technology Collaborate

**L&T TECHNOLOGY SERVICES LIMITED** has announced that it has signed a collaboration agreement with UK's Coventry University to build and deliver new generation engineering solutions for the automotive and manufacturing sectors. The partnership will see research was undertaken in autonomous mobility solutions and vehicle dynamics to strengthen LTTS' technology capabilities for their global customers. Specifically, LTTS and Coventry University will collaborate towards developing technologies and deepening skillsets in autonomous driving, EVs and Software-Defined Vehicles. The university will also enable LTTS engineers to acquire advanced knowledge in automotive and manufacturing technologies and sustainability, empowering them to face myriad challenges around technology upgrades.

The partnership is expected to result in the joining of like-minded experts to research and develop new products, processes and services; the building of a talent pool that will impact local and global economies; and a working relationship that connects two global organizations to create change in the transport sector. The University's contribution is being led by



the IFTC which researches transport design, electric, connected and autonomous vehicles, cybersecurity and manufacturing technologies.

Abhishek Sinha, Chief Operating Officer and Member of the Board, L&T Technology Services, said, “The potential of technology and engineering to positively disrupt our lives is limited only by imagination. LTTS' GLOCAL (global + local) strategy has helped in strengthening relationships across the globe by breaking barriers and deepening the regional ecosystem comprising talent pool and local economy. The IFTC-LTTS alliance aims to fast track the new-age mobility solutions for the transportation industry across the globe, including aspects of safety and comfort that can

benefit millions of commuters. LTTS is delighted to collaborate with Coventry University in scripting a new chapter for transportation engineering services both in the UK and globally.”

Professor Richard Dashwood, Deputy Vice Chancellor (Research), Coventry University said, “This partnership with LTTS underlines the university's commitment to research with impact, directing the scope of our academic expertise to support the areas where we can make a real difference. As one of the world's leading engineering and technology service providers, LTTS is a natural partner for Coventry University and I look forward to supporting this relationship as it grows to encompass all relevant themes within our research portfolio.”



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## GE Receives Air Force Airworthiness Qualification For First Metal 3D-Printed, Critical Jet Engine Part

**GE AVIATION** has received Engineering Change Proposal (ECP) approval from the US Air Force (USAF) for an F110 additively manufactured sump cover. The latest milestone in the USAF and GE's pathfinder Pacer Edge program, this F110 component is the first engine component designed for and produced by metal additive manufacturing to be qualified by any US Department of Defense entity.

"Much like the GE90 T25 sensor that was an FAA certification pathfinder for metal additive manufacturing for GE Aviation in commercial aerospace, the F110 sump cover sets a solid foundation for many more additively manufactured component qualifications with GE's military customers," said Matt Szolwinski, Chief Engineer and leader of GE's Large Military Engineering team.

"The Pacer Edge program is an important initiative for reducing risk and showcasing the application of additive manufacturing in aerospace. The ability to additively manufacture an aircraft engine part and gain military airworthiness



is a significant step forward in growing the adoption of additive manufacturing in the Air Force," said Nathan Parker, Deputy Program Executive Officer for the USAF RSO.

The airworthiness qualification of the sump cover brings Pacer Edge Phase 1a of the pathfinder to its conclusion. Part of the key to the accelerated qualification - in under a year - was GE's decade of metal additive engineering and manufacturing expertise.

The team's in-depth knowledge of commercial aerospace engine airworthi-

ness for flightworthy 3D printed metal parts is proving instrumental in helping USAF establish its own robust process validation and certification processes for military airworthiness. Close collaboration and knowledge sharing have enhanced USAF's spiral development approach of continuously identifying, reverse engineering and developing technical data packages (TDPs) for increasingly complex and larger parts suitable for metal additive manufacturing.

"USAF's strong vision for additive as part of its wider sustainment and readiness strategy has allowed our combined team to progress at speed. We continue to share our learnings and have developed an efficient, structured way of working - especially for developing qualification processes and expediting design iterations. This lean, operational efficiency is already driving results and now sets us up for the next phases of the program, including looking at complex and large format, load-carrying structures," added Szolwinski.

## SABIC And Local Motors Conduct Feasibility Study

**WITH THE DESIRE** to improve the circularity of large format additive manufacturing (LFAM), SABIC, a global leader in the chemical industry, and Local Motors, a next-generation vehicle manufacturer, completed a joint study on the feasibility of recycling scrap thermoplastic parts and shavings from the 3D printing process. The study explored more sustainable alternatives to landfilling large, printed parts in anticipation of wider adoption of LFAM. It included analysing the printability and mechanical properties of SABIC's LNP™ THERMOCOMP™ AM reinforced compound, used by Local Motors, after being printed, reclaimed, ground and reprocessed into pellet form. The study determined that material from post-production parts and scrap can potentially be reused in LFAM or other processes, such as injection molding or extrusion, at amounts up to 100 per cent. These insights can help identify a feasible path to circularity and an extended lifecycle for materials used by the LFAM industry.

"As adoption of large format additive manufacturing accelerates, it is essential to find sustainable alternatives to landfilling large, printed parts," said Walter Thompson, Senior Applications Development Engineer, SABIC. "SABIC and Local Motors have investigated the practicality of using mechanically ground scrap material and end of life parts generated from LFAM. Our study showed great potential for reusing these materials and marks a first step in supporting reuse within the value chain."



## Ascend Expands HiDura™ LCPA Production Capacity

**ASCEND PERFORMANCE MATERIALS** has expanded production capacity for HiDura long-chain polyamides in its Greenwood, S.C., plant. The multi-million dollar expansion will help the company meet the growing demand for its new product line. Launched in November 2020, Ascend's HiDura PA610 and 612 products are used in a variety of consumer goods, industrial, renewable energy, automotive and electric vehicle applications.

"Exceptional ductility, UV weather ability and hydrolysis resistance give HiDura resins and engineered plastics reliable, long-term performance in some of the harshest conditions," said Kaan Gunes, Business Manager -HiDura, Ascend.

Gunes cited applications in solar photovoltaic supports, battery seals and brush bristles to illustrate the versatility and durability of HiDura. "Each of these parts faces extreme conditions, whether the 25 years a solar PV installation will be exposed to the elements or the constant contact with corrosive chemicals inside a battery cell. The various grades we developed are designed to improve the reliability of our customers' products."

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By Kruti Bharadva

## JOSEPH F ENGELBERGER – THE FATHER OF ROBOTICS

Conceived from a design for a mechanical arm patented in 1954 (granted in 1961) by American inventor George Devol, the Unimate (very first industrial robot) was developed because of the foresight and business acumen of Joseph Engelberger - the Father of Robotics

**J**oseph F. Engelberger, an American physicist, engineer and businessman, was responsible for the birth of one of the most important and impactful industries, gaining him global recognition as the 'Father of Robotics.'

At a cocktail party in 1956, Joseph Engelberger met inventor George Devol and the two got to talking about George's latest invention - his Programmed Article Transfer Device. "Sounds like a robot to me!" exclaimed Engelberger, who had a deep fascination with robots because of his love for writer Isaac Asimov's science fiction stories.

In 1957, Engelberger, who at the time was director of Consolidated Controls Corp. (Condec subsidiary) located in Bethel, Connecticut, convinced Condec's CEO to finance the development of Devol's invention. After almost two years in development, Engelberger and Devol produced a prototype - the Unimate #001.

### MASS-PRODUCED ROBOTIC ARM

Mindful of the uphill battle he would face from manufacturers and motivated by Asimov's Three Laws of Robotics that relate to a "first no harm" philosophy, similar to the Hippocratic Oath, Engelberger focused on employing the robots in tasks harmful to humans. His



Image source: automate.org

After an invitation to speak to 400 Japanese executives in Tokyo who were interested in robotics for manufacturing, Engelberger signed a licensing agreement in 1969 with Kawasaki Heavy Industries (now Kawasaki Robotics) to manufacture and market the Unimate robots for the Asian market.

On this side of the pond, General Motors had jumped ahead of its competition to become the most automated automotive plant in the world. In 1969, it rebuilt its Lordstown, Ohio plant installing Unimate spot welding robots. Capable of production speed never-before achieved, the robots built 110 cars per hour - more than double the rate of any automotive plant in existence at the time! With the help of the Unimate, GM revolutionized the automotive industry. The Europeans were quick to follow suit and companies like BMW, Volvo, Mercedes Benz, British Leyland, and Fiat installed Unimate robotic arms to perform jobs that were unpleasant and dangerous for humans, a robot benefit very important to Engelberger.

From a two-dimensional drawing to an industrial and societal revolution, the Unimate robot remains one of the most significant contributions in the past one hundred years not only to manufacturing but to civilisation. It has left a living legacy in the industry to which it gave birth. As a result of the Unimate, the field of robotics continues to expand beyond manufacturing to virtually every facet of human life and service. 



Mindful of the uphill battle he would face from manufacturers and motivated by Asimov's Three Laws of Robotics that relate to a "first do no harm" philosophy, similar to the Hippocratic Oath

strategy worked and in 1959 the 2,700 pound Unimate #001 prototype was installed on an assembly line for the first time at a General Motors diecasting plant in Trenton, New Jersey. By 1961, the Unimate 1900 series became the first mass-produced robotic arm for factory automation. In a very short period, approximately 450 Unimate robotic arms were employed in diecasting.

In 1966, he licensed Nokia of Finland to manufacture the robots in Scandinavia and Eastern Europe.



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By Kruti Bharadva

## EXXONMOBIL IS PRESENTING PARTNER FOR ET PROMISING PLANTS

The ET Promising Plants – a first of its kind initiative to recognise and felicitate the best, innovative and state-of-the-art plants and manufacturing facilities in India, join hands with ExxonMobil as Presenting Partner

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The Economic Times Edge is pleased to announce ExxonMobil as its presenting partner for the 1st ET Promising Plants. Conceptualised by the ET Edge, together with The Machinist, the “Promising Plants” is an initiative to recognise and felicitate those factories and plants in India, which have truly scaled excellence and can be labelled as ‘factories of the future.

Exxon Mobil is a pioneer in lubrication technology, helping Indian manufacturing companies to in-

crease their productivity and profitability goals. With a legacy of over 120 years in India, the company has become a synonym for lubricants. With a deep knowledge of its customers and their needs, Mobil works directly with more than 6,000 OEMs to understand new industry trends and technologies. In addition to providing cutting edge lubricants, Mobil provides a host of services to help save time and money, while boosting equipment reliability and productivity.

