**Table of Content**

| Feature 1 | FISHES DETECTION INSIDE FISH LADDER USING SIMPLE BACKGROUND SUBTRACTION | Page 4-10 |
| Feature 2 | MARINE CORROSION AND PROTECTION | Page 11-15 |
| Feature 3 | EFFECTS OF WEAVING PATTERNS TOWARDS DIFFERENT WELDED JOINTS | Page 16-20 |
| Feature 4 | ANALYSIS ON FIRST LANGUAGE (L1) INTERFERENCE IN LEARNING SECOND LANGUAGE (L2) WORDS WITH MULTIPLE MEANINGS | Page 21-28 |
| Feature 5 | EXPLORATION OF OFFSHORE FISHING BY INTERGRATED OFFSHORE FISHING VESSEL CONCEPT (IOFVC) IN MALAYSIA | Page 29-39 |
| Feature 6 | TREND ANALYSIS OF SEA LEVEL RISE FOR WEST COAST OF PENINSULAR MALAYSIA (PULAU PINANG) | Page 40-48 |
| Feature 7 | THE INFLUENCE OF MARPOL CONVENTION ON LLOYD’S REGISTER RULES AND REGULATIONS | Page 49-54 |
| Feature 8 | A BRIEF REVIEW OF MODULAR CONSTRUCTION METHOD IN THE SHIPBUILDING INDUSTRY | Page 55-61 |
| Feature 9 | DEVELOPMENT OF LEGAL FRAMEWORK GOVERNING THE CARRIAGE OF LIQUIFIED NATURAL GAS (LNG) WITHIN COASTAL WATER FROM CARRIER ASPECT (DESIGN SPECIFICATION) | Page 62-69 |
| Feature 10 | WAKE ADAPTED PROPELLER DESIGN BASED ON LIFTING LINE AND LIFTING SURFACE THEORY | Page 70-84 |
| Feature 11 | SEVEN WAYS TO MASTERING A COURSE | Page 85-93 |

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- SEMINAR ON WPC TECHNOLOGY
- 2nd BRAINSTORMING SESSION
- FIELD EMISSION SCANNING ELECTRON MICROSCOPY (FESEM) AND ENERGY DISPERSIVE X-RAY SPECTROMETER (EDS) SEMINAR

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Publish or Perish

Academics in Universities are expected to accomplish three things as part of their responsibilities. They have to teach to impart knowledge to their students. They must do research in order to increase the reservoir of knowledge and lastly they have to share their knowledge through service and doing consultancy work for companies and society.

Research carried out should, as far as possible, be relevant and useful to society. The days of “research for research’s sake” are over. As such, research results must be published to disseminate new findings, to elucidate problems and complexities. These research findings must be written in simple explanation such that fruitful discussions can be exchanged amongst researchers by way of writings. Conferences are held to discuss these results and to come to consensus and conclusions.

For research Universities, the statement “Publish or Perish” is bandied about by the academics themselves. For promotional purposes, especially to the senior levels of academe i.e. the professor and associate professor level, publications in reputed and refereed journals is a must. If not, the lecturer will remain a lecturer forever. At most, he/she may be promoted to senior lecturer.

For us at UniKL-MIMET, we are nurturing our younger brethren to publish in our own “Marine Frontier”. We hope this is the beginning of more quality publications later on for our academic staff. Use “Marine Frontier” to hone our skills at writing good presentations of our research and consultancy work for the benefit of all.

Obviously, our first efforts may not be the best. Hence, do not be discouraged or upset if the referees or editors comment on your writings. They do it with good intentions and to ensure your presentations are understandable, precise and succinct. Keep on at it and you are sure to succeed and produce quality writings later on.

Happy writing!!!

Chief Editor.
FISHES DETECTION INSIDE FISH LADDER USING SIMPLE BACKGROUND SUBTRACTION

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ABSTRACT
Automatic detection of moving objects is the fundamental tasks of many video-based surveillance and monitoring systems. Motion detection provides the basis for detection of increased activity, detection of objects left behind, tracking of optical flow against established motion patterns, and other similar surveillance requirements. There are many challenges in developing a good background subtraction algorithm. First, it must be robust against changes in illumination. Second, it should avoid detecting non-stationary underwater background objects such as underwater ray or light noise, underwater dust etc. This paper compared various background subtraction algorithms for detecting fishes inside fish ladder. Detection of moving objects in grayscale videos is based on changing texture in parts of the field of view. This report proposed the method to create a background model in underwater non-stationary scenes. For each component several different algorithms were first evaluated. For background subtraction, simple Frame Difference technique was evaluated. Simple technique often produces inferior performance but the result is still acceptable, while complicated techniques often produce superior performance but the process itself will take some time because of the computational complexity. The experiments showed that simple techniques such as background subtraction can produce good results with much lower computational complexity.

Keyword: fish detection, motion detection, Background Subtraction, Approximate Median filter, Mixture of Gaussian.

INTRODUCTION
Background modelling and subtraction are widely used nowadays in many vision systems. The main idea of this module is to automatically generate the background that is then used to classify any new observation as background or foreground. A common approach in background subtraction is to identify the moving objects, where each video frame is compared against a reference or background model. Pixels in the current frame that deviate significantly from the background are considered to be moving objects. These foreground pixels are further processed for object localization and tracking. Since background subtraction is often the first step in many computer vision applications, it is important that the extracted foreground pixels accurately correspond to the moving objects of interest. Even though many background subtraction algorithms have been proposed in the literature, the problem of identifying moving objects in complex environment is still far from being completely solved.

The main concern is how to effectively detect of the interested moving targets exist in the underwater monitoring system. Underwater environment is very complicated. There are a mass of inorganic material and various organic substances which are in different sizes, shapes, and performances. We must extract the interesting targets from complex background. Researchers have proposed many methods, for example M estimation, character matching method and main motion estimation based on light flow. However, these methods have some shortcomings: complicated transform, large computation, ineffectively extracting moving targets from complex background. We analyze in detail characteristics of underwater images and select an appropriate threshold level to

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binaries the difference image of image sequence. Then, the segmentation of every part of the binary image changes into a single object in one image by using image segmentation algorithm.

We can see that the images are covered with a layer of green color and fog because of light noise introduced by scattering of complex composition of water. Scattering has declined image contrast greatly. Medium of objective space causes so great difference on image illumination between on‐axial and extra axial point that brightness of background is very different. In figure 1(a) part of the image is brighter than 1(b) since installment error of the underwater camera. Image background is so complicated that if we only process a single image and detect effectively moving targets from it, the corresponding algorithm will be too complicated, large computation and bad real-time function. Image background is little different between two continual frames in image sequence.

If we can wipe off resemble background to large extent, restrain noise and stand out targets the precision and efficiency to detect targets can meet the real-time requirement of monitoring system.

**FISH DETECTION BASED ON BACKGROUND DIFFERENCE**

The fish detection system requires several steps in order to detect the fishes. While at implementation level some of these steps can be merged, for clarity the different components are shown separately. The complete overview starting from the raw image feed from the digital camera ending with a segmented image and fish boundaries is shown in Figure 2.

This system is proposed in which to detect the fishes inside the water ladder. Hence, from this project, it is expected that the system should be able to detect the fishes using background subtraction algorithm.

![Diagram of the fish detection system](image-url)

**Fig. 2: Fish detection system algorithm**
INPUT IMAGE

This research project recorded a video of the fish ladder including the background at a daytime with good weather condition. The video was captured by a digital video camera located at the sideline of the fish ladder. The image captured by the camera is in RGB image, Figure 3.

PRE-PROCESSING - UNDERWATER ENHANCEMENT

The pre-processing method typically only concentrates on non uniform lighting or color correction and often requires additional knowledge of the environment. It reduces underwater perturbations, and improves image quality. It is composed of several successive independent processing steps which correct non uniform illumination, suppress noise, enhance contrast and adjust colors. Performances of filtering will be assessed using an edge detection robustness criterion. After the pre-processing process is done, the video will be converted to grayscale image by using rgb2gray in MATLAB.

BACKGROUND SUBTRACTION

The algorithm discussed is very straightforward algorithm; both in implementation and computational time. The algorithm explained in more detail is Frame Difference (FD) and using a single value for a pixel. In reality a pixel consist of more components, usually a red, green and blue component. Of course it is possible to use all three color components but to save memory; every frame is converted to grayscale before it is stored as background frame. The output from these three background subtraction is converted to uint8 or 8-bit integer. The values of a uint8 range from 0 to 255. Values outside this range saturate on overflow, namely they are mapped to 0 or 255 if they are outside the range. The differences of each pixel between the current frame framei, and the previous frame framei-1 is calculated. If the difference is larger than a certain threshold Ts the pixel is counted as foreground. The following equation is used,

\[ |framei - framei-1| > T_s \]

Figure 4: (a) Original image, (b) image after enhancing process, (c) grayscale image.

Figure 5: Frame differencing algorithm
\[ |frame_i - frame_{i-1}| > T_s \] (1)

Where \( i \) is the pixel index in a frame. Obviously, by only using the previous frame FD adapts very quickly to changes in the background. If a fish stops moving for more than 1/15 of a second it becomes part of the background.

**THRESHOLDING**

Thresholding is the operation of converting a grayscale image into a binary image. Thresholding is a widely applied preprocessing step for image segmentation. Often the burden of segmentation is on the threshold operation, so that a properly thresholded image leads to better segmentation. There are mainly two types of thresholding techniques available: global and local. In the global thresholding technique a grayscale image is converted into a binary image based on an image intensity value called global threshold. All pixels having values greater than the global threshold values are marked as 1 and the remaining pixels are marked as 0. In local thresholding technique, typically a threshold surface is constructed that is a function on the image domain. See Figure 6 for the thresholding process.

![Figure 6: Images of Frame Difference after applied thresholding process](image)

**NOISE REDUCTION**

As can be seen in figure 6, there are a lot of noise associated with the resulting images of each proposed background subtraction. This noise can be classified as a so called Salt and Pepper noise which are abrupt dots in a random position in the image. The best way to deal with noise of this type is to apply a median filter to reduce the noise. The median filter considers each pixel in the image in turn and looks at its nearby neighbors to decide whether or not it is representative of its surroundings. It will simply replacing the pixel value with the median of neighboring pixel values. The median is calculated by first sorting all the pixel values from the surrounding neighborhood into numerical order and then replacing the pixel being considered with the middle pixel values. If the neighborhoods under consideration contain an even number of pixels, the average of the two middle pixel values is used. Seems that the image is in logical array, the processed output after applying this operation either 0 or 1. The result for FD process is shown in Figure 7.

![Figure 7: Images of Frame Difference after applied median process](image)

**EXPERIMENTAL RESULT**

**Test Sequences**

The proposed method was examined on fish ladder somewhere in Canada during daytime with good weather condition. This video was tested by using the proposed procedure as described in the previous chapter. The duration of the video is 15s length. The camera appeared to be side of the fish ladder so that we can see the fishes inside the fish ladder.
Figure 8: Frame differencing methodology (a) Original image, (b) underwater image enhancement, (c) gray level image, (d) frame difference background subtraction result, (e) thresholding process and (f) final image after noise reduction.
Figure 9: Frame differencing methodology (a) Original image, (b) under-water image enhancement, (c) gray level image, (d) frame different background subtraction result, (e) thresholding process and (f) final image after noise reduction.
EVALUATION AND DISCUSSION

Based on the visual examination on the resulting foreground masks, the following observations have been made regarding the background algorithms tested in this paper.

- Automatic underwater enhancement is a parameter free algorithm which reduces underwater perturbations and improves image quality. The algorithm composed several successive independent processing steps which respectively correct non uniform illumination, suppress noise, enhance contrast and adjust color.
- All background algorithms tested are sensitive to environmental noise. As we can see inside water the images are covered a layer of fog because of light noise introduced by scattering of complex composition of water.
- The performance of the frame difference is very poor. Even though the fish is detected, the shape of the fish is still hard to recognize at the end of the process. Furthermore the system cannot detect the fishes that situated more depth inside the fish ladder.

Some of the experimental results of fish detection are shown in Figure 8. These images represent process of frame difference background subtraction from straight forward background subtraction to more complex algorithm. It can be seen that the approach method generally worked good enough when detecting fishes but face some difficulties in detecting fishes. Figure 9 shows the results of other video of fishes inside fish ladder and same methodology has been applied.

CONCLUSION

An improved background subtraction based motion detection method was proposed to detect the objects in the Computer Vision-based fish behavior monitoring system. It fused the background difference and frame difference to update the background more correctly and completely with shorter time and the use the post-processing method to segment the foreground objects from the frames. The improved algorithms are effective to detect fish in real-time video sequence.

