

Aerospace machining

Clear skies ahead

Aerospace industry in India has come of age. Currently, India, the second largest aviation industry of the world, is riding high with over 8 per cent economic growth coupled with a developing middleclass, and a burgeoning base of air travellers. The rising need for amending the present fleet of fighter jets adds to India's positives and makes it an exciting market full of untapped opportunities. It is poised for greater strides in the years to come and boost the demand of specialised machines in the aerospace industry, thus contributing to the overall growth of Indian manufacturing sector...

Prasenjit Chakraborty

The global spending on engineering services was \$ 750 billion in 2004, with aerospace accounting for 8 per cent, and it could rise to \$ 1.1 trillion by 2020, according to the industry figures released by NASSCOM. The total offshore engineering expense is expected to grow to \$ 150-225 billion by 2020 and India, with its talent pool and experience in engineering services, could pick up 25 per cent of that. According to the Civil Aviation Ministry, the Indian civil aviation market is set to log on an annual growth of 25 per cent in the next decade. The ministry further said that to sustain the growth, India would require 1,500-2,000 aircrafts, and \$ 75 billion of hardware business.

Taking due cognisance of the fact, QuEST Manufacturing Company plans to integrate and develop design to manufacturing capability in the coming years. In this direction, QuEST is promoting an aerospace SEZ at Belgaum, Karnataka, where they intend to develop an aerospace manufacturing ecosystem that will cater to the aerospace offset opportunity for India. "We will integrate design and manufacturing to provide complete solution to customers. This will help QuEST graduate to risk and reward sharing partner with tier-1s," said Arvind Melligeri, CEO, QuEST Manufacturing. He further said, "We will enter into partnerships with the right organisations for market and the technology know-how access. We will further invest in our manufacturing capabilities in order to provide more build services."

With aerospace industry contributing significantly to the national economies of developed countries, the well being of this industry is extremely important for developed countries. The industry provides largest trade surplus in the US manufacturing sector. However, every industry has its demerits. Aerospace industry, with a greying workforce, finds it difficult to attract fresh talent. According to industry sources, close to 20-25 per cent of the workforce would be retiring in the next five years. Additionally, the number of engineers and technicians interested in pursuing career opportunities in the aerospace industry is diminishing. Although the demand for aircraft is buoyant, the industry has

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a few challenges and the main one comes from its limited access to talent pool. Controlling costs and meeting delivery schedules are the other challenges.

Whatever the challenges may be, the industry is growing, and the demand is buoyant, with India and China contributing significantly to the industry's expansion. It is a common practice referred to as the 'offset policy' - in the aerospace industry to spend a portion of the order value in the country acquiring the aircraft by procuring some of the aircraft components. Therefore, the industry, which on one hand is seeking to control costs and on the other is facing challenges on the human resource front, the offset policy is coming handy.

Machine tool musts

Aerospace manufacturers face constant pressure to control cost and ensure quality in each project. Every minute detail has to be taken care of. Even consistency in tool is equally important. For instance, at high speed, slight variations in the cutting tool can significantly affect tool performance and may affect the harmonic characteristics of the cut. According to Melligeri, close to 40 per cent of machining of structural parts for aerospace is aluminium machining. And this requires high speed machining with high material removal rate. "Here speed is the criterion (machines more than 20,000 rpm is becoming norm). This is followed by titanium machining, which is 20-25 per cent and requires very high torque at low rpm. "However, there are very few reputed machine tool builders who have specialised dedicated machines for such application," said Melligeri. Rest are exotic materials like Inconel, Nimonic

alloys and high strength steels. This needs a combination of speed and rigidity in machine tools. Vivek Lall, vice president & country head, Boeing Integrated Defense Systems, is of the opinion that the requirements for machine tools depend on specific work packages. "However, the standard tools include vertical turning lathes, milling machines, friction stir welding machines, plasma arc welding machines and gantry milling machines," Lall said and added, "Of course, highly skilled and trained employees to operate these tools are the most critical elements of all." According to Eswari Prasad, president, MAG India IAS (P) Ltd, aircraft manufacturers are investing in composites fabrication technologies, faster and more productive metal-cutting equipment, lean manufacturing techniques and greater use of automation. He said that the bulkheads, wing spars, seat tracks, door frames and other large prismatic parts require big work envelopes on gantry machining centres and new high-speed horizontal platforms.

Fateh Singh, general manager & head of aerospace division, Bharat Fritz Werner (BFW) and formal general manager, Hindustan Aeronautics Ltd (HAL), firmly believes that the machine tools have to be robust and sturdy with high accuracies in terms of positional location and very low spindles run outs. "High speed machining is becoming order of the day. Spindle speed in excess of 20,000 rpm are being widely used," he pointed out.