In its endeavour to help India achieve its ‘Aatmanirbhar’ mission in manufacturing, ExxonMobil has been working closely with industries to give them a competitive edge. We are proud to associate with them as our presenting partner for the maiden edition of the ET Promising Plants.

### THE NEED FOR RECOGNITION

With a pool of skilled resources, competitive costing and an exponentially developing eco-system, the Indian manufacturing industry is emerging as one of the country’s highest growth sectors. Additionally, the flagship initiative by the government of Prime Minister Narendra Modi’s ‘Make in India’ is serving to place India as a major hub on the global manufacturing map.

“With these developments in mind, we have drawn up the blueprint of the Promising Plants initiative. The aim is to feature and felicitated these Promising Plants success stories on our platform, which will inspire others on their journeys towards transforming into state-of-the-art facilities,” commented *Rabul Kamat, Editor, The Machinist*.

This initiative will also significantly work towards showcasing the avenues open to future generations of manufacturing stakeholders and fulfil the government’s pledge of a hundred million jobs.

The aim is to mirror the plants featured and felicitated on this platform as success stories and blueprints for other plants on their path towards making their units state-of-the-art facilities. Through this initiative, we aim to truly magnify the best of Indian manufacturing and ‘Make in India’. 

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The aim is to mirror the plants featured and felicitated on this platform as success stories and blueprints for other plants on their path towards making their units state-of-the-art facilities. Through this initiative, we aim to truly magnify the best of Indian manufacturing and ‘Make in India’

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**TYROLIT**

By Mr Ramesh Revuru, Head-Digital Engineering, L&T Infotech

## EXPERIENCE @ SPEED!

Technology today has accelerated the need for quicker and more efficient digital solutions. Here is a brief look at the whole ethos of quicker digital transformation.

The new 'normal' world has brought agility and resilience at the forefront of all business considerations, and the resultant outcome enabled by these two critical factors is the acceleration of momentum. Businesses thus are looking for solution providers who can accelerate their digital product roll-outs and open newer channels.

Most of the pre-COVID physical world face-to-face interactions now take place virtually. Businesses need to gear up for this shift in engagement mode and provide similar or better experiences through virtual mediums. Experience transformation connected enterprise and intelligent content services are at the core of these services. IT companies need to create a stronger culture of design and engineering as a backbone to cater to this growing digital "engineering" demand. Companies need more full-stack digital engineers at one end to low code platform engineers at the other end. Conventional Indian IT service providers are yet to match up to the requirements of this ecosystem shift and largely continue to follow the age-old approach of restricting themselves only as per customer brief.

Digital Engineering, however, requires a completely different approach, mindset, innovation and cultural considerations. A comprehensive multi-pronged framework to pursue it meaningfully can be based as below:

- **Structure** – To be able to deliver in PODs, companies should create tribes and chapters. Chapters constitute specialised skills (say experience, process/integration, automation) and hence allow for collaboration and sharing of information amongst themselves. Tribes bring together multiple different chapters with the sole intent of servicing a customer outcome (say smart parking app, field service app)
- **Talent** – Getting the structure right in itself is not sufficient. One needs to make sure to get the right people to occupy the right seats on the bus. This calls for creating an "Engineering Academy" with the intent of creating dedicated and specialised "Digital Engineers" as part of grooming and creating the right talent.
- **Culture** – From skill-based delivery to solution led delivery. From single skilled engineers to multi-skilled engineers – this calls for a cultural trans-

formation in the way we perceive IT business and services. Our ability to change customer conversations from staffing to POD led delivery needs a shift in our thinking and execution. We also need to create a culture of engineering-based approach to our solutions.

### What Is "Experience @ Speed"

Faster time to market is at the core of what customers want. Providing enhanced experience to customers alone is not sufficient, we need to fast track (speed up) their digital journeys. Experience@ Speed is not just a catch-phrase but a way of working as well – specifically, providing a way to accelerate all aspects of engineering a digital product

- 1) Assess
  - Conduct a quick portfolio assessment by offering customer self-service tools
  - Generate a recommendation report
- 2) Design
  - Based on the recommendation, make wireframes/blueprints available
- 3) Migration
  - Provide migration tools that can take existing applications that were not created with the new channels and interaction patterns in mind and create new rich, responsive applications
- 4) Pre-built code components
  - Fast track development by reusing pre-built components and accelerators that reduce coding significantly

Fundamentally the 'Experience @ Speed' triggered by digital engineering encompasses a wider set of stakeholders as eventual beneficiaries. The enablement of convergence of the physical and digital world results in a connected world involving people, equipment and on-the-ground operations, thereby allowing stakeholders to transact anywhere and anytime. It also brings along a proactive element that pre-empts any potential break-in momentum and allows foolproof monitoring of technical, operational, financial, resource-related and any other risks.

All in all, the future ahead looks exciting indeed and this is the time to provide "Experience @ Speed" for customers, employees, citizens, and partners. 

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By Kruti Bharadva

## ACCELERATING MANUFACTURING – A DESIGN PERSPECTIVE

An in-depth look at how both machining and 3D printing can be employed in harmony to give you the best metal part

**D**esigning metal parts? By incorporating both CNC machining and metal 3D printing into your manufacturing toolbox, you not only enjoy far greater flexibility in part design but also gain the ability to procure them in less time and more cost-effectively than ever before. To take advantage of this, however, you must understand the shared strengths and inherent differences of each process, and how to best use them to your benefit.

### EMBRACING THE YIN AND YANG OF METAL MANUFACTURING

Nowhere is this relationship more significant than the bond that exists between CNC machining and direct metal laser sintering (DMLS), the leading technology for 3D printing complex metal parts. The latter can produce virtually any part shape using nothing more than a laser beam and a pile of metal powder, but it can be a slow process. Machining on the other hand is more limited in terms of geometry but offers far faster production speeds. The choice, then, of which to use is primarily a question of A) can the part or parts be machined, and B) how many parts need to be made?

In many cases, the two manufacturing processes can work together. Examples? Oftentimes metal-based additive manufacturing relies on its subtractive alter ego to finish the job. Holes must be bored or reamed, threads tapped or thread-milled, critical surfaces milled, turned, or ground to size. At the very least, 3D-printed parts need some manual TLC in the form of cleaning, blasting, and support removal, pretty much guaranteeing a visit to the machine shop.

What does all this mean to you or anyone looking for the most effective way to manufacture functional prototypes and lower quantities of end-use metal parts? Plenty. By adopting a strategy where metal 3D printing and machining can be different steps in the same manufacturing process, you can leverage the best of



Image sources: Wevolver

both worlds, eliminating surprises, reducing costs, and improving the part design. Here's a handful of design considerations to think about before diving into your next metal part design project.

### BUILDING VS CUTTING METAL PARTS

Of the five additive manufacturing technologies mostly used around the globe, DMLS is the only one that prints metal. Like any powder bed printing process, it uses a laser (or lasers) to fuse flour-sized grains of metal powder within the machine's build chamber. Starting from the bottom up, the machine fuses one paper-thin workpiece layer at a time, with a recoater blade dragging fresh powder across the top after each pass until the part is complete.

By comparison, machining uses super-hard cutting tools to remove metal, either by rotating said tool against and around a fixed workpiece (milling) or by moving a stationary cutting tool against and around a rotating workpiece (turning). There's far more to the machining process than this micro-explanation, but what's important to know right now is that machining picks up where DMLS leaves off. In other words, DMLS adds material in single layers. Machining removes material, sometimes in large chunks, but sometimes very lightly to attain fine surface finishes.



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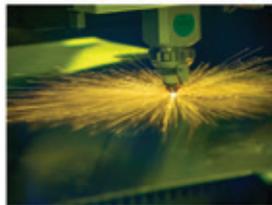
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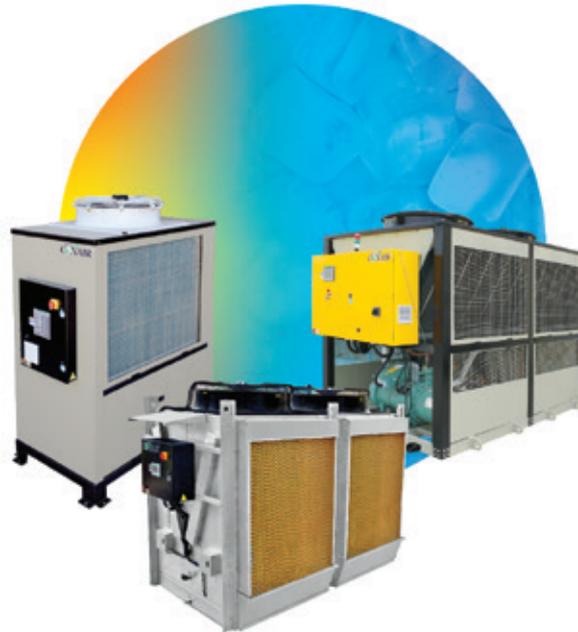
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### ACCURACY CONSIDERATIONS FOR METAL PARTS

Although DMLS can create extremely complex shapes that might otherwise be un-manufacturable, it's not without its limitations. For starters, significant heating and cooling of the metal take place as the laser does its work, creating internal stresses that must be removed via post-build heat-treating. This means little to the people designing the part, except that stress relief equates to some amount of part movement and therefore some loss of accuracy. This is one reason—though not the only one—why even a well-designed DMLS-produced part requires machining of any part feature where tolerances tighter than  $\pm 0.1\text{mm}$  are required.

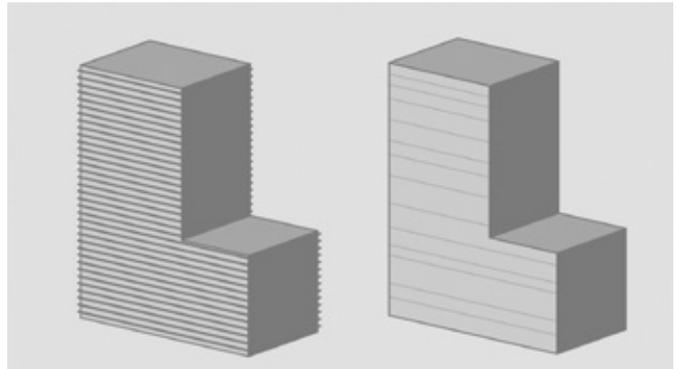
Another reason for combining DMLS and machining is surface finish. On a vertical or horizontal surface, DMLS produces part roughness about equal to a sand casting. All other surfaces will see some amount of stair-stepping, an effect that's largely dependent on how the part is situated in the build chamber. If your part design requires a smooth finish, it will need to be blasted, sanded, or quite possibly machined. This last part is no big deal unless your part design calls for a fine finish on a surface that the end mill, drill, or turning tool can't reach. Whatever the case, be sure to call out such critical features on your CAD model, so the features needing secondary processing, including machining, can be identified.



