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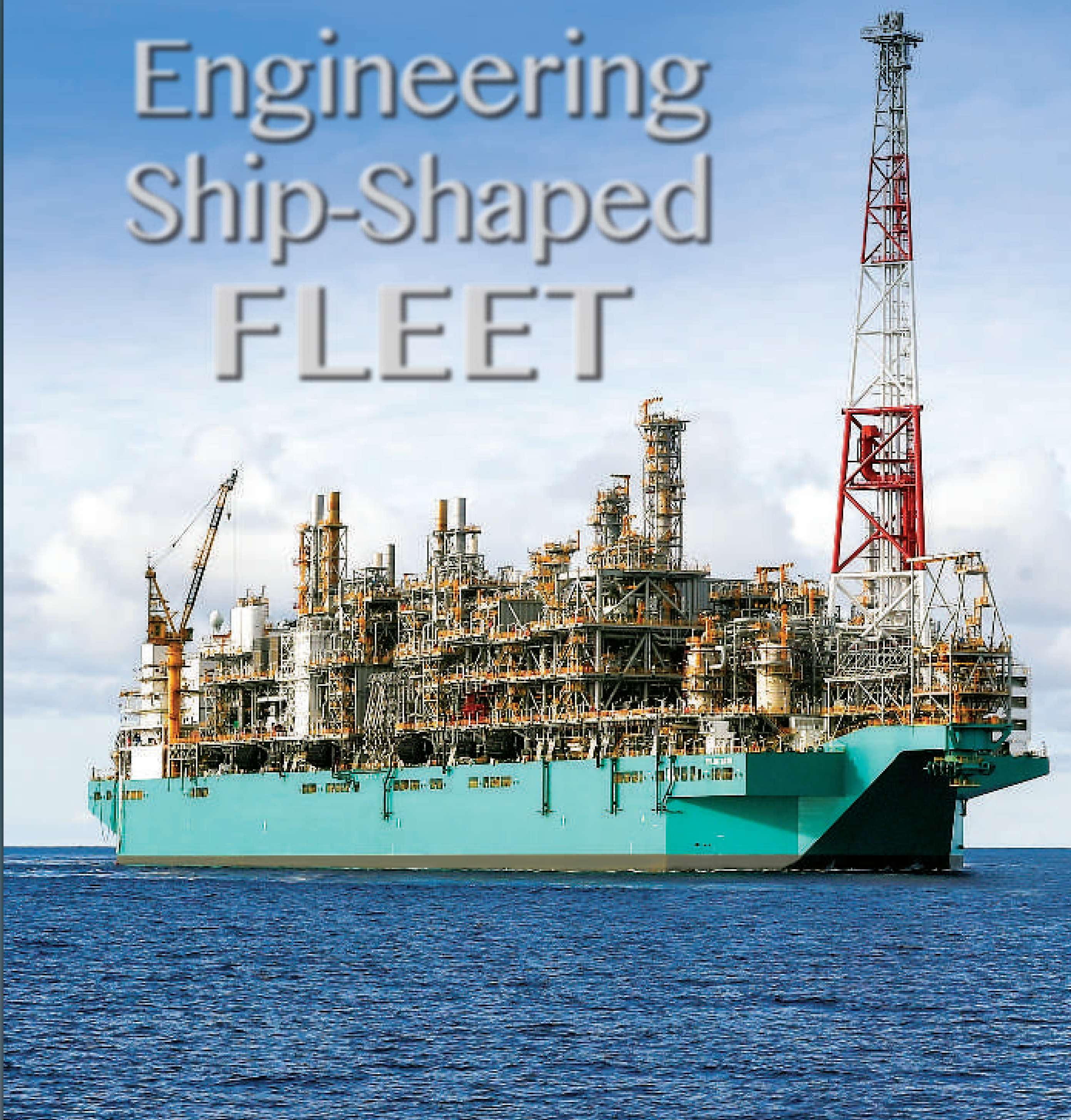
Engineering Ship-Shaped FLEET



Xypex C Series Admixture was specified by HDR Engineering and added at the time of concrete batching to achieve concrete protection and durability for a largely submerged concrete fish ladder located on the Russian River in Senoma County, California, USA. This structure is a key environmental element in ensuring the protection of the annual salmon migration up this river.

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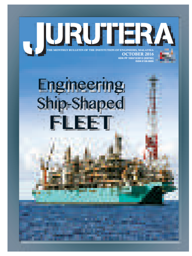
CONTENTS



by Rear Admiral Dato' Pahlawan Ir. Jasan Ahpandi bin Sulaiman

***Rear Admiral Dato' Pahlawan Ir. Jasan Ahpandi bin Sulaiman** is currently the Chairman of Marine Engineering and Naval Architecture Technical Division (MNATD). He has served in the Royal Malaysian Navy and Boustead Heavy Industries Corporation.*

Maritime Industries: Meeting the Challenges

Malaysia is a member of the International Maritime Organisation (IMO), an agency under the United Nation that is responsible for the regulating the shipping industry. The rules and regulations concerning the maritime industry are constantly reviewed to ensure that safety, environment, security, ship crew and efficiency of the industry remain valid.

The employment of new types of marine "vessels" at sea such as Floating Production Storage and Offloading (FPSO) as well as Floating Liquefied Natural Gas (FLNG) calls for new rules and regulations. Existing rules and regulations for regular ships have to be reviewed and adapted to suit such marine structures.

Over and above these "technical" challenges are even bigger challenges such as the prolonged downturn in charter rates and the very "damp" shipbuilding activities. The government and maritime industry players should think very hard about meeting these challenges to keep the industry afloat. ■

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MALAYSIA'S MARINE DEPARTMENT BEARS MUCH ON ITS SHOULDERS

The Marine Department of Malaysia, under the purview of the Ministry of Transport, administers matters related to shipping and ports including maritime affairs within Malaysian waters. Its role is to establish a safe, secure and systematic sea communication system, and marine conservation towards quality development of national maritime policy. *JURUTERA* spoke to Director General of Marine, Dato' Baharin bin Dato' Abdul Hamid recently on the department's various functions and related issues.

Its objectives are to administer matters related to shipping and ports, including maritime affairs within Malaysian waters, to establish a safe, secure and systematic sea communication system as well as to provide marine conservation towards quality development of the National Maritime Policy.

The Marine Department's vision is to be a leading agency in world-class maritime safety and conservation of marine environment by 2020, and its mission is to strengthen the maritime transportation system based on the compliance of national and international safety standards.

The department is currently under the leadership of director-general Dato' Haji Baharin Dato' Abdul Hamid who said the department has evolved into Malaysia's lead agency in maritime safety.

By investing in the Information and Communication Technology (ICT) infrastructure, it has introduced more online services including e-payment for payment of light dues.

"All our offices nationwide, even the most remotely located, are connected and accessible," said Dato' Baharin. "With this extensive ICT infrastructure in place, we can guarantee that the quality of our service will be of the same standard, regardless of the location. With ICT and having trained and competent officers possessing the right skills and attitude, we are able to provide frontline delivery of the highest standards.

"Our commitment is to continually improve the safety of Malaysian ships, and to provide up-to-date information to all ships that navigate in our waters. Ultimately, our goal is to ensure the competitiveness and sustainability of the Malaysian maritime transportation industry."

FUNCTIONS AND ACTIVITIES

The main functions of Marine Department Malaysia are to ensure safe navigation of merchant vessels, to provide services to merchant vessels such as ship inspection, certification, registration and licensing, to provide services to ships navigating in Malaysian waters and to supervise examinations of seafarers.

Its main activities are registration of ships and licensing of boats, regulating shipping laws, inspection of ship safety, inspection of Flag State and Port State Control, regulating the International Safety Management Code (ISM Code), verification of International Ship and Port Facility Security (ISPS) Code, investigation on shipping accidents, maritime safety and inspection of ships, conducting training and examinations, prevention and control of marine pollution and implementing and monitoring the implementation of international conventions.

Dato' Haji Baharin bin Dato' Abdul Hamid

REGISTRATION OF SHIPS

For registration, ships owned by Malaysians or, in the case of body corporates, must have been incorporated in Malaysia, with the company's principal office as well as management office located in the country. The majority of its directors and partners, including voting partnership, must be Malaysians free from any trust or obligation.

There are no restrictions imposed on the age of the ship to be registered. However, oil tankers and bulk carriers which are 20 years old and above, are required to obtained approval from the Registrar General of Malaysian Ships, subject to verification of the following reports: Previous Ship Docking report, Ultrasound Thickness Gauging report and Hull & Machinery Report from the ship's previous Classification Body.

Oil tankers and bulk carriers of 20 years and above are required to be docked and surveyed by a Marine Department surveyor prior to the issuance of a Provisional Certificate of Registry. Ports of Registry in Malaysia are located in Penang, Port Klang, Kota Kinabalu and Kuching.

SHIP SAFETY AND SECURITY

The Industry Control Division ensures that Malaysian ships comply with safety standards as stipulated in national laws and international conventions. It comprises the Ship Registry Unit, the Ship Accreditation Unit, the International Ship and Port Facility Security Code Unit and the Ship Safety Management Unit.

The Ship Registry Unit ensures efficient management of ships registry in accordance with the rules and regulations stipulated under the Merchant Shipping Ordinance 1952 and all related Acts in force as well as complying with the instructions given by the Registrar General of Malaysian Ships.

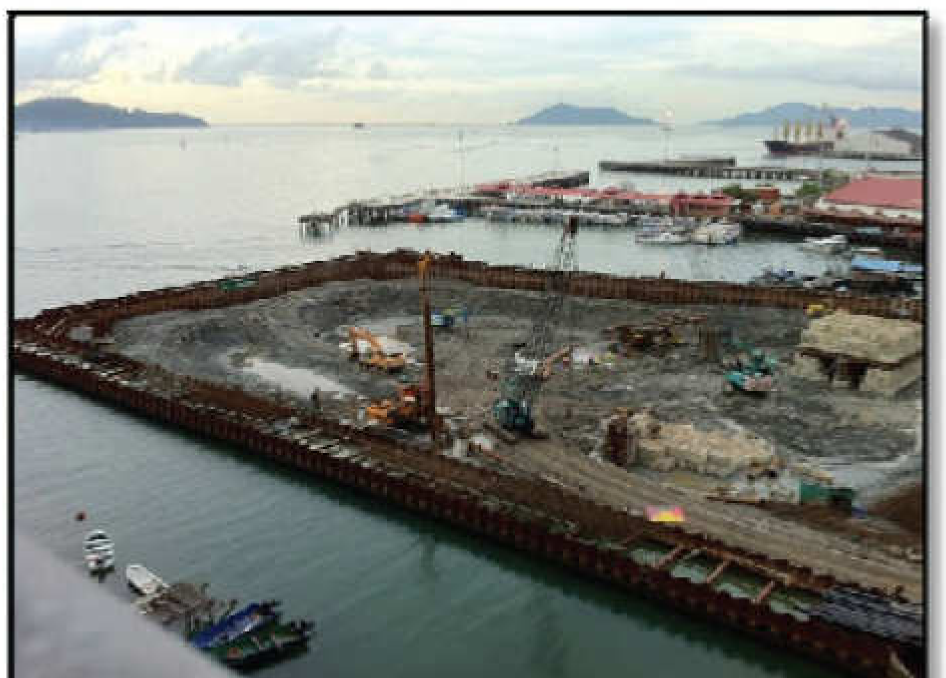
Its primary functions are to coordinate and monitor ship registration activities at Marine Head Office and Regional Marine Department, the Malaysian Ship Registry, the Malaysian International Ship Registry, the Langkawi International Yacht Registry and the Terminable Ship Registry, to regulate boat licensing matters, to conduct validation inspection on ships registration in Malaysia, to issue Continuous Synopsis Record, to issue Certificate of Survey and to prepare statistics on ship registration for maritime industry usage in Malaysia.

The Ship Accreditation Unit ensures ship seaworthiness in compliance with safety standards and environmental


STP Tank – Klang, Selangor


PTP Port – Tg. Pelepas, Johor


Advanture Waterpark – Desaru, Johor


Jesselton Residence – K. Kinabalu, Sabah

GM Klang – Klang, Selangor


Country Garden – Danga Bay, Johor


Menara MPPJ – Petaling Jaya, Selangor


Jetty Lumut – Lumut, Perak


Bangsar South – Bangsar, KL

care as prescribed under the national regulations, international conventions and guidelines.

Its primary functions are to conduct port state control inspections, to conduct validation inspection of ships/boats registered in Malaysia, to process and issue statutory certificates for ships registered in Malaysia, to conduct annual audits on authorised Ship Classification Body and Life Raft Service Stations, and to issue directive on technical standards to ships registered in Malaysia in accordance with national and international regulations in force.

The International Ship and Port Facility Security Code Unit ensures that the standards of Area and Port Facilities operating in Malaysia comply with resolutions under Chapter XI-2 (ISPS Code) of SOLAS Convention 1974 and Merchant Shipping Ordinance 1952 by conducting unscheduled verification every year.

In addition, it enforces and regulates the legal implementation of the Merchant Shipping Ordinance 1952 and implements Flag State Control Inspection, conducts unscheduled annual verification on Area and Port Facilities under ISPS Code, performs Flag State Control inspection on Malaysian ships and complies with Merchant Shipping Ordinance 1952.

The Ship Safety Management Unit ensures that ships and shipping management companies comply with the provisions under Chapter IX (ISM Code) SOLAS Convention 1974 through annual audits including managing the investigation of marine accidents pursuant to the Merchant Shipping Ordinance 1952 and International Conventions.

Its primary functions are to conduct audits under ISM Code on shipping management companies, to conduct marine accident investigations and to conduct audits on vessel management of Marine Department's agencies.

MARINE ENGINEER CERTIFICATION AND COMPETENCIES

Dato' Baharin said that all workers on board a merchant ship or vessel, are required to have a certificate. The Certificate of Competency (CoC) is like a combination of the Malaysian passport and driving licence. The outside looks like a passport and the inside has particulars such as a licence. It contains information about the holder, grade, date of issue, date of expiry, issuing authority, signature of holder, signature of Director General of Marine, function, limitation, capacity, page for endorsement, etc.

"The CoC issued by the Marine Department Malaysia consists of different grades, capacities, plying limits and functions," explained Dato' Baharin. "Like a driving licence, the CoC has different grades, such as Master, Chief Officer, Officer in Charge of Navigation Watch, Chief Engineer, Second Engineer and Officer in Charge of Engineering Watch. It is also divided into Gross Tonnage (GT) and Kilowatt (kW) and plying limit or voyage such as Domestic, Near Coastal and Unlimited."

Dato' Baharin said only Malaysians are eligible to obtain the CoC.

"It is no easy task to get one. The higher the CoC grades, the harder it will be. If you are interested to get one and have seriously decided on seafaring as a career, this is what you should do: Make an application to enroll in courses provided by the Approved Maritime Training Institution," he said.

"Those who have good results in SPM, STPM, Matrikulasi, Diploma or even Degree can make an application to Akademi Laut Malaysia (Navigation & Engineering) or Politeknik Ungku Omar (Engineering only). Akademi Laut Malaysia and Politeknik Ungku Omar only provide courses for higher grades."

INTERNATIONAL MARITIME ORGANISATION

To become a member of the International Maritime Organisation, a state ratifies a multilateral treaty known as the Convention on the International Maritime Organisation.

As of last year, there were 171 member states of the IMO, which included 170 UN members and The Cook Islands. Most UN member states which are not members of IMO are landlocked countries. The majority of conventions adopted under the auspices of IMO or for which the Organisation is otherwise responsible, fall into three main categories.

The first group is concerned with maritime safety, the second with the prevention of marine pollution and the third with liability and compensation, especially in relation to damage caused by pollution. Outside these major groups are a number of other conventions dealing with facilitation, tonnage measurement, unlawful acts against shipping and salvage, etc.

FIRE CONTROL AND SAFETY PLAN DRAWING

The provisions regarding Fire Control Plans are set out in Regulation II-2/15.2 of the International Convention for the Safety of Life at Sea, 1974 as amended (SOLAS 74) with additional requirements relating to passenger ships found in Regulation II-2/13.3.2 of SOLAS 74.

Malaysian ships are required to be provided with revised and updated Fire Control Plan(s) and Life Saving Appliances Plan(s) as set out in regulation II-2/14.2.3.

Dato' Baharin said that it is the obligation of the Owners, Managers and Operators of ships flying the Malaysian flag to comply with the requirements of the present circular. In this respect, it should be noted that action will be taken by the Recognised Organizations in case it is found that the requirements of the present instructions are not complied with.

The combined Fire Control and Life Saving Plan(s) should indicate all the equipment and arrangements referred to in Regulation II-2/14.2.3 of SOLAS 74 and should illustrate all life-saving appliances and arrangements which fall within the scope of Chapter III of SOLAS 74.

In addition are passenger ships with the requirements of Regulation II-2/14.2.3 of SOLAS 74, and the International Maritime Organization Assembly Resolution A.756(18).

In other words, on board every ship flying a Malaysian flag, there shall be a combined Fire Control Plan and Life Saving Appliances Plan. However, passenger ships may carry Fire Control Plan(s) and Life Saving Appliances Plan(s) separately.

