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LEMBAGA TEKNOLOGIS MALAYSIA
MALAYSIA BOARD OF TECHNOLOGISTS

TECHIES

Construction Technology and the Fourth Industrial Revolution

Industrialised Building System: Ideals and Realities

Thermal Comfort and Buildings

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LEMBAGA TEKNOLOGIS MALAYSIA
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President's Note

Tan Sri Dato' Academician (Dr.)
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Malaysia aspired to be a developed country by 2025. The emerging technology has taken our life and work to create opportunities. The Internet and other advances in Technology have contributed to the development of nation's economy. Along with the rapid economic progress, new technological adoption and skilled labour demands drive stronger competitions for workforces to be recognized as professionals.

With the recognition through membership registration with Malaysia Board of Technologists (MBOT), the Technologists and Technicians now have a clearer path towards gaining recognition. The recognition is one of the important elements that will help weather the Industrial Revolution 4.0.

The construction industry in Malaysia has undergone accelerated evolution, driven by technology and innovation. Building and Construction Technology is one of the 23 technology and technical fields recognized by MBOT. Thus far, 575 Professional Technologists (Ts.) and 44 Certified Technicians in Building and Construction Technology has been recognized by MBOT. As one of MBOT's Technology Expert Panel (TEP), Technological Association of Malaysia (TAM) carries the responsibility to help MBOT in developing the best practises in the field of Building and Construction Technology. TAM is actively assisting MBOT in providing professional assessment framework and advising the Examination and Qualification Committee (EQC) in terms of technology and technical aspects that needs to be covered during the assessment to ensure that all related assessments are covering the latest technology.

Apart from that, MBOT has been given the opportunity and accepted as provisional signatory of Seoul Accord in June 2019. The proactive step towards joining Seoul Accord is crucial to upgrade the computing and information technology programs accredited by MBOT as professional programs that will be recognized by the signatory countries of Seoul Accord.

For future plan, in November 2019, MBOT in collaboration with Majlis Bandaraya Shah Alam (MBSA), Malaysian Society of Engineering and Technology (MySET) and the Board of Town Planners Malaysia (BTPM) will work together to organise a conference entitled "Smart Technology for Smart City Summit 2019". The event is organized as an effort to empower the professions of Technologists and Technicians by enhancing cooperation of various parties especially academics, industry players and higher education institutions.

Lastly, MBOT is committed to have more linkages with various parties in order to develop our functions and constantly expand the recognition of technologists and technicians more resourcefully.

About MBOT

LEMBAGA TEKNOLOGIS MALAYSIA
MALAYSIA BOARD OF TECHNOLOGISTS

- The Parliament of Malaysia has enacted the Technologists and Technicians Act 2015 (Act 768), an act to provide for the establishment of Malaysia Board Technologists (MBOT), in line with other professional bodies in Malaysia.
- MBOT is responsible for the registration of graduate technologists and qualified technicians as well as to recognise professional technologists and certified technicians.
- MBOT promotes education and professional training in related technology and technical fields.
- MBOT recognises technological careers and empowering Technical and Vocational Education and Training (TVET).
- MBOT strives to be internationally recognised in the accreditation of technology and technical programmes with international accords in various fields. To date, MBOT has been accepted as provisional signatory to Seoul Accord for the field of Information & Computing Technology and Cybersecurity Technology.

VISION

To be a world class professional body for technologists and technicians.

MISSION

To elevate the standing, visibility and recognition of technologists and technicians.

OBJECTIVE

To increase the pool of skilled workforce required to attain a high income economy, and to protect public safety and health.

WHO SHOULD REGISTER?

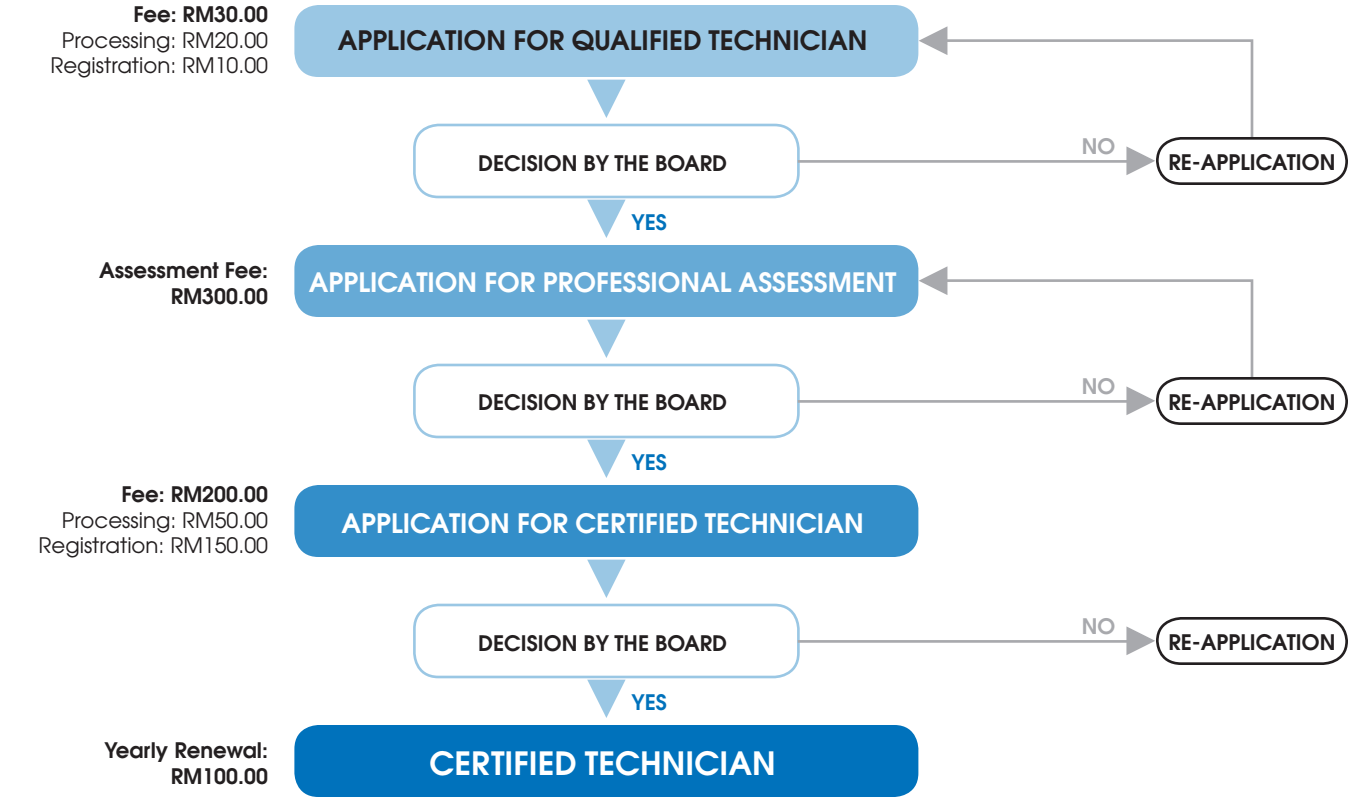
✓ **Professional Technologists**
Graduate Technologists with practical experience as stipulated by the Board