In many cases, the two manufacturing processes can work together. Examples? Oftentimes metal-based additive manufacturing relies on its subtractive alter ego to finish the job.

### REMOVING DMLS SUPPORTS

Support structures should also be considered when designing metal parts in additive manufacturing. DMLS is a little like building a metal sandcastle—without some seashells and twigs to hold the thing together, the ramparts will fall, the architraves crumble. With DMLS, scaffold-like supports are needed to keep the semi-molten metal from drooping, curling, or otherwise misbehaving. Oftentimes, these supports can be removed with a Dremel tool, but machining may be the preferred method where larger part volumes are called for, or when the workpiece is headed to the ma-



On a vertical or horizontal surface, direct metal laser sintering (DMLS) produces part roughness about equal to a sand casting. All other surfaces will see some amount of stair-stepping (as seen at left). If your part design requires a smooth finish, that stair-stepping will need to be blasted, sanded, or machined (as seen at right).

Image sources: Wevolver

chine shop anyway for one of the drilling, milling, or turning operations mentioned previously.

Unlike DMLS, which requires nothing more than a simple “build plate” to carry the workpiece through to completion, machined parts must be clamped, bolted, or otherwise securely fixtured to the machine to prevent cutting tool-induced movement. If your 3D-printed workpiece is composed entirely of curved, organic shapes (which is one of 3D printing's greatest appeals), how will the machinist hang on to it for turning or milling? Chances are, you might need to design in a pair of parallel surfaces or some mounting holes by which to clamp the 3D-printed workpiece for machining.

### MULLING OVER MACHINABILITY

Lastly, there's the metal to think about. The lasers used by DMLS don't really “care” how hard or tough metal is, but cutting tools sure do. DMLS is known for its ability to 3D print aerospace- and medical-grade metals like titanium, Inconel, cobalt chrome, and others, and even though different laser parameters and build speeds may be called for, it does so with relative impunity. Machining those same metals, on the other hand, requires lighter depths of cut, slower speeds and feeds (a little machining-speak here), and will consume more cutting tools and machining time.

The overall point is this: You can in fact leverage the best of both worlds—3D printing and machining—together for metal parts, but carefully consider the design options covered in this tip. Machining and metal 3D printing are deep, complex technologies, and it's only by understanding how each will affect your design project that success will be achieved. Ask questions, embrace each process, and understand that both are close-knit partners in manufacturing. 

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## FLIP SIDE OF THE COIN

The industry 4.0 revolution has brought about unprecedented levels of efficiency in manufacturing. But it also comes with its own set of challenges, the biggest one being cybersecurity and the protection of data

By Kruti Bharadva

When Torstein Gimnes Are's phone rang at 4 am in Oslo, Norway, he knew it wouldn't be good news.

"We may be under attack," were the words from the other end, from Gimnes's IT colleague at Norsk Hydro, one of the world's largest aluminium companies. Production lines had stopped at some of its 170 plants. Other facilities were switching from computer to manual operations.

The breach would ultimately affect all 35,000 Norsk Hydro employees across 40 countries, locking the files on thousands of servers and PCs. The financial impact would eventually approach \$71 million. All this damage had been set in motion three months earlier when one employee unknowingly opened an infected email from a trusted customer and allowed hackers to invade the IT infrastructure and covertly plant their virus.

The cyberattack on Norsk Hydro is perhaps one of the most well-known, and certainly the most well documented as the company made a swift and unshakeable decision in face of the ransom demands – Transparency. We shall circle back to this vital point, but first a look down to the very roots of cyber security in manufacturing.

### THE ROLE OF INDUSTRY 4.0

McKinsey defines Industry 4.0 as 'the next phase in the digitisation of the manufacturing sector, driven by four disruptions: The astonishing rise in data volumes, computational power, and connectivity, especially new low-power wide-area networks; the emergence of analytics and business intelligence capabilities (BI); new forms of human-machine interaction such as touch interfaces and augmented-reality systems; and improve-

ments in transferring digital instructions to the physical world, such as advanced robotics and 3-D printing.'

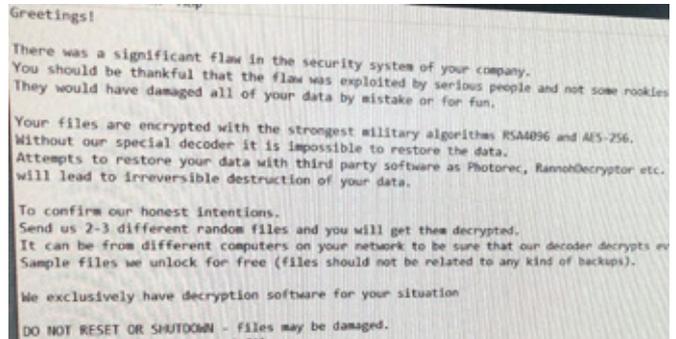
Industry 4.0 is followed by 'the smart factory.' More than just the latest buzzword, the smart factory is a confluence of trends and technologies that are reshaping the way things are made and revolutionising the way factories function. Industrial control systems (ICS), supervisory control and data acquisition (SCADA) systems, big data, the Internet of Things (IoT), the Industrial Internet of Things (IIoT), smart and self-learning machines, advanced analytics, robotics, and cognitive computing all fall under the Industry 4.0 umbrella.

There's a lot to be gained by adopting Industry 4.0 technologies, and Indian manufacturing seems to be at the forefront of 'talking' about doing so. Why then, has the adoption of industry 4.0 not kept pace with expectations? The answer is simple: Security.

As it continues to adopt Industry 4.0, the manufacturing industry becomes an increasingly appealing target for attackers, who have the opportunity to move laterally across a manufacturing network, jumping across IT and OT systems for their malicious activities. Without strong protections in place, bad actors can take advantage of systems for industrial espionage, intellectual property theft, IP leakage, or even production sabotage.

### THE SITUATION IN INDIA

According to the annual IBM X-Force Threat Intelligence Index, India reported the second-highest number of cyber-attacks after Japan in the Asia-Pacific region in 2020. The report additionally states that India accounted for 7 per cent of all cyber-attacks observed in Asia in 2020 and that finance and insurance were the top attacked industry in India (60 per cent), followed by



Ransomware note at the Norsk-Hydro attack

manufacturing and professional services.

The 2020 threat landscape in India was largely shaped by the pandemic. As the pandemic's timeline of events and progress unfolded, so did attack trends shift. Ransomware was the top attack type in India with a 40 per cent share in the overall threat landscape. Further, digital currency mining and server access attacks hit Indian companies last year. We also witnessed cybercriminals using relief efforts and public health information as spam lures including targeted attacks on critical components of the vaccine supply chain.

In essence, the pandemic reshaped what is considered critical infrastructure today, and cyber attackers took note. Many organisations were pushed to the front lines of response efforts for the first time – whether to support Covid-19 research, uphold vaccine and food supply chains, or produce personal protective equipment. Cyberattacks on healthcare, manufacturing, and energy doubled from the year prior, with threat actors targeting organisations that could not afford downtime due to risks of disrupting medical efforts or critical supply chains. Attackers took advantage of the nearly 50 per cent increase in vulnerabilities in industrial control systems (ICS) – on which manufacturing and energy greatly depend.

### INDUSTRY 4.0 CYBERSECURITY CHALLENGES

Manufacturing is the second-most attacked industry, yet the manufacturing sector lags when it comes to security. Smart factories can be subject to the same vulnerability exploitation, malware, denial of service (DoS), device hacking, and other common attack methods that other networks face. And the smart factory's expanded attack surface makes it extra difficult for manufacturers to detect and defend against cyberattacks. These threats now work on an entirely new level with the dawn of the IoT, and they can result in serious physical consequences, especially in the realm of the IIoT.

Here are a few new security challenges that organizations face in the age of Industry 4.0:

- Every connected device represents a potential risk
- Manufacturing systems such as Industrial Control Systems (ICS) have unique vulnerabilities that

- make them particularly susceptible to cyberattacks
- Industry 4.0 connects previously isolated systems, which increases the attack surface
- Upgrades are often installed piecemeal since the systems are very complex
- Manufacturing has many fewer regulated compliance standards than other sectors
- Visibility is poor across separate systems and isolated environments

Also, note that the battle is decidedly unbalanced. While organizations must protect a wide swathe of technology over a very large attack surface, attackers need only pinpoint the weakest link.

### TOP 5 MANUFACTURING CYBERSECURITY THREATS

The evolution of cybercrime is constant. If you are a manufacturer, it's imperative to understand the biggest dangers you are facing so that you can brace for them. We've rounded up five of the most common cybersecurity threats manufacturing companies come up against:

#### 1. Intellectual Property Theft

The technology-driven world in which we live has made IP theft easier. Unfortunately, it's often overlooked in favour of other types of cyber-attacks. For manufacturing firms, where IP- through innovation and creativity- is often a driving force behind their success, this is a critical risk area.

#### 2. Phishing

No matter what industry your business operates in, phishing is a constant threat. It's also one of the oldest threats and it continues to be one of the most widespread forms of attack.

To carry out deadly phishing attacks, hackers utilise a tool that workers are on and checking multiple times a day — email. And while certain tools can help prevent phishing, it's ultimately an attack on humans, not systems or networks. It all starts with a malicious email that's disguised as a trustworthy one. The goal is for targets to believe

the email is reliable, leading them to click a link or download an attachment.

What's especially alarming about phishing attacks in 2020 is how sophisticated and convincing they are getting. Many individuals assume they can easily spot phishing emails. However, criminals are getting extremely good at imitating emails from authoritative and trustworthy sources, making it much easier than people think to fall for a phishing scam.

#### 3. IoT Attacks

IoT solutions can decrease supply-chain risk, ensure high-quality products, and increase efficiency. However, connected IoT systems come with an inherent downside. They can enable deadly cyber-attacks that allow a criminal to infiltrate your network through your devices. Often, organizations pay less attention to securing IoT devices than other aspects of their network. And because these devices connect to the internet, they can open a doorway for hackers if left unprotected. When these devices affect critical systems, one successful IoT attack can halt the entire manufacturing process. And we all know that with downtime, come costs.