PFLNG SATU

National oil company Petronas's first floating liquefied natural gas (LNG) facility, PFLNG Satu, made its historic 2,120 nautical mile journey to the Kanowit gas field, offshore Sarawak, recently on May 14. Its construction began with the official steel cutting in June 2013, followed by the launching of the hull on April 2014.

At 365 metres long and with a dry weight of 132,000 tonnes, PFLNG Satu was towed by tugboats from the Daewoo Shipbuilding & Marine Engineering Co Ltd (DSME) shipyard in Okpo, South Korea, to the offshore phase of the project.

Designed for water-depths of between 70 and 200 metres, it has a processing capacity of 1.2 million tonnes per annum (mtpa), with 145 crew members onboard. PFLNG Satu will support Petronas's global LNG portfolio and enhance its reputation as a preferred and reliable LNG supplier.

The PFLNG Satu will proceed with the installation, hook-up and commissioning of the floating facility once it is moored at the Kanowit gas field, 180 kms off the shore of Sarawak.

Petronas's advisor of Global LNG Project – Project Delivery and Technology, Datuk Abdullah Karim, said the floating LNG facility marks a significant milestone in the company's bold decision to deliver a game changer in the global LNG business as it paves the way for opportunities to monetise the greater availability of stranded gas reserves.

"The sail away of PFLNG Satu is an achievement that everyone in Petronas, DSME and Technip can be proud of," he said.

PROVIDING CLASSIFICATION AND STATUTORY SERVICES AND ASSISTANCE TO PFLNG SATU

The purpose of a Classification Society is to provide classification and statutory services as well as assistance to the maritime industry and regulatory bodies with regards to maritime safety and pollution prevention, based on the accumulation of maritime knowledge and technology.

The objective of ship classification is to verify the structural strength and integrity of essential parts of the ship's hull and its appendages, the reliability and function of the propulsion and steering systems, power generation and other features and auxiliary systems which have

been built into the ship in order to maintain essential services on board.

Classification societies aim to achieve this objective through the development and application of their own Rules and by verifying compliance with international and/or national statutory regulations on behalf of Flag Administrations.

The Rules published by Classification societies, together with the requirements set down in the various International Conventions of the IMO and the marine legislation of the flag states, form a comprehensive and coherent set of standards for design, construction and maintenance in operation of ships.

ABS, a leading provider of classification and technical services to the global offshore industry, has been awarded the classification contract from Petronas for the company's second floating LNG facility (PFLNG 2).

"This is a very significant award for us," says ABS Chairman and CEO Christopher J. Wiernicki. "It also is the natural next step for an organisation that is widely recognised as the leader in the classification of offshore production units and LNG ships."

ABS has had a long history working with floating gas concepts, classing the first offshore LPG storage unit in the world in 1997 and the first LPG FPSO in 2005. ABS has awarded approval in principle (AIP) for 10 floating LNG concepts and has performed pre-front-end engineering and design (FEED) and FEED work on a number of others.

As the selected class society for the PFLNG 2 unit, ABS will provide a comprehensive suite of technical services, including classification.

PFLNG 2, which is scheduled to see first gas production early next year, will be moored via an external turret at the deep-water Rotan gas field offshore Sabah, Malaysia, which is projected to produce 1.5 million metric tons of LNG per year. The vessel is expected to operate on site for a minimum of 20 years without dry docking.

ABS Vice-President for Global Gas Solutions Patrick Janssens views this as the first of many potential awards. "The search for new energy reserves is seeing exploration activities shift to the type of remote offshore fields on which facilities like the PFLNG 2 are perfectly suited to operate," said Janssens.

"With the growing demand for gas around the world, there will be a continued emphasis on FLNG-related technology, and ABS will continue to play a leading role."

While classification societies do not own, design, or operate floating assets, they play a role as a verifier in the process of developing and building the units.

As a verification agency, ABS is often involved at the front end of concept development when designers and developers wish to earn AIP for their designs. The organisation's role is to provide third-party review of new or novel design concepts.

AIP is granted to acknowledge that a proposed concept or design complies with the intent of ABS rules and/or appropriate codes. The AIP process gives companies which are introducing new technologies or concepts, to earn recognition by an independent party that attests to the acceptability of the concept at that stage of development.

Beginning more than a decade ago with the introduction of the first FLNG designs, ABS has awarded AIP for more than a dozen concepts and has performed reviews for pre-front-end engineering and design (pre-FEED) and FEED work on others. Several designs which have earned AIP will be developed into FLNG vessels and in time, these will be used to produce natural gas from fields around the world.

FURTHER COLLABORATIONS BETWEEN MARINE DEPARTMENT MALAYSIA AND THE MARINE ENGINEERING AND NAVAL ARCHITECTURE TECHNICAL DIVISION OF IEM

Dato' Baharin said the Marine Department Malaysia and the Marine Engineering and Naval Architecture Technical Division of IEM can collaborate, promote and advance the science and profession of marine engineering and naval architecture as well as to foster the involvement of Marine Department Officers and IEM Members in national as well as international activities related to marine engineering and naval architecture.

The two organisations will also be able to create awareness through discussions, seminars, forums and talks on present technology, issues and legislation related to marine engineering and naval architecture as well as to disseminate news and technological advancement in marine engineering and naval architecture to the engineers and public at large.

"We would like to engage with each other in professional and technical capacities," said Dato' Baharin. "The aim is to look after the safety and seaworthiness of our vessels as effectively as possible." ■

Shipbuilding in Malaysia

Is it still a lucrative business for small time marine contractors?

First Admiral Dato' Ir. Ahmad Murad Omar (Rtd)

First Admiral Dato' Ir. Ahmad Murad *is a Chartered Marine Engineer (CMarEng) and Chartered Engineer (CEng). Having a career in the marine sector for more than thirty years, Dato' Ir. Murad has a wide experience in marine consultancy and matters related to shipbuilding and ship repair technology.*

In his opening speech at the recent Rio Olympiad Opening Ceremony 2016, Thomas Bach, President of International Olympic Committee (IOC) mentioned that the world is facing various issues such as prices and economic uncertainties.

Indeed, the world is facing various economic uncertainties and the shipbuilding industry in Malaysia has not been spared either. The current dip in prices of oil and gas has impacted many oil companies which, according to energy expert[i] Mark C. Lewis, have had adopted a diverse energy portfolio in order to remain competitive.

Capital expenditure is much higher than output at the moment and investors are going to want a return on their money. Already we are seeing a slow-down in shipbuilding activities associated with the oil and gas industry. Building of Offshore Support Vessels (OSV) has stagnated; some pre-constructed vessels are not able to secure ready charterers and future utilisation of those presently under construction is uncertain.

Oil prices dropped from more than US$100 a barrel in January 2014 to less than US$45 a barrel in November 2015. Exploration and production (E&P) companies have cut growth plan for offshore rigs. At the same time, the demand for service vessels and crews is slowing down, putting pressure on daily rates, reducing revenues and curbing growth rates. OSV day rates have dropped to 40% since 2014[ii].

But what of other industries which require shipping vessels such as fishing, recreation, utility and defence?

The Malaysian fishing industry is also under the threat of encroachment by foreign fishing vessels from neighbouring countries. Enforcement and policing of this scenario is another chapter in the books of Malaysian maritime enforcement agencies which require some serious initiatives (Figure 1). Utility vessels such as marine leisure and recreational vessels are not a big contributor to the shipbuilding industry.

Therefore, what is left is the defence and enforcement sector where the need to replace old ships and build new ones may sustain the shipbuilding industry. Enforcement is a must to meet the challenges of maritime encroachment and infiltration of subversive elements[iii]. This sector could also be a result of the current situation where various nations, which are making overlapping claims to riches within the Exclusive Economic Zones (EEZ), seem to be flexing their muscles.

Boosting nation's maritime security

EXCLUSIVE

Figure 1: Sourced from New Straits Times, Tuesday August 9, 2016

DISCUSSION

Malaysia's Economic Transformation Programme (ETP) transcended under the Entry Point Project (EPP) 6, focuses on providing competitive pricing, enhanced facilities and increased capabilities for the Shipbuilding and Maintenance, Repair and Overhaul (MRO) market to cater to the growing shipbuilding and repair industry[iv].

The Government has a well-charted course for the Shipbuilding & Repair industry, so what has gone wrong? Why do we still see workers being laid off nationwide at shipbuilding and repair yards?

Small time contractors in the marine sectors are struggling to make ends meet. Diversity is limited and eventually they will be left with no choice but to wind up business. In short we can conclude that the shipbuilding sector is shrinking. If so, how can we cushion this impending threat?

In a paper[v] written by the Chairman of Association of Marine Industries of Malaysia (AMIM), Tan Sri Dato' Seri Ahmad Ramli bin Haji Mohd Nor, and a senior fellow at Maritime Institute Of Malaysia (MIMA), Nazri bin Khalid, some conclusions drawn at that time might have been relevant but whether these had withstood the test of time as well as prevailing economic changes and pressures, had yet to be seen.

Here are some thoughts and opinions.

- **Balancing state help and competitiveness:** Crucial to the current situation is survival. In order to survive, one must be willing to do anything, including going out of the normal business ethics and that may not be good for the business fraternity. The shortage of funds in state-owned organisations has affected small time contractors who need financial assistance and, without collateral to offer, they are helpless. Their greatest concern is cash-flow management.
- **Tackling the woes of the industry and providing impetus for growth:** Has anyone identified the problems facing the industry, let alone tackle the woes, find solutions and encourage growth? Some efforts are being done for Small and Medium Industry (SMI) to approach Malaysian Industrial Development Finance Berhad (MIDF), SME Bank and Ministry of International Trade And Industry (MITI) for some assistance but are they able to convince the financial providers that they are deserving cases? Showing collateral and proof of their ability to pay back loans will be the first item on their agenda.
- **A capital intensive industry:** Shipbuilding is heavy capital intensive industry. Once an investment is undertaken, a long term revenue generating project should be put in place. Otherwise the return of investment (ROI) will never be met and cost benefit analysis done will come to naught. Alternatively, the prime beneficiary of the investment must exercise an "umbrella structure" in providing jobs to SMIs, very similar to a bird feeding its young. The solution probably lies in a controlled, structured awarding of projects as well as a consistent and fair distribution of jobs among the SMIs.
- **Capability vs Capacity:** Intensifying technologies and upgrading skill base are more easily said than done. Technologies require R&D and financial strength which, unfortunately, SMIs would not have in abundance. Manpower with requisite skill sets will go where the returns are lucrative. Keeping skilled manpower will incur high overheads and sustainability will prove very difficult.
- **Changing stakeholders' mind-set to "Malaysia First":** The mind set of ship-owners, state and stakeholders are usually hardened and they are not easily moved. As for the state, central government policies are always the driving force. Standard procedures may also change, depending on the time and situation. Ship-owners and ship-charterers are always looking for the best and

most profitable deals. When cost is the driving force, building ships outside Malaysia seems to be the solution. Therefore, it will not be easy to persuade ship-owners to have their ships made locally. For local shipbuilders and SMIs to capture their share of the market, the challenge will be to improve quality and punctuality of construction delivery as well as keep costs down (Figure 2).

Figure 2: Sourced from Omahams Corp Sdn. Bhd.

CONCLUSION

Some organisations have helped identify the salient points that need scrutiny and recommended swift actions to be taken. These sound like good suggestions but only if the initiatives are implemented with due consideration of the fact that SMIs are not without constraints such as:

- The need for financial support;
- Non-availability of job opportunities in related skill sets available;
- If and when opportunities are given, SMIs do not necessarily have the right mix of capability to accomplish the task;
- Support from state-owned bodies and GLCs which should be more prudent in the distribution of work amongst SMIs, executed in a controlled and organised manner to assure fairness;
- The need to be guided in the correct field of market segment so that confrontation and conflict are reduced. This way, SMIs can develop their strengths rather than try to do everything and not excel in any. This also ensures a balance between capability and capacity;
- Requiring assistance in capital injection to help in capital investment in improving facilities and skill base;
- Encouraging ship-owners and ship-charterers to be mindful of local products and builders, thus allowing growth of the shipbuilding market.

In conclusion, shipbuilding is still a market that is exploitable for small time marine contractors who are serious and determined to be successful. This is also provided that certain conditions in the market are controlled and managed with fairness and that the government must be committed to expedite what has been promised in the Shipbuilding & Ship Repair Strategic Plan 2020 launched in 2011. On their own, SMIs will face great difficulties to grab what little business opportunities that are still available in the country today; outside our borders, the competition is too stiff and challenging. ■

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Underwater Localisation Techniques for Marine Applications

Prof. Dr Mohd. Rizal Arshad

***Prof. Dr Mohd. Rizal**, B.Eng. (Medical Electronics & Instrumentation), Liverpool University, MSc. (Electronic Control Engineering), PhD (Electrical Engineering – Robotic Vision System), University of Salford, UK is currently the Deputy Dean, School of Electrical & Electronic Engineering, Universiti Sains Malaysia (USM).*

Mohd. Helmi Abd Majid

***Mohd Helmi Bin Ab. Majid** graduated from the International Islamic University Malaysia (IIUM), in 2009 in Bachelor of Engineering (Mechatronic). He has Master of Science (Mechatronic Engineering) in September 2012. He is currently a PhD student at Universiti Sains Malaysia (USM) with specialization in a field of robotic.*

The disappearance of Flight MH370 has significantly increased awareness of the importance of underwater technology to our country. From the global perspective, the incident shows how far underwater technology has evolved and the extent of its capability.

Locating the black box of the plane in the deep ocean requires very advanced and sophisticated underwater technology. This process is known as underwater localisation or positioning. The basic principle of underwater localisation is very similar to the concept of Global Positioning System (GPS) but, instead of using GPS signals (radio waves), underwater localisation relies on acoustic signals as the medium of operation.

GPS radio waves are unable to penetrate water, unlike acoustic signals. The speed of sound in water (about 1450 m/s) is about four times faster than in air (about 334 m/s) though this can be changed subject to water temperature, salinity and pressure. Applications of underwater localisation include, but not limited to (1):

- Subsea vehicle positioning, such remotely operated vehicles (ROV) and autonomous underwater vehicles (AUV)
- Diver tracking
- Towed fish tracking
- Underwater pipe and cable laying operations
- Pinger localisation

Oceans can be divided into several zones according depth, temperature and level of sunlight penetration. The details of the ocean zones classification are shown in Figure 1.

As we go deeper under the water surface, the temperature will decrease and pressure will increase. These physical characteristics will significantly affect the accuracy of underwater localisation. In the ocean, the speed of acoustic signals varies according to temperature and pressure. The accuracy of underwater localisation depends on our ability to predict and estimate the speed of acoustic signals travelling in the water as a function of depth. This changing speed of acoustic signals has created challenges in designing an underwater localisation system. Figure 2 illustrates the profiles of sound speed, temperature and pressure as a function of depth. These profiles are very important for developing an accurate underwater localisation system.

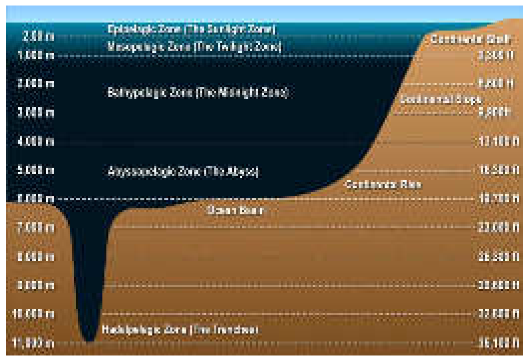

Figure 1: Division of ocean zones [2]

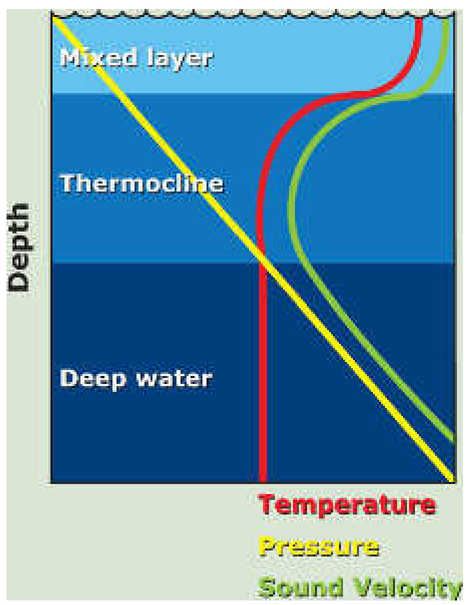

Figure 2: Temperature, pressure and sound speed variation with ocean depth [3]

Underwater sound can also be easily affected by the noisy environment in the ocean. In shallow water, sound experiences a reverberation effect. These problems can be solved through extensive signal processing and filtering and reliable underwater positioning can be developed with high positioning accuracy. Because of these problems, underwater localisation technology is slightly different for shallow water and deep water.

Apart from being able to overcome wobbly conditions of the ocean environment, underwater localisation schemes should fulfill the following desirable qualities:

1. Accuracy: The location of the sensor for which sensed data is derived should be accurate and unambiguous for meaningful data interpretation.
2. Fast: Since sensor nodes may drift with water currents, the localisation procedure should be fast so that it can report actual location when data is sensed as otherwise, the device to be located or tracked will drift away with the underwater current.
3. Wide Coverage: The localisation scheme should ensure that all sensor nodes can be localised. However, the extent of the area to be covered will depend on the method of localisation being used.
4. Low Communication Costs: If the nodes are battery-powered and may need to be deployed for a long duration, it should not waste energy for unnecessary transmissions during the procedure.