✓ **Graduate Technologists**
Holds a bachelor's degree recognised by the Board

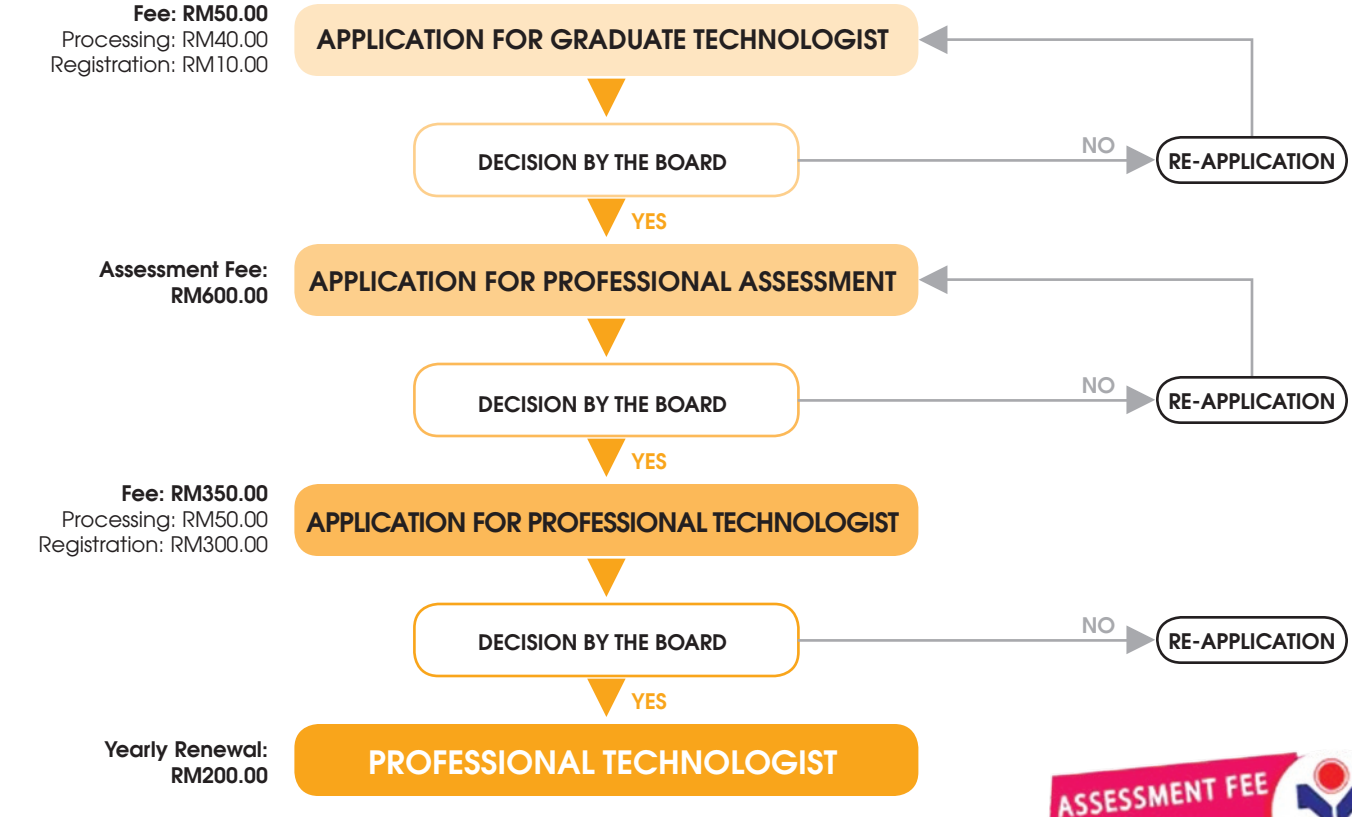
✓ **Certified Technician**
Qualified Technician with practical experience as stipulated by the Board

✓ **Qualified Technician**
Holds a certified qualification recognised by the Board

MBOT Flowchart: Application for Certified Technician



MBOT Flowchart: Application for Professional Technologist



Construction Technology and the Fourth Industrial Revolution

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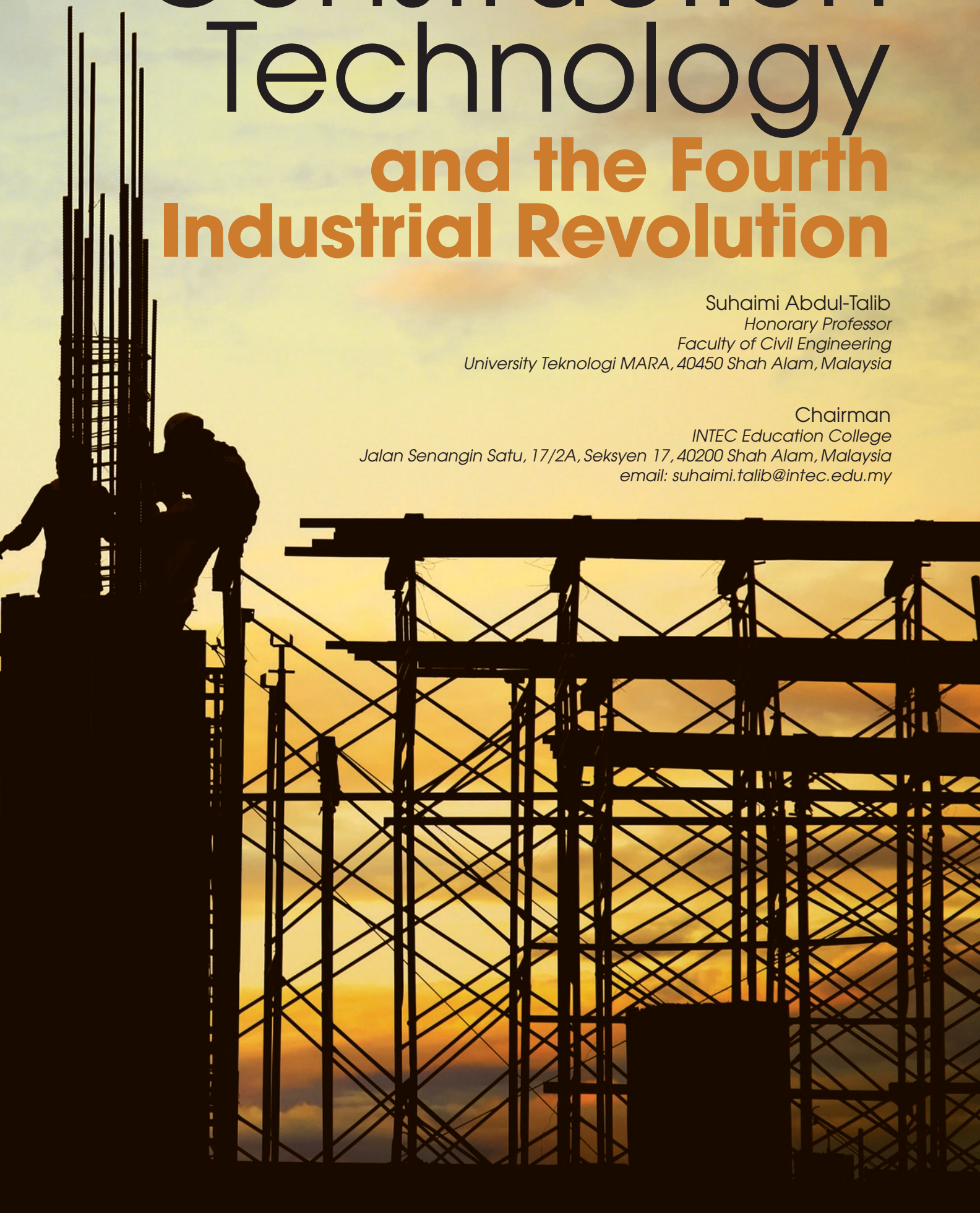

Introduction

Construction, together with manufacturing and services sectors are instrumental in maintaining growth of the Malaysian economy. Compared to the latter sectors, construction has not shown much progress in terms of technological innovation. Apart from the use of modular construction and Building Information Management (BIM), the construction industry has not changed much over the last 50 years (King, 2017). It has continued to operate with heavy reliance on manual labour, mechanical technology and established business model (Castagnino *et al.*, 2018). Construction has been and still is perceived as an environmentally destructive and degrading activity. In order to meet the ever increasing demand of rapid urbanization, the industry has utilised natural resources to the extent that we are now faced with the challenge of managing resource scarcity. In addition, the World Economic Forum (WEF, 2018) had attributed 30% of the greenhouse gasses to construction and the products of construction activities. The industry is also acutely suffering from under investment in capital, innovation and digitization (BDC, 2018). The coming of the Fourth Industrial Revolution provides an opportunity for the construction industry to rebrand its image by embracing innovative technology that has benefited the manufacturing, services and other sectors. If positive changes are not taken in line with the technology and life styles accompanying the fourth industrial revolution, then there is a high possibility that the construction industry will contribute towards deterioration in standards of living for our society.