In the words of Carl Martin Welcker, president, Alfred H Schutte, GmbH & Co KG, "The aerospace sector demands machine tools of high productivity and accuracy like automotive sector. It is driven by safety and the industry requires machines of high

tolerance." "Complicated machining (milling a single type of machine, which can handle aluminium, steel and titanium machining), turning, grinding and routing are required for the industry," said Anil S Bonal, vice president planning & procurement, Taneja Aerospace & Aviation Ltd (TAAL).

Diverse demands

The combination of turning and wheeling machines is required for turning the wheel centres and 5-axis machines for controlling. These machines are required for controlling and to provide flexibility. Flexibility is very important to produce different possible parts. "Here, 5-axis, high-speed machine tools are in demand because they are versatile and do not require multiple set-ups," opined Lall. Echoing similar opinion, Melligeri said, "3-5 axis machining centres and 2-3 axis turning and turn mill centres are in demand from the industry. According to Welcker, the priority is from milling to turning, wrapping, grinding, honing and forming machines. "The industry also requires laser-cutting machines," he said.

"For aluminium processing, super high-speed machines in both vertical and horizontal platforms are highly in demand," opined Prasad. He also claimed that MAG Cincinnati's Hyper Mach Linear Motor Profiler is achieving the highest metal removal rate in production today, which is 7,538 cm³/min (460 in³/min). There is also tremendous need for titanium processing capacity, which requires extremely rigid machines. In this direction, MAG Cincinnati is designing and building machines that are specially equipped for high performance processing of hard metals in particular titanium. "We have seen a surge in multi-spindle machine sales to support the demand from the industry," said Prasad.

In order to meet production schedules and quality expectations for composite structures, automated composites processing equipment is critical. Increasing number of highly productive tape layers and fibre placement systems are being installed in aircraft manufacturing sites across the globe to support a wide variety of parts production

including fuselages, wings, nacelles, engine blades, military aircraft inlet ducts and satellite launch vehicle components.

Throwing light on the new materials used in tooling, Melligeri said that carbide tools remain the most used cutting tool material. "CBN will become increasingly used where higher cutting parameters are used," he asserted. "The plastics and composites are lighter and easier to use from an ergonomic standpoint," opined Lall. Bonal strongly believes that apart from regular aluminium and hylum materials, INVAR may play a big role in tooling material in future, specially in composites application. "There has been some new carbide materials developed but this is only a portion of what's been happening with tooling," pointed out Prasad. However, the biggest improvements recently have been advancements in cutter geometries and flute density. "These developments are providing tremendous productivity gains-sometimes in excess of seven times currently cutting performance," said Prasad.

The industry is constantly working on new aircraft and engine designs as well as reduced weight. Does it affect the demand of machine tool? The collective opinion of most of the industry people is that such issue only drives innovation and productivity. "In general, it means that machine tools need to be more versatile to handle a variety of requirements. That is why there is an increasing demand for 5-axis, high-speed tools that do not require multiple set ups or additional operators," said Lall. All new aircraft contain a higher percentage of composite materials than the previous generation. The growth in composite aerospace structures has resulted in surge in demand for both automated composites lay-up equipment and machine tools for producing complex, monolithic titanium components to join them together. "This has created a focus on quality-weight reduction - and cost in the manufacturing. The rapidly growing use of titanium in aerospace has focused industry attention on the need for improved processing capabilities and capacity for this difficult-to-machine material," explained Prasad. Taking due cognisance, certain long-time equipment suppliers, including MAG, have responded with comprehensive package covering machine

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tools, automation, tooling, coolant delivery and chip handling. According to Melligeri, the issue calls for new type of metals/alloys machining and composite laying machine tools, which needs to be in sync with the designs that are being produced to achieve the reduced weight, higher efficiency and green engine initiatives.

It is a constant endeavour from design engineers to work on new designs for aero engines and aircrafts in order to improve the performance and reduce the weight. "This leads to the use of difficult machine material with higher strength/weight ratio. New designs also envisage the shapes, which are complex and hence require 5-axes or even 7-axis machines for machining these shapes," said Singh and added, "The thickness are designed to be bare minimum with reduced factor of safety. Dimensional tolerances are also made very close. Coming across the thickness of 1.2 mm on 2,000 mm, long components is a common sight."

Global prospects

On manufacturing front, India is doing well and its growth is quite impressive. Global product development depends on several factors. And it's a systematic and strategic process by which product companies critically examine how they need to use global resources to build and deliver products to their customers, take their products faster to the market, and turn them better and cheaper. In the process, they will build competitive advantage for themselves.

