VORTEX

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SATEC 2018

Shaping Aerospace Through Innovation

Robin Viva Thevathasan
Asst. Hon Secretary, SIAE

As with several other industries, aerospace is going through unprecedented changes. At the heart of much of this is the way that new technologies are impacting the way that aerospace engineering and operations are undertaken.

For several years now, Singapore Institute of Aerospace Engineers (SIAE) has organised the biennial Singapore Aerospace Technology and Engineering Conference (SATEC). In conjunction with the 2018 Singapore Airshow and RSAF 50, the next SATEC (the 8th) will again be co-organised with RSAF Air Engineering & Logistics Department (AELD) at the Suntec Convention Centre on Wednesday 7th February 2018.

SATEC has been evolving over the years to become the premier aviation technology and engineering conference, a platform for researchers, operators, practising engineers and technologists to share and discuss the latest and key developments in this dynamic industry.

Taking its cue from Singapore's SMART Nation initiative, SATEC 2018 has adopted as its theme ***"Shaping Aerospace Through Innovation"***. This will involve how innovative use of technology and engineering will go a significant way towards fuelling the changes and addressing the challenges in the industry.

The organising committee, consisting of representatives from SIAE and RSAF AELD, have a challenging time reviewing through the many excellent technical papers which came as a result of the call for papers sent out late last year. What has come out of it is the best SATEC programme ever.

Featuring a whole-day programme, the conference has attracted speakers and representatives from some of the world's leading and eminent aviation organisations, as well as a regional audience of industry practitioners and military personnel.

Our Guest of Honour for SATEC 2018 will be **Mr Neo Kian Hong**, ***Permanent Secretary (Defence Development) of the Ministry of Defence, Singapore.*** He will be giving the Keynote Address.

Representing three of the most important centres of aerospace technology, we will then have Distinguished Guest Speakers from France, the United Kingdom and the USA:
- **IGA Caroline Laurent,** ***Director, Strategy Directorate, DGA, France***
- **Sir Stephen Dalton,** ***President, Royal Aeronautical Society, UK***
- **Mr. Carl E Burleson,** ***Acting FAA Deputy Administrator, Federal Aviation Administration***

The morning session will be rounded off by a presentation by three plenary speakers, each representing leading and innovative organisations:
- **Dr Peter Weckesser,** ***Head of Digital Transformation Office, Airbus Defence and Space***
- **Dr Alan H Epstein,** ***Vice President, Pratt & Whitney***
- **Mr Timothy Yap,** ***Deputy Head of Air Engineering & Logistics, RSAF***

In the afternoon, 5 tracks concurrent of breakout sessions will be held:
Track 1: Structures and Mechanical Systems – academics and practitioners will speak on subjects as varied as the efficiency of paint and coatings to the smart restoration of defects in composite aerostructures.

Track 2: UAV/Aerodynamics – this is a "hot" topic and researchers from Singapore and UK as well as from further afield will address some of the many issues around this.

Track 3: Propulsion – representatives from engine OEMS as well as academics will share their views on various innovative ideas from digital transformation through to additive technologies.

Track 4: Mission Systems/Virtual Training – not just the domain of the military, this is nonetheless an important topic for airspace-constrained Singapore.

Track 5: Innovation and Applicable Technology – speakers from large companies (Airbus, ST Engineering) as well as technology development ones (A*Star, GVH Aerospace) will give us a glimpse of exciting things on the horizon or even closer!

Contents

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Event Details

Date: 7 **February 2018**
Venue: **Suntec Singapore Convention & Exhibition Centre**
For more details, visit ***siae.org.sg/satec-2018/***

Schedule at a Glance

Time	Activity
7:50am	Registration
8:20am	Guests to be seated
8:30am	Welcome Address • **Head Air Engineering & Logistics** *(HAEL)* • **Mr. Lim Yeow Khee,** *President of SIAE*
8:40am	Keynote Address by GOH • **Mr. Neo Kian Hong** *Permanent Secretary (Defence Development), Ministry of Defence, Singapore*
9:10am	Speech by Distinguished Guest Speaker • **IGA Caroline Laurent** *Director, Strategy Directorate, DGA France*
9:35am	Speech by Distinguished Guest Speaker • **Sir Stephen Dalton** *President, Royal Aeronautical Society*
10am	Tea Break
10:30am	Speech by Distinguished Guest Speaker • **Mr. Carl E Burleson** *Acting FAA Deputy Administrator, Federal Aviation Administration*
10:50am	Presentation by Plenary Speakers • **Dr. Peter Weckesser,** *Head of Digital Transformation Office, Airbus Defence and Space* • **Dr. Alan H. Epstein,** *Vice President, Pratt & Whitney* • **Mr. Timothy Yap Soon Haw,** *Deputy Head of Air Engineering & Logistics, RSAF*
11:50am	**Q & A**
12:20pm	Lunch Break
1:30pm - 4:30pm	**Afternoon Breakout Sessions** • *Structures and Mechanical Systems* • *UAV/Aerodynamics* • *Propulsion* • *Mission Systems/Virtual Training* • *Innovation and Applicable Technology*

Dear Fellow SIAE Members,

It is with enthusiasm that I greet you a Happy New Year for 2018. While the weather in Singapore is cooler than normal, our activities in SIAE will be warmer than usual. This is the year of the Singapore Airshow. The aviation community will be bustling with activities and so will SIAE. We have a new Exco Committee working for you since mid-2017 and they have planned a slew of activities for our members. First, we will be jointly hosting the Singapore Aerospace and Engineering Technology Conference (SATEC) with the Republic of Singapore Air Force. Next we are participating in the AeroCampus at the Airshow site to promote aerospace as a career to students. More activities are in progress but what I consider particularly important is this new issue of the SIAE Newsletter which has been inactive for some time due to other commitments. While we have an active website, nothing beats a hardcopy to read about happenings in the industry and interesting technical developments. So we hope you will find this rejuvenated SIAE Newsletter interesting and if you do have suggestions on how to make this publication more attractive, do drop us a line at 82275291 and let us know.

Happy reading!

P.S. -- We would like to take this opportunity to wish our Chinese SIAE members a Prosperous and Joyous Lunar New Year.

Chow Kok Wah
Editor, SIAE Newsletter

VORTEX

President's Message

Lim Yeow Khee
President, Academic Chair (Hon), ATTC

The launch of *Vortex* is an important juncture in our continuing efforts to rejuvenate SIAE to stay relevant in the coming years. The key to an effective organisation is communication and *Vortex* will represent a critical channel for us to reach out to our members, industry and potential NGAP.

