

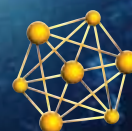


MOSTI Ministry of Science, Technology and Innovation Malaysia

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# INSIGHTS@MASTIC

Breaking New  
Scientific Frontiers



MASTIC

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## Editorial

At the ripe age of 51, Malaysia has carved a name in space science and technology. Perhaps not many realise that the country's foray into this highly specialised field began way back in the 1960s when the plan for the country's space programme was first put into place. The construction of the country's first communication satellite receiving station started then and in 2007, we saw the country's first astronaut (angkasawan) blasted into space, breaking yet another frontier in space science and technology. While the Angkasawan Programme received the limelight and perhaps the highest accolade ever acknowledged in the space science and technology industry, there are many other space and space-related programmes that have taken place in the country, which also deserve to be given special mention and merit. All of these contribute towards making Malaysia remain ahead in space science and technology particularly within ASEAN today. It is a fact that has been acknowledged and indeed, we are ahead in this field in this region. Many Malaysian scientists, researchers and professionals in space science and technology have been invited to participate in international programmes including becoming key speakers in relevant international seminars and conventions.

To give you an overview of how far the country has progressed in space science and technology, we have dedicated this entire issue to this industry. The Ministry of Science, Technology and Innovation (MOSTI) is the lead body responsible for putting the country's space science at the forefront by spearheading many space-related initiatives. The Ministry's agency, the National Space Agency (ANGKASA) is our focus in the Pioneer segment. ANGKASA identifies space research and development priorities, formulates space laws and devises strategies as spelt out in the national space policy. It is one of the agencies responsible for the Angkasawan Programme and has commissioned various projects including development of satellite systems and space infrastructure.

In the segment on Application of Advanced Technology, we emphasise on satellite technology development in Malaysia as well as on new initiatives in remote sensing. The country has made great strides in both areas and further achievements will only seal our mastery of space science and technology in line with our aspiration to become a developed nation.

Besides venturing into the space industry, Malaysia has also broken new scientific frontiers as highlighted in our Focus segment. Malaysian scientists have embarked into new areas including research and development in biotechnology, nanotechnology and Antarctic research. Malaysians have been bold to explore new pathways and new destinations in the quest for greater progress and acquisition of knowledge and skill. To succeed further, capacity building is extremely crucial and this subject is emphasised in the Innovation/Research and Development segment. To help create a knowledge-based economy as envisioned by the leaders of the country, the space science and technology industry must harness all its resources to build human resource capacity that will ensure the continuous growth of the industry. Building capacity must be progressive and it is undoubtedly one of the main challenges of the industry. The roadmaps have been put in place and what must be done now is for us to move forward steadfastly and not lose sight of our national goals even when our eyes are cast high towards the sky.

**While the Angkasawan Programme received the limelight and perhaps the highest accolade ever acknowledged in the space science and technology industry, there are many other space and space-related programmes that have taken place in the country, which also deserve to be given special mention and merit. All of these contribute towards making Malaysia remain ahead in space science and technology particularly within ASEAN today. It is a fact that has been acknowledged and indeed, we are ahead in this field in this region.**

# Space Venture – ANGKASA Taking the Lead

Within five years, between the setting up of the space agency in 2003 and sending the first Malaysian into space, Malaysia has demonstrated its commitment to be among the leaders in space exploration in this region. Ministry of Science, Technology and Innovation (MOSTI) through ANGKASA is the body responsible for putting the country's space science at the forefront by spearheading many space-related initiatives.

which provide communications services, observations of the Earth through remote sensing, and navigation applications. ANGKASA develops the space infrastructure for the country through and by applying knowledge acquired by implementing space science projects and programmes," he says.

The *Angkasawan* Programme is just one of the many space science programmes of ANGKASA. The others include both basic and advance space science programmes, such as micro-gravity science experiments and research in space weather. During his 10 days stay at the International Space Station, our *angkasawan* conducted five scientific experiments prepared by local scientists. The recently presented results of the analysis have shown that several new findings were successfully obtained from these experiments, with at least five IP's patented. Research works in space weather are being conducted at the Langkawi National Observatory (LNO). This facility is equipped with robotic telescope systems that allow astronomers to do research on astronomy. Other research activities include astrophysics, atmosphere physics and Solar-Earth relations. The Observatory essentially provides a platform for Malaysian scientists to conduct research on space science and R&D programmes using its advanced facilities.

According to Dr. Mustafa, another major programme of ANGKASA is space science education and promotion to generate and foster public interest as well as to build human resource and expertise in the field. ANGKASA operates the National Planetarium, which serves as an education facility on space science for the general public including students. The Planetarium organises numerous outreach programmes to inspire the public to have an interest in space science. Among the facilities at the Planetarium are a Space Theatre, an Exhibition Gallery and a Theatre where space science workshops, seminars, courses, night observation sessions and outreach programmes are held throughout the year.

## DEVELOPMENT OF SATELLITE SYSTEMS

In developing space technology, projects commissioned by ANGKASA include the development of satellites and sensors. Malaysia's first micro-satellite, the TiungSAT-1, was launched in year 2000. Its mission objectives are Earth observation; scientific Cosmic-Ray Energy Deposition Experiment (CEDEX) to study the space radiation environment near Earth and its short and long term effects on satellite electronics; and digital store and forward communications. Earth images captured by TiungSAT-1 also provide useful information on land use, offshore conditions as well as weather and haze patterns. Another important outcome of the TiungSAT project was in the aspect of human capacity and capability building. "We started from 10 engineers and now we have 100 of them," enthuses Dr. Mustafa. In relation to human development for the industry, he says, the "Man Space Flight" was a natural progression in space technology. "We have to go into it. We have to pursue the *Angkasawan* Programme to push boundaries – build capacity, build engineers. The opportunity to send our *angkasawan* to space has given us the potential to go into new programmes, such as the micro-gravity experiments. Our future *Angkasawan* Programme will include more significant experiments. As it is now, Malaysia has been offered by Russia



Dr. Mustafa Din Subari  
Director General  
of ANGKASA

When Malaysia's first *angkasawan* (astronaut), Dr. Sheikh Muszaphar Shukor Sheikh Mustapha blasted off into space on October 10, 2007, it marked a milestone in Malaysia's history. The successful launch into space in a Russian spacecraft, the SOYUZ, sparked overwhelming enthusiasm for space science among Malaysians all over the country. While the *angkasawan* stole the limelight with his infectious spirit and smiles, the people behind the *Angkasawan*

Programme glowed in quiet pride. They were instrumental in putting Malaysia on the world map of space science through the *Angkasawan* Programme. More importantly, they were committed in achieving one of the key tasks ever entrusted by the Malaysian Government on the agency they represented – the National Space Agency (ANGKASA).

Within five years, between the setting up of the space agency in 2003 and sending the first Malaysian into space, Malaysia has demonstrated its commitment to be among the leaders in space exploration in this region. ANGKASA is in fact the body responsible for putting the country's space science at the forefront by spearheading many space-related initiatives, such as identifying space research and development priorities, formulating space laws and strategising national space policy.

## SPACE PROGRAMMES

The new Director General of ANGKASA Malaysia, Dr. Mustafa Din Subari says the development of space sector covers three areas, namely space science, space technology and applications, and space infrastructure. "The space science serves as the foundation for the building of the space technology and applications. We have scientists and engineers that carry out R&D works in related areas. Within the space technology, we are developing satellites

and Japan to conduct experiments in the areas of biological and medical sciences through their astronauts, and this is good progress for Malaysia.

Dr. Mustafa is also enthusiastic on the prospect of launching RazakSAT, the nation's first operational remote sensing satellite, early next year. It is a pioneer project that began in 2001 and it was then known as Medium Aperture Camera Satellite (MACSAT). RazakSAT which was developed by a Government-owned company, Astronautic Technology Sdn Bhd (ATSB), carries optical sensors that will provide high-resolution images of the Earth. What makes RazakSAT different from other satellites, such as the French's SPOT satellite, is that it will be placed in unique orbit close to the Equator allowing it a more frequent revisit of Malaysia. "Its orbit over Malaysia will be about a dozen times per day, giving five or six imaging opportunities daily. This will definitely make the country's disaster monitoring activities more efficient," says Dr. Mustafa, adding that other satellites are "polar orbiting" which means, they take images of the whole globe. "Revisiting the same place hence takes times, sometimes two weeks, but with RazakSAT, the frequency of imaging will be higher hence we will be able to use it for our purposes," he stresses. Images taken by RazakSAT can be used to detect changes of land over time and for a wide range of other applications, such as in the fields of agriculture, forestry, cartography and topography.

RazakSAT will be launched by the Falcon-1 launcher from the Marshall Islands. Since there is excess space in the launcher, two other micro-satellites will also ride along. One is an experimental satellite from ATSB. The other, known as Innosat, carries experimental payloads from five Malaysian universities to be sent to space.

Satellites may not have received as much attention as the *Angkasawan* Programme but developing them can bring Malaysian technology to the next step. It may also be one way for Malaysia to earn revenue from its space ventures. ATSB, which used to sell components of satellites, is now in the process of marketing full satellites to other countries.

