

TECHIES

**Commercialising Nanotechnology
Innovation in Malaysia:
A Nanotechnologist's Point of View**

**Fashion Shift: How Nanotech
Revolutionise What We Wear**

**Internationalization of TVET Fashion
Education : Paradigm shift for
Professional recognition**

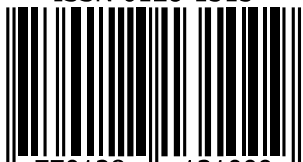
**Aviation Crisis: Reflections of an Aviation
Professional Technologist**

**Qualified Technician, Graduate
Technologist, Certified Technician,
Professional Technologist - Perspectives
of a Technical Recruitment Manager**

**Implementation of Artificial Intelligence
(AI) in the construction industry during
the COVID-19 pandemic in Malaysia**



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Ts. Yap Sheng Lin
Datin Ts. Dr. Norsaadah Zakaria
Nornazihah Binti Abdul Hadi
Thomas P. S. Ong
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PRESIDENT'S NOTE

Techies 10th Edition

*YBhg. Tan Sri Dato' Academician (Dr.)
Ts. Ahmad Zaidee bin Laidin, FASc.,
MBOT President.*

Salam and Good Day everyone,

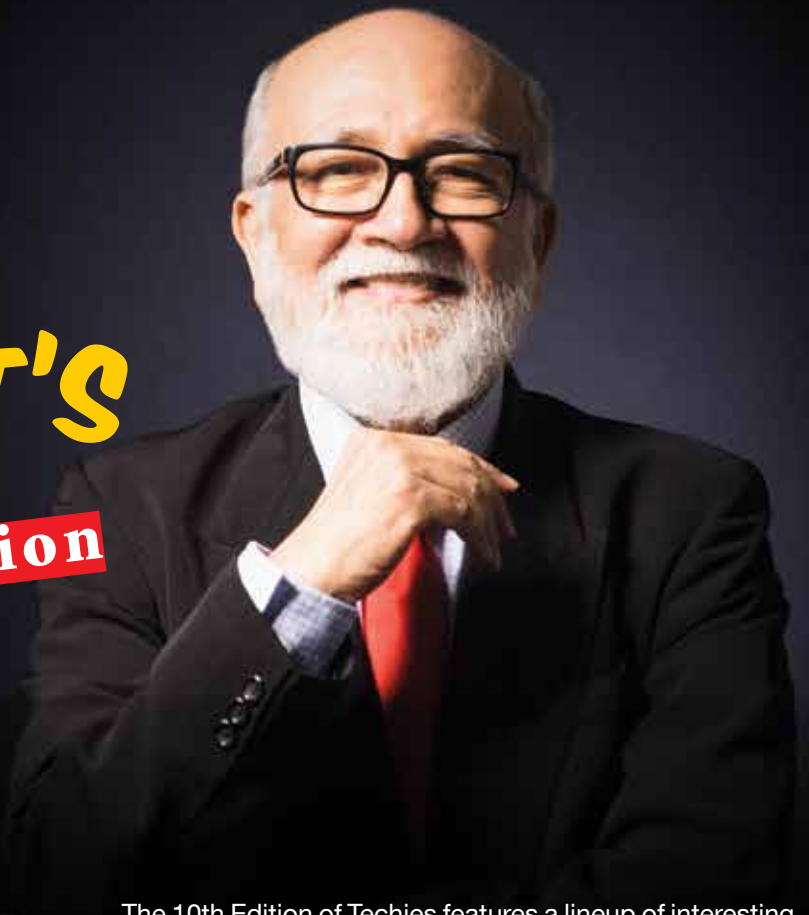
In the midst of pandemic Covid-19, technologies are playing crucial role in helping to build sustainable society. Virtual communication has become a norm for everyone. The statistics released by the Malaysian Digital Association (MDA) showed huge spikes in traffic for video conferencing platforms during the extended Movement Control Order (MCO). In compliance with working from home, organizations and companies opt for video conferencing to continue their operations. That is when we saw the emergence of many virtual communication platforms such as Zoom, Microsoft Teams, Google Meet, Cisco Webex, Skype, Google Hangouts.

In line with the development of the said applications and also to reaching out more people, MBOT started our strategic effort to increase the registration during the MCO through video conferencing. With the collaboration of Technology Expert Panels, MBOT has successfully organized our very first MBOT Webinar Series for 12 weeks from 27th April to 24th July 2020. The Webinar Series covered all 23 Technology and Technical fields recognized by MBOT. The responses were encouraging and on behalf of MBOT, we are pleased to hear that many have requested for MBOT Webinar Series 2.0. Apart from Webinar, Closed Working Group (CWG) was organized with a number of institutions, organizations and industries joining in. With these efforts, MBOT is looking forward to have more Technologists and Technicians to register and be recognized.

The 10th Edition of Techies features a lineup of interesting articles, from nanotechnology and fashion to aviation and construction! Commercializing any innovation is not easy, even more so nanotechnology. However, this is possible with a product which is created from a market pull rather than a technology push within the right niche market. Nanotechnology has also penetrated the textiles industry with the ability to provide consumers with more than just fabric. Garments can now be stain-repellent, wrinkle free, even anti-microbial and more! Read how TVET fashion education is shifting towards internationalization through efforts made to produce more professional apparel technologists. We also feature an interview with a licensed aircraft maintenance engineer, who shares his journey from a trainee artisan to his current position. He is also a recipient of MBOT's Active Technologist Award in 2019. Finally, read about reflections from an aviation professional technologist regarding the current aviation crisis due to Covid-19, and an article on the implementation of Artificial Intelligence in the construction industry during this pandemic.

Lastly, I believe that everyone is playing a role in adapting with the new challenges and we need to be prepared to go through a phase of global change. This pandemic is a lesson for us to learn many new things and unite as a nation. I am wishing the best for everyone. There really is often a silver lining in a cloud, Insya Allah.

Thank you.



Commercialising Nanotechnology Innovation in Malaysia: A Nanotechnologist's Point of View

Assoc. Prof. Ts Dr. Suraya Abdul Rashid, CEng
Institute of Advanced Technology, Universiti Putra Malaysia.

Nano is a prefix to indicate the scale of 10^{-9} . Nanotechnology is a branch of expertise that involves the manipulation of matter at the nanoscale, specifically, a scale that is less than 100 nanometers. To visualise how small 1 nanometer is, try compare the size of the earth to the size of a small marble. If the diameter of the earth is 1 meter, then the marble, having a 1-centimeter diameter, is equivalent to 1 nanometer!

Nanotechnology is a big deal in the frontiers of knowledge because it is disruptive, which means, it has the potential to replace conventional technology. Think about it - conventional technology, which encompasses healthcare, energy, devices, textiles, environmental remediation, transportation, agriculture, and food, is now at stake with the advent of nanotechnology.

In Malaysia, nanotechnology is already home grown, and hence we have the potential to produce many local nanotechnologists in the near future. However, to-date, only 32 nanotechnologists are registered with MBOT. There must be thousands more who have yet to do so.

The common ground for most nanotechnologists is nanomaterials characterisation. More often than not, nanotechnology involves the manipulation of nanomaterials, namely, the harnessing of their unique properties at the nanoscale. Understanding nanomaterials and their properties is crucial in order to use them in various applications. In some circumstances, a whole new market can emerge from nanotechnology innovation.

Nanomaterials can be divided into carbon and non-carbon based materials. Perhaps the most common nanomaterials that have been studied extensively are the carbon-based nanomaterials, which include carbon nanotubes (CNT), graphene, graphene quantum dots (GQD) and carbon quantum dots (CQD).

Back in 2004 when I came back from completing my PhD, CNT was the rage, with many researchers studying CNT synthesis processes. Having higher tensile strength compared to steel of the same dimension made CNT a better choice to be used as fillers in strong yet lightweight nanocomposites. To add, the conducting properties of CNT propelled more research in the area. At the same time, CNT-based sensors





and supercapacitors were also heavily researched. When graphene was catapulted into the limelight in 2010, research into graphene received tremendous attention, making it a trending research theme. The superlative properties of graphene propelled research in the same areas of CNT, covering nanocomposites, sensors and supercapacitors.

While most research attention was on the production of large area graphene for their promise in future flexible devices, I personally decided to swim against the current and studied small area graphene. In this area I discovered GQD and CQD and their unique photoluminescent properties.

My experience with CNT research showed that it was almost impossible to commercialise the technology as it is very much a technology push. In this regard, I had grown tired and weary of trying to pursue something which was beyond my capacity as a humble university researcher. Although the technology for scaling the production of CNT was available in Malaysia, there was no demand for it. Malaysian companies were not ready to invest in the expensive commercialisation of nanocomposites. But my personal desire to commercialise research innovation was strong, because I felt that the ultimate aim of research is to develop technology for the benefit of society. From then on, I decided that my future research would revolve around technology that could create a market pull.