The last four years have been very difficult as we struggled to re-build *SIAE* with a new mission to reach out to potential NGAP. The impetus to push hard on education and training came when ATTC was given the opportunity to build a campus in *Seletar Aerospace Park*. It was a monstrous task as we did not have the money nor expertise to embark on a building project which came to about S$8 million.

ATTC management contracted the project to Cambridge Trust which completed the project in Nov 2012. The new *Seletar Aerospace Training Complex (SATC)*, as the campus is now known, was officially opened by then Acting Minister of Manpower, Mr Tan Chuan Jin on 22 May 2013.

The new campus created a ***crisis*** – loosely in Chinese terms (危机 Wéijī), it indicates *danger* and *opportunities*. Danger because the cost of operating SATC comes to more than a million dollars per year - 25% of the total operating cost. Opportunities also abound to remodel our operation with our unique hangar, workshop facilities and lecturers and trainers with decades of experience working on aircraft.

We have learnt to live with the danger and the challenge today is to turn opportunities to revenue. We did drastic changes to integrate SIAE and ATTC operations and last year, we created *SIAE Consultant* to tap on the expertise of our membership.

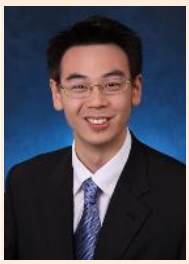
I thank the Editorial Committee for their brave initiative to launch *Vortex*. With passion and dedication, Vortex will provide the power we needed badly to push our transformation of SIAE and ATTC.

I wish all members and readers a Happy and Prosperous 2018!

Lim Yeow Khee *BBM Hon F.SIAE, FRAeS, A/Prof (Adj) NTU, Adult Education Fellow (IAL SG)*
President, SIAE

New Executive Committee

Tan Chu Hiang
1st VP, CEO, HMSS



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Simon Wayne
Member, General Manager, Bombardier

Orbituary

US astronaut John Young passed on at 87 on 05 Jan 2018. He was the first astronaut to have flown 6 times to space and one of only 12 humans to walk on the moon. John was in Singapore attending our Asean Airshow in the 1990's and visited SIAE office. He gave us a commemorative plaque.

John Young was an aeronautical engineer. He was US Navy test pilot before joining NASA proceeding to a distinguished 42 years space career spanning the Gemini, Apollo and Space Shuttle programmes. He commanded NASA's first space Shuttle flight in 1981. Members of the Aerospace community mourn the loss of this accomplished astronaut. His legacy will live on as we take comfort that his achievements have inspired many students to pursue aeronautical engineering leading to outstanding careers.

MRO

Grooming the Next Generation of Aviation Professionals

Lim Yeow Khee
President, SIAE

Aviation is a complex industry which is uniquely labour intensive, technology oriented and high capital. And because of its unforgiving nature, it is termed a high consequence industry where weaknesses in any part of the chain of complex processes can have disastrous consequences. Hence, aviation workers need be specially trained and groomed to understand this unique and critical nature of aviation to ensure safe flight for everyone.

SIAE has a mission to build an aviation culture for our NGAP to grow. Together with ATTC and SIAE Consultant, we will be developing courses to groom NGAP to be proficient in their work and activities to prepare potential NGAP for their exciting and fulfilling careers in aviation. In the first of our series of courses, Prof Lim describes the nature and objectives of the course for executives in MRO.

Executive Introduction to MRO

MRO represents 80% of Singapore's aerospace industry output. It will continue to be a major contributor in the coming years. Each year, new people joined the MRO sector as technicians, engineers, executives and managers. In the past, MRO activities were managed by airlines and the division of labour was clear. MRO is a now stand-alone business requiring multi-discipline knowledge and experience to operate and manage effectively.

The course is designed to give participants an overall view of MRO operation and the principle of maintenance to ensure effective use of the key asset of air transport – the aircraft. Participants will learn about aircraft maintenance philosophy, airworthiness control, maintenance programs and how MRO facilities are organised.

The lecturer will share his experience in development of processes and systems used in MRO operation over each generation of commercial aircraft. The challenge of decision making in an environment of conflicting requirements of economics, safety and reliability will be discussed.

Course Structure and Schedule

The course consists of 6 hours of lectures and a 3-hour forum discussion with experts on aircraft maintenance, conducted over one and a half days as follows:
Day 1: 0900 – 1200h Lectures
Day 2: 0900 – 1200h Lectures
1200 – 1500h Lunchtime forum – (Lunch provided)

To make it easy for busy executives to attend, 8 courses will be scheduled from Mar to Oct 2018, with one course in each month. Participant may attend any part in any of the courses and a Certificate of Attendance will be issues on completion of the whole program.

Who should attend?

Specialists and managers in airlines, MRO companies, government agencies and aerospace related businesses.

Course Facilitator
Prof Lim Yeow Khee *BBM*
Hon FSIAE, FRAeS, A/Prof (Adj) NTU
Adult Education Fellow, IAL SG

Prof Lim hold BSc (Hon) Degree in Engineering (Leeds, UK, 1977), Diploma in Electrical Engineering (Singapore Polytechnic, 1973) and AME Licence B2 (CAAS, 1972).

Current Occupation

MD LYK Aerospace (S) Pte Ltd
President, SIAE
Academic Chair (Honorary) ATTC
A/Prof (Adj) MAE - NTU

Professional Experience

Started aviation career as Apprentice AME with Malaysia-Singapore Airlines (1968) and continued with the airline, which became Singapore Airlines (SIA) in 1972, until retirement in Dec 2006.

Worked in technical and management positions in Singapore Airlines and SIA Engineering Company covering Base Maintenance, Technical Services, Workshops, Technical Projects, Inflight Entertainment, Line Maintenance, Quality & Safety and Productivity & Engineering Training.

Responsible for the technical development of the world's first global airborne satellite telephone system operated by SIA and its early Inflight Entertainment system. Actively involved in the introduction of ATE (Automatic Test Equipment) in SIA Avionics Workshop in 1981 through 1994.

Subject Specialty

Air Transport Engineering, MRO operation and processes, Avionics Systems, Human Factors, Safety Management Systems, Quality and Reliability Engineering.

Research Interest & Publications

Human Factors in Aircraft Maintenance and Training methodology.

