RISING TRENDS & FUTURE GROWTH OF MRO

The aviation and aerospace industry are constantly evolving and the Maintenance, Repair and Overhaul (MRO) sector too is gearing up to meet the robust demand. Notably, the Asia Pacific region will see a huge growth with a delivery order of 3,500 new aircrafts by 2023. The Asia Pacific MRO market is expected to average 6 percent annual growth and reach US$32.2 billion (approx. S$44.3 billion) by 2025. With these promising developments let's take a look at what the future will look like for the MRO industry.

UPCOMING TRENDS

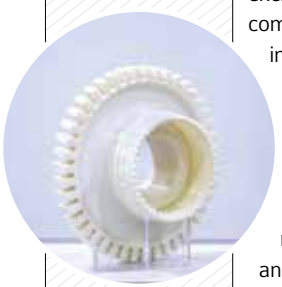
The Oliver Wyman's 2015 MRO Survey noted that as the delivery of next generation aircraft and engines outfitted with new technologies and services is due, new business models will emerge and change how the industry works, cutting or redistributing industry revenue by up to 20 percent, or US$15 billion (approx. S$20.7 billion).

With many airlines announcing fleet modernisation and cabin refurbishment plans in the coming years, the OEMs and MRO providers are faced with new challenges in repair technologies, life-cycle management, maintenance planning, data application and inventory management among others.

As of recent years, additive manufacturing or 3D-printing is rapidly being adopted to reduce material costs, decrease labour content and increase availability of parts at point of use.

In April 2016, GE Aviation inaugurated testing of the world's largest jet engine with several unique technologies and advanced material in the core including a 3D printed fuel nozzle tip, a new combustor dome design as well as an ultra-lightweight, heat-resistant ceramic matrix composite (CMC) inner and outer liners.

The 3D printed nozzles is 25 percent lighter and still as strong as existing nozzles but the advantage of being lighter means less fuel consumption and monetary savings for airlines that incorporate the GE9X engine into their planes. Besides the weight-saving, the nozzles can also be manufactured at a much faster rate and with less waste than traditional nozzles, which required GE to weld up to 20 smaller pieces to form the final product.



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Pratt & Whitney's product solutions

The GE9X can produce up to 100,000 pounds of thrust and will be the primary engine for Boeing's next generation 777X jet. The engine is scheduled to enter service in 2020 with more than 700 engines collectively worth US$29 billion (approx. S$40 billion) already on order with airlines like Emirates, Lufthansa, Etihad Airways, Qatar Airways and Cathay Pacific planning to add the 777X jet and GE9X jet engine to their fleet of aircraft.

INNOVATIONS & ROBOTICS

Innovation has also become a buzzword among many MROs, airlines and small enterprises as they find ways to expand their capabilities. Lufthansa Technik currently has a total of 210 employees dedicated exclusively to innovation and the company is increasing its investment in innovations to US$200 million (approx. S$310 million) for the period up to 2018.

On the local front, GE Aviation Engine Services-Singapore plans to invest S$110 million in new technologies and capabilities over the next 10 years. The investment will fund several projects including research and development on innovative processes as well as new robotic technologies to match the advanced materials suite in new generation engines such as the CFM Leap, GEnx and GE9X. The robotic arms will help the Singapore and other GE repair sites to cope with the increasing volume of work.

SIA Engineering Company (SIAEC) also plans to invest up to S$50 million over the next few years on innovation initiatives and technology adoption projects in aerospace MRO with the support of Singapore's Economic Development Board (EDB). Among the key areas that SIAEC will explore include additive manufacturing, robotics and data analytics.

"We are investing for the future by identifying and gaining competencies in emerging technologies that will be an integral part of the MRO industry in the next 10 years," said Mr Png Kim Chiang, Chief Executive Officer of SIAEC.

A Dutch industry expert, Mr Paul van IJsselstein, CEO of Stratagem Group believes that robotics or automation is an essential part of the disruptive innovation in the MRO industry. This new technology will result in new business and cost models, more efficient hangar operations and organisation, and higher predictability on quality.

New developments will include approved repair methods for primary composite structures, new non-destructive inspection technologies for large scale (automated) inspection and new surface treatment methods that can replace the conventional abrasive and chemical stripping (de-painting) processes. It is an innovation that can deal with the increasing use of large composite structures in aircraft design. A large scale introduction of automated process will result in significant reduction of manpower, more acceptable labour conditions, a clean work floor, more efficient use of hangar space and a reduced Co^2 footprint.

"A global introduction of robotic solutions will allow rapid MRO capability development in emerging countries that traditionally does not possess a large skilled workforce," said Paul. He shares that robotic solutions should lead to more insourcing rather than outsourcing of work with an enhanced employment through stimulation of local or in-house capability development along with improved profitability, competitiveness and corporate social responsibility.