#### 4. Supply Chain Attacks

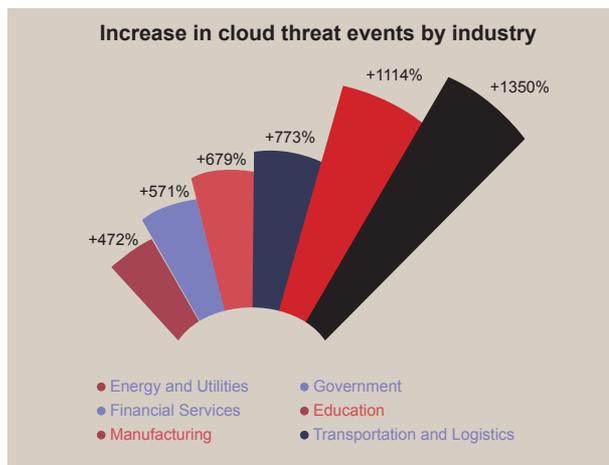
Now more than ever, manufacturing firms receive and supply sensitive information to many different enterprises. From vendors to partners, these digital touchpoints allow for more efficient and effective operations. In a supply chain attack, a hacker will gain access to a partner or provider that has access to your systems and data. Through this relationship, the criminal can enter your network, steal your data, and cause significant harm to your company. To manage this third-party risk, manufacturers need to be extremely aware of who they are sharing information with and what cybersecurity measures these partners have in place. It's no longer enough to worry about your own company's safeguards. You need to protect your data and systems from every point.

#### 5. Ransomware

Ransomware is an increasingly dangerous threat and, unfortunately, all too common. Every business is in fear of a ransomware attack, but for manufacturers especially, it can cost them everything.

This deadly malware variant usually infects your systems when an unsuspecting employee accidentally clicks on a malicious link or attachment in a phishing email. And once someone opens this door for ransomware to creep in, it encrypts an organisation's data, possibly spreading throughout the entire network. To regain access to their information, companies must pay the requested ran-





som, which is often enormous. Not to mention, the cost of downtime.

#### THE ISSUE OF TRANSPARENCY

In November 2019, The Nuclear Power Corporation of India Limited (NPCIL) confirmed that there had been a cyberattack on the Kudankulam Nuclear Power Plant (KKNPP) in Tamil Nadu, India, in September. The nuclear power plant's administrative network was breached in the attack but did not cause any critical damage. KKNPP plant officials had initially denied suffering an attack and officially stated that KKNPP "and other Indian Nuclear Power Plants Control Systems are stand-alone and not connected to outside cyber network and Internet- and any Cyber-attack on the Nuclear Power Plant Control System was not possible." This statement brings forward the issue of transparency, something lagging quite behind in the Indian manufacturing sector.

Back to Norsk Hydro, their decision to be 'transparent' gained accolades from security experts around the world because it bucked the usually secretive responses many organizations employ after getting hacked. Senior staff hosted daily webcasts and answered audience questions. Executives held daily press conferences at their Oslo headquarters posted updates to Facebook, welcomed journalists into their operations control rooms – and even launched a new company website during the attack's first week.

In India, an organisation which is working towards bringing about change is the Data Security Council of India (DSCI) - a not-for-profit, industry body on data protection in India, set up by NASSCOM®, committed to making the cyberspace safe, secure and trusted by establishing best practices, standards and initiatives in cybersecurity and privacy. To further its objectives, DSCI engages with governments and their agencies, regulators, industry sectors, industry associations and think tanks for policy advocacy, thought leadership, capacity building and outreach activities.

DSCI also endeavours to increase India's share in the global security product and services market through global trade development initiatives. These aim to strengthen the security and privacy culture in India.

#### EMERGING INDUSTRY 4.0 BEST PRACTICES FOR ENHANCED SECURITY

As more connected systems are deployed and the opportunities for an attack against intellectual property increase, protecting against evolving threats is becoming a full-time task.

The manufacturing sector needs to:

- Adopt a risk-based security mindset (tying business criticality to defence strategies)
- Keep an accurate inventory of all OT assets in real-time
- Marry the best of IT and OT as an integrated defence strategy across all attack surfaces
- Identify and fix outdated systems, unpatched vulnerabilities and poorly secured files
- Take a security-first approach to the deployment of new connected systems
- Remain ever vigilant to spot potential threats with real-time vulnerability assessments and risk-based prioritisations
- Ensure that technology suppliers and connected equipment manufacturers commit to regular security and software patches and audits
- Threat intelligence, including monitoring of the dark web, can also act as an early warning system to uncover planned attacks. Thus, the organisation can pre-empt a breach and take immediate action to protect its digital corporate assets and physical infrastructure

#### TAKING BACK CONTROL

The combination of elevated security processes, enhanced training and manufacturing industry-specific security solutions is helping progressive organisations to reduce the risk of cyber-attacks.

This approach is also allowing breaches to be discovered more quickly while mitigating damage. There is still no "magic bullet" that will guarantee complete protection but the journey towards better security often starts with a security assessment. Typically, the assessment would start with non-intrusive network traffic recording, with no interruption to ongoing production (OT) operations. This would be used to create a clear, drill-down visualization of the OT network topology including all connected assets along with detection of all known vulnerabilities and analysis of the risks to the customer network with a prioritized risk-mitigation plan.

In the end, cybersecurity best practices will certainly be key to the success of Industry 4.0. 

By Rolf Olofsson

## FIXING WHAT ISN'T BROKEN

**Rolf Olofsson**, Product Manager at Sandvik Coromant, a global leader in metal cutting tools, explains why NOW is the time for machine shops to embrace a new generation tooling solution to tackle steel ISO P turning challenges and make their production more efficient and productive.

The father of modern political philosophy, Machiavelli, said that “Whosoever desires constant success must change his conduct with the times.” We are surely living in unprecedented times with the ongoing effects of COVID-19 on the industry. For manufacturers, stepping away from the established way of doing things — whether it’s a production process, method of communication, or a trusted machine or tool — invites risk. No wonder it so tempting to fall back on the adage of “if it ain’t broke, don’t fix it.” Could a new tool or digitalised process create more disruptions than it’s worth?

Yet, there is more onus than ever on manufacturers to change with the times — whether they are dealing with mass or batch production scenarios. Research by Pinsent Masons, the German law firm, has identified three main drivers for change.

First, a survey of hundred German manufacturers and German students found that disruptive Industry 4.0 technologies, like artificial intelligence (AI) and intelligent automation, are sparking a fresh industrial revolution. Second, the green agenda is driving man-

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The green agenda is driving manufacturers more quickly towards low carbon business models and macro-economic pressures such as Brexit, and now COVID-19 will cause global supply chains to fragment

ufacturers more quickly towards low carbon business models. Third, Pinsent Masons found that macroeconomic pressures such as Brexit, and now COVID-19, will cause global supply chains to fragment.

How can manufacturers overcome this trio of obstacles without losing sight of the two main challenges: increasing output and reducing costs? And, how can they do so while machining one of the most common and complex ISO P (steel) workpiece materials? The answer lies in next-generation tools — even if the last generation of tools ain’t broke.



### THE RIGHT STUFF

First, let’s look at the two ultimate goals for manufacturers to achieve profitable steel turning- increasing output and reducing costs. Manufacturers should drive down the appropriate production costs for their specific situation. The situation will depend on whether they are dealing with mass or batch production and is more unpredictable in the COVID-19 era where manufacturers are facing changeable high- or low-demand scenarios and must adapt accordingly.

Manufacturers must always strive towards maximizing their machining output that, according to Sandvik Coromant’s findings, can reduce the overall cost per component by 15 per cent. To properly maintain a higher machine output, it’s also necessary to increase metal removal rates and reducing scrap and component rejections to manufacture more steel components in a shorter time. Central to all of this is the manufacturer’s choice of tool, specifically their choice of insert. That’s why Sandvik Coromant recommends choosing steel turning insert grades that can deliver the most predictable and consistent performance.

### STAY IN SHAPE

Sandvik Coromant added two high performing car-

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bide insert grades to its existing range, GC4415 and GC4425. The inserts' designations refer to P15 and P25, the demands that different working conditions impose on machining parameters — cutting data, surface finish, depth of cut, machined or rough surfaces, continuous or interrupted cuts.

These new carbide inserts can meet these parameters. While GC4425 delivers improved wear resistance, heat resistance and toughness, GC4415 is designed to complement GC4425 where enhanced performance and better heat resistance is needed. Both contain the second generation Inveio® coating technology. What makes Inveio unique can be examined at the microscopic level: the material's surface has a uni-directional crystal orientation. Each crystal lines up towards the cutting edge, creating a strong barrier that improves crater and flank wear resistance. Heat is also lead away from the cutting zone more quickly, which keeps the cutting edge in shape for a longer time in cut. Therefore, GC4415 and GC4425 can machine a larger number of pieces within a mass and batch production set-up. Each insert contributes towards extended tool life, eliminating sudden breakages and reducing reworking and scrap.

With the ability to machine more components in one set-up, the new insert grades can reduce the production interruptions caused due to frequent insert changes and time spent in finding the right insert for each application or material — both factors are considered to be the biggest time killers in modern production.

#### COOL IT

Coolant can further improve the insert performance, deliver even better performance in all aspects and play a crucial role in reducing overall production cost. Under coolant controls the heat in the cutting zone, which leads to improved tool life and predictable machining. This makes it possible for operators to increase the cutting speed or feed, which allows for a greater productivity increase and maximized output. In addition, precision coolant with pre-directed nozzles focused

directly at the cutting zone, which is a good way to achieve chip control. That is why, if correctly applied, coolant will maximize output, increase process security and improve cutting tool performance and component quality. These are all important cornerstones in successful machining.

#### FOCUS ON EFFICIENCY

We've examined how factors like choice of tool and the use of coolant can yield tangible machining benefits — but what could manufacturers gain by applying a new methodology to their steel turning operations? Sandvik Coromant's specialists asked themselves this question and the result was a new ethos that we call PrimeTurning™, designed as a good choice for mass production or components needing frequent set-ups and tool changes.

Specifically, if turning is a bottleneck operation, then companies suffer a restriction on the number of components produced per run. Therefore, manufacturers need to reconsider their turning process to get maximum output from their modern machine tools, which are currently being underutilized.

This is where the PrimeTurning™ can support, offering flexibility to do turning in all directions. With it, machine shops can realise a multi-fold productivity increase without compromising process security and tool life. This way of turning is found to be much more efficient and productive compared to conventional turning.