Our discovery of photoluminescent CQD and their green, economical and scalable production (PI2016703467) was a breakthrough for my research team and I. We had discovered a method to produce CQD with no harsh chemicals, which meant that unlike conventional CQD, the material was biocompatible without the need for complex purification steps. At the time, typical applications of CQD were limited to sensors and devices. However, our innovation opened up the possibility of a whole new market sector which had never been pursued before. Being biocompatible meant that our CQD could be used for living beings like humans, animals and plants.

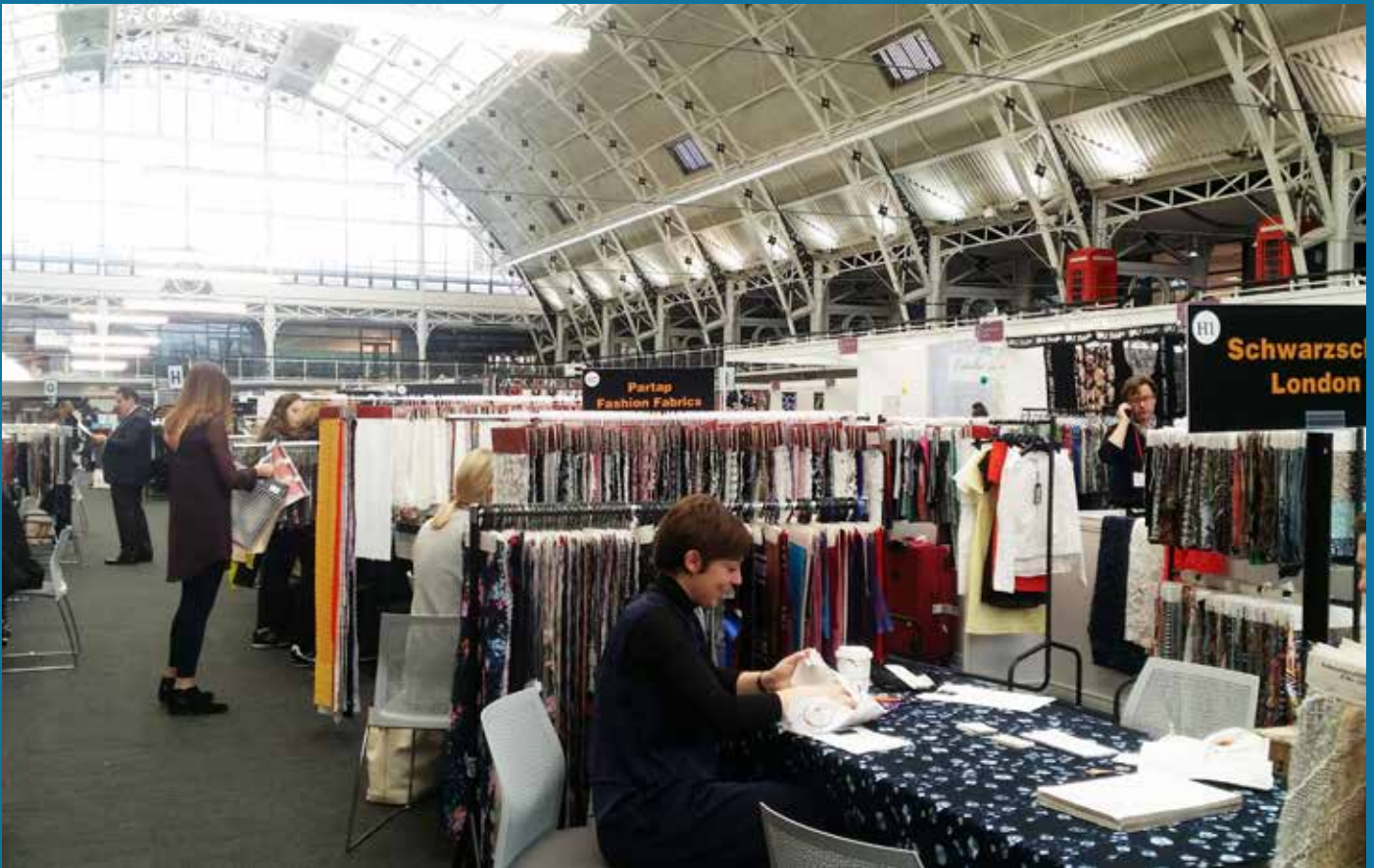
As UPM researchers, our niche areas are related to agriculture, and hence it immediately became apparent that our photoluminescent CQD had the potential to be used as a photosynthesis enhancer - the first of its kind in Malaysia and even the world at the time. I quickly connected with co-researchers with expertise in plant physiology and photosynthesis, and we tested the hypothesis. At the same time, toxicity tests were carried out to ensure that the product would be safe to be used and handled. A prototype was developed and a market validation study was carried out under Putra Science Park - UPM's innovation hub. Encouraging testimonials and recommendations from early adopters gave us the confidence that the product was ready to be marketed - not for the agriculture sector that we initially targeted, but for an even more niche market of home gardeners and plant enthusiasts.

In the course of this journey, it became clearer to us that in order to commercialise innovation, we must:

- Be willing to work outside our comfort zone. This means taking the path less travelled, even if it goes against the grain.
- Be creative and innovative in solving problems and finding solutions. Technology cannot be commercialised unless it is scalable and has economical edge.
- Identify a niche area and subsequent niche markets. Focus on market pull, not technology push.
- Work with a multidisciplinary research team. It is impossible to know everything, hence, we need to leverage on other people's expertise. For example, as a chemical engineer, my expertise is in nanomaterials processing. In order to develop nanotechnology in a niche area, I have to work with experts in that particular field. Going about it in a silo is possible but you will lose out on time. And to commercialise any product, time is of the essence.

Fashion Shift: How Nanotech Revolutionise What We Wear

Nornazihah Binti Abdul Hadi
Thomas P. S. Ong



TEXFUSION - The London World Textile Fair 2017. This trade fair caters exclusively for international fashion fabrics and apparel accessories

Of late, there is a steady shift in fashion, particularly in clothing textiles. Regardless of which market segment – be it sportswear, kids' garment or women's clothing, a measure of functionality is on offer. Thanks to nanotechnology, certain properties in textiles are now created and/or enhanced. With nanotechnology, garments can now be stain-repellent, wrinkle-free, static-eliminating, electrically conductive and anti-microbial – all without compromising quality and comfort.

In recent years, consumers are demanding more than just fabric. A 2016 report published by Cientifica Research shows that industry players in the textile industry look forward to improve technology adoption on their shop floors. The market for nanotechnology-assisted textiles has risen rapidly starting from \$20.3 billion in 2008 and is projected to reach \$205 billion by 2022, representing 16% of the global textile industry by value.

Fashion and technology are inevitably a blend of art - each comprising its own advancements and developments. In 2019 when NanoTextile launched the themes "When Fashion Meets Technology" and "When Mighty Meets Nano", fashion companies were quick to pick up on the trend. It was then that many realised that the fashionista and the technologist must collaborate. NanoTextile did just that - by collaborating not just in clothes design and processes, but also in business models. Such collaborations have resulted in new innovations, leading to a range of functionalities, technical offerings and production methods.

NanoTextile offers the opportunity for industry players to invest in functional clothing as part of their product series. We focus on the nano-embedment activity, which is the final finishing process of textile production. Our technologies are compatible with different types of fabrics including composite fabric, leather, cotton, PE, chiffon, silk, lycra, linen, and a multitude more. Optimization of the embedment process is custom-made in accordance to the requirements of the target market segments such as automotive, industrial, home and clothing textiles. This is advantageous to the particular segment as it enables the offering of unique characteristics desired by the market – be it in terms of performance, comfort, cleanliness or other current needs. The technology used in each one is different, corresponding to the groupings of Hygienic, Care, Comfort, Protection, Advanced and Premium series. For example, the Hygienic Series consist of anti-fungus, anti-microbial, anti-bacterial, self-cleaning and odour control technologies. By offering the embedment process through friendly and approachable business models, clients can maintain their supply chain undisrupted.

“When Fashion Meets Technology” has definitely infused confidence to the consumer. Using nanomaterials in industrial textiles advances a way for the creation of textiles that fit this bill. For instance, NanoTextile’s collaboration with Poney targets specific audience with the launch of Baby Essential Extra Care collection that has anti-bacterial properties. Positive feedback keeps coming in – with parents expressing satisfaction with the enhanced protection the fabric brings. Similarly, “When Mighty Meets Nano” promotes odour-free characteristics in women’s clothing and sportswear.



NanoTextile and NanoMalaysia Bhd in Asia Nano Forum (ANF) 2018, Taipei.

In 2020, NanoTextile sets forth to continue the attempt to revolutionise the fashion industry. In collaboration with our partners, there will be three products launches and two strategies to extend the spill-over success from the past years, including free consultation all year long. The aim is to catalyse the industry to embrace functional textile manufacturing. If 2019 was about setting footprints at international fairs such as the Fibre2Fashion and World Textile Information Network (WTiN), 2020 and beyond are about converting and reaching business realisations.