Dr. Mustafa also says that between the 9<sup>th</sup> Malaysia Plan (9MP) period and the 10<sup>th</sup> Malaysia Plan (10MP) period, more communication satellites like the Malaysia East Asia Satellite (MEASAT) will be launched. Communication satellites are launched to provide regional communication services that include telephony, television broadcasting, and business networks and data transmission. The Government also has planned to build and operate its own communication satellite to serve the communication needs of the public and military sector.

### DEVELOPING SPACE INFRASTRUCTURE

ANGKASA develops, maintains and operates the national space infrastructure including satellites and ground station facilities, such as the Mission Operations Centre (MOC), which is a facility that drives satellites. The Malaysia Space Centre (MSC), located at Sungai Lang in Banting, Selangor, is currently housing the MOC for RazakSAT. The centre also has an optical calibration laboratory to calibrate and test the performance of an imagery system. "Under the 9MP, ANGKASA has planned to build several other laboratories, including the Assembly Integration and Test or AIT Lab. Apart from testing future satellite sub-systems, the facility can also be used for other industries testing such as the automotive industry," says Dr. Mustafa.

"The other strategic area of space infrastructure to be developed in the future is the capability to launch satellites that we have built," he further says. "From our experience in managing the launch of RazakSAT, this capability is crucial. Imagine if you can build the much needed satellite but you cannot have it launched at the required time, then it is going to be strategically ineffective."

### SPACE APPLICATIONS

Besides developing space infrastructure, ANGKASA is also focusing on enhancing space applications. "Applications are built on three

areas and these must benefit Malaysians. The three areas involve direct applications of different satellite systems, namely satellite communications, remote sensing and satellite navigations," explains Dr. Mustafa. Satellite communications encompass services such as telephone and Internet connections as well as broadcasting. Dr. Mustafa says the advantages are numerous from establishing communications anywhere on Earth to bridging the digital divide between rural and urban areas.

As for remote sensing, Dr. Mustafa says currently satellite images were obtained from overseas and most of the times, the images supplied did not meet the country's requirements. "With our own remote sensing satellites, our needs will be fulfilled. There has also been an increase in applications, demands and coverage. We have to have more remote sensing satellites, specifically, there is demand for more precise and real time images, which Google Earth, for example, cannot provide," he says.

On satellite navigations, he says civil usage has outdone the use for military purposes. Positioning and navigation gadgets are now used to track locations in real time, not only to track goods, vehicles and animals, it is also even used to track spouses (under private investigations). The Global Positioning System (GPS) owned by the United States, as part of the Global Navigation Satellite System (GNSS), has becoming a basic infrastructure to build further on location-based applications. "I envisioned in a near future for mass usage of this technology provided by our very own local industry. One example is lowering the cost of the receiver so that it is affordable by all the near-shore fishermen that enable them to locate and navigate precisely to their 'tukuns', hence increasing the fuel efficiency and catch," Dr. Mustafa says.

### STRATEGISING AND CAPACITY BUILDING

While benefiting Malaysians, all the three areas of satellite communications, navigations and remote sensing also need to cover equally important factors of safety of use, security and defence. Malaysia has yet to develop strategic documents pertaining to these issues; therefore what is needed is for the country to have an overarching Space Policy and Space Bill to regulate space activities.

"Space technology is one of the most advanced technologies for mankind; therefore it requires a lot of strategising involving among others, international collaborations and building capacity to sustain space-related programmes. Malaysia has limited resources to venture into these programmes. To me, building the nation's capacity is a progressive step in nature and this is one of the key challenges we are facing."

Malaysia has taken giant steps into space since more than a decade ago. The country's space industry consists of both upstream and downstream activities. Production of satellite sensors and sub-system batteries as well as the introduction of launchers and space qualified materials and technologies are part of upstream activities. ATSB is currently the only company spearheading the space technology and system and this is part of the Government's efforts in capacity building. ATSB will eventually export its expertise and services. Downstream activities involve rolling out satellite applications, such as satellite communications and commercialisation of scientific findings, for example protein crystallisation experiments initiated by Universiti Putra Malaysia and carried out by our *angkasawan* in space. The experiments were 100% successful and the product commercialisation will benefit the oleo chemical industry. The other spin-off from space technology is the development of steriliser of life samples, such as microbe samples developed by University of Malaya, which can be commercialised and applied by the industry.

Through ANGKASA, the country has firmly set the direction to sustain an active space industry. The country's 14-year technology, infrastructure, human capital and governance roadmaps have already been put in place, albeit progressively. The achievements have been progressive too, and as to what the country can do in future, suffice it to say that only the sky is the limit. 🌌



# Satellite Technology Development in Malaysia

Malaysia has made great strides in its satellite programme, as evidenced by its considerable network of communications satellites, remote sensing satellites and fully equipped ground stations. It must continue to be committed to the mastery of space technology in its quest to become a developed country.

When the Soviet Union launched Sputnik, the first man-made satellite, on October 4, 1957, Malaysia (then Malaya) was barely over a month old. It was a new nation of small villages, rubber plantations and tin mines, and its citizens still grappling with poverty, illiteracy and the threat of the communist insurgency in its creepy jungles. Under such a scenario, the thought of glancing 500 miles above at the basketball sized Russian spacecraft circling the earth and wonder about the dawn of the space age was just too far fetched. As with all other aspects of its development, Malaysia would have to play catch up in space science. And catch up she did. 50 years later, there are bustling cities connected by vast highways, the jungles are tourist attractions and Malaysia's space programme is bouncing – the country has put a man in space, opened South-east Asia's first space centre and has its own fleet of imagery and communications satellites.

## OUR EYE IN THE SKY

Any object that revolves around another object is called a satellite. The moon is the Earth's natural satellite. There are also a lot of man-made or artificial satellites that are put into orbit, which is the path that a satellite follows, around the Earth, other planets or the sun. Satellites as man-made moons are custom built to perform a variety of tasks. Weather satellites take pictures of the Earth's atmosphere and help meteorologists predict the weather. Navigational satellites form the backbone of global positioning systems that help ships, aircrafts and vehicles find their way. Scientific satellites are used to study the Earth's shape and its ocean and atmosphere, as well as observing other planets, stars, comets and galaxies. Military satellites act as space spies, eavesdropping on radio communications and taking high resolution pictures for intelligence gathering. Communications satellites in geo-stationary orbit, where the satellite is fixed on the same spot above the Earth's equator, allow voice, data and the broadcast of television to homes around the world.

## MALAYSIA'S SATELLITE PROGRAMME

Although Malaysia's satellite programme officially started in the 1990's, the groundwork for the country's space programme was

laid in the 1960's with the construction of its first communication satellite receiving station. In 1988, the Malaysian Centre for Remote Sensing (MACRES), now known as Remote Sensing Malaysia, was established to undertake research and development in the field of remote sensing.

The development of satellite technology in Malaysia was largely shaped by the country's National Telecommunication Policy (NTP) which called for Malaysia to have its own satellite and stated that "Continued reliance on other countries' satellites will create future problems in terms of security and balance of payments".

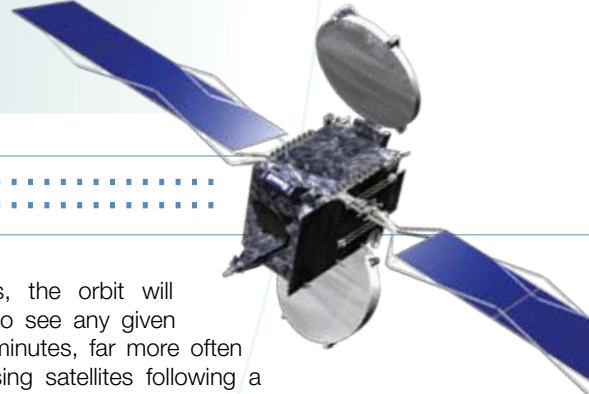
The National Space Agency – ANGKASA – is the main body responsible for strategic planning and policy formulation of space related activities. It works in tandem with various agencies, departments, universities and research centres to advance space science in Malaysia and played a key role in the development of the TiungSAT and RazakSAT remote sensing satellites as well as the MEASAT series of privately owned communications satellites.

## MEASAT

MEASAT-1 (Malaysia East Asia Satellite No. 1) became Malaysia's first communications satellite when it was launched on Ariane rockets from Europe's Spaceport in Kourou, French Guiana in January 1996.

The MEASAT project began in 1992 in response to then Prime Minister Tun Dr. Mahathir Mohamad's call for Malaysia to develop its communications infrastructure as part of the Vision 2020 plan. Binariang Sdn Bhd engaged Hughes Space and Communications International Inc. (HSCI), to build the MEASAT system. HSCI is now a part of Boeing's Satellite Development Center. As part of the agreement, HSCI would construct the satellite, supply equipment for the satellite control station in Gunung Raya, Langkawi and train Malaysian ground control crew.

MEASAT-1 and MEASAT-2 which was launched in December 1996, are high powered Boeing 376HP communications satellites



designed to provide 12 years of regional communications services that include telephony, television, business networks and data transmission for an area spanning from India to Hawaii and from Japan to East Australia. They were the first commercial communications satellites to use gallium arsenide solar cells.