The Need to Embrace Disruptive Technologies

The leaders and main players of the construction industry need to have a change in mind set or a paradigm shift. A shift from an industry that sells products (buildings and infrastructure) to that of providing or selling services (living and life styles). Construction must now be viewed as an industry that sells services related to affordable living for the society.

The industry must design facilities related infrastructure that will enable the present and future society to live in a cyber-physical environment brought about by the fourth industrial revolution. Focus should be more on providing designs that incorporate sustainability, technology for future living, including the internet of things (IoT), smart operations and maintenance of facilities.

During the construction stage, serious efforts and investments must be made to engage advanced and possibly disruptive technologies in the context of optimising human and machine interaction while at the same time safeguarding the integrity of the natural environment. These include the use of digital simulations to study impacts on the environment, the use of augmented reality for design and components fabrication, the use of 3D printing for components manufacturing, the use of drones for surveying, monitoring and controlling of activities on construction sites, the use of autonomous machines and robots for dangerous or ergonomically hazardous works both in fabrication facilities or on construction sites. In addition, extensive use of sensors should be deployed in order to create facilities which are IoT-ready. This will allow large data to be collected and analysed using artificial intelligence and machine learning that will further enhance the cyber-physical environment and improve the facilities during their service life.

The industry must also accord similar focus to ensure adequate supply of appropriately trained talent that is ready to work under the disruptive environments. This will require two major efforts. First is the effort to retrain, reskill and upskill existing talents in line with the life-long learning concept that has now become inevitable with the coming of the fourth industrial revolution. Second is to train fresh talents that will be joining an industry that is transforming. Both would require a collaborative effort between academia and the industry. The current training programmes aimed at producing talents for the construction industry would need to undergo major transformations.

Keywell (2017) emphasised that the emerging advanced technologies will not replace the role of humans. As such, training programmes must be designed so that learners use these technologies to empower them in enhancing their skills, intelligence and ingenuity. Both parties will need to work together in reinventing education and training. This will involve curriculum design and instructional design that will be able to develop the required mind set and skillsets (learning outcomes). Furthermore, the design must ensure that future talents are exposed to suitable and relevant learning environments and learning experience.

With the right business concept of selling services using advanced technologies delivered by competent talents, the construction industry will be able to rebrand itself as a relevant industry in the era of the fourth industrial revolution.

Benefits of embracing the disruptive technologies

By embracing the disruptive technologies that come with the fourth industrial revolution, the industry can enjoy better standards related to health and safety for construction personnel and for users of the built facilities. In addition, the competency of the construction personnel will be further enhanced leading to greater productivity. Furthermore, there will most likely be improved efficiency and effectiveness leading to long term cost savings resulting in the industry being able to offer more affordable facilities and services. On the macro scale, the transformation of the construction industry in line with the fourth industrial revolution will certainly result in better environmental sustainability and higher standards of living for the society.

Concluding Remarks

Leaders and players in the construction industry must be prepared to reform the industry in line with the changes that are globally sweeping all the sectors. The effort must involve innovation in seeking solutions to the new cyber-physical living environments.

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From Solar Garden Lights to Solar Farms

Datin Hasnah Awang
Executive Director Gading Kencana Sdn. Bhd.

Solar powered garden lights

Malaysia enjoys an abundance of sunlight throughout the year. This provides an opportunity to cut down energy consumption by utilising solar energy. In some instances, solar energy operates from a stand-alone system, which does not require the use of cables to supply electricity to remote areas. This significantly reduces the cost of infrastructure development. From tiny solar lights that lit up the home garden to huge solar farms that supply electricity to big cities, solar energy proves itself useful over and over again in a range of set-ups and conditions.

Solar garden lights are amongst devices that utilizes a relatively higher electric power (compared to solar-powered calculators). The LED in the garden light was powered by a 2-watt photovoltaic panel, which charged a lithium ion battery. The high reliability of the garden light resulted in great demands from both local and overseas markets. However, competition was fierce, especially with the influx of imported cheap, low quality solar garden lights. Lasting just a few days only, this lack of reliability and durability led the public to lose interest in purchasing more solar garden lights.

Larger-sized solar light systems that illuminate junctions and high-risk roads do not require the laying of electrical cables for light poles. The solution that was created for off-grid street lighting by equipping light


Solar powered street lighting

Rest area at the Gap (stop over for Fraser's Hill) with solar power for lighting

poles with solar photovoltaic panels and rechargeable batteries that could store energy for 3-day operations without the need to re-charge. Batteries are valuable items hence they are placed inside locked boxes located 10 feet from the ground. Off-grid street lighting systems have been installed at the Batang Kali - UNISEL road and the Baling - Gerik highway. Later, the system was expanded to rest areas along the Simpang Pulai - Gua Musang road, the Raub - Bukit Fraser road and the new Orang Asli village in Cameron Highlands.

A combination of solar photovoltaic and diesel generator system produces a more reliable off-grid electricity supply at a lower cost. This technology is particularly useful in the rural areas of Sabah and Sarawak. To improve the standard of living of students and teachers at schools in rural areas, in 2009, the Ministry of Education initiated a 24-hour electricity supply programme. The implementation of the programme posed many challenges, ranging from technical to social to geographical, which were all very tricky to deal with. In terms of technical, automation of power generation devices and regulation of power supply were required. As for geographical, access to each location was a big issue, which significantly affected the prediction of the operating cost. For instance, some roads were not accessible even to four-wheel drive vehicles during rainy seasons, and this caused delay in the delivery of diesel.

As for social challenges, employee turnover rate was very high. The employees who stayed on in the project were *kampung* boys and girls who did not expect the luxury of a bed or a washing machine to wash their clothes. Travelling to project sites meant having to sleep in four-wheel drive vehicles at night in the middle of the jungle and taking turns for guard duty. Washing clothes and bathing were done by the river, while cooking was done using small kerosene stoves.

In 2012, a new phase of the solar photovoltaic industry, namely, solar farm development began. When the Malaysian Government passed the 2011 Renewable Energy law, of which feed-in tariff was enforced, competition as solar contractors who performed engineering, procurement and construction works became stiff. From only a handful of companies, the number of industry players multiplied into a few hundreds.

Solar hybrid systems for 24-hour electricity suppy in a remote school in Sabah

Solar powered telecommunication system (VSAT) in Sarawak

An example of a solar farm is the 37.5 MWdc farm in Bidor, Perak. A special documentary titled *"Bidor: Dari Jambu Batu ke Ladang Solar"* (Bidor: from Guava to Solar Farm) was published to document and celebrate the success of the project. Many locals from and around Bidor were employed during the construction of the solar farm. Local caterers provided catering services to the construction team. Other services such as cleaning, security and landscape design and maintenance were all provided by locals. Many parents in Bidor were proud to announce that their children were working at the new solar farm. Maintenance of the farm was monitored remotely from a control centre. The workers on site were those who carried out physical maintenance such as cleaning of buildings, landscape maintenance and inspecting the system, with instructions coming from the control centre.

