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Commercial Space Gets A Booster

Crew Dragon Home Safely

Prof Lim Yeow Khee *BBM*

Crew Dragon docked directly onto ISS
Picture credit: Planetary Society

Falcon 9 returning to earth, vertically

*11 Mar 2019 - **SpaceX Crew Dragon** completed its first uncrewed flight SpX-DM1 with a splashdown in the Atlantic at 0345h UTC. This important milestone in commercial space ventures, demonstrated Crew Dragon's ability to safely transport crew to International Space Station (ISS) and back.*

Founded in 2002 by Elon Musk with the goal of reducing space transportation costs and colonising Mars, SpaceX developed the Falcon launch vehicle family and the Dragon spacecraft family, under NASA's Commercial Orbital Transportation Services (COTS) Program.

SpX-DM1 mission was closely watched by experts and enthusiasts as the vision of a commercial company to send manned flight to space was viewed with skepticism. Besides cost challenges, SpaceX also embraced the policy of using the latest technology and reusable rockets and spacecraft to protect the environment.

The mission incorporated several daring applications of new technologies like docking to ISS without the assistance of the robot arm and using PICA (Phenolic Impregnated Carbon Ablator) for the reentry heat shield. The Dragon cockpit was designed with minimalist principle and 3-D printing of many parts. SpaceX has flown 16 resupply missions to the ISS under COTS and SpX-DM1 was the prelude to launch its first astronauts to space in a Dragon later this year.

SpaceX Crew Dragon landing at Atlantic

In 2011, SpaceX announced its reusable launch vehicle program and by Dec 2015, the first Falcon 9 accomplished a propulsive vertical landing near the launch site. In Mar 2017, SpaceX became the first to re-use and land the first stage of an orbital rocket.

How SpaceX is Making Space Cheaper

In 2012, SpaceX advertised a launch price of $57 million for Falcon 9. (The first stage accounts for 75% of total launch costs, or $46.5 million). A reusable rocket adds economies of scale to operations.

SpaceX is vertically integrated and has built its entire supply chain, from rocket engines to the electronics

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components used in its rockets, from scratch.

In SpaceX, the production floor and engineering are situated right next to each other in the company's factory for faster turnaround and better communication. Similarly, its two-stage rockets carry just one set of fuel tanks loaded with propellants that will be used across both stages. Most previous rockets used three sets of propellants for their 3 stages. One can presume that the decline in the cost of certain components, such as sensors and electronics, has also helped the company reduce prices.

SpaceX Achievements First by private enterprise	
2008	Liquid-propellant rocket to reach orbit (Falcon 1)
2010	Launch, orbit, and recover a spacecraft (Dragon)
2012	Send a spacecraft to ISS (Dragon)
2018	Send an object around the sun (Tesla Roadster)
	World's First (Falcon 9)
2015	Propulsive landing for an orbital rocket
2017	Reuse of an orbital rocket

First reusable Spacecraft - 14 Apr 1981

Editor's Message

Aviation news, no matter how mundane, never fail to excite aviation professionals. Last month's momentous splashdown of SpaceX Crew Dragon was a timely reminder that it was 50 years since we landed on the Moon! It also marked the first attempt by a private enterprise to attempt manned space flights.

Our cover story looked at Elon Musk's adventure into commercial space travel, notching up several firsts including the first reusable spacecraft since Columbia returned to Earth in 1981.

SIAE's drive to reach out to aviation professionals and NGAP took Vortex to schools and IHL to contribute articles on STEM education and industry outreach.

We have stories from airline safety survey and aerial photography to music to maintain your mental well-being. The centrespread highlights recent changes to SIAE's Constitution.

Our editorial team have worked hard to produce Vortex for your reading pleasure. We hope you enjoy our stories and we welcome your feedback.

We thank our supporters and contributors and we look forward to your continued contributions.

Like the Vortex.... drawing the energy inwards.

EDITOR
LIM CHUI PING

Comparison with other reusable spacecraft

Aviation Safety Competition 2018

Lim Chui Ping
Executive Committee, SIAE

The Scenario:

Time T = 2030 (T+0)

The engineer and technicians arrived at the aircraft and proceeded to power up the aircraft using the Ground Power Unit (GPU) and turn on the air-condition and electrical systems, in preparation for the arrival of the flight crew and the passengers. Preparation work was completed as was required and on time for passenger boarding. Everything seemed to be in good order. All the ground team, except the engineer, left the aircraft after their work was completed.

T = 2230 (T+2hrs)

The Flight Crew arrived at the aircraft and the cabin crew started preparing the aircraft for departure. As part of the pre-flight check, one of the pilots is required to perform an external walk-around check of the exterior of the aircraft to ensure serviceability. Passenger boarding commenced. During the walk-around, the pilot realised that a GPU that was parked at the nose of the aircraft (but not in use) was having a major fuel leak.

How would air and ground crew work as a team to resolve the issue with minimum disruption to the passengers and flight operation?

Industry visit to Helicopter Simulation Center

With the theme ***"Safety in Flight"***, Aviation Safety Competition (ASC) 2018 focused on **Crew Resources Management (CRM)**. ASC 2018 was the fourth (4th) competition of the series. Over a hundred students from 9 schools and Institutes of Higher Learning participated in this annual event. Between Jul to Dec 2018, our ASC Committee conducted lectures and workshops, organised industry visits and set problem statements about CRM.

The ASC is one of SIAE's major projects aimed to reach out to students, generate their interest in aviation and encourage them to consider careers in the aviation industry. The mission is to build an aviation culture for the Next Generation of Aviation Professionals.

6 teams from 16 entries were picked to present before an astute panel of judges consisting of:

1) ***Mr Chan Wing Keong*** *(Advisor, Transport Safety Investigation Bureau, Ministry of Transport)*
2) ***LTC Danny Koh*** *(Dy Head Air Force Inspectorate, RSAF)*
3) ***Mr Ivan Neo*** *(Executive Vice President Operations, SIA Engineering Company)*
4) ***Mr Lim Kah Bin*** *(Associate Professor, Mechanical Engineering, NUS)*

Panel of Judges (from left) Prof Lim Kah Bin, Mr Chan Wing Keong, Mr Ivan Neo, Mr Danny Koh

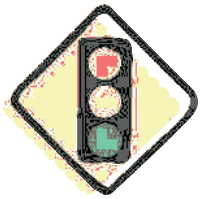
Prior to the essay competition, the students attended flight safety-related lectures on Aero Medicine by Dr. Soh Feng Wei, Flight Disruption by Captain Jimmy Ooi and Crew Resource Management by Captain Kevin Khoo. After each lecture, students were also given free access to the training aircraft and instrumentation workshop setup in ATTC and Singapore Polytechnic.