#### POSITIVE CHANGE

GC4415 and GC4425 have already proven advantageous since they were launched to market, earlier this year. In one case, a manufacturer in general engineering pitted the GC4415 insert against a competing insert and put it to work in machining an AISI/SAE CMC 02.1 steel workpiece with a Brinell hardness of 220 HB. As the workpiece was subjected to axial external turning and light roughing, the customer was able to run the GC4415 at a higher cutting speed (vc) of 300 m/min (984 ft/min) and feed rate (fn) of 0.33 mm/rev (0.013 inches/rev) compared with a competitor's insert, which ran at a vc of 250 m/min (820 ft/min) and fn of 0.25 mm/rev (0.009 inches/rev). The competitor's insert machined 200 pieces (pcs) per edge before breaking down, whereas GC4415 machined 256 pcs before only shown signs of risk of breaking down.

By switching to GC4415 and increasing the cutting data, the customer was able to achieve a productivity of 210 per cent and reduce costs by 53 per cent. As this example shows, manufacturers can indeed prove Machiavelli's assertion that "whosoever desires constant success must change his conduct with the times." 



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By Kruti Bharadva

## A HIGH SPEED TROCHOIDAL SLICER

A closer look at trochoidal milling and why its most suited to high speed machining and the efficiency it offers

Several decades ago, the introduction of machine tools with significantly increased rotary and linear velocities was the success to efficient high-speed machining (HSM) methods. Peel milling, also known as slicing, was one of these methods. The main principle of peel milling is its high depth of cut (usually, no more than five-tool diameters) when coupled with a low width of cut (typically, up to 0.2 of a tool diameter). This combination features significant advantages.

Decreasing the width of cut reduces heat load on a cutting edge and allows increasing cutting speed. In peel milling, the cutting speed can be higher when compared with traditional milling methods. The low width of cut significantly diminishes the radial component of a cutting force, which causes mill bending and vibrations. This ensures high operational stability and facilitates an increased depth of cut.

Radial chip thinning enables higher feeds to maintain the required accurate chip thickness. Therefore, milling with a small radial engagement and a substantial depth of cut performed at high cutting speeds and feed rates is a good cause for improving machining productivity. Moreover, such a machining method provides gradual, uniformly distributed wear along the whole cutting edge, thus increasing tool life.



**The low width of cut significantly diminishes the radial component of a cutting force, which causes mill bending and vibrations. This ensures high operational stability and facilitates an increased depth of cut**

Peel milling has proven to be productive in milling deep shoulders and wide edges. The slicing technique is successfully applied to rest milling – a machining process where a small diameter tool cuts various hard-to-reach areas, such as cavity corners.

The advance of computer numerical control (CNC) and computer-aided manufacturing (CAM) systems have generated further improvement: trochoidal milling with a complicated tool trajectory instead of a linear feed motion - suitable for peel milling.



**Fig. 1 – CHATTERFREE multi-flute solid carbide endmills produced in a series of different cutting length-to-diameter ratios.**

In mathematics, a trochoid is the curve, generated by the point of a circle rolling along a guide without sliding. In trochoidal milling, a cutting tool moves along a curve slicing thin and slim material layers. Commonly, the curve is a circular arc (semicircle) and the tool returns to the initial point by the arc chord and then repeats the path with a small stepover. In this case, the tool path looks like the letter “D”. Milling along the curvilinear trajectory facilitates constant loading of a cutting edge and eliminates a sharp increase in load when entering the material.

In addition to the D-shaped path that is now considered “classical”, today, most advanced machines with high-end control systems are much more complex. Trochoidal tool trajectories minimize non-cutting time and optimize machine unit motions.

Trochoidal milling is known to be very effective in machining deep slots, pockets, and cavities and is also a very promising method to mill hard and difficult-to-cut materials, in particular titanium and high-temperature superalloys (HTSA). In addition, trochoidal milling is extremely useful for improving performance when cutting in unstable conditions: non-rigid workpieces, thin-wall areas, poor work holding devices, etc. And

even more so, uniform and considerably reduced tool loading makes trochoidal milling efficient and applicable in micromachining.

The major challenges in trochoidal milling are machine tool control and intelligent path programming. However, when solving these challenges, another important factor – the cutting tool – is often overlooked. Without the right tool, all efforts to design the trajectory and maintain uniform loading on the cutting edge reduces the expected results, which creates a challenge for tool manufacturers to produce an optimal tool to meet trochoidal milling requirements.

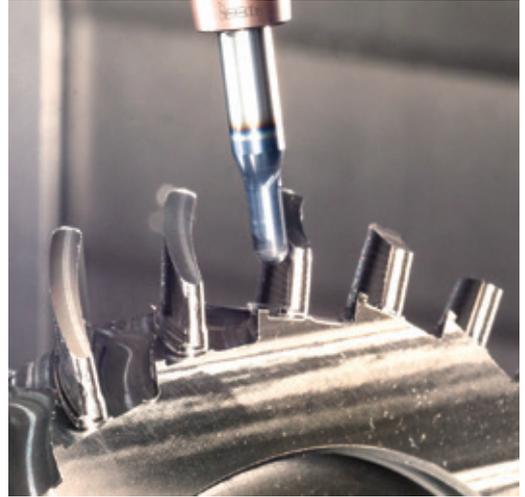
#### WHAT ARE THE FEATURES OF A HIGH-PERFORMANCE TROCHOIDAL MILLING CUTTER?

To begin with, the trochoidal milling cutter must be suitable for high-speed machining. This relates to appropriate accuracy parameters, balancing, safety when operated at considerable rotational speeds, and more. Milling with high depths of cut increases the tool's overhang while the dynamical behaviour of a cutter is crucial to ensure machining stability. When milling with a low width of cut, only one tooth engages the workpiece material at any given time. Optimizing a contact area along the tooth is an important factor for stable milling, and the cutter with the most favourable tool cutting edge inclination is a principal part for finding the best solution. The effective evacuation of the thin chips, which are generated when trochoidal milling, does not require a large chip gullet in the cutter.

Even a brief examination of the above shows that multi-flute solid carbide endmills (SCEM) or assembled mills carrying replaceable solid carbide heads comply with the requirements in the best way. Indeed, SCEM represents most trochoidal milling tools today.

Understandably, these endmills have their own design features that can be identified in the latest, innovative ISCAR product line. Several features characterize these products: a) different helix and variable angular tooth pitch that provide a vibration-resistant design to improve stability in HSM with high overhang, b) a specially shaped flute that results in an increased core diameter to improve dynamic strength, and c) enough space for chip gullet to ensure smooth chip flow. These products maintain high accuracy and deliver maximum metal removal rates when machining the main types of engineering materials. The diameter range of ISCAR's solid carbide endmills (SCEM) for trochoidal milling is 2-25 mm.

CHATTERFREE EC-E7/H7-CF solid carbide endmills have 7 flutes and a variety of corner radii. They are available in a series of two, three, four and six



**Fig. 4 – Trochoidal rough milling of a blisk airfoil by a multi-flute solid carbide endmill, which is mounted in a heat shrink chuck.**

cutting length-to-diameter ratios (Fig. 1). The endmills are produced from PVD coated ultra-fine carbide grade IC902.

The key distinctive feature of 7 flute endmills ECP-H7-CF (Fig. 2) is the chip-splitting geometry of a cutting edge. Introducing this geometry provides increased performance at high overhang and significantly improves chip evacuation in machining deep pockets and cavities. It is important to note that the chip-splitting edge ensures a satisfactory surface finish for most operational requirements.

Ti-TURBO 7- and 9-flute solid carbide endmills ECK-H7/9-CFR, which were designed especially for high-speed machining titanium alloys, have a cutting length of around two-tool diameters. Due to remarkable chatter dampening and an optimized-edge geometry, these solid carbide endmills show good results in trochoidal milling of various aircraft components, including machining curved slots in titanium bladed rotors (blisks).

If trochoidal milling is applied to shallow slots or corners of titanium parts, 6 flute MULTI-MASTER exchangeable heads that were recently introduced may be a more suitable solution (Fig. 3). The head design incorporated ISCAR's competence and experience in this field and has enabled a robust product for efficient machining hard-to-cut titanium grades such as Ti-10V-2Fe-3Al and Ti-5Al-5Mo-5V-3Cr.

This review would be incomplete without some notes about tool holders, which are essential to the success of trochoidal milling. Machining practice shows that the best results are reached when the milling cutters are mounted in hydraulic or heat shrink chucks. 

By Kruti Bharadva

## STEELBIRD FLIES HIGHER

In an interview, **Rajeev Kapur, Managing Director, Steelbird Hi-tech India** talks about why his company's products meet the most stringent safety standards and what's new in the auto-ancillary sector

**W**hile a lot of automobile manufacturers have shut their plants, all thanks to the ongoing pandemic, a lot of related industries are affected just as much. Manufacturers of components, helmets and other automobile-related ancillaries have their business in the doldrums. We spoke with Rajeev Kapur, Managing Director, Steelbird Helmets, to find out about how the helmets and protective gear manufacturers are coping with the new normal:

### **Tell us about Steelbird, its origins and current product portfolios**

Steelbird, one of the largest helmet manufacturing companies in Asia, was launched in 1964 and I joined the family business at quite a young age, handling all the plants single-handedly at the age of 18. Despite the years I have already put in, I still feel there is a long way



The good news is that the ban on helmets that are not ISI-certified has finally come into effect. This takes us one step closer to making two-wheeler usage safer in India.

to go in terms of what we want to achieve- specifically promoting helmets as a mandatory accessory. It is a life-saving device, and I have personally given numerous talks on why it is vital, in several states. Apart from helmets, we also manufacture a wide range of related accessories, such as pannier boxes and auto accessories. That said, during the pandemic, we diversified into the healthcare sector manufacturing face shields, PPE kits, gloves, oximeter and masks besides OTC immunity booster medicines for the domestic market.

### **Throw some light on your manufacturing plant in Baddi, Himachal Pradesh as well as your other manufacturing plants in India**

We have six manufacturing plants in India, of which the biggest one is in Baddi, Himachal Pradesh. To boost our manufacturing capacity, in 2019, we decided to expand the Baddi manufacturing facility to over six lakh sq. ft. With this expansion, now we are manufacturing 22,000 helmets per day at this particular plant. With the expansion, we have given employment opportunity to over 2,000 skilled manpower and are selling around 6 lakh units per month.