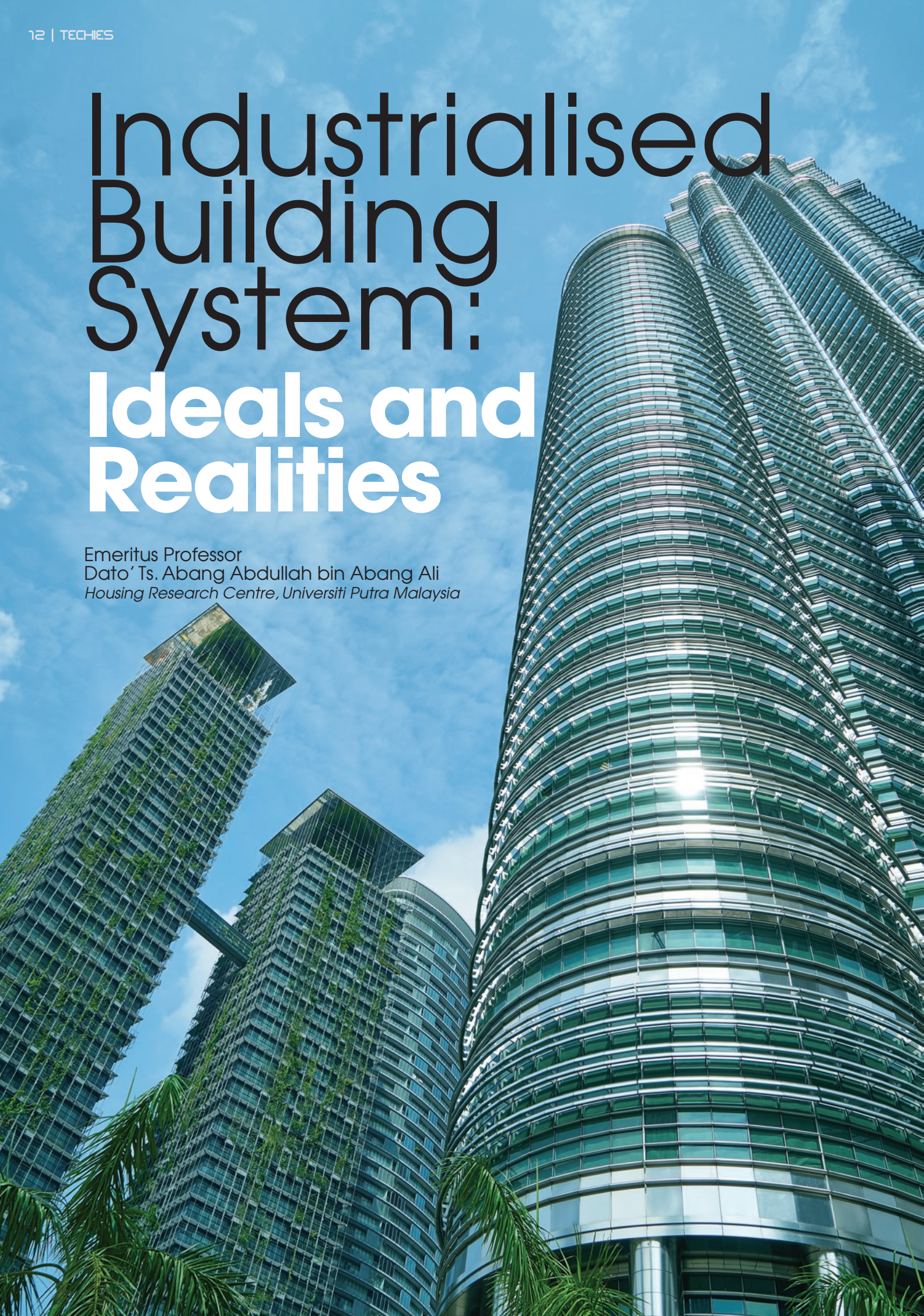
In the future, local companies can explore business opportunities on the development of solar energy infrastructures at abroad. The experience and knowledge gained from solar garden lights, until the successful solar farm development has made local companies are more than qualified to develop larger solar farms around the world.

Night-time at the solar farm in Ayer Keroh Melaka

Aerial view of the solar farm in Bidor, Perak

Industrialised Building System: Ideals and Realities

Emeritus Professor
Dato' Ts. Abang Abdullah bin Abang Ali
Housing Research Centre, Universiti Putra Malaysia

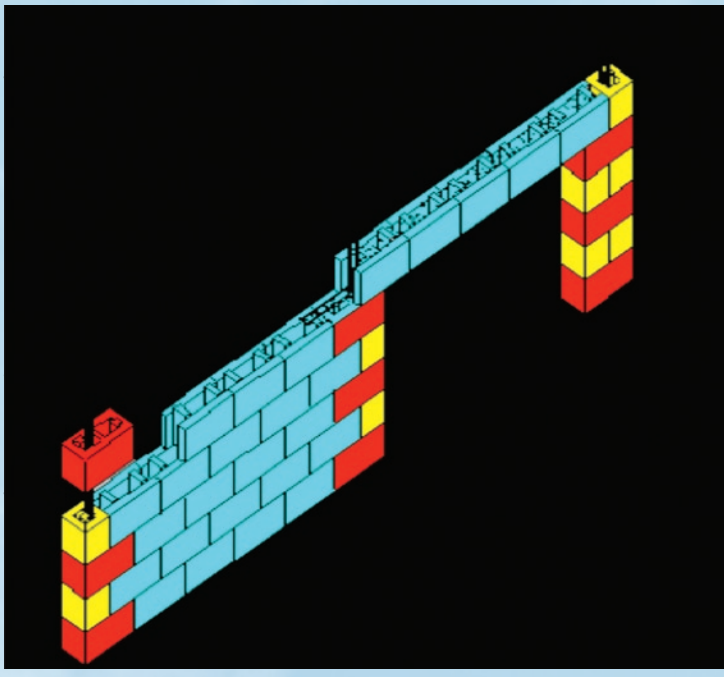


Industrialised building system (IBS) has been touted by many as a new construction approach, although it had been employed in the Malaysian construction industry for some time, mainly in the form of precast concrete or prefabricated construction. Ideally, IBS promises better quality, higher speed and more cost-effective construction compared to the conventional approach of construction, which local builders are so used to and quite reluctant to depart from.

IBS can be classified into three major groups, namely the frame, panel and box systems. A generic system of differentiation with subdivision based on the predominant component weight has also been proposed as: Light - timber, light gauge metals; Medium - metal, reinforced plastics, laminated timber, composite materials; and Heavy - mainly concrete. Heavy concrete structures can be further classified as factory produced or produced on site.

Advantages of the IBS over the conventional method of construction are often quoted as speed of construction, savings in labour, optimum use of material, better quality, less prone to weather changes and cost effectiveness. The disadvantages of IBS on the other hand are high initial capital outlay, sophisticated plants and skilled operators, water tightness issue, site accessibility, and large work area.