The students were as usual awed by the industry visits to the RSAF Aeromedical Centre, RSAF Helicopter Simulator Centre and ST Aero Academy where some of them were given the opportunity to experience flying the simulators.

On 13 Dec 2018 at Air Force Museum in Paya Lebar Airbase, the 6 finalist teams presented their assessments and recommendations of a difficult situation on the flight line that was posted to them. The overall consensus by the panel was that the teams had researched and prepared well for the presentations. They demonstrated their understanding of flight safety and presented their analysis from different but interesting perspectives ranging from technical/ engineering, economical and human behavioral aspects. It was most encouraging to hear from the students and to feel their enthusiasm in aviation topics.

From left: Guest-of-Honour Prof Lui Pao Chuen & Mr Lim Yeow Khee

We look forward to an even more interesting ASC 2019!!



Operational Interruptions

A Field Representative Perspective

Cedric Constant
Safran Landing System Sgr

Field Reps are very important to airlines. A good field rep can help airlines save money and protect brand reputation by improving dispatch reliability. In this article, we discover first-hand the work of a field Rep.

As a Field Representative, the main aspect of my job is to prevent and reduce operational interruptions of the aircraft. We provide technical support and feedback for the airlines and follow up on technical events. Interruptions have a huge impact on airlines. Interruptions affect their operations as they need to find alternative flights and pay for passengers' inconveniences. It also has an impact on their image and marketing abilities.

A field engineer's response can be divided into three parts: After-Event, During-Event and Before-Event. My job used to focus more on the first two responses. We study events after their occurrences and we provide support during events. With the advancement of technology and the evolution of data, our new objective is to prevent the failures **before** they occur.

After-Event

After an event occurrence, the first action is to recover the defective part. This could be at the main base or outstation. Once collected, the part will be shipped to an approved repair shop for a in-depth investigation. It first goes through a visual test to identify any evidence of shack damage or external abnormal condition. Then, it goes on a bench test according to the Component Maintenance Manuals specifications.

Results from these tests will determine if the part is faulty or not. Potentially, the part will also go through a full stripdown and investigation at a sub-component level to identify the root cause of the failure. This will be reported for future development of the part.

During-Event

When an event occurs, it is crucial to react as fast as possible in order to reduce the down time of the aircraft.

We first have to identify the defect which could be flagged out via a fault message reported by the crew or a visual defect found by a maintenance operator. Identifying a defective part to be replaced is simple, provided it is a Line Replaceable Unit. But when it comes to a system fault message, troubleshooting can be complex.

For example, a drifted valve triggering a fault message. The message pops up once the computer detects a signal from the sensor that is out of range. Looking through the removal history, using engineering judgement and performing practical troubleshooting on the aircraft, such as part swapping, we are able to identify the root cause of the fault, which can then be corrected.

Additional time is required as the part is ordered. The logistics team has to handle the request, check against their stock, and if empty, contact OEM for a replacement part. Part of the job on-site is to ensure no time is lost during the order, clearing all issues on paperwork, customs clearance and applicable fees to prevent any spares from being held. Once the part is received, it can be fitted on the aircraft. A further test is necessary to ensure the aircraft recovers its full serviceability.

Before-Event

Ideally, we would like to prevent a failure. This was not easy because of the lack of good information. With the availability of data and advancement in data analytics, we are now able to move toward more preventive measures.

This involves the analysis of First Data - the history of previous removals and delays, obtained after the event. This provides a guideline for troubleshooting and preventive removals.

Analysis can be continued by cross-referencing this data with several others. They include the repair shop's findings report, retrofit progress information, flight hours or flight cycles and part serial numbers.

With the capability to be able to capture data while on the fly, real-time data can be transmitted from the aircraft. New aircraft models can monitor up to 20, 000 parameters. Gathering and reading data is a tedious task but trend monitoring algorithms can help to recommend a removal at the right moment.

Linking all the data and extracting the right information is the key parameter for improving the operational time of the aircraft. The advent of new data analytics technologies has provided all field engineers with new methods to anticipate failures and keep the skies safe for all travelers.

Airline Safety Rating

Jonathan Chan
SIT Student

Travel websites boomed with comments after AirlineRatings.com released the "World's Safest Airlines for 2019". AirlineRatings.com is a product and safety rating website with an editorial team that has achieved international recognition since it was launched in Jun 2013. The site rates safety and in-flight products of over 400 airlines. In Nov 2018 it rated Singapore Airlines top for in-flight service, new aircraft types, fleet age, passenger reviews, profitability and investment rating and operational safety.

For the 2019 Safety rating, it uses a seven-star rating system, with Qantas emerging top, due to their prominence in safety innovation. Singapore Airlines came out among the top 10 safest airlines with a 7/7 rating. Scoot scored 4/7 together with 63 other airlines which did not have IOSA (IATA Operational Safety Audit) Certification. Among the 64 airlines losing three stars because of non-IOSA, 8 are from Canada, 6 from Japan, 4 from Australia and 3 each from UK and USA. Ryanair from Ireland and Air Iceland are among them too. This prompted comments from industry experts asking whether the seven-star rating is sufficient to cover all the important elements of aviation safety.

AirlineRatings.com 7-Star Criteria	Stars
Is the airline IOSA certified?	3
Is the airline on the European Union (EU) Blacklist?	1
Has the airline maintained a fatality free record for the past 10 years?	1
Is the airline FAA endorsed?	1
Does the country of airline origin meet ICAO safety parameters?	1
Has the airline's fleet been grounded by the country's governing aviation safety authority due to safety concerns?	-1
Does the airline operate only aircraft built in the former Soviet Union and designed up to 1990?	-1

While *AirlineRatings* would have gone through rigorous deliberation to come up with this 7-star safety rating, it can be argued that some important elements may have been missed. Airlines have allotted resources to other areas, such enhancing Safety Management System to maintain high standards of safety.