### **How has the last fiscal been for you financially and how are you coping with the effects of COVID on your overall business activities?**

We have witnessed a bare minimum effect on our business due to the pandemic. Thanks to two-wheeler sales, which has picked up rather quickly and that have given a positive boost to our helmet sales. We are now planning on expanding our manufacturing units. That said, we have recently opened our new shops in Ranchi, Patna and Noida and are planning on opening some more this year in various metropolitan cities

### **India is on its way to becoming a globally recognised manufacturing hub. What opportunities and challenges do you see towards achieving this status?**

The main challenge is still buying and selling the non-ISI marked helmets. Selling non-ISI marked helmets is equivalent to selling fake medicine. And just as fake

medicines are harmful and poisonous, so are fake helmets. Many people are still not aware of how to differentiate between cheap and real helmets.

The good news is that the ban on helmets that are not ISI-certified has finally come into effect starting 1st June 2021. This means the selling of cheap and non-standardised helmets on the roadsides will no longer be available. The sale and stocking of these non-ISI helmets would consider as a criminal offence, as per the government norms.

This takes us one step closer to making riding a two-wheeler safer in India as the cheap roadside helmets that offer little or no protection in case of a crash will no longer be available.

**How important is R&D and innovation for manufacturing helmets? Do you incorporate R&D at Steelbird? Are you planning for any innovative product launches ?.**

It is always our constant endeavour to innovate our products. R&D plays a huge role in this, and we have a dedicated R&D team in Italy who constantly work on processes, features and ideas to improve our work. R&D is of many kinds, it could improve the cycle time of a process, increase efficiency or could reduce rejection etc. Hence, we are always focused on spending more and more on R&D. As far as innovation is



of the Blauer Pod uses material that complies with the European REACH (Registration, Evaluation, Authorization and Restriction of Chemicals) standards. It gets dual visors with an inner sun shield. The helmet offers a quick-release buckle mechanism as well.

We plan to keep innovating and introducing products that are state-of-the-art and advanced in all aspects.

**As one of the major players in the automotive ancillary industry segment, how do you view India's automotive future? How do you plan to leverage the same for Steelbird?**

The two-wheeler segment is bound to grow as more and more people are migrating from cycle to a scooter and from a scooter to a motorcycle. The sales trend also show that this segment is growing at a brisk pace. As an ancillary to this segment, we also hope to leverage the upwards trend of sales for our products. Also, because of COVID, people are avoiding public transport and switching to their own mode of transportation – the majority of which is a two-wheeler.

**How is your export business shaping up?**

My father, with his efforts, converted our small-time family business into a multimillion-dollar empire. We are now exporting across 50 nations including Brazil, Indonesia, Korea, Taiwan, Kenya, Tanzania, Egypt, Vietnam, Bahrain, Dubai, Nepal, Colombia, Uruguay and other European countries. We have also tied up with an International brand- Blauer. Meanwhile, amidst these desperate times, FIA (Federation Internationale de l'Automobile) has collaborated with us for a new project. Through this partnership, FIA will supply helmets to countries where they have not been made mandatory yet. The organisation plans to provide Steelbird helmets free of cost to two-wheeler users in African countries while also spreading awareness on two-wheeler safety and proper use of protective gear. 



**Boasting of a fibreglass shell, the Blauer Pod is helmet is manufactured using the balloon moulding process and has ECE 22.05 and IS 4151 certifications meeting European as well as Indian safety standards**

concerned, we have introduced some of the industry's newest features in helmets like night vision visors and photochromic visors. Other innovations include user-friendly and user experience improvement-based features like push-button visor opening mechanism and many others.

Recently, we have launched the new Pod open face helmet in India, in collaboration with Blauer. Boasting of a fibreglass shell, the Blauer Pod helmet is manufactured using the balloon moulding process, and has ECE 22.05 and IS 4151 certifications meeting European as well as Indian safety standards. The inner side

By Gitesh Chavan, Assistant Professor- Marketing, FLAME University

## PROCUREMENT PATTERNS – A BEHAVIOURAL STUDY

A key finding from a research involving a study of the purchasing performance factors in EPC firms found that the 'buying personality' of the professionals in charge of the purchasing function, had a significant bearing on the operational efficiency and success of the engineering, procurement, and construction (EPC) firms.

**A** key finding from a research involving a study of the purchasing performance factors in EPC firms found that the 'buying personality' of the professionals in charge of the purchasing function, had a significant bearing on the operational efficiency and success of the engineering, procurement and construction (EPC) firms. This finding provides a very crucial guideline for the human resource teams of EPCs in their employee hiring and performance evaluation systems and processes.

This is the first of its kind study conducted globally to gain additional insights into the different types of buying behaviours, also known as purchasing performance (PP) factors. PP models for EPC firms have not

been published nor validated empirically, nationally or internationally prior to this study. The research was carried out on a global level across verticals such as oil and gas, metals & mining and construction, considering views of Industry experts from countries like USA, UK, Australia, UAE, and India. Additionally, the research also reviewed purchasing spend data in India, covering at least fifty years.

As the dynamics of business environments changed over the years, purchasing departments in organisations had to manage supplier relationships in a volatile, uncertain, complex, ambiguity (VUCA) era. Meanwhile, the role of the purchasing function also underwent considerable changes - from being just a clerical function to a strategic function, with the integrative buyer-supplier relationship receiving high importance.

Engineering, procurement, and construction (EPC) contracts are the most common form of contracts awarded to contractors by the private sector on large-scale and complex infrastructure projects. Under an EPC contract a contractor is obliged to deliver a complete facility to a developer who needs to only turn a key to start operating the facility. Hence EPC contracts are sometimes called turnkey construction contracts. In addition to delivering a complete facility, the contractor must deliver that facility for a guaranteed price by a guaranteed date and it must perform to the specified level.

EPCs are employed by clients for an effective management of large-scale capital-intensive engineering projects catering to different industry verticals under one roof and take complete ownership of engineering projects from the design to the engineering phase. This is further optimised by dividing an engineering project into complete assets, main components, and basic components. Purchasing in EPC projects majorly includes market research, procurement and contracting and site material management with purchasing capital ranging from





## These findings have the potential to be used for merit rating of the purchasing professionals, job evaluation and assigning the right individual to the right task.

40 per cent to 60 per cent of the total cost of works projects. These costs could range from a few hundreds to some thousands of crores and it is important to understand the factors that impact this function in the EPCs.

In this context, the research primarily attempted to determine the factors which affect the purchasing activity, the interaction between them and the extent to which these factors can influence the performance of the purchase function. The research also included a study of the three different types of buying- New Task, Straight Rebuy and Modified Rebuy. A straight rebuy is a repeat purchase, where awareness is high, risk is less with scope of negotiation. Modified rebuy has the least risk. But, while buying under a new task, there is high risk and uncertainty since the buyer may not have adequate knowledge of the product/ service and the decision making requires expertise and a deep understanding of where, what is available and what needs to be done. With large scale budgets and spends, one wrong move in negotiation/ purchase can have a consequential impact on the company's finances. As the design of every project is unique and most of the purchasing is a new task, EPC purchasing becomes challenging. To ensure efficiency, they have large specialised teams who manage procurement and management of highly specialized equipment, services, technology, service contracts etc. which may include import processes and international and domestic regulations.

Against this scenario, what assumes a very strategic importance is the kind of professional resources that are employed in decision making positions in the purchasing function of EPCs. A survey was conducted

among professionals from EPCs to understand more about this 'profile' to understand the factors influencing their functions. The results showed a significant pattern across various industry verticals, with some things standing out in common - personality of the purchasing professional and his/her negotiation skills, quality of the human resource, location advantage, in-depth understanding of the products, are some of these.

These findings have the potential to be used for merit rating of the purchasing professionals, job evaluation and assigning the right individuals to the right task. These could also serve as a guideline to the HR department and the leadership to review their performance evaluation processes, employee recruitment systems as well as understand whether they are recruiting talent that is the right fit for the role and is resulting in the desired value add. This means that EPCs have to prioritise their focus on hiring of talent that possesses functional expertise, inter-personal skills, knowledge of global best business practices and a strong network. At the same time, the company must also commit itself to investing in the 'performing employees' by upgrading their skills through training and external exposure, incentivise them in diverse ways and give them opportunities for growth.

Apart from the above findings, the study also helps EPCs to review the effectiveness of their internal processes and the optimal use of resources, adherence to standards and timelines resulting in time, effort and monetary savings, effective negotiating position and how all these will ensure that the EPC maintains high levels of professionalism and delivery. 

## GREENPLY TO INVEST RS 75 CRORE IN A NEW FACILITY

**G**reenply Industries Ltd will invest around Rs 75 crore to set up plywood and allied products manufacturing unit through a wholly owned subsidiary in Sandila Industrial Area in Hardoi, Uttar Pradesh. The proposed capacity addition is 13.50 million square metres per annum while the existing capacity of the company is 24.90 million square metres per annum. Greenply has decided to set up the plant at Hardoi considering the proximity of principal raw materials such as agroforestry timber and availability of workers, along with growing demand in northern and central markets of India. The new project is expected to be operational by the fourth quarter of 2021-22.

Sanidhya Mittal, Joint Managing Director – Greenply Industries Ltd “We at Greenply is continually striving on building a sustainable operational framework vital for sustained value creation by working on capacity building and securing resource accessibility. We have decided to infuse zest, sustainability, and support all of which enhances the meaning of 'green' in a more meaningful way to a world and thus we are aiming to promote sustainable development amongst the local community through our plantation unit in Tizit Nagaland. Our new manufacturing unit in Uttar Pradesh will also generate jobs for both skilled and unskilled labour.”

By Kruti Bharadva

## MACHINING THREADS – THE ‘DO’S & DON’TS’S!

When it comes to machining threads, that little bit of extra expertise always comes in handy – here is a brief look at the five questions you should ask yourself when undertaking this complex piece of machining

**T**here are many elements to consider when threading a workpiece. When is a solid carbide thread mill better than an indexable? How does the workpiece material behaviour impact thread milling? Understanding your program as well as diagnosing issues that arise are just as important. Luckily, thread milling can be better understood by asking five specific questions.