"India will increasingly offer design to manufacture solution," stated Melligeri. According to him, currently, engineering outsourcing and manufacturing sourcing are standalone due to the nature of available capability with companies in India.

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Aravind
Melligeri
CEO, QuEST
Manufacturing

These companies are either engineering services companies or manufacturing companies. "QuEST will offer integrated solution to customers," he said. As part of India's defence modernisation drive, the Government of India has a goal of identifying select global aerospace companies that will bring high value work and long-term benefits to the aerospace sector of the country. "For its part, the Boeing Company is committed on its own to partnering with leading members of the Indian aerospace industry to support the Government's strategic drive. So the two objectives, the Indian Government's and ours, are intertwined," said Lall. According to Bonal, apart from the opportunity of offset clause, India is emerging as a low cost high quality sourcing nation, which will lead to immense growth in aerospace industry. "With aerospace industry growing constantly at the rate of 20 per cent annually, the aircraft, spares and MRO business will witness a big boom. India must gear up to grab this opportunity at the earliest," exhorted Bonal.

No wonder, Indian aerospace sector is not only looking at domestic needs but has set its eyes firmly on the international market. "Products like Advance Light Helicopter (ALH) and Light Combat Aircraft (LCA), both indigenous products, have enough export potential," said an elated Singh. India, being a low cost country with tremendous knowledge pool, forced people to outsource works from here. "Plethora of high technology work like aircraft engine development, etc, is being done here. Besides this, works for Boeing and Airbus are also being carried out. This proves that the



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country has the potential to excel further in this field," said S Manivasagam, head-engineer, Tooltech Software (India) Pvt Ltd.

The view of Prasad in this regard is ultimate, "Global leaders in aerospace sector have already rooted not only the basic design work but also research and development. India is truly developing into one of the major source of technical talent in the world."

Progress plans

Aerospace manufacturing, which was so far considered as a low-key affair in India, has started getting momentum lately. Anticipating the potential of the market, leading companies of the world have contemplated plans for the market. For instance, Boeing values India as a key partner and is committed to leverage their industrial participation/offset obligation to grow and enhance their strong, long standing relationship with the Indian Government and industry. "We are already growing our presence here, and increasing the pace and depth of our engagement with Indian industry on software development, engineering and technology," revealed Lall. As part of Boeing's globalisation strategy, they have expanded footprint with an increase in headcount, strengthened in-country executive team, technology partnership with tier-1 Indian IT firms, investment in MRO and training facilities, and strategic research and development partnerships with HAL and IISc.

HAL has recently signed a \$ one-billion manufacturing outsourcing contract with Boeing over ten years. According to the contract, HAL will manufacture subsystems for Boeing's wide range of fighter planes like F-15, F-18 Super Hornets and Apache Helicopters. Boeing will also support the training and transfer of its best practices for lean principles and supplier and programme management to the extent allowed by the US government.

Interestingly, the aerospace division at BFW, which was conceived barely 18 months ago, has made rapid strides and currently manufacturing aircraft structural components, aero engine turbine blades and compressor blades, etc. What's more, the division will graduate from component supplier to sub-assembly supplier in the areas of manufacturing and assembly of aircraft structure modules like rudder, fin, aileron, elevator, wing sub-

assemblies and fuselage sub-assemblies. Besides this, manufacture of compressor rotor blades, discs, shafts and supply of low and high pressure compressor rotor assembly modules will also be undertaken soon. "From the present status of component supplier to national defence sector, the division envisions to be an assembly/system supplier as a fully export-oriented unit by 2015 with a sales turnover of Rs 100 crore," said an elated Singh.

Similarly, TAAL would like to be a sourcing destiny for sheet metal details, machined component details and sub assembly packages. "The future of aerospace sector is bright and equally challenging. It is the right time to invest in facilities and skills to grab a potential of several million dollar business opportunity," exhorted Bonal.

Prasad is also upbeat about the segment and said that the potential for the future growth of aerospace sector is abundant both in private and public sectors. "India will be one of the major gateways in the aerospace engineering and production," asserted Prasad. He further

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Fateh Singh, GM & head, Aerospace Div, BFW

said that the production to support new commercial aircraft designs is just ramping up now and demand in military is also growing. "This simultaneous upturn is the first in decades and is providing a strong boost to primes. This boost is expanding globally as production from traditional primes such as Boeing and Airbus reaches new markets. Global aerospace manufacturing is forecasted to remain healthy through 2010," Prasad said.

In a nutshell, it can be said that if things go in the right direction, aerospace industry will contribute significantly to the growth of the Indian manufacturing sector. **MMT**