The MEASAT system accelerated the infrastructure development of Malaysia's telecommunications and broadcasting industry. Many Malaysians then were able to subscribe to the multitude of channels from the country's first direct broadcast satellite television service that was beaming from the MEASAT satellites.

In December 2006, the MEASAT fleet expanded with the addition of MEASAT-3 which blasted into space from Baikonur Cosmodrome, Kazakhstan. MEASAT-3 is based on a Boeing 601HP bus and introduced bandwidth intensive applications such as High Definition Television (HDTV) and Video on Demand (VOD) services. It expanded MEASAT's coverage to more than 160 million households and over 100 countries including Australia, Africa, the Middle East and Eastern Europe.

### TiungSAT

TiungSAT-1, Malaysia's first micro-satellite, was launched from Baikonur Cosmodrome, Kazakhstan in December 2000. Named after the Mynah bird (burung tiung), TiungSAT-1 was built by Surrey Satellite Technology Ltd (SSTL) at the Surrey Space Centre under a Know How Transfer and Training Programme between the United Kingdom and Malaysia. The programme saw engineers from Astronautic Technology (M) Sdn Bhd (ATSB) train with SSTL engineers for one year on the build, integration, test, launch and orbital operation of TiungSAT-1.

The 50kg micro-satellite, equipped with a 72-metre resolution multi spectral earth imaging camera and a 1.2km Meteorological earth imaging camera, operates at a low Earth orbit of 650km. Its mission objectives are advanced remote sensing and digital store and forward communications.

Onboard the TiungSAT-1 is the Cosmic Energy Deposition Experiment (CEDEX). CEDEX is designed to detect particles such as high energy protons in the Van Allen Belt, heavy galactic ions and cosmic rays. The experiment aims to study the space radiation environment near earth and its short and long term effects on satellite electronics.

The satellite also has a more practical application. Earth images captured by TiungSAT-1 provide useful information on land use, offshore conditions and weather patterns, as well as the haze menace.

### RazakSAT

RazakSAT is Malaysia's upcoming earth observation satellite that is scheduled to be launched from the Marshall Islands in 2009 using the SpaceX Falcon 1 launch vehicle. It will be the country's second remote sensing satellite after TiungSAT-1 and is a joint project between ATSB and South Korea's Satrec Initiative Company. The RazakSAT programme began in 2001 and was originally known as MACSAT (Medium-sized Aperture Camera Satellite). The satellite, delivered in late 2006, weighs 150kg and carries a mainly electro-optical payload that includes a medium-sized aperture camera (MAC) with 2.5 metres resolution in pan mode.

When launched, RazakSAT will follow a unique orbit. While other remote sensing satellites orbit near 90 degrees, RazakSAT will be inclined just 9 degrees to the Equator. Although it will only see the

equatorial regions, the orbit will allow RazakSAT to see any given point every 100 minutes, far more often than remote sensing satellites following a 90-degree orbit that takes days to fly over the same spot.

Similar to the TiungSAT-1, RazakSAT will provide high resolution images of Malaysia that can be used to detect changes of land over time as well as a wide range of other applications such as in the fields of agriculture, forestry, cartography and topography.

### GROUND RECEIVING STATIONS

A ground receiving or Earth station is an integral part of a satellite system. It is a communications facility that allows the ground crew to track the movement of satellites, receive data from it, and send data to it. Remote Sensing Malaysia Ground Receiving Station (MGRS) was constructed in Temerloh, Pahang in March 2000. MGRS is run by Remote Sensing Malaysia, and enables real time acquisition of remote sensing data from satellites. The station is equipped with three antennas, including a 13-metre tall one and is currently capable of acquiring data from six remote sensing satellites: Radarsat-1 of Canada; SPOT 2, 4 and 5 of France; Landsat-7 and NOAA of the United States; American Terra and Aqua satellites; and Indian IPS-P\$ satellite. It is also planned to receive data from RazakSAT remote sensing satellite when it is launched. Another ground receiving station that will be receiving images from RazakSAT is ANGKASA's ground station in Banting, Selangor.

### THE WAY FORWARD

For a newcomer to the space arena, Malaysia has made great strides in its satellite programme, as evidenced by its considerable network of communications satellites, remote sensing satellites and fully equipped ground stations. It must continue to be committed to the mastery of space technology in its quest to become a developed country.

One area that the country might look at is to develop its own launch capabilities and/or build an independent launch site on Malaysian soil. Malaysia's proximity to the Equator makes it an ideal launch site. The rotation speed of the Earth is fastest at the Equator, and satellites launched from here reach orbit faster and use less fuel. ✨

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# New Initiatives in Remote Sensing

Remote Sensing Malaysia has developed and conducted various programmes – including using remote sensing techniques for the management of natural resources, environment, disasters and strategic planning.

Malaysian Remote Sensing Agency, or Remote Sensing Malaysia, is the nation's leading research and development (R&D) centre in the areas of remote sensing and related technologies. Previously known as Malaysian Centre for Remote Sensing (MACRES), Remote Sensing Malaysia was established in August 1988 and is a department under the Ministry of Science, Technology and Innovation (MOSTI). It serves as the advisor to the Government on matters regarding remote sensing, co-ordinates the implementation of remote sensing activities in the country.

To date, Remote Sensing Malaysia has developed and conducted various programmes – including using remote sensing techniques for the management of natural resources, environment, disasters and strategic planning.

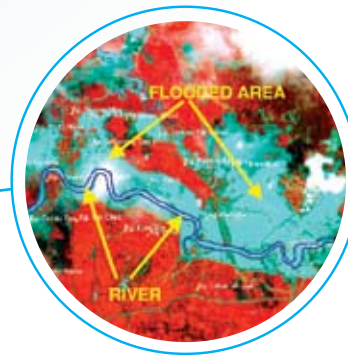
## FISH FORECASTING USING SATELLITES

Successfully locating and catching fish used to depend, to a large extent, on fishermen's intuition and sense of sight, smell and hearing. However, an initiative by Remote Sensing Malaysia will show how remote sensing technology can change all that. Under the programme, satellites will be used to help fishermen spot potential fishing zones, enabling them to maximise their catch each time they go out to sea and hence improve their income. No more guessing for the country's fishermen – they can now start each day knowing where their catch will be, or where it won't be.

The project, fully funded by the Government, is in its pilot stage in the states of Kelantan, Terengganu and Pahang. If everything goes according to plan, the fish forecasting programme will be expanded nationwide by 2010. Apart from Remote Sensing Malaysia, other agencies involved in the project include the Fisheries Department, Fisheries Development Board (LKIM), National Fishermen's Association (Nekmat) and Malaysian Institute of Microelectronic Systems (Mimos Bhd). Remote Sensing Malaysia also has plans to seek the expertise of countries which are advanced users of fish forecasting methods.

The fish forecasting programme undertaken by Remote Sensing Malaysia uses satellites to capture a wide variety of data that can be used to detect fish indirectly. The Aqua, Terra, OceanSat, NOAA and AVHRR satellites used for the programme become the fishermen's new eyes and ears, allowing them to see beyond what is possible with human senses. One technique takes advantage of the bioluminescence of certain types of plankton. When planktons are disturbed by fish, they emit light from their bodies. This is an indicator that schools of fish are nearby. Orbiting satellites capture this bioluminescence and direct fishing vessels towards the area.

Another indirect method of detecting fish is done by observing changes in the sea surface. For instance, an increase in plankton population causes the colour of the ocean to change from blue to green. This is due to chlorophyll in the phytoplankton. Satellite imagery can precisely record these variations in ocean colour over a wide area.



Distribution of different species of fish can be known through measuring water temperature. Temperature mapping through satellites can identify boundaries between cold and warm waters where some species of fish congregate.

are believed to have an effect on Aedes mosquito population. The data acquired is then integrated with ground data collected by the health ministry, and from these inputs the map is generated. The map shows the exact location and severity of dengue outbreaks using a colour-coded system whereby darker colours reflect higher severity. For example, areas which are in the “very high” risk category are coloured dark brown, areas under the “high” category are coloured red and areas with “very low” potential for dengue cases are coloured white.

Apart from the detection of fish, remote sensing can be used for long term monitoring of marine and coastal environments such as sediment types, marine plants, waves, currents and freshwater and saltwater mixing. Studying these phenomena can provide analysts with better understanding on how physical environments support and affect marine life.

The potential usage of the maps is nothing short of remarkable. Authorities will be able to pinpoint where the next dengue outbreaks will be, allowing them to focus on preventive measures at high risk areas, saving them time and money. The dengue risk map will also identify areas that, at present, are not prone to dengue outbreaks, but have the potential to be in the future.

Information derived from the satellite will be integrated with data collected on the ground such as from observer’s onboard commercial fishing vessels that measure total catch by fishermen. Satellite images captured are sent to the ground station in Temerloh, and these together with ground data are processed and analysed for any correlation. The resulting data would then be used to create a computerised fish forecasting model, complete with location maps of fishing areas with good potential. Of course, any amount of information collected is ineffective if it does not reach the fishermen in time. Timeliness is particularly important for the fishing industry due to the constantly changing nature of marine life and sea conditions. In this case, data collected is distributed to fishermen as often as possible through various means available such as telephone, text message, email, or even a hard copy. This way, fishermen will be constantly updated and be able to fish at the right time and at the right place.