In an article "Why You Can Safely Ignore AirlineRatings Safety Rankings", the Forbs contributor challenged that *"the 3 stars for IOSA certification does not do justice to airlines that may have worked hard in challenging conditions and is an unsurprising omission as budget airlines may not see it as a priority to be a member of IATA".*

While Scoot itself is not listed on the IOSA Safety Registry, NokScoot- a joint venture of Thailand's Nok Air and Scoot airlines, has been registered. Although they have had a rough run with delays due to unforeseen circumstances, Scoot was nominated top 10 airline, and 4th for World's Best Long-haul Low-Cost Airlines 2018 by Skytrax.

Scoot attracted negative attention due to an unfortunate incident on 30 Jan 2019, where an unclaimed baggage accepted by the flight crew resulted in an air turnback, when the crew failed to locate the owner.

This is a serious breach of ICAO Annex 17 security requirement, showing lapse by cabin crew. The Captain, however, displayed professional judgement to turn back the aircraft. Scoot CEO Mr Lee Lik Hsin has apologised for the lapse and sought to review the training processes to prevent a recurrence.

Budget airlines operate with tight schedules and limited resources, to keep costs down and fares low. While working on other issues such as maintenance and flight delays are priority, airline safety should not be compromised. Safety makes good business. It should not be viewed as a cost and the safety element must always be incorporated in all processes through the airline.

Why Qantas is Top in Safety?

Besides scoring 7/7, Qantas was described as having the most innovative safety systems. Although many airlines are using some or all of these systems, Qantas use them more rigorously to ensure a very high standard of safety is maintained. Some of the systems are:

- Future Air Navigation Systems
- Flight data recorder to monitor plane and later crew performance
- Automatic landings using Global Navigation Satellite System as well as precision approaches around mountains in cloud using RNP.
- Lead airline with real-time monitoring of its engines across its fleet using satellite communications, which has enabled the airline to detect problems before they become a major safety issue.

Farnborough Air Show 2018

Jasper Ng
Airbus UK Intern

Every two years, Farnborough hosts the biggest aviation event in the UK. Like Paris Airshow and Singapore Airshow, Farnborough offered the third showcase of what the aviation industry has to offer. Representatives of manufacturers, airlines and military all come together for a 'trade week' before the Airshow is open to the public on the weekend. In addition to hosting a range of exhibitions and huge static displays of aircraft, the Airshow boast a stunning flying display of different aerobatic, military and civil aircraft.

In Jul 2018, I had the pleasure of visiting the Airshow as a member of the Airbus Filton Choir during my year-long internship with Airbus. I had only started my internship only a few weeks prior and thus, was incredibly fortunate to get a spot to Farnborough.

On the day of the Airshow, the choir arrived early and greeted the visitors with our singing at one of the atriums. Many people stopped to enjoy our choir arrangements of classic English songs such as *Fly Me to the Moon*, *It Don't Mean a Thing* and *Hallelujah*; each song was met with warm applause.

We did a singing tour around the exhibition hall, singing and chanting *'Airbus is coming!'*. The tour around the exhibition hall gave me a glimpse of the projects undertaken by companies and an understanding of what each of them had to offer. Interactions with exhibitors behind the booth gave me unprecedented insights into their job scope. Everyone was having a good time enjoying the music and I was glad that we could provide these exhibitors and visitors with some entertainment as they patronised the exhibition hall.

The choir was invited on a special tour on board the static display of the A380 by Hi Fly Malta which was situated in the middle of the airfield facing the runway. This A380 was specially painted to promote the conservation of coral reefs. On one side, the design depicted a flourishing coral reef with a colourful array of fishes while the other provided a contrast by showing the destruction of coral reefs.

There were also other aircraft on display in the airfield. These included civil aircraft such as the A330-900NEO and A220-300 from Airbus and 777-300ER and 737-MAX8 from Boeing. There was also a strong presence of military and business jets, as well as helicopters.

2018 marked the 100th anniversary of the Royal Air Force (RAF) and this was commemorated with a performance by the Royal Air Force Red Arrows during the aerial display in the afternoon. The highlight of the flying display was the Red Bull Air Race. Italy's Dario Costa and UK's Ben Murphy wowed the audience with a spectacular performance on the Edge 540 race-planes, reaching speeds of 370km/h and enduring forces of up to 12G, as they navigated just a few metres from the ground through a series of giant inflatable pylons. The A350-1000 took to the skies for the first time in Farnborough, captivating the audience as it performed a series of low altitude manoeuvres over the crowd.

Red Arrows in formation

Soon, it was time to head back. My visit turned out to be a long but fruitful day filled with amazing experiences. I am glad that I had the opportunity to witness the Farnborough Airshow and bring joy to people through singing, all at the same time.

Airbus Filton Choir

University Industry Collaboration

Prof Lee Yong Tsui
MAE

In our last issue of Vortex, Luca Mueller wrote about how engineering students in Germany are assigned to industrial projects from the time of entry to university. In this article, we look at how Nanyang Technological University (NTU) reaches out to industry to use its research prowess and give opportunities for students to engage with industry at an early stage of their course.

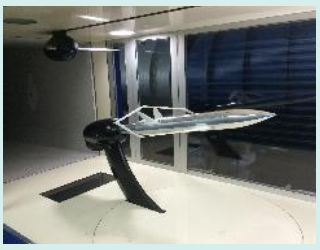
NTU's Mechanical & Aerospace Engineering (MAE) Department, has over 100 faculty members and 400 research staff and students. It has breadth and depth coverage in different fields, spanning solid and fluid mechanics, thermodynamics, materials engineering, intelligent manufacturing and automation, aircraft engines and propulsion, robotics, human factors engineering and logistics.

MAE has three main missions: to produce the next generation of engineers and scholars, to generate new knowledge and to serve industry. The professors are established experts in their fields, advancing the missions by actively pursuing teaching and research, working with industry to help solve problems. Universities are not ivory towers; professors live in the real world and tackle real world problems. Here are a few examples.

Building Inspection Robot

Professors Chen I-Ming and Cai Yiyu created technologies that help the construction industry. Prof Chen, a renowned expert in robotics and human robot interaction has developed robots for wall painting and other repetitive and dangerous work. Prof Cai works closely with HDB and various companies in digitalization - from capturing digital models of existing buildings to the intelligent handling of cranes using virtual reality simulations. Their technologies are in the forefront of Industry 4.0, offering efficient and effective alternatives to many traditional practices and opening up new avenues in a very old industry.