Course Outline

- Safety, Quality & Reliability
- Airworthiness Control
- Maintenance Philosophy
- Regulatory & Licensing
- Maintenance Programme
- MRO Organisation
- MRO Cost Structure

The Future of Commercial Airline Travel

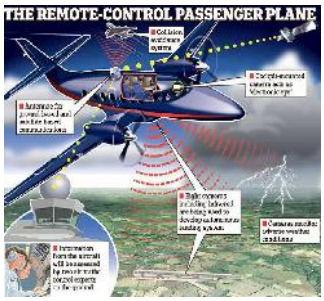
Alex Hale
Senior Instructor, ATTC

B707 Test Flight Crew

There was a time when flying a multi-engine passenger aircraft required a crew of five - Pilot, Co-pilot, Flight Engineer, Navigator and Radio Operator. Today, we are left with a crew of two operating a commercial airliner transporting hundreds of passengers across the globe. Advancements in automation has dissolved the cockpit crew from five to two. Eventually, will we even need pilots?

This norm may be overtaken by Drone robotics and Satellite Data link communication that will eventually rid the man-to-machine element required in flying a commercial airliner. We may end up with a remote pilot controlling the aircraft from his ground station or autonomously on set routes.

Imagine boarding a plane with no cockpit, no pilots and no cabin crew to serve you – the ultimate budget flight!



Drones have been used extensively by the US Military in Iraq and Afghanistan. They include the Global Hawk, MQ-1 Predator and the MQ9 Reaper. These are unmanned aerial vehicles (UAV), piloted either autonomously or by remote control, designed to observe or destroy enemy targets from the air with no crew on board.

This concept has been in existence since the mid-1990s. Northrop Grumman, Boeing and Lockheed Martin are all developing unmanned combat air systems (UCAS) fighter jets. Fighter pilots need not be physically in the aircraft but on ground, safe from being shot down and killed. A machine can be replaced but an experienced fighter pilot is priceless.

Boeing and Airbus are actively developing UAV technology for commercial aircraft. An airline can save US$35 billion a year in going pilotless - a sure-sell proposal for today's cash strapped airlines.

An autonomous aircraft does not have the peripheral acuity to identify nearby aircraft. Military UAVs are supported by network latency of less than half a second, because they are linked to their ground controllers' half a world away via an owned-and-operated satellite system supplemented by undersea cables. Current air-traffic control systems have not risen to that challenge yet. When it happens, safe pilotless passenger flights will be possible. All technical problems can be solved - as proven by the military, which has placed trust in automation to do things that few human pilots could do. For example, automatic landing systems used to land an airplane on a moving aircraft carrier or on airport runways rated with a similar system.

Pilotless commercial flight is overdue. The autopilot typically takes over flight minutes after takeoff and can land - pilots could literally "babysit" the aircraft during the transit to the destination.

Today's technology can use the auto flight systems, in conjunction with a quickly mobilized ground controller, to fly a plane to safety should something happen to both the pilot and the copilot.

Artificial Intelligence (AI) can help a robotic aircraft make decisions and learn to identity other aircraft and obstacles through its sensors and use standard algorithms to prevent collision.

A pilot provides comfort to the passengers, beyond flying the aircraft. Trusting computers to fly the aircraft may represent a formidable psychological barrier. However, the reality with man-machine collaboration in flight is quite different. Automation has caused human skills to wither, providing pilots with too much help, to a point of becoming dangerous. Pilots are hindering the capabilities of computers rather than helping it. Is it better to use humans alone, or computers alone, but not integrating their functions? We are clearly in a Catch-22 situation.

To win the public opinion, designers will have to exploit functions where pilots cannot do better than computers. The first change will be the role of the pilot from flying the aircraft to managing the flight computer. When this happens, we will see only one person in charge and he need not be in a cockpit. Fully autonomous commercial flights will become a reality when systems reliability and performance improved over time.

The technology for pilotless aircraft is here. In our next issue of Vortex, Part 2 of this article on The Future of Air Travel will discuss the social, economic and psychological aspects of autonomous flying.

Decompression prompted greater use of composites

Teo Xinyi
Imperial College London

On 4 Jan 2014, Singapore Airlines SQ317 en-route from London to Singapore encountered a loud noise from one of its passenger doors shortly into the flight. Amidst fear of decompression, coupled with a cabin pressure warning, the flight crew performed an emergency landing at Azerbaijan. This incident brought into question the vulnerability of the pressurisation system in modern aircraft. The development of the pressurised cabin has revolutionise air travel, contributing to the boom in commercial air travel since the 1950s.

Conditions at airliners' operational altitudes are deadly for humans. Hypoxia and altitude sickness will pose a threat to passengers and they will also be exposed to temperatures as low as -60^{0}C. Cabin pressurisation allows the aircraft to travel at higher altitudes while ensuring the safety and comfort of the passengers. It enables the aircraft to take advantage of the less dense air in the stratosphere, resulting in less parasitic drag on the aircraft and thus greater efficiency. It also allows the aircraft to cruise above the turbulent lower atmosphere, improving its aerodynamic efficiency.

Cabin pressure is typically maintained, through an intricate series of engine bleed air to maintain a cabin altitude of between 6,000 to 8,000 feet for the comfort of passengers. An aircraft cabin is like a pressure vessel. Extra care must be taken in designing for surface discontinuities, and any lapses could potentially set the aircraft in a highly undesirable decompression state.

In the case of SQ317, subsequent investigations revealed fatigue fracture, which initiated from stress-concentrated rivet holes due to high cyclic loading of the coverplate. Essentially an extension of the door mechanism, the coverplate serves to fill the gap between the fuselage and upper edge of the door, preventing air leaks from the aircraft cabin to the external atmosphere.

The A380-800 aircraft, like most passenger aircraft, is installed with a plug door. Typically wedged-shape, the door is designed to capitalise on pressure differences to seal itself inflight. Contrary to popular belief, opening the aircraft door mid-flight is near impossible.

Problems relating to decompression are always treated with high priority. Hence, this incident of fatigue fracture has further encouraged more use of composite materials for different parts of the aircraft. Experimental validation of composite materials' superior resistance to fatigue compared to aluminium alloys has prompted designers to use composites for structural and flight controls parts. The main problem is the lack of experience on the failure modes of composites. While we have over 80 years of experience with metal on aircraft design, repair and operation, composite is relatively new. Extensive research is being carried out on failure modes and repairs of composites in recent years. Cracks due to fatigue stress like the incident of SQ317 have plagued the aviation industry since the Comet 4 days. Composites may be the solution.