Nanotechnology is no doubt an interdisciplinary technology often seen as a new industrial revolution. It offers a novel means of processing fabric that could transform the clothing industry. The expectation of the modern-day textile consumers has increased dramatically and will continue to rise. They want textiles that suit their taste and are comfortable, hygienic and eco-friendly. The ever-increasing demand for sophisticated fabrics with special features and exceptional comfort drives the need for the use of nanotechnology in this industry.

For media enquiries, please contact:

Corporate Strategies

NanoTextile Sdn Bhd

Tel : +603 8051 6990

Email : info@nanotextileinnovation.com / azie@nanotextileinnovation.com

Website: www.nanotextileinnovation.com

Facebook: [@nanotextileMY](https://www.facebook.com/nanotextileMY) | Instagram: [@nanotextile](https://www.instagram.com/nanotextile) | LinkedIn: NanoTextile Sdn Bhd



NanoTextile and Nano Center Indonesia working together, leveraging on each other’s strengths.

Internationalization of TVET Fashion Education : Paradigm shift for Professional recognition

Datin Ts. Dr. Norsaadah Zakaria, CText ATI
Clotech Atelier Academy

1.0 Introduction

Telestia Technology was introduced to Malaysian market since 2016 under the name of Telestia Malaysia which is now parked under Clotech Atelier Academy. The Telestia Technology comprises of a system for apparel product development learning process and can be used as the system for tailoring and garment industry. Clotech Atelier Academy is the world partner of Telestia AB-Greece, corporate member of Professional International Body-Textile Institute (TI) and the the Technology Expert Panel (TEP) for Malaysia Board of Technologists (MBOT). Both renowned international partners; Telestia and Textile Institute has been established since the 1940s. Firstly, the main goal of Clotech Atelier Academy is to support the national agenda of High TVET education and to produce more Malaysian (MBOT) and International (TI) Professional Apparel Technologists. The Academy is given the right by world partner to offer all the professional programmes to Malaysians which complement and give added value to the graduates from academic and TVET institutions. The mission is to reskill, upskill and provide competency skills needed in both the manufacturing and tailoring garment industry. Secondly, the main objective is to offer international comprehensive technical skills to the locals. International Professional TVET fashion education prepares the participants with the expected competency skills accepted by the international market.

In addition, Clotech Atelier Academy is also involved in fundamental and applied research in 3D body scanning and anthropometric studies to enhance the fit of garments. Anthropometric research incorporates the understanding of the human body dimensions, which is the core factor for a better fit of functional and fashionable garments. Thus, it is the target of the academy to provide consultations to apparel SMEs industry adopting the Telestia technology.

2.0 Internationalization of higher education

The word “Internationalization” refers to the action or process of making something international. In another definition, it is a term used to describe the act of designing a product in a way that it may be readily consumed across multiple countries. Internationalization is a strategy to make the products and services as adaptable as possible so that it can easily enter different national markets. The process often requires the assistance of subject matter experts, technical experts and people of international experience.

The paradigm shift for professional recognition in the TVET Fashion Education, harmonizes the Malaysian Education Blueprint 2013-2025, which has a great impact to the nation. It signifies the use of technological tools and advanced pedagogic technology in either classroom setting (offline) or home setting (online). The internationalization of the fashion education is seen as the important move for students to learn world class competences and related multiple intelligences for lifelong development in the twenty first century. It is clearly strategic to shift the education from the traditional model towards a new model of globalization, localization and individualization to create unlimited opportunities for optimization of human capital potentials of the nation.

3.0 Internationally competent graduates and trainers.

The internationalization of TVET Fashion Education will prepare the participants to:

- Sell to the world (penetrate international market).
- Buy from the world (networking).
- Work for international companies.
- Team up with employees from other cultures and countries.
- Collaborate with people all over the world in joint ventures.

On the other hand, in order to fit the bill of becoming international and globally competent trainers, the participants need to :

- Envelope the entire Centre of Excellence (CoE) mentality – mission, strategic plan, which is infused throughout curriculum from participants to trainers.
- Maximize partnerships with international players
- Develop internationally minded educators expected to apply the knowledge and skills to their teaching.

4.0 Clotech Atelier Academy solution at hand

The global partnership has these shared missions:

- Offering programmes that is recognized by the Professional Body,
- Professional curriculum embedding competency skills, academic theory and technology,
- Structured learning system that trains comprehensive technical skills,
- Detailed knowledge of apparel product development,
- Unique platform for learning TVET skills available by both face to face and e-learning mode

5.0 Professional TVET Fashion Education in Classroom

The blended learning technology from Telestia system involves teaching using softwares consisting of text, multimedia video, pictures and interactive animation in the classroom. In addition, this learning can further be adopted by the e-learning mode. This is where the software can be accessed from online platforms, for participants to practice at any convenient space in their own personal time. The flexibility of time and technology usage will enhance the learning of generation X and Y; the glass generation in the future. The system also uses sophisticated tools that already has embedded formula, to avoid calculation and to expedite the process of learning pattern making. The Telestia programme consists of comprehensive modules of fashion design, pattern making, sewing and grading technology in both mode of manual and CAD (computer aided design). The competency skills obtain from the disciplines taught from the system is the most completed syllabus anybody can go through, as it covers the whole spectrum of apparel product development.

The application of learning is made easy using the step by step instructions to reach the final output. The usage of the sophisticated formulated ruler also makes it easier and faster to conduct the practices. This will make the participants involved in the industry gain the right techniques and skill and able to work faster, efficiently and effectively. It gives participants the feeling of empowerment when learning, as it is a self-explanatory education software to train self-independent learners whom can benefit from the modern concept of learning.

In conclusion, the internationalization of fashion education using Telestia Technology provides:

- visual adoption and conducive learning environment
- experiential practical learning through ‘try and see’ using multimedia software
- facilitator whom can create more flexible learning environment with different teaching practices
- collaborative students interaction; move students to a definite learner centric
- open book world adoption and provide more learning through glass and device.

My experience of adopting this system in the Malaysian education has immensely given the results that is expected. Furthermore, the quality of the training can be efficiently adopted by more Malaysian fashion designers, apparel producers and garment makers (tailors). Although the training is a bit costly, it is not comparable to the normal garment making training in the country as it involves the international education system, with years of establishment and is applied all over the world. The Telestia system are adopted in the UK, USA, Australia, New Zealand, France, Germany, Albania, Israel, Moscow, Indonesia, Saudi Arabia and Malaysia. The Telestia Apparel Product Development Programme is accredited by the International Professional Textile Institute-UK and on the completion of the programme, participants can be awarded the licentiate as a professional from TI and recognized worldwide.

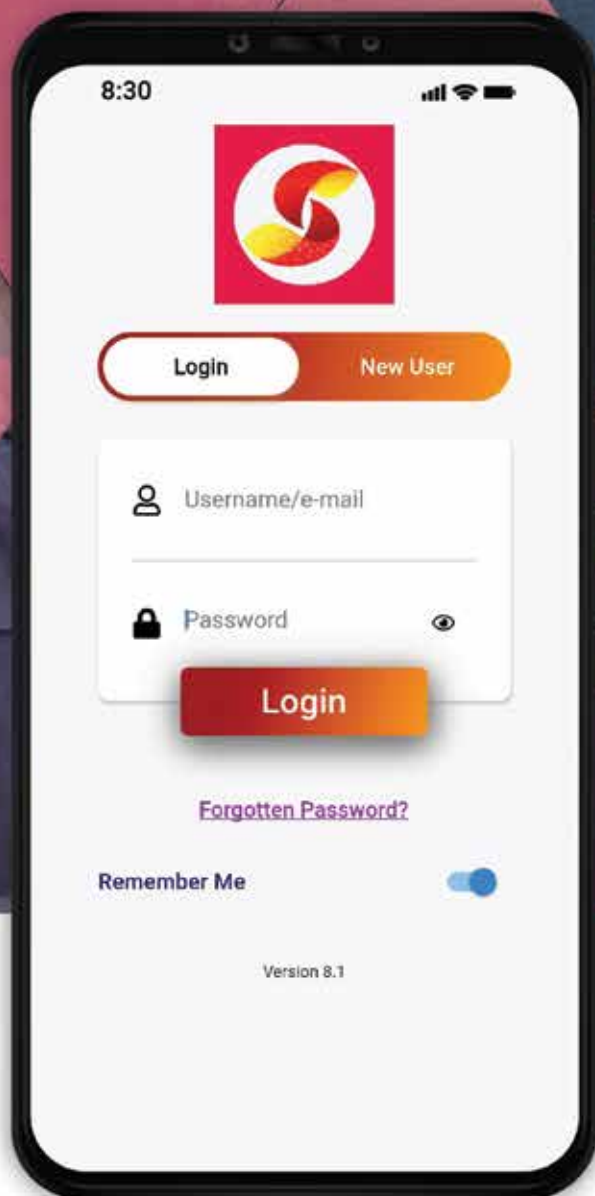


Telestia Malaysia Fashion TVET Education adopting multimedia blended learning methodology



Bibliography:

Datin Ts. Dr. Norsaadah Zakaria CText ATI is the founder of the Telestia Malaysia, Clotech Atelier Academy- Shah Alam. She has international experiences of developing the fashion academy and is also the academic director managing academic portfolio. She holds a Phd and TVET Professional qualification in clothing technology. She is a Chartered Clothing Technologist from Professional Textile Institute-UK.