Painting Robot



Wind Tunnel Model

Prof Daniel New specializes in aerodynamics and supersonic flows. He explores ways to mitigate aircraft noise emissions, as well as civil aircraft designs that are more compact but with improved flight performance. He is also engaged in improving helicopters' fuselage aerodynamic performance.

MAE is well-endowed with 40 modern laboratories and research centres serving NTU's teaching and research needs. Their close relationship with industry is evident in the corporate laboratories that have been set up with companies like Rolls-Royce, HP, and SMRT. Such collaborations, besides delivering engineering solutions to industry, give professors and students opportunities to take on real world problems.

While MAE do not have the solution to every problem, their professors have a wide network of collaborators which helps to extend their reach and coverage, especially in multi-disciplinary problems extending beyond mechanical and aerospace engineering.

"We see ourselves as a resource for industry. Companies can "exploit" us, by engaging our professors in consultancy or collaborative research and development", said Prof Ooi Kim Teow, Chair of MAE. *"NTU prefers to engage companies directly and hear firsthand from each company the problem(s) they needed help on. Relevant professors will be identified to engage the companies' engineers to work on the solution."*

There are three ways companies can work with NTU:

Student projects: These are exploratory projects for undergraduates or postgraduates, for periods from 15-weeks to one-year duration.

Consultancy: NTU professors with the relevant expertise work with companies directly within a stipulated time.

Research collaboration: NTU can collaborate with companies in conducting research to find the solution to a problem.

Companies wishing to use NTU's vast engineering expertise and resources may contact the following:
The Chair,
School of Mechanical and Aerospace Engineering
Nanyang Technological University, Singapore
Nanyang Avenue
Singapore 639798

Email: d-mae@ntu.edu.sg
The full list of our professors and their capabilities can be found in NTU website at ***http://www.mae.ntu.edu.sg/aboutus/FacultyandStaff***

SIAE Constitution Review

By Prof Lim Yeow Khee *BBM*

Since 1975 when SIAE was founded, the aviation industry in Singapore has gone through several transformations. From a single airline with an engineering base supporting turboprop aircraft and early Boeing 707 and 737 jets, we have grown to be the biggest MRO base in the world. In 2015, as we celebrated our 40th Anniversary, we embarked on a New Direction to make use of our members' intellectual resources and experience to groom the NGAP. To expand our membership and create more values for members, we need to update our constitution to meet the evolving workforce in the industry.

Constitution Review Committee

A Constitution Review Committee comprising Lim Yeow Khee, Mike McCormack and Ian Richards was formed. The Committee's task was to review membership categories and criteria to make SIAE membership relevant to the evolving aerospace industry in Singapore. Among the considerations is the alignment of membership criteria to various job titles in the aviation industry. Besides engineers, membership categories will include other professionals in the aviation industry.

It is hoped that the proposed membership categories and eligibility will enhance an individual's career status and identity and provides a more visible comparison with other sectors. It should also give members a clearer progression route within the Institute. With these revisions, members can be identified to employers, potential employers and the industry of their credentials.

On the administrative matters, the current practice of electing all the ExCo positions has been changed to align with practices in other similar organisations. Members will only elect the President, Vice President, Hon Secretary and Hon Treasurer and ten Committee Members. The elected President may then appoint two additional VPs, assistant Secretaries and assistant Treasurers from the ten elected Committee Members. We have also added clauses on appointment and removal of Trustee and the dissolution of The Institute. This became necessary as SIAE now has ownership of substantial asset in ATTC.

After 3 years of deliberation, the changes were finally presented and approved by the AGM in 2018. Here are some highlights of the changes:

Membership

Associate Fellow has been renamed **Companion** for academics and senior executives who are not directly involved in aerospace engineering. Ordinary Member and Associate Members have been renamed **Member** and **Associate**, respectively.

Honorary Fellows are elected with a two-thirds majority and a term may be imposed. Previous Honorary Fellows were elected for life and we have some who had not attended our event for more than 10 years. The ExCo will decide on the appropriate term. Qualification for **Fellows** will now include Fellows from other relevant organisations.

Requirements for **Members** are still based on certification responsibilities and tertiary education qualifications. In addition, senior management experience is now considered.

Associate is open to a wider scope of people in various support services to aerospace. The original requirement for technical personnel working in aerospace remained.

Life Member

Age for qualifying a **Life Member** has been raised to **65** to align to our ageing workforce.

Executive Committee

The Executive Committee shall consist of seven (7) **Office Bearers** and seven (7) members. A total of 13 members will be elected at every alternate AGM to form the ExCo. The Immediate Past President will be co-opted to be part of the 14-member ExCo. The composition of the ExCo shall be:

Position	Process
President	Elected
Vice President	Elected
2nd Vice President	Appointed
Honorary Secretary	Elected
Assistant Hon Secretary	Appointed
Honorary Treasurer	Elected
Assistant Hon Treasurer	Appointed
Nine Committee Members	Elected
Immediate Past President	Co-opted

Not more than three (3) of the six (6) Ordinary Committee Members may be appointed by the ExCo to act as additional assistants to the President, Hon Secretary or Hon Treasurer, should the need arise. Unless with the prior approval in writing of the Registrar of Societies, majority of the Committee Members shall be Singapore Citizens or Singapore Permanent Residents.

The ExCo may co-opt up to f**ive (5) advisors/observers** to sit on the ExCo, and such members shall hold office until the AGM following their co-option. Such co-opted members shall not have a vote at the meetings of the ExCo and shall not be deemed to be members of the ExCo. They shall be called advisors/observers.

An ExCo meeting shall be held at least once in **two months**. The ExCo has power to authorise the expenditure of a sum not exceeding **$20,000** per month from The Institute's funds for The Institute's purposes. The ExCo is authorised to purchase capital equipment not exceeding **$50,000** per year for The Institute's purposes from The Institute's funds.

Trustees & Properties

A new clause to accept any bequest, gift or donation made to the Institute by a member of The Institute or any legitimate person was included to allow for volunteer contributions to The Institute.