### WHEN WOULD YOU WANT TO USE A THREAD MILL INSTEAD OF TAP?

There are many instances where you would want to consider using a thread mill instead of a tap. In numerous cases, this comes back to one common issue: taps break. Because the tap is the same size as the hole, there is a lot of pressure when you are forcing the threads into the hole—even more so in difficult-to-machine materials. Additionally, a tap’s cutting edges are constantly in the cut, thus generating more heat. A thread mill on the other hand has little contact with the material, and the

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Not only would you want to thread mill whenever the part is expensive, but you would also want to thread mill when working with a large hole diameter

heat generated is much lower—an added benefit in any manufacturing process. Finally, when using a tap, chips are more difficult to form and remove.

All the factors above lend themselves to tool failure. When the tap breaks off, it often results in a scrapped part, so using a tap works better when it is an inexpensive part being made. If it is a more expensive part and the tap breaks, you are now faced with the challenge of trying to remove the tap and salvage your part. This is a time-consuming operation that impacts your part’s quality and manufacturing cost.

Not only would you want to thread mill whenever the part is expensive, but you would also want to thread mill when working with a large hole diameter. Of course, a tap is just as large as the hole, so for a four inch thread diameter, you need a four inch diameter tap. Instead of buying this expensive, large piece of



metal or storing taps for every thread size, you could buy an off-the-shelf thread mill and interpolate the thread into multiple thread sizes including those large diameters. Lastly, thread mills consume significantly less power from your machine in the instance of large diameters.

Other advantages of thread mills include the ability to hold tight tolerances by controlling the tool’s cutting path. As the tool shrinks slightly from wear, you can easily compensate for this at the machine by using tool diameter offsets.

Nevertheless, there are occasions where tapping may be the better choice over thread milling. For example, you would want to use a tap when machining long lengths of thread. Due to the lack of radial load, there is no concern about the tap’s stability or tool deflection. In addition, when speed is preferred over thread quality, taps are again the better choice. In many applications, a tap will have a shorter cycle time than a thread mill. However, this still comes with the risk of breaking the tap and spending your valuable time to get it removed.

### WHEN SHOULD YOU USE SOLID CARBIDE THREAD MILLS VS. INDEXABLE THREAD MILLS?

In choosing to thread mill, you have the option of solid carbide or indexable thread mills for your application.



Factors mentioned previously like how much material you are removing and what the material is like to machine can be battled by adjusting the number of passes to remove the material as well as the combination of speed and feed

This choice often comes down to the needs of the application in terms of quality, repeatability and flexibility.

#### **Solid carbide thread mills**

Quality and performance are key advantages of solid carbide thread mills. Solid carbide thread mills run and cut faster every time. Having constant surface footage between two different diameters will result in a different RPM. Due to their smaller cutter diameter, solid carbide thread mills will run at a higher RPM. In combination with typically having more flutes, this will result in a faster penetration rate (in/min or mm/min) and improved cycle time. These tools typically outperform indexable thread mills in terms of quality because threads are being ground at the same time. This improves the consistency of threads. With a smaller cutter diameter, there is less contact with the workpiece, resulting in less heat generation and deflection as well.

#### **Indexable thread mills**

Most users are attracted to indexable thread mills because they provide the ability to change out thread forms frequently. You can take one body and change out inserts, and the machine is up and running with different forms and pitches rather quickly. Ultimately, this makes indexable thread mills better for low production batches as well as job shop type of work with a lot of change over and variation in the manufacturing. This again comes back to the flexibility of the tooling. You have a one-time purchase of the body and then switch over the inserts as needed.

All in all, a thread mill is simply milling a thread form and a pitch and can usually be used for both left and right-hand threads, internal or external, multiple start threads and various tolerances.

#### **HOW DOES THE MATERIAL IMPACT A THREAD MILLING APPLICATION?**

Material removal in threading is no different than any other manufacturing process like boring or turning. There are always two things to consider:

- How much material is being removed?
- What is the material like to machine?

The first question can be answered by the thread's pitch. While a fine pitch does not require much material to be removed, a coarse pitch requires a lot of material to be removed. The combination of these two questions will also help you determine whether your

material can be removed in one pass or not. Regardless of how many passes you use to remove the material, just like with boring or turning, a finish pass can be used for improved quality. This is often referred to as a spring pass. If needed, you should refer to the technical section of your manufacturer's catalogue or an available thread mill programming software like InstaCode to choose the number of passes that are right for you.

#### **WHAT ARE THE BEST PRACTICES FOR PROGRAMMING?**

As mentioned above, a thread mill can create a variety of threads like left or right-hand, internal or external by simply manipulating the program/tool path. Writing a program in incremental movements instead of absolute is always preferred. In doing so, you can insert your code for the threading portion as a sub-program or sub-routine. This is beneficial when threading multiple holes because it provides a single place for program edits. This also allows you to quickly complete a test run above the part to prove the program. In addition to writing this in incremental movements, an arc-on and arc-off movement will improve the quality of the thread and extend the life of the thread mill.

#### **HOW SHOULD YOU DIAGNOSE ISSUES WHEN THREAD MILLING?**

Because thread mills have radial cutting forces, the deflection should always be kept in mind. Factors mentioned previously like how much material you are removing and what the material is like to machine can be battled by adjusting the number of passes to remove the material as well as the combination of speed and feed. Additionally, consider the tool holder you are using. Because of the radial forces and potential deflection, it is necessary to use tool holders such as milling chucks, hydraulic chucks or shrink fits that minimize deflection. Ultimately, these tooling solutions are more rigid and, therefore, improve the quality of the thread you are machining.

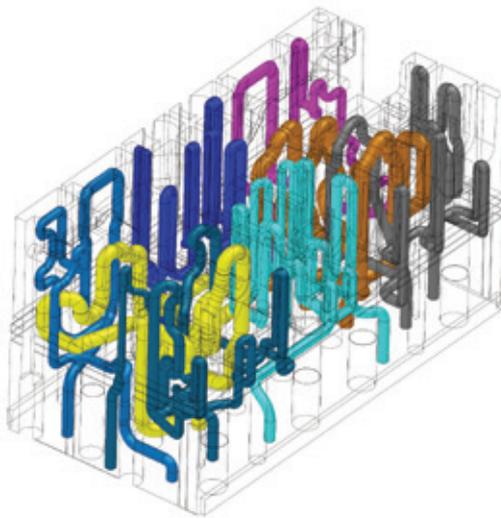
It is also necessary to understand if the programmed tool path is based on the centre of the thread mill or the outer diameter of the thread mill. This changes how wear offsets should be applied in the machine.

While you may encounter additional challenges when machining threads, asking these five questions aids in building the foundation for a successful application. 

By Kruti Bharadva

## PRINTING THE WAY THROUGH INNOVATION

The Erofio Group recently 3D printed its first mold core using a GE Additive Concept Laser M Line system. The Machinist takes a closer look at this successful trial



**Internal 3D view of the core to be printed with the eight independent conformal cooling channels**

**G**E Additive is a leader in metal additive design and manufacturing, a pioneering process that has the power and potential to transform businesses. Through their integrated offering of additive experts, advanced machines, and quality powders, the company empowers its customers to build innovative new products— products that solve manufacturing challenges, improve business outcomes and help change the world for the better. GE Additive includes additive machine brands Concept Laser and Arcam EBM, along with additive powder supplier AP&C.

An industrial molding sector company and long-standing user of GE Additive's DMLM laser technology was recently selected to test and put the GE Additive Concept Laser M Line through its paces, ahead of its commercial readiness later this year. Less than three months since receiving and installing an M Line system at its 6,500m<sup>2</sup> mold making facility in Batalha, central Portugal, a team led by EROFIO Group's metal additive

manufacturing leader, Luís Santos has successfully 3D-printed its first mold core.

The core was manufactured using M300 hot work tool steel – a material often used for the production of injection molding and die-casting tool inserts with conformal cooling, as well as functional components. The core contains more than eight independent, internal conformal cooling channels, stretching over eight meters in length and between five to eight millimetres in diameter.

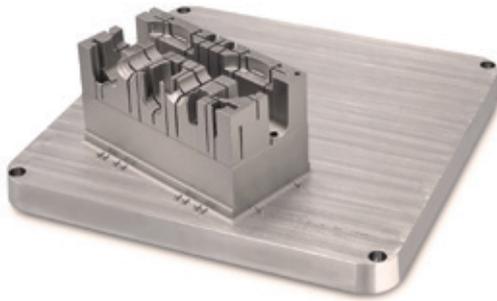
### THE ADVANTAGES ACHIEVED

Additively manufacturing the part affords the team the design freedom to enable conformal cooling to create a more efficient heat exchange. This improved cooling will increase the overall plastic injection process productivity through decreased cooling cycle time and warpage, and the improvement of the injected plastic part aesthetics.

In addition to the benefits of geometric freedom on the design of inner channels, using additive manufacturing has reduced finishing requirements by 90 per cent. Another advantage identified, when compared with conventional manufacturing processes, was a reduction in the total manufacturing time -- from powder to mold assembly - by 30 per cent.



**GE Additive Concept Laser M Line system installed at EROFIO Group's facility next to a GE Additive Concept Laser M2**



**Additively manufactured mold core using hot-work tool steel, printed on a GE Additive Concept Laser M LINE system.**



The core contains more than eight independent, internal conformal cooling channels, stretching over eight meters in length and between five to eight millimetres in diameter

### THREE MONTHS FROM INSTALLATION TO FIRST PRINT

Santos and his team already experienced users of GE Additive's Concept Laser M2 system, opted for an existing parameter – already developed for the Concept Laser M2 Series 5 – and made only very minimal changes to adapt it for the M Line system. Following remote optimisation support from the GE Additive team in Lichtenfels, the part was successfully printed on its first attempt, over six days in May 2021.

“We are honoured to be part of GE Additive's thorough commercial readiness process. We're learning a lot

from them and I think it's safe to say they are learning a lot from us and our first impressions working with the M Line. Having the first part come off our system is a great milestone and we're looking forward to supporting the wider team as the solution comes to market and beyond,” said Luís Santos, EROFIO Group.

“We have a solid working relationship with the team at EROFIO that goes back well over a decade. As we near a critical phase in commercialising the M LINE system, we specifically sought out a trusted partner to gain early installation experience, data and honest customer feedback,” explained Wolfgang Lauer, Concept Laser M Line Product Manager, GE Additive.

According to Jan Siebert, General Manager, Laser Technologies, GE Additive, “We expected the first part to be printed on the M Line to go well. And when it did, there was a rush of excitement felt across the entire team here in Lichtenfels. Work continues here in Germany on the M Line, ahead of the launch, and we will factor in additional feedback from the team at EROFIO.”