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The GE9X will be the primary engine for Boeing's next generation 777X jet

ADVANCEMENT OF COMPOSITES AND REPAIRS

The performance of future aircraft is expected to be further enhanced with greater adoption of lighter materials such as carbon fibre composites.

Composite materials are increasingly being used in many sectors replacing conventional materials in applications that require high strength yet remain lightweight and corrosion resistance. In the face of such requirements, aviation and aerospace companies have begun looking at developing engine components from CMC.

CMC can be made as strong as metal, yet much lighter in weight and can withstand much higher temperatures. CMC can also help lower fuel burn and emissions, while increasing the efficiency of future aircraft engine platforms. The benefits are undeniable but the implementation does come with challenges such as high costs and long lead times in production and machining.

As with new materials, new aircraft built largely of composites and supermetal alloys, will need to be maintained differently than their predecessors. This would require the MROs to address issues involving equipment and technology, as well as those for composite parts inspections, layup and the more innovative machining methods needed. New generation airplanes will also generate a large amount of component performance and health monitoring data, of which data-management technology will be of utmost importance.

MRO companies will need to look into R&D in areas such as engine shops and composite airframe MROs as the next generation platforms require much higher proficiencies in avionics and electrical understanding. A key sector that will benefit from continuous R&D is surface and stress-fracture repair work which will continue to see major changes. Advancements in non-destructive testing methods will

> "A GLOBAL INTRODUCTION OF ROBOTIC SOLUTIONS WILL ALLOW RAPID MRO CAPABILITY DEVELOPMENT IN EMERGING COUNTRIES..."

help identify where repair technology R&D should be focused on.

The introduction of a relatively new cold spray method for dimensional restoration and corrosion repair of engine components is also gaining traction. Cold spray is a solid-state coating process using a high-speed gas jet to accelerate powder particles at a supersonic speed on a substrate.

In the area of welding technologies, Pratt & Whitney has been looking into dimensional restoration and one of its findings is set to replace tungsten inert gas (TIG) welding. This reduces the time normally involved with the TIG welding process by as much as 75 percent and is applicable to a wide range of non-structural parts where TIG welding is applied.

At the newly launched Pratt & Whitney manufacturing plant in Seletar Aerospace Park, the company will perform a comprehensive variety of engine component repairs. It will also be producing its innovative hybrid metallic fan blades and critical turbine rotating components in addition to creating additional manufacturing capacity and capability for its PurePower engine family.

MAINTENANCE AND MOBILITY

With the advancement of equipment and production, a major challenge for aviation companies is to ensure that the application or methods to inspect their critical assets are as up-to-date as the new technologies themselves. Boeing predicts that the aviation industry will need 609,000 new maintenance technicians over the next 20 years. Hence, the support for digital technology and training developments will be useful in addressing this.

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"An experienced workforce that can meet the MRO needs of the future is essential for the continued health of the sector. New training methods that will appeal to a younger generation of technicians should make extensive use of virtual maintenance training (VMT) and developments such as serious gaming, augmented reality and intuitive (haptic) devices," shared Paul.

He opined that the introduction of VMT, will help overcome some of the problems of classroom-based training, such as lack of sufficient practical training environment and the availability of training experts. The use of VMT results in a continued learning environment and the capability of remote access to training content.

In addition to training, new IT solutions such as advanced sensor technology and intelligent data analysis systems are leading the change in this industry. According to SITA, 75 percent of airlines will be increasing their spending on new IT solutions to optimise their costs and spare part procurement processes.

In the emerging Industry 4.0 environment, Big Data forms a large chunk of the new technology where machines, components and workpieces are digitally integrated to enable it to 'communicate' with one another. Factory operators can then analyse and predict the optimal point to initiate maintenance. This new approach known as predictive maintenance or PdM will pinpoint impending outages before they occur, speed up overhaul processes and avoid production outages.

A recent study by the World Economic Forum and the consulting firm Accenture found that PdM can reduce the cost of planned repairs by 12 percent, cut maintenance costs by almost 30 percent and reduce unscheduled downtime by a massive 70 percent.

While Big Data and pattern detection are making predictive maintenance possible, wearable tech, smart glasses, voice technology and augmented reality applications will substantially simplify MRO work processes. Autonomous equipment such as UAVs and robotics are also beginning to gain popularity in maintenance processes especially in aircraft health-monitoring systems. Applications of new technologies is expected to reduce maintenance delays and unexpected downtime which reportedly costs the airline industry an estimated US$8 billion per year.

A point of interest is the role of mobile technology and how it will affect the workflow within the MRO industry. The integration of mobile apps into a full Information System (IS) across all operations will see maintenance 'at-the-asset' providing the crews with instant access to relevant information at the time of need. A new generation of mobile devices can be installed with apps that are targeted toward maximising effectiveness, minimising user overhead and avoiding complexity in the operating environment.