All the funds and property of The Institute shall be vested in **Trustees** for the members of The Institute and may be dealt with or disposed of in any manner as the ExCo shall think fit, subject to the provisions of this Constitution.

The number of Trustees shall not be less than **two (2)** or more than **four (4)** at any time and shall be elected at the AGM or Special General Meeting.

The term of office for a Trustee shall be **four years** from being elected, upon completion of the term, the Trustee shall be ceased and eligible for re-election.

Any Trustee may resign his Trusteeship by giving **one (1) month's** written notice to the ExCo.

A Trustee maybe removed by an AGM or Special General Meeting if, in the opinion of a majority of members present and voting at an AGM or Special General Meeting, he is guilty of misconduct of a kind as to render it undesirable that he shall continue as Trustee.

a) Notice of any proposal to remove a Trustee must be given by affixing at the premises of the Institute a document containing such proposal at least two (2) weeks prior to the meeting at which such proposal is to be discussed.

b) The result of such meeting shall then be notified to the Registrar of Societies.

If a Trustee dies or if he is mentally or physically incapable of managing his own affairs, if he becomes insolvent or is an undischarged bankrupt, if he is convicted and sentenced to imprisonment of not less than one year or a fine of not less than S$2,000, or if he has lost his Singaporean citizenship or declared himself allied to a foreign country, or is absent from the Republic of Singapore for a period of one year, he shall be deemed to have resigned his Trusteeship.

Trustee Duty of Care

a) When exercising any power (whether given to them by the Charter, these By-Laws or by any rule of law) in administering or managing The Institute, each of the Trustees must use the level of care and skill that is reasonable in the circumstances, taking account of any knowledge or experience that he claims to have (the 'duty of care').

b) No Trustees and no one exercising powers and responsibilities that have been delegated by the Trustees, shall be liable for any act or failure to act unless, in acting or failing to act, he has failed to discharge the duty of care. No act of the Trustee which has received the expressed or implied sanction of the members present at a General Meeting of the Institute, can be impeached by any member of The Institute on any grounds.

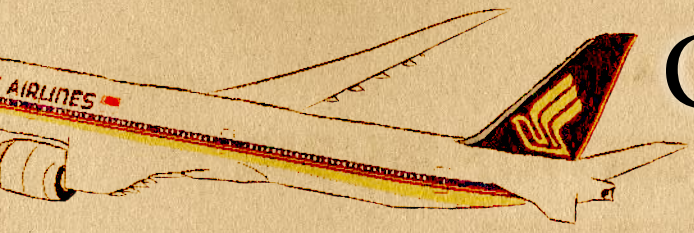
c) No Trustee of the Institute has power, without the express authorisation of the ExCo, to enter into any contract, obligation, pledge, or expense on behalf of the Institute. A member will be held personally liable for any such contract entered into.

A vacancy occurring in the office of auditor during its term shall be filled by such person so designated by the ExCo. The members of the Institute shall not have any personal claim on any property of The Institute and no portion of the income or property of The Institute shall be paid or transferred directly or indirectly by way of dividend bonus or otherwise howsoever by way of profit to persons who at any time are or have been members of the Institute or to any of them provided that nothing herein contained shall prevent the payment in good faith of remuneration to any officer or servant of The Institute in return for any services rendered to The Institute.

The Institute shall not be dissolved, except with the consent of not less than **sixty percent (60%)** of the **voting members** of The Institute for the time being **resident in Singapore** expressed, either in person or by proxy at a general meeting convened for the purposed.

In the event of the Institute being dissolved as provided above, all debts and liabilities legally incurred on behalf of the Institute shall be fully discharged, any property whatsoever, the same shall not be paid to or distributed among the members of The Institute but shall be given or transferred to some other charitable institution or institutions having objects similar to the objects of The Institute, and which shall prohibit the distribution of its or their income and property among its or their members to an extent at least as great as is imposed on The Institute under or by virtue of **Clause 15** of the Constitution, such charitable institution or institutions to be determined by the members of The Institute, in General Meeting, at or before the time of dissolution, and if and so far as effect cannot be given to such provision, then to some other charitable object.

We hope these changes could set the ground for SIAE to move on and continue to contribute to safety in the new era of air transport.



Café Aeronautique

The importance of lubrication on aircraft

By Mike McCormack
Executive Committee Member, SIAE

What is the best way to open a can of oil? There is a right and a wrong way to do this. Using the time-honoured method of punching two holes in the top of the can with a screwdriver is convenient but wrong! The screwdriver can produce small "curls" of metal from the can that will be introduced into the engine oil tank and would circulate through the oil system. Such metal "curls" have been found in the oil system of gas turbine engines removed for repair following reports of "metal contamination" and "chip light" illumination.

The correct way to open a can of oil is to wipe the top of the can before opening the can with a proper can opener (see photo). These can openers, which produce a triangular-shaped hole, can be obtained from good kitchenware shops or by asking your friendly ExxonMobil representative.

Mr Lim Yeow Khee, Singapore Institute of Aerospace Engineers

Special Oil Can Opener – gift from the Sponsor

Mr Russell Chan, Victor Enterprises Pte Ltd

This tip was shared during the SIAE's popular Café Aeronautique on Sep 2018 at the SIA Group Sports Club. Daniel Tan, Distributor Business Consultant for ExxonMobile Aviation Lubricants shared on the range of commercial aviation lubricants, giving details of their history, chemical composition, approval process and performance expectations. Products discussed included jet turbine oils, hydraulic fluids and greases, but everyone seemed to want to hear about the latest oils for gas turbine engines.

The audience learnt how the earliest gas turbine engines were developed using straight mineral oils, but with the progressive development of gas turbine engines which demanded higher thrust and compression ratios, mineral oils were found to lack stability, and degrade at the higher temperatures that they are now subjected to.

The changes which have taken place over the last two decades in engine performance (in terms of higher operating temperatures and pressures) and in maintenance practices, have correspondingly increased the severity of lubricant operating conditions. These changes placed demands on the engine oil and evolved the oils from the first generation of synthetic oils which were based on the esters of sebacic acid, principally dioctyl sebacate, to the second generation, or "Type II" oils and to today's synthetic turbine engine oils which offers very good (and improved) thermal stability, generally known as third generation or "HTS" (High Thermal Stability) oil.