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MARINE CORROSION AND PROTECTION

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ABSTRACT
Marine corrosion and protection in the marine environment is not just about choosing very durable paint coatings for application on corrosion prone materials, but rather the ability to synergize all the important elements to reduce corrosion to an acceptable and cost-economic level. The selection of parent material and type of anti-fouling coating therefore has to meet the requirements of both performance and cost. A most challenging factor in the marine environment is the protection of a ship’s hull that is submerged for prolonged periods and become prone to marine micro-organism attacks. The area most severely affected is the boot topping zone that is intermittently exposed to both immersions and weathering. Normally, underwater corrosion is suppressed through the use of a marine coating system that prevents electrolysis by excluding the electrolyte and oxygen that trigger corrosion. This capability of marine coating goes beyond the ordinary superstructure paint coating in term of adhesion, toughness, resistance to chemical, humidity and weather. In complying with IMO regulations it is required to protect the hull using non-polluting and non-toxic coating that protects ship hulls from marine fouling organisms and corrosion while keeping safe the non-targeted marine environment organisms. This paper will seek to explore some recent developments in this field of underwater corrosion prevention and their performance in marine environment.

Keywords: Marine Corrosion, Bio-Fouling, Corrosion Prevention, Anti-Fouling Paints

INTRODUCTION
A ship’s underwater hull spends a large proportion of its operational life submerged in water and is exposed to the harsh marine environment with high chloride content and high levels of humidity. Under these conditions corrosion is a common occurrence. Corrosion is a term used to describe the destruction of a metal that occurs through a chemical process when the metal reacts with the environment. This reaction is an electrochemical oxidation process that usually produces rust or other metal oxides. A metal which corrodes rapidly is of little practical value as a structural material unless measures are taken to reduce the rate of corrosion. This is true for mild steel in a marine environment, but fortunately there are effective prevention measures that can help reduce the rate of corrosion. Marine related corrosion can be divided into three broad categories; a. Corrosion in sea water b. Corrosion in high humidity coastal environments c. Microbiologically induced corrosion.

Although mild steel is most commonly used for the construction of a ship’s hull it is not because of its resistance to marine corrosion. Its importance is more on its economic and physical strength perspective, easy availability and ease of fabrication. Corrosion in sea water is normally associated with electrochemical reactions that can be illustrated by using two dissimilar metals, the anode (normally of zinc which is sometimes called the ‘sacrificial’ anode) and the cathode (normally the mild steel hull of a ship) that is submerged in seawater through which current flows from the more reactive anode to the less reactive cathode, thereby corroding the zinc while protecting the steel from corro-

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sion. The zinc, being less noble than steel in the galvanic series, is eaten away while the cathode which is nobler in the galvanic series is always protected. However, the reaction may change depending on the type of metals used for the underwater hull and their hierarchy in the galvanic series. Electrochemical corrosion can be prevented by proper selection of materials and adequate cathodic protection. Thus, the correct choice of metals used for underwater hull construction will determine whether the hull is amply protected from corrosion or otherwise. For corrosion that occurs in structures exposed to the high humidity such as in coastal marine environment, it is usually triggered by the following factors.

a. Bimetallic contact (contact between two dissimilar metals)
b. Break down of protective surface films
c. Crevice corrosion

When two different metals come in contact, the metal that is nobler will act as cathode and the other as anode and corrosion of anode then takes place. Underwater hull of ships are usually made up of different materials and this difference results in the corrosion of the material that is lower than the other in the galvanic series.

While attack in the form of pitting would usually occur on protected surfaces when there is local breakdown of paint coating. When the paint coating is damaged a corrosion cell is established between the exposed cell metal which becomes the anode, and the surface mill scale (rust) that readily conducts electrons becomes the cathode. Although this exposed cell metal and the mill scale are of the same origin they continue to be affected due to their differing levels in the galvanic series. In fact, new steel, although of similar origin with old steel, will soon become anodic to this old steel. Similarly, brightly cut surfaces, such as pipe threads, are anodic to uncut surfaces. Therefore, corrosion not only affects two dissimilar metals in a humid marine environment but would also affect similar metals that have changed form.

Corrosion that occurs in crevices usually results from two areas of the same metal being exposed to an electrolyte under conditions where different oxygen concentration prevails. The area with a reduced level of oxygen becomes anodic and corrodes. This situation is prevalent in crevices and corners where there is less oxygen, hence the most severe corrosion seems to occur in those positions. Microbiologically induced corrosion or bio-corrosion occurs due to the accumulation of bio-fouling organisms on the underwater hull of the ship. Organisms may create corrosive products through their metabolism or decomposition that may damage the protective film of anti-corrosion products applied on the metal surfaces. Protective coatings or anti-fouling paints are used to control their accumulation, but they contain chemical substances which are toxic to those species which accumulate on the hull. These chemical substances remain toxic in seawater for a long time and may also kill non-targeted marine species.

LITERATURE REVIEW

In gathering information on marine corrosion and its prevention further understanding was sought in not just knowing what corrosion is but how to control it. Controlling of corrosion is of paramount importance to the maritime industry as a ship’s downtime may affect the sustainability of a shipping business that relies heavily on its ships’ availability that also would determine the business’s bottom line or profits. Knowledge in corrosion control would therefore require better understanding of materials selection, coatings, chemical inhibitors, cathodic and anodic protection (Bradford, 2001). As marine corrosion is important to both ship maintainers as well as ship owners who are concerned with their bottom line, it is imperative that basic concepts need to be mastered and understood by both parties on how corrosion problems occur and how they can be prevented or controlled with modern tools before more serious problems can set in that may jeopardize operational availability of ships (Roberge, 2006).

Galvanic corrosion affects the maritime industry in just about every field, thus information was sought on what to do when galvanic corrosion of common engineering materials occurs, especially in the marine environment. Further understanding on gal-
vanic corrosion was thus derived through a practical guide for engineers (Francis, 2000).

More valuable insights on corrosion were gathered (Roberge, 2000) that covers general considerations of corrosion prevention and control with a focus on underwater materials selection. The coverage includes elements for understanding of protective coatings, corrosion inhibitors, cathodic protection and anodic protection.

**SIGNIFICANCE OF PAPER**

This paper is significantly important because it involves major and expensive assets, namely ships, which require increasingly greater attention by ship owners on the maintenance of underwater hull areas. This particular area of a ship is important because problems associated with underwater corrosion would usually require costly downtimes as a result of up-slippings or dry-dockings. As operational availability of ships is tied to business sustainability an appropriate knowledge of corrosion management of the underwater hull is therefore necessary. Ship owners can no longer underestimate the importance of maintaining their ship’ bottoms. This paper will seek to explore some areas of marine corrosion and recent developments in the area of corrosion prevention.

**CORROSION PREVENTION**

Most of the underwater hull corrosion types can be prevented by proper selection of hull materials, proper design of underwater appendages and structures, appropriate anti-fouling coating and by cathodic protection. Appropriate coating or painting is the most extensively used process for the prevention of corrosion. Paint compositions cover a multitude of proprietary products but the basic components that make up the mechanisms of corrosion protection as incorporated in the mixture of the underwater paint composition are as follows:

a. A barrier coating (or primer) which prevents ingress of water and oxygen. To be effective the painting must be of adequate thickness that can provide an impervious layer above the metal surface, free from flaws and firmly adherent to the metal surface throughout its life.

A corrosion inhibitor carrier such as zinc chromate which is incorporated in the paint mixture. Cathodic protection of hull is made possible by incorporating a high concentration of zinc in the paint mixture. This high concentration of zinc would be effective in preventing corrosion under the paint film. For painting to be cost effective good surface preparation is therefore essential.

The zinc composition in the paint seals the underlying parent metal from the corrosive environment. The anodic action of the zinc continues until the paint film is converted into a dense, impervious barrier, resistant to weather, water and fume attack. However, if paint coating is damaged, fresh zinc would be readily available to provide further anodic action. Paint coating may also be damaged by micro-biological organism that results in localized corrosion. The area with the lowest oxygen availability (under the corrosion deposit) is forced to become the anode (gets eaten away) in the reaction, while the area outside acts as the cathode (being protected).

The reaction depends on the electrolytic continuity between the anode and the cathode. If there is no electrolysis under the deposition then a crevice effect may occur, resulting in crevice ring of corrosion around the edge of the deposit. As a ship’s hull becomes fouled with biological matter (such as barnacles), the resulting surface friction also causes a significant increase in the power required to maintain a desired speed. The additional power required results in increased fuel consumption, which adds cost. As power output increases, the air pollution emission from a shipboard propulsion system also increases.

Components of this air pollution include Nitrogen Oxides, Sulphur Oxides, particulate matter, and green house gases such as Carbon Dioxide.
Therefore, using an appropriate anti-fouling coating system helps in producing the following:

- Increases fuel efficiency
- Prevents corrosion
- Decreases air pollution emission
- Increases operating speeds
- Prevention of bio-fouling that causes bio-corrosion on underwater hull

Thus, to control bio-corrosion would require preventing bio-fouling organisms from settling on the underwater hull of the ship. This can be done by using anti-fouling paints, which form the final paint coating on a ship’s underwater hull.

ANTIFOULING PAINTS

Anti-fouling paints are applied on the underwater hull of ships to prevent bio-fouling that causes bio-corrosion. These anti-fouling paints release chemicals into the sea which are poisonous to bio-fouling organisms and prevent their attachment to the underwater hull surface. The main components of these paints are biocides and an acidic binder. The biocides are particles of poison and are distributed throughout the film of acidic binder. When this binder comes in contact with sea water which is alkaline in nature, hydrolysis reaction takes place and they release the poisonous biocide that kills the fouling organisms. Types of anti-fouling paints commonly used by ship owners are as follows;

- Copper-based anti-fouling paint
- Tin-based anti-fouling paint
- Organo-metallic anti-fouling paint (TBT or Tributyl Tin)

Copper-based anti-fouling paints are toxic mixtures that are formulated to kill or discourage sea life from attaching to an underwater hull of a ship. The cuprous oxide paints leached at a high rate in order to perform their function, and therefore had to be mechanically removed and renewed at frequent intervals. The high frequency of maintenance makes this type of anti-fouling paint less efficient due to high downtime because of dry-docking requirements.

To overcome the difficulties posed by the usage of copper-based anti-fouling paints ship owners are replacing it with newer and improved anti-fouling paints containing organo-metallic compounds called TBT-Tributyl Tin. The advantage of this new paint over the previous Cuprous Oxide type of anti-fouling paint is that it is far more toxic to sea life and can be formulated with very low leach rates to perform their anti-fouling function. Their anti-fouling life may thus be prolonged and longer than Copper-based anti-fouling paints. However, ships' hulls using these organo-metallic coatings do eventually require abrasive blasting to facilitate repainting. Since most of these organo-metallic compounds are not bio-degradable, they remain toxic in the sea water for longer periods and may kill non-targeted organisms in the environment. The majority of anti-fouling coatings contain solvents which are harmful by inhalation, by skin or eye contact. They can have a narcotic effect resulting in headache, dizziness, irritability and mental confusion. These reasons later resulted in the International Maritime Organization (IMO), the United Nations Agency concerned with prevention of marine pollution, to introduce a world-wide ban on the use of TBT in anti-fouling paints for ships. The IMO had agreed to ratify the following:

a. A global prohibition on the application of organo-tin compounds acting as biocides, in anti-fouling coatings on ships from January 2003; and

b. A complete prohibition on the presence of such compounds in anti-fouling coatings on ships by 1 January 2008.

The ban on TBT based anti-fouling paints by IMO spurred the shipping industry to think of more cost effective non-polluting paints to fight against biofouling and bio-corrosion. At present, the principal substitutes for TBT are still the Copper based system which was used earlier. Copper is far from a perfect solution because it is also associated with negative environmental effects, though not believed to be as serious as those of TBT. Although there are less toxic alternative biocides under consideration, some of the most promising alternatives are those that approach the problem by
inhaling or repelling the adherence of the fouling species to the underwater hull rather than killing the species directly. Some anti-fouling paint types are available which function by physical means rather than by wholly relying on the poisonous biocides that they release. However, such methods tend to be more expensive than the usual biocide anti-fouling coatings and their practical application is quite limited. Some of these products are still at their early stage of development and if used carefully may prove to be useful alternatives. An example of this new type of anti-fouling application is the Self-Polishing Copolymer paint or SPC. This SPC paint is used quite extensively on various ship types throughout the world, being quite successful in a few local trials conducted on certain Royal Malaysian Navy ships during late 1990’s. In this anti-fouling paint type the release of biocides takes place by hydrolysis, but the reaction occurs only near the underwater surface. Thus, controlled biocide release is made possible. SPC paint coatings have a longer service life than other types but they cost more than TBT and thus may be quite prohibitive, unless cost is not a primary concern to ship owners.