Reports from our UK Correspondents

Jasper Ng
Imperial College London

'Engineering the UK's future success', an interactive talk led by Boeing Defence UK Managing Director, David Pitchforth on the 10 Oct 2017. This is part of the RAE's (Royal Academy of Engineering) View from the Top series, a platform featuring engineers and industrialists at the forefront of innovation, to enable them to share their viewpoints on key engineering issues.

Mr Pitchforth spoke on the challenges faced by the aviation industry. 'In 60 years' time, am I able to find a like-minded engineer, one who is able to share the same vision I have for the design of this aircraft?', Mr Pitchforth challenged the audience, while drawing everyone's attention to the Chinook helicopter model.

Sustainability of aircraft design vision aside, Mr Pitchforth got the audience thinking about how to inspire the future generations towards more than just science and math, but engineering a solution with all the theory.

One meaningful advice to college students was to closely follow their passion and interest when entering the industry, rather than dwell on remuneration benefits and political implications on career path. During the informal mingling session, we had the honour of meeting Richard Pillans, Boeing's chief test pilot.

A similar event, 'Gas Turbine Engineering – The Physics, and the Reasons we set the Engines up as we do', an exclusive lecture by Professor Jim Wickerson, Design Training Specialist at Rolls-Royce Derby UK was conducted at Imperial College on the 13 Oct 2017.

The Evolution of the Satellite Industry

Teo Kahhow

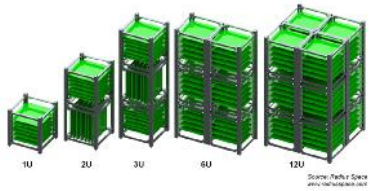
Traditionally, satellites have been large devices, tightly packed with various subsystems which work together to achieve missions in space. These satellites weigh in the range of thousands of kilograms and are huge, capable of reaching up to 30 m when solar panels are fully deployed. They require teams of specialists working in coordination to bring the satellite from design to launch.

Part of the complexity in building satellites may be attributed to the harsh environments of space and the difficulty of accessing satellites already in orbit for maintenance or repair. Outside of the Earth's magnetic field, satellites are exposed to high levels of radiation which can damage sensitive equipment on board. Moreover, depending on the orbit altitude, satellites may have to undergo cycles of extreme temperature fluctuations throughout its life. These are just some of the challenges faced by designers. To overcome such challenges, redundancies are built into the satellite, and prototypes are tested intensely to ensure functionality once in space. These activities drive up the costs of building a satellite which can easily reach hundreds of millions of dollars, without even accounting for the costs of launch and operation of the satellite.

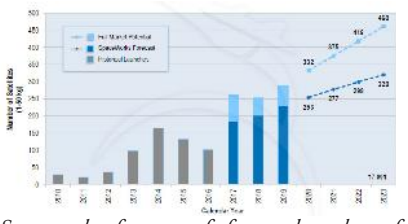
In the late 1980s, the launch of small satellites ushered in a new paradigm for the satellite industry. Satellites that were physically smaller were much less unwieldy and obviated the need for large facilities and equipment which drove down capital costs. Design lifetimes of small satellites were also reduced to 5 years, allowing the focus of test efforts to shift from component to system level.

Components were starting to be sourced commercially without having to only use space qualified parts. Redundancies were also reduced in favour of multifunctional systems with lower performance. The switch in development philosophy has allowed satellites to be developed at a much quicker pace, and at a much lower cost, which has lowered the barriers for other players to enter the industry.

Fast forward to today where this practice has been further refined and the costs of developing and launching a satellite have fallen even further. 3U cubesats have been estimated to cost just shy of $400,000 to be developed and launched – not exactly pocket change, but within the budgets of universities. As launch costs continue to fall with the entrants of new launch providers, small satellites are only going to become more accessible to interested parties. The boom of the small satellite industry is only just beginning, with SpaceWorks forecasting continuous growth over the next few years. Various missions are on-going, with prominent examples being maritime data collection by Spire Global and Internet providing services by the OneWeb constellation. There is no shortage of money-making opportunities, only limits on technological capability and the relevant expertise.



Size comparison of cubesat units - 1U is approx. 10cm3 and weighs 1kg



Spaceworks forecast of future launches of micro satellites

Currently, the production of satellites is a labour intensive process with touch labour taking up the bulk of the assembling, integration and testing tasks before the final product is qualified for flight. This contributes to the long lead times experienced in the delivery of the final product. With the need for more satellites in the future, some optimization of the production stage is required before production scaling can be done to meet the demands of the market.

Spacecraft specialists prepare satellites. Credits: NASA

Standardisation has consistently been the key to success in other industries when ramping up production. Yet the prevailing conditions surrounding space missions are such that there are as yet no definitive ways to standardise satellites. Every little detail of the satellite has to be designed carefully to cater to the mission. Both over and under-designing would hold significant influence on the final cost of the mission.

In the case of the OneWeb constellation, even though multiple identical satellites are being produced, the volume of production is barely high enough to justify the use of a fully automated production line. With the exception of fitting chips on electronic boards, touch labour may in fact continue to be cheaper in many aspects of production.

How then can the production process be improved such that the benefits can be reaped when developing satellites across a range of missions? To fully exploit the advantages offered by small satellites, new methods of production have to be explored, and this begins with identifying new strategies of production to reduce mission costs.

AVIATION SAFETY COMPETITION

Jia Wei Wei

Aviation Safety Competition(ASC) aims to reach out to schools, polytechnics, colleges and university students, generating interest in aviation and encourage them to consider careers in the aviation industry. It is in line with our mission to build an aviation culture for the Next Generation of Aviation Professionals.

ASC 2017, with the theme *"Maintenance for Air Safety"* is the third competition of the series. The program was launched in April 2017. Lectures on Aircraft Maintenance, Landing Gears Design & Maintenance, and Human Factors were conducted by industry experts, including senior practitioners of agencies involved in aviation safety, navigation and MRO. Participants have visited ***SIA Engineering Company, Jet Aviation, Safran Landing Systems Services Singapore*** and ***Eagle Services Asia*** to get a feel of real life aircraft and airport operations. Students in teams of 3 to 5 were given a scenario of airline operation for case analysis and presentation. The entire program culminated with a contest on October 2017, where a panel of judges selected 6 short-listed entries for the final presentation. The Award Ceremony was on 31 Oct 2017. More than 350 attendees have witnessed the success of winners.