Daniel also shared how routine oil analysis, sometimes referred to as "SOAP" checks (Spectrometric Oil Analysis Programme) is a great tool to determine wear and tear in an engine and to predict its continued airworthiness. A periodic oil sample is sent to be analysed for the presence of minute metallic particles, typically measured in parts per million (PPM) by weight.

An increase in PPM of certain materials can be a sign of component wear or impending failure of the engine, whereby repair or specific maintenance procedure or inspection would be triggered accordingly.

After the talk, a lively Q&A session ensued before wrapping up another fulfilling sharing session with great food and drinks and catching up among the good company of members and guests of SIAE.

Victor Enterprises

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30 years of experience offering technical expertise and innovative solutions.

Victor Enterprises offers a diverse range of automotive, aviation and marine lubricants, diesel, and specialty chemical products for commercial, industrial, aviation and marine applications. Holding authorized distributorship for major petroleum companies, it services a clientele of more than 3,000 in Singapore and regionally. Founded in 1982, Victor Enterprises is a wholly owned subsidiary of Santa United International Holdings Pte Ltd. As a Strategic Distributor for ExxonMobil, Victor Enterprises is well established in its role as regional supplier of fuels, lubricants and specialty chemicals.

Victor Enterprises, ExxonMobil's authorised distributor for SEA markets, headquartered in its Changi logistics complex

Backed by reputable products, a competent sales team, a highly qualified technical support team and a dedicated customer support team, we drive significant, measurable returns for our customers, including OEMs (Original Equipment Manufacturers) and fleet operators, users in the transportation, building and construction and manufacturing sectors, as well as airlines, marine and MRO (Maintenance, Repair and Overhaul) service providers.

Our total service package includes the provision of professional technical experts offering comprehensive analysis and troubleshooting to enhance equipment performance. Technical assessments are also conducted to identify the best products for specific operational needs. In our strive to deliver one-stop convenience for our customers, we provide a range of services which include bulk deliveries for on-site operations, storage facilities, transportation and a flexible array of logistics services to suit customers' needs.

We are constantly enhancing our services to better serve our valued customers. Our systems and processes comply with international quality, environment, health and safety standards including ISO 9001, ISO 14001 and OHSAS 18001. Our vehicles and warehousing facilities are certified for the transportation and storage of highly flammable liquids and hazardous products.

Victor Enterprises is highly responsive to customers' needs and provides uncompromising service standards 24/7. Our role as official fuel supplier for the Singapore Formula 1 Grand Prix circuit attests to our commitment to reliability and peak performance, customer responsiveness and uncompromising service standards.

Importance of lubricant on aircraft

Victor Enterprises is an appointed ExxonMobil Aviation Lubricants' strategic distributor for South East Asia region covering six countries likes Singapore, Malaysia, Indonesia, Thailand, Philippines, Vietnam and Brunei, since 2009. We have grown and achieved successful records serving most of the leading airlines, MRO operators and other aviation industry players. Our capabilities have enabled us to pro-actively anticipate the needs of general and commercial aviation customers. Our customers are assured of a ready inventory, logistics and technical supports that exceed industry specifications.

Singapore is currently one of the world's leading Maintenance, Repair and Overhaul (MRO) hubs, responsible for 10 per cent of the global output. A home to a big and diverse cluster, with over 130 companies providing a whole range of services for engines, components, avionics as well as aircrafts. Major industry players like Airbus, GE Aviation and Rolls-Royce have significant footprints in Singapore. The long-term presence and investments of these companies, together with continued expansion of local companies like SIA Engineering Company and ST Aerospace denote trust in the trajectory of Singapore's aerospace sector.

In today's competitive environment and the increased complexity of aircraft engines have added to the requirements for proper lubrication system. Operators and MROs require up-to-date knowledge and better understanding on these areas.

In 2018, Victor Enterprises celebrated its 10th Year Anniversary as ExxonMobil Aviation strategic distributor and commensurate this significant milestone and achievement with a synopsis themed "Importance of Lubrication on Aircraft" at SIA Sports Club on 6th September 2018.

Victor Enterprises has a range of high quality Mobil Aviation Lubricant Products to suit your every need.

The Unmanned Wonders

Jonathan Chan
SIT Student

It has always been a challenge to capture aerial images of stunning places which are difficult to reach. The traditional method of using helicopters is expensive and sometimes dangerous. Unmanned Aerial Vehicles (UAV) are obvious alternatives. Commonly known as drones, these UAVs could easily do the job, spawning a large following to Aerial Photography.

Picture taken during his roadtrip through Scotland

We spoke to two aerospace students from Singapore Institute of Technology. "With drones, aerial shots (top-down or landscape), and fly-bys allows for breath-taking footage for any video-production" Hidayat told us. "Drones allowed us to capture unique point of view. It is more beautiful to capture photographs from afar and also more scenery are captured to produce a wider frame of view'', he added.

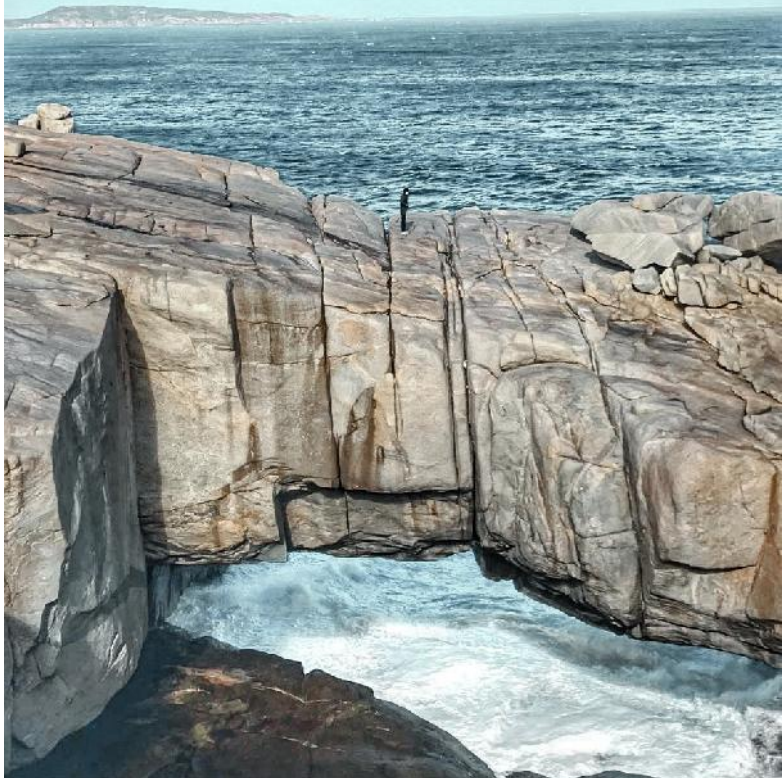
Jia Cheng started exploring photography using mobile phone. "However, I realised that good photographs of certain landscape are only possible with a bird's eye view. That was when I started using a drone for my photography", said Jia Cheng.