The pilot project of the dengue risk map began in 2005, covering the Subang Jaya area, which was chosen because it had recorded one of the high incidences of dengue fever. Under the pilot project, which was a joint effort between Remote Sensing Malaysia, Institute for Medical Research (IMR) and the Subang Jaya Municipal Council (MPSJ), dengue risk maps were created for the years 2002 and 2005. These risks maps were then tested for accuracy by comparing them with the actual incidence of dengue outbreak for those two years. The results showed the maps to be accurate and the order was given to draw a risk map for 2009.

The benefits of fish forecasting using satellites are numerous, and are especially beneficial to Malaysia’s fishing community of 90,000 fishermen, where the majority of the country’s less fortunate people comes from. In addition to improved yield and income, the programme saves fishermen valuable time since they know the location of fish stocks before they go out. Malaysia currently produces 1.2 million tones of marine and freshwater fish and seaweed a year. Satellite-based fishing can boost this output to 2 million tonnes by 2010.

According to the 2009 risk map, Seri Kembangan and USJ 11 are predicted to be areas with the most number of dengue cases. The map also identified 20% of the area covered to be in the very high-risk category.

### DENGUE OUTBREAK PREDICTION

One of the deadliest mosquito borne diseases in Malaysia is dengue fever. The dengue virus, of which there is no vaccine, is spread by the Aedes mosquito and causes severe fever, headaches, rashes and muscle and joint pains. In some cases haemorrhaging occurs, which can be fatal.

Authorities have already come across several interesting findings from the pilot project. Here are some of them: dengue cases were lower in areas with bungalows compared to areas with terrace houses, most dengue cases occurred near construction and industrial areas, and that areas recording temperatures higher than 30°C and those that were 100 metres below sea level were more prone to outbreaks of dengue.

Typical responses to a dengue outbreak include fogging areas with insecticides. However, this approach and others only address the disease after it has happened. As the saying goes – prevention is better than cure – and Remote Sensing Malaysia has plans to prevent the outbreak of dengue fever using remote sensing technology. The plan calls for the creation of a dengue risk map that will show in advance areas where dengue fever is likely to happen.

Remote Sensing Malaysia, IMR, MPSJ and Universiti Kebangsaan Malaysia are currently working on improving the accuracy of the dengue risk map. Once the map is ready by the end of this year, it will provide information on dengue hot spots on a monthly basis. Remote Sensing Malaysia intends to make it available to the public so that the people are well informed and able to co-operate with the Government on efforts to prevent the disease. 🌟

So how are the maps generated? Satellites are used to monitor a host of physical and environmental parameters such as changes in land use, housing types, land surface temperatures, land elevation, population density and weather patterns – all components that

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# Breaking New Scientific Frontiers

Malaysia is on the right track of investing in its human capital development and supporting research in new sciences as these have proved to be timely with the growth of new scientific and technology based companies. Businesses are attracted by the availability of the right talents and expertise.

Moving into the next frontiers of science, Malaysian scientists are already toying with other emerging areas in biotechnology, such as nanobiotechnology. With the right support and incentives from the Government, it is not impossible for Malaysian scientists to explore these new areas as capabilities have been consistently nurtured and developed through various programmes in these advanced scientific disciplines. Malaysia is on the right track of investing in its human capital development and supporting research in new sciences as these have proved to be timely with the growth of new scientific and technology based companies. Businesses are attracted by the availability of the right talents and expertise.

## ANTARCTIC RESEARCH

Pushing further beyond the frontiers of knowledge, Malaysia boldly embarked on polar research with the first scientific expedition to the Antarctic taking place in 1999. Currently, the National Antarctic Research Centre at University of Malaya is actively involved in research activities covering atmospheric and climate change, geological, biodiversity and micro-organism. Outputs of these research projects had contributed significantly to the wealth of knowledge and humanity in dealing with the changing environment. Governed by the Academy Science of Malaysia, the centre also coordinates research activities from other institutions involved under the Malaysian Antarctic Research Programme.

## SPACE SCIENCE AND TECHNOLOGY

As the nation expands its scope of economic development and as the vast opportunities for new growth are being created particularly in the field of global communication, the proficiency and indigenous capability in space science and technology will enable Malaysia to secure respectable position as a global player in this field. Several initiatives have been implemented including the RazakSAT satellite technology development project and capacity development in space application, space science and space technology project and most notably, the Malaysian Astronaut Project. The RazakSAT satellite developed by Astronautic Technology (M) Sdn Bhd, was started in 2002 involving a team of local scientists and engineers not only in the control technology, communication, power and satellite structure but also in other space-specific technologies, including softwares and electronics. The success of this project included the development of highly skilled scientists and engineers in satellite technology. The capability developed has attracted the attention of other nations to co-operate in similar programme. The satellite to be launched by next year will serve as a mini-satellite for remote sensing using a Medium Aperture Camera (MAC) to detect objects as small as 2.5 metres. Once launched, the satellite will be controlled by the National Space Centre in Banting, Selangor. Data will be received by the centre as well as by the Remote Sensing Malaysia Earth Data Receiving Station in Temerloh, Pahang. Earth data received by this station will help the nation monitor environmental as well as the country's natural resources information. The services provided by this satellite will not only benefit Malaysia but will also be accessible to other nations located in the equatorial region.

The satellite programme will enhance the country's capability in managing its strategic information not only for security but also for economic development and natural disaster mitigation through remote sensing technology. Remote Sensing Malaysia under the Ministry of Science, Technology and Innovation (MOSTI) is entrusted to carry out this function and with the launching of the satellite, more highly skilled personnel, including engineers, will be developed by the agencies concerned as well as for the industries involved in satellite communications. This complements the rapid development made in this area by the industry, which launched the commercial satellites MEASAT-1, MEASAT-2 and more recently MEASAT-3. The



MEASAT Network covers over 145 countries across Asia Pacific, Middle East, Africa, Europe and Australia supporting many of region's leading broadcasters, DTH operators and telecommunication companies. To meet growing customer needs, a fourth satellite, MEASAT-3a is being developed for launch soon.

Perhaps, the most anxiously awaited project in 2007 was the launching of the first Malaysian Astronaut in October to commemorate Malaysia's 50<sup>th</sup> Anniversary. Two candidates were short-listed and put through intensive training at the Yuri Gagarin Astronaut Training Centre in Star City Russia. The two candidates were Dr. Sheikh Muszaphar Shukor and Dr. Faiz Khalid. Of the two, Dr. Sheikh Muszaphar Shukor was selected as the first Malaysian Astronaut or *Angkasawan*. On October 10, 2007, the first Malaysian *angkasawan* was launched into space with two other astronauts in a Soyuz spacecraft on a journey to the International Space Station (ISS). The journey to ISS took two days and upon docking, the *angkasawan* spent 12 days on ISS during which time, he successfully carried out five experiments, one of which involved protein crystallisation. The launch marked the beginning of Malaysia's involvement in space exploration and created a very important milestone in the country's science and technology (S&T) development after 50 years of independence. Malaysia's decision to participate in space exploration is seen as a significant step in opening up new passage into the next frontier of S&T development. The experience, knowledge and the interest generated from this launch are expected to enhance the country's aerospace technology development. Besides the special scientific experiments conducted on board the ISS, the valuable lessons learned by all parties involved should be fully optimised and exploited for use in other areas. Perhaps the most dramatic of the space programme was the rousing interest created among the younger generations in S&T. This was further enhanced through roadshows and exhibitions participated by the *angkasawan*. There are now greater awareness on space science and other space-related issues. And for the future of the Malaysian space programme, there could be numerous possibilities ahead, with ideas about spin-off industries dealing with space tourism, space craft development, advanced materials and various instrumentations and supporting services needed by the industry in the future.

#### **HARNESSING S&T**

Malaysia has indeed come a long way in harnessing S&T to build its economy and develop its people. It has reaped the bountiful harvest from its investment in agriculture research, reduced infant mortality, increased life expectancy of adults and connected people from all over the world with the latest communication technologies and created a more comfortable life for its people. As Malaysia moves to achieve developed nation status, there is no turning back. This is best

appreciated by quoting former Prime Minister Tun Dr. Mahathir Mohamad:

**"We have to be brave enough to explore new pathways and new destinations, to do this, we must have more faith in ourselves and be more hardy and determined. If we do so, we may come out ahead of those who went before us."**

To stay ahead, Malaysia must not lose sight of its goals, stay focus on the strategies set and strengthen the foundations laid earlier. And most important is the strength and the resilience of its human capital in upholding the aspiration and the future directions of S&T development. This is reflected in Vision 2020 which states,

**"... the challenge of establishing a scientific and progressive society, a society that is innovative and forward looking, one that is not only a consumer of technology but also a contributor to the scientific and technological civilisation of the future."**

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# Capacity Building for Space Science and Technology Industry

Malaysia has made an impact in space science and technology particularly within ASEAN. The country is ahead in this field in this region, and it has to maintain its lead position. Building capacity for the industry hence becomes extremely important.

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Dato' Dr. Ahmad Sabirin Arshad  
CEO of ATSB

What does it take to build capacity in space science and technology? In the same vein, what does it take to develop a career in this highly specialised field?