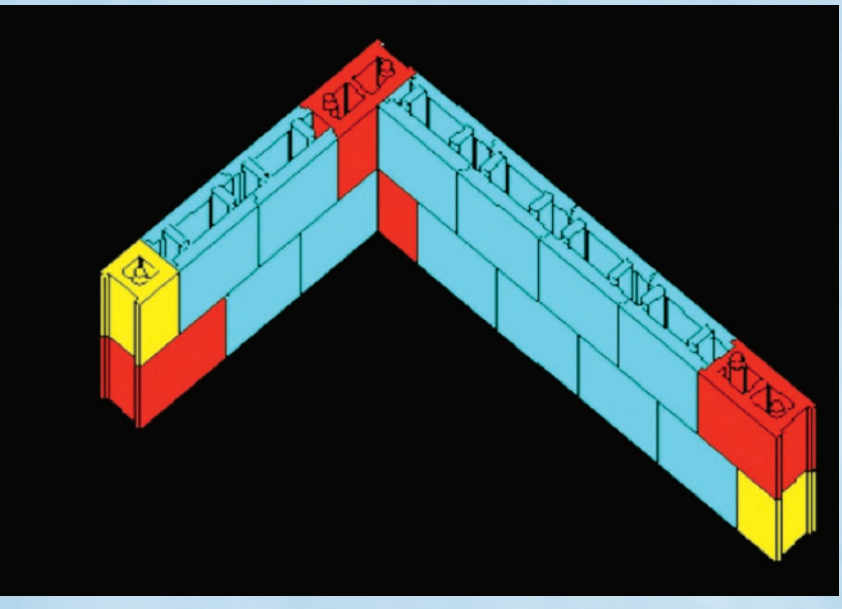
The design of an IBS involves a complex process of studying and coordinating user and market needs, development of standard building components, setting up of manufacturing and assembly layout and process, and allocation of materials and resources.



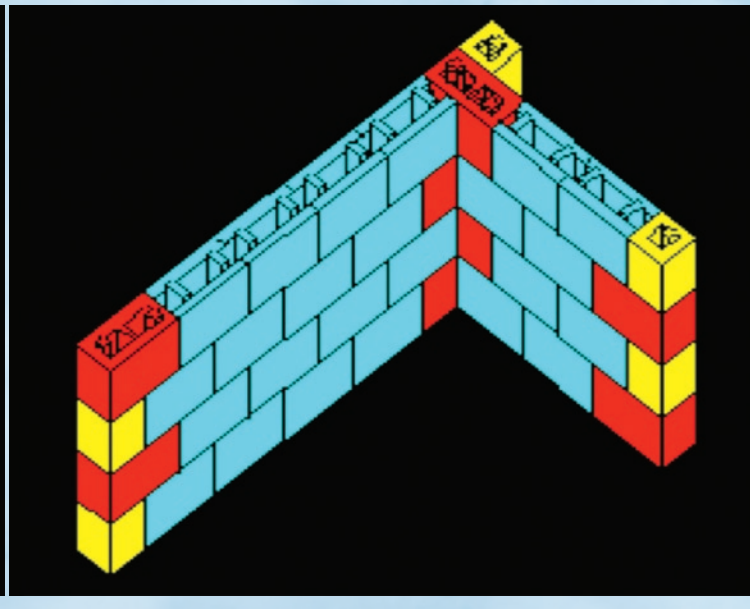
Putra Block IBS: Wall with Opening

In an age when construction speed, quality and cost are of utmost importance, the use of suitable IBS is inevitable. However, it is necessary to identify the strength and weakness of the various IBS that can be found in the market. The choice of a suitable building system can vary from project to project, depending on the project size, location and cost. It is therefore necessary to assess and classify the different systems according to the different building applications.

Efforts must be made to encourage the development of indigenous and more cost-effective building systems for the local building market. This is where research and development work on IBS is important.



Putra Blok IBS: Corner Joint



Putra Blok IBS: T Joint

Putra Block IBS: Designed and Developed for Affordable Quality Housing

Housing Research Centre, Universiti Putra Malaysia has developed two IBS: a modularly coordinated interlocking loadbearing hollow block building system called Putra Block and a precast sandwich panel building system. The Putra Block building system, when used, is able to reduce the cost of constructing housing units in the country, while maintaining quality and providing higher speed of construction.

To-date, there are various initiatives by researchers to come up with better and more cost-effective IBS. To add, the government makes it mandatory to have IBS 70 score in major government projects, and IBS 50 score for major private sector projects. There are also promotions and development & training programmes run by the CIDB IBS Centre.

However, the reality is, the construction industry in general shows very little interest in IBS. It tries hard to avoid this new building approach whenever possible. It is an industry secret that the use of IBS would invite about 20% higher project cost compared to conventional construction methods.

Initial high capital outlay and economy of scales have always been the major hurdles in the industry. The market for IBS may not be sufficiently large to amortize the capital investment needed. In addition, the slow adoption of modular coordination and open building system approach, together with standardisation of component sizes, have been impeding the progress of IBS despite the government's push to make it mandatory in the future.

It is unfortunate that this ideal construction approach is impeded by the realities of the local construction scenario. An integrated solution involving researchers, government and the industry is thus called for.

Putra Block Commercialisation

Technical and Vocational Education and Training (TVET):

An Interview with Dato' Ts. Dr. Mohd Mansor Salleh

Associate Professor Dr. Mohamad Asmidzam Ahamat & Ts. Dr. Eida Nadirah Roslin

Dato' Ts. Dr. Mohd Mansor Salleh was employed as a Professor in Universiti Kuala Lumpur for 15 years. He joined Universiti Kuala Lumpur in 2004 as the Provost of Universiti Kuala Lumpur Malaysia France Institute. Later he was transferred to become the Head of Campus and Dean of Universiti Kuala Lumpur Malaysian Institute of Marine Engineering, for four years and then held a similar post at Universiti Kuala Lumpur Malaysian Institute of Industrial Technology in Pasir Gudang for three years. He spent the rest of his years teaching in Universiti Kuala Lumpur Malaysia France Institute and Universiti Kuala Lumpur Institute of Product Design and Manufacturing.

Ts. Dr. Mansor graduated in Metallurgy in 1969 from the University of Wales in Cardiff. He obtained an MSc in Industrial Metallurgy and Management in 1970 from Birmingham University and a PhD in Corrosion from University of Manchester in 1978. He was the first metallurgist in Malaysia and the first PhD graduate specializing in corrosion in the country.

Ts. Dr. Mansor started working life as a lecturer in Meltallurgy at University of Malaya's Engineering Faculty in 1971. He left in 1984, after 13 years, and was seconded to head SIRIM, then a Statutory Body before it was privatized. He then spent seven years from 1986 to 1993 running the MARA Institute of Technology (now Universiti Teknologi MARA) as its Director. He resigned from the government service in 1994. He later spent three years as Managing Director of a construction company, involved in Precast Concrete Technology from Australia.

At the same time, with some friends, he started a brass casting company making souvenirs and later, water meters, with help of PUNB. He was made the CEO of HICOM Diecastings Sdn Bhd, an aluminium high-pressure die-casting company in Shah Alam in 1997, for four years and subsequently became the CEO of Aluminium Alloy Castings in 2002. Both companies were subsidiaries of DRB-HICOM Group. In 2004, Ts. Dr. Mansor was back in the education arena as a Professor in Universiti Kuala Lumpur Malaysia France Institute.

Ts. Dr. Mansor started the Malaysian Materials Science and Technology Society (now Institute of Materials Malaysia) back in 1987 by becoming its Founder President for many years. This was because he was keen to be involved in professional societies. He also started the Malaysian Welding Society in 1989 (known as the Malaysian Welding and Joining Society since 2007).

During his nearly 40 years involvement in higher education, Ts. Dr. Mansor has taught Metallurgy, Materials Engineering, Manufacturing Technology, Welding Metallurgy, Corrosion, Manufacturing Processes, Technopreneurship and Management.

Interviewers: ***Based on your observation, what differences are there between the current state of TVET in the country compared to that of 50 years ago?***

Dato' Ts. Dr. Mohd Mansor Salleh: You want to go back 50 years? (laughs). I think we can write many books on the story of TVET in Malaysia for the past 50 years. Let me begin from the late 1950's. At the time there were Junior Technical Trade Schools (JTTS). I remember one in Penang where I stayed in the hostel with elder students when I was studying temporarily in the newly-opened Georgetown Secondary School in 1956. These JTTS were later converted to Technical Institutes (TI's). There was one in Penang, one in Cheras, Kuala Lumpur and one in Kuantan.