LOCALISATION METHOD

In general, there are two types of underwater localisation: Passive localisation and active localisation. Passive localisation involves listening for an emitted acoustic signal, such as that from a plane's black box. The ping signal emitted by the black box is picked up by sensors for further position estimation process and only involves unidirectional acoustic signal transmission.

Active localisation, on the other hand, involves both transmitting and listening for acoustic signals such as when tracking the location of underwater vehicles. In active localisation, when a beacon attached to the underwater vehicle receives a signal from a surface vessel, it will respond by emitting its own signal at a certain frequency. When it receives the responding signal, the surface vessel then processes it and calculates the position and direction of the target. These two concepts of localisation are illustrated in Figure 3. Passive localisation consists of a receiver only while active localisation requires both receivers and transmitters (or transceivers).

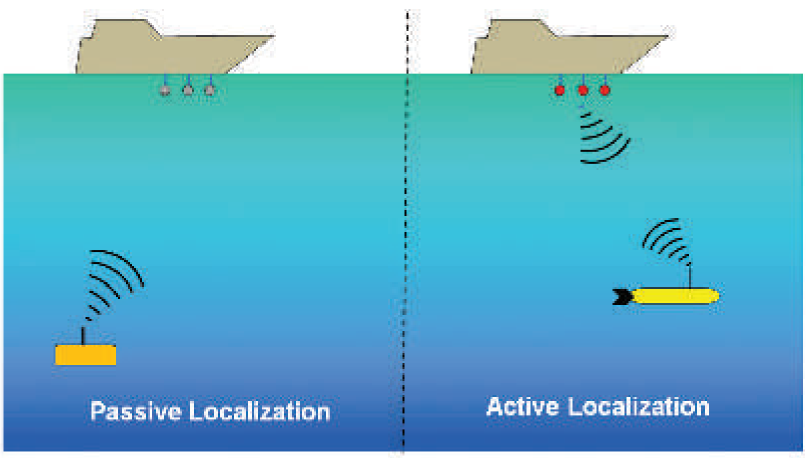

Figure 3: Passive (left) and active underwater localisation

There are three famous generalised approaches used widely in underwater localisation: Ultra-Short Baseline Length (USBL), Short Baseline Length (SBL) and Long Baseline Length (LBL) as illustrated in Figure 4. The baseline length refers to the separation distance between the receivers used to capture the acoustic signal. Each receiver consists of multiple transducers. These methods are generally based on range measurement which is directly related to sound-speed propagation in underwater. Working principles of the above localisation methods are summarised in Table 1.

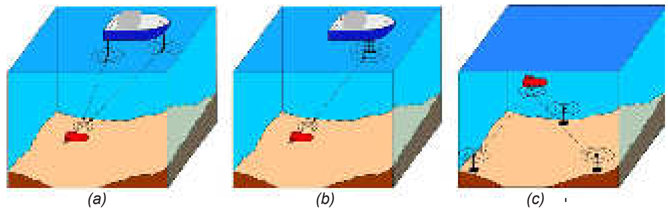

Figure 4: Stationary beacons (a) USBL/SSBL (b) SBL (c) LBL [4]

Table 1. Working principles of USBL/SSBL, SBL and LBL

Method	Description
USBL/SSBL	Positioning calculation is based on range, horizontal and vertical angle measurement from a single multi-elements transducer or very close range transducers (measuring centimetres in length). It provides three-dimensional transponder positions relative to the surface vessel.
SBL	Positioning calculation is based on range, horizontal and vertical angle measurement from a minimum of three transducers mounted on the vessel hull (metres in length). Accuracy is about < 0.5% of the slant range. It provides a three-dimensional transponder position relative to the surface vessel.
LBL	Positioning calculation is based on range measurement alone. The underwater vehicle or module and the vessel are positioned relative to a calibrated array of transponders install on the seabed (kilometres in range). Very accurate positioning of 1m to 0.1m.

Apart from the above three basic localisation methods, buoys are also widely used for underwater localisation. Unlike conventional buoys, this is known as GPS Intelligent Buoy (GIB) and possesses a special characteristic. It can calculate the signal's times of arrival (TOA) to determine the range before a geometrical solution calculates the position of the transponder.

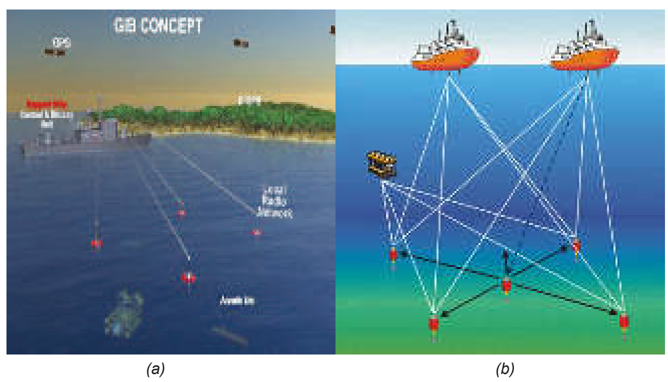

Figure 5: (a) Illustration of GIB Concept [5] (b) MULBL Localisation [6]

Multi-User Long Base Line (MULBL) is another method of underwater localisation where several underwater vehicles can position themselves using a few similar transponders installed on the seabed. This method can be viewed as enhancing LBL because the localisation concept is similar to LBL positioning, except that it is configured to locate multiple targets at the same time. Figure 5 illustrates GIB working principles and MULB in localising underwater vehicle.

CURRENT UNDERWATER LOCALISATION TECHNOLOGY

1. Shallow Water

Through the years, technology related to underwater localisation has evolved to include that for shallow water and deep water localisation and led to an innovative acoustics-based system. An acoustics modem (Figure 6) has simplified conventional localisation techniques where a transducer array is not necessary.

It also eliminates the need for the installation of on-site beacons as commonly found in a conventional method of localisation. The acoustics modem not only serves as a localisation device but it also provides direct communication between two underwater devices. It consists of a receiver and a transmitter. The principle of operation is still based on acoustics as in the conventional positioning system. See Figure 7.

Figure 6: Mobile beacons (acoustic modem) [7]

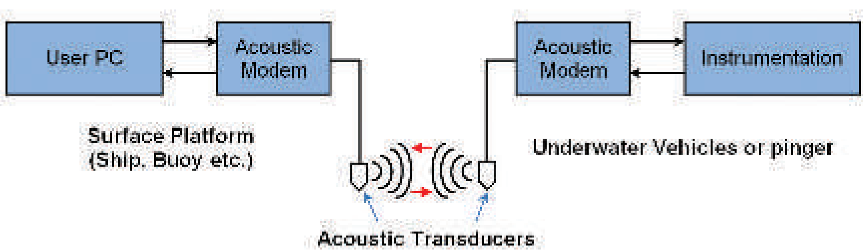

Figure 7: Basic acoustics modem working principle

Open water Remotely Operated Vehicle (ROV) positioning using USBL is one of the underwater localisation technologies that use the acoustics modem. It is useful for pipeline and tunnel inspections. The communication network consists of data transmission interchanging between multiple components: Satellite, surface vessel, ROV garage and ROV.

Figure 8 shows a satellite used to provide GPS data to the vessel. Apart from the GPS device, the vessel contains a gyroscope to measure heading, pitch and roll which will be a reference to the ROV location. The ship is also used to deploy a transceiver, a device which can transmit as well as receive sounds underwater. The transceiver is submerged underwater and positioned just below the ship.

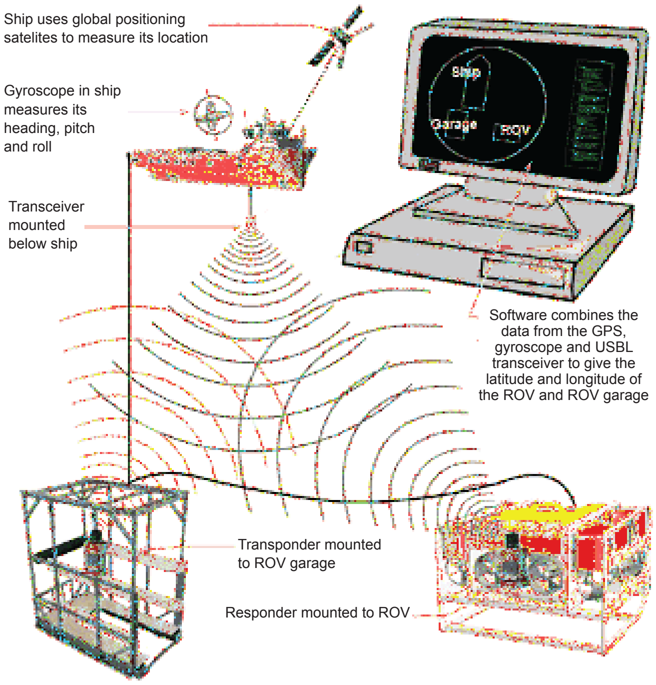

Figure 8: ROV positioning using USBL [8]

There is a cable linking the ship and an underwater ROV garage which is used to launch and recover the ROV. Most importantly, it has a mounted transponder to receive and send an acoustics signal to the transceiver.

Using a transponder has the advantage of simple deployment but this is at the cost of calculation inaccuracies due to sounds travelling twice and being affected by thermoclines. A responder installed on the ROV is similar to a transponder but it receives the trigger signal from the cable instead of sound and gives a more accurate position of the ROV since the sound signal only travels once through the water.

A computer equipped with underwater positioning software is included in the system to locate the ROV and ROV garage based from the fetched GPS, gyroscope and USBL transceiver data. The transponder capability determines the operation depth of the system but usually it is designed for shallow water application.

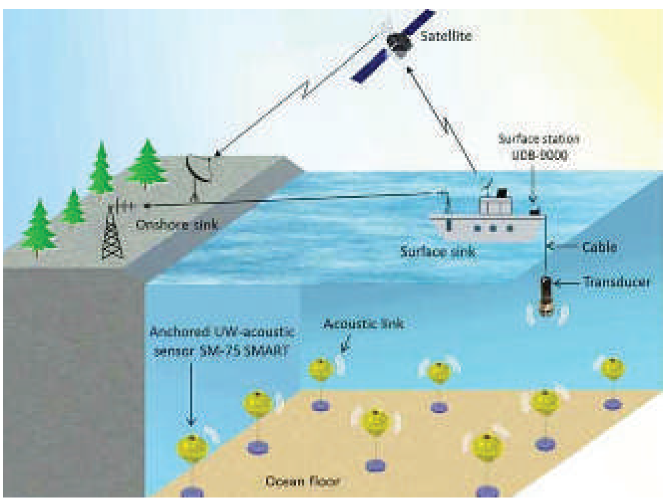

Figure 9: Underwater acoustic networking testbed [9]

An underwater acoustics networking test bed is another interesting underwater localisation technology which uses numerous acoustic sensors on the ocean floor. It is a wireless networking application used primarily to monitor and inform operators about an incoming tsunami. The system comprises a satellite, onshore sink, surface sink, surface station, transducer and acoustic sensors (Figure 9).

An onshore sink is positioned on the beach to receive data from a surface sink (ship). The surface sink conveys data from a surface station. The surface station is a wireless control unit for acoustics modems and acoustics releases. A transducer is placed just below a ship to monitor underwater communications. It converts the sound it receives to an electrical signal which is then processed and displayed on the surface station. This system is different from other localisation techniques in the sense that there are multiple anchored acoustic sensors installed on ocean floor. These sensors combine an underwater acoustics release with an acoustics modem for easy management and deployment.

An even more advanced shallow water AUV positioning technology is a cooperative type of localisation system (Figure 10). In this system, the ship is not fixed in a single position as it acts as a mobile surface vehicle.

The mobile surface vehicle acquires its absolute position in real-time and conveys the data to multiple AUVs which measure the difference in range between their positions and the mobile surface vehicle to bind the localisation errors accumulated by dead-reckoning. The advantage here is it has a larger operating area than a static beacon.

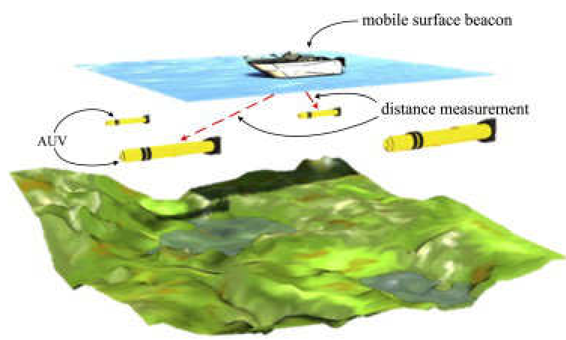

Figure 10: AUV cooperative localisation using mobile surface vehicle [10]

DEEP WATER

Discovering and tracking an underwater target of interest is a challenging task, especially in deep oceans. There is limited technology for performing deep water localisation. Towed ping locator is a technology used to locate an underwater pinger position. Figure 11 shows its working principle.

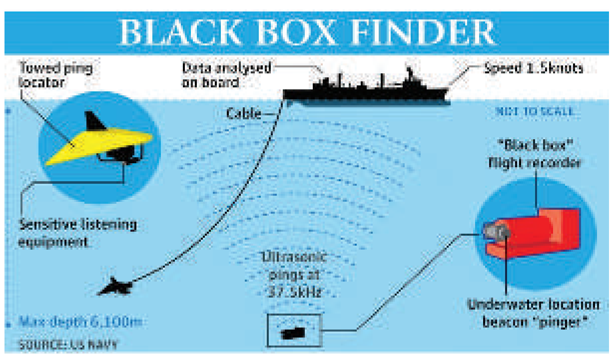

Figure 11: Towed ping locator (Source: US Navy)

This technology became well known to the public when the search for Flight MH370 began. Towed ping locators are used to locate emitted signals which cannot be detected by a surface transponder as signal strength weakens as depth increases. Using a towed pinger locator will increase the chances of detecting the emitted pinger. This technology allows us to localise the source of the pinger to thousand of metres in depth.

FUTURE DEVELOPMENT

Current technology of underwater localisation is limited in term of area of coverage and localisation time span. Thus, if we can introduce an autonomous, flexible, robust and scaleable receiver or transponder platforms, we will be able to solve these problems.

By using the swarm robot concept as part of the underwater localisation system, we can improve the search for and efficiently track underwater targets. See Figure 12 for an illustration of this concept.

Theoretically, by implementing a swarming concept, more simultaneous readings can take place, thus reducing any positioning error. In addition, large number of swarming platforms can cover large areas, reducing the time taken to locate a target.

A simple, smaller yet effective autonomous platform can replace the large surface vessel currently used for underwater localisation. Last but not least, this system can locate and track multiple targets at the same time without losing localisation sensitivity and accuracy.

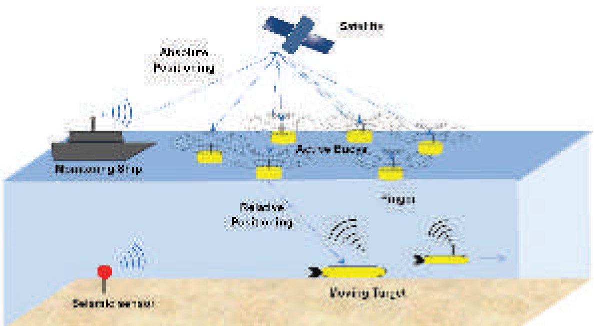

Figure 12: Proposed method of underwater acoustic postioning

CONCLUSION

We have discussed the general overview of underwater localisation for both shallow and deep water. From this, we can conclude that underwater localisation is a very important technology. There is plenty of opportunity for research and development in underwater localisation by local and international research institutions.

At Underwater, Control and Robotic Group (UCRG), Universiti Sains Malaysia, we are exploring the realisation of the underwater localisation, developed from beginning concepts and ideas towards real world implementation. ■

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Improved Hull Designs for Energy Saving, Better Efficiency and Environment Protection

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With the increase in global population, the demand for natural resources has also risen drastically. Fossil fuel is expected to last another 30-40 years only. Another main concern is emissions from industries and transport systems.

We should introduce the concept of sustainable development in future ship designs. Almost all emissions from ships are reduced when less energy is consumed (1). According to an IMO study on greenhouse gases, it was found that there is potential for improvement in the existing technologies such as more efficient engines and propulsion systems, improved hull designs and larger ships. This simply means improvement through technical and design based measures that can reduce fuel consumption and emissions. It was also found that reductions could be obtained through operational measures such as lower speed, voyage optimisation, etc. (2).