“Passion!” says Astronautic Technology (M) Sdn Bhd (ATSB) Chief Executive Officer, Dato’ Dr. Ahmad Sabirin Arshad. “Yes, you must have passion. The industry is not for the faint hearted. It takes years for you to complete a project, and when it is done, and you launch a satellite into space, for example, the launch may fail. Launch failures are part and parcel of the space industry. Success of a launch vehicle is actually an act of God. Failure is the norm, so you must have passion in order to carry on.” Dr. Sabirin should know, as he heads ATSB, the country’s only company that designs and manufactures satellite systems. Being a pioneer in this field, the company takes it upon itself to develop human resource (HR) capacity to meet its own needs and subsequently, the requirements of the industry to spur its growth.

### EARLY DAYS

When the company first started 13 years ago in 1995, it was practically a one-man show with the help of a few administrative staff. “Later, we took in seven engineers,” Dr. Sabirin recounts the early days. A graduate of Universiti Sains Malaysia (USM) in Mechanical Engineering with a PhD, Dr. Sabirin went on to do his post-doctoral studies in space engineering at the University of California, Los Angeles (UCLA), United States of America (USA). His foray into space engineering actually took a giant leap when he was seconded from USM in 1997 to join a select group to design, develop, launch and operate Malaysia’s first micro-satellite, TiungSAT-1, which marked the country’s venture into space technology. Launched successfully in year 2000, TiungSAT-1 carried Cosmic Energy Deposition Experiment (CEDEX) space radiation equipment to characterise near-Earth space radiation environment and study its effect on satellite electronics over a period of time. After the completion of the TiungSAT-1 project, a proposal was forwarded to the Malaysian Government to continue developing satellite technology in the country. Dr. Sabirin was later invited to head ATSB and become part of the pioneering group to develop Malaysia’s communication satellite, the Malaysia East Asia Satellite One (MEASAT-1) that facilitates regional communication.

### GROWING STRENGTH

One project led to another and from seven engineers, ATSB today has about 80 engineers out of 102 total employees. The company’s services also grew from design and manufacture of satellite systems to development of space and ground optical systems (high resolution cameras and telescopes); satellite imaging and sensor and related products; navigation, communications and tracking systems; ground station systems; tsunami early warning



systems; radiation detection systems; calibration and validation as well as project management; engineering training and consultancy and engineering warehousing. ATSB is the main implementation agency for TiungSAT and RazakSAT as well as the main contractor for the Government. RazakSAT is the country's second remote sensing satellite after TiungSAT-1 and it will be launched this year using the SpaceX Falcon 1 launch vehicle supported by a secondary payload adaptor and separation system (SPASS) designed and manufactured by ATSB. It was also the project manager for the National Astronaut (Angkasawan) Programme, particularly in training the final two angkasawan candidates on the aspects of space technology as well as in developing the hardware for space food containers and the hardware for space science experiments conducted by Malaysia's angkasawan in space.

### MOTIVATING EMPLOYEES

With expanded portfolio of its services, ATSB continuously faces the challenge of attracting and sustaining people to work in the company. Hence, HR capacity building is high on the company's agenda, not only for its own continued existence and progress but also for the development of the industry.

"How do we get people in? We look for the ones with passion so that they will stay with us for years. Many young people we spoke to are young and impatient. They want to see a factory like the ones that produce mass products. But the lifecycle of satellites is six years and the time taken to develop them is very long. Delay of satellite launching is very common and impacts the spirit of our engineers. But when satellites are successfully launched, we don't get to see them again. They simply "dissipate" in space – what we call as going on graveyard orbit and remaining in space infinity," says Dr. Sabirin, adding that the company has then to boost the morale and confidence of its engineers and keep them motivated and occupied. The company has done this successfully based on the fact that it is able to retain the majority of its pioneering staff in the last ten years.

For many of the employees, the ATSB sprawling complex in Hicom Glenmarie Industrial Park in Shah Alam, Selangor is their second home, if not their first, for many of them spend 24 hours of their time in the complex. It is equipped with recreational facilities including a gym and a swimming pool. "Part of our strategy to build our HR is to give our staff flexibility. There's no nine to five rigid structure in the organisation. Creativity is 24 hours per day. By being flexible, we find that our engineers tend to stay longer," says Dr. Sabirin. What he would like to see happen in the future is that the children of the current employees will join the company too. "The company is the main family and with employees and their children joining the stable, it will become an even bigger family," he adds. Already, plans are in place to set up a children's nursery in the company's complex with the idea of giving the children early exposure to the industry besides of course putting the parents at ease by providing childcare facilities within the office premises.

### ACADEMIC ALIGNMENT

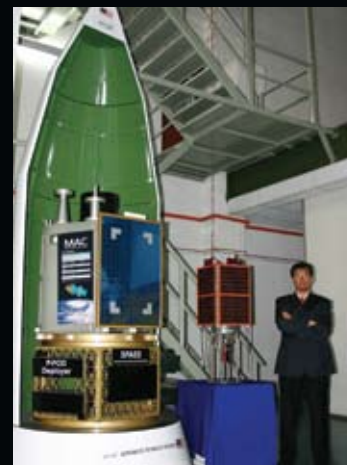
While Dr. Sabirin is passionate about the HR development in the company, he is also equally enthusiastic about capacity building for the industry. Having served as an academic in USM, it is only natural for him to look at universities as an important source of manpower for the industry. Students with an academic background in physics as well as electrical, mechanical and aerospace engineering can be trained and given on-the-job exposure to become space satellite engineers. "Now that Malaysia has joined in the international space race, especially with the Angkasawan Programme, it is all the more important for us to develop our capacity in the industry. ATSB is doing its part by training students and professors from various universities. We also have attachment programmes for students and many of them have been employed by us," he says. As for the professors, close contacts are maintained to get them to promote space technology and to get students to become aware and excited about space and space-related projects.

"In all our programmes, we did technology transfer by engaging university lecturers to participate so that they will then roll out their knowledge to the students, and this is part of capacity building," he says, adding that internally, knowledge is transferred through in-house seminars and talks where engineers share their experiences and gain new knowledge. They also gain from similar activities overseas.

### TECHNOLOGY DEVELOPMENT AND ACQUISITION

The company has taken one step further by moving from technology transfer to technology development and acquisition. By doing so, the company does not only enhance the capability of its engineers but also allows it to embark on share acquisition.

"Acquiring shares in a company allows us to buy its intellectual property (IP). This is the faster way to develop in this industry. We want to engage in active learning, not just being the recipient of technology developed elsewhere. In the last few years, we have been looking at acquiring some stake in potential companies. This is part of the Malaysian effort in going global. The space industry cannot be solely built in Malaysia because the market here is small. So we are looking at getting prospective customers in world market this year. Already, we are making inroads into new and bigger markets and we are offering complete solutions to foreign countries, mostly in the Middle East but we also want to go into USA and Europe. In the USA, we have developed a partnership with a company there to market carriers of small satellites for launch vehicles. It is a USA IP owned by Malaysia. The IP is 'parked' in the USA as the country tightly protects its space industry and it has good protection of IPs," elaborates Dr. Sabirin.



He further says that Malaysia has made an impact in space science and technology particularly within ASEAN. "The country is ahead in this field in this region, and we have to maintain our lead position. Some Malaysians who have become experts in this field have been invited as keynote speakers in international conferences.