Nevertheless, the use of SPC paint may reduce resistance on underwater hull through the self polishing nature of the paint coating when bio-foulings find itself difficult to adhere to the underwater hull. Reduced resistance may be translated to increase in speed at lower engine loads, thus improvements in overall fuel consumption may be achieved. Newer anti-fouling developments are making it possible for newer technologies to be applied for underwater hull protection. This can be found, such as, in the form of using natural fungus in anti-fouling paint mixtures. This new type of anti-fouling paint uses an extract from the microscopic fungus *Streptomyces Avermitilis* to poison the barnacles. The fungus is extremely poisonous to barnacles and other crustaceans which commonly stick to the underwater hull. When this fungus is added to the anti-fouling paint for ship hulls, the underwater hull surface remains entirely free from barnacles. The pure fungal extract in paint is sufficient to seriously affect the nervous system of barnacles that prevent any further growth, as long as the paint is on a painted surface. The main advantage of these paints is that when the paint is dissolved in sea water it does not harm other organisms in the open sea. The fungal extract is probably both cheaper and, above all, more environmentally friendly than other anti-fouling paints based on copper compounds and TBT available today.

**CONCLUSION**

Protection of a ship’s hull from corrosion is one of the most challenging factors facing ship owners and maintainers. Even a small corrosive element may eventually lead to tremendous financial or operational loss if not rectified early. The protective anti-fouling paints that are commonly used to prevent the bio-fouling are usually quite toxic in nature that may adversely affect the marine environment. However, if the anti-fouling paints are not used then the underwater hull would be subjected to bio-corrosion, lower operational availability of ships, increase in hull resistance that in turn would increase fuel consumption, increase in costs to ship owners. A maritime nation like Malaysia would suffer in terms of reduced earnings from sea trade and all these can be attributable to the effects of underwater corrosion. So, anti-fouling coatings are important as far as ships’ availability and sea trade are concerned. There are IMO regulations in place to control the detrimental effects of anti-fouling coating systems. These regulations are in place due to the compelling need to minimize the environmental harm that is caused by the usage of these biocides in the anti-fouling paints. Although less toxic alternative biocides are under consideration, other most promising alternatives may be those that approach the problem by inhibiting or preventing the adherence of the bio-fouling species to the hull rather than killing the species directly that would also affect the non-targeted marine species.

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EFFECTS OF WEAVING PATTERNS TOWARDS DIFFERENT WELDED JOINTS

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ABSTRACT
Welding plays major role in shipbuilding activities as it joins most metals. This requires many welders to be employed. When it comes to weaving, most welders have preferable patterns. There will be circular in motion, zigzag, crescent, straight and many more. Weaving can be defined as the way of manipulation of the torch during the welding process. However, there was no analysis done to study their effects on heat affected zone (HAZ) for each type of welded joint. In this paper, the author will focus on tee and butt joint.

Keywords: Welding, weaving and heat affected zone (HAZ)

INTRODUCTION
Welding is very important in term of productivity and quality of the end product, especially in shipbuilding practices. The quality of welding is not only restricted on the work done by the welder but also depends on many other factors such as welding parameters, shielding gaseous, working environment, joint accessibility, joint design, edge preparation, weld sequence, welding equipment and welder skill etc. Furthermore, a thorough training regarding preferable welding techniques is essential to ensure consistency in welder skill (Mandall, 2004).

The weaving styles used are varying depending on the welder’s preferred choice. This weld can be made by moving the electrode/welding torch backward and forward. There were many different patterns/techniques can be used to make a weld including circles, J zigzag, crescent, straight and many more which shown in Figure 1. A clear understanding of the whole process is also required in order to produce sound (good) welds (American Welding Society, 2003).

The use of welding processes and techniques may produce defects which are usually associated with a given process or technique. Therefore, it is important to consider how the change in weaving style (welding techniques) can affect the HAZ of the welded joints (Jeffus, 2004, Sacks and Bohnart, 2005).

There will be several joints and weave patterns to be tested and analyzed. Tests that will be conducted after the welding are the morphological observation in order to identify the HAZ by using the stereo zoom microscope and also the macro test with the compliance of ISO 5817. The results was then used to propose whichever patterns that have minimum distortion characteristic and also to identify the effective methods that are able to represent smallest (HAZ) precisely.
METHODOLOGY

The semi-automatic gas metal arc welding (GMAW) process with the 100% carbon dioxide (CO₂) as shielding gas, and 1.0mm diameter of ER70S-6 filler wire will be used in this experiment. There will be eight (8) specimens to be welded which are 4 specimens for each type of welded joints, tee and butt joint respectively. 4 specimens for each joint will accommodate for straight, circular, crescent and zigzag weaving styles for each joint. The materials used are 10mm thick of A36 low carbon steel. The specimens differ in weld joints and weave patterns. Figure 2 shows the preparation of butt joint (Cary and Helzer, 2005).

Both plates were welded together with no preheat, using triple runs in order to get the right weld size for each specimen. The welding is done manually and parameters used in this activity are shown in the Table 1 as below and the specification for ER70S-6 filler wire is shown in Table 2.

Then, specimens were prepared for macro test under stereo zoom microscope to look into HAZ section (Nayar, 2003, Megson, 2005). However, ASTM E340 should be followed during etching process. Any defects on the sample will be assessed for compliance with the ISO 5817. The HAZ area also can be measured using this facility under 7x magnification.
EXPERIMENTAL RESULT

A. Visual Inspection
The result that presented in Table 3 shows the different heat-affected zone (HAZ) width area for different weave pattern.

B. Heat Input
In order to calculate the heat input, the welding speed needs to be known first. The welding duration for every joints and patterns has been recorded and represented in the Table 4.

The formula below is used to calculate the heat input for each specimen (Megson, 2005)

\[ H = \left( \frac{60 \times E \times I}{1000 \times S} \right) \times \text{Efficiency} \]

Where
- \( H \) = Heat input (kJ/mm)
- \( E \) = Arc voltage (V)
- \( I \) = current (A)
- \( S \) = welding speed (mm/min)
- Efficiency = 0.9 for GMAW process

The results should be as stated in Table 5

DISCUSSION

Straight pattern for the butt joint shows the largest HAZ, by means more heat is used. For the tee joint single run, the straight pattern has the largest HAZ compared to zigzag motion in triple runs. Normally, the straight weave pattern favors the least HAZ, however in this study it proved the other way.

Based on the results obtained in Table 5, it is clearly shown that crescent and circular weave pattern was the least affected by the heat and they can be ideally used in most of the welding joint.
<table>
<thead>
<tr>
<th></th>
<th>Straight</th>
<th>Zigzag</th>
<th>Crescent</th>
<th>Circular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butt</td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
<tr>
<td>H (mm)</td>
<td>3.65</td>
<td>2.52</td>
<td>2.05</td>
<td>3.00</td>
</tr>
<tr>
<td>Tee (single)</td>
<td><img src="image5.png" alt="Image" /></td>
<td><img src="image6.png" alt="Image" /></td>
<td><img src="image7.png" alt="Image" /></td>
<td><img src="image8.png" alt="Image" /></td>
</tr>
<tr>
<td>H (mm)</td>
<td>2.05</td>
<td>1.36</td>
<td>1.16</td>
<td>1.12</td>
</tr>
<tr>
<td>Tee (triple)</td>
<td><img src="image9.png" alt="Image" /></td>
<td><img src="image10.png" alt="Image" /></td>
<td><img src="image11.png" alt="Image" /></td>
<td><img src="image12.png" alt="Image" /></td>
</tr>
<tr>
<td>H (mm)</td>
<td>1.57</td>
<td>2.02</td>
<td>1.29</td>
<td>1.06</td>
</tr>
</tbody>
</table>

Table 3 – Mean width of HAZ

<table>
<thead>
<tr>
<th>#</th>
<th>Weave Pattern</th>
<th>Specimens’ Length (mm)</th>
<th>Time Taken (min)</th>
<th>Welding Speed (mm/min)</th>
<th>Time Taken (min)</th>
<th>Welding Speed (mm/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Straight</td>
<td>150</td>
<td>2.22</td>
<td>67.57</td>
<td>2.10</td>
<td>71.43</td>
</tr>
<tr>
<td>2</td>
<td>Zigzag</td>
<td>150</td>
<td>1.57</td>
<td>95.54</td>
<td>1.59</td>
<td>94.34</td>
</tr>
<tr>
<td>3</td>
<td>Circular</td>
<td>150</td>
<td>1.51</td>
<td>99.34</td>
<td>1.41</td>
<td>106.38</td>
</tr>
<tr>
<td>4</td>
<td>Crescent</td>
<td>150</td>
<td>2.14</td>
<td>70.09</td>
<td>1.05</td>
<td>142.86</td>
</tr>
</tbody>
</table>

Table 4 – Welding speed and duration
Considering on the time taken and welding speed for these patterns, the shipbuilder can make more profit when these patterns were applied in their work. However, this welding process is done manually. Therefore the uniformity of travel speed and weave pattern cannot be confirmed fully thus it will affect the final result. It is recommended that, robotic arm welding should be used in future research to perform this activity as this will give better and reliable result (Marlow, 2002, Houldcroft and John, 1989, Marlow and Galvery, 2000).

CONCLUSION

As conclusion, crescent motion gives the least HAZ for butt joint and circular motion for tee joint respectively. At the same time, these weave patterns also give least heat input for each joint. Thus provide minimum distortion characteristic for specified joints using these weaving styles.

Although most welder have preferred pattern, hopefully with this findings it can give a clear view for better selection of the weave pattern during welding process which can produces less distortion and very practical in time saving.

ACKNOWLEDGEMENT

Special thanks to Advanced Materials Research Centre (AMREC) Kulim and, Science and Technology Research Institute for Defense (STRIDE) Lumut for their kind support for laboratory works and facilities.

REFERENCES

ANALYSIS ON FIRST LANGUAGE (L1) INTERFERENCE IN LEARNING SECOND LANGUAGE (L2) WORDS WITH MULTIPLE MEANINGS

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ABSTRACT
This study analyzed first language (L1) interference on second language (L2) vocabulary learning among Universiti Kuala Lumpur (MIMET) students. For this study, the first language is Malay language, as all students are Malays and the second language in this study is English. Fifty students participated in this study. Data were collected from essays, answers for translation exercise and vocabulary test answer scripts. The occurrences of misuse of homonyms or words with multiple meanings were identified and analyzed. Results suggested that the students have yet to master a certain number of words in English despite learning English for more than eleven years. Lessons on vocabulary especially words with multiple meanings are needed to improve students’ proficiency level.

Keywords: L1 interference, L2 vocabulary and homonyms

INTRODUCTION
English is known as the “most significant and global language” (Akande, 2003), which is used as the sole official language in relation to a wide range of topics. Based from the 7th Edition of Oxford Advanced Learner’s Dictionary (2005), one in five of the world’s population speaks English with some degree of competence and is spoken as a first language by more than 300 million people throughout the world and used as a second language by as many, if not more. As a result of the exceptional global spread of English, approximately only one out of every four users of the language in this world is a native speaker of it (Seidhofer, 2005). Thus, it is acceptable to say that the interaction s in English happen among the non-native speakers of the language.

Jamian, Sidhu and Muzafer (2008) stated that learning a second or foreign language involves not only learning the rules that govern the grammar but also the vocabulary of the language. It is agreeable that learning a SL or FL is associated to lexical knowledge and syntactic rules, which are the crucial component of overall communicative competence. Knowledge of vocabulary is vital for the development and demonstration of other related linguistic skills. Furthermore, English has more than 100 000 words, phrases and meanings, which may make the acquiring of the language becomes difficult. If a L2 learner speaks the target language with grammatical error, the message can still be delivered as long as the words used in the sentences are in context and can be grasped by the listener. However, if the use of words is limited, the process of communication may be broken down by the failure of the listener to digest the content of the message. Obviously, unfamiliarity with certain vocabulary may give rise to problems in discourse (Webb, 2008). Frisson and Pickering

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(2001) mentioned in their study, a great deal of evidence indicates that both spoken and written language comprehension are essential, with the ability to interpret the meaning of each new word as soon as it is encountered by the students.

In L2 learning environment, specifically in Malaysia, vocabulary items are taught in the earlier stage of the schooling years, either explicitly or implicitly. The words taught at this stage are mostly high frequency words, which need to be taught as the fundamental knowledge of acquiring the L2. When it comes to secondary school levels, the lesson may not include explicit vocabulary teaching but is usually merged together as a whole. Nunan (2003) explained in his book Practical English Language Teaching that high frequency vocabulary should get deliberate attention, for receptive and productive use, through teaching and study and should be met and used in communicating messages. Webb (2008) found out through his study that L2 learners may incidentally gain knowledge of meaning through reading. However, some researchers suggest that explicit learning of vocabulary may be responsible for most L2 vocabulary learning.