WINNERS OF ASC 2017

Temasek Polytechnic (ASC 2017 First Prize, Category A)

Republic Polytechnic (ASC 2017 Second Prize, Category A)

Nanyang Technological University (ASC 2017 Third Prize, Category A)

ITE College Central (ASC 2017 First Prize, Category B)

ASC 2017 SPONSORS

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Nanyang Girls' High School (ASC 2017 Second Prize, Category B)

Hillgrove Secondary School (ASC 2017 Third Prize, Category B)

ASC 2017 Award Ceremony Guest-of-Honour Ms Low Yen Ling, Senior Parliamentary Secretary, MOE & MTI

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ASC 2017 Lecturers

Mr Lim Yeow Khee (SIAE)
Mr Ronald Pennington (Safran Landing)
Mr Geoffrey Grier (Airbus)

ASC 2017 Judges

Mr Gunter Emmerich (Airbus)
Mr Yip Ying Kiong (Eagle Services Asia)
Mr Tan Chu Hiang (Heavy Maintenance Singapore Services)
Prof Lim Kah Bin (National University of Singapore)

Can Mobile Technology Uplift MRO Productivity?

Chow Kok Wah
Honorary Secretary, SIAE

Productivity Tools

MROs often apply KAIZEN, LEAN and Six Sigma methodology to drive productivity. While effective in the manufacturing world where these tools originated, they do not provide the big productivity jump sought by the MROs.

MRO Shortcomings

One of the biggest bugbears of the airframe MRO industry is the handling of large amount of documents and spares. The C-check of a wide-body aircraft can involve thousands of job-cards, consumables and rotables. Hangar personnel endures the frustrations of dealing with missing job-cards, searching for critical spares, and guessing the status of work. Unlike manufacturing, MRO is not a sequential repetitive process. As defects are found, work is disrupted. Even after completion of the check, all documents must be retrieved, signed, stamped, checked and sorted. Unused spares must be returned to Stores. Compounding an already inefficient system is the current practice of performing multiple aircraft checks concurrently in the same hangar and personnel moved from one aircraft to another depending on urgency. The complexity has multiplied.

Engineering or Logistics?

One can argue that an MRO operation is as much a logistics operation as it is an engineering activity. While newer industries with even more complex logistics such as the courier and online shopping companies have overcome the complexities through digitization, MROs remain slow adopters of technology. To be fair, the courier and online shopping companies have one major advantage – volume. MRO activity on the other hand, is too varied.

Technology to the Rescue

MRO Enterprise Systems have been around for decades. Some of these are sophisticated enough to manage the full gamut of operation. But in hangar and line operation, the human-machine interface is still located in the operations room and is PC-based. Engineers have to constantly return to the operations room to update job-cards, read manuals, check spares availability and report progress. The ubiquitous paper job-cards seem indispensable. Many MROs still operate in this old-fashion way while the banks, online shops, even government departments have simplified workflow, progressed to cloud-based systems and adapted to mobile digital operation.

Missing Link -- Mobile Devices

What has become a major game-changer is the combination of the MRO enterprise system and the mobile devices. With this new tool, engineers working on the aircraft are now fully connected while located at the aircraft. The engineer will now be able to obtain information through these devices without walking back to the office. All job-cards will be digitally pushed to their devices and electronically signed by the engineer on job completion. All paper documents have been eliminated. There will be huge savings in back-end planning and paper handling. For the first time, hangar supervisors will be able to track progress real-time and allocate resources to where it is needed. Cost information is available live and invoices are accurate and available on check completion.

Safety Advantages

There are safety advantages too. When working on critical systems, cautionary and warning messages can be pushed to the mobile devices demanding the engineer's attention. Another advantage is the elimination of outdated paper or CD-version of Illustrated Parts Catalogs and Aircraft Maintenance Manuals. Only the latest version of these documents will be available in the system.

Technical/People Issues

For sure, there are technical issues to be resolved. A hangar made of metal structure will distort wifi and limits its range. But there are ways to overcome this. Hardwired wifi routers could be placed near the aircraft for maximum signal strength.

The mobile device is another issue. Should it be a large screen device like the ipad or a palm-size device like a Samsung mobile phone? How will the engineers carry these as they worked? Should the engineer own the device or it must be a company-issued tool? Can the device withstand the oil and hydraulic fluids in the work environment? How will the batteries be charged if it is a shared company device? Will the battery lasts a 8-hour shift?

Change management will be another issue. It will take effort to remove a system that is in use for decades. Then there is the issue of re-deploying the excess backroom employees to other duties. All these are valid considerations but not unsolvable.

Conclusion

As new MROs appear in Eastern Europe and Asia, the legacy MROs with their higher unit costs will have to change to remain relevant. But thanks to mobile technology and MRO enterprise system, they can stay competitive if there is a willingness to adopt technology.

SIAE Consultant

A new aerospace resource centre

Chen Pai
Head of Management Services, ATTC

As a resource centre for the Singapore aviation industry, Singapore Institute of Aerospace Engineers (SIAE) has been frequently approached by individuals, companies and government bodies to provide advisory services. To meet this demand, SIAE has incorporated its second subsidiary named SIAE Consultant Pte Ltd to further promote professional aerospace consultancy services to our clients and to extend our members' business and professional profile within their areas of expertise.

The debut of SIAE Consultant Ptd Ltd opens a grand new era for SIAE with the three entities in place by forming a stable 'Triangular' structure. SIAE is our aviation atmosphere which provides platforms and resources for our congenial partners. Air Transport Training College (ATTC) dedicates to continuous aviation education and training with equipped hangar facilities to our students and corporate clients. SIAE Consultant carries the mission to help local SMEs and foreign developing aerospace sector in the following fields:

1. Technical Solutions
2. Business Strategies and Organizational Restructuring
3. Process Improvement & Certification
4. Training Programme
5. Project Management

With all our members and partners together, there are bound to be wonderful aerospace games ahead of us.

On 31 Oct 2017, SIAE signed collaborative agreements with Chongqing on the development of aviation projects between China and Singapore. Upon this formalization of collaborations, SIAE would like to extend the opportunities to our corporate partners to join this promising project and expand your business operations through this platform.

SIAE will proactively explore any business collaborative opportunities from Chongqing government and their local companies to match your business model and benefit your operations profitably.

Strategically, SIAE invites our corporate partners to join this network by participating in the advisory committee for this initiative. The aim is to build up our Singapore Aviation brand with China's fast-growing aerospace industry and to benefit your local operations in Singapore.

SIAE & Chongqing Collaborations

Singapore and China have been working together for some time now in a series of projects to boost Chongqing's connectivity.