This was the beginning of technical and vocational education in secondary schools. The pupils joining them were from the less-academically inclined group. They were more interested in using their hands to learn the trades. Later, vocational secondary schools were also set up, known as Sekolah Menengah Vokasional (SMV). The main thrusts of the studies were what later came to be known as Kemahiran Hidup (life skills). Subjects taught like Home Economics, Agriculture, Plumbing, Electricity, etc., were very practical and useful subjects for later life. The Education Ministry later also started the Polytechnics to cater for more advanced technical and vocational training.

In the 1960's, the ITI's (Industrial Training Institutes) were set up by the Ministry of Labour (now, Ministry of Human Resources) in a few states in Malaysia. There was one in Kuala Lumpur and one in Prai. This was set up to train youths in technical trades and skills. MARA under the Ministry of Rural Development then, also started it's IKM (Institut Kemahiran MARA—MARA Skills Institute) to train young Malays in vocational skills in the 1970's. Meanwhile, the Ministry of Works through their Public Works Department set up their own skills training institutions (e.g. the Akademi Binaan Malaysia). The Agriculture Ministry also started their own ILP (Institut Latihan Pertanian, Agriculture Training Institute) dedicated to agricultural training for youngsters. Not wanting to be left out of this youth vocational training, the Youth and Sports Ministry had to have their Institut Kemahiran Belia Negara (IKBN) in many states.

So, now you can see the mess we are in, or how complex TVET training is. Almost every Ministry is wanting to set up its own training institution for the same group of people, the youths of Malaysia. Presently, the Human Resources Ministry is coordinating through its Jabatan Pembangunan Kemahiran (JPK—Skills Development Department) skills training up to Diploma level. The trainees are awarded Sijil Kemahiran Malaysia (SKM) at various levels. The Education Ministry is coordinating for those above the diploma level through its Malaysian Qualification Agency. But please do not despair. Things are now looking much better for the TVET education industry.

Now, we have TVET education from schools up to the university. With the setting up of Universiti Kuala Lumpur under MARA in 2002, and the incorporation of public technical universities by the Education Ministry, namely Universiti Malaysia Pahang, Universiti Malaysia Perlis, Universiti Teknikal Malaysia in Melaka and Universiti Tun Husein Onn in Johor, those students who are technically and vocationally-inclined can study right through secondary school up to the university level.

Of course, like everything else, TVET education industry has been facing a lot of problems from day one it started. Among the many problems were:

1. The recognition of qualifications and training
2. The curriculum
3. Infrastructure and facilities, particularly with funding for the latest expensive equipment for the workshops and laboratories
4. Funding problems for student trainees from the Human Resources Development Funds

In trying to overcome some of the complex problems related to TVET Education industry, the Government, in 2018 set up a Jawatankuasa Pemerkasaan Pendidikan Teknikal dan Latihan Vokasional with Permatang Pauh M.P, YB Nurul Izzah Anwar as Chairman.

One of the recommendations from this Committee was to set up a TVET Commission (along similar lines as the Public Service Commission and Education Commission) under the purview of Parliament to

oversee the development and control of the TVET education and industry, so that the coordination work for all the ministries can be done properly. Unfortunately, until now, we have not heard anything more about the proposal and the Committee's Recommendations.

To answer your original question (laughs), I almost forgot since I was talking about a little history of TVET. From the story so far, you can see that things are looking much better for TVET education and the industry now. Those students that are not so academically inclined can start into TVET after Form 3 (based on their results and their interest). They can go through TVET education all the way to university. The chances of them being employed after graduation is much better. Surveys show that about 96 % of TVET graduates are employed soon after graduation compared to non-technical university education. The Government is also much more concerned with TVET education, especially with respect to the upcoming Industrial Revolution 4.0. Let us hope that this concern is followed up by action, so that TVET Education can get ahead more smoothly. Now we also have MBOT which is part of the support infrastructure for TVET graduates as professional technologists and technicians.

Interviewers: ***Acceptance by the society on the importance of TVET in nation-building is essential to help us in empowering the role of TVET. Can you share with us your perception on the level of acceptance of TVET by the society?***

Dato' Ts. Dr. Mohd Mansor Salleh: The Manpower Department of the Human Resources Ministry expects to increase the target of 35% skilled manpower by 2020 from the 28% at present. It is a very ambitious plan but let us hope we can get closer to the target by next year.

When we talk about TVET education, much of our society still think of TVET as low-level or second-class education compared to academic courses. Every student and parents dream of their children going to the university through the normal route and learning theoretical subjects as opposed to learning in a technical university.

Many in society look down upon those who work with their hands rather than working in the offices with suits and ties. Even though many TVET graduates can earn as much, sometimes more than, the theoretical degree, Malaysians, especially Malays generally shun TVET education. I still remember in the early days, I observed that many Malay IKM and ITI graduates ended up as clerks in banks and cashiers in supermarkets. They do not use their training and qualification because they want to work in air-conditioned environment surrounded by beautiful ladies, which they do not get whilst working in the dirty workshops. Malay parents also prefer their son-in laws to be working in 'clean environment' as opposed to dirty workshops etc. I think and I very much hope this situation does not exist anymore.

The Government must also look at the salary scales of TVET Graduates vis-à-vis engineering graduates from universities. At one time B. Tech graduates cannot be paid similar salaries compared to normal University graduates. This is an anomaly that must be corrected especially when we have MBOT to help us in this matter.

Society must also change its perception of the ability of TVET graduates. For example, many TVET graduates in the oil and gas industry are earning better salaries even though they are only armed with a Diploma, compared to a graduate engineer from the normal university, especially if they are hired in international companies. Some of us may not know that top level Sous Chef in restaurants are earning five figure salaries. Some working in sea-going ships have world-wide travel thrown in on top of that. So, it is time that society wakes up to realise the importance of TVET education. Society will only jump onto the bandwagon once they see the actual situation and figures. It means that we must advertise and publicise success stories of TVET graduates especially in the Malay press and media. From there we can promote TVET Education. Not everybody is slated to get 10 A's at SPM and 5 A's at STPM level to enter the normal university. Those that have other and different abilities than academic can opt for TVET and skills education.

Interviewers: ***The decline in number of student's enrolment to university for STEM programmes is very alarming. What is your opinion on how to reverse this trend?***

Dato' Ts. Dr. Mohd Mansor Salleh: This decline in students wanting to enrol in STEM programmes is a worldwide phenomenon.

Even in Western advanced countries, enrolment in Science and Technology courses are declining. To reverse this trend, we have to go back to basics and find out the reasons for the decline. For us in Malaysia, we have never really got our targets for the science-based faculties except for medicine. The government planned for a 60/40 Science/ Arts student ratio. But we always end up the other way around, especially for the Malays. It would take up too much time and space to discuss this here, but we will try.

In Malaysia, if we study the top-level captains of the industry and very senior civil servants, nowadays, we see most of them are accountants, lawyers or Arts-based faculties' graduates. The technologists/engineers normally end up playing second fiddle. In other words they will remain at lower levels, as Directors only, not Managing Directors or Executive Chairman. Getting an engineering degree is more difficult than getting the other degrees in terms of having lots more to learn and absorb. Engineers have to learn management subjects in their degrees, whereas the others do not have to learn engineering in their courses.

Another point to note is interest in and curiosity about what is around us. If you are NOT curious about your surroundings, then it is difficult to make you learn science.