Understanding the meaning of words can either be easy or difficult, depending on the students’ ability to identify the meaning or meanings of the words. Moreover, majority of English words have multiple meanings, based on their types of the part of speech, the form and the structure of the words. Thus, it might be difficult for L2 learners to grasp each meaning for this type of words, known as ‘homonyms’, words that have different meanings but are pronounced and spelled the same. Examples are book, meaning a written work or to arrange with a hotel or restaurant. Obviously, L2 learners may not able to acquire all meanings and the forms of the used are being used. Moning (2007) said that learners’ meaning-making is a complex and cognitive process which occurs within the individual. It will be more difficult if the meanings are not related and the learners will interpret the meanings by making sense and looking for contextual clues within the sentence (Frisson and Pickering, 2001). Another problem that may arise is the learners will have to deal with the literary devices, sociological aspect and cultural aspects of L2. Moning (2007) again mentioned in her study that learners have to use their schemata and worldview to understand the meaning. Thus, if the context of the clues is unauthentic to the learners, the most possible way to get the meaning of the word or to use the word in a sentence is guessing and translation. L2 vocabulary learning is rather difficult as it is influenced by learners’ first language and if a word is learned per se, learner’s depth of vocabulary knowledge will not be depicted (Jamian, Sidhu and Muzafar, 2008). It is impossible to keep two languages apart. Therefore, when L2 learners fail to understand the meaning of a word or uncertain on how to put the word in a sentence, they will shift back to their L1 and try to directly translate the word. Even though the issue of translation from L1 to L2 has been a controversial issue in ESL classroom, some studies have proved that translation is a big help in L2 learning but if translation involves the instruction only. The learning through translation can be a meaningful learning if the students able to seize the lesson. Vaezi and Mirzaei (2007) stated that L1 can have various uses in L2 classroom, in creating authentic L2 uses rather than something to be shunned at all costs. Translation might work if the translation method only involves instruction but may not be appropriate for students to translate the meaning of words into L1 as the differences between the two contexts are quite significant. The use of mother tongue had been banned since the existence of Direct Method. One of results found in a study by Kavari and Fazeli (2009) indicated that L1 translation method is not successful in meaningful learning and cannot help students to be successful in L2 acquisition.

**PROBLEM STATEMENT**

L1 has various uses in L2 classroom. Vaezi and Mirzaei (2007) mentioned that L1 is used in classroom management, giving instruction, explaining errors, discussing cross-cultural issues and checking comprehension. Thus, it can be said that L1 use in L2 classroom basically enfolds 100% of L1 teaching. Teachers use L1 to convey meaning, explain grammar and also organizing the class. This may be an
alternative for teachers in order to make sure that learning is taking place. Then again, one of the effects of L1 instruction in L2 learning environment is translation and guessing technique apply by the learners in L2 learning. If the teachers use translation in teaching, the learners may not be able to memorize all the translation items given to them. Moreover, majority of English vocabularies are homonyms, which will make it trickier for learners to understand the words in context.

The purpose of this paper is to present an analysis on L1 interference in word meaning. Besides that, this paper will also examine the occurrence of misuse of homonyms in English essay among Universiti Kuala Lumpur students.

METHODOLOGY

Subjects

The subjects were 50 diploma programs Malay students in Universiti Kuala Lumpur Malaysian Institute of Marine Engineering Technology (UniKL MIMET). These students were in their first semester in various courses such as Diploma in Engineering Technology (DET) Ship Design, DET Ship Construction and Maintenance, DET Marine Engineering and DET Marine Electrical and Electronic. The similarity among them is that they enrolled in a foundation course known as ‘Proficiency English’ after they failed the UniKL English Placement Test (UEPT). The placement test is compulsory for all UniKL students. The scoring scheme is Band 1 (weak) to 5 (excellent). Students who obtain less than Band 3 will have to enroll in this course. The subjects were 15 female students and 35 male students.

Instrumentation

The following instruments were used in this project:
1. Essay writing
2. Translation exercise
3. Vocabulary test

Procedure

Firstly, the subjects’ UEPT essays were analyzed and L1 interference was identified. Next, the subjects were given a translation exercise whereby they translated five English homonyms to L1, in this case, Malay language. After that, they were given a test, which consisted of ten Multiple Choice Questions. The questions in the test included the five similar words that they translated before. They had to choose the meaning of the word based from the given options. This test was carried out after a few lessons on ‘Words with Multiple Meanings’.

DATA ANALYSIS

The subjects’ essays were analyzed and the sentences that demonstrated the most obvious L1 interference were discussed.

For Task 2, the students were asked on the translation of the six words given. The subjects’ feedbacks were discussed.

For the last task, the subjects’ answers from the vocabulary test were analyzed and discussed.

Results and Discussions

The subjects wrote an essay entitled “Are mobile phones harmful?” for the UEPT. Out of 50 essays analyzed, there were seven sentences that demonstrated the most obvious L1 interference. These essays were written before they enrolled in Proficiency English course.

<table>
<thead>
<tr>
<th>Erroneous Sentence 1</th>
<th>Correct Sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>It can snap picture with easy. Malay: Ia boleh mengambil gambar/ foto dengan mudah.</td>
<td>It is easy to snap a picture by using mobile phones.</td>
</tr>
</tbody>
</table>

Table 1: Occurrence of L1 Interference in L2 sentence
In the first example sentence, the participant directly translated a Malay sentence to English and the most obvious part is ... with easy. The translation for each word was done for these two words, *dengan* means with and *mudah* means easy. There is a vocabulary error respectively.

<table>
<thead>
<tr>
<th>Erroneous Sentence 2</th>
<th>Correct Sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>We get hearing a song from it. <em>Malay: Kita boleh mendengar lagu darinya.</em></td>
<td>We can listen to songs from mobile phones.</td>
</tr>
</tbody>
</table>

Table 2: Occurrence of L1 Interference in L2 sentence

Similar to Erroneous Sentence 1, the participant translated the sentence but could not find a more suitable word for *mendengar*. So, instead of using the word listen, the word hearing was used. There is only one Malay word for hear or listen which is *dengar*, thus, Erroneous Sentence 2 could be the result of interference of L1 on L2.

<table>
<thead>
<tr>
<th>Erroneous Sentence 3</th>
<th>Correct Sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>With watch this video, it can be somebody down attitude. <em>Malay: Dengan menonton video ini, ia akan merendahkan moral sesorang.</em></td>
<td>By watching this video, one’s moral values will be demoted.</td>
</tr>
</tbody>
</table>

Table 3: Occurrence of L1 Interference in L2 sentence

This sentence also appeared to be another example of L1 interference in English. However, it showed the incompetency of the participant to convey his/her meaning in a sentence due to the lack of vocabulary knowledge as well as syntactic knowledge. There are vocabulary and grammar errors respectively.

<table>
<thead>
<tr>
<th>Erroneous Sentence 4</th>
<th>Correct Sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>No false to hear a song but the music and the rhythm is so bad and the lyrics not suitable for we as Malaysians. <em>Malay: Tidak salah untuk mendengar lagu tetapi muzik dan ritmunya tidak bagus dan liriknya tidak sesuai dengan kita sebagai rakyat Malaysia.</em></td>
<td>It is not wrong to listen to songs but the music and rhythm are not decent and the lyrics are inappropriate to us as Malaysians.</td>
</tr>
</tbody>
</table>

Table 4: Occurrence of L1 Interference in L2 sentence

This sentence proved the capability of the subjects to interpret but the sentence he/she wrote to convey the meaning was incorrect; translation method was used as well as the presence of subject-verb agreement error. This may due to the non-existence of SVA in Malay grammar.

<table>
<thead>
<tr>
<th>Erroneous Sentence 5</th>
<th>Correct Sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Don’t because of mouth, your body become destroyed. <em>Malay: Jangan kerana mulut, badan binasa.</em></td>
<td>Do not say anything that you will regret later.</td>
</tr>
</tbody>
</table>

Table 5: Occurrence of L1 Interference in L2 sentence

This is a Malay idiom which is translated to English, thus the sentence looked improper and funny. However, the message is clear and can be easily understood if read by a Malay speaker.

Task 2 of the study is a translation exercise. This exercise seeks for the subjects’ understanding on words with multiple meanings. Five simple words...
were given to them. The words are skirt, mind, address, base and break. The subjects were asked to list down as many meanings that they know on the given words. These are the answers and the percentage of subjects who gave the answers. The meanings are also translated to English.

As shown in the Table 6, most subjects gave the same meanings for the words. Only a certain meanings derived from a few number of subjects such as the second meaning for skirt, second meaning for mind, first meaning for base and the third meaning for break.

The second meaning for skirt refers to an outer covering or part used to protect the base of a vehicle or machine. This definition is taken from Oxford Advanced Learner’s Dictionary. This answer may derive from subjects who are passionate about motoring or car accessories.

For the second meaning for mind is believed to derive from the overuse phrase like “I don’t mind” or “Would you mind?”, thus it can be said that they gave the answer by translating the phrases directly to Malay language.

The first meaning of base is derived due to the nearby Royal Naval Army base camp that situated in Lumut, Perak. The common name used for the army base is NAVY base, which is used by the residents in this district.

The third meaning for break is similar to the first meaning, only the composition of the objects is different. The first meaning refers to a broken glass, which the object breaks into pieces, while the third meaning refers to a broken wood, which the object breaks into several parts. It also refers to a broken heart (patah hati), which means to be disappointed in love.

Hence, from this exercise, it can be concluded that the knowledge of word meaning of the students is modest, which, the students have inadequate knowledge on words with multiple meanings. After 11 years of learning English in schools, they cannot grasp the meanings even for simple words. The vocabulary knowledge of the students is still very limited.

Task 3 is a vocabulary test which the subjects were given a 10-question MCQ and the questions required the subjects to choose the meaning best complements the underlined word in a sentence. All underlined words are the same five words given in Task 2. This test was carried out after a few lessons on ‘Words with Multiple Meanings’ were delivered. This topic is one of the lessons in the syllabus.

**Question 1**

Tom was uncomfortable talking about money, so he skirted the issue.

1. Garment worn to the waist
2. A flap on a saddle
3. To pass along the edge
4. To avoid

86% or 43 of the subjects chose the correct answer which is D. This shows that the subjects can guess the other meaning for skirt besides the meaning that they have listed earlier.

**Question 2**

Even though raking leaves is hard work, I don’t mind it at all.

1. Reason or sanity
2. To heed or obey
3. To pay attention to
4. To feel disturbed by

The respondent had chosen the correct answer for this question which is D. The meaning for mind has already existed in the subjects’ schemata.

**Question 3**

George had a mind to become a chef, so he practi-
1. The brain
2. Reason or sanity
3. Intention or desire
4. To pay attention to

86% or 43 of the subjects chose the correct answer which is C. This shows that the subjects can guess the other meaning for mind besides the meaning that they have listed earlier.

**Question 4**

The manager held a meeting to address the issue of employee health benefits.

<table>
<thead>
<tr>
<th>Words</th>
<th>Meanings Derived</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>skirt</td>
<td>1. Pakaian (A piece of clothing)</td>
<td>100% (50 subjects)</td>
</tr>
<tr>
<td></td>
<td>2. Aksesori kereta (Car accessories)</td>
<td>52% (26 subjects)</td>
</tr>
<tr>
<td>mind</td>
<td>1. Minda (Brain)</td>
<td>100% (50 subjects)</td>
</tr>
<tr>
<td></td>
<td>2. Rasa peduli (To not care or not be concerned about something)</td>
<td>40% (20 subjects)</td>
</tr>
<tr>
<td>address</td>
<td>1. Alamat (Details of where somebody lives)</td>
<td>100% (50 subjects)</td>
</tr>
<tr>
<td>base</td>
<td>1. NAVY base</td>
<td>30% (15 subjects)</td>
</tr>
<tr>
<td></td>
<td>2. Tapak (The part or surface that something stands)</td>
<td>100% (50 subjects)</td>
</tr>
<tr>
<td></td>
<td>3. Merujuk kepada (Refer to, e.g. based from ...)</td>
<td>60% (30 subjects)</td>
</tr>
<tr>
<td>break</td>
<td>1. Pecah (To be damaged into pieces)</td>
<td>100% (50 subjects)</td>
</tr>
<tr>
<td></td>
<td>2. Putus (To go away in different ways e.g. in a relationship)</td>
<td>84% (42 subjects)</td>
</tr>
<tr>
<td></td>
<td>3. Patah (to be damaged into more parts)</td>
<td>34% (17 subjects)</td>
</tr>
</tbody>
</table>

1. Location of an organization
2. A formal speech
3. To deal with or discuss
4. To put delivery directions

96% or 48 subjects got the correct answer, C. The subjects may have guessed the answer by the clue given such as manager and meeting.

**Question 5**

When you address an audience, be sure to make eye contact and speak clearly.

1. A formal speech
2. To deal with or discuss
3. To put delivery directions
Question 6

The doctor based her diagnosis on medical test results.

1. A fundamental principle
2. The bottom layer of coating
3. To establish as a fact
4. Of little or no value.

98% subjects chose the correct answer which C. Only one respondent chose A as the answer.

Question 7

The statue looks valuable, but it is made of base material, not real gold.

1. The bottom layer of coating
2. A military supply site
3. Morally low, mean-spirited
4. Of little or no value

72% or 36 subjects answered D which is the correct answer. There are 10 subjects answered A.