The agreements were inked between Singapore's Deputy Prime Minister Teo Chee Hean and China's Vice Premier Minister Zhang Gaoli. The partnership has been further enhanced after our Prime Minister' visit in Beijing. IE Singapore partners Chongqing's municipal government's CCIB (Chongqing Connectivity Initiative Bureau) to enhance municipality's transport links from Chongqing to the rest of China and beyond. SIAE has been in contact with CCIB which is tasked with developing various industries in Chongqing including aviation. Recently CCIB has brought various aerospace groups such as airport development, aviation education and air cargo logistics delegations to visit SIAE and ATTC at our premises in Seletar.

As part of the strategic overview, Chongqing is proposing to develop its next aerospace industrial park in one of its districts called Liang Jiang District. This aerospace industrial park at Liang Jiang will be very similar to what we have at Singapore, which is our Seletar Aerospace Park. SIAE, being the leading aerospace institute in Singapore, is engaged by CCIB to help Liang Jiang to build its aerospace industrial park with our resources and expertise in the aviation sector.

On 31 Oct 2017, CCIB and Liang Jiang visited our facilities at Seletar again and officially formed the collaborative relationship with SIAE by signing a collaborative agreement with the witness of more than 300 guests during ***SIAE Aviation Safety Competition & ATTC Graduation Ceremony***. As the first initiative for SIAE Consultant, the collaborative agreement is to help CCIB and Liangjiang establish an aerospace eco-system and to expedite their pace on aviation education in Chongqing.

Mr. Lim Yeow Khee (second from the right), President of SIAE, signing collaborative agreements with Chongqing Liangjiang New Area Committee on 31 Oct 2017.

SIAE is pleased to share our resources to help Chongqing build its infrastructure just like how our Singapore aviation industry took off 45 years ago. We believe the collaborations with Chongqing China will benefit our Singapore aviation community to the same extent.

Crayons to Perfume

Carol Cheng

Those schoolgirl days of telling tales and biting nails are gone
But in my mind I know they will still live on and on
But how do you thank someone who has taken you from crayons to perfume?
It isn't easy, but I'll try
If you wanted the sky I would write across the sky in letters
That would soar a thousand feet high 'To Sir, With Love'

Ring a bell? If it does, you are probably in your 60s. Yes, this is the song from the 1967 movie *"To Sir With Love"*. An inspiring and touching movie about an engineer who couldn't find a job after graduation and accepted a teaching position in a rough London East End school. Against all odds and taunted by a demoralized school admin, he won over his class of disruptive students and taught them what life and respect are. An excellent example of a flip classroom.

The song *"To Sir, With Love"* was specially dedicated to the lecturers and instructors of ATTC at the recent 18th Graduation Ceremony on 31 Oct 2017. ATTC's very first band *'Crayons to Perfume'* made their debut performance in front of the biggest crowd ever in the Hangar.

From left: Joshua, Lester, Zahid, Vishnu, Ms Low Yen Ling (guest-of-honor), Suhailah and Hanafee

We asked the band leader, Suhailah, how did the band started. *"Prof Lim came to our class and asked who can sing or play a musical instrument. He was looking for students to perform at the graduation ceremony"*, said Suhailah. Six students proudly stood up and spoke of their music skills. Lester and Suhailah sing, Zahid and Hanafee play the guitar, Joshua plays the piano and Vishnu the drums.

It was an amazing debut performance, considering the fact that they only get to practise on school days during lunch time. *"We have only 3 weeks to practise before the graduation"* said Lester, the bathroom singer, with no prior music background. He is not alone. sings in her bedroom or to her closest friends and Hanafee learnt to play the guitar by ear and occasionally through friends. Everyone was excited to form a band and Crayons to Perfume became the first band of ATTC since its inception in 1999.

"I have always wanted to be in a band and to perform in front of a crowd. When I found out that my classmates are musically inclined, I was extremely happy and excited!" said Zahid. He started learning classical guitar at Yamaha Music School at the age of 13.

We caught Vishnu and Joshua singing an acapella version of *"Stand by Me"* together with Lester at one of the rehearsals. It came as a surprise as none of them breathe a word about their singing talent and surely we know it requires good singing techniques to do an acapella.

We were curious about why the band name *"Crayons to Perfume"*. *"The lyrics of the song To Sir With Love kept ringing in our heads ever since we started practising, particularly, crayons to perfume - it has special meaning to it"* said Joshua.

The band hopes to have more opportunity to perform in future. *"We do need to have a proper time management plan for ourselves to ensure we'll perform well both academically and musically"* said Hanafee. Certainly, it requires time, effort and discipline to achieve these. We asked the band what's the takeaway for this whole event. *"We gain confidence and more importantly, our friendship has strengthened along the way!"*

Guided Imagery & Music

Carol Cheng

ATTC has started a Well-Being Program for staff and students. We have Sports Day on Wednesdays where badminton and table tennis games are arranged for staff and students from 4 to 6 pm. Table tennis and table soccer are also available in ATTC premise. In this article, our Resident Well-Being Therapist introduced a little-known music psychotherapy known as GIM.

Guided Imagery and Music (GIM) was developed by American music therapist Dr Helen Bonny in the 1970s. It is a receptive form of music therapy that has been practised worldwide since then. The Bonny Method of GIM in Music is the conscious use of imagery evoked by relaxation and music to effect self-understanding and personal growth processes in the individual. It is an evidence based therapeutic tool for people with a wide range of psychological and emotional difficulties. An increasing amount of research have been done over the last few decades validating the effectiveness of GIM.

GIM sessions have been shown to be effective for:
- **Grief and loss support**
- **Relationship issues**
- **Enhancing wellbeing and quality of life**
- **Accessing creative potential**
- **Supporting spiritual practice**
- **Stress**

GIM has been successfully used to address:
- **PTSD (Post Traumatic Stress Disorder)**
- **Trauma related to sexual abuse**
- **Addiction**
- **Psychiatric conditions**
- **Chronic illness**

Although GIM is used on adults, including medical and palliative care, a modified form of GIM can also be used with children and adolescents.

GIM can bring a richer understanding of one's life and possibilities for the future by drawing on past events for healing and resolution. Healing is a holistic process that comes from within a person, requiring inner balance of the body, mind and soul. In GIM, altered states of consciousness occur with the music listening experience. Altered, dreaming states are initially evoked in concentration and focus on the body, breath and mind in preparation for listening. These states are sustained and modulated in intensity throughout the listening experience by the particular mood of the music and verbal dialogue between client and therapist. *(http://www.musicandimagery.org.au/)*

The role of a GIM therapist is to facilitate the healing, helping the clients to gain a deeper understanding of their emotions associated with the imagery. However, the interpretation is client-centred; music is the generating stimulus and serves as therapist and healer alongside the guide.