### VENDORS AND PARTNERS

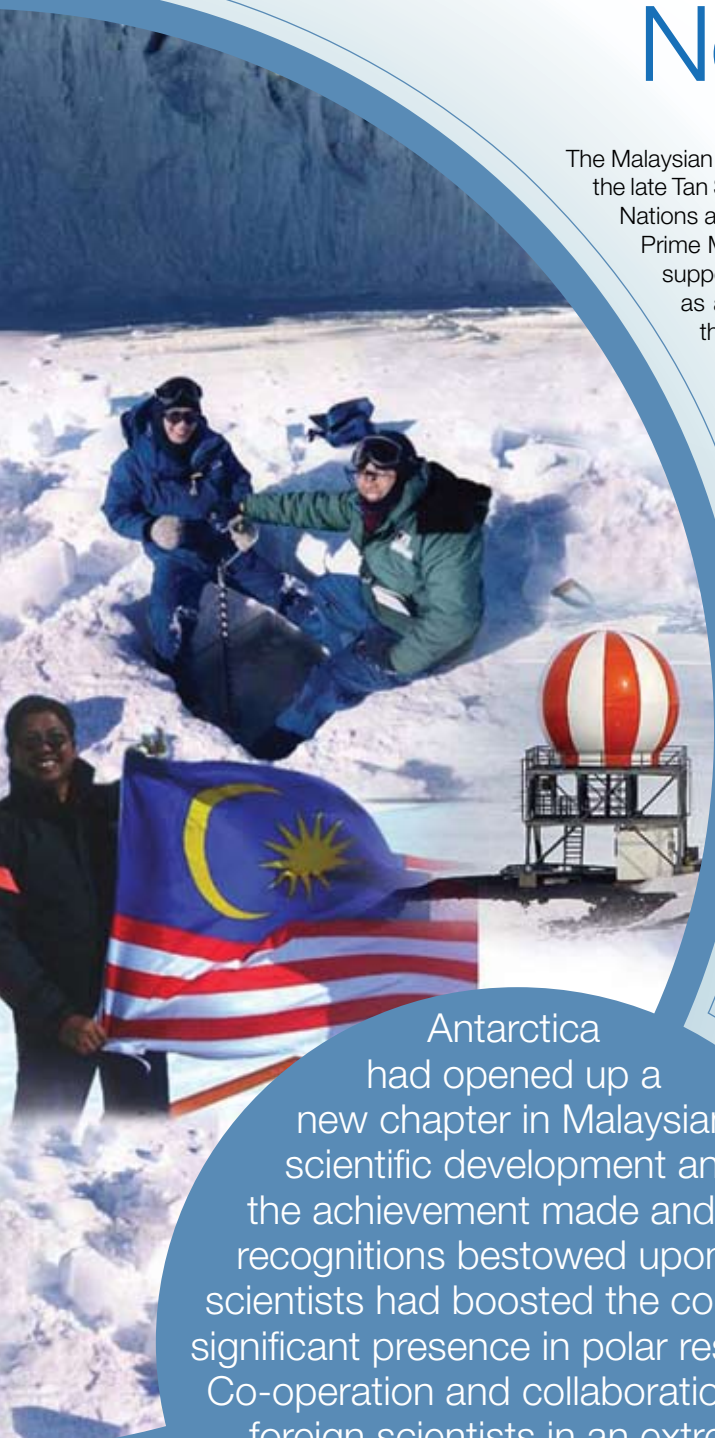
Another initiative of ATSB to build capacity for the industry is its vendor development programme. Dr. Sabirin says: "ATSB manufactures products that other companies cannot build and produce. But we train and develop other companies to become new players in the industry by becoming our vendors and partners. They can produce satellite components for our international partners. We have gone upstream many years ago, and now it is time to go downstream. We want to see many vendors in the industry and nurture them in line with our company's tagline: imagine, inspire, innovate..."

### BRIGHT FUTURE

There is definitely passion in his voice as he goes on to talk about the future. To him, it looks very bright indeed. "Definitely, there is a future for space industry. It is very much a knowledge business and it involves millions of dollars partly due to the high cost of IP. The West is capitalising on this. Space can be a profitable business and we are happy to register profits every year and paying dividends to our shareholders," he says smilingly.

He goes on to add that for Malaysia, it is important to build HR capacity in order to create a knowledge economy. Therefore, capacity building must be continuous. 🌟

# Malaysian Antarctic Research - Breaking New Frontiers



Antarctica had opened up a new chapter in Malaysian scientific development and the achievement made and the recognitions bestowed upon our scientists had boosted the country's significant presence in polar research. Co-operation and collaboration with foreign scientists in an extreme environment provided the crucial stimulus for sharing of expertise, technology transfer and scientific innovations.

The Malaysian Antarctic research endeavour was first conceptualised following the visit by the late Tan Sri Zain Azraai, the former Malaysia's permanent representative to the United Nations and Tan Sri Datuk Dr. Omar Abdul Rahman, the Scientific Advisor to the then Prime Minister in 1985. The research undertaking was made possible through the support given by member countries of the Antarctic Treaty Consultative Parties as a result of Malaysia's stand and efforts on issues concerning Antarctica in the United Nations. However, the actual development of Malaysian research interest in Antarctica was realised only in 1997, when the Cabinet approved the establishment of a Malaysian Antarctic Research Programme. A bilateral scientific agreement with New Zealand provided the necessary logistic supports for Malaysian scientists to carry out their research activities in Antarctica. The Academy of Science Malaysia was made responsible to oversee and co-ordinate the participation of researchers from various institutions involved in the programme.

Starting with two research projects focusing on atmospheric events and biodiversity in Antarctica, the programme was later expanded to include other fields such as geology, remote sensing analysis, polar microbiology and ecology. The efforts had provided strong foundation for international collaboration and adoption of new research cultures among the Malaysian scientists.

Under the 8<sup>th</sup> Malaysian Plan (2000-2005), an allocation of RM10 million was provided to the Malaysian Antarctic Research Programme. To facilitate better implementation and co-ordination of the research activities of member researchers from various institutions in the country, the Malaysian Antarctic Research Centre (MARC) was established in the University of Malaya on August 5, 2002.

## MARC'S OBJECTIVES

MARC provides the base and is entrusted with the responsibility of co-ordinating research activities under the Malaysian Antarctica Research Programme, which aims to achieve the following objectives:

- Facilitate and co-ordinate Malaysian scientific efforts in the area of global sciences, such as climate change and biodiversity. One of the niche areas concerns the relationship between the tropic and the poles.
- Encourage and foster efforts to develop the capability and capacity of Malaysian scientists to compete at international level via international networking.
- Promote and maintain Malaysia's presence as a significant player in the Antarctic research to pave the way for Malaysia's entrance into the Antarctic Treaty System.

To achieve these objectives, MARC formulated and carry out various research projects and organised numerous expeditions by Malaysian scientists to the frozen continent.

Setting the stage for Malaysia's scientific presence in Antarctica was the first scientific expedition by four scientists from the University of Malaya in 1999. Working on trans-boundary air pollution, the team not only gathered scientific data for their research but also provided valuable

information and better understanding on the living and working environment in such an extreme condition. Their experience laid the groundwork for subsequent expeditions and established better co-operation and collaboration with scientists from other countries.

To date, more than 40 scientists and post-graduates from various local institutions are involved in Antarctica research. These include University of Malaya, Universiti Sains Malaysia, Universiti Kebangsaan Malaysia, Universiti Putra Malaysia, Universiti Malaysia Terengganu, International Medical University, Multimedia University, Universiti Malaysia Sabah, Malaysia University of Science and Technology and Remote Sensing Malaysia.

## PROGRAMME HIGHLIGHTS

Beginning with the first expedition by the four scientists in 1999, Malaysia's scientific activities in Antarctica had made remarkable progress in putting Malaysian scientific research in Polar and Global Sciences to a world-class level. It was successful in forging closer co-operation and sharing of ideas between local and foreign expertise resulting in increased technology transfer and innovation. Focusing on several key research areas, researchers from both public and private institutions participated in specific research teams based on their area of expertise and field of study. Their works had gained recognition both nationally and internationally for the contributions made in each field. The following are some notable highlights and achievements made by various teams under the programme.

### Atmospheric Science Research

The project titled Modelling and Observational Studies of Antarctic Katabatic (MOSAK) – Study on the role of gravity wave in the dynamics of the stable Antarctic boundary layer, was the earliest to be carried out. The research group from the University of Malaya proved to be among those in the forefront of polar numerical weather modeling. The outcomes of this project were presented at various national and international scientific meetings thus establishing Malaysia as a contributor in atmospheric science research. The project also produced highly competent personnel in cutting edge technologies required in research. Further recognition was accorded to Malaysia when the project leader was appointed as head of a four-year Action Group on MOSAK, working closely with the British survey team. This project was also proposed to be included as an activity under the International Polar Year 2007-2008.

### Biological Sciences Research

The Malaysian biological research in Antarctica focused on two aspects i.e. to cultivate and profile Antarctic microbes with potential expansion into novel compound isolation and examine the effect of environmental changes on the organisms in the frozen continent in comparison against those in the tropical environment. Besides adding to the wealth of knowledge, it was also expected to provide answers to such issues as environmental remediation, pharmacological and nutraceutical development as well as cleaner industrial processes. The projects carried out are as follows:

- Diversity and Metabolic Abilities of Antarctic Bacteria led by University of Malaya team. More than 100 bacteria isolates were obtained and screened for production of biochemical compounds and other characteristics including desirable traits for industrial applications. The project was also proposed and accepted to be included under the International Polar Year 2007-2008 programmes.
- Microalgae Biodiversity at Antarctica led by University of Malaya in collaboration with other local as well as international institutions. A collection of more than 20 Antarctic microalgae has been established and deposited in the University of Malaya Microalgae Culture Collection (UMACC). Identification and biochemical characterisation were done on the properties with potential industrial application. Besides the production of numerous publications and progress in human resource

development, the most notable accomplishment of this project is the founding of the first Malaysian Antarctic Microalgae Collection enabling further experiments to be carried out locally. The project was also included as an activity under the International Polar Year 2007-2008.

- The Evolution and Diversity of Antarctic Periphytic Algae led by Universiti Sains Malaysia. The study compared the Antarctic and the tropical algal compositions and among others also identified a number of algal species as good biological indicators for pristine environment and pollution. A database and collection of the algal species in Antarctica has also been established.
- Phylogenetic Analysis of Bacteria and Screening for those with Antimicrobial activities led by Universiti Malaysia Sabah. Fifty strains from lakes have been successfully isolated and grown. Several strains have been found to have anti-microbial activity and have the ability to inhibit the growth of *Salmonella* spp. and *Staphylococcus* spp., pathogens found in Malaysia.
- Biodiversity of Fungi from Antarctica led by University of Malaya. Several interesting fungi were isolated from soil samples and characterised. Some of the fungi records for science contributed significantly to the wealth of scientific knowledge for Antarctica.
- The Biodiversity of the Benthic Invertebrates Fauna from the Antarctica Marine Eco-system led by Universiti Sains Malaysia. The project, among others, is expected to produce a comprehensive collection of marine invertebrates for further studies including pollution and conservation as well as their commercial importance particularly to the pharmaceutical industry.
- Bacteria Biodegradation and Bioremediation of Hydrocarbons in Antarctica led by Universiti Putra Malaysia. The study has provided new information and identified novel microbes for bioremediation of hydrocarbon in cold climates. This led to the construction of a microbial-based bioremediation system and four patents were being filed from this project.
- Study of the Biodiversity of the Nitrogen Fixing Microbes of Antarctic Origin and Their Physiology, Evolution and Enzyme Structures led by Universiti Sains Malaysia. The project aimed at determining the bacterial diversity in Antarctica sampled 1,700 strains from seven Antarctic seawaters. Five isolated colonies of bacteria were found to be nitrogen fixing. The findings opened up new areas of investigation to further understand the different characteristic forms and properties.