Looking at their breathtaking pictures, it makes us wonder if the shots were all planned before taking. "Sometimes at the perfect spot it just comes together and other times it is planned", said Hidayat. "I will have a rough idea on how my photographs will look like and how I'm going to fly my drone to obtain best result", explained Jia Cheng.

Although using a drone to take desired pictures looks easy, controlling a drone requires some knowledge and skills and a lot of practice. Hidayat shared with us the importance of wind and height accommodation. "Make sure the drone does not fly out too far as we may end up losing connection. And be aware that wind gusts can easily blow your drones away out of range". Jia Cheng added "Always remember to check whether the area you are flying at is no-fly-zone".

Bird's-eye view of the Old Man of Storr

For beginners on aerial photography, Hidayat and Jia Cheng recommended these drones: *DJI Mavic Pro, Mavric Air* and *Spark*.



UAVs Not Just Here To Stay. It's Part of Our Everyday Lives

Robin Viva Thevathasan
Asst. Hon Secretary, SIAE

"Drones ply the liminal space between the physical and the digital – pilots fly them, but aren't in them. They are versatile and fascinating objects – the things they can do range from the mundane (aerial photography) to the spectacular – killing people, for example"

John Battelle, entrepreneur, author and journalist.

From palm-sized hobby photography and Virtual Reality Racing through to inspection of hard-to-reach places through to weaponised aircraft such as the General Atomics Predator *('Eye In The Sky')*, drones are here to stay!

Moving from military, security and freight to the personal domain, drones are taking aerial pictures of wedding ceremonies and prospective property acquisitions. We may soon have our parcels delivered by drones to our doorsteps, beyond just off-shore ships! The combined value of these markets is expected to reach US$100Bn by 2020.

Besides gaining prominence in the media, UAVs are biting into display space in Singapore Airshow and Paris Air Show. At the recent Consumer Electronics Show in Las Vegas, Bell Helicopter announced its Nexus Air Taxi and APT (Autonomous Pod Transport) vehicle, a family of 10-50 kg transport drones for cargo and law-enforcement.

In Jan 2018, a 'Little Ripper' drone dropped a life-saving device to a couple struggling in rough surf in Australia. Those two owed their lives to the drone operated remotely by a lifeguard.

In Rwanda, hospitals used to take hours to pick up blood from a regional centre. Since 2016, they have been using Zipline drones to deliver blood directly to the hospitals in less than 30 minutes. The country's vision is to put all its 12 million citizens within 30 minutes of any essential medical supplies. Since 2017, Dubai has been testing the Volocopter (see picture), a drone that can carry a 100-kg payload.

Will we see the day when we board a jetliner without a pilot in front? The technology may be ready, but changing our mindsets will take longer. What is likely to happen in the near-term is first accepting single pilot operation for cargo and military transport aircraft. After these become commonplace, single pilot operation would be introduced to passenger aircraft while freight and military go into unmanned operations.

Many positive and exciting UAV applications are indeed taking place all over the world. There are however, darker aspects of drone usage, such as their use by drug traffickers to slip by border authorities undetected.

Several reports involving disruption of commercial air traffic in major international airports were filed recently (specifically Newark, London Gatwick in the past two months). Such incidents have the potential to cause serious damage to aircraft in their critical landing and take-off phases. There have also been two assassination attempts (in Venezuela and in Yemen) using drones. Like all new technology, UAVs can be abused by those with evil intent.

The authorities responsible for security and air safety in each country are facing serious challenges in policies formulation to embrace UAV deployment. While they are wary of potential abuses, they are also cognizant of the business opportunities that drones can bring to the country. Overly conservative policy would dampen or delay great opportunities that drones could bring to the market. However, the reality of elements with evil and disruptive intent to the public could not be ignored. It is a challenge to strike a balance between the opportunity and threat of scaling up the deployment of UAVs.

UAV deployment is exciting and evolving rapidly. It is arguably the most dynamic in the aerospace arena now. Watch this space for more updates in the next issue.

Where words fail, Music speaks

Carol Cheng

Music has been called 'food for the soul' and 'medicine for the mind'. Its lasting influence on a person is testimony to this. The impact of music on human behaviour has been studied and documented throughout history. It is a strong medium for expressing feelings and a powerful source of bonding.

In the past decades, we have seen an increasing number of people with physical, mental or emotional issues needing special care beyond the routine doctor's visits. It is a global concern, perhaps the result of our industrialised society. It has been predicted that in this millennium, mental disorder will overtake cancers and heart disease as the dominant health problem in the world.

Based on Singapore Institute of Mental Health latest findings, 1 in 7 people in Singapore have experienced a mood, anxiety or alcohol use disorder in their lifetime. Major Depressive Disorder (MDD), alcohol abuse and Obsessive Compulsive Disorder (OCD) are the top three mental disorders in Singapore.

MDD was the most common with one in 16 people in Singapore experiencing the condition at some point in their lifetime, while alcohol abuse and OCD affected one in 24 and one in 28 people, respectively.

Historically in some western cultures, *Man* was compared to a 'musical instrument' which could be 'out of tune', meaning losing his equilibrium mentally and emotionally. Hence, music has been used as a tool to bring Man back "in tune" - restoring one's equilibrium. Danish writer, Hans Christian Andersen famously quoted *"Where words fail, music speaks"*.

Indeed, music never fail to speak, it could speak to our deep unconsciousness and bring light to our consciousness. Each of us has an innate strength to heal ourselves and once it is in our realm of consciousness, we will be able to draw upon it to come to healing.

