
FEATURE

AERO



Photo credit: Rolls-Royce



INNOVATION IN SPACE

A SINGAPORE PERSPECTIVE

With a number of Asia-Pacific countries demonstrating a strong desire to increase their presence in the regional aircraft maintenance, repair, and overhaul market, aerospace companies here are spearheading efforts to boost local innovation and training to maintain Singapore's leading market position.



Singapore has grown to host one of the largest, most comprehensive concentrations of aerospace companies in Asia. With over 130 companies in the sector employing more than 20,000 employees, the industry here accounts for a quarter of the maintenance, repair, and overhaul (MRO) market in the Asia-Pacific. It is well-positioned to capitalise on the robust demand for air travel and freight that underpins global economic growth.

Aerospace giants Airbus and Boeing anticipate that the global aircraft fleet size will double over the next two decades, with the region accounting for over a third of international aircraft deliveries. Regional aircraft fleets are also expected to account for 37 percent of the global fleet by 2034, according to the Singapore Economic Development Board (EDB).

Companies which *Aerospace Singapore* spoke to have unanimously agreed that the country can maintain its competitiveness by staying responsive to evolving customer requirements, focusing on

ABOVE:
Singapore is the regional leader in MRO services and is investing in innovation and technology to support new aircraft types.

increasing the breadth and depth of services, embracing innovation and digital transformation.

NATIONAL IMPERATIVES

Cognisant of industry's need to innovate constantly to keep its competitive edge, the Singapore government launched the national Research, Innovation & Enterprise 2020 (RIE2020) plan in 2016, which will invest a record S\$19 billion in research and development (R&D) by 2020. The aerospace industry is one

of the eight targets for funding under the plan's Advanced Manufacturing and Engineering domain.

Already past the halfway mark, RIE2020 nurtures an ecosystem that enables research outcomes to be effectively translated into products, processes and services. To realise this goal, the government has offered a diverse range of funding opportunities to industry and start-ups to develop new ideas and bring them to the market.

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These include the Individual Research Grants (IRG), which investigate novel concepts across the research ecosystem, the Programmatic Funds which seed long-term capabilities for future industry readiness, and the Industry Alignment Fund Prepositioning Programmes and Industry Collaboration Projects that aim to mature industry-ready capabilities within a three-to five-year timeframe, and support R&D efforts between industry and public sector.

Underscoring the importance of the Aerospace sector, the Singapore government launched the Aerospace Transformation Map in January 2018. Developed in collaboration with industry partners, unions and trade associations, the masterplan provides directional guidance for development of the industry. It proposes three focus areas for industry transformation: operational excellence, technology innovation, and workforce development. It also outlines a new basis for competitiveness, based on deployment of technologies such as digitalisation, data analytics, the industrial internet-of-things (IIoT), and additive manufacturing.

“The global aerospace industry is characterized by safety regulation and safety management and Singapore’s strength is that it is



ABOVE RIGHT: Rolls-Royce works closely with top universities and government agencies to promote innovative R&D in the Asia-Pacific region through private and public partnerships.

BELOW: Skills training is a focus area of the Aerospace Industry Transformation Map, which will support the creation of higher-value jobs.



ideally positioned in both,” Mr Derek Sharples, former Chief Executive Officer of Airbus Helicopters South East Asia and a member of the AAIS Panel of Experts, told *Aerospace Singapore*.

“The aerospace and air transport sectors are high-growth, with the Asia-Pacific set to become the world’s largest market for commercial air transport, general aviation, aircraft deliveries, MRO and training over the next 10 years,” said Mr Sharples. “There are significant investment opportunities outside Singapore for Singaporean companies to take positions in this future; encouraging overseas investment could be a key axis for internationalization allowing Singapore to be a key player in this exciting future.

BOOSTING INNOVATION

Professor Tan Sze Wee, Executive Director of the Science & Engineering Research Council at the Agency for Science, Technology and Research (A*STAR) noted that Singapore had historically competed for maintenance, repair, and overhaul (MRO) work on productivity and cost. However, as competition heats up, the Singapore

government is investing significant resources to move its aerospace industry up the value chain, reinforcing existing strengths in MRO with R&D and advanced manufacturing.

For example, A*STAR launched its Advanced Remanufacturing and Technology Centre (ARTC) in a public-private venture with Nanyang Technological University and industry players in 2015. The ARTC develops and deploys the latest digital manufacturing processes and technologies to return worn or end-of-life components to like-new or better performance.

In September 2017, the centre launched a Smart Manufacturing Joint Laboratory involving A*STAR, Rolls-Royce and Singapore Aero Engine Services Private Limited (SAESL). This project will invest up to S\$60 million over a five-year span to develop cutting-edge manufacturing technologies such as, additive manufacturing of complex aero-engine components, and advanced robotic and automation solutions.

ARTC’s Model Factory and other capabilities of A*STAR will be used to test-bed these new technology applications for the aerospace industry. These

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technologies will eventually be used on-site at Rolls-Royce and SAESL's facilities.

Aircraft engine specialist Pratt & Whitney (P&W) has also launched several initiatives to enhance its local operations, Mr Brendon McWilliam, senior director, Aftermarket Operations – Asia Pacific at P&W, and executive sponsor of the Singapore Operations Council for United Technologies Corporation, told *Aerospace Singapore*.