The projects under the Antarctic biological science research have contributed significantly to the wealth of knowledge and identified several potential compounds, microbes and enzymes that have commercial application. These include applications in the pharmaceutical, food and environmental and agriculture sectors. Success in these research undertakings had also enhanced Malaysia's credibility and strengthened the country's prospects for further involvement in Antarctica.

### Upper Atmosphere and Solar Terrestrial Research

The ionosphere is a component of the atmosphere that is ionised by solar radiation. Understanding the structure of the ionosphere and the dynamics of the ionisation variability is important in improving the present as well as future radio communication and navigation services. Antarctica offers great opportunity for research in this area. The project titled 'Polar Atmospheric Water Vapour/ionospheric and Sensing using Global Positioning System or GPS' led by Universiti Kebangsaan Malaysia was successful in establishing methods for determining the GPS ionospheric total electron content (TEC) and scintillations and GPS predictable water vapour (PWV) using GPS sensing technique. In addition, a GPS receiving system was also installed at Scott Base in Antarctica. This includes the development

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of software for data processing. This project also led to the establishment of a Centre of Excellence in Sun-Earth Connection Study at the Institute for Space Science UKM to enable continuity of research and training in this area.

### Geological Science Research

Rock weathering is one of the geological processes that shape the landscape of the environment. Antarctica's environment provides a great opportunity to study rock weathering and other geological and geophysical processes in an extreme weather, temperature and landscape. Two projects were carried out as follows:

- Geochemical study of Rock Weathering in Maitri Station Antarctic, Antarctica led by Universiti Malaysia Sabah. The project had been successful in conducting geological mapping and generating data on mineralogical development in the rock weathering profiles.
- Geological and Geophysical investigations in Queen Maud Land East Antarctica led by University of Malaya. The project involved geological survey and analysis of geo-physical phenomenon in the Antarctica. Among discoveries made include the occurrence of a mixed carbonate – elastic sequence underneath the thick mesoproterozoic volcanic. The findings so far contribute towards understanding geological processes with applications for mineral and fossil fuel excavation in other parts of the world.

### Remote Sensing Research

Remote Sensing data are used in weather prediction, harvest monitoring and prediction in agriculture, traffic control and environmental changes. Observation and understanding of the Antarctic terrain and environment including the surrounding sea ice using remote sensing will provide vital information on how the Earth responds to global changes in temperature and weather in particular, and to the global warming phenomenon.

The project titled Model Development and Application of Microwave Remote Sensing in the Antarctica led by Multimedia University, Cyberjaya was designed to develop a theoretical model to study the interaction of electro-magnetic waves with sea ice. The result showed that the model developed was applicable for sea ice and snow and will provide a useful tool in understanding microwave remote sensing of Antarctica. The findings also contributed better understanding of the global warming and help improve measures to counter the consequences of the environment.

### INTERNATIONAL CO-OPERATION AND ENGAGEMENT

Co-operation with other national Antarctic Research groups from countries with established Antarctic research facilities help provide the necessary logistic supports and paved the way for the Malaysian scientists to build a strong presence in Antarctic research. Some of the national Antarctic research groups working with Malaysians are the Antarctica New Zealand, Australia Antarctic Division, Institute Antarctica Argentina, South Africa National Antarctic Program, British Antarctic Survey, Korea Polar Research Institute as well as those from India, Chile and Ecuador.

Based on the commitment and efforts demonstrated by the programme, Malaysia was made an Associate Member of the Scientific Committee of Antarctic Research (SCAR) in 2004. MARC has also been invited to become a member of the Joint Committee on Antarctic Data Management (JCADM) as well as a member of Asian Forum on Polar Sciences. Another important

milestone for Malaysia's involvement in the Antarctic research is the participation of Malaysian scientists in the Third International Polar Year 2007-2008. The programme has a long history of international co-operation for the advancement of science. Following a briefing held at the Institute of Postgraduate Studies, University of Malaya, seven projects ranging from atmospheric to biological sciences headed by Malaysian scientists had been selected. Besides these, Malaysian scientists were also involved in nine other projects as collaborators. The involvement of Malaysian scientists in the International Polar Year research programmes further strengthens Malaysia's interest and commitment in support of Antarctica as a heritage site and forges a closer working relationship with the Antarctic Treaty System.

### BENEFITS AND FUTURE STRATEGIES

While the main objectives of MARC had been to facilitate Malaysian scientific efforts, develop capability and capacity of Malaysian scientists towards Malaysia's position in the Antarctic Treaty System, the programme had over the years since 1999 made valuable contributions in many areas. The opportunities offered new challenges for our scientists to savour the uncharted groups in scientific investigations bringing forth fresh perspectives and understanding to the world around us. Antarctica had opened up a new chapter in Malaysian scientific development and the achievement made and the recognitions bestowed upon our scientists had boosted the country's significant presence in polar research. Co-operation and collaboration with foreign scientists in an extreme environment provided the crucial stimulus for sharing of expertise, technology transfer and scientific innovations.

Research findings in the area of atmospheric, biological, geological, upper atmosphere and remote sensing had contributed to the wealth of knowledge not only for Malaysia but also for the world. The knowledge and new data obtained had been translated for further development and applications in various industries such as pharmaceuticals, food, agriculture, energy and communication. Understanding the weather and the climatic stresses as well as the role of micro-organisms in the Antarctic facilitates better efforts in alleviating the Earth's environmental problems.

The experience and the interactions with other scientists at Antarctica or other participating laboratories helped nurture and developed Malaysian scientists to be more dynamic and innovative. The research projects also produce well trained graduate students in various fields and their experience in expeditions and postings in foreign laboratories provided them with valuable knowledge and technical skills. With an on-going awareness programme undertaken by MARC, it is hoped that knowledge and experience gained could be shared with other Malaysians and promote the importance of science and technology in appreciating the world that we live in. It is also a good opportunity to emphasise on the need to invest in more fundamental research so that Malaysia can be in the forefront in developing and applying new technologies and scientific discoveries.

Moving on into the Ninth Malaysia Plan, an allocation of RM6 million had been added to the programme, largely to continue with existing projects. A number of new challenges have also been identified to strengthen Malaysia's commitment and position it closer to being accepted as a member of the Antarctic Treaty System. Towards this end, MARC will have greater responsibility to develop a sustainable and significant science strategy and fuel the momentum to move Malaysia's research to world-class level. ✨

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James R. Hansen

## First Man: The Life of Neil Armstrong

Pocket Books, 2006, London, United Kingdom.



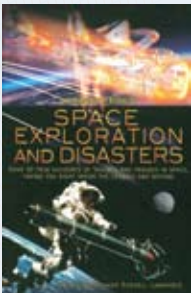
In this biography, authorised by Armstrong, James Hansen uses his access to numerous personal documents, official records and interviews to give viewers an in-depth look at the extraordinary life of the first person to walk on the moon. First Man traces Armstrong's ancestors in 15<sup>th</sup> Century Scotland, his childhood love of engineering, his days as an aviator and astronaut leading to the historical moonwalk, as well as his present life. The 700-page book also offers readers remarkable insight into Armstrong's character, his relationships, recollections and views and even debunks popular myths about him.



Richard Russell Lawrence (editor)

## The Mammoth Book of Space Exploration and Disasters

Constable & Robinson Ltd, 2005, London, United Kingdom.



Humankind's exploration of space, the final frontier, has been met with both triumph and tragedy. The Mammoth Book of Space Exploration and Disasters contains over 50 riveting, true tales of space adventure, stretching from stories on the development of the rocket to the present day. Read about Apollo 13's desperate attempt to get back to Earth, feel cosmonaut Vinogradov's horror as precious oxygen leaks from his spacesuit, and marvel at the excitement of a planned European space mission to land on a comet. It's all here and more.

Gary Hamel & C.K. Prahalad

## Competing for the Future

Harvard Business School Press, 1996, the United States of America.



Co-authors Hamel and Prahalad show that in order to become industry leaders, companies must have their own point of view about the future and create strategies for building it. The book emphasises on strategic planning, and presents tools and concepts for managers and workers to take hold of tomorrow's market opportunities. At times provocative and counter-intuitive, Competing for the Future challenges organisations to fight complacency, look beyond restructuring and re-engineering as a means of staying competitive, and re-invent themselves to take control of future markets and reach the future first before their rivals.