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Aircraft Maintenance Engineer : A Dream to Reality

Ts. Ricky Liew Chee Leong
Licensed Aircraft Maintenance Engineer
SR Aviation Sdn Bhd

Ts. Liew Chee Leong is a licensed aircraft maintenance engineer (LAE) with the UK and Malaysian Civil Aviation Authority (CAAM) aircraft maintenance license (AML) in category A, B1 (Mechanical) and C. He performs airworthiness certification after accomplishment of maintenance task on an aircraft. He started his aviation career in Malaysia Airlines (MAS) as a trainee artisan in 1989. After two separate training programs in MAS (trainee artisan and trainee aircraft maintenance engineer program), he established as a B737 type rated LAE in 1993. He subsequently moved to Eva Airways Corporation as station engineer before moving on to KLM Royal Dutch Airlines to gather additional exposure and experience. In 2006, he returned to Subang airport to set up and head his current corporate jet maintenance, repair and overhaul (MRO) company. In 2017, he became the first LAE to be certified as MBOT Professional Technologist under the Aerospace and Aviation (AV) field. He completed his MBA with Victoria University, Australia in 2010. Apart from his daily work, he serves as the Vice President of Technological Association Malaysia (TAM), Head of TAM Aviation Working Group and a council member of Malaysian Society for Engineering and Technology (MySET). Currently, Ts. Liew also carries the responsibility as an adjunct professor at the Department of Aerospace Engineering, Faculty of Engineering, Universiti Putra Malaysia. With humbleness, he was selected as a recipient of 30 Sunway Stars award in 2017 and MBOT Active Technologist award in 2019.

1. Can you share your experience on how did you get involved in the aviation field? Is it a childhood dream or interest that grows along with time?

As a child, I have always been fascinated with aircraft. I live in Sungai Buloh (Selangor) new village. It is closed to Subang airport and seeing aircraft climbing and approach from my house captivates me. I used to hear aircraft engine ground run noise from my house. People used to tell us that beyond the thick forest opposite of our house is the Subang airport. I always hope that one day, I am able to work at the airport.

My involvement in aviation started in 1988 after a very small advertisement in a local newspaper that was spotted by my uncle. I then submitted an application to MAS while I was doing my upper six science in Methodist Boys Secondary School, Kuala Lumpur. Eventually I joined a 3 years trainee artisan program on 19 April 1989 in Subang.

2. What is the work experience required to become Licensed Aircraft Maintenance Engineer?

Firstly, before we even discussed about experience, we must understand that LAE cognitive domain (Bloom's taxonomy) are developed through stringent theoretical syllabus in accordance to International Civil Aviation Organization (ICAO) standards and the Malaysian CAAM requirements. This is the part that we learned subjects related to mechanics of flight, construction of aircraft, systems of aircraft, materials combined with good foundation in mathematics, physics and chemistry subjects. A typical theoretical classes if one pass all modules (subjects) at first attempt (which may not always be the case) may take up to two years. Many have to re-sit their exams again because of the high passing mark (75%) requirements. During my time, our answers were marked with negative marking system. Ever since the first LAE was established in UK in 1919, we are trained to be extremely careful and do not take chances if we are not sure because public safety is in our hands.

Secondly, part of the experience that LAEs need is the psychomotor skills. An LAE's high levels of psychomotor domains are compulsory and are developed through stringent structured practical hand skills training. A good combination of high level of cognitive and psychomotor skills is a norm for LAEs and translated to combine theoretical knowledge with our hand skills when performing aircraft engineering and maintenance work on aircraft. These delicate hands skills are the psychomotor skills developed through practical such as drilling, riveting, filing, lock wiring, components removal, precision, flexibility, agility etc. The mental paradigm driving our role as an LAE is the mandatory safety as our first priority. LAEs are versatile group of people and have contributed very well to the Malaysian economy and aviation industry development.

As far as the work experience required before becoming a competent type rated LAE who have airworthiness certification privileges under Civil Aviation Act 3(1967) and Malaysian Civil Aviation Regulations 2016 (with its amendments), it covers the accumulated experience right from the beginning of apprenticeship learning process as described above to the specific type rating (e.g. B737NG, A320NEO, B787, Gulfstream G280, Bombardier Challenger 350 etc.) which will be described in the later paragraphs. There is no direct route nor short cut to become an LAE. Individual may be a diploma, bachelor or even master degree holder but, in order to be a type rated certifying LAEs, individual must go through the tedious and thorough process per CAAM requirements. This is because of the high level of competency, safety and responsibility that an LAE shoulder. It may also be quite a lengthy process with only a handful made it successfully within a desired period of 5 years. Majority takes more than 5 years to be a certifying type rated LAE.

3. Do you mind to share with us, the day to day responsibilities of Aviation engineer?

LAE have technicians and mechanics reporting to him/her. LAE lead them to perform routine and non-routine checks on aircraft and its systems. On completion of task the appropriately rated B1/B2 LAE will perform airworthiness certification as a release to service for the maintenance task performed. LAE takes the airworthiness



*Ts. Ricky and his LAE mentor,
Dato' Sri Azharuddin Abdul Rahman in 1993*

responsibility that the specific system is safe and fit for flight. LAE work at the hangar for base maintenance checks or LAE is assigned to work at the line maintenance (apron) such as at the aircraft arrival and departure bays where passengers fly out or in.

The day to day task for LAEs at the hangar includes base maintenance scheduled checks which includes overseeing zonal maintenance progress related to the his/her own team, inspections, repair, overhaul, testing, modifications, components/systems commissioning on aircrafts, servicing, troubleshooting etc. The scheduled maintenance checks includes base maintenance check from as low as 2 days base check up till 2 months major check (heavy maintenance) of an aircraft. The cat C base maintenance certifying engineer is the overall engineer in charge (chief engineer) for a particular base check and takes the responsibility of certifying a base maintenance release (BMR) of an aircraft which had completed a base check on a single certificate. Major checks are complex and complicated checks whereby, without the cat C LAE BMR certification, an aircraft cannot be release back for flight from the hangar.

At the line maintenance, LAE leads technicians to perform pre-flight, departure, arrival, transit, layover and night stop checks. This includes aircraft flight log review and certifications, walkaround checks, line defects rectification, minor trouble shooting and sometimes component replacement. Defects that require prolong ground time may be transferred to base maintenance for support and rectification depending on the operational requirements.

LAE also move to various other positions in an MRO, industry or regulatory body locally or as expatriates. They can become management engineer such as quality assurance engineer, workshop engineer, test cell engineer, safety engineer, air crash investigators, aircraft insurance investigators, aviation regulatory body surveyors/inspectors, aircraft engineering/maintenance instructors/lecturers/specialist, continuous airworthiness management organization (CAMO) engineer, forward planning engineer, project engineer, marketing and sales engineer etc.



Ts Ricky Liew and his Academic Mentor, Ts. Ir. Prof. Dr. Abdul Rahim

4. Tell us about the most challenging engineering project that you have been involved with during the past years.

Setting up an aircraft MRO facility as my project to provide maintenance services with the relevant approval was the most challenging to me. Huge financial resources and networking are required. Not only my technical competencies are important, I also need to have the appropriate experience and management skills (soft skills). I need to develop stringent recruitment process to identify the right technical and administrative talent, establish inhouse training process, design safe working processes, design the logistics system and processes, develop the vision/mission and strategies to ensure safety, competency and the financial sustainability of my current company is attainable. Setting up from zero to what we are today took years and have been a challenging with all kinds of factors especially the human factors.

5. Share an experience when you applied new technology or information in your job. How did it help your company?

During the 70s and 80s, we used to have paper manuals, drawings, schematics and the expensive microfilm machine to work on in our daily maintenance activities. In the 90s, computer technology becomes more readily available in our day to day maintenance to access manuals (cd and dvd format) and documentations. That expedited our maintenance activities with wider information accessibility. Today's internet of things (IOT) technology enable us to have virtual reality, augmented reality, simulation and twinning that makes visualization and understanding real time aircraft systems accurately. Data may be received as "live" from aircraft that can be interpreted or used to predict an impending failure effectively well before actual failure. Data may be plotted or translated into graph easily to diagnose aircraft defects with high level of precision. With the Industry 4.0 technology adoption progressively, we are able to work even faster and paperlessly, thereby saving resources, improving efficiency and effectiveness of aircraft maintenance operation economically. The overall performance improved and the safety margin of an aircraft maintenance is enhanced even further in my company. LAE needs to adopt technological progress dynamically and need to continuously upskill and reskill ourselves to stay relevant in the aviation industry.