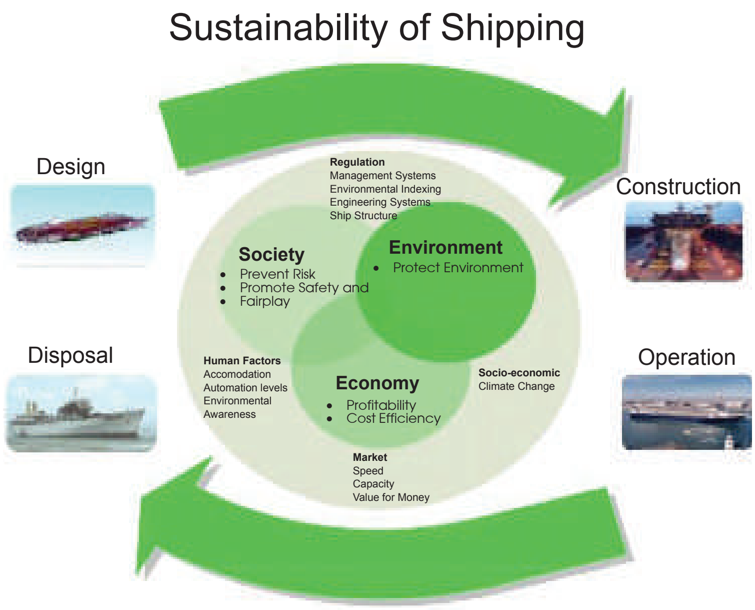

Figure 1: Sustainability of shipping

Although ship vessels are the most fuel-efficient mode of transport, the industry has been tasked to reduce its greenhouse gas emissions. One of the technical measures that had resulted from this was Energy Efficiency Design Index (EEDI), which was mandatory for new vessels built from January 1, 2013, as per IMO. The intention was to provide a new building standard, assuring that ship designs achieved a certain level of efficiency and decreased carbon emissions. It represents the energy efficiency of a ship's design, indicates the ratio between environmental impact (CO_2 emission per transportation work) and economic benefit and provides a benchmark against which a ship's efficiency may be evaluated (2).

We are designing eco-friendly ships so that future generations can enjoy natural resources to the fullest. Nature is a gift to mankind and we have a responsibility to protect it. Hence, sustainable development is necessary to safeguard our planet. Sustainability includes three elements (people, planet and profit) and has three pillars (economic, social and environmental). The shipping industry should be safe and secure, environmentally responsible, reliable and efficient in operation.

Figure 1 shows the lifecycle of shipping, from design to construction and operation and disposal. It is important to note that efficient shipping is only possible if we balance the three aspects of sustainability, i.e. economic responsibility, society and concern for environment. The design is the first step and optimisation of the hull design will play a major role in reducing resistance and emitting less greenhouse gases.

Designing a ship is a complex process. There are various enablers to be considered when designing a ship, including economy, technology, accidents, environment, security people and cultures. A design spiral is widely used and this forms a structured format for efficient and innovative ship designs as shown in Figure 2.

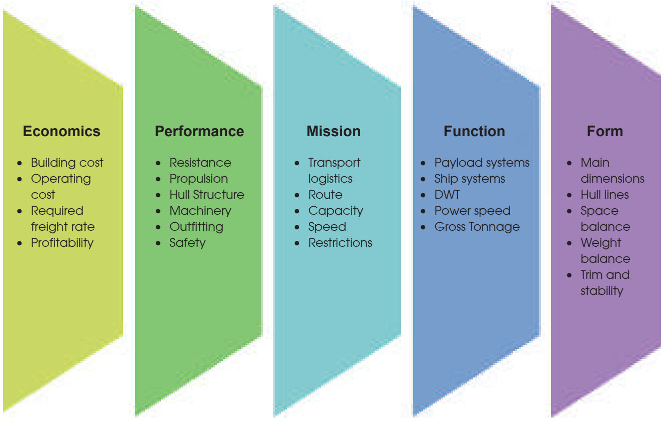

Figure 2: System based ship design spiral (Lavender, 2009)

The hull of a ship is divided into three main parts: Fore, Parallel Middle Body and Aft. Modifications can be done in the Fore and Aft parts to improve the design of the ship. The lines plan drawing of a ship is important in knowing the shape of the hull and providing information on hydrostatic data. In modern ships, new technologies have been used to improve efficiency.

DEVELOPMENTS IN SHIP HULL

Presently, there are modifications being done to the dimensions of a ship and hull forms to reduce the total weight and enable the ship to move faster and consume less fuel. Increasing the length while reducing the beam and maintaining the draft, displacement and block coefficient (Cb) constant typically yields improvements in hull efficiency, provided additional ballast is not needed to maintain adequate stability. A higher length/beam ratio tends to reduce wave making resistance, while the reduced beam/draft ratio tends to reduce wetted surface and therefore the frictional resistance (3). Hull form optimisation is mostly done in the Fore and Aft. The modifications in hull designs will greatly improve design efficiency. The improvement areas include:

- Fore body optimisation
- Aft body optimisation
- Propeller wake optimisation

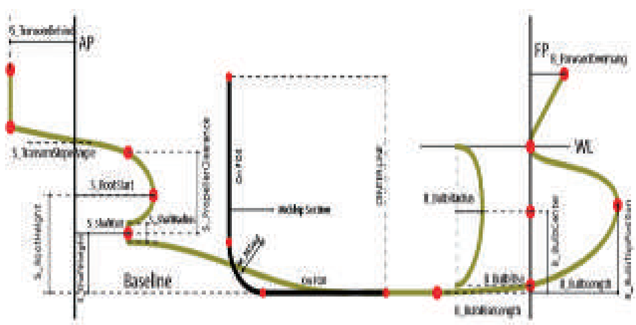

Figure 3: Exposed parameters for Aft and Bow parts of the ship and Midship section (Duvigneau et al., 2013)

Figure 3 describes the three main parts of a hull: Fore, Middle and Aft. It also determines the basic outline of measurements for optimising the hull.

1. FORE BODY OPTIMISATION

A properly designed bulbous bow reduces wave making resistance by producing its own wave system that is out of phase with the bow wave from the hull, creating a cancelling effect and overall reduction in wave making resistance. The flow is more horizontal, reducing eddy effects at the forward bilge. Physical factors considered in bulb optimisation include volume, vertical extension of the center of volume, longitudinal extension and shape (4).

Improving bulb characteristics is a complex process. We should know what kind of bow matches with the design. There are different types of bulbous bow design like the pear shaped bow, Goose neck type bow, V shaped hull etc. These modifications can be done using advanced computer software by fairing the B-spline and checking the pressure variations towards the hull.

A bulb with a reverse pear-shaped section is primarily effective at the design condition. Pear-shaped bulbs work best for drafts below the design draft. A V-shape may be introduced at the base of the bulb to mitigate slamming impact loads. Faster, more slender vessels favour larger volume and forward extension of the bulb. Goose-neck bows and stretched bulbs are particularly effective when draft and speed vary over a small range (5). The characteristics of the bulbous bow must be carefully balanced with the shape of the entrance and the transition towards the forward shoulder and bilge. Bulbs are most effective at certain Froude number (speed-length ratio) and draft. Changes in speed and draft significantly change the wave created, such that reductions in draft or speed can actually lead to increases in wave making resistance. Maersk Lines reports fuel savings of over 5% by modifying the bulbous bow (Figure 4) of a shipyard design which was optimised to the design draft. Hence, it provided a more favourable performance over the anticipated operating profile of drafts and ship speeds.

Bow flare also influences motion and added resistance in waves. A V-shaped rather than U-shaped flare is generally preferred, as it can reduce motion without adding resistance. The increased resistance in heavy seas due to a pronounced flare is currently not fully understood and consequently, rarely considered during the design process. However efforts are on-going to find out more (5,14).

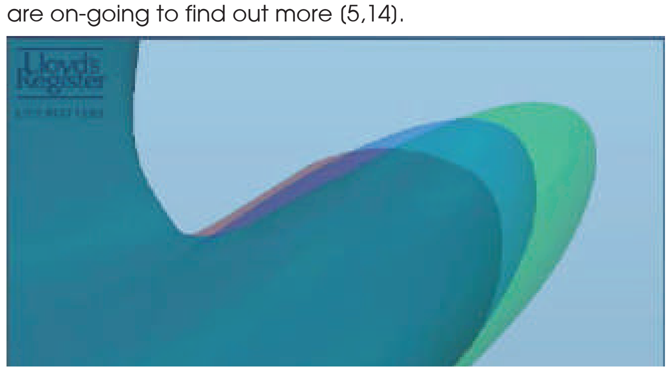

Figure 4: Bulbous bow variations (Lloyd's Register)

According to Lloyd's Register, variations in the bulbous bow can give fuel saving of 3 tons per day for a feeder container ship. In the figure above, the colour blue indicates the original shape, red gives the worst results and green is considered to give best results (6).

1.1 Modern Bow Designs

Using advanced technology, many well-known companies have put a lot of emphasis on developing efficient hulls. One of the advances in forward hull design is done by Ulstein Design companies which has come up with the concept of X-bow hull design (Figure 5). This introduces a larger and smoother volume distribution in the Fore, allowing for submersion. Combined with a sharper bow shape, the typical challenges of conventional bow shapes are solved. The shape of the hull has been optimised with a view to high top speeds, low resistance and reduced fuel consumption. Great emphasis is also placed on the crew's safety and comfort (7).

The key benefits of this type of hull design are:

- Elimination of slamming and bow impact.
- Soft entry in waves.
- Less spray.
- Low acceleration levels.
- Reduced vibration levels.
- Increased comfort and available crew rest time.
- Safer workplace due to smoother motions and protection provided by hull.

Figure 5: X-bow hull

Another improvement in the forward part of hull design was done by Rolls Royce which had been patented this year. The design features a bow with a vertical stem for smooth entry into the water. When it encounters a wave, the hull shape pierces through the water rather than rides over the top, while the bulb contours the shape of waves along the ship's side to reduce wave resistance. The straight flare in the bow design also minimises speed loss and slamming during operation.

2. AFT BODY OPTIMISATION

Aft body optimisation includes efforts to mitigate stern waves, improve flow into the propeller and avoid eddy effects. A properly designed stern can reduce the aft shoulder crest wave as well as the deep wave trough and stern waves. Improving the nature of the stern flow can lead to greater propulsive efficiency. But the aft body optimisation is a bit tricky when compared to forward part because of the presence of appendages such as the rudder, propeller etc.

Single screw sterns forward of the propeller may be V-shaped, U-shaped or bulb types. The trend today is towards the bulb shape, as the improved wake reduces cavitation and vibration. This is one of the environment friendly designs as these days, pram type stern hulls are used to shift the Longitudinal Centre of Buoyancy (LCB) aftwards, enabling smoother forward shoulders and lower waterline entrance angles which reduce resistance (8).

Three types of aft ship hull shapes can be distinguished:

i. Extreme pram type aft ships
ii. Variations of a moderate pram type with a moderate stern bulb
iii. Aft ship shapes featuring a moderate tunnel (originated from inland waterway vessels with draught limitations) (9).

Of the three types of aft ship hull shapes, the third is most efficient and the latest in operation because it can accommodate a propeller with a larger diameter. The tunnel shape ensures a steady flow into the propeller even in heavy seas, reducing propeller racing and providing sustained good thrust as shown in Figures 6 and 7.

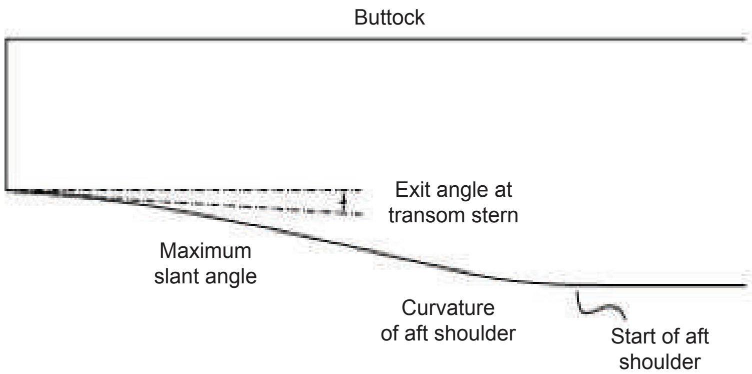

Figure 6: Aft hull seen from starboard side includes slant angle, exit angle and start of aft shoulder (Tregde, 2003)

Figure 7: Moderate tunnel shaped aft ship (J.j.nieuwenhuies, D. 2002)

When the hull is properly improved, it will reduce resistance, which means less power will be required to propel the ship. This will also help reduce emissions from the engine and increase the overall efficiency of the ship.

2.1 Propeller Rudder Interaction

The efficiency of a ship also depends greatly on propulsive efficiency. There have been on-going studies on propellers and rudders for a long time. With developing technology, engineers and designers at Rolls Royce have come up with a unique and interesting technology of propeller and rudder integration to satisfy the demands of energy efficient design. It is named as Promas Lite (Figure 8).

Behind a normal propeller hub, a strong low pressure vortex (hub vortex) acts on the propeller hub, increasing drag and reducing propeller thrust. In the Promas Lite, a special hubcap fitted to the propeller streamlines the flow onto a bulb that is added to the rudder, effectively reducing flow separation immediately after the propeller. The result is an increase in propeller thrust as previously wasted energy is recovered from the flow. In addition, the bulb on the rudder streamlines the flow aft of the rudder, further reducing drag. The hubcap is mounted outside of the propeller hub and acts purely as a hydrodynamic fairing. No special hub design is needed, so cost and technical complexity are kept to a minimum (10). Benefits of this design include:

- Reduced fuel consumption – improvements of 5-15% are possible, depending on the vessel's operating profile.
- Reduced environmental impact – corresponding reduction in emissions with lower emission taxes, wake wash and noise.
- Short payback period – depends on vessel operating hours, but the return on investment is usually less than two years.
- Increased propulsive efficiency – integrated rudder and propeller design, reduced pressure pulses for improved comfort.
- Simple and quick installation – can normally be fitted within a week
- Lower maintenance costs – reduced engine loads means less oil consumption and potentially reduced engine wear.

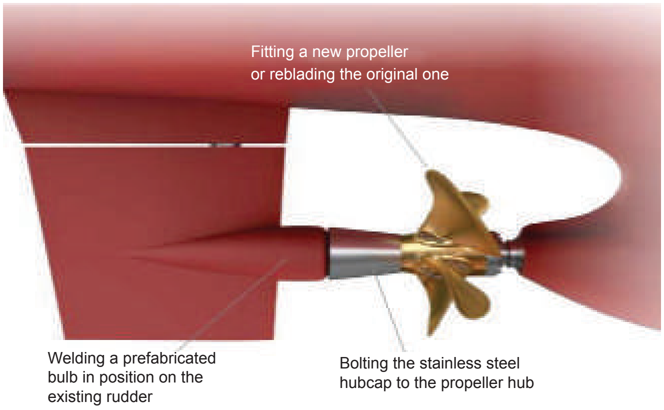

Figure 8: Promas Lite, propeller rudder interaction by Rolls Royce (Rolls Royce Marine)

ANALYSIS OF HULL OPTIMISATION AND FUEL SAVINGS

Table 1 was taken from a report by Lloyd's Register. According to this, when the hull of a ship is optimised, it affects the trim of ship ahead and aft. If we carefully distribute the weight along the length of ship and produce a stable trim, there will be reduced resistance and savings on fuel consumption. This optimisation was done on various types of ships and it was found that there were confirmed savings on fuel greater than 1-2% and improvements in ship speed. Resistance was minimised and fuel consumption was reduced as less power was needed to propel the ship. At the same time, overall efficiency was increased.

Table 1: Trim Optimisation (Lloyd's Register)

TRIM OPTIMISATION	DESIGN YEAR	FOC IMPROVEMENT EXPECTED / CONFIRMED IN OPERATION
VLCC	2006	<1% confirmed Saving abt. $250k/year
ULCS 13K Teu	2007	<1% confirmed Saving abt. $700k/year
PCTC	2005	1 – 2% confirmed
87K Dwt Bulk Carrier	2004	Speed-up experienced
Feeder Container		Speed-up experienced
MT Tanker		Speed-up experienced
32k dwt Bulk Carrier		0.2 knots increase on average speed for same FOC
General Cargo	2013	0.4 knots increase speed at 14 knots

1. EXAMPLES OF HULL OPTIMISED SHIPS

If we analyse Table 2 and 3, we can see that optimisation of the hull not only helps save fuel but also protects the environment. The results are based on Lloyd's Register survey, which is one of the best classification societies involved in ship design for years.

Table 2: Integrated hull form optimisation (Lloyd's Register)

Delta Marin B DELTA 39k DWT Bulk Carrier for CNCO Delivered in 2013	
INNOVATIVE SOLUTION	Integrated Hull Form Optimisation
PERFORMANCE	• FOC of 18.5 t/day @ 4554kw • EEDI 21% below required limit • High Cargo Volume • Shallow Draft • High Deadweight Design

Table 2 shows a bulk carrier delivered in 2013 with this integrated hull form optimsation. Its performance showed that it had high cargo volume and a great reduction of CO_2 content i.e. EEDI of 21% below required limit. If this technology is applied to most ships in future, we will be able to produce highly efficient, eco-friendly ships.

Table 3 also describes a bulk carrier with optimisation in its super structure and propeller that also amounted to savings of at least 3% in fuel consumption and EEDI of 12% below required limit. These two ships have proved to be efficient and environment friendly.

Development of the hull form is important to minimise the weight of the structure as this is related to resistance and fuel consumption.

Table 3: Optimisation of hull and propeller (Lloyd's Register)

VICTORIA STEAMSHIPS 95k dwt BC Fletttner Rotors & Aerodynamic Accommodation	
INNOVATIVE SOLUTION	Optimisation of Hull (Superstructure and Propulsion) by Lloyd's Register, Nakashima and Flettner Rotors
PERFORMANCE	• Up to 3% FOC savings against 22 knot headwind • "Saving 700 kw" • EEDI about 12% below required limit • 15 t/day @ 10.5 knots!

