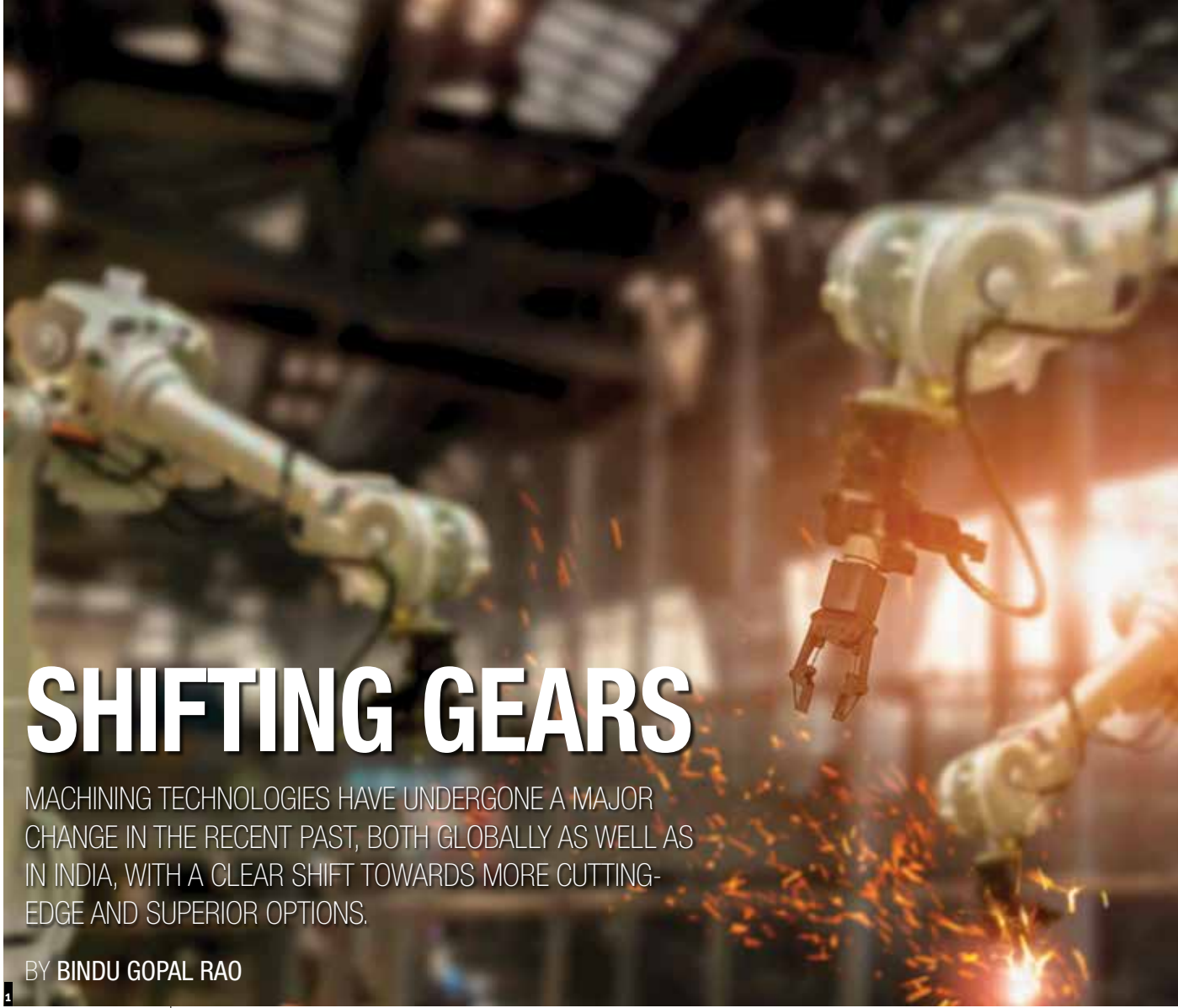

SHIFTING GEARS

MACHINING TECHNOLOGIES HAVE UNDERGONE A MAJOR CHANGE IN THE RECENT PAST, BOTH GLOBALLY AS WELL AS IN INDIA, WITH A CLEAR SHIFT TOWARDS MORE CUTTING-EDGE AND SUPERIOR OPTIONS.

BY **BINDU GOPAL RAO**

1. Today, OEMs and their supply chains are undergoing major changes as companies embrace digitisation of their shop floors.

WHILE INDIA CONTINUES TO REMAIN dependent on imports for more sophisticated technologies in machine tools, the availability of these advanced technologies only means that there is an opportunity for creation of value by vendors for their customers as well as end-users. Latest technologies have unleashed the power digitalisation in CNC machines, robotics for complex processes and multi-axis machining for faster, speedier and smarter processing of machine parts with more robust machine tools. Additive manufacturing is the latest technological advance that is making waves. India definitely remains a good market for these technologies.