6. Can you share with us, why do you choose to apply for the professional title, Ts.?

Actually, I applied to be recognized and certified as a professional rather than for the title solely. LAE are expert in aircraft and maintenance technology by nature of our stringent training. However, an expert is NOT a professional. A professional must have many other attributes apart from the systems knowledge and skills that an LAE strongly possessed. A professional must have high quality attributes of leadership/management, interpersonal skills and code of conduct. I wanted to test myself if I meet the level stipulated by the Malaysian law. Fortunately and thankfully, I was assessed, confirmed and certified by MBOT to have attained the professional level in accordance with the Technologist and Technician Act 768. A professional must have continuous professional



Equipment training in an aircraft MRO

development (CPD) component, something which may be quite remote if an LAE stays as an expert and did not move to professional level. Honestly, ever since I was being certified, I enjoyed CPD related activities primarily due to the vertical-horizontal knowledge and experience expansion while fulfilling the CPD requirements. It is actually joyfully interesting to find out that there is so much more that I did not know! It is my hope that all LAEs in Malaysia moved from the expert level to the professional level and contribute to our beloved aviation industry development.

7. Who is your inspiration or person that you look up to in this field?

Well, there are quite a few. My LAE mentors are the seniors of the aviation industry such as Dato' Sri Azharuddin Abdul Rahman, Tuan Rashid Shariff, Tuan Yuzer Yusoff, Mr. Albert Ang, Mr. Christopher Danker and Mr. Patrick Ho. Technician mentors of the industry such as Mr. Tan KC, Mr. Lee YS, Mr. Chillayah, Mr. Ian Crosbie and late Mr. Muniandy guided me well on the field. My academic mentor is Ts. Ir. Prof Dr. Rahim Abu Talib. These are the very fine personality that taught me to practice aviation profession with honor and dignity. I hold them highly in my heart and always be indebted to them as someone who had inspired me to be a professional and beyond one day.

8. Do you have any advice to the young generation who aspires to pursue their studies or dream job in the aviation field?

Commitment to safety and integrity is compulsory in our aviation life. Passion in aviation science and technology drives us very far. Inculcate the right attitudes such as discipline, dedication and strong sense of responsibility as an AV professional technologist. Continuous learning and improvement is part of our life. The public safety is highly dependent on our attributes and sound judgement when we practice. Be accountable. Professional technologist has the capability to develop technologies that can benefit mankind positively and be ready to contribute to it. I was part of the team that developed the local sauna32 infrared thermometer (reported in the news) with renown medical physicists Prof. Dr. Ng Kwan-Hoong (UM), Assoc. Prof. Dr. Nahrizul Adib (UM) and Assoc. Prof. Dr. Yeong Chai-Hong (Taylor's University) during the MCO period this year. Remember to participate at various areas for the good cause and help the nation to achieve national aerospace industry blueprint 2030 aspirations.

Aviation Crisis: Reflections of an Aviation Professional Technologist

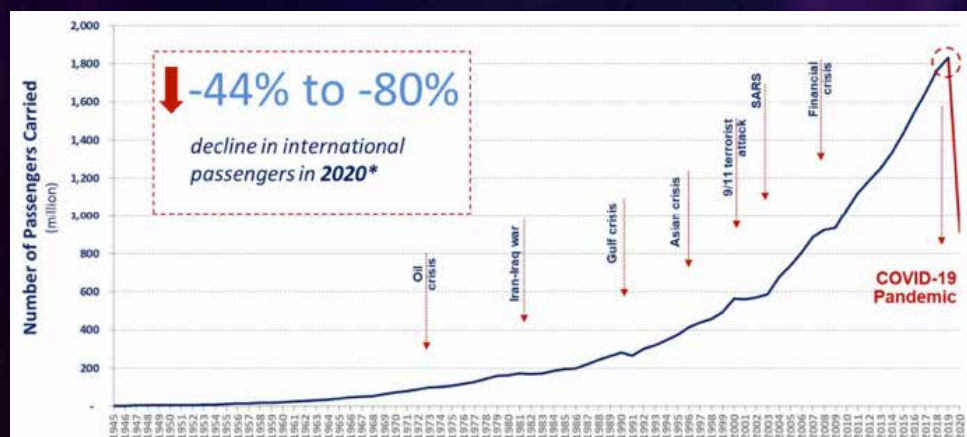
Ts. Yap Sheng Lin

Committee Member of Aviation Working Group, Technological Association Malaysia (TAM)



A crisis is a situation that happens unexpectedly. It usually comes with an element of surprise, posing threats and demanding decisions to be made in a very short time. Crises or emergencies in the aviation industry are either aircraft- or non-aircraft-related. Aircraft-related crises include aircraft accidents, hijacks, bomb threats, biological weapons, and pandemic. In contrast, non-aircraft-related emergencies arise due to natural disasters involving meteorological and topographical causes.

Crises bring about negative implications. Operation disruptions, financial catastrophes, low morale among employees, increased customer complaints, and bad publicity are some examples that could lead to the collapse of business.



World international passenger traffic evolution, 1945 – 2020*

Source: ICAO

https://www.icao.int/sustainability/Documents/COVID-19/ICAO_Coronavirus_Econ_Impact.pdf

The Coronavirus Disease 2019 (COVID-19) pandemic (which is ongoing at the time of writing) has brought the global aviation industry to an almost complete standstill. More than 90% of scheduled commercial passenger flights are canceled as demand falls drastically in tandem with strict border controls and travel restrictions set up to contain the spread of the virus. The International Air Transport Association (IATA) estimates that airlines in the Asia Pacific region alone will experience a decline of revenue in the order of USD113 billion and a 50% drop in passenger demand in 2020 compared to 2019. This staggering figure sends a shockwave across the industry, indicating a huge problem approaching the entire aviation ecosystem. Airlines are burning cash with zero revenue, and are bracing themselves in survival mode.



Fleets are grounding all across the world.

Source: Linsay Wasson/REUTERS

<https://www.weforum.org/agenda/2020/04/infographic-covid19-air-traffic-aviation-coronavirus-international-travel/>

In Malaysia, all flights are suspended except humanitarian flights and flights that carry essential supplies. Indeed, air transport operations and aviation services are essential services under the logistic category. They play an important role in support of vital supply chains and humanitarian missions.



Airlines in Malaysia are temporarily grounded due to COVID-19 pandemic

Source: Azhar Mahfod/THE STAR <https://www.thestar.com.my/lifestyle/travel/2020/04/02/grounded-airlines-in-malaysia-take-to-the-skies-to-help-covid-19-frofliners>

During this difficult time, front liners working in aircraft maintenance must pay special heed to professional ethics, integrity, code of conduct and continuous learning. People react differently in unprecedented situations. As an aviation technologist or technician, one must truly comprehend the facts and figures and not panic and believe in hearsays. Fake, negative or unconfirmed information should be discarded as it will worsen the already tense atmosphere in the organisation. One must remain calm and collected, facing the challenge by responding positively, and taking prompt and effective actions. Honesty, integrity and professional ethics must underlie whatever actions taken in support of the organisation's existing emergency response plan and/or business continuity plan. One must try to innovate and adapt to fast changing operational environments to ensure operational readiness. Effective communication and dissemination of information is paramount in the time of emergency, whereby timely and effective information sharing can prevent confusion and demotivation among workers.

Many aviation personnel have been affected with unpaid leave, pay cut, and furlough, which are some cost cutting initiatives to survive the pandemic. Those affected should use the available time wisely by volunteering their knowledge, skills, experience, and time within the organisation or by focusing on upskilling and reskilling. For instance, one might consider going for training on leadership, management, customer relations, or latest technologies such as data analytics and big data. This will enhance one's value in case of a job function rearrangement within the organisation.

Announcement about the gradual resumption of domestic flights starting April 2020 was a relief in the local aviation industry, especially after news of the collapse of airlines such as FlyBe (UK) and Virgin Australia following the pandemic. Aviation personnel must always be ready to take the aircraft to skies again safely and efficiently.

Even though the COVID-19 pandemic sends every society, business and industry in turmoil with the impending economic recession around the corner, it reminds us of the importance of being humble and human again, as we are in this together after all. Industry leaders, management teams, and professionals must reap from the lessons learned and move forward. Armed with perseverance and resilience, we must strive to emerge stronger and better than before.