Question 8

When people trip, they instinctually try to break the fall with their hands.

1. To rupture the surface of
2. To disclose or reveal
3. To lessen the impact of
4. To stop working

All subjects chose the correct answer which is C. the subjects said that the meaning for break in this sentence was easier to understand.

Question 9

Anthony was so happy when he heard the good news that he broke into a song.

1. To smash violently
2. To disclose or reveal
3. To rupture the surface of
4. To begin suddenly

52% or 26 subjects got the correct answer, D. However the other 24 subjects answered B. This may due to the lack of understanding in the context. Malays usually will break into a prayer after getting good news.

Question 10

After weeks of raining, the sun came out and we had a break in the weather.

1. An opening or gap
2. An abrupt change
3. A stroke of good fortune
4. A sudden dash or rush

52% or 26 subjects got the correct answer, B. However the other 24 subjects answered C. It is expected that this question is difficult, which is proved by the number of correct answer given.

SUMMARY AND CONCLUSION

The essay written by the subjects were taken from the UniKL English Placement Test, which was held during the induction week of July 2010 Semester. Thus, the comprehension of the essay was basically a raw responds from the subjects who are mostly school leavers and certificate holders. On the vocabulary exercise given to the subjects, all of them performed relatively well as none of them got below 6 out of 10 questions given. This may due to the lessons on related topic before conducting the test. However, a critical look at their performance indicated that more than half of the whole subjects did not have a good knowledge of vocabulary, for example the answers given by then in Task 2, translation exercise. When they were given the contextual
clues form of questions, they were able to guess the meaning of the words by looking at clues that unfold the sentence.

Though this study revealed that the subjects did not have a good mastery of English vocabulary, it was found that there were few errors in the way the meanings for the words interpreted. Most errors were made either as a result of carelessness or ignorance on the meaning of clues given in the sentence. Ali (2002) stated in his article that native language interference is one of the sources of errors in L2 acquisition. A learner cannot escape from his/her dominant first language. Furthermore, the negative aspect of L1 interference is quite worrying because this may result in erroneous occur in utterances or writing, and unacceptable language switch.

The study suggests that the type of pedagogical approach of the L2 vocabulary learning may have an impact on retention of the new L2 words. The findings clearly demonstrate some results that can be applied in the preparation of vocabulary lessons, which suggests that contextual clue is one of the ways to teach homonyms. Some implications from this study may include the type of teaching method that supposedly cater the needs of the students in vocabulary acquisition, the functions of L1 translation method in vocabulary learning and the preparation of teaching materials that should provide the students with proper examples and drills. Some of the limitations of this study are similar to other studies, which in need of a larger size population and the need to conduct similar experiments on population with different proficiency levels.

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EXPLORATION OF OFFSHORE FISHING BY INTERGRATED OFFSHORE FISHING VESSEL CONCEPT (IOFVC) IN MALAYSIA

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ABSTRACT
This paper discusses the status of deep sea fisheries exploitation and development in Malaysia and its potential by the introduction of Integrated Offshore Fishing Vessel Concept (IOFVC). As a backdrop to this discussion, this paper begins by briefly presenting the status of the national fisheries industry and leading on to ideas on how to further develop the offshore fishing. The main part of this paper discusses a number of key areas upon which the potential development of fisheries in Malaysia especially on IOFVC and its functions in booster the deep sea market and supply towards balancing the supply. The approach is by reducing oversaturated situation on inshore and enhances the equilibrium and sustainable protein supply from both sectors. Finally, the paper highlights the main constraints and issues pertaining to fisheries development in Malaysia.

Keywords: Integrated Offshore Fishing Vessel Concept (IOFVC),

INTRODUCTION
Marine fish catches are allegedly falling, species disappearing and many other symptoms of chronic overfishing are among the main issue reported. There is an assumption that overfishing of the sea creatures is to blame by given symptoms. Malaysia inshore fish resources is also facing the same symptoms and it is proven by stagnant data from Department of Fishery Malaysia. It is already heavily exploited and there is evidence that inshore fishing grounds are starting to be over saturated.

Two consequence study conducted in 2005 and 2006, the inshore capture fishery peaked in the last two decades and is now stable or declining, depending on the area being fished (Simon, et. al, 2005), and Department of Fishery, Malaysia stated that landing from this sector (Malaysia) have peaked and is not expected to expand any further. Simon, et. al, (2005) also found that the increasing of “Low value/trash fish” species with various characteristics which they are generally small in size, have low consumer preference and have little or no direct commercial value. Later in 2009, Green Fact has summarized in FAO, (2009) that a bit more than half of all monitored fish stocks are now fully exploited, producing catches close to their maximum sustainable limits with no room for further expansion. Over a quarter are overexploited, depleted, or slowly recovering. Likewise, according to Fishery Economic October 2008 (FAO, 2008), the global fish production per capita has been declining since 1980. According to a 2008 study commissioned by the World Bank and the UN Food and Agriculture Organization (FAO), the exploitation and near depletion of the ocean’s most valuable fish stocks have caused an annual net loss in the value of global marine fisheries in the order of US$50 billion. The excess-
sive build-up of redundant fishing fleet capacity, the deployment and mismanagement of increasingly fishing technologies, and increasing pollution and habitat loss are to blame (World Bank and FAO 2008). In order to increase catch and production in fishing means the world’s fishing fleets need to work harder to keep their catch rates steady under sustainable approach and methodology.

Meanwhile, over a ten year period from 2000 to 2009 and as of 2nd of July 2010, the total population of Malaysia had increased by 19.64% from 23.32 million to 27.90 million (Dept of Statistics of Malaysia, 2010). All else constant, the figure is expected to grow up to 34.22 million in 2020. However the deep sea sector has shown positive sign-age and has further potential for development as explored by David, J., A., (2003) which is about 4% of world catches are currently taken from deep sea species (including blue whiting, scabbardfish, grenadiers, redfish, orange roughy, Greenland halibut and argentines). Hong, et, al., (2010) argues that enhancing the effort in such having better vessel for deep sea fishing grounds where fish stocks are more abundant, take longer fishing trips and get a larger catch as well as having more choice catch will contribute to achieving a larger amount of gross revenue.

RESEARCH BACKGROUND AND THE IDEA OF IOFVC

Fishery is an important part of Malaysian agriculture sector and it contributes quite significantly to its economy. Apart from contributing to the national Gross Domestic Product (GDP), it is a significant source of employment and foreign exchange revenue as well as a source of cheap animal protein. It directly contributes to the country’s economic strength through job creation and national income. 1,391 million metric tons of fish were landed in 2009 valued at RM8.583 billion and when compared to the statistic in 2008 it shows an increase of 6.56% by quantity and 16.84% by value compared to 2008. During the same year fishing has contributed 1.3% of the national GDP (JPM, 2010). However, offshore fishing only contributed 16% or 0.23 million metric tons valued at RM1.373 billion. This rather slow performance of the offshore fishing sector was closely related to its low productivity due to the following contributing factors:

- There is a high possibility that the catches were not landed at the registered fishing ports around Malaysia but were sold to exporters while in the middle of the ocean
- Globally, the illegal, unreported and unregulated (IUU) fishing was seriously undermining international efforts to conserve and manage fish stocks in a sustainable manner,” says Ichiro Nomura, FAO Assistant Director-General for Fisheries (FAO, 2004)
- The number of deep-sea fishing vessels remained small when compared to those operating in the inshore waters. In 2008, only 2.5% of deep-sea fishing vessels were licensed in Malaysia. (Dept. of Fishery, Malaysia, 2008)

Intergrated Offshore Fishing Vessel Concept (IOFVC) is a genuinely new concept to be built exactly with such intention. IOFVC will bring all the services the offshore fishermen require closer to them. These services shall include fish landing terminal, packing, packaging and storage, supplies and refueling, and tourism, etc. IOFVC would be strategically anchored in the middle of the ocean, close to the offshore fishing grounds. It will be a well equipped, safe and environmentally sustainable terminal.

MATERIALS AND METHODS

The information on marine capture fisheries management and utilization of fishing ground in Malaysia (especially in the East Coast) was derived and in cooperation with and from the Malaysia Fisheries Research Institute (MFRI), Department of Fisheries Malaysia (DOF), Food and Agriculture Organization (FAO) and related papers related to the development of IOFVC in Malaysia. The data on marine catches and landing from Peninsular Malaysia was collected from the Annual Fisheries Statistics (2000–2009). Wherever possible, this has been complemented, cross checked and compared with secondary data, national fisheries and other statistics.
Informal interviews (which is a quantitative approach) were conducted with skippers, crew and knowledgeable key informants of fishing units who were specifically selected for their perceived responsiveness.

THE STATUS OF MALAYSIA FISHING INDUSTRY

A. Malaysia on the Map

Malaysia is located at Latitude: 2°30’ North of the Equator and Longitude: 112°30’ East of Greenwich which lies in South East Asia (CIA World Fact Book, 2011). Mainly the country is divided into two parts separated by the South China Sea. West Malaysia is known also as Peninsular Malaysia while the other side of the sea is known as East Malaysia formed by the states of Sabah and Sarawak. It is part of Borneo Island, located 1200 km to the east of the Peninsular across the South China Sea. The east coast of West Malaysia faces the South China Sea, as with Sarawak, and the western part of Sabah.

B. Malaysia Fisheries

In 1996, overall fish production was 1,126,689 tonnes valued at RM3.3 billion. From this 994,144 tonnes were from coastal fisheries, 132,545 tonnes from deep sea fishing and 109,462 tonnes contributed by the aquaculture sub-sector. The value of the 1996 fish production made up about 2.3% of the national GDP or some 3.5% of the agriculture GDP. In terms of labour employment, there were 79,616 fishermen active in the sector.

Then in 14 years time, according FAO (2009), 1,391 million metric tons of fish were landed in 2009 valued at RM8.583 billion and when compared to the statistic in 2008 it shows an increase of 6.56% by quantity and 16.84% by value. During the same year fishing has contributed 1.3% of the national GDP (JPM, 2010).

On the other hand, offshore fishing only contributes a 16% or 0.23 million metric tons valued at RM1.373 billion. Comparison the official landed fishery catch of 1996 and 2009, Malaysia is considered as a net importer of fish in terms of volume and an exporter in monetary terms in order to accommodate of Malaysian protein intake from fish. In fishery and aquaculture report by FAO (2009), Malaysian Government is urged to make further expansion of capture fisheries that would need to come from the offshore subsector. It has been estimated that the potential yield from the offshore areas is slightly over 400 000 tonnes.

Given the present level of landings, the scope for an increase in landings is quite limited. The contribution from the coastal fisheries has remained fairly static lately at around 1.2 million tonnes based on official data given by Department of Fisheries of Malaysia. It is generally well accepted that the coastal fishery resources have been fully exploited.

According to DOF (2009) report of fishery status (based on fishing gears) as in Table 1.1 and Table 1.2; the registered vessels of Trawlers (above 70 GRT) is 1,377 vessels and on Purse Seiners (above 70 GRT) is 1308 vessels in the West Coast of Peninsular Malaysia against the East Coast Peninsular of Malaysia with 1439 vessel for Trawlers and 1,710 vessels for Purse Seiners. Comparing the figures of Table 1.1 against those of Table 1.2; the fishing effort in East Coast of Peninsular Malaysia has reduced by 19.7% on Trawls Net and 42.6% on Purse Seiner effort given for deep sea fishing.

Most of the deep sea fishing is carried out by purse seiners larger than 70 GRT which use FADs (lights and payao-like devices). According to the author’s quantitative study which is based on informal interview processes, most of the deep sea fishing vessels actually operated not far from 30 nautical miles limit. The true deep sea fishing vessels, which are those that can operate far out in the 200-mile EEZ and which are 100 GRT and bigger, are only 4 in numbers and operated off the West Coast of Peninsular Malaysia. Based on fishery and aquaculture report by FAO (2009), it has been predicted that the South China Sea (in the EEZ waters) has a potential yield from the offshore areas of more than 400 000 tonnes and of that pelagic resources about 100,000
Figure 1.1: Illustration of Malaysia Map  
(Source: Information of Fisheries Management in Malaysia, DOF April 2001.)

Table 1.1: Peninsular Malaysia: Cumulative Number of Fishing Unit by Type of Fishing Gear and State, 2009  
Source: Fishery Department of Malaysia, Table 4.9, 2009
tonnes are commercially exploitable fish stocks. The above figure is probably a conservative figure. (To date, no data is available about the resources there because there was no specific study and stock assessment work done.) However, fish landing reports from the few fishing vessels which operated in this area revealed that this place is rich in tuna and other deep sea pelagic fishes. Shattri., M., et., al., (2001) found by applying Satellite Fish forecasting, there were plenty fishing grounds with the highest fish density area containing 17.16 metric tonnes/km² recorded.