It is critically important that when GE Additive brings new solutions to market, it can tangibly and immediately demonstrate business impact. Siebert further added, “Our M Line system operates at higher levels of reliability and repeatability, meeting customers' needs from day one. This is not a science experiment and we are not developing laboratory equipment. Overly ambitious claims and incomplete specifications in other vendors' product launch announcements only serve to undermine the trust that our wider industry has collectively built-in metal additive technology in recent years,” he added. 

## BIRLA CELLULOSE'S GRASIM VILAYAT SITE ACHIEVES THE EU BAT COMPLIANCES

**B**irla Cellulose's Grasim Cellulosic Division, Vilayat, India has successfully commissioned the Carbon-disulphide Adsorption Plant (CAP) and has achieved the stringent level of sulphur-to-air emission norms stipulated in the EU BAT references (EU Best Available Technologies BREFs) for the viscose manufacturing process.

This initiative is in line with Birla Cellulose's aim to apply the best available technologies (EU BAT) at all its fibre locations and investments of \$170 million are in progress in order to achieve this by the end of 2022.

“Adapting the best available technologies is an important milestone towards achieving global leadership in sustainable practices in the MMCF industry”, informed Mr H K Agrawal, Chief Operating Officer of Birla Cellulose, “we are investing in innovation to con-

tinually improve our performance. This is the reason that our products come with sustainability credentials that are global benchmarks.” Birla Cellulose has already achieved Carbon Neutrality in Scope 1 and 2 emissions by sequestration of carbon in its managed forests. Birla Cellulose is also ranked number 1 in Canopy's Hot Button Report for its sustainable forestry practices and innovations in NextGen solutions. Birla Cellulose has also established the global benchmark for lowest water intensity in the viscose manufacturing.

Grasim Vilayat has installed state-of-the-art closed-loop technologies to recover and recycle CS<sub>2</sub>, which is the key raw material for viscose manufacturing process. With these technologies, the site can significantly reduce its emissions and achieve 90-95 per cent recovery in terms of sulphur and recycle it back to the process.

## THE NEW EVOLINE KNURLING SYSTEM

With the TK EVO, precision tool manufacturer LMT Tools is expanding its successful EVOLine product family to include a tangential knurling system specifically for machining knurled components. The new knurling system guarantees the highest profile quality with extremely short machining times, a high degree of process reliability, and safe, simple tool handling - making it the first choice for producing knurled profiles in the tangential process.

Whether it's a gearshift knob or a drive shaft, whether decorative or high-precision: knurls come in a wide range of variants with the most diverse technical requirements. Extreme quality requirements characterize knurl production in the e-mobility and automotive sectors, and this trend is increasing. LMT Tools has developed the innovative EVOLine tangential knurling system to meet the individual requirements for knurling and at the same time enable fast, economical and reliable production.

The EVOLine knurling system is a robust monoblock tool with individually designed knurling rollers. The sturdily designed rolling head body with its force flow-oriented component structures ensures high rigidity and guarantees precise knurling profiles for top component quality. The chip less forming process and the precision of the roller also contribute to the high profile accuracy. The integrated cooling and flushing nozzles are manually



adjustable and reach the effective zone in a targeted manner.

### Rolling instead of machining

The roller system moves onto the workpiece with tangential feed and forms the desired profile. Rolling offers significant advantages over machining processes. Since the material fibers are not cut during cold forming but only displaced, high component strength and constant dimensional accuracy can be achieved. The user also benefits from high

cost-efficiency thanks to short production times and high process reliability. For example, the rolling time with the TK EVO is generally less than two seconds. Incidentally, with tangential rolling it is also possible to produce profiles in front of or behind a shoulder collar or interfering contour.

### Safe and easy tool handling

Installation of the EVOLine knurling system is quick and error-free thanks to defined installation positions and a labelling system with specific product information. Tools are not required for installation and removal. The roll diameter can be set very easily and precisely, thanks to fine adjustment with accuracies in the  $\mu$ -range. Rolls can also be changed in just a few simple steps.

The compact design of the knurling system also allows integration into many existing processes.

*For more Information please visit [www.lmt-tools.com](http://www.lmt-tools.com)*

## BARREL-SHAPED END MILL HALVES MACHINE TIME

Dormer Pramet has launched an advanced barrel-shaped end mill for efficient five-axis machining for aerospace and die and mold applications. The new S791 cutter provides excellent surface quality and is suitable for semi-finishing and finishing in steel, stainless steel, cast iron and super-alloys. It's the first design of its type within the company's Dormer range and includes a nose radius for fillet milling, plus a larger tangential form for curved and deep wall surface machining.

Providing more overlap compared with conventional ball nose end mills, the barrel-shaped cutter achieves a greater area of contact with the workpiece, increasing tool life and lowering cycle time. With fewer passes needed, it can help reduce machine time by half, while continuing to achieve all the usual benefits associated with a robust ball nose end mill. In a recent example, the barrel end mill required just 18 passes, compared to 36 with a ball nose version, when machining with the same parameters.



The S791 achieves high surface quality, minimizing the time spent polishing, and its positive rake angle enables smooth cutting action in stainless steels and super-alloys, reducing the risk of work-hardening. An AlCrN coating provides thermal stability, reduced friction, excellent

wear resistance and prolonged durability, with several three or four-flute options available for more productivity (compared to a common two-flute ball nose cutters).

*For more information please visit [www.dormerpramet.com](http://www.dormerpramet.com)*

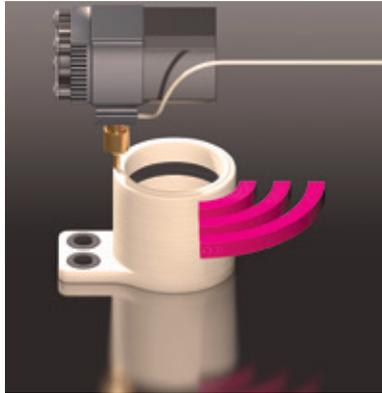
## ADDITIVE MANUFACTURING MEETS INDUSTRY 4.0

Even today, 3D printed wear-resistant parts from igus often have the same service life as original parts. Now igus goes one step further and makes the printed components intelligent. Manufactured in filament printing, they warn against overload and report their maintenance requirements. The special feature: for the first time, the sensors are directly “printed into” the parts. As a result, they not only have extremely short delivery times and low costs but also feature useful Industry 4.0 options.

“We have now achieved a real breakthrough with the smart 3D printed bearing”, says Tom Krause, Head of Additive Production at igus. “In this way, predictive maintenance is also possible for special parts in a cost-saving manner.” Long before the failure, the intelligent 3D printed component signals that a replacement is imminent. It can also detect overload to stop the application immediately and prevent further damage to the bearing position and the entire system.

### Wear or Load is Monitored

igus has been producing intelligent wear-resistant parts for energy chains, plain bearings and linear guides since 2016. At the start, plain bearings were manufactured from iglidur I3 in laser sintering and the intelligence was subsequently introduced in a second processing step. In this case, however, the production of intelligent special parts in small quantities is complex and expensive, as the downstream work steps are very specifically designed for the respective component. Using a new process, igus developers are now able to produce such intelligent



wear-resistant parts in just a single work step. No further processing steps are necessary and intelligent special wear parts can be produced cost-effectively within 5 working days. The sensor layer is applied to those parts of the component that will be subjected to load. Wear-resistant components with integrated sensors are created using multi-material printing. The components are manufactured from iglidur I150 or iglidur I180 filaments and a specially developed electrically conductive 3D printing material that bonds well with the tribo-filament.

Currently, two areas of application are possible: if the electrically conductive material is located between the layers subject to wear, it can warn against overloading. Because of the load changes, the electrical resistance also changes. The machine can be stopped and further damage can be prevented. To determine the load limits, the bearing must be calibrated accordingly. If, on the other hand, the conductor track is embedded in the sliding surface, the wear can be measured via the change in resistance. Predictive maintenance is possible with the 3D printed component. The lubrication-free and maintenance-free tribo-component announce when it needs to be replaced, avoiding system downtime and enabling maintenance to be planned. If the 3D printed components are also used in the pre-series stage, the collected wear or load data provide additional information about the service life of the individual component or the planned application in the series. This makes it easier to adapt and optimise the development process.

## DEP'S SIMULATION TECHNOLOGY IMPROVES QUALITY

Detroit Engineered Products (DEP) proprietary product development platform- MeshWorks- is a unique and powerful simulation tool that enables manufacturing organisations to increase throughput, identify process bottlenecks and inefficiencies within the production line. In manufacturing, simulation technology significantly impacts many decisions like project complexities and challenges. With MeshWorks' simulation-driven-design technology, opportunities to change the manufacturing processes are made available at the early stages of design and development. This in turn leads to increased structural efficiencies achieved by minimizing the weight of components and assemblies, ultimately resulting in optimized products.

As the use of simulation tools for enhancing product performance increases, there are simultaneous efforts focused on the democratisation of simulation and boosting advanced simulation tactics using multi-disciplinary optimisation (MDO), Artificial intelligence (AI), Machine

Learning (ML), etc. Given MeshWorks' advancement as an easier and more accessible simulation tool even for non-experts, it is now the choice of the manufacturing organisation as an insight provider for a better design and process.

DEPMeshWorks' manufacturing simulation functions are designed to help improve the life of tooling and reduces manufacturing defects. For manufacturers, it gives real-time inputs to reduce scrap during manufacturing by way of design suggestions like shape effects, structural



performances, connection types, joint strength, and joining sequence. Also, there are part level and assembly level assistance programs for manufacturing processes that are applicable based on product development requirements.

For further information, please visit: [www.depusa.com/company](http://www.depusa.com/company)

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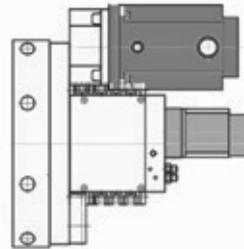
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#### SPECIFICATION

Swing over bed	500 mm
Max. turning dia	250 mm
Max. turning length	500 mm
Spindle nose	A2-6
Max. spindle speed	4000 rpm
Spindle Power	Fanuc - 7.5 / 11 kW Siemens - 9/13.5 kW



Type of guideways	Linear Motion
X-axis stroke	193.5 mm
Z-axis stroke	500 mm
X & Z axes rapid rate	30 m/min.

Turret type	Axial live tool turret (VDI 30)
Max. No of tools	12
Boring bar dia	Ø32
Rotary tool motor power	2.5kW (11 Nm)
Rotary tool motor speed	5000 rpm