Session Structure

A traditional individual GIM session lasts about 1.5 to 2 hours and begins with a preliminary discussion of the client's concerns. This is followed by a body relaxation induction of the client. A music program (35 - 45mins) chosen by the therapist to suit the client's concerns will then be played.

The music may evoke imagery, memories, emotions, embodied experience and spiritual expansiveness while the client describes his/her experiences. The therapist serves as a support to the unfolding of the client's imagery experience with verbal intervention in a non-directive way. At the end of the music program, the client will explore further with creative media such as drawing or musical improvisation together with the therapist.

GIM can also be modified for group sessions and is particularly suitable for groups working towards a common goal. A focus is chosen and brought to mind following the induction and music selection. The individuals in the group experience imagery in silence and integrate their experience through verbal discussion, drawing or other creative forms after the session.

Duration & Cost

A series of 10 individual sessions is recommended to feel the positive effect of GIM. Each session is 90 mins and would cost S$120 (package discount of 20% for 10 sessions). GIM will be made available to staff of SIAE and ATTC at $40 per session. To ensure that students can benefit from GIM, a special rate of $20 will be charged for students of ATTC. Other SIAE members will enjoy a special rate of $70 per session.

Carol Cheng is the resident Well-being Therapist at ATTC and she is the only Singaporean currently trained as a music psychotherapist. Apart from music, she also uses other forms of therapeutic method such as Acceptance Commitment therapy, Narrative therapy and Cognitive Behavioural therapy. She has worked with children and adults with disabilities and people who have psychological and emotional difficulties. Email your concerns to ***carolcheng@siae.org.sg*** to explore potential use of GIM.

NTU MAE Students' Project

Dialogue with a Passionate Engineer

an engineer dedicated to the profession for more than 30 years

Four students given a project to interview an exemplary engineer spoke to Mr Chow Kok Wah who has spent more than 30 years working in the Engineering Division of Singapore Airlines and SIAEC. Mr Chow, currently Honorary Secretary of SIAE and Director of SIAE Consultant, holds aircraft maintenance engineer's licence and BE(Hon) from Monash University (1980). Mr Chow shared his views on engineering as a career and how students could excel in the discipline.

Q: Why did you choose your profession in the aerospace industry?

I was very curious about how things work. I would dismantle the television set, the bicycle, the oven and all kinds of gadgets in the house. It was only natural that I took up engineering. My classmate sent me an advertisement that Singapore Airlines was hiring apprentice aircraft maintenance engineers, providing training and a salary. As we could not afford a university education, that was a good alternative. It was talent, passion and opportunity coming together. Hence my career in SIA.

Q: What are your work and responsibilities when you are in charge of engineering?

My job as a ground engineer was to fix problems on airplanes. As I progressed, I dealt with different kinds of problems: design, reliability, planning, airport services, financial and people problems at departmental and later at divisional level.

Q: Has being an engineer enjoyable and fulfilling for you?

Yes, immensely. I enjoyed fixing problems. From the passengers' perspective, what is most frustrating is a flight delay when you are flying to a meeting or looking forward to their holidays. It's really satisfying when I can fix the problems and the passengers can continue their journey. This was my day-to-day work; fixing urgent but solvable problems. Then there are the "mystery problems" which seemed to defy the rules of engineering but even more fulfilling when fixed.

We had a yaw damper problem on a 747 with an intermittent fault for over two years! We replaced every component in the system but to no avail. Then we noticed that when we pulled the attachments of the yaw damper computer, the fault sometimes appeared. Eventually we discovered that during airplane production, someone had accidentally painted the mounting points of the attachment. These points are electrical ground returns. When the attachments are disturbed, electrical continuity is momentarily lost. This is one of the discoveries that gave me great satisfaction.

Q: Is there any time when you feel frustrated about your work?

Yes, many times. The biggest challenge is people, not machines. If you work for a big organization, bureaucracy can be frustrating. What appears to be a simple job, requires you to go through layers of bureaucracy to get it done.

Q: Is there any time that you doubted your career path?

Yes. I actually thought of quitting within the first 2 years of my training. After completing my A-Level, I was suddenly thrown into a trade-based training which I then naively saw as inferior. Only much later did I understand that theory alone cannot build or fix a plane. Now looking back, I am very grateful for the training. Besides the theory classes, I did on-the-job training in the electrical workshop, welding workshop, pneumatics workshop, hydraulics workshop. I spent time in the ground equipment shop which repaired diesel engines. I also had three months of welding, milling, lathing and cutting training at the VITB (today's ITE). You don't get such broad training anymore.

Q: If there is one advice you can give to future engineers, what would it be?

Focus on your soft skills. Engineering skills are useful up to a point but soft skills are useful throughout life. The higher you go, the more important the soft skills. You learn from people who are good at it. But you must be prepared to open up and observe. You should participate in organizing college charity drives and induction programmes. Public speaking is another skill I encourage all engineers to learn.

I know some people felt that engineering has poor prospects, compared to other disciplines which appeared to be more lucrative. But Engineering is not a single-track career. Check out the past and present senior management in major corporations and institutions in Singapore. You will be surprised at the number of engineers.

From left: Thian Hui Ning, Low Wei Lun, Chow Kok Wah, Wong Guo Wei, Emily Fatima Yunan

I quote Prince Philip, Duke of Edinburgh. As the UK was recovering from the Second World War, he noted the contributions of engineers and praised their vital work. He said: *"The whole of our infrastructure, from sewers to power supplies and communication, everything that wasn't invented by God is invented by an engineer."*

Aerospace ITM

The Aerospace Industry Transformation Map was launched on 17 Jan 2018 with the objective of helping the industry create 1,000 new jobs by 2020. The ITM has identified three key thrusts – operational excellence, innovation and equipping Singaporeans with relevant skills.

SIAE is a partner in the government's drive to transform the aviation industry, together with AAIS and NTUC Aerospace and Aviation Cluster.

Equipping Singaporeans with relevant skills

The Skills Framework for Aerospace is jointly developed by ***SkillsFuture Singapore (SSG), Workforce Singapore (WSG)*** and the ***Singapore Economic Development Board (EDB)***, with inputs from industry stakeholders, unions, and education and training institutions.

It covers 86 job roles and allows individuals to explore career growth opportunities along or across four different tracks within the sector – aircraft maintenance, fleet maintenance, aircraft engine/component maintenance, and manufacturing.