2. METHODS TO IMPROVE ENERGY

Here are some methods that will improve present fuel efficiency and ship efficiency systems.

a. Optimisation of Ballast and Trim-The Ballast, cargo and bunker distribution. The relationship between these is fundamental to give a ship optimal position in the water, a crucial consideration for optimisation of fuel efficiency. If these operations are carefully carried out on board, it can save up to 4% fuel (11).

b. Optimisation of Propeller/Hull interface can also save up to 4% fuel.

c. Lightweight construction lessens the weight of the ship, leading to a reduction in the propulsive energy required and savings in fuel.

d. Alternative fuel engines can also help save fuel and protect the environment.

e. Air Lubrication System (Figure 9). The frictional resistance of the hull can be significantly reduced by the introduction of a thin layer of air pumped in between the hull and water. This can save up to 15% fuel and increase ship efficiency (12).

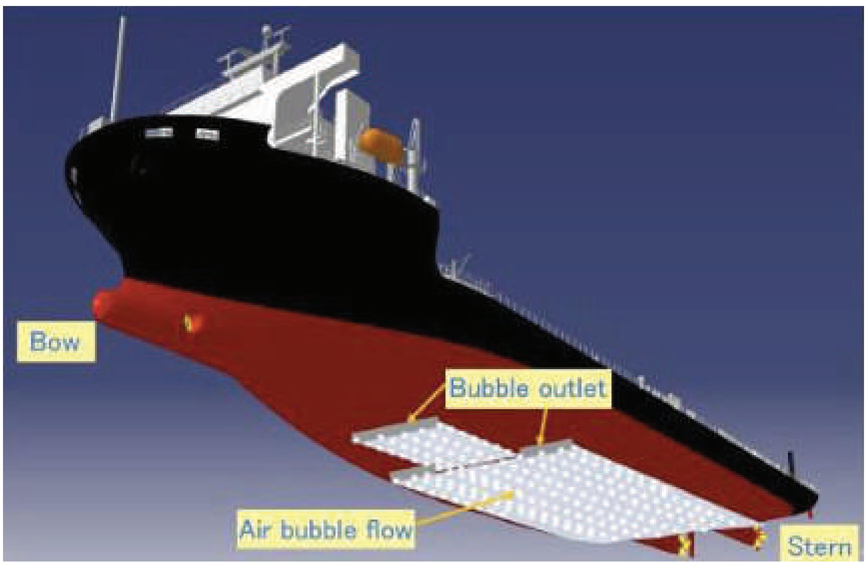

Figure 9: Ship Air Lubrication System

f. Waste heat recovery system. The heat of the engine exhaust can be captured and converted into electrical power for on-board applications, mechanical power (e.g. shaft of a steam turbine or used directly for heating. Reducing the demand on auxiliary power generators can save up to 10% fuel.

3. FUTURE SHIPS

We can expect to see environment-friendly ships being built in the future, such as the NYK Super Eco Ship 2030 (Figure 10), so named because, with its energy ef ciency, it will produce less CO_2 emissions than today's vessels. It is considered energy efficient in design because the water resistance of its hull has been reduced by cutting down on its dead weight – a simple but effective solution to increase energy efficiency and propulsion power increased through the use of energy sources such as LNG-based fuel cells, solar power and wind power. These emit little or no CO_2. It also created an in-built loading system in the hull. The independent in-built crane not only reinforces the vessel's strength but also reduces loading and unloading time by not having to rely on third-party onshore operators (13).

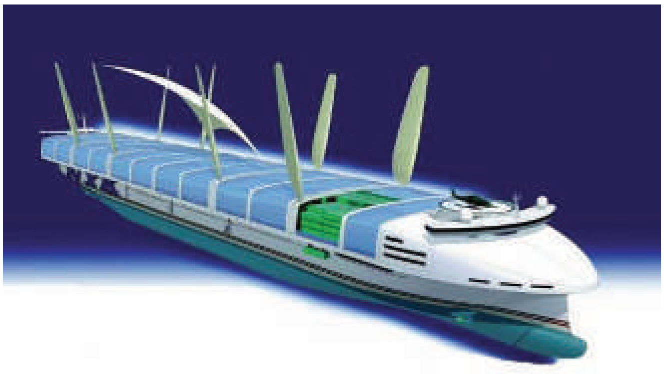

Figure 10: NYK ECO SHIP 2030 (Google)

CONCLUSION

We have presented an analysis based on hull form in order to predict the kind of ships which will be designed and developed in the future. An optimised hull design is both cost effective and environment friendly. A well designed hull can reduce resistance as well as emissions through the use of less fuel.

In terms of hull design we need to improve the fore and aft part of ship to get better efficiency. X-bow type designs are efficient as these reduce the slamming effect and are smooth in operation. A sharper bow also reduces the wave making resistance.

In terms of aft body, pram type hulls extended with a tunnel have been found to be efficient because they allow a steady flow to the propeller and produces good thrust. For good propulsion and sea keeping, it is important to have propeller rudder interaction which reduces fuel consumption and emissions. An integrated hull form optimisation also helps reduce noise and wake wash.

Other methods to reduce fuel consumption and improve overall ship efficiency have also been discussed. The ships of the future will be efficient in terms of hull profile as well as reduced emissions to meet the requirements for environment protection. We also showed the concept design of future vessel, the NYK Super Eco Ship. This heralds the beginning of a sustainable planet. ■

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IEM DIARY OF EVENTS

Title: Talk on Certification of Construction Materials & Products

19 October 2016

Organised by : Civil and Structural Engineering Technical Division
Time : 5.30 p.m. – 7.30 p.m.
CPD/PDP : 2

Title: Talk on "E/One Low Pressure Sewer Systems"

19 October 2016

Organised by : Building Services Technical Division
Time : 5.31 p.m. – 7.30 p.m.
CPD/PDP : 0

Title: OGMTD One Day Course on Demolition Using Explosives

20 October 2016

Organised by : Oil, Gas and Mining Engineering Technical Division
Time : 9.00 a.m. – 5.00 p.m.
CPD/PDP : 6.5

Kindly note that the scheduled events below are subject to change. Please visit the IEM website at www.myiem.org.my for more information on the upcoming events.

Safety and Health Professional

by Ir. Shum Keng Yan

Ir. Shum Keng Yan is a chemical engineer and a certified accident prevention and safety practitioner. He advises on EHS in the chemical, fast moving consumer goods, heavy metal manufacturing and building services industries across Asia Pacific and beyond. He regularly delivers talks at conferences, forums and universities.

Over the last few years, we have taken a journey to understand the building blocks of a Safety Management System and the drivers. One of the key drivers is the Safety Professional. The Safety Professional is the company's internal consultant and subject matter expert who advises the management on the direction of Safety and Health.

Who is a Safety Professional? Let us refer to our legislative framework. Under Section 29 (4) of the Occupational Safety and Health Act of 1994, the safety and health officer shall possess such qualifications or have received training prescribed by the Minister from time to time by notification in the Gazette. In addition, under Regulation 4 of the Occupational Safety and Health (Safety and Health Officer) Regulations 1997, no person shall act as a safety and health officer unless he is registered with the Director General of the Department of Occupational Safety and Health (DOSH).

Thus there is an element of a qualification and experience before a person can be registered as a Safety and Health Officer.

In Malaysia, the preferred qualifications are the Safety and Health Officer Certificate, Executive Diploma, Degree or Master. For the list of qualifications and training institutes, visit *http://www.dosh.gov.my/index.php/en/list-of-competent-training-centre/79-3-safety-and-health-officer-training-centre/file*

However, multinationals may have in-house requirements of their preferred qualifications such as the more common NEBOSH (UK) or CSP (US).

An applicant still needs to meet a minimum of 3 years relevant experience in Safety and Health. There are also other supporting documents to be submitted in the application process.

Once the application is approved, the applicant can be registered as a Safety and Health Officer. Many job advertisements erroneously states that the advertiser is looking for a person with only the Safety and Health Officer NIOSH certificate. The correct version should be a person with a Safety and Health registration from DOSH.

So if you are looking to put in place a proper Safety and Health Officer, make sure you check the applicant's certification and registration. Similarly, if you want to embark on a career in Occupational Safety and Health, the above is a start.

Here is a question: Does a Safety and Health Manager need a Safety and Health Officer registration?

Send your comments to: *pub@iem.org.my*

Professionalism goes beyond Qualification. Safety Professional does not equate to Professional Safety. ■

The safest risk is the one that you do not take. Often, it is the gap in the risk perception that leads to a gap in risk control.

Melaka Chief Minister Conferred AFEO Honorary Fellow Award

IEM MELAKA BRANCH

Courtesy Visit to Melaka Chief Minister on 29 August 2016

The Institution of Engineers Malaysia (IEM) made a courtesy visit to the Melaka Chief Minister on 29 August 2016. During the visit, IEM President Ir. Tan Yean Chin bestowed the AFEO Honorary Fellow Award on Y.A.B. Datuk Seri Ir. Hj. Idris bin Hj. Haron on behalf of AFEO (ASEAN Federation of Engineering Organisations). It was witnessed by Ir. Ong Ching Loon, Secretary General of AFEO, Ir. Ellias Saidin, AER Head Commissioner and IEM delegates.

Also present at the ceremony were Datuk Wira Naim Abu Bakar (Melaka State Secretary), Ir. Khairul Ezuan Haron (CEO, Kumpulan Melaka Berhad), Ir. David Lai Kong Phooi (Deputy President, IEM), Ir. Yam Teong Sian (Honorary Secretary, IEM), Ir. Wong Chee Fui (Executive Director, IEM), Ir. Ooi Kah Huat and Ir. Mohammad Ariff bin Hj. A. Karim (IEM Melaka Branch representatives and Past Chairman of IEM Melaka Branch).

AFEO is a non-governmental body comprising engineering institutions and organisations from ASEAN countries. Its aim is to develop an ASEAN baseline standard for the engineering profession to facilitate the mobility of engineers within ASEAN countries. Each year, the AFEO Governing Board confers the AFEO Honorary Fellow Award on persons of acknowledged eminence who have rendered outstanding services to the engineering profession and/or to their nation.

There are three main criteria for the AFEO Honorary Fellowship Award.

1. The candidate must have contributed to the advancement of the engineering profession, the institution or the nation.
2. The candidate must have shown outstanding greatness of spirit, integrity and devotion to the engineering profession, the Institution or the nation.
3. The candidate must have shown selfless service without expecting public recognition.

IEM has had close collaborations with Melaka State Government and has signed Memorandums of Understanding (MoU) with several Melaka local councils such as Majlis Bandaraya Melaka Bersejarah (MBMB) and Majlis Perbandaran Hang Tuah Jaya (MPHTJ).

IEM can channel engineering support and professional advice to the Melaka State Government as well as assist the local councils to promote public awareness of engineering and safety regulations related to engineering.

Datuk Seri Ir. Hj. Idris has been a member of IEM for more than 10 years and under his leadership, Melaka has developed and advanced, with the focus on engineering achievements.

IEM would like to extend its congratulations to Datuk Seri Ir. Hj. Idris on his conferment of the AFEO Honorary Fellow Award. ■

Conferment of AFEO Honorary Fellow to Y.A.B. Datuk Seri Ir. Hj. Idris bin Hj. Haron, the Chief Minister of Melaka

IEM COUNCIL ELECTIONS 2017/2018

NOTICE ON NOMINATION PAPERS FOR COUNCIL ELECTION SESSION 2017/2018

A notice inviting nominations for the Election of Council Members for Session 2017/2018 would be posted on the IEM Notice Board and IEM website from **16 November 2016** for the information of all Corporate Members of IEM. Thereafter, following the close of nominations on **28 December 2016**, the election exercise will proceed. All Corporate Members residing overseas are requested to take note of the requirements of the Bylaw, Section 5.12, as shown below.

The voting paper shall, not less than twenty eight (28) clear days before the date of the Annual General Meeting, be sent by post to all Corporate Members residing in Malaysia and to any other Corporate Members who may, in writing, request to have the paper forwarded to him. The voting paper shall be returned to the Honorary Secretary in a sealed envelope so as to reach him by a specified date not less than seven (7) days before the Annual General Meeting.

Voting papers will be posted out by **22 February 2017**.

Any Corporate Members residing outside Malaysia, who wish to receive voting papers, are advised to write to the Honorary Secretary on or before 10 January 2017.

Thank you.

Election Officer, IEM

ASEAN Federation of Engineering Organisations (AFEO) Midterm Meeting in Hanoi

WOMEN ENGINEERS SECTION

reported by
Ir. Assoc. Prof. Leong Wai Yie

***Ir. Assoc. Prof. Leong Wai Yie** is currently the Chairman of Women Engineers Section. She is involved in biomedical signal processing analysis and wireless communications.*

The President of The Institution of Engineers, Malaysia (IEM), Ir. Tan Yean Chin, led a delegation of 22 committee members to the midterm meeting of the ASEAN Federation of Engineering Organisations (AFEO) in Hanoi, from 24 to 26 May, 2016.

Malaysia delegates at the Welcome Dinner

Dr Boh Jaw Woei of IES chairing the Engineering Education Work Group

AFEO Heads of Delegates and the Staff of VUSTA Secretariat

AFEO Midterm Meeting Closing Ceremony

WELCOME RECEPTION (24 MAY 2016)

At the Welcome Reception, where plenty of Vietnamese food and drinks were served, more than 60 delegates from ASEAN met, networked and got to know each other. In his welcome speech, the President of Vietnam Union Of Science and Technology Associations (VUSTA), Mr. Dang Vu Minh, said that the AFEO Midterm Meeting was a platform for sharing experiences and discussing ideas and problems of common interest.

In his speech, AFEO Chairman The Philippine Technological Council (PTC) President Engr. Fred Monosada said AFEO covers engineering education, energy, transportation, environment and natural disaster risk management. ASEAN engineering countries should generate and maintain a mutually beneficial relationship and cooperation with regional and international organisations having similar goals and objectives.

The Conferment of Certifications and Medals to registered Vietnamese ASEAN Engineers marked the new progress of VUSTA. The Welcome Ceremony was then followed by a Vietnamese cultural, art and music performance.

AFEO MIDTERM MEETING (25 - 26 MAY 2016)

AFEO comprises 10 ASEAN member organisations. At its midterm meeting, the representatives and engineering leaders of Southeast Asian nations discussed progress made via wider networking and strategic alliances within the ASEAN engineering community. The AFEO Governing Board, Women Engineers, Engineering Education, Young Engineers and Working Groups also held meetings to look into various issues affecting ASEAN countries, including Smart Sustainable Cities, Disaster, Mobility of Engineers Forum, Energy and Environmental Engineering Work Group.

During the Midterm Meeting, the Transportation & Logistic Workshop discussed the compilation of a Road Safety Manual for ASEAN. Ir. Noor Fardila from Malaysian Institute of Road Safety Research (MIROS) proposed a joint collaboration between MIROS and AFEO.

The Chairman of Engineering Education & Capacity Building Workgroup discussed the formulation of guidelines for the implementation of CPD for AER registration.

At the Environmental Engineering Workgroup meeting, Persatuan Insinyur Indonesia (PII) made suggestions on the best ways to solve the haze problem. Members were also interested to learn about waste management from Singapore, Malaysia and Thailand, especially on the types of products which can be recovered from waste.

At The Disaster Group meeting, The Engineering Institute of Thailand under His Majesty the King's Patronage (EIT) planned to host a seminar from 24-25th AUG 2016, on "Disaster Mitigation Technologies" for the Member Organisation. Issues on haze, flash floods, earthquakes and drought were discussed, especially on the reconstruction of Kumamoto in 2016, the drought in Thailand and the reconstruction of Tibet after the massive earthquake.

The WEAFEO Chairperson from PTC gave updates on the Second Women Summit 2016 and WE networking held in September 2016 at Century Park Hotel, Manila, while YEAFEO reported on the Graduate Affairs Workgroup Progress and Cross Border activities with neighbouring countries.

AFEO Chairman PTC President, Engr. Fred Monosada thanked VUSTA for hosting the meeting and extended his invitation to everyone to attend CAFEO 34 in the Philippines.

The night ended with a sumptuous Vietnamese Farewell Dinner with lots of traditional music and art performances to mark the end of a very successful Midterm Meeting.

TECHNICAL VISITS (26 MAY 2016)

The host had organised technical visits to Vietnam National Assembly House and Imperial Citadel of Thang Long. The National Assembly is the highest government organisation and the highest-level representative body of the people. It has the power to draw up, adopt and amend the Constitution as well as to make and amend laws. It also has the responsibility to legislate and implement state plans and budgets. The delegates were impressed with the building and the design.

The next CAFEO will be held in November, 2016, in Pahlawan, The Philippines. ■

IEM DIARY OF EVENTS

Title: Conference of the ASEAN Federation of Engineering Organisations (CAFEO 34)

21 - 24 November 2016

Venue : Citystate Asturias Hotel, Puerto Princesa, Palawan, Philippines

Kindly note that the scheduled events below are subject to change. Please visit the IEM website at www.myiem.org.my for more information on the upcoming events.