NEW VISTAS

In today's world of manufacturing, all OEMs and their supply chains are undergoing major changes as companies embrace digitisation of their shop floors by continually adapting innovative technologies to optimise their operations, improve efficiency, remain competitive, enhance profitability and generate more value for their customers. This is evident within fast-paced manufacturing industries such as automotive, transportation and consumer goods. The latest entrants to embrace digital transformation are the aerospace and oil & gas industries.

"Over the last decade, there have been dramatic advances in the capabilities and technologies of digital manufacturing, which has shown the pathway to connect the virtual world to the real shop floor environment. By this, the flow of data from a drawing board to a CNC machine is now connected and seamless. Closed Loop Manufacturing Process is manufacturing of a part with online quality checks and validations using specially designed tactile/ non-contact type probes to measure the quality concurrently and continuously, while it is still being produced. This is integrated within the CNC machine, which receives specific instructions from its controller through specially coded probe cycles written within its programme," explains **Vijay Anand R, practice leader - manufacturing engineering, QuEST Global**.

Closed loop technology gives 100% real-time, automated, quality inspection data enabling the shop floor frontline for quick and on-the-spot decision

making, tracking data with intelligence modules using process signature techniques, to quickly identify the root cause of issues affecting production and post-processing analysis for all manufacturing data.

Rama Krishna Kuppa, founder & CEO, ONGO Framework, adds, "The machine primarily allows automation of workflow and decreases human efforts involved. Robotics are two dimensional when it comes to automation of machine tools. The first is a focus on manual tasks, and the second is built on intelligence. Integration of sensors, chips and machine learning allows the ordinary machines to become smarter. These technologies are the future of manufacturing. Intelligent automation tools reduce the price of the product. This is directly proportionate to the price of production, which is directly proportionate to the GDP of the country. When compared to human labour, the machines decrease the overall production charges and multiply the ROI."

CREATING EFFICIENCIES

Centralised manufacturing is the process of controlling multiple CNC and other automated machines from a common command center to monitor/ control the progress of all connected machines. Communicating with remote locations is another benefit of handling various sites concurrently. This ensures optimum utilisation of manufacturing resources and, at the same time, achieves 100% Overall Equipment Efficiency (OEE).

"The command center has the ability to bring many different resource statistics together and establish connections between them to realise the overall efficiency of the system considering all parameters. The major advantages of centralised manufacturing include connected environment with robust 24x7 progress monitoring, one-stop solution centre for shop floor health monitoring and controlling to achieve higher efficiency, secured, predictive and automated to identify and prevent unwanted outcomes with a prognostic approach and standardisation of best practices with consistent processing across an organisation," says Anand.

Likewise, Flexible Manufacturing System (FMS) is where a group of NC machines are operated by a central command centre, where various machines

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"Intelligent automation tools reduce the price of the product."
– Rama Krishna Kuppa

2. Welding robots work at a car factory.

3. The inherent challenge of starting up with CNC machining is offset by the return.

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are interconnected with automatic loading and unloading docks guided by automated vehicles for pick and place. It is a system with flexibility that will enable to make adjustments for handling manufacturing efficiency improvement such as mixed family of parts, assembly variations, change in manufacturing process, demand for volume uplift, and other changes. FMS has the capability of producing a variety of products using the same machines and producing the same products on different machines, producing new products on existing machines and accommodating changes in the design of products. It also

FMS REFERS TO THE ADAPTABILITY TO CHANGES IN VOLUME, CAPACITY AND CAPABILITY.

refers to the adaptability to changes in volume, capacity and capability.

TECH EDGE

Feature-based Machining (FBM) is a technique used to generate automated NC toolpath using feature recognition of an enriched 3D model to create optimised cutting tool path, which can be easily derived from the Machining Knowledge Editor (MKE) library. Cutting toolpath will be generated quickly and efficiently by auto recognition of geometries, dimensions and surface finish to devise the required machining strategy with robust simulation, and thereby deliver a gouge-free CNC programme.

"Developing of MKE libraries will need investment

TRADITIONAL MANUFACTURING WITH CONVENTIONAL METHODS REQUIRED HIGH CAPITAL INVESTMENTS.

of time, but once the library is developed for specific cutting toolpath/ features, this can be reused multiple times, thereby reducing nearly 65% of the programming time. FBM can define custom feature types interactively in the graphics environment and then easily build up machining process definitions from NX CAM operations and identify process specific parameters," says Anand.

Adaptive machining, on the other hand, is the process of manufacturing high complex parts through in-process sensing, monitoring and capable of correcting methodologies for errors. It is a concept that represents the adaptation of the cutter path to actual shape and position of a part in the machining space working with a part based on how it actually exists in reality, rather than working with a part based on its computer-generated ideal shape.