Satish Nambisan & Mohanbir Sawhney

## The Global Brain

Wharton School Publishing, 2008, New Jersey, the United States of America.



In their quest to innovate more effectively, companies today are looking beyond their in-house research and development department (the local brain) and to the world outside – the global brain, for new sources of creativity.

Here, Satish Nambisan and Mohanbir Sawhney draw on the experiences of successful innovators to help you systematically identify and implement a network-centric innovation strategy that best fits your company. The Global Brain contains a step-by-step, practical guide on how to choose from four major network-centric approaches, identifying opportunities for tapping external sources of innovation and overcoming potential challenges in order for your company to achieve its objectives for innovation.

Mark Dodgson, David Gann and Ammon Salter

## The Management of Technological Innovation

Oxford University Press Inc, 2008, New York, the United States of America.



Technological innovation is important in enhancing the competitiveness for firms from all business sectors, making it is essential for the strategies and practices of the management of technological innovation (MTI) to be well understood. This fully revised version of an earlier book by Mark Dodgson brings onboard authors David Gann and Ammon Salter. It has been updated to reflect the latest teaching and research materials in MTI. The new edition contains 50 newly written case studies and analyses MTI all over the world in companies of different sizes and in the services, manufacturing and resource-based sectors.

These books are available at MOSTI's Library, Level 4, Block C5, Complex C, Federal Government Administrative Centre, 62662 Putrajaya. Tel: 603 8885 8099 / 8885 8100 / 8885 8098

# Study on Science and Technology Facilities and Equipment 2006/2007

The growing number of research and development (R&D) institutions in Malaysia has brought a surge in the number of science and technology (S&T) facilities and equipment. The presence of S&T facilities and equipment indicates the strength of R&D of the institution and the whole country. Hence, it is imperative that a database of existing S&T facilities and equipment be developed to help decision makers in allocating resources for the development of S&T in the country.

The Malaysian Science and Technology Information Centre (MASTIC) has since 1994, taken the initiative to develop an information database on S&T facilities and equipment. The Study on Science and Technology Facilities and Equipment 2006/2007 is the latest in the series, with the previous one carried out in 2002. The objective of the study is to collect information on S&T facilities, equipment and software from both private and public institutions of higher learning, Government research institutes and agencies and Government linked companies. The information will be used by the Government for policy planning and development and to monitor the procurement of S&T equipment by Government agencies.

The study also hopes to encourage the culture of sharing equipment, increase access to S&T facilities, identify laboratories that have acquired accreditation and help optimise Government spending on S&T equipment. A total of 93 organisations were included in the survey conducted by MASTIC in 2006.

The findings of the study are divided into three main topics: The Organisations, Facilities and Equipment. It ends with a brief conclusion and recommendations.

## THE ORGANISATIONS

Out of 93 organisations surveyed, 65 (or 70%) claimed to have Science and Technology (S&T) equipment costing more than RM100,000 or unique in nature and were thus considered as respondents to the study. Out of these 65 organisations, 16 are Public Institutes of Higher Learning (IPTA), 15 are Government Research Institutes (GRI), 18 are Government Departments and Agencies (GA), 11 are Government Linked Companies (GLC) and 5 are Private Institutes of Higher Learning (IPTS).

As for the remaining organisations, 22 responded that they do not have equipment costing more than RM100,000 while 6 declined to disclose information about their S&T equipment, viewing the matter as private and confidential.



For categorising the locations of organisations, 5 zones comprising of several states each were created. North zone comprised of Perlis, Kedah, Pulau Pinang and Perak. South zone is made of Johor, Melaka and Negeri Sembilan. Central Zone consists of Selangor, Kuala Lumpur and Putrajaya. The East zone includes Kelantan, Terengganu and Pahang while the East Malaysia zone consists of Sabah, Sarawak and Labuan.

Of the organisations surveyed, 66% came from the Central zone. GLCs had the biggest R&D budget, with over RM1 billion for both the 8<sup>th</sup> and 9<sup>th</sup> Malaysia Plans. In terms of establishment period, over 40% of the organisations were established before 1991. In keeping track of equipment, 74% of the organisations had an inventory system. Out of the total of 7,820 R&D personnel, the majority (55%) came from IPTA followed by GRIs (19%).

## FACILITIES

A total of 586 facilities belonged to the organisations involved in the study. Out of this, IPTA recorded the most facilities with 337 or 58%. The fewest number of facilities were found in IPTS, which had less than 2% of all S&T facilities recorded. Similar to the distribution of organisations, most facilities (65%) came from the Central zone. The second highest number of S&T facilities was found in the East Malaysia zone, which had 13% of all facilities recorded. Only 7.67% of the S&T facilities were accredited, with the majority coming from Government agencies. Most of the accredited facilities (72%) are in the Central zone. Most facilities were smaller than 500 m<sup>2</sup>.

In terms of fields of research (FOR), most of the facilities were used for hard science purposes. The top three fields include applied sciences and technologies (149), engineering sciences (111) and medical and health sciences (98). Most of the facilities (35%) were set up during the 8<sup>th</sup> Malaysia Plan from 2001 to 2005.

The bulk of facilities came from the Central zone (65%), which also has the most number of organisations. As for distribution of facilities according to FOR, the highest number of facilities was found in the applied sciences and technology field.

## EQUIPMENT

Total number of equipment including software amounted to 2,036 with close to 50% coming from IPTA and 20% from GA. GLC at 35% used the highest number of software followed by IPTA at 29%. Equipment from the Central zone amounted to 64%, with 12% in East Malaysia and 10% in the North zone. Selangor had the most number of equipment at 836 units, while the Federal Territory came in 2<sup>nd</sup> place with 253 units. The total purchase price of all equipment in the study was RM1,236,570,172, out of which 75% fell in the price range of between RM100,000 and RM500,000. The Central zone had the most number of equipment in all price ranges.

In terms of equipment according to type of organisation, IPTA and GLC had the greater proportion of unique equipment or software. Equipment was also grouped by sources of funds. The number one source of funding for equipment was by the institutions themselves (778), followed by the Federal Government (667). In contrast, State and local authorities were insignificant sources of funds.

A pattern in the year of purchase of equipment was apparent, with a sharp rise seen in purchasing equipment during the 7<sup>th</sup> and 8<sup>th</sup> Malaysia Plans. The oldest equipment was purchased in 1964 and the newest one in 2006. Nearly three-quarters of equipment was used for R&D purposes. All types of organisations cited R&D as their main purpose of usage for equipment, except for IPTS where the usage for R&D purposes is equal to Service.

Out of all the equipment, 63.65% was available for sharing, with institutions of higher learning and research institutes showing a greater willingness to share. Operation and maintenance costs for most of the equipment were less than RM1,000 per month. The total operation and maintenance costs are RM4,407,546 for equipment and RM637,939 for software. In terms of level of usage, more than half of the equipment was used less than 10 days per month. IPTS was a notable exception, with close to 80% of equipment used more than 10 days per month.

## CONCLUSIONS AND RECOMMENDATIONS

The highest concentration of S&T facilities and equipment was found in the Central zone comprising of Kuala Lumpur and Selangor, which also has the highest number of organisations. Out of all the types of organisations, IPTA had the most number of facilities and equipment. Most facilities are small (less than 500m<sup>2</sup>) and few are accredited.

Half of the organisations surveyed had an inventory system. The Government should promote the use of an inventory system to monitor S&T facilities and equipment in the country. This improves the efficiency of asset management and helps future data gathering exercises.

A high percentage of equipment was found to be under utilised. This indicates inefficient resource allocation and wastes the usage of the nation's assets. Two possible solutions to increase equipment usage are to promote sharing and enhance inter-organisation co-operation.

Accreditation of facilities should be encouraged as this enhances the image and credibility of the organisations.

Future studies should also include equipment that costs less than RM100,000. Respondents to the survey should be expanded to include hospitals, polytechnics and other private organisations apart from private institutes of higher learning.

It is also recommended that the Government form a department to manage all equipment bought under the MOSTI grant for R&D projects. Institutions that have completed their projects would return the equipment to the department, which will be responsible for maintaining it and loaning it to other institutions if needed. ❁



# S&T Experts 2007/2008

This directory, published by the Malaysian Science and Technology Information Centre (MASTIC), provides a listing of Malaysian science and technology (S&T) experts and their fields of expertise, making it a handy reference for users seeking information on specific S&T areas.

The 2<sup>nd</sup> edition of the Directory for S&T Experts contains over 6,000 experts – twice the number in the first edition – and includes their contact details as well as information on their Field of Scientific Experience (FSE), Academic Qualification (AQ) and Organisation (ORG). The experts listed include those from public and private universities, research institutes and Government agencies.

The directory is divided into two sections. The first section – Natural Sciences, Technologies & Engineering – includes fields ranging from agricultural sciences and chemical sciences to marine sciences and information, computer and communication technology. In the second section, one may find experts in the areas of social sciences, humanities & business, economics and administration. ❁

Those interested in a copy of 'Study on Science and Technology Facilities and Equipment 2006/2007' or the 'Directory of S&T Experts 2007/2008', please contact MOSTI's Library

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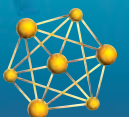
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