**FISHERIES POLICY AND LEGALITY OF MALAYSIA**

Malaysia Government is high commitment to develop the fisheries sector is evident from its increasing funding support to programs and projects and from the incentives and infrastructure aimed at achieving sustainable development. The pillars of the development for fisheries and other concerted efforts started since the Third Malaysian Plan (1976-80) where some RM322.63 million was allocated to the sector. In 1979, 71 specific recommendations on agriculture policy and including the development of offshore fishery were forwarded. As result the National Fishery Development Plan (NFDP) was formulated in 1985 to ensure a balanced and sustained rate of growth in the agricultural sector vis-a-vis the other sectors of the economy.

The ambitious plan listed on the second part which is on the offshore fishery that aimed for the modernization and increased efficiency by approving 646 vessels of 70 GRT and above. Later the government introduced several incentives such as pioneer status; investment tax allowance - tax allowances given for up to 100% of investment value for a predetermined period; and tax relief for fishery equipment. Mohd., I. M., (1991) argues that Malaysia’s
Fishery management goals are based on maximum social yield (MSCY) targeted to manage and regulate the exploitation of fishery resources with a view to realizing the optimum production of fish and fishery products to meet national needs; and to increase the productivity, income and socioeconomic level of fishermen and fish farmers.

In 1991, the Second Outline Perspective Plan 1991–2000, which singled out the maritime sector, whose potential has not been fully utilized, has accordingly laid out some strategies for its development over the plan period (Saharuddin, A., H., 1995). This statement still holds true today where the Government of Malaysia adheres to the objectives of the National Agricultural Plan of 1992–2010 with respect to the fisheries sector to achieve a total fish production of 2.9 million metric tonnes in 2010 with an annual growth rate set at 5.5 percent per annum. The challenge of a set growth rate is to ensure that fishing pressures remain within the limits of sustainable exploitation.

Malaysia has a comprehensive legislative framework for the management of its fisheries, hinging on the Fishery Act of 1985 and regulations made under that Act. In the early 1990’s Malaysia took dramatic steps to gain control of its fishing areas: over fishing; illegal fishing; the lack of timely submission of fishery data for planning and the enhancement of its fisheries management regime. This effort is summarized in the listing of the various regulations and legislations in Table 2.1. There are no international agreements permitting foreign fishing vessels access into Malaysian waters, but joint ventures are approved. The following Table 2.1 is the summary of the national policies and legal frameworks applicable to fisheries management.

The government is also encouraging deep sea fishing companies to undertake vertical integration of the business. Thus, holders of deep sea licenses will find favourable considerations for manufacturing licenses and export permits if they undertake value-added downstream processing of their catches.

Table 2.1: The summary of Malaysia’s policies framework and legal frameworks for Fishery Management

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<td>1</td>
<td>The Department of Fisheries policies and strategies for the management and development of the national fisheries.</td>
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<td>Exclusive Economic Zones Act of 1984 (Act No. 311)</td>
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<td>3</td>
<td>Fishery Management Zones; Zone A, Zone B, Zone C, Zone C2 and Zone C3</td>
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<td>Land Conservation Act 1960 (revised 1989)</td>
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<td>Policy on Conservation of resources</td>
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<td>National Land Code 1965</td>
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<td>Rehabilitation of resources</td>
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<td>Town and Country Planning Act 1974</td>
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<td>Prohibition of destructive fishing gear and methods</td>
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<td>Street Drainage, Buildings Act 1974</td>
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<td>Fisheries Development Authority’s</td>
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<td>Environmental Quality Act (EA) 1974</td>
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<td>Uniform Building By-Laws 1986</td>
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<td>Fisheries (Prohibition of Method of Fishing) Regulations 1980</td>
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<td>Malaysia, Fisheries (Maritime) (Licensing of Local Fishing Vessel) Regulations 1985</td>
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<td>Fisheries (Licensing of Local Fishing Vessels) Regulations 1996</td>
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<td>Fisheries (Prohibited Fishing Methods for the Catching of Grouped Fries) Regulations 1996</td>
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PROSPECTS FOR OFFSHORE FISHING DEVELOPMENT

The prospect for the IOFVC development of the deep sea fisheries is urgently required as a balancing mechanism during the saturation era of inshore fishing. This observation is based on a number of considerations. First, the potential for future exploitation of fisheries resources is still very high in deep sea fishing especially in the South China Sea. In addition, Malaysian fishermen has quite extensive number of vessels that are able to be converted into shuttle vessels (vessels with capacity between 30-60 GRT) in the operation of IOFVC and the existing figure of deep sea vessels capable to do catch process with the support from IOFVC. Second, there is a solid government support for fisheries development. Thirdly, fishing technology is readily available and only requires some modification in order to be applicable in Malaysia; hence will reduce the dependability of the country to import fish.

INTEGRATED OFFSHORE FISHING VESSEL CONCEPT (IOFVC) CONCEPT

The concept of IOFVC encompasses a design for dynamic positioning and operation in offshore waters. This system can either be utilized as conventional fish storage, an early production system or as a full-fledged caught fish processing field development solution. The main idea is to have an efficient system to support post fish catch activities by referring to the detail in the conversion of the Floating Production Storage Operation (FPSO) from Liquefied Natural Gas (LNG) vessel for offshore fishing application. In order to generate the functional decision, design process and IOFVC layout, genetic algorithms (GA) will be applied; which have several important features that predestine them to solve design problems. Lech, J., et al, (2002), explained that in each (hardware or software) implementation of the original function (relation), the incompatibility relation defined by the original specification must be preserved in order to preserve the originally specified behavior (functionality).

INTEGRATED OFFSHORE FISHING VESSEL CONCEPT (IOFVC) FUNCTION

The present fishing technology employed by deep-sea fishermen is a long-established one. Principally fishing is done by the use of trawl nets and purse seines as in Figure 2.4. Trawling is commonly carried out by vessels of 60 to80 GRT sizes towing bottom trawl nets in waters of depths up to 100 meters. Purse seines are nets which are used to first encircle the fish shoals and then the bottom part is pursed leaving the fished trapped inside. Present nets in use can be as big as over 1000 meters in
length and 100 meters deep.

Other examples of modern technology used on board deep sea fishing vessels that are not yet found in majority of Malaysian vessels includes the use of autopilot and global positioning system receivers, satellite imagery particularly sea surface temperature maps, fish pumps, long line setting machines and electronic long line control. To fully exploit the offshore resources, fishermen need to upgrade the fishing capabilities. First, bigger, cost-effective and highly efficient vessels are needed.

Amongst the functions offered by IOFVC are:

- Fish landing terminal
- Fish storage system & Refrigerant system
- Fish processing plant
- Packing, packaging
- Facility for minor servicing and maintenance
- Fuel storage for fishing vessel
- Marine tourism (Saharuddin, A., H., 2001)

With these types of vessels not only the fishing season can be prolonged but with the extension efforts, the deeper shoaling fishes (especially large skipjacks and yellow fins) can be caught. Apart from embedding with these improvements, it must also lie on the sustainability criteria which can be simplified in following Table 2.2.

Table 2.2: Sustainable Criteria for IOFVC application
This technology could go a long way in improving the cost-effectiveness of fishing operations and there is no reason why this should not be introduced to the local industry.

**INTEGRATED OFFSHORE FISHING VESSEL CONCEPT (IOFVC) IMPLEMENTATION CHALLENGE**

To introduce a new invention to the industry, it is highly suggested that the IOFVC concept should be able to mitigate the current problem of less effort put into deep sea or offshore fishing. Akanni, K., A., (2008) found in his research that there are things need to be taken in consideration in any development effort to the fishing community such as:

- Education level
- Fishing distance
- Fish catch level
- Available credit facilities
- Comfortable fishing
- Security reasons, as against fishing in the far turbulent deep sea waters.
- Experience
- Household size
- Pollution
- Fishing technology
- Risk level and probability

**RECOMMENDATION**

This concept is namely called as Intergrated Offshore Fishing Vessel Concept (IOFVC) and latest generation offshore fishing technology for dynamic positioning and operation. The infrastructure concept is mainly aimed to improve the productivity by the implementation of post fish catch system hence reducing the effort of catching fish especially in unexploited environment of the East Coast of Peninsular Malaysia. Floating Production Storage Operation (FPSO) is proposed to be the preliminary design to the development of offshore fishing operation. This concept will help to retain the freshness of the fish caught since fresh fish should be able to fetch higher price. Jagdev, S., et., al., (2006) during his qualitative interview session, any first grade fresh tuna can fetch around RM50/kg and it must be sold in less than a month after being caught. The efforts should directed to support the catch of valuable fish rather than on small pelagics such as sardines, small scombrids (e.g. mackerels), neritic tunas and carangids (mainly round scads, hardtail scads and scads). Furthermore, the domestic market prices for these species are generally low (wholesale price range : RM0.50 – 3.00/kg) and the local market potential is rather small.

**CONCLUSION**

In view of the saturation of inshore fishing resources, it is therefore timely to consider the IOFVC as a significant development in deep fishing sea sector. It is hoped that the introduction of IOFVC will be a turning point for the protein supply balancing system and will help promoting a more sustainable ecosystem.

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TREND ANALYSIS OF SEA LEVEL RISE FOR WEST COAST OF PENINSULAR MALAYSIA (PULAU PINANG)

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ABSTRACT
Future sea level rise would be expected to have a number of impacts, particularly on Malaysia coastal systems such as flooding and inundation, coastal erosion and salt water intrusion. This study analyzes the trend variation of sea level rise for selected locations along the West Coast of Peninsular Malaysia. Furthermore, rate of future SLR at selected station which is in Teluk Ewa, Langkawi will be predicted in the year 2050 and 2100. This study also examines the trend of sea level rise throughout the Straits of Malacca. The historical mean sea level data from the selected stations were used in the trend analysis. In this study, the non-parametric Mann Kendal test was carried out to determine trends in sea level rise. From the analysis, the result shows that the SLR rate in Teluk Ewa, Langkawi is in incremental trend. The future projections of the trend line for an estimate SLR in the year 2050 and 2100, for all the selected station exhibit an increment in sea level rise. In 2050, the incremental SLR is 9.175 cm. Subsequently, in 2100 the highest increment in SLR is 19.595 cm. The trend analysis and the future projection also have proven that the Straits of Malacca will experience a rise in sea level in 2050 and 2100.

Keywords: sea level rise, trend analysis, prediction, Straits of Malacca

INTRODUCTION
Sea level can change, both globally and locally, due to (i) changes in the shape of the ocean basins, (ii) changes in the total mass of water and (iii) changes in water density. Global mean sea level (MSL) has been rising since the end of the last ice age almost 18,000 years ago. Factors leading to sea level rise (SLR) under global warming include both increases in the total mass of water from the melting of land-based snow and ice, and changes in water density from an increase in ocean water temperatures and salinity changes.

As the world’s oceans rise, low-lying coastal areas will disappear. Flooding of coastal areas will become more common and more severe as storm surges have easier access to these low-lying areas. The occurrence of extreme high water events related to storm surges, high tides, surface waves, and flooding rivers will also increase. Flooding and loss of land will have significant impacts on humans, wildlife, and entire ecosystems.

PROBLEM STATEMENT
Malaysia is a coastal nation, rich in biodiversity and natural resources. The country covers an area of 329,750 km² with a coastline of 4809 km and is divided into two landmasses that are separated by the South China Sea. Peninsular Malaysia, in the west, has an area of 131,590 km² and a coastline of 2031 km. Peninsular Malaysia comprises 11 states and the Federal Territory of Kuala Lumpur. Two other states, Sabah and Sarawak, occupy an area of 73,711 km² and 124,449 km² respectively, and the Federal Territory of Labuan is located in the northwestern coast of Borneo island. Sabah has a coastline of 1743 km while Sarawak has a coastline of

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1035 km. The major towns, ports, large agriculture and aquaculture projects of Malaysia’s coast contribute significantly to the nation’s economic development. It is anticipated that the physical and economic impact for the whole nation of a greenhouse-induced sea level rise could be devastating. According to J.E Ong (2000) as quoted from Geyh et.al (1972), Kamaludin (1989) and Peltier & Tushingam (1989), there is good geological evidence that showed over the last 5,000 years, sea level around Malaysian coast has been falling at a mean rate of about 1 mm/yr and the global tidal level is dropping at 2.4 ± 0.9 mm/yr. Meanwhile, the sedimentation rate which appears to be playing a critical role in relative sea level change in Malaysia is in the region of a few millimeters per year. In more recent finding, Malaysia sea level has risen at an average rate of 1.25 mm/yr over 1986 to 2006 (Initial National Communication, 2000 and National Coastal Vulnerability Index Study, DID, 2007). All of the above findings are signals to show that Malaysia coastal system might be vulnerable to SLR. Therefore, there is indication of the urgency for Malaysia as one of the coastal nations to begin the progression of adapting to sea level rise not because there is an awaiting catastrophe, but because there are opportunities to avoid unpleasant impacts by acting now, opportunities that may be lost if the process is delayed. Unfortunately, there is lack of official indication or measurement has been done in Malaysia on SLR. Hence, how should Malaysians prepare for sea level rise? Thus, this particular study is required to analyze the trend variation of SLR for selected locations along West Coast of Peninsular Malaysia and to predict SLR in the year 2050 & 2100 so that the consequences of SLR can be reduced through a proper management and implementation of adaptation and mitigation measures.