Profile



Ts. Yap Sheng Lin has more than 13 years of experience in aircraft maintenance and engineering. Currently working as Assistant Lead Engineer in Part 145 Maintenance Organization. Completed his Master of Business Administration (Aviation Management) in 2019 and Diploma in Mechanical Engineering (Aeronautic) in 2006 from Universiti Teknologi Malaysia (UTM). Joined the aviation industry in 2006 as an apprentice engineer and subsequently established as a practising Licenced Aircraft Maintenance Engineer in both Mechanical and Avionics trade. Current holder of both CAA Malaysia Part 66 B1.1 & B2 Aircraft Maintenance Licence Type Rated in Airbus A318/A319/A320/A321 (CFM56 and CFM LEAP-1A) and CAA United Kingdom EASA Part 66 B1.1 & B2 Basic Aircraft Maintenance Licence. He is a certified professional technologist registered with Malaysia Board of Technologist (MBOT) and serving as committee member in Technological Association Malaysia (TAM) Aviation Working Group.

Qualified Technician, Graduate Technologist, Certified Technician, Professional Technologist – Perspectives of a Technical Recruitment Manager

Ts. Ricky Liew, Recipient of MBOT Active Technologist Award 2019
Technological Association Malaysia (TAM)

Ever since I registered with MBOT and subsequently assessed to be a professional technologist in 2017, I have been involved in many talks and sharing sessions with industry practitioners comprising both technologists and technicians. One of the most common questions has always been, “what are the benefits of registering with MBOT?” No matter which industry the enquirer is from, he/she usually expects immediate benefits upon registration - in the form of financial gain or promotion.

I would like to highlight that there are actually numerous intangible benefits that one experiences in the course of one’s career before starting to see the tangible benefits of registering with MBOT. I have done a number of recruitment exercises on behalf of the company I work for, and I must say, registered individuals usually have more advantage compared to those who are not.

Let me share my perspectives as a technical recruitment manager in order to illustrate the benefits of registering, and subsequently being professionally assessed by MBOT to be a Certified Technician (Tc.) or Professional Technologist (Ts.).

When I review the resume of an individual and find him/her registered with a statutory body, it indicates to me that this individual understands the legal requirements to practice in his/her respective field. Whether the registration is mandatory or voluntary, it means he/she is willing to comply with the related regulations set forth. Naturally, employers would like to employ individuals who comply with the law, especially now that the Technologist and Technician Act 768 (2015) has been gazetted by the government. Compared to his/her unregistered counterpart, the registered job-seeker

would be the preferred choice to go for the next stage of the recruitment process. Thus, his/her employment opportunity increases.

Registering as a qualified technician (QT) or a graduate technologist (GT) means that the individual’s field of study has been audited and recognised. This minimises the prospective employer’s hassle of checking if the individual has studied in an accredited or recognised programme. Fake and “un-cooked” degrees are out there and may have slipped into the employment system. I remember an applicant who submitted a technical degree certificate to me, and pitched himself to join my company. After I told him that there would be an assessment, he literally “vanished”. Recruiters tend to have confidence in a registered rather than unregistered applicant. Again, employment opportunity improves.

The technology profession is by no means an easy profession to be involved in. One must master both the theoretical and practical aspects of the discipline, which takes years of study and practice to attain the right level of competency. Only then would the safety of the public be protected appropriately. Registering as a QT or GT, and then proceeding to be assessed as Tc. or Ts. implies that the individual has attained a high level of competency. Organisations tend to choose individuals with recognisably high competency (ie., the professionals), rather than the regular ‘expert’ in their employment.

In today’s dynamic environment, technology becomes obsolete very quickly. This means one must learn and improve his/her skills continuously in order to be effective. A Tc. or Ts. meets this profile because of the continuous

professional development requirement that must be fulfilled as part of the registration renewal process. It goes without saying that continuous improvement is an attribute much desired by prospective employers.

Employers are part of the economic eco-system that want to see the well-being of the industry, and the well-being of the industry can be attained by training employees in accredited programmes organised by the MBOT Technology and Technical Accreditation Council (TTAC). The instructors of such programmes are Tc./Ts., indicating that the Tc./Ts. is able to support their employer's agenda to strengthen the industry. This leads to a higher chance of employment of the Tc./Ts. compared to non Tc./Ts.

Recently, I came across a technical study programme in a local university. The programme could not be launched due to the absence of professionally registered lecturers required for the programme to be accredited. This shows that the Tc./Ts. has an employment opportunity at institutions of higher learning (IHL). Many IHLs need Tc./Ts. to have their technical programmes accredited. Teaching in IHLs enables the Tc./Ts. to transfer his/her knowledge and skills to future generations. Once again, additional employment opening is available for registered and certified individuals compared to non-registered individuals.

In the course of my job, I have encountered people who have attained expert level in performing a particular technical work but have failed to be productive as a team member. Many times, the dominating mindset is "I just do my work, the rest I don't care". This denotes an individual's failure to demonstrate good leadership and commitment, which leads to lower productivity and efficiency of operations. Fortunately, the Tc./Ts. is assessed for having attributes of leadership, management and supervision. These attributes are desired by prospective employers. I have observed again and again that an individual may be an expert but may not be a 'professional' in the truest sense of the word, leading to the Tc./Ts. having a higher chance of employment compared to the non-professionally registered individual.

Over the years, I have recruited experts who have many more years of experience than me. No doubt they are able to solve various technical problems. However, some have weak interpersonal skills, which then results in huge conflicts in the company. This eventually demoralizes the team and causes a climate of hostility. On the other hand, a Tc./Ts. has his/her interpersonal skills assessed. Good interpersonal skills lead to high productivity and safety level - an aspect employers look for in an employment candidate.

Recently, I received a call from an ex-colleague who was known as a "walking maintenance manual" due to his extensive knowledge and experience. Unfortunately, his recent bidding for a contract was turned down because the company wanted a professional rather than just an expert to do the job. A professional is known to not act

irresponsibly due to his/her adherence to the professional code of ethics. Such adherence means staying clear of unethical or irresponsible actions while providing technical services. Dishonesty, fraud, falsifying documents, bribery, corruption, violating rules and regulations are some of the prohibited practices of the registered individual. Of course organisations prefer to recruit such registered professionals rather than unregistered experts who are not bound by any professional code of ethics.

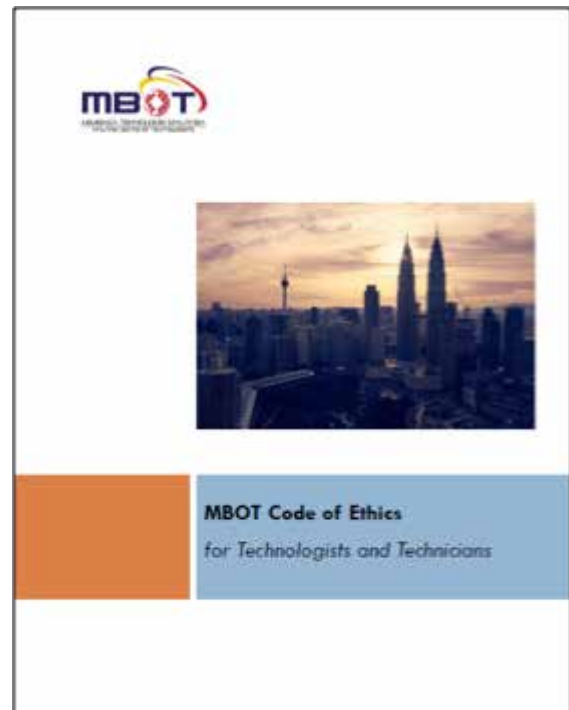


Figure 1. MBOT Code of Ethics for Ts. and Tc.
Source: www.mbot.org.my/act-regulation/code-of-ethic

Compliance to the professional code of ethics, which is what every Tc./Ts. is obliged to do, contributes to the well-being of the industry. This translates to better employment and promotion prospects compared to the non-registered technical individual. As a responsible employer, the Tc./Ts. is the first priority to be considered for employment or promotion in order to safe guard the industry and to move towards Industry 4.0 agenda in Malaysia.

Established in 2015, MBOT is an avenue for technical personnel from 23 technological fields to be registered. It is important to realise that becoming a registered professional is an investment that benefits the individual, organisation, industry and eventually the nation. I encourage all technical individuals to register and eventually become a Tc. or Ts.