Air Transport Training College

– the Professional Training and Development Centre of SIAE

ATTC offers academic programmes catering to the Next Generation of Aviation Professionals as well as customised training solutions for our partners and clients. As part of our Transformation, SIAE and ATTC will focus on developing and delivering bite-sized industry-relevant modules to meet the needs of industry. Currently, we have the Executive Introduction to MRO course as a primer for executive entering the MRO sector. We have also developed customised courses including "Reading and Interpreting CMM" for UTAS and M10 (Air Legislation) for Mitsubishi Aircraft in Japan. We are working with several aerospace companies to develop customised courses on specific skills.

Under our SAR 147 approval, ATTC conducts Part 66 CAT A & B1 basic licence training which provides career advancement paths for aerospace technicians and engineers. ATTC developed the Professional Certificate in Aerospace Workshop Operations (PCAWO) course which is accepted by CAAS for workshop inspectors.

SIAE and ATTC played crucial roles in developing Singapore's WSQ Aerospace Framework to ensure we have the relevant skills to keep our aerospace industry competitive. Our WSQ Apply Human Factors Principles course has been adapted for other industries, including MRT, chemical and hospital.

Underpinning the effectiveness of our training is the wide-range of aerospace expertise of our SIAE members and the experience of our ATTC teaching staff.

Details of ATTC Course schedule for 2018. Dates are subject to change and cancellation if there are insufficient participants. For enquiries, please contact ATTC @ (65) 8494 8180.

CERTIFICATE IN SAR-66 Training Programmes		2018 Schedule	
		Cat A	Cat B
1.	BM01 Mathematics	05 Mar	03 Apr
2.	BM02 Physics	20 Mar	24 Apr
3.	BM03 Electrical Fundamentals	10 May	24 May
4.	BM04 Electronic Fundamentals	N.A.	28 Feb
5.	BM05 Digital Techniques / Electronic Instrument Systems	13 Mar	02 Apr
6.	BM06 Materials and Hardware	17 Apr	18 Mar
7.	BM07 Maintenance Practices	23 Jan	19 Apr
8.	BM08 Basic Aerodynamics	03 Aug	01 Jun
9.	BM09 Human Factors	16 Mar	12 Jan
10.	BM10 Aviation Legislation	20 Feb	TBC
11.	BM11A Turbine Aeroplane Aerodynamics, Structures & Systems	27 Mar	31 Jan
12	BM15 Gas Turbine Engine	28 Feb	14 May
13	13 BM17 Propeller	03 Aug	12 Jun
14	14. BP100 Practical Skills Training at Hangar / Workshop	03 Apr	15 Mar
15	15. BP200 Practical Aircraft Maintenance Training at Hangar	02 May	TBC

SPECIAL SHORT COURSES		2018 Schedule
1	Human Factors & Error Management (Refresher)	01 Feb 23 Apr 25 Jun
2	Human Factors & Error Management (Technicians & Operators)	
3	An Introduction to Safety Management System	23 Jan 20 Feb 20 Mar 17 Apr 15 May 19 Jun
4	Airworthiness Administration	15 Jan 05 Feb 02 Apr 07 May
5	Executive MRO	Mar, Apr, May, Jun, Jul, Aug, Sep, Oct
6	Aircraft Maintenance Operations	TBC
7	Aerospace Technology	TBC
8	Air Transport Economics	TBC
9	Mathematics and Physics for Practitioner Engineers	03 Apr
10	Electrical Engineering Fundamentals	24 May
11	Aerodynamics and Aircraft Electronic and Digital Systems	28 Feb
12	Aircraft Practical and HE Study Skills	26 Mar
13	Aircraft Materials, Hardware and Maintenance	19 Mar
14	Aircraft and Their Systems	31 Jan
15	Aircraft Maintenance and Professional Practice	TBC
16	Propulsion Systems	14 May

WORKSHOP PROFESSIONAL CERTIFICATE IN AEROSPACE OPERATIONS (PCAWO)			2018 Schedule
1	M1000A	Basic Module	
2	M1000B	Basic Module	
3	M2000A	Airframe – Fixed Wing	
4	M2000B	Airframe – Fixed Wing	
5	M2200A	Engine	
6	M2200B	Engine	08 Jan
7	M2500A	Airframe – Rotary	
8	M2500B	Airframe – Rotary	09 Apr
9	M3000A	Avionics (General)	
10	M3000B	Avionics (General)	
11	M3200A	Avionics (Instruments)	
12	M3200B	Avionics (Instruments)	
13	M4000A	Avionics (Comm & Nav)	
14	M4000B	Avionics (Comm & Nav)	

WSQ Courses		2018 Schedule
1	AR-CCU-507C-1; Apply Human Factors Principles	05 Feb 16 Apr 18 Jun
2	AR-CCU-201C-1; Perform Basic Aircraft Safety Practices and Documentation	TBC
3	AR-CCU-201G-1; Perform Aircraft General Maintenance	TBC
4	AR-CCU-202G-1; Perform Electrical Terminations & Connections	TBC
5	AR-CCU-203G-1; Perform Electrical Measurements	03 Apr
6	AR-CCU-201E-1; Maintain Sheetmetal Structures	TBC
7	AR-CCU-202E-1; Maintain Composite Structures	15 Jan 12 Mar 14 May
8	AR-ERO-201G-1; Perform General Engine Workshop Practices	TBC
9	AR-ERO-201E-1; Disassemble and Assemble Engine	TBC
10	AR-ERO-203E-1; Inspect Engine Component Parts	TBC
11	AR-AMM-201E-1; Maintain Airframe Systems	TBC
12	AR-AMM-202E-1; Maintain Aircraft Fuel & Engine Systems	TBC
13	AR-AMM-203E-1; Maintain Aircraft Cabin Equipment & Furnishing	14 May
14	AR-AMA-204E-1; Maintain Aircraft Instrument Systems	05 Mar 21 Mar
15	AR-AMA-207E-1; Maintain Aircraft Electrical Systems	09 Apr
16	MF-COM-101C-1 Apply 5S Techniques	TBC
17	MF-COM-102C-1 Apply Quality System	TBC
18	MF-COM-103C-1 Apply Teamwork in the Work Place	TBC
19	MF-COM-104E-1 Apply WSH Policy	TBC
20	MF-PEC-101E-1 Use Hand Tools	TBC
21	MF-PEC-102E-1 Operate Basic Measuring Devices	TBC