The Bonny method of Guided Imagery and Music (BGIM) is one of the most effective method that could bring Man back 'in tune'. This evidence-based method used worldwide for many decades was developed by music therapist Dr Helen Bonny in the 1970s in USA. The use of imagery and music for healing would seem to be an abstract concept for many. Although the power of music is well-acknowledged, people are still skeptical about its ability to heal. This is especially so in Asian culture and in Singapore the number of people seeking music as therapy is much lower than our western counterpart.

GIM serves as a tool to unlock our potential of self-healing and awakening. This is the power of music at work. The following vignette may give a feel of the effect of BGI on a woman who came to seek help three years ago.

Lea (not her real name) a 45-year old teacher divorced her husband when she found out about his affair. Her daughter was badly affected by it and had to consult a psychiatrist. Lea was in great distress and went into depression. She could not cry anymore. She appears to be lifeless and apathetic when she came for therapy. The 27-minute music program based on western classical tradition was specially prescribed to address her distress.

In a typical GIM session, the client (traveller) listens to the music with eyes closed and 'travels' with the music while the therapist serves as a 'guide'. The client then shares the spontaneously generated imagery in dialogue with the therapist. However, Lea did not say a single word throughout the whole session. Her face was red and she appeared to be in pain. The session ended without much discussion about her imagery and emotions. That was a very rare situation and as a therapist, I felt the goal of the therapy was not achieved at all. However, the next day, she wrote me the following message:

"When the first piece of music was played my upper body "flared up" with "smoke". Heat is expelling from my upper body (hands, head and face). That was why I couldn't speak a word. I feel the last session took effects on my physical body. I am clearing. For the very first time yesterday, I practice Yoga half way, got so uncomfortable, felt nausea and head spinning. After I got home, immediately slept without showering. My body was detoxing. My body had effect after the therapy.. so its expelling slowly.."

Lea showed progress after 5 sessions for a period of 10 weeks. She was able to reconcile with her life situations and move on from then. For Lea, although she did not speak a word in the session, music has clearly spoke for her.

Editor's Note: The writer is an Associate of SIAE who, as Honorary Counsellor has helped many students at ATTC over the past few years. She is a trained GIM therapist and would be happy to help engineers in distress.

Grooming The Next Generation Aviation Professionals

Prof Lim Yeow Khee *BBM*

In this 2nd part on Grooming the NGAP, we look at the school children and school leavers. SIAE has been a keen partner of STEM efforts by educational authorities all over the world. Over the years, our members have participated in science and technology competitions as organisers and judges. These include the National Junior Robotics Competition and the Singapore Amazing Flying Machine Competition organised by Science Centre Singapore and the TKK Young Inventors' Award organised by the Tan Kah Kee Foundation.

We also participated in the Space Challenge organised by the Singapore Space and Technology Association and various D&T fairs in schools and polytechnics. Our own Aviation Safety Competition (ASC) attracted over a hundred students every year.

Programs for school children and school leavers

SIAE has been working with schools to conduct short courses to develop interest and bring the excitement of aviation to young school children. These courses will teach some basic knowledge and skills which the people behind the scene use to make air travel safe. It will bring awareness of the importance of aviation culture in our industry. Above all, these courses will uncover the mysteries of air transport processes and highlight the excitement of working on the *Aircraft* in the *Airport* and the *Hangar*.

These short courses will be similar to the programs we developed for our ASC. The aim is to bring industry practitioners to engage the young children. Tell them stories, show them the hardware, let them touch the aircraft, let them feel the hangar environment. Capture their imagination while they are young.

The General Assembly Model

In 2011, *General Assembly*™ pioneered an education system to help IT graduates transit to the job market. They engaged industry practitioners to provide experiential education to prepare university graduates with the essential skills and understanding of the work culture, enabling them to get into the right job and pursue careers they love.

This is the type of experiential education we need to ensure that engineers, passionate about aerospace find good job match and pursue careers they love. We need practising aircraft engineers and aviation executives to come forward to form a pool of trainers to deliver the much-needed experiential education for our NGAP.

Aviation Culture

In aviation we deal with complex machines, developed over a hundred years, absorbing every known technology to provide safe and efficient air transport. The key elements in the whole process are the *aircraft* and the *people*. From the onset of man flying a heavier-than-air machine, we become aware that we are encroaching on the unnatural environment of the birds and the insects. The common-sense in the normal world will not be sufficient. We need a different set of rules of behaviours to survive and flourish.

We did. Air travel grew with each wave of new technology from the jet engines through the electronic revolution and non-metal structures to achieve the safest year of air travel in 2017. We did it through painstakingly learning from each mistake and developing new strategies and philosophies to deal with each new wave of challenges posed by technology, economic, social and political factors.

We developed a culture to respect the aircraft which cost millions of dollars and to recognize that people make mistakes. The culture focuses on removing risk at source and building defences against people making mistakes.

Over the last fifty years of phenomenal growth in aviation, we saw the maturity of this culture from the designers of aircraft to pilots, cabin crew and engineers to airport workers and ground support workers. This culture of putting *technology*, *people* and *business* together in a tight bound must be strengthened to maintain the safety margin.

Challenges to Develop the Aviation Culture

Aviation is technology driven. A good logical framework based on scientific analyses is important for decision making. For the Europeans and Americans who pioneered flying and grew through the scientific and industrial revolutions, this was naturally embedded in their culture. Like most other countries, we need to put effort to build the culture.

The aviation culture needs more than just profitability of operation. Sustainability through understanding of maintenance of aircraft, infrastructure and human capital is essential to survive disruptive challenges as well as capturing opportunities for growth and development.

National Airfix

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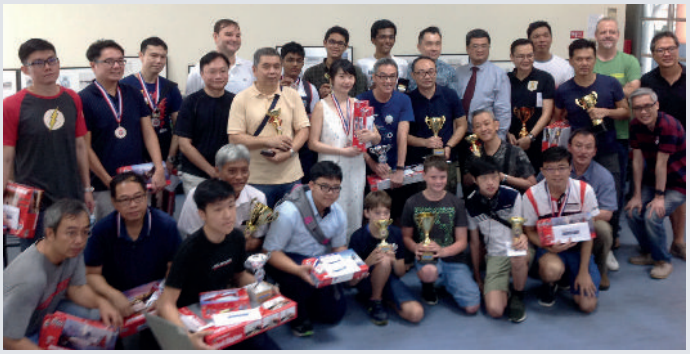

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