Implementation of Artificial Intelligence (AI) in the construction industry during the COVID-19 pandemic in Malaysia

Dr. Shalini Sanmargaraja, Dr. Abdullateef Olanrewaju (Universiti Tunku Abdul Rahman) and Ts. Dr. Khoo Boo Kean (Technological Association Malaysia)



Coronavirus disease (COVID-19) is a contagious disease spread by a novel coronavirus. This virus is predominantly transferred through droplets produced by cough, sneeze, or exhalation of an infected person. These droplets will then fall on floors or surfaces and can be transmitted when someone touches the contaminated surfaces and then touches their eyes, mouth or nose. You can also become infected by inhaling the virus if you are too close to the COVID-19 carrier. Outbreak of COVID-19 started from China in 2019 has led to the closure of most economies. The Global Gross Domestic Product (GDP) has been estimated to reduce by almost 3% which is almost USD 9 trillion due to this pandemic. Although, COVID-19 crisis has not led to financial crisis yet, it is clear that the impact it has on economies worldwide is great. It might take up to 5 years for economies to make significant improvement. So far, this pandemic has affected 6,416,828 confirmed cases and has claimed more than 382,867 deaths (WHO, 2020) as shown in Table 1. Within the same period in Malaysia, there are 7,970 confirmed cases and has claimed 115 death cases. To curtail the spread of this pandemic in Malaysia, a Movement Control Order (MCO) was imposed from 18th March 2020 to 31st March 2020 which totally locked-down almost all the sectors in Malaysia including agriculture, fishery, education, construction, mining and quarrying, manufacturing and many more. However, the MCO was further extended to 9th June 2020 with some conditional movements to allow some economic sectors to resume with appropriate Standard Operating Procedures (SOP). Till date, there is no vaccine to combat this COVID-19 pandemic.

WHO Regions	Confirmed cases
Americas	3,022,824
Europe	2,211,148
Eastern Mediterranean	570,026
South-East Asia	309,597
Western Pacific	186,853
Africa	115,639

Table 1: Global COVID-19 cases statistics (WHO, 2020)
Data last updated: 2020/6/4, 4:17pm CEST

Like other major economic sectors, the MCO has led to the closure of construction sites in Malaysia. The construction sector is facing decisions about how to continue operation while keeping construction labour, especially the site operatives safe and healthy from the scourge for the COVID-19 and the site related disease that are spreading fast and ill understood. All construction projects except those considered extremely necessary for national reason have stopped operation and construction site operatives were asked to stay at home. The Post-MCO pose a great challenge to the global construction industry as it moves to recover from the effects of the COVID-19 pandemic. It will face many challenges such as insufficient site labours, closing of factories, low morale among the labours, less productivity, shortage of materials, failure to handover the projects in the stipulated period, shortages of plant and materials, borders closing, delay or inability to obtain required permits and changes in work culture on the sites. These challenges require a paradigm shift in the construction and construction management processes and procedures. As such, the role of construction management has become more critical and significant now compared to previously. At present, COVID-19 has exposed the inadequacy in the construction management. For instance, the poor health and safety practice on sites has been exposed. There is a cogent need to rethink the ways projects are monitored and how site progress is evaluated among the others. As a player in the construction industry, a question that comes in our mind is can we expect social distancing to accelerate innovation in the construction management? Our answer would be YES!

Thus, to help our Malaysian construction industry to face the new normal working culture, it is imperative for the industry to invest in the most advanced technology applications like drones, robotics and Artificial Intelligences (AI) to ease construction site activities. Even though AI is implemented in Malaysia since 2018 in the evolution of Industry Revolution 4.0 (IR4.0), many construction players are still ignorant about its benefits, and are reluctant to adopt it. The reason is simply because the players are “too comfortable” with the conventional method and not ready to adopt any other new technologies. However, in the Nine Pillars of Industry Revolution 4.0 it has

been recommended by the government that Big Data, Augmented Reality, Simulation, Internet of Things (IoT), Cloud Computing, Cyber Security, Systems Integration, Additive Manufacturing and Autonomous Systems should be adopted to ease the operations of the industry. AI is a branch of computer science that allow machines to mimic the human brain in decision making. The term AI was first coined in 1956 but its application just gained popularity lately due to the huge amount of data available to make an informed decision. Although AI is perceived as future potential technological evolution, there are several barriers, threats and risks associated with it, as shown in Table 2.

Barriers	Threats	Risks
Lack of understanding	Fake videos contains of impersonate figures to manipulate public opinion	Often hidden bias
Lack of resources	Automated hacking	Neutral networks deal with statistical truths rather literal truths
Lack of willingness to change	Spam emails using information taken from the social media	When errors occurred, diagnosing and rectifying it can be difficult
	Exploitation of vulnerability of AI through examples and data poisoning	
	Crashing fleets autonomous vehicles	
	Turning commercial drones into face-targeting missiles	
	Holding critical infrastructure for ransom	

Table 2: Barriers, threats and risks of AI (Prieto, 2019)

The adoption of AI into the construction projects has both medium- and long-term implications as shown in Table 3.

Medium Term	Longer Term
With the rapid evolution of technology, there will be an increased need for engineers to research, create and test AI systems.	History has shown that technological advances in the past have helped to create new jobs.
Engineers have an enormous opportunity to showcase their creativity in response to advances in AI.	AI literacy or proficiency will be a prerequisite for survival.
New types of experts will increasingly be in demand in response to the new types of work.	Existing business model will be replaced by value added business model.
New developments in AI will enable engineers to complete their work more efficiently and solve a wide range of problems.	Risk of new entrants to business growth.
Exemplar AI use cases become mainstream. First movers accrue competitive advantage in winning work and executing work.	Technology partnerships important but also increasingly transitory
Existing labour time business model will be put under stress	Continuous innovation and improvement process are prerequisite for survival

Table 3: Implications of the usage of AI for Engineering and Construction (Prieto, 2019)

In the construction sector, AI is useful in making decisions for example on business development marketing, sales, analytics, financial, legal, project health, human resources, information technology, engineering and design, operations, supply chain, and logistics. The major objectives of AI in construction management is to assist decision makers in the following areas:

Selecting appropriate procurement strategies	Preparation of work schedule	Selection of construction methods
Health and safety prevention	Project monitoring and control	Dispute and claim resolution
Budget preparation and control	Project coordination	Plant and equipment inspections

However, the adoption of construction and information technology in Malaysia is relatively very low. Besides the AI application to drive productivity and efficiency in the construction industry, there are many other software and applications that can be used to ease the construction activities, especially to ensure social distancing and to work remotely. Some of the technologies are Building Information Modelling (BIM), drone application and Low Power Wide Area Networks (LPWAN). Building Information Modelling (BIM) helps the construction players to monitor the stages of a project lifecycle from the early conceptual phase up until the handover and maintenance. In addition, BIM is also capable to integrate time and cost which supports real-time data to enhance the efficiency of the project phases. It can also be utilized in the assessment and analysis of green building, which helps in detecting clashes and design optimization. Drone or Unmanned Aerial Vehicle (UAV) can be easily used in urban planning by creating an animated

feature of buildings, streets, and open spaces which will then be used in creating 3-D modelling forms in traditional Malay cities. Kaamin et al. (2017) indicated that drones are commonly used nowadays in construction sites replacing the conventional method of photographing using digital camera. Drones help solve issues faced by the site engineers to monitor high reach points and view the entire construction site. The highest usage of drone is recorded in the construction industry followed by mining, agriculture, surveying and agriculture as shown in the Figure 1.



Figure 1: Usage of drones (The Asean Post, 2019)