FEIAP Meetings and General Assembly in Perth, Australia, July 2016

STANDING COMMITTEE ON CORPORATE AFFAIRS

The 24th Federation of Engineering Institutions in Asia and the Pacific (FEIAP) Standing Committee meetings and General Assembly were held in Perth, Australia, from 6 to 9 July, 2016 and IEM President Ir. Tan Yean Chin, who is also the FEIAP Secretary General, led a delegation to the event.

Most members took the opportunity to incorporate a personal tour by flying in to Perth earlier or extending their stay after the event. Some delegates left early. Among them were Ir. Tan Yean Chin, Deputy President Ir. David Lai Kong Phooi and their spouses as well as FEIAP Immediate Past President and Academician Dato' Ir. Prof. Dr Chuah Hean Teik. The group went on a private tour of Western Australia before joining the rest of the Malaysian delegation on 6 July.

The General Assembly and meeting was hosted by Engineers Australia, at its Western Australia (Perth) Division office. Among those who attended the GA were FEIAP President Ir. Dr John Chien-Chung Li and his entourage from Taiwan, with representatives from Korea Professional Engineers Association (KPEA), The Institution of Professional Engineers, Japan (IPEJ), American Association of Engineers Societies (AAES), Pakistan Engineering Council (PEC), The Institution of Engineers, Singapore (IES), The Institution of Engineers, India (IEI), The Institution of Engineers, Papua New Guinea (IEPNG), Myanmar Engineering Society (MES), Philippines Technological Council (PTC) and the host, Engineers Australia (EA) which was represented in full force by its National President, Mr. John McIntosh, and its country representatives. Also present were observers from The Institution of Professional Engineers, New Zealand (IPENZ) and the President from the South Pacific Engineers Associations (SPEA).

To welcome the delegates, a cocktail reception was arranged on 6 July at the Origins Restaurant in Hotel Pan Pacific. After the event, some delegates stayed on to renew old ties while others went out for a stroll in the night. The cold winter air was a refreshing change for those who came from tropical countries and other Asian countries which were experiencing a hot, dry summer.

During the Committee Meetings and General Assembly held the next morning, FEIAP President Ir. Dr John Li thanked EA for its warm hospitality. After a brief word of welcome by Dr Marlene Kanga (past President and regular FEIAP Member of EA), the meetings started with the Standing Committee on Engineering Education. Also present were the Regional Director Regional Science Bureau for

Delegates of 24th FEIAP General Assembly

FEIAP delegates at the Welcome Reception on 6 July 2016

Presentation of the Accreditation Equivalence Certificate to Pakistan Engineering Council (PEC)

Asia and the Pacific and UNESCO Representatives for Brunei Darussalam, Indonesia, Malaysia, the Philippines and Timor-Leste.

Then there were meetings of the Standing Committee on Engineering Education, Environment Engineering Information and Communication Technology and Natural Disaster and Preparedness. Various discussions and strategies were exchanged on initiatives and contributions on these issues.

The two-day programme included meetings and a technical visit as well as provided valuable information for bright engineering minds to interact on technical exchanges, to share personal experiences and to network on related issues concerning Asia and the Pacific region.

At the Dinner & Award night, three eminent engineers were awarded the FEIAP Engineer of the Year:

1. Prof. Dr Shahbaz Khan, UNESCO Regional Director, nominated by Engineers Australia and Pakistan Engineers Council.
2. His Honorable Excellency, U. Win Khaing, Union Minister of Construction Myanmar, nominated by Myanmar Engineering Society.
3. Dr Lydia Tansinsin, Founding Member of AFEO and Past President of PTCm nominated by Philippines Technological Council.

Dr Bob Every, former Chairman of Westfarmers Group from Australia, gave a very informative keynote address on *"Looking Back Over The Years"*.

The dinner at the hotel ballroom also saw the presentation of Engineers Australia Honorary Fellow conferment and Fellowship certificate presentation to members of EA, followed by the presentation of the Accreditation Equivalence Certificate to Pakistan

Engineering Council (PEC) which was the first member to complete the FEIAP accreditation process.

The evening ended with soft music while delegates mingled and talked into the wee hours in the ballroom foyer.

The President of Chinese Institute of Engineering, Taiwan (CIE), Dr John Li, was re-elected as President of FEIAP for session 2015/2017 and China Association for Science and Technology (CAST), as Vice-President.

8 July was the day set aside for technical visits and sight-seeing. The GA delegations also took the opportunity to tour Perth city, Freemantle and Swan River.

The 24th FEIAP General Assembly in session

TECHNICAL VISITS (8 JULY 2016)

The FEIAP Delegates visited the Australian Marine Complex (AMC) on Friday, 8 July, 2016 as part of the official programme for the FEIAP 24th General Assembly in Perth, Australia. The delegates were picked up by coach from the hotel in the morning to the venue for the Technical Visit. AMC is located in Henderson, 23kms south of Perth, the capital city of Western Australia.

On arrival, the delegates were received by Jonathan Smith, the General Manager of the AMC at AMC Jakovich Centre, who gave everyone an insight into the company.

The AMC was developed to service the marine industry and to enhance the opportunities created by clustering of sectors in the industry such as marine, defence, oil & gas and resources. It is a world-class centre of excellence for the manufacturing, fabrication, assembly, service and repair for marine, defence and resource industries. Located on the shore at Cockburn Sound, AMC provides protected deep water harbours, world class multi-user loadout and fabrication facilities and is connected to industrial areas by road. It must be noted that the AMC is strategically located near the Australian Naval Base in Garden Island where it periodically maintains the naval vessels as a priority.

Jonathan explained the millions of dollars were invested in AMC and the master plan of the AMC which comprises of four precincts and two facilities: Shipbuilding Precinct, Technology Precinct, Marine Support Precinct, Support Industry Precinct, Common User Facility (CUF) and Fabrication Precinct.

The delegates were later taken to the CUF where they boarded the Floating Dock, a one-of-its-kind facility in the world which is able to lift 12,000 tons of vessels. Also of interest was the Self Propelled Modular Transporter, used to move and haul vessels for service and repair.

Jonathan highlighted that the CUF, operated and owned by the Western Australia Government, was an integrated facility with an open access policy for multiple users in support of the other precincts. The CUF consisted of the following:

- 80m x 60m fabrication hall featuring a 200t lift portal crane
- Floating Dock (as described earlier)
- 40ha laydown assembly area
- Amenities
- SPMT's 4,6000t capacity
- Project Offices
- Workshops and Warehouse Facilities.
- Two deep-water heavy loadout wharves.
- Provision for underground reticulated services including power, water, telecommunications and sewer.
- 24-hour manned security with CCTV surveillance.
- Links to high wide load road corridors (9m x 9m x 50m).

Its 40-hectare laydown area provided ample space for the modular assembly and testing of major plant infrastructure and components

The delegates were then taken to the control room of the Floating Dock where they had a bird's eye view of the extent of the AMC facilities. The facility's Main Fabrication Hall is an 80m x 60m x 42m state-of-the-art hall with 200 tonne portal crane and two auxiliary cranes for an all-weather work environment. Four wharves, one equipped with a 300-tonne crane, offer loadout capability and cost-effective sea transportation direct to site.

The visit ended at 12.30 p.m. and the delegates left impressed that the AMC was indeed one of Australia's finest engineering achievements. ■

FEIAP Delegates at AMC Jakovich Centre

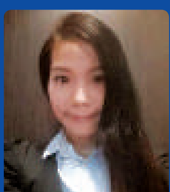
FEIAP Delegates at the Floating Dock

IEM Engineers' Run 2016

YOUNG ENGINEERS SECTION

reported by
Angie Lee Hooi Chie

Angie Lee Hooi Chie *was a member of the organising committee for IEM Engineering Week 2016. She is with G&P Water & Maritime Sdn. Bhd.*



reported by
Jasmine Goh Hooi Bein

Jasmine Goh Hooi Bein *was a member of the organising committee for IEM Engineering Week 2016. She is with Y&S Environment Sdn. Bhd.*

Participants during the run

The Engineers' Run was held in conjunction with the launch of IEM Engineering Week 2016. Congratulations to all those who took part in the event on 14 August at the grounds of Universiti Malaya, Kuala Lumpur.

Some 1,000 participants from all walks of life came together in eight different categories: 10km Men's and Women's open, 5km Men's and Women's Run, 5km Boy's and Girl's Run, and 5km Men's and Women's Veteran.

Ir. Tan Yean Chin, President of The Institution of Engineers Malaysia, was present to flag off the runners at 7.30 a.m. The run was completed within the 2-hour cut-off time. The guest-of-honour, Y.B. Datuk Ir. Dr Abu Bakar bin Mohamad Diah, Deputy Minister of Mosti (Ministry of Science, Technology and Innovation), said: "The role of an engineer is imperative in building our society and our country for the future. Owing to this fact, I am proud to note that I am an engineer and I take great pride in the accomplishments of my profession."

The IEM Engineers' Run 2016 was made possible with support from various organisations and individuals including major sponsorship from Siemens Malaysia (Platinum Sponsor), PESTECH Sdn. Bhd. (Gold Sponsor), Ekovest Berhad, CIMB Bank (Silver Sponsor), MMC-GAMUDA KVMRT (T) SDN. BHD. (Bronze Sponsor), Universiti Malaya (venue sponsor) and Y&S Environment Sdn. Bhd. (drone photograph and video sponsor).

There is a saying: "The thirst you feel in your throat and lungs will be gone minutes after the race is over, the pain in your legs within days, but the glory of your finish will last forever". We hope all participants have enjoyed themselves and will join us again next year. See you in 2017! ■

Group photo with YB Datuk Ir. Dr Abu Bakar bin Mohamad Diah

Winners of the 5km Women's Veteran

BULETIN BULANAN IEM

JURUTERA

THE MONTHLY BULLETIN OF THE INSTITUTION OF ENGINEERS, MALAYSIA

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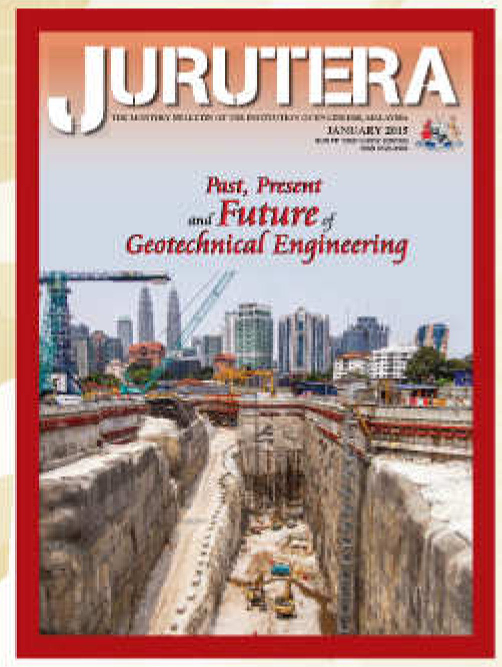

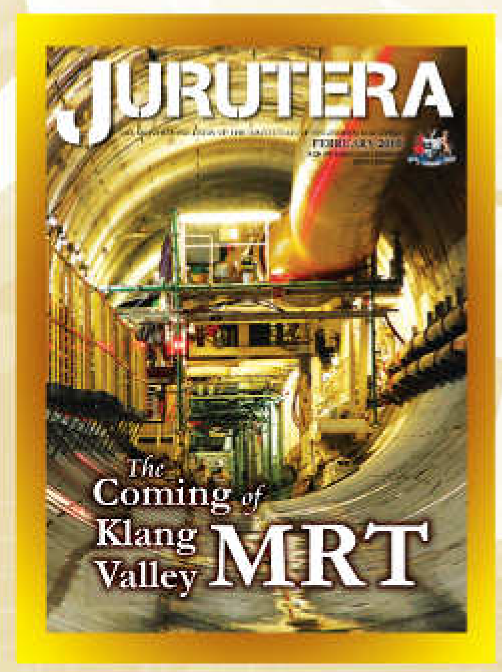

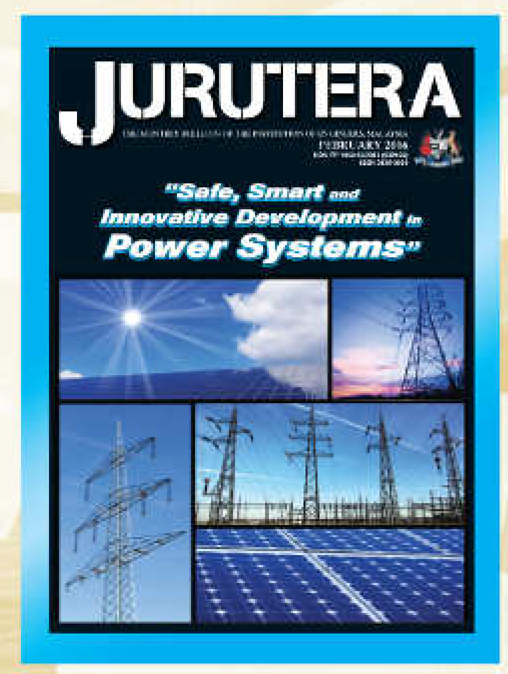

DISPLAY ADVERTISING RATES

SPECIFIED POSITION *(Full color ad)*	PRICES PER INSERTION IN RINGGIT MALAYSIA (RM) 1 INSERTION	3 INSERTIONS	6 INSERTIONS	9 INSERTIONS	12 INSERTIONS
Outside Back Cover (OBC)	7,800	7,050	6,750	6,450	6,150
Inside Front Cover (IFC)	7,250	6,650	6,350	6,050	5,750
Inside Back Cover (IBC)	6,750	6,250	5,950	5,650	5,350
Page 1	6,650	6,150	5,850	5,550	5,250
Facing Inside Back Cover (FIBC)	6,150	5,850	5,550	5,250	4,950
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Showcase of Quixotic Chivalry

Ir. Chin Mee Poon
www.facebook.com/chinmeepoon

Ir. Chin Mee Poon *is a retired civil engineer who derives a great deal of joy and satisfaction from travelling to different parts of the globe, capturing fascinating insights of the places and people he encounters and sharing his experiences with others through his photographs and writing.*

When Spanish novelist Miguel de Cervantes Saavedra published his book, The Ingenious Gentleman Don Quixote of La Mancha in 1605, he probably did not foresee that the fictitious character he had created in the book, would one day surpass him in popularity.

My first contact with Don Quixote was during my secondary school days when I came across a copy of an abridged Chinese translation of Cervantes' famous book in a local bookshop. I was very much amused and fascinated by the many heroic adventures of the protagonist that verged on insanity. So you can imagine how excited I was when I learnt that there was a museum in the city of Guanajuato dedicated to this idiosyncratic character when my wife and I arrived in central Mexico in March 2011. We had then just started our 4-month backpacking trip in Central America and West Caribbean.

Founded at about the same time as the release of Cervantes' book and situated in a narrow ravine, Guanajuato is a beautiful city. It once produced large quantities of silver and was the richest city in Mexico. Its historic centre became a UNESCO World Heritage Site in 1988.

The little Quixote Iconographic Museum is located in the eastern part of the city, close to the pretty pink Church Of San Francisco. The museum exhibits were the personal collection of a Spaniard who fled the Franco-era oppression to Mexico. There were paintings, drawings, prints, engravings, murals, tapestries, sculptures, busts, miniatures, medals, plates, glassware, chess sets, playing cards, pipes and cutlery; some were works of great masters like Pedro, Rafael Coronel, Dali and Picasso. I found the museum extremely interesting and we spent two hours there. Fortunately photography was allowed and I was able to capture many of the exquisite exhibits with my camera.

Cervantes (1547-1616) was also a poet and playwright, but his most important work was obviously the two-volume novel on Don Quixote. He published the sequel of the novel in 1615, 10 years after the publication of Part One and just one year before his demise. The novel is a classic of Western literature and is considered one of the best works of fiction ever written.

The 50-something Don Quixote read so many books of chivalry that he decided to do something to revive the virtues of chivalry. He went to an inn, imagining it to be a castle, and pestered the innkeeper, whom he regarded as lord of the castle, to dub him a knight.

Then, wearing an old armour, with a lance in hand and his neighbour Sancho Panza beside him as his squire, Don Quixote set off as a knight-errant riding an old horse named Rocinante, to rid society of injustices and other evils, but alas, all his adventures invariably ended as misadventures. The most hilarious episode was probably when Don Quixote tried to tilt (attack) at windmills which he believed to be giants, with disastrous consequences of course.

Four centuries after Don Quixote was first published, Cervantes lives on, as evidenced by the annual International Cervantes Festival held in autumn in Guanajuato. This important cultural event on the international scene was started in 1953 when short plays written by Cervantes were staged in Guanajuato. The city had always shone culturally despite its relatively small size.

Don Quixote, the eccentric knight-errant, has almost become a household name and has found his way into the English dictionary in several forms: Quixote, quixotic, quixotism and quixotry. We say "tilting at windmills" to mean attacking imaginary enemies. And the popular phrase, "the proof of the pudding is in the eating", comes from this novel too.

Now you understand why I was so pleased to meet an old friend in a city so far from his birthplace. ■

Editor's Note: *We welcome contributions from all members on travel stories.*

Tarikh: 19 September 2016

Kepada Semua Ahli,

SENARAI CALON-CALON YANG LAYAK MENDUDUKI TEMUDUGA PROFESIONAL TAHUN 2016

Berikut adalah senarai calon yang layak untuk menduduki Temuduga Profesional bagi tahun 2016.