OBJECTIVES OF STUDY

The objectives of this study are:

i. To analyze the trend variation of sea level rise for selected location in Peninsular Malaysia which is Teluk Ewa, Langkawi.

ii. To predict sea level rise for these locations in the year 2050 and 2100.

SCOPE OF THE STUDY

The scope of this study can best be described as follows:

i. A review of all literatures related to trend analysis methodologies and to apply the most suitable technique in the analysis for Teluk Ewa, Langkawi Station.

ii. Collection of data (tidal records) for all selected stations will be used for the purpose of trend analysis.

iii. Conduct of the selected methodology for the sea level rise trend analysis and prediction for the year 2050 and 2100.

STUDY AREA

In this study, six locations along the West Coast of Peninsular Malaysia are selected for the purpose of trend analysis. The locations are Langkawi, Penang, Lumut, Port Klang, Tanjung Keling and Kukup. The locations are selected based on the existing tidal gauge stations along the West Coast of Peninsular Malaysia. Figure 1 below shows the selected locations.

LITERATURE REVIEW

THE CONCEPTUAL UNDERSTANDING OF SEA LEVEL RISE

Sea level rise is due to a number of causes, some of which may exert a more regional influence than others. These include:

- Thermal expansion – As seawater becomes warmer it expands. Heat in the upper layer of the ocean is released quickly into the atmosphere. However, heat absorbed by the deeper layers of the ocean will take much longer to be released and therefore, will be stored in the ocean much longer and have significant impacts on future ocean warming.
• **Freshwater inputs** – Increase in freshwater inputs from mountain glaciers, ice sheets, ice caps, and sea ice, as well as other atmospheric and hydrologic cycles due to rising global surface and ocean temperatures.

• **Physical forces** – Subsidence and lifting are associated with tectonic activity and the extraction of water and resources such as gas and oil. These types of forces do not actually change the volume of the ocean, only the relative sea level. However, these changes do affect movement over land, as well as estimates from satellite altimetry.

• **Ocean current variations** – Large, regional ocean currents which move large quantities of water from one location to another also affect relative sea level without changing the actual volume of the ocean. For example, el Niño moves water from one side of the Pacific to the other every three or four years. These large-scale variations also affect the relative sea level of certain areas. In normal conditions, trade winds blow across the Pacific toward the west. According to NOAA, the trade winds push warm surface water to the west Pacific, so the sea level is roughly 1/2 meter higher in Indonesia than it is in Ecuador. During el Niño years, this warm water is pushed over to the eastern Pacific.

• **Atmospheric pressure** influences sea level by impacting the surface itself. This also only affects relative sea level as the water pushed out of one place will move to another.

**THE IMPACTS OF SEA LEVEL RISE**

The sea level rises due to the global warming might cause certain physical change and the possible reactions are:

• The low lying coastal line will be inundated with water, causing damage to houses, industries and crops.

• Low level islands could sink and disappear.

• The quality and salinity will drop when fresh water from the melted ice caps drain into the ocean.

• The water levels in rivers will increase and cause flooding in the low level area.

• River water temperature and the ocean water temperature will also change accordingly.

• The river water will mix with salt water from the ocean making it unsafe for human consumption.

• The total water density will also change and it changes the freeboard length of the ship. This is danger especially on the large cargo vessel as it has lesser distance from the deck to the vessel water line.
vessel water line.

- The marine life, like fish and even coral will have to migrate as to find waters that are more suitable or perish.
- Topography of the respective affected country will change and the country’s size can decrease.
- Millions of money need to be allocated as to mitigate the global warming reaction especially on the sea level rise.

TREND ANALYSIS

Trend analysis is a forecasting technique in which (1) a baseline scenario is constructed using trend extrapolation, (2) future events that may affect this scenario are identified and evaluated on the basis of their probability of occurrence and degree of impact, (3) the combined effect of these events is applied to the baseline scenario to create future scenarios. Trend studies are valuable in describing long-term changes in a population. They can establish a pattern over time to detect shifts and changes in some event.

DATA COLLECTION

The data collection is an important element in this study. In order to do the trend analysis of sea level rise, the mean sea level historical data (tidal data) is necessary. The data for all the selected locations was obtained from the Malaysia Survey and Mapping Department (MSMD). The detailed information of the location as per Table 1 (below).

<table>
<thead>
<tr>
<th>Bil</th>
<th>Station</th>
<th>KOD STN</th>
<th>LAT</th>
<th>LONG</th>
<th>Data Period</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pulau Pinang/ Penang</td>
<td>PEN 05 25 18</td>
<td>100</td>
<td>20 48</td>
<td>1985 - 2008</td>
<td>24 years</td>
</tr>
</tbody>
</table>

Table 1: Station Information

METHODOLOGY

DATA ANALYSIS

Basically an analysis process will be conducted on the collected data. Data analysis consists of two types of analysis, which is trend analysis and statistical analysis.
Statistical Test (Non-parametric) – Seasonal Mann-Kendall

Mann Kendall test is a specific tool for seasonal data that able to compare all pairs of observations, counts the number where values are increasing, subtracts the number decreasing and calculates a probability. The robust macro function that does not require specific distribution, less sensitive to extreme values, less sensitive to missing values and able to validate data for further investigation and analysis.

Trend Analysis

In the trend analysis, raw data were transferred into Minitab Software (Trial Version), which is a statistics package. It was developed at the Pennsylvania State University by researchers Barbara F. Ryan, Thomas A. Ryan, Jr. and Brian L. Joiner in 1972. Minitab began as a light version of OMNITAB, a statistical analysis program by National Institute of Standards and Technology.

Based on the trend line plotted, the fitted linear regression model was determined. The equation demonstrates whether the trend has increased or decreased over time, and if it has, how quickly or slowly the increase or decrease has occurred. There after, by making future projection using the equation, an estimate of the SLR rate in the year 2050 and 2100 will be obtained.

DATA ANALYSIS AND RESULTS

Introduction

The analysis of sea level rise trend for West Coast of Peninsular Malaysia has exposed the actual trend of sea level rise according to the selected tidal station. The results were obtained from the analysis of historical mean sea level data at Pulau Pinang tidal station. The mean sea level data for Pulau Pinang (1985 - 2008) were processed and analyzed accordingly using statistical package.

Figure 3 shows the results of Mann-Kendall Test on Penang MSL data for the year 1985 – 2008. From the test, it has indicated enough evidence to determine that there is an upward trend at confidence level 95% or alpha, \( \alpha = 0.05 \). The p-value of the significant upward trend is 0.0121493 and the calculated z value is 2.25238.
Table 2: Summary of Mean Sea Level Trend Analysis

<table>
<thead>
<tr>
<th>Station</th>
<th>Fitted Linear Regression Model</th>
<th>Intercept</th>
<th>Coefficient/Slope</th>
<th>Confidence Interval</th>
<th>Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulau Pinang</td>
<td>$Y(t) = 268.894 + 0.00690944t$</td>
<td>268.894</td>
<td>0.00690944</td>
<td>95%</td>
<td>Upward</td>
</tr>
</tbody>
</table>

Figure 4: Trend analysis of MSL for Pulau Pinang (Penang)

Trend Analysis of Mean Sea Level

From the non-parametric Mann-Kendall test, for Pulau Pinang trend analysis, and prediction test exhibit of upward trend. The slope is at 0.00690944 in Pulau Pinang. The summary of the mean sea level trend is summarized as in Table 2. The plot for Teluk Ewa, Langkawi tidal station stations are illustrated in Figure 4.

Sea Level Rise (SLR) Prediction

Trend lines of mean sea level for all the selected station are extrapolated for an estimate SLR in the year 2050 and 2100 as in Figure 5. Table 3 summarized the Predicted Sea Level Rise (SLR) in year 2050 and 2100 for each of the selected station. In year 2050, Pulau Pinang will encounter a 3.994 cm incremental of SLR and in year 2100, Pulau Pinang will encounter of 8.395 cm incremental of SLR.

Figure 5 shows the actual, fits and predicted/forecasts graph line for Penang MSL data. The trend is seconded by the following linear trend model equation;

$$Y(t) = 268.894 + 0.00690944t$$

Figure 5: Trend lines of mean sea level

The red line indicates the fitted rate of mean sea level from the historical actual data, while the green line indicates the future projection of mean sea level. The graph shows( Figure 6) that in year 2050, Penang’s mean sea level is increase to 274.760 cm and in year 2100 is increase to 279.161 cm.
Meanwhile, Figure 7 indicates the four-in-one residual plot (i.e. normal probability plot of residuals, histogram of residuals, residuals versus fitted values and residuals versus order of the data) for Pulau Pinang (Penang). Overall, the figure shows that the data are generally normal distributed, the variance is constant and only four outliers exist in the data. Even though there were outliers existing in the data set, the result may still be considered reliable because the non parametric Mann-Kendall test is robust to the effects of outliers and gross data errors, and within the 95% confidence level.
CONCLUSION AND RECOMMENDATION

From the analysis, the result shows that all the Pulau Pinang have an upward trend of sea level rise based on 95% Confidence Interval. The rate of SLR lies between 0.829 mm/yr to 2.021 mm/yr. This value is still within the IPCC global SLR rate for the 20th century which is 1.7 ± 0.5 mm/yr.

The future projections of the trend line for an estimate SLR in the year 2050 and 2100, for the selected station exhibit an increment in sea level rise.

Subsequently, in 2050, the increment value in SLR is 3.994 cm. In 2100 the increment value in SLR is 8.395 cm. The trend analysis and the future projection also have proven that the Straits of Malacca will experience a rise in sea level in year 2050 and 2100.

As a conclusion, the results of this study impose a signal of SLR threat to the Pulau Pinang and will lead the state government to come out with a National Plan on adaptive measures to mitigate the SLR impacts.

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ABSTRACT
The continuous expansion of the merchant fleet has threatened not only the safety of other users of sea but also the marine environment and the living marine resources. Over the years since the beginning of the 20th century, unilateral enforcement of maritime laws and regulations seemed to be ineffective since customary international law allows ships to from one territorial sea to another without any requirement to notify the coastal states. Hence, many conventions were developed by the IMO over the last half a century and one of the most important conventions is the ‘International Convention for the Prevention of Pollution of Ships 1973/1978’ or popularly known as the MARPOL convention. The Convention includes regulation aimed at preventing and minimizing pollution from ships’ accident and routine operation. This paper is meant to examine the development of the rules and regulations by Llyod’s Register in supporting the implementation of MARPOL Convention.

Keywords: MARPOL, LR, IMO, IBC Code, BCH Code

INTRODUCTION
More than two third of the world is covered by the sea and it is the most important transportation route for international cargo. Navigation and fishing are the common activities since the ancient history but today the sea is used for many other purposes, including recreation, scientific research, seabed mining, power generation, military exercise, weapon testing and waste disposal. Notwithstanding the above activities, the world’s oceans are dominated by shipping activities serving about 90 percent of international trade, carrying huge quantities of cargo in the most cost effective medium. The continuous expansion of the merchant fleet has threatened not only the safety of other users of sea but also the marine environment and the living marine resources. Over the years since the beginning of the 20th century, unilateral enforcement of maritime laws and regulations seemed to be ineffective since customary international law allows ships to from one territorial sea to another without any requirement to notify the coastal states. Hence, it would be easy for ships to escape the law enforcement of a particular state by choosing to operate within the waters where law enforcements were less stringent. In this regard, the international community had recognized that there was a need for international standards to regulate shipping, which can be adopted and accepted by all states involved in shipping and international trade.

The International Maritime Organization (IMO) was established in order to fulfill the obligation to promote maritime safety at sea through the development and enhancement of various international conventions and regulations. Those conventions and regulations will then be enforced by the member countries normally through the assistance of recognized ship classification societies that set specific technical standards in order to comply with various international conventions. In order to be safe and seaworthy and be allowed to operate freely by the
law enforcement authorities of her flag state, the port states and the coastal states, a ship will have to comply with safety and other regulations during her construction and operations. For an example Lloyd’s Register (LR) of Shipping is one of the classification societies highly recognized by IMO member countries to conduct the required inspection and ensure that ships follow the required standards. Many conventions were developed by the IMO over the last half a century and one of the most important conventions is the ‘International Convention for the Prevention of Pollution of Ships 1973/1978’ or popularly known as the MARPOL convention. The Convention includes regulation aimed at preventing and minimizing pollution from ships’ accident and routine operation. In order to achieve its goals, MARPOL 73/78 contains six annexes in which detailed regulations are given with respect to the handling on board ships and the discharge into the sea of harmful substances.