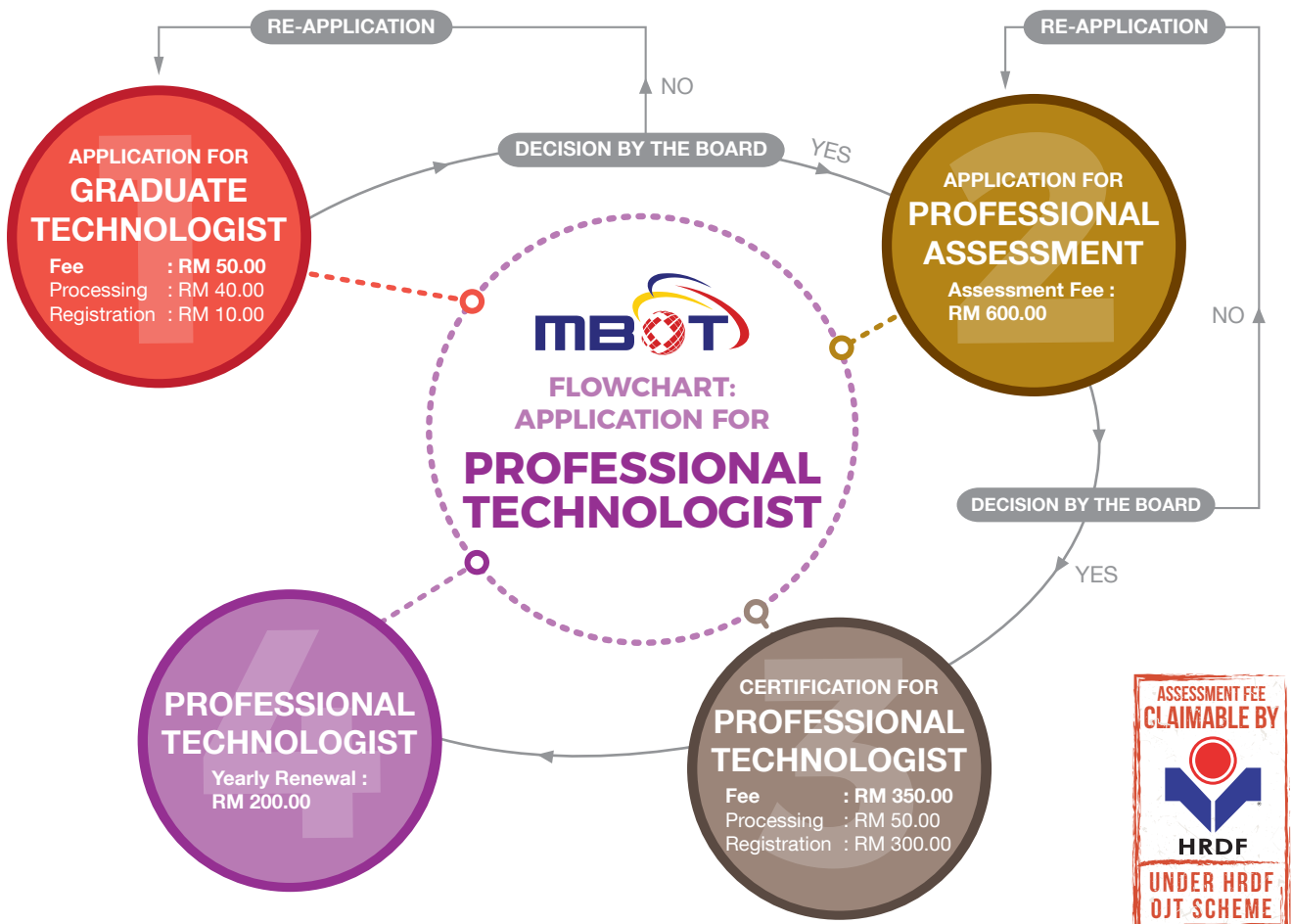
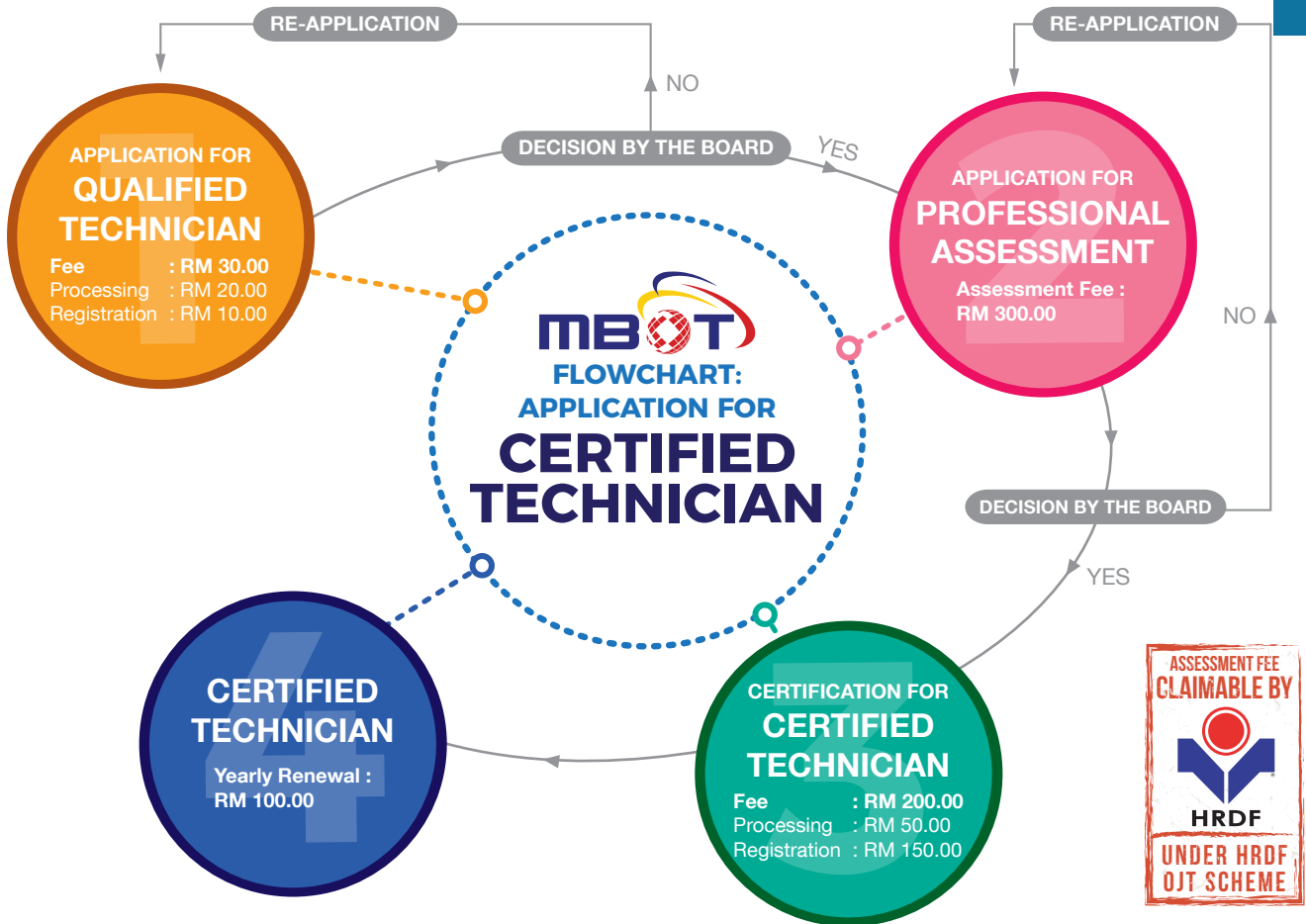
Evolution of the Internet of Things (IoT) can be seen clearly with many developments of Smart Cities, Smart Homes, Smart Transportation and many more. Recently, outdated wireless network is no longer considered as the expedient network anymore, especially for the low mobility communication devices. Due to the complex operations involved in construction sites, wireless distributed sensor applications would be the best option to track locations and to monitor progress. Many of the construction projects in Europe are using Low Power Wide Area Networks (LPWAN) which operate in public Long Range (LoRa) networks for location and disposition of assets, tracing off-site construction and checking incoming deliveries, finding of tools, monitoring machineries, geo-fence alerting and managing inventory. Adding to this, LoRa also helps in managing inventory, optimizing workflows, shock or temperature monitoring, counting the operation hours and billing services at the office. Many studies have shown that LoRa technology is above the human capacity for record keeping and data analysis of huge data which are available in construction projects (Teizer et al., 2018).

Concluding remarks

The COVID-19 pandemic has indeed brought in more responsibilities and challenges to the construction sector. There are many modern tools, machinery, software, and applications that the construction industry can employ to drive productivity. Applications of the technology enable real-time collection and transmission of data for effective decision making on all the segments in construction processes and procedures. The changes in construction landscape means that the roles of construction management in the construction industry is increasing and more sophisticated. It is not difficult to explain that the major problem confronting productivity, efficiency, profit, and client satisfaction are construction management problems. The roles of consultant construction managers are now more demanding than it used to be. Without the engagement of consultant construction managers, it will be difficult to drive efficiency, higher productivity and attain better communication to ensure greater accountability in project delivery.

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23 FIELDS OF TECHNOLOGY

What is MBOT's Recognized Technology Fields?

To-date, MBOT has recognized 23 Technology and Technical Fields. These technology fields are not permanent and will dynamically change based on the rapid growth of technology. Each Technology Fields has gone through rigorous verification and requirements study before it was being approved by the Board and recognised as MBOT Technology and Technical Fields.

Each Technology and Technical fields was defined by MBOT's Technology Expert Panel which consists of representative for the industry, relevant government agency and academia.

The Key Area for each Technology and Technical Fields was also defined properly to cover the wide angle of Technology Fields and its implementation in the industry.



Electrical and Electronic Technology (EE)



Information and Computing Technology (IT)



Chemical Technology (CM)



Telecommunication and Broadcasting Technology (TB)



Biotechnology (BT)



Building and Construction Technology (BC)



Resource Based, Survey and Geomatics Technology (RB)



Manufacturing and Industrial Technology (ME)



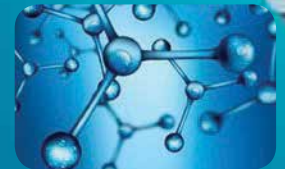
Agro-based Technology (AF)



Cyber Security Technology (CS)



Transportation and Logistic Technology (TL)



Material Technology (MT)



Marine Technology (MR)



Maritime Technology (MI)



Atmospheric Science and Environment Technology (AC)



Green Technology (GT)



Oil and Gas Technology (OG)



Automotive Technology (AT)



Aviation and Aerospace Technology (AV)



Food Technology (FT)



Nano Technology (NT)



Nuclear and Radiological Technology (NR)



Art Design and Creative Multimedia (AM)