Some universities and companies have teamed up to organise science competitions for schools. This is a good move to create extra interest in science. This kind of outreach activity can help rekindle interest in science and mathematics. Obviously, we need as many universities to be involved as possible so that the activity covers many schools in Malaysia. This can be done even at the kampung or rural schools because it is here that pupils' interests and inclination can be developed.

Our society, especially the Malays are prone to idolise film stars and artists, politicians and successful businessmen. Nowhere have we ever promoted and publicised success stories of personalities in science, technology, innovation, research and development of products. We need to tell our youngsters that there are a lot of success in STEM in the future. The future belongs to science, technology and engineering. Videos, films and telemovies can be shown depicting successful scientific research and intricacies of science, or how things work, etc. The best place to start this is in the home. With the present availability of modern communication technologies in the home (e.g. You Tube and others), they can be harnessed to create an interest in our children as to what is happening around them.

We can also go to the primary schools, or kindergarten even where we can slowly introduce simple and exciting scientific experiments and simple explanations to answer their 'WHY' questions. We have to work hard to arouse the interest and curiosity of science in kids.

The TVET education can ideally be started at the primary level. The pupils can start using their hands in many other ways, not just for writing or pressing buttons on their smartphones. This is the initial hands-on activity required of TVET education.

Interviewers: ***Establishment of Malaysia Board of Technologists (MBOT) provides a recognition for people that are actively involved in TVET. Can you suggest to us on how MBOT can contribute to the development of TVET?***

Dato' Ts. Dr. Mohd Mansor Salleh: I must confess that, being a true-blue technologist, I was very much looking forward to the setting up of MBOT. I graduated in Metallurgy in 1969 from University College Cardiff, Wales, and I was the first metallurgist in the country. I taught in the Faculty of Engineering, University of Malaya, teaching Properties of Metals. I applied to join the Institution of Engineers but was turned down as I have no engineering degree. I do not belong to the Materials Science group either. So, I am a technologist.

I hope that MBOT will quickly get down to business of registering all technologists and technicians in Malaysia. It would be very useful too if MBOT works on getting proper recognition in terms of service and remuneration in the government service as well as in the private sector for professional technologists.

MBOT can take the lead in coordinating all TVET education and industry activities. This will overcome the present cumbersome and complex interaction of numerous ministries and agencies involved in TVET Education. MBOT can also take the lead in popularising STEM to school students and thus help in increasing the number of future scientific and technological personnel.

Tunnel Construction: Design As You Go Approach

Ir. Mohd Kamarul Azhar Mohd Sibi

In Malaysia, tunnel construction has recorded its significant achievement, roles and uniqueness. Varying in terms of length, width, height, location, method of construction and purposes, tunnels have become one of the most effective man-made structures to manage traffic congestion (motorway / railway tunnel), water transfer/diversion (stormwater tunnel) or the combination of these two functions, commonly known as dual purpose tunnel (e.g Malaysia SMART tunnel). The rapid development of technology has promoted the study' and exploration of tunnels' optimum potential for the benefit of humankind and the environment.

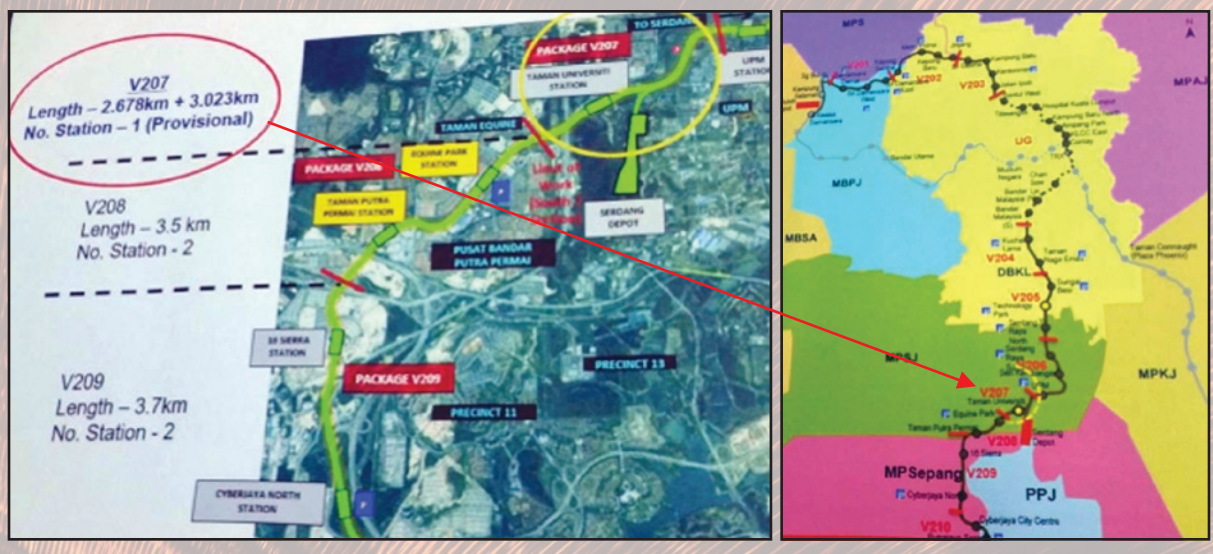
A tunnel can be described as an opening or an artificial underground passage, especially one built through a hill or under a building, road, river or sea. The typical core function of a tunnel is to allow the smooth and safe mobility of people and vehicles from one point to another, or to channel or divert water from its source to the intended areas. However, the process of getting a tunnel in place is not that simple. Meticulous studies on numerous aspects such as the geology of the area, availability of engineering expertise, economic, social and environmental impact as well as the financial capacity as the 'fuel' to drive the tunnel construction project is crucial.

Mass Rapid Transit (MRT) project is one of the nation's prominent project owned by the Government of Malaysia and executed by MRT Corporation Sdn Bhd (MRT Corp). The KVMRT (Klang Valley MRT) – SSP(Sungai Buloh – Serdang – Putrajaya) line involves the construction and completion of viaduct guideway and other associated works. The SSP Line is one of the three planned KVMRT lines to be constructed where it is divided into 10 packages namely V 201 to V 210. The 52.2 km SSP line alignment comprising both the 38.7 km elevated and 13.5 km underground lines, respectively. A total of 26 elevated and 11 underground stations are to be constructed.

On 11 August 2018, the author participated in the technical visit to KVMRT Line 2 (the V 207 Mined Tunnel Site) organized by IEM Tunnelling & Underground Space Technical Division. The half day visit was aimed to expose the participants with the various aspects and features of the tunnelling construction methods and technologies.

Package V 207 is part of SKSA (Southern Kuchai Lama Serdang Alignment). The total length of V 207 is 5.701km. Within the 5.701km stretch, a 0.182 km (182m) tunnel is constructed; 12.1m wide and 10.1m high across the hilly area to accommodate a twin-track railway. The west portal of the tunnel construction site can be seen from the Maju Expressway (MEX) heading towards Putrajaya from Kuala Lumpur – on the left-hand side. Based on the geological data, the mountainous terrain is formed of Kenny Hill with interbedded weak rocks and residual soils.

Constructing tunnels using the TBM (Tunnel Boring Machine) has become



synonymous with the nation's underground space development. Tuah and Gemilang, the first and second TBM for SMART had played significant roles in 2004 until 2006 for the dual-purpose tunnel construction history in Malaysia.

As an alternative to drilling or blasting methods in rock and conventional mining in soil, TBM has the advantages of limiting the disturbance to the surrounding ground, is highly efficient and results in shortened tunnel completion times. However, the major drawback is the TBM's substantial upfront cost. There are many types of TBM to suit the specific ground conditions where the costs can vary greatly from project to project.