"When coupled with standard CNC machine tools, adaptive machining provides the capability to machine and blend complex three-dimensional components and features automatically, where geometrical differences may or can exist between one component and the other. It is a powerful application for machining parts that have bulk residual stresses, thin walled sections and parts subject to shrinkage variations from temperature fluctuations," says Anand.

Additive Manufacturing (AM) or 3D printing is a process of depositing material layer upon layer to make objects from 3D model data, as opposed to subtractive manufacturing methodologies such as machining. Instead of milling a workpiece from solid block, Additive Manufacturing builds up components in required layers and thickness by melting or depositing materials to its near net form. The process involves the use of a computer and special CAD software, which can relay messages to the printer in a numerical machine understandable language so that it prints to the desired shape. Conventional manufacturing techniques are capable of producing a great range of shapes and designs, but additive manufacturing takes production to the next level.

VALUE ECONOMICS

Traditional manufacturing with conventional methods

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"In some cases, the bottleneck for just how fast CNC machining works is the speed at which the computer sends instructions to the device under control."
– Satanik Roy

"Over the last decade, there have been dramatic advances in the capabilities and technologies of digital manufacturing."
– Vijay Anand R

4. Digital manufacturing suites have shown overall efficiency improvement by 40% through connected systems.

required high capital investments. Historically, few players could dare to break the entry barrier. The product life cycle also would involve a cumbersome process, which was and still is daunting, wherein the product has to navigate through multiple stages and processes before reaching the end user. Today, modern technology offers multiple platforms to break this barrier by streamlining the process, simplifying the methods and connecting the flow of information to all stakeholders in real time. Government and public policies for these technologies are also attractive, which enables increased participation of players ready to use disruptive ideas. Digital manufacturing suites have shown overall efficiency improvement by 40% through connected systems. It has a proven record of reducing 70% of the total cost in new product introductions. Right First Time indices have increased three-fold with the help of robust simulation and predictive analytics and also, not to forget, ergonomic studies have certainly improved the quality of life for shop floor operators.

"Digitising the industrial infrastructure through modern technologies and Industry 4.0 is opening up the manufacturing sector to many newcomers. Digitised knowledge literally eliminates or shortens the time to learn and concurrently elevates the competency levels. The connected tools serve as a platform to interact with technical experts, real time and quickly formulate the required solutions," says Anand.

CHALLENGE FACTOR

It is generally true that what a skilled tradesman may excel at, CNC machining may have trouble with, and vice versa. Whereas, it is a true show of skill for a tradesman to work metal with precision, such as cutting in straight lines, or circular patterns, a CNC controlled machine can do this easily. But with more asymmetrical or unique geometric patterns, CNC machining may struggle where an experienced artisan can get the job done. This challenge, however, is mostly a technical limitation. Older CNC machines operated only two or three axes. Newer machines have a much greater range of movement.

"CNC machining, because of its mechanical nature, can operate well within the boundaries of the hardware. But the performance may be affected by the software that runs the machine. In some cases, the bottleneck for just how fast CNC machining works is the speed at which the computer sends instructions to the device under control. This is easily overcome with an upgrade. The computer that runs the software may require an update to faster, more powerful hardware. Or, the controlling software itself may be due for retirement to make way for a newer, more versatile and powerful piece of software that can fully utilise a machine's inherent strengths," says **Satanik Roy, co-founder, HyperXchange**.

Also, there is no getting around the fact that the initial financial outlay required to purchase CNC machining equipment is not cheap. That's especially true for people who are coming in fresh and have no existing equipment to upgrade from. However, the inherent challenge of starting up with CNC machining is offset by the return. This is not a simple purchase of a consumable. This is an investment that will yield profits in the long-term through many indirect benefits, such as faster results, longer operation, and the ability to take on more work. One of the problems with CNC machining is that when things break down, the repairs can be costly. CNC machining requires a complex mix of hardware and software in order to work efficiently. Any breakdown in these systems may require a combination of mechanical and programming expertise to get it up and running again.

"In the past, the requirements to perform more complex machining tasks required artisans or engineers with a solid understanding of metallurgy or other subjects. This often had an indirect benefit on a company as this knowledge educated many of the people in a business. CNC machining vastly simplifies things, meaning that because the machine knows what to do, workers no longer require the knowledge behind these results. On the other hand, fewer people are required to get a job done now that CNC machining has taken over. The loss in specialised knowledge is offset by the lower operating costs of having fewer staff that do not require expensive schooling and training in order to get the job done," adds Roy.

Future success and sustainability would depend upon how these technologies are adopted, and how attractive the value economics remains, going forward. MT