Mengikut Undang-Undang Kecil IEM, Seksyen 3.8, nama-nama seperti tersenarai berikut diterbitkan sebagai calon-calon yang layak untuk menjadi Ahli Institusi, dengan syarat bahawa mereka lulus Temuduga Profesional tahun 2016.

Sekiranya terdapat Ahli Korporat yang mempunyai bantahan terhadap mana-mana calon yang didapati tidak sesuai untuk menduduki Temuduga Profesional, surat bantahan boleh dikemukakan kepada Setiausaha Kehormat, IEM. Surat bantahan hendaklah dikemukakan sebulan dari tarikh penerbitan dikeluarkan.

Ir. Yam Teong Sian
Setiausaha Kehormat, IEM,

PERMOHONAN BARU

Nama	Kelayakan
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ERNEST LAI HENG WEI	BE HONS (SURREY) (CIVIL, 2003) MSc (SURREY) (2004)
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HASNOOR KHUZAIRAH BINTI HASIM	BE HONS (UiTM) (ELECTRICAL, 2010)
KAHAR BIN KADU	BE HONS (UiTM) (ELECTRICAL, 2009)
MOHD SAIFUDDIN BIN ZAKARIA	BE HONS (ELECTRICAL-INSTRUMENTATION & CONTROL, 2008)
MOHD SHAFANIZAM BIN MD SAAD	BE HONS (UTM)(ELECTRICAL, 2009)
MOHD ZULKHAIRI BIN ZAINAL	BE HONS (UKM) (ELECTRICAL, ELECTRONIC & SYSTEMS, 1998) CONVERSION (UNITEN) (2010)
NIK MOHD HAZMAN BIN CHE HASAN	BE HONS (UKM) (ELECTRICAL, ELECTRONIC & SYSTEMS, 2004)
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FADZLIN SARAH MOHD GHAZALI	BE HONS (UiTM) (MECHANICAL, 2006)
MOHD HAFEEZ BIN AWANG HAMAT	BE HONS (UTeM) (STRUCTURE & MATERIAL, 2009)
KEJURUTERAAN ELEKTRONIK	
YAP KEEM SIAH	BE HONS (UTM) (ELECTRICAL, 1998) ME (UTM) (ELECTRICAL, 2000) PhD (USM) (2010)

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No. Ahli	Nama	Kelayakan
KEJURUTERAAN AWAM		
36742	ANG CHIN WEI	BE HONS (UNITEN) (CIVIL, 2012)
KEJURUTERAAN KIMIA		
53737	MUTHMIRAH BINTI IBRAHIM	BE HONS (UTM) (CHEMICAL-POLYMER, 2007) ME (UTM) (POLYMER, 2011)
KEJURUTERAAN SUMBER AIR		
20630	TEE YI SHENG	BSc (NEW BRUNSWICK) (CIVIL, 00)
KEJURUTERAAN ELEKTRIKAL		
58011	MOHD KHAIRIL AKMAL BIN AHMAD	BE HONS(UiTM) (ELECTRICAL, 2011)
49428	NIK ABDULLAH SHARRIS BIN NIK SHIHABUDDIN	BE HONS (MALAYA) (ELECTRICAL, 2004)
33765	QUAH YEAN MAY	BE HONS (MULTIMEDIA) (ELECTRICAL, 2006)
86004	TENGKU MOHD MAIZATUL IZWAN BIN ENGKU MAJID	BE HONS (UTM) (ELECTRICAL, 2009)
54229	YUSOF BIN KAMARUDDIN	BE HONS (UTM) (ELECTRICAL, 2007)
87517	AHMAD FAUZI BIN OTHMAN	BE HONS (UTM) (ELECTRICAL, 2005)
85886	KANG CHING YEW	BE HONS (UNITEN) (ELECTRICAL & ELECTRONICS, 2012)
KEJURUTERAAN MEKANIKAL		
53690	ALAN CHAN TECK WAI	BE HONS (QUEENSLAND) (MECHANICAL, 2006)
32331	CHRISTOPHER JANTAI ANAK BONIFACE	BE (UiTM) (MECHANICAL, 2011)
85924	ELLY NADYA BINTI BAJURI	BE HONS (UNIMAS) (MECHANICAL, 2006)
81273	MOHD NASIR BIN MOHD ISA	BE HONS (SUNDERLAND) (MECHANICAL, 2012) ME (UPM) (MANUFACTURING SYSTEMS, 2013)
48109	MOHD ZAKRIMAN BIN MOHD ZAMIN	BEAppSc (COLOGNE) (MECHANICAL, 2009)

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KEJURUTERAAN MEKANIKAL		
07096	AHMAD SUHAILI BIN IDRUS	BSc (MANCHESTER) (MECHANICAL,1977)
-	KASDI ANAK PULAI	BE HONS (UTM) (MECHANICAL-MARINE TECHNOLOGY, 2002)
-	MUAMMAR QUADAFFI BIN MOHD ARIFFIN	BSc (CORNELL) (MECHANICAL, 1995) ME (CORNELL) (MECHANICAL, 1996)
KEJURUTERAAN AERONAUTIKAL		
-	OON ENG HOCK@OON KAM KHUAN	BSc (BRISTOL) (AERONAUTICAL, 1971)

Pengumuman yang ke-96

SENARAI PENDERMA KEPADA WISMA DANA BANGUNAN IEM

Institusi mengucapkan terima kasih kepada semua yang telah memberikan sumbangan kepada tabung Bangunan Wisma IEM. Ahli-ahli IEM dan pembaca yang ingin memberikan sumbangan boleh berbuat demikian dengan memuat turun borang di laman web IEM http://www.iem.org.my atau menghubungi secretariat di +603-7968 4001/5518 untuk maklumat lanjut. Senarai penyumbang untuk bulan Ogos 2016 adalah seperti jadual di sebelah:

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2	78989	AZHAR BIN ABDULLAH
3	20955	CHOK CHING HUAT
4	59113	CHONG SHIAU IUN, ABRAHAM
5	36280	ERNY HARMIZA BINTI KAMARUDIN
6	61924	HENG INN CHEN
7	09952	LIM CHENG SENG
8	25860	MD RAZLI BIN AB RAHIM
9	70344	MOHAMAD ROHMAT BIN SAMSURI
10	60601	MOHLIS ARIFIN B. RUKIB
11	31825	MUHAMMAD HAFIZ BIN HASSAN
12	24713	SHIA SIN SAN
13	38741	UNANG ANAK BUNDAN
14	76051	VOON JIA HUI

OBITUARY

With deep regret, we wish to inform that Ir. Dr Ramlee bin Karim had passed away on 2 August 2016. On behalf of the IEM Council and management, we wish to convey our deepest condolences to the family.

- IEM Editorial Board

PERMOHONAN BARU / PEMINDAHAN AHLI

Persidangan Majlis IEM yang ke-399 pada **19 Oktober 2015** telah meluluskan sebanyak **4,251** ahli untuk permohonan baru dan permindahan ahli. Berikut adalah senarai ahli mengikut disiplin kejuruteraan:

DISIPLIN	GRED KEAHLIAN								
	FELO	SENIOR	AHLI	COMPANION	SISWAZAH	"INCORPORATED"	"AFFILIATE"	"ASSOCIATE"	SISWA	JUMLAH
Aeronautikal				1					22	**23**
Pertanian									2	**2**
Automotif									4	**4**
Biokimia					1					**1**
Bioperubatan					1				10	**11**
CAD/CAM									1	**1**
Kimia			4	1	38				286	**329**
Awam			52	9	204				808	**1073**
Komputer				1						**1**
Pembinaan			1							**1**
Elektrikal			24	2	60				606	**692**
Elektronik			10	2	13	1			608	**634**
Alam Sekitar					3				16	**19**
Lebuhraya			2							**2**
Industri									3	**3**
Kawalan & Instrumentasi			3							**3**
Pembuatan					7				221	**228**
Bahan									1	**1**
Metallurgi						1				**1**
Mekanikal			33	9	72	1			940	**1055**
Mekatronik					2				28	**30**
Sumber Mineral			1		3		1			**5**
Perlombongan			1							**1**
Arkitek Naval									1	**1**
Petroleum				1	76				38	**115**
Polimer					1				1	**2**
Telekomunikasi			1						4	**5**
Sumber Air			1							**1**
Pengangkutan			1							**1**
Hidraulik			1							**1**
Nuklear									4	**4**
Sistem Mekanikal					1					**1**
JUMLAH	**0**	**0**	**135**	**26**	**482**	**3**	**1**	**0**	**3604**	**4251**

Senarai nama ahli dan kelayakan adalah seperti di bawah. Institusi mengucapkan tahniah kepada ahli yang telah berjaya.

Ir. Yam Teong Sian
Setiausaha Kehormat
Institusi Jurutera Malaysia

PERMINDAHAN AHLI KEPADA AHLI KORPORAT

No. Ahli	Nama	Kelayakan
KEJURUTERAAN AWAM		
50749	ABD WAHID BIN DAUD	BE HONS (UTM) (CIVIL, 2008) ME (UPM) (HIGHWAY & TRANSPORTATION, 2011)
27260	AHMAD FAHMI BIN ABDULLAH	BE HONS (UTHM) (CIVIL, 2007)
19848	AHMED HASSAN BIN MOHD SHARKAWI	BE HONS (UITM) (CIVIL, 2001)
16220	AMRAN BIN MOHAMED	BSC (ARIZONA) (CIVIL, 1990)
75283	CHAI PAK SHIN, ERWIN	BE HONS (UTM) (CIVIL, 2006) ME (UTM) (CIVIL-GEOTECHNICS, 2009)
33805	CHAN WEI THIEN	BE (WESTERN AUSTRALIA) (CIVIL, 2006)
49413	CHEN TIAN HEE	BE HONS (UTHM) (CIVIL, 2007)
42517	CHEW MEI LING	BE HONS (UNITEN) (CIVIL, 2006)
27292	CHIN YIT TING	BE HONS (USM) (CIVIL, 2007)
58690	FADHLI SHAZLAN ABDUL RAHMAN	ME (UMIST) (2004)
41327	GAN CHIN PHANG *	BE HONS (MALAYA) (CIVIL, 2008)
21747	GOH KWANG MENG	BE HONS (WALES) (CIVIL, 1997)
29592	HASRINA BINTI MOHD RAMAZI	BE HONS (UTM) (CIVIL, 2003)
80167	HERMAN BIN TAWIL	BE HONS (UTM) (CIVIL, 2007) ME (UTM) (CIVIL-STRUCTURE, 2014)
25659	LEE JEN SHIONG	BE HONS (UKM) (CIVIL, 2004)
27120	LEE KIM TEE, DANIEL	BE HONS (UNIMAS) (CIVIL, 2003)
22332	LEE TOUNG TIAN	BE HONS (MALAYA) (CIVIL, 1997)
28096	LOW KAI WAH	BE HONS (USM) (CIVIL, 2007)
44127	LUM WAI CHOONG	BSC (IOWA STATE) (CIVIL, 2009)
28799	MOHD ZAKI BIN MOKHTAR	BE HONS (UTM) (CIVIL, 2005) ME (UTM) (CIVIL-STRUCTUTRE, 2006)
14032	OO GIN PHENG	BE HONS (UTM) (CIVIL, 1992)
29873	PANG KET SOON	BE HONS (USM) (CIVIL, 2008)
37929	SHAHARUL BIN HAMZAH	BE HONS (UKM) (CIVIL & STRUCTURAL, 2002)
28966	SITI AMINAH BINTI ITHNIN	BE HONS (UKM) (CIVIL, 2004)
54501	SREERAMALU A/L NAMATHEVAN	BE HONS (UTM) (CIVIL, 2005)
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26864	YAZDI B. MOKTAR	BE HONS (UKM) (CIVIL & STRUCT, 2002)
38321	YONG HUI FOONG	BE HONS (UKM) (CIVIL & ENVIRONMENTAL, 2008)
24525	YONG JIA YIH	M.ENG (PORTSMOUTH) (CIVIL, 2003)
22504	ZURINA BINTI ABDUL HAMID	BE HONS (UTM) (CIVIL, 2001)
KEJURUTERAAN ELEKTRIKAL		
24514	AHMAD BIN ABU SEMAN	BE HONS (UKM) (ELECTRICAL, ELECTRONIC & SYSTEMS, 1999) CONVERSION (UNITEN) (2012)

60072	IRYANI BINTI MOHAMED RAWI	BE HONS (UTM) (ELECTRICAL-TELECOMMUNICATION, 2002) CONVERSION (UNITEN, 2011)
51705	LIM HAN SIANG	BE HONS (MMU) (ELECTRICAL, 2008)
49616	MOHD JOHANIF BIN MOHAMED NADZIRIN	ME (LOUGHBOROUGH) (ELECTRONIC & ELECTRICAL, 2005)
44593	MOHD SAIFUL ANUAR BIN MOHD RAPHEAL	BE HONS (UNITEN) (ELECTRICAL POWER, 2007)
36331	MUHAMAD FARIZ BIN MD BAKIR	BE HONS (UTM) (ELECTRICAL-MECHATRONICS, 2006)
42267	MUHAMMAD FAQIH BIN BADRISHAH	BE HONS (UNITEN) (ELECTRICAL POWER, 2011)
54531	NIK MOHAMMAD FADZLAN BIN MAT YASIN	BE HONS (UKM) (ELECTRICAL & ELECTRONIC, 2006)
61907	SRI DARAN A/L RAMAKRISHNAN	BE HONS (UNITEN) (ELECTRICAL POWER, 2007)
58682	TAN HAK VUI, MALEK	BE HONS (UMS) (ELECTRICAL & ELECTRONICS, 2008)
37278	TAN JACK CHEONG, VINCENT	BE HONS (LIVERPOOL) (ELECTRICAL, 1997)
19194	TAN LAY PHIN	BE HONS (CANTERBURY) (ELECTRICAL & ELECTRONIC, 1997)
54003	TAN WEI HOW	BE HONS (USM) (ELECTRICAL, 2004)
43136	WONG MENG FAI	BE HONS (MMU) (ELECTRICAL, 2008)
73461	ZAKARIA BIN HUSSAIN	BE HONS (HUDDERSFIELD) (ELECTRONIC & ELECTRICAL, 1997) PHD (SHEFFIELD) (2010)

KEJURUTERAAN ELEKTRONIK

52561	ABANG RAZALI BIN MOHAMAD MUNIR	BE HONS (UNIMAS) (ELECTRONICS & TELECOMMUNICATIONS, 2007)
54286	AHMAD SYAHRIN BIN MOHD IDRIS	BE HONS (UTP) (ELECTRICAL & ELECTRONIC, 2003) MPHIL (SHEFFIELD) (2011)
38915	AZMAN BIN DAUD	BE HONS (UTP) (ELECTRICAL & ELECTRONICS, 2003)
37281	MOHAMAD SHAIFUDIN BIN HASSAN	BE HONS (UTM) (ELECTRICAL, 2001)
51713	RAZALI BIN MOHD ARSAD	BE HONS (UKM) (ELECTRICAL, ELECTRONIC & SYSTEM, 2000)
34315	SHAIFUL NIZAM BIN SAMIN	BE HONS (UKM) (ELECTRICAL & ELECTRONIC, 2002)
49418	TAN BAN SOON	BE HONS (UTM) (ELECTRICAL - ELECTRONICS, 2005)
54312	ZAHARI BIN AWANG AHMAD	BSC (KENTUCKY) (ELECTRICAL, 1994) ME (UTM) (ELECTRICAL-COMPUTER & MICROELECTRONIC SYSTEM, 2010)

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54225	MOHAMED FAIZAL AZNIL BIN MOHAMED SAFFIAN	BE HONS (UNITEN) (ELECTRICAL POWER, 2005)
76028	SYED FAZAL BIN SYED THAJUDEEN	BE (NEW SOUTH WALES) (ELECTRICAL, 2006)

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44133	CHING YERN CHEE	BE HONS (UTM) (CHEMICAL, 1999) ME (UTM) (POLYMER, 2002) PHD (UM) (2011)
41078	SURESH ANAND A/L VIJAYAKUMARAN	BE HONS (UMS) (CHEMICAL, 2006)