Drilling and blasting however remains the preferred method when working through heavily fractured and sheared rock layers. As for the V 207, the 0.182km tunnel is adapting the NATM (New Austrian Tunneling Method) with permanent cast in-situ concrete lining. NATM is a method of modern tunnel design and construction. Figure 1 shows the stages in tunnel construction. The Austrian Society of Engineers and Architects defines NATM as a method where the surrounding rock or soil formations of a tunnel are integrated into an overall ring-like support structure. Thus, this formation of ring-like support will be part of the tunnel supporting structure.

The NATM has often been referred as a `design as you go' approach, by providing an optimized support based on observed ground conditions. Alternatively, it can be described as a 'design as you monitor' approach, based on observation of convergence and divergence in the lining and mapping of prevailing rock conditions. It is not a set of specific excavation and support techniques.

As a conclusion, NATM offers economic advantages by exploiting the inherent geological strength available in the surrounding rock mass to stabilize the tunnel. This plays a vital factor in the 0.182km tunnel construction of V207, a tunnel that is considered shorter compared to other tunnels at other locations along the MRT line.

Stages in construction of concrete lined tunnel

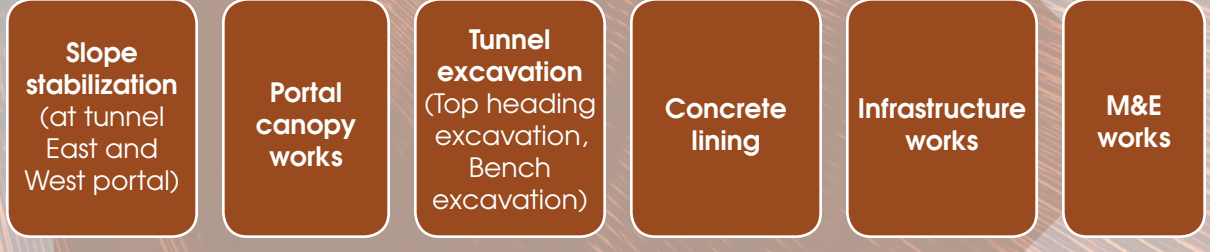


Figure 1: Stages in the construction of tunnels

Thermal Comfort and Buildings

Assoc. Prof. Dr. Mohamad Asmidzam Ahamat

Buildings are roofed and walled structures usually built for permanent use for human occupancy and other applications. The space inside a building is isolated from its surrounding to provide comfortable conditions for humans. This is important because a comfortable built environment is one of the factors that affect the productivity of its occupants.

Thermal comfort is a condition where a person feels at ease. This is one of the aims when constructing built environments. Factors that contribute to thermal comfort are air temperature, radiant temperature, air velocity, humidity, clothing insulation and metabolic heat. This article discusses some strategies and challenges in creating thermal comfort in buildings.

To achieve a thermally comfortable built environment, an appropriate building design and construction materials, in accordance to the local environment, are required. The orientation of a building assists in the reduction of direct solar radiation to areas occupied by humans. For instance, west-facing or east-facing buildings may receive excessive heat gain throughout the day. Malaysia's ambient air temperature slightly exceeds comfortable temperature ranges (17 °C to 28 °C as stated in ANSI/ASHRAE Standard 55). Hence, it is impossible to use only natural or mechanical ventilation in buildings. However, this ambient air can provide cooling to building façades and walls. Indirectly, it reduces the amount of energy needed in air conditioning systems. The use of glass curtain walls in the tropics leads to a higher demand in cooling capacity (*Figure 1*). Nevertheless, this strategy is beneficial in countries where heating is required.

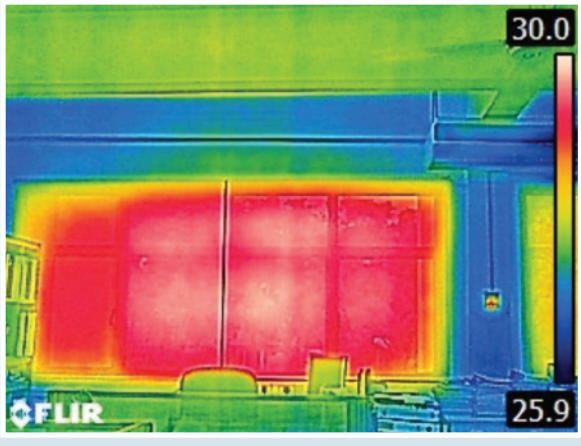


Figure 1: Glass sections of buildings have higher temperatures compared to concrete walls

One of the challenges in Malaysia is to keep heat from entering the building. A very thick insulation layer can reduce heat gain at the expense of gross internal area, which means less space for the occupant. The use of innovative materials such as a mixture of wood wool and cement (*Figure 2*), which has lower thermal conductivity, can reduce the amount of heat entering the building. Another way is to use lightweight construction materials that enable heat to readily enter and leave buildings. Smart insulation materials that can change its heat resistance according to the internal temperature of the building can ensure better insulation.

The roof is a structure that covers the top part of a building, and it usually has the highest temperature (*Figure 3*). Up to 86% of heat that comes into a typical house is transmitted through its roof. As such, ways to reduce this are pursued. For instance, there is the `green roof' option that utilises plants to reduce heat transmission into the building.

Figure 2: Innovative materials that have lower thermal conductivity can reduce heat transmission into buildings

Alternatively, the use of highly reflective roof enables a large portion of heat radiation that falls on the roof to be turned back towards the environment, thus reducing the amount of heat absorbed by the building. A porous roof combined with an evaporative cooling mechanism is another means.

In contrast, to retain heat in the building, phase change materials are integrated into the roof. Phase change materials are good because they absorb heat at a fairly constant temperature. However, cost and heat storage capacity of phase change materials limit their application in roof construction.

Challenges in creating a thermally comfortable building include high-energy consumption and variation in occupants' backgrounds. High-energy consumption requires elements of passive and low energy building design and operational strategies. In Malaysia, the use of air conditioner is unavoidable due to the hot and humid climate. Strategies to reduce the size of the air conditioning unit through innovative design of buildings are needed. Occupants' gender, age, health, physical conditions, and clothing are some of the variations that must be taken into account in order to achieve thermal comfort. Personalised ventilation techniques that suit the unique preferences of each occupant should be sought after appropriately.

It can be concluded that a thermally comfortable space in buildings can be achieved by adopting proper design strategies aided by suitable cooling techniques. Variations in the occupants' requirements could be addressed utilising advances in artificial intelligence. By integrating these tactics, it is possible to create a thermally comfortable built environment without consuming excessive energy.

Figure 3: This thermogram shows that, generally, the roof has higher temperature compared to other parts of the building

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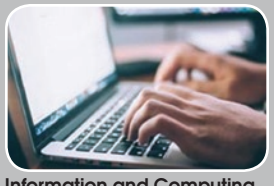
23 Fields of Technology

LEMBAGA TEKNOLOGIS MALAYSIA
MALAYSIA BOARD OF TECHNOLOGISTS

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.

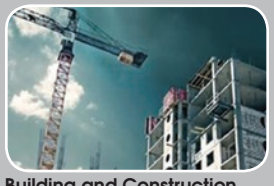

Electrical and Electronic Technology (EE)


Information and Computing Technology (IT)


Chemical Technology (CM)


Telecommunication and Broadcasting Technology (TB)

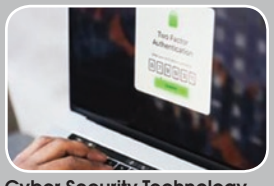

Biotechnology (BT)


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)

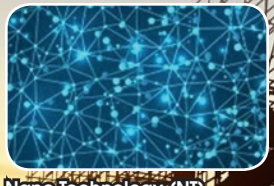

Green Technology (GT)


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)