In February 2018, P&W announced an increase in production at its first advanced manufacturing facility in Singapore. The facility produces fan blades and high-pressure turbine discs for its Geared Turbofan (GTF) engine family. It uses adaptive machining and cutting-edge automated inspection systems, as well as the latest advanced manufacturing tools and processes. For example, the facility is equipped with customised intelligent milling machines with automated compensation to reduce high-pressure turbine disc production time by as much as 60 hours per piece.

RIGHT: Pratt & Whitney has developed an extensive range of education and training programmes to improve the effectiveness of its workforce.

BELOW: Digital technologies such as data analytics are expected to transform SIA Engineering Company's operations.

Photo credit: Pratt & Whitney



"Singapore has a very conducive environment for R&D, as exemplified by the establishment of many innovation centres from top players in various industries here," Mr McWilliam said.

"We have actively encouraged and promoted our teams here to develop innovative solutions that raise productivity and address technology challenges," he added. "This has resulted in innovations that have made it to many of our facilities around the world, and is a testament to the Singapore workers' ability to develop new processes and technology to meet the challenges of today."

Meanwhile, SIA Engineering Company Limited (SIAEC) is banking on emerging technologies such as additive manufacturing, robotics and data analytics to support technology adoption projects with airlines, research institutions and technology partners. This is part of its S\$50 million effort to develop new innovations and solutions to meet future airline MRO requirements.

SIAEC's new joint venture with Strasys, Additive Flight Solutions, will produce 3D-printed parts for use in commercial aviation. The company will offer design, engineering, certification support, and parts production to its global customer base. This includes the production of plastic aircraft cabin

interior parts for airlines and tooling for MRO providers and original equipment manufacturers (OEMs). SIAEC is also the first MRO provider to obtain the Civil Aviation Authority of Singapore's (CAAS) approval for the design and production of 3D-printed parts.

The company is also harnessing the creativity of future talent being groomed in Singapore's aerospace education and research institutions. One such example is the student-led Air Leakage Detection System concept being commercialised for SIAEC and ST Aerospace Services Co (SASCO) by Republic Polytechnic. This innovative concept aims to develop a faster and safer method to detect cabin air leaks by combining audio, visual, and infrared analysis. This minimises the number of aircraft cabin pressurisation and depressurisation cycles, which are time and resource intensive and exposes workers to safety risks. The project has been conceptually proven to reduce maintenance man-hours by 12 percent with an 8 percent reduction in cost, potentially leading to improved turnaround at MRO centres if successfully implemented.

ST Engineering Aerospace is enhancing its global MRO operations with its Smart MRO initiative. This aims to deploy revolutionary digital technologies in



Photo credit: SIA Engineering Company Limited

the factory environment to replace traditional operating methods and processes. The initiative includes emerging solutions such as additive manufacturing, augmented reality (AR) tools, collaborative robotics and data analytics to speed turnaround times and help maintain competitiveness. For example, AR glasses will improve the efficiency and safety of aircraft maintenance operations and training. These will provide aircraft technicians with critical information such as maintenance records or assembly and repair instructions. The benefits include time savings and a reduced likelihood of human error. In the future, customers will have access to real-time status updates on equipment under repair and maintenance, parts inventory by 'just-in-time' 3D printing of components, and the ability to streamline their operations using predictive analytics solutions.

OVERCOMING CHALLENGES

Aerospace innovation involves extensive collaboration between industry and researchers, and costly investments that can span years without guarantee of success. In many cases, MRO service providers also need to work closely with OEMs and airworthiness authorities in order to have their innovations approved and certified.

"[Nevertheless], innovation is essential even for procedures- and regulation-compliant minded aviation companies in the Industry 4.0 era. They have to be highly dependent on technology, to remain relevant in an increasingly competitive market," Mr Lim Tau Fuie, Chief Technology Officer at ST Engineering Aerospace, told

Aerospace Singapore. He noted that robust risk measures put in place enable the company to trial new ideas and processes safely and enable quick deployment should they prove successful. These measures prescribe how new technologies are to be matured under laboratory and controlled environments before implementing them into real-world applications.

"Public-private collaboration between research institutions and the aerospace industry also mitigates risk by enabling industry players to tap on research expertise to speed up the development of new concepts or technologies. Such collaboration is underpinned by the

strong support of the Singapore government with platforms such as RIE2020 and the Aerospace Transformation Map," he added.

It is no wonder that Singapore has the endorsement of industry veterans and observers. "Singapore is an ideal location for external research and technology development," said Mr Sharples. "There are some signs that multinational corporations are exporting some R&D activities to Singapore and this should be encouraged; particularly aftermarket product and services research and development where Singapore is well-placed to act as a spring board to other locations in Asia." ^{AS}

BELOW:
ST Engineering Aerospace is leveraging emerging technologies such as augmented reality and data analytics to cement its pole position in global aircraft MRO.

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... INNOVATION IS ESSENTIAL EVEN FOR PROCEDURES- AND REGULATION-COMPLIANT MINDED AVIATION COMPANIES IN THE INDUSTRY 4.0 ERA.

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Photo credit: ST Engineering Aerospace