KEJURUTERAAN LEBUHRAYA

26496	KANTHIMA NUIN	BE HONS (UNITEN) (CIVIL, 2005)

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30976	ALEXANDER GOTTE	BE HONS (UNIMAS) (MECHANICAL & MANUFACTURING, 2008)
42321	ANG KIAN HO	BE HONS (UMS) (MECHANICAL, 2010)
31753	BULAN BINTI ABDULLAH	BE HONS (UTM) (MECHANICAL, 1998) ME (UTM) (MECHANICAL, 2003) PHD (UITM) (MECHANICAL, 2012)
70400	CHIN WAI LOON	BE HONS (UNITEN) (MECHANICAL, 2009)
59998	CHONG KOK CHUNG	BE HONS (UTAR) (MECHANICAL, 2009) MSC (UTAR) (2015)
26430	CHUA BIH LII	BE HONS (UMS) (MECHANICAL, 2004) ME (UMS) (ROBOTICS & INDUSTRIAL AUTOMATION, 2008)
22778	FAISAL ELAHI BIN SAIRUDIN	BE HONS (UPM) (MECHANICAL-SYSTEM, 1999)
49905	L. THIRUVARASU LETCHUMANAN	BE HONS (UTM) (MECHANICAL, 2010)
64575	MARUAN ARIF BIN ARIFFIN	BE HONS (USM) (MECHANICAL, 2000)
32610	MOHD FAHMI BIN MOHAMAD JAAFAR	BE HONS (UNITEN) (MECHANICAL, 2007)
49971	MOHD IBRAHIM ARIF BIN ZAINUDDIN	ME (SHEFFIELD) (MECHANICAL, 2007)
39996	MOHD IZWAN BIN A. RAHMAN @ AB. RAHMAN	BE HONS (UTM) (MECHANICAL, 2004)
52375	MOHD SHAIFUL ADLI CHUNG	BE HONS (UTM) (MECHANICAL, 2000)
31747	MUHAMMAD KHAFIF BIN ZOL AZLAN	BE HONS (UNITEN) (MECHANICAL, 2000)
46858	NADIAHNOR BINTI MD YUSOP	BE HONS (USM) (MECHANICAL, 2001) MSC (LEEDS) (2002) PHD (LEEDS) (2008)
41199	RUSLIZAM BIN DAUD	BE HONS (UKM) (MECHANICAL, 1999) ME (UTM) (MECHANICAL, 2003) PHD (UKM) (MECHANICAL & MATERIALS, 2013)
72731	SAW CHERN - YANN, JULIAN	BE HONS (MONASH) (MECHANICAL, 2009)
72588	TANG CHEE KHOAY	BSC (WICHITA STATE) (MECHANICAL, 1993)
29173	TEH CHIN HWANG	BE HONS (MALAYA) (MECHANICAL, 2005)
22267	YUSRI BIN MD YUSOFF	BE HONS (UKM) (MECHANICAL & MATERIALS, 2000)

KEJURUTERAAN PEMBINAAN

50745	LEE JIN CHAI	BE HONS (TAIWAN) CONSTRUCTION, 1991) MSC (WALES) (STRUCTURAL, 1994)

KEJURUTERAAN SUMBER AIR

41977	GAN CHIAT KWANG	BE HONS (BIRMINGHAM) (CIVIL, 1998)

KEJURUTERAAN TELEKOMUNIKASI

60660	MUHAMAD SABRI BIN RAZALI	BE HONS (MMU) (ELECTRONICS, 2007)

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KEJURUTERAAN AWAM	
AB. RAHMAN BIN JAKIN	ADVANCED DIPLOMA (UITM) (CIVIL, 1986)
ABDUL KHALID S. ABDULLAH	BE HONS (UITM) (CIVIL, 2007)
AHMAD SAFWAN BIN ANUAR	BE HONS (UITM) (CIVIL, 2009)
AZHARIE EFFENDDY BIN AZMI	BE HONS (UTM) (CIVIL, 2000) ME (UTM) (CIVIL, 2008)
CHANG CHAO KIAT	BE HONS (ADELAIDE) (CIVIL & STRUCTURAL, 2005)
CHRISTOPHER LIM	BE HONS (UTM) (CIVIL, 2002)
FAUZI BIN MAT	BE HONS (UITM) (CIVIL, 1998)
LIM LIAN CHONG	BE HONS (UTAR) (CIVIL, 2010)
LOKMAN HAKIM BIN ABDUL AZIZ	BE HONS (UITM) (CIVIL, 2009)
MOHD AZIM BIN MOHD AZMI	BE HONS (UITM) (CIVIL, 2007)
MOHD SHAHMAN BIN SHAARI	BE HONS (UTM) (CIVIL, 2007)
MUHD HAZWAN HISYAM BIN ABU HASSAN	BE HONS (USM) (CIVIL, 2004)
MUSTAFA MAAROF BIN JUNID	BE HONS (UTM) (CIVIL, 2001)
NG BAN FOUN	BE HONS (UKM) (CIVIL & ENVIRONMENTAL, 2009)
NG SAIK AIK	BSC (LEEDS) (CIVIL, 1978)
NOR IFTITAH BINTI IBRAHIM	BE HONS (UKM) (CIVIL, 2008)
RAJA ANDIFARIZAN BIN RAJA AHMAD	BE HONS (UTM) (CIVIL, 2003)
SUZANA BINTI JAIT	BE HONS (UTM) (CIVIL, 1992)
SYED MUHD NAGUIB BIN SYED MOHD	BE HONS (UITM) (CIVIL, 2009)
TAN CHONG SENG	BSC (LEEDS) (CIVIL, 1981)
ZULKERI BIN NOORDIN	BE HONS (UTM) (CIVIL, 2001)
KEJURUTERAAN ELEKTRIKAL	
AHMAD SAZREE BIN ABD AZIZ	BSC (PURDUE) (ELECTRICAL, 1998)
AZHAR BIN MD SURI	BE HONS (ABERDEEN) (ELECTRONIC, 1996)
GANASON MUNUSAMY	BE HONS (USM) (ELECTRICAL & ELECTRONIC, 2005) ME (UTM) (ELECTRICAL - POWER, 2008)
HAFIZA BINTI MOHD RAZALI	BE HONS (UITM) (ELECTRICAL, 2009)
LEE CHIH YONG	BE HONS (MALAYA) (ELECTRICAL, 2008)
MOHD ZAID BIN MOHD NORDIN	BE HONS (UTM) (ELECTRICAL - ELECTRONICS, 2005) CONVERSION (UNITEN) (2011)
NOR ZIHA BINTI ZAINOL ABIDIN	BSC (RENSSELAER POLYTECHNIC INSTITUTE, USA) (ELECTRICAL, 2001) MSC (RENSSELAER POLYTECHNIC INSTITUTE, USA) (ELECTRICAL POWER, 2001)
SAIFUL AMRI BIN ISMAIL	BE HONS (UITM) (ELECTRICAL, 2006)
YAP WOOI KEN	BSC (TOLEDO) (ELECTRICAL, 1998)
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KHAIRI BIN ABDUL RAHIM	BE HONS (UNITEN) (ELECTRICAL & ELECTRONICS, 2001) ME (UKM) (COMMUNICATION & COMPUTER, 2008) PHD (NOTTINGHAM) (2012)
NOR AZHAR BIN MOHD ARIF	BE HONS (LONDON) (COMMUNICATIONS & RADIO, 1998) MSC (MMU) (2002) PHD (MMU) (2013)
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JASICA CHUA	BE HONS (UKM) (CIVIL & ENVIRONMENTAL, 2001)
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TAN YEE CHIEH	BE HONS (MALAYA) (CHEMICAL, 2006) ME (MALAYA) (SAFETY, HEALTH & ENVIRONMENT, 2009)
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AHMAD ZAKI BIN MOHAMAD AFIFI	ME (BRISTOL) (MECHANICAL, 2006)
BURHANUDDIN BIN ABDUL RAHMAN	BE HONS (USM) (MECHANICAL, 2001)
CHIN MIN FONG, CORNELIUS	BE HONS (UPM) (MECHANICAL, 2007)
COLIN CLIFTON ABAYASUNDRA	BE HONS (UNITEN) (MECHANICAL, 2005)
HAIN YAU CHEONG	BE HONS (UKM) (MECHANICAL, 2008)
HASSIM BIN IBRAHIM	BSC (WALES) (MECHANICAL, 1987)
JAMALUDDIN BIN MAHMUD	BE HONS (UITM) (MECHANICAL, 1996) MSC (IIUM) (MANUFACTURING, 2002) PHD (CARDIFF) (2010)
MOHD MAZLAN BIN MAT ANI	BE HONS (UTM) (MECHANICAL-MANUFACTURING, 2010)
NEO CHIN KIAT	BE HONS (UTM) (MECHANICAL, 2005)
SEE GIN KOOI, SAMUEL	BE HONS (UTP) (MECHANICAL, 2006)
TAJUL ARIFFIN BIN MOHAMED NORI	BE HONS (MECHANICAL, 2008)
TAN CHIN HWA	BE HONS (STRATHCLYDE) (MECHANICAL, 1987)
TEOH WEE MING	BE HONS (MALAYA) (MECHANICAL, 2006)
KEJURUTERAAN PENGANGKUTAN	
ER CHIA CHIA	BE HONS (UTM) (CIVIL, 2001)
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KEJURUTERAAN AWAM		
80601	ALEXANDER ARULPRAGASAM ANTHONY A/L ANTHONYSAMY	B.E.HONS.(MALAYA) (CIVIL, 1993)
81317	CHE MAT NAWI BIN MAT DAUD	B.E.HONS.(UITM)(CIVIL, 2001)
80784	DR. SITI FATIN BINTI MOHD RAZALI	B.E.HONS.(UTM) (CIVIL, 2006) P.HD.(WESTERN AUSTRALIA)(CIVIL, 2011)
81063	KWONG JEE KONG	B.E.HONS.(UPM)(CIVIL, 1999)
80200	MOHD TAUFIK BIN HARON	B.E.HONS.(UPM)(CIVIL, 1997)
80785	NASRULLAH BIN ARIFUDDIN	B.E.HONS.(UPM)(CIVIL, 2003)
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80781	NOR ASHEKIN BINTI AHMAD ADZMAN	B.E.HONS.(MALAYA) (CIVIL, 2001)
80756	ROZLAN BIN DAUD	B.SC.(TOLEDO)(CIVIL, 1989)
KEJURUTERAAN ELEKTRIKAL		
80604	SHAIFUL BIN MAT ISA	B.E.HONS.(UTM) (ELECTRICAL, 2004)
80185	ZAMRI BIN IBERAHIM	B.E.HONS.(UPM) (ELECTRICAL & ELECTRONICS, 2002)
KEJURUTERAAN ELEKTRONIK		
80783	MAISARAWANI BINTI SPAHAT	B.E.HONS.(KUITTHO) (ELECTRICAL, 2002) M.E.(UTEM) (MANUFACTURING-MANUFACTURING SYSTEM, 2012)
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KEJURUTERAAN MEKANIKAL		
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80199	DR. TAN YONG CHAI	B.E.HONS. (PORTSMOUTH) (MECHANICAL, 2000) P.HD.(PORTSMOUTH) (MULTI EXPERT CONCURRENT ENRG. SYSTEM TO ASSIST A DESIGNER, 2006)
80782	MARYATI BINTI MARZUKI	B.SC.(UTM)(MECHANICAL, 1998)
80651	MOHD MARZUKI BIN ABDUL MAJID	B.E.HONS.(UTM) (MECHANICAL, 2005)
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80787	ZAINUDIN BIN ZULKIFLI	B.E.(CANTERBURY) (MECHANICAL, 1990)

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KEJURUTERAAN AWAM		
68838	A S NOR FAEZZAH BT IBRAHIM	B.E.HONS.(UITM)(CIVIL, 2015)
68840	ABDUL ASYRAF BIN ABDUL AZIZ	B.E.HONS.(UITM)(CIVIL, 2015)
56634	ABDUL MUIZ AIZAT B. ABDUL HALIM	B.E.HONS.(UITM)(CIVIL, 2015)
68844	ADIELA BINTI ADNAN	B.E.HONS.(UITM)(CIVIL, 2015)
68848	AHMAD ALIF HALIMI BIN CHE MOHAMAD NOOR	B.E.HONS.(UITM)(CIVIL, 2015)
76411	AHMAD AMMAR LUQMAN BIN ABDULLAH	B.E.HONS.(UTM) (CIVIL, 2011) M.E.(UTM)(INDUSTRIAL, 2015)
68853	AHMAD FATHIN BIN ZAINAL	B.E.HONS.(UITM)(CIVIL, 2015)
30889	AINOR SYAFARIZAN BINTI MOHAMAD YUSOF	B.E.HONS.(UTP)(CIVIL, 2009)
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68878	AMIRUL BIN AMIR	B.E.HONS.(UITM)(CIVIL, 2015)
68888	AWANG MUHAMAD AYAHTULLAH BIN AWANG NAJERI	B.E.HONS.(UITM)(CIVIL, 2015)
68889	AZLANSHA BIN ABD MUNIR	B.E.HONS.(UITM)(CIVIL, 2015)
68890	AZMA IFFAH BINTI AMIN NUDIN	B.E.HONS.(UITM)(CIVIL, 2015)
28265	CHAN KHANG HAI	B.E.HONS.(USM)(CIVIL, 2009)
68894	DINIE BIN HAMDAN	B.E.HONS.(UITM)(CIVIL, 2015)
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68905	FARAH USWATI BINTI MOHAMMAD ROHMATULLAH	B.E.HONS.(UITM)(CIVIL, 2015)
68913	FATIN FAREHAH BINTI ABDUL RAZAK	B.E.HONS.(UITM)(CIVIL, 2015)
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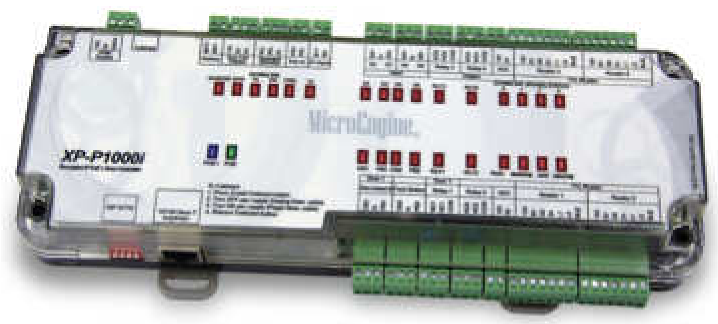

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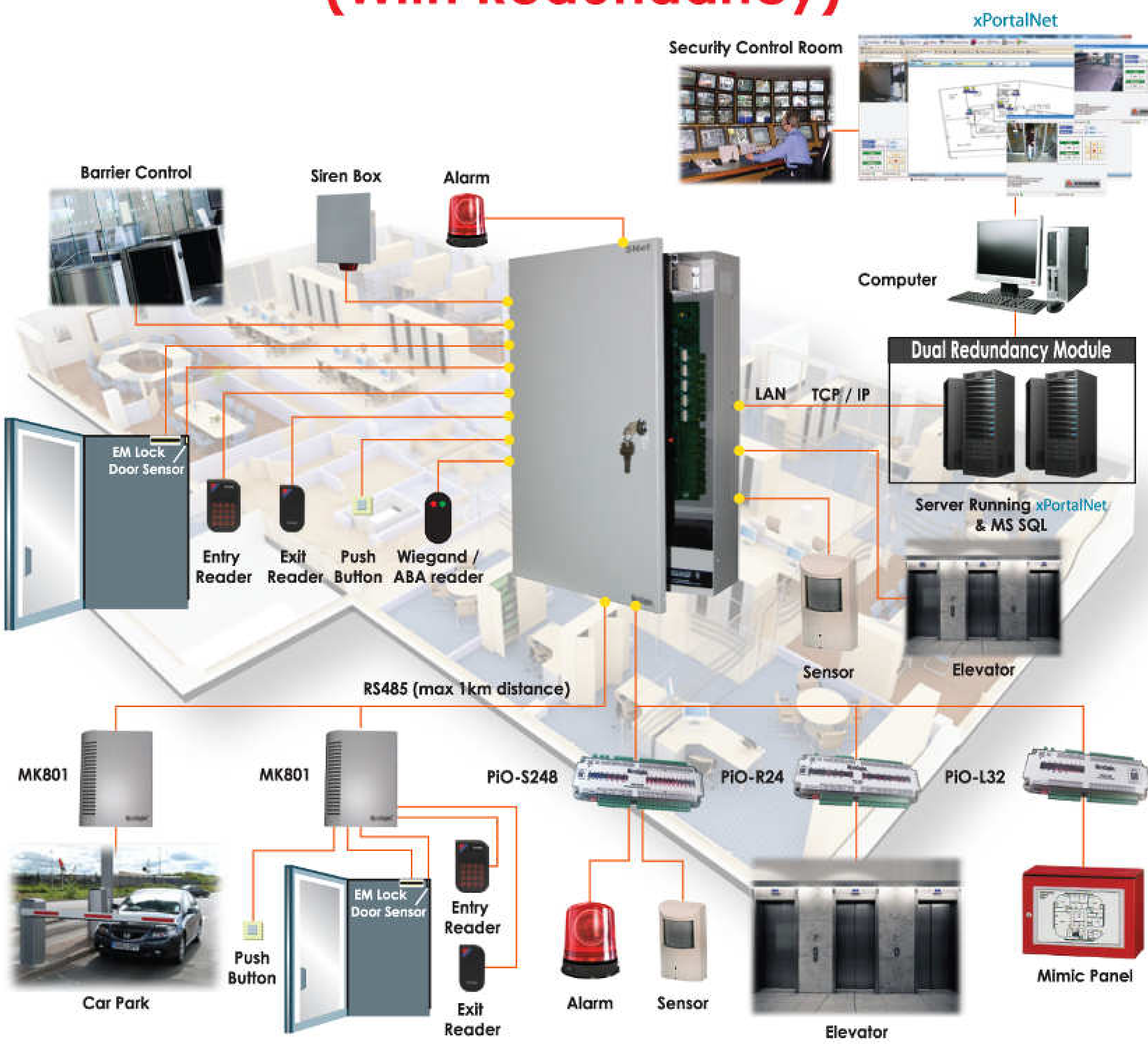

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