Annexes I and II are compulsory for state parties and are implemented together with the main MARPOL convention whilst the other four annexes are made optional in order not hinder the timely enforcement of the Convention. Malaysia for instance, is also a signatory of MARPOL Convention and has ratified all the optional annexes of MARPOL in 2010. Although shipping is only one of the sources to marine pollution, the strict enforcement of MARPOL is still important because ships produced about 12% of pollution at the sea, as compared for to oil exploration and production that only contributed 1% of the marine pollution. Figure 1 shows the sources of marine pollution.

**MARPOL – ANNEX I**

MARPOL Annex I outlines the regulations on the prevention of pollution by oil. The 1973 Convention maintained the oil discharge criteria prescribed in the earlier convention where operational discharges of oil from tankers are only allowed when all of the following conditions are met. Firstly, the total quantity of oil which a tanker may discharge in any ballast voyage whilst under way must not exceed 1/15,000 of the total cargo carrying capacity of the vessel. Secondly, the rate at which oil may be discharged must not exceed 60 liters per mile travelled by the ship and the last condition indicates that no discharge of oil what so ever can be made from the cargo space of a tanker within 50 miles of the nearest land (IMO-MARPOL, 2006).

The requirements involve the fitting of appropriate equipment, including an oil discharge monitoring and control system, oily water separating equipment and a filtering system, slop tanks, sludge tanks, piping and pumping arrangements. In interpreting the above regulation, LR specifies the requirement for a discharge pipe in more detail. It states that scuppers and discharge pipes should not normally pass through oil fuel or cargo oil tanks (LR, 2006). Where scuppers and discharge pipes pass, unavoidably, through oil fuel or cargo oil tanks, and are led through the shell within the tanks, the thickness of

![Marine Pollution Chart](image)

**Figure 1: Sources of marine pollution**
the piping should be at least the same thickness as the shell plating, but need not exceed 19 mm.

MARPOL Annex I, Chapter 2, Regulation 9 (g), states that any discharge from machinery space bilges into the sea of oil or oil mixtures from such a ship shall be prohibited except when the ship is operating an oily water separating equipment of an approved design. In enforcing the preceding requirement, LR requires the bilge, ballast and fuel oil arrangements to be provided with a suitable drainage not connected with machinery space. It also requires a secondary barrier to machinery space, to provide necessary return of any cargo leakage to the liquid cargo piping and to provide the means for detection of leakage (LR, 2006). Figure 2 shows the example of oil water separator system onboard ship. This system must be approved by the appropriate classification society before operation and the testing must follow the required guideline or procedure to achieve the required standard. Figure 2 demonstrates that the oil mixture with water produced by ship activities is retained in the bilge well and is required to go through a treatment process before discharge to the sea. Another important feature outlines by the MARPOL Convention in the design and construction of an oil tanker is the double hull requirement. In 1992, MARPOL Annex I, Regulation 19 was amended to make it mandatory for tankers of 5,000 dead-weight-tons (DWT) and more ordered after 6th July 1993 to be fitted with double hull, or an alternative design approved by IMO.

In supporting the requirement, LR specifies in more detail on the structure of the double hull in Part 4 of Chapter 9 for Double Hull Oil Tanker. In this chapter, it also requires for the structure configuration and ship arrangement to be based on ship’s type. LR also indicates the calculations or measurements for the double hull such as the cargo tank boundary requirements, where it indicates the minimum distance for the double side width and double bottom depth. A double hull is a ship hull design and construction method where the bottom and sides of

![Figure 2: The oil water separator system (Source: Joint Systems)](image-url)
the ship have two complete layers of watertight hull surface; one outer layer forming the normal hull of the ship, and a second inner hull which is somewhat further into the ship that forms a redundant barrier to prevent or minimize the risk of the oil spill when collision or grounding occurs. This is to prevent an accident such as the oil spill that occurred in Prince William Sound, Alaska, on March 24, 1989, when the Exxon Valdez, an oil tanker bound for Long Beach, California, struck Prince William Sound’s Bligh Reef and spilled between 260,000 to 750,000 barrels (41,000 to 119,000 m³) of crude oil from happening again.

**MARPOL – ANNEX II**

Together with Annex I, Annex II is also a mandatory annex to MARPOL Convention. Annex II are implemented through the International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code) and the Code for the Construction and Equipment of Ships Carrying Dangerous Chemical in Bulk (BCH Code). It deals with the categorization and listing of noxious liquid substances (NLS) where chemicals that could harm the marine environment are divided into 4 categories namely X, Y, Z and other substance (OS). The most dangerous chemicals are in category X and it is completely banned to discharge into the sea. The substance must be discharged into a shore reception facility. Regulation 13 of Annex II to MARPOL 73/78 prohibits the discharge into the sea of NLS of Categories X, Y or Z or of ballast water, tank washings or other residues or mixtures containing such substances, except in compliance with specified conditions.

The conditions include the procedures and arrangements based upon standards developed by the IMO to ensure that the criteria specified for each Category are met. (IMO-MARPOL, 2006) Both Annex II and LR Rules require each ship certified for the carriage of NLS in bulk to be provided with a Procedures and Arrangements Manual. The manual has been written in accordance with Appendix 4 of Annex II and is concerned with the marine environmental aspects resulted from the cleaning of cargo tanks and the discharge of residues and mixtures from these operations. The purpose of this manual is to identify the arrangements and equipment required to enable compliance with Annex II and to identify for the ship’s officers all operational procedures with respect to cargo handling, tank cleaning, slops handling, residue discharging, ballasting and de-ballasting, which must be followed in order to comply with the requirements of Annex II. Chapter
Table 1: Stripping Requirements

<table>
<thead>
<tr>
<th>Category</th>
<th>Stripping requirements (in litres)</th>
<th>Ship details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category X</td>
<td>75</td>
<td>300 + 50 tolerance</td>
</tr>
<tr>
<td>Category Y</td>
<td>75</td>
<td>300 + 50 tolerance</td>
</tr>
<tr>
<td>Category Z</td>
<td>75</td>
<td>Empty to the most possible extent</td>
</tr>
</tbody>
</table>

2 of LR rules also explains about the ship survival capability and location of the cargo tank. It interprets the damage and flooding assumptions of the ship with regards to the survival and stability of ships carrying NLS in bulk. Annex II prohibits the discharge into the sea of any effluent containing substances falling under these categories, except when the discharge is made under conditions which are specified in detail for each Category.

These conditions include, where applicable, such parameters as, the quantity of substance to be discharged, the speed of the ship during discharge, the minimum distance from the nearest land, the depth of the sea and the need of underwater discharge outlets. All products in Categories X, Y and Z are subject to stripping limits, while all products in Category X and high viscosity and solidifying substances in Category Y are subjected to pre-wash. Table 1 dictates the stripping requirement in every category. For Categories X and Y the requirement is similar whilst for Category Z the remaining amount permissible is higher since the environmental hazard caused by NLS in this category is minor.

All pre-wash of Category X and Y and substances in category Z are subjected to underwater discharge. Chapter 2.3 of LR rules and regulation on Shipside Discharge below the Freeboard Deck explains that ship must be provided with underwater discharge including the valve selection. Table 2 shows the ex-

Table 2: Cleaning and Disposal Procedure by Lloyd Register (Source: LR)
ample of Cleaning and Disposal Procedures (CDP) as required by LR. This is an example of the flow chart diagram on the handling of various categories of NLS. The chemicals need to go through various steps and stages before discharge depending on their category and their level of hazard to the marine environment.

CONCLUSION

The preceding discussions focus on selected areas address in the two mandatory annexes of MARPOL convention and the supporting regulations by LR. Notwithstanding that, Malaysia has implemented all annexes all MARPOL beginning January 2011. In Malaysia, MARPOL is implemented through various parliamentary acts particularly the Malaysian Shipping Ordinance 1952, Environment Quality Act 1974 and Exclusive Economic Zone Act 1984. These acts permit Malaysia to enforce laws until the border of her Exclusive Economic Zone that may extend until 200 nautical miles from her land territory. Before MARPOL 73/78 can be implemented by any IMO member country, she must be in a position to meet the requirements as stated in the Convention and its appropriate annexes. The marine administration of IMO member states will have to perform their roles and responsibilities as Flag States, Port States and Coastal States. When all the countries and the maritime fraternity at large are concerned about the negative effect of marine pollution, a countless effort can be undertaken as prevent or at least to minimize marine pollution.

REFERENCES

A BRIEF REVIEW OF MODULAR CONSTRUCTION METHOD IN THE
SHIPBUILDING INDUSTRY

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ABSTRACT
Modular construction is a contemporary approach to shipbuilding and has demonstrated its capabilities to be more cost effective as compared to traditional methods. Cost effectiveness is realized through savings in the utilization of workforce, reduced reworks that lead to higher quality output and lesser disruptions on site. As a result, shipbuilders become less exposed to construction delays and able to maintain the production momentum that serve to enhance their reputation in the shipbuilding market.

Keywords: Modular Construction, Design Spiral, Work Breakdown Structure, Multi-Sites Construction

INTRODUCTION
In the early shipbuilding era ships were built largely using medieval means whereby from the keel, the hull was made by overlapping planks on either side with rivets fastening them together. The West later moved on into a new era of building the first regular ocean going vessels. These were of unprecedented size, complexity and costs. Shipyards later became large industrial complexes and the ships built were financed by consortiums of investors. During the Industrial Revolution, ships were generally built piece by piece, an approach with a very low investment cost, minimum crane requirements, and small-scale transport.

In the 20th Century, along with the development of production method, most shipbuilders have recognized the advantages of building larger portions of ships in covered production facilities, then assembling those portions in a dry dock or on a slipway. As larger numbers of similar ships are built, standardization, repetition, and automation lead to economies of scale and production efficiencies, and cause to lower the costs and reduced schedules. Today, the technique has evolved into what is now known as modular or block construction, a method which involves the assembly of prefabricated sections (Deans, 2010).

When a deck is constructed on a ship, and before the next deck above is laid, prefabricated cabin modules are lifted by a crane from a pier, carried over the ship’s hull, and deposited directly by the crane substantially at their final locations in a row spaced from the hull. Before the cabins are completed by the erection of wall elements that extend from the prefabricated cabin modules toward the hull, workers can attend to the construction of the overlying deck, and easily carry out the welding and outfitting operations needed to secure the overlying deck to the hull. Furnishings and fixtures for each cabin are concentrated and fixed within the prefabricated cabin modules, so that at least approximately 80% of the cabin construction labour is carried out ashore in the prefabrication process.

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MODULAR CONSTRUCTION: THE PROCESS

Modular, or sometimes referred to block, construction has become a common practice in many modern shipyards. It is an approach that uses a prefabricated building process involving sub-assembly on site to produce temporary parts of a ship that would later be brought together for the final ship assembly [1]. The main reasons for the popularity of the modular construction process are its proven efficiency in the supervision of ship building process and its ability in meeting project timelines.

Modular construction takes full advantage of a controlled production environment that combines its design flexibility with traditional building methods to produce high-quality prefabricated structures. The results are faster construction process, more cost-effective, easier supervision and better control of product quality.

Modular construction method was introduced in the shipbuilding industry mainly to shorten or improve the construction timeline. Basically, modular construction in shipbuilding can be defined as an engineered assembly that contains a set of predefined modules that would later form a complete ship (Siddiqui, 2008). The rapid growth of ship design technology has made it possible for modules to be designed and built independently and then assembled to form a complete ship. Modules and the blocks are built to very tight and exacting tolerances. The processes during construction and assembly of the modules are continuously monitored and aided by laser trackers to ensure they are in the exact positions. The following are some advantages that can be derived from the modular construction method;

<table>
<thead>
<tr>
<th>• Short build times</th>
<th>• Low weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typically 50-60% less than traditional on-site construction, leading to an earlier return on investment and savings in preliminaries.</td>
<td>Compared to site construction, modular construction is about 30% of the weight of conventional masonry construction.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>• Superior quality</th>
<th>• Economy of scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achieved by factory-based quality control and pre-design of similar modules.</td>
<td>Repetition of prefabricated units leads to considerable economy of scale in production.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>• Environmentally less sensitive</th>
<th>• Reduced site labour requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficient factory production techniques are much less wasteful and installation is less disruptive on site.</td>
<td>The erection and finishing teams, which install and complete modular buildings, involve fewer workers on site than traditional buildings.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>• Safer construction</th>
<th>• Services and bathrooms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modular construction sites have proved to be significantly safer than traditional on-site building.</td>
<td>Service modules can be used, even in traditional builds.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>• Reduced professional fees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standardized design details simplify and reduce the need for specialist design input, hence reduce professional fees.</td>
</tr>
</tbody>
</table>
DESIGN SPIRAL

The design spiral process consists of iterations through a sequence of design tasks, with each of the iteration defining the boat to the next stage of design (Taggert, 1980). The design spiral is a general concept, but most designers end up modifying it to suit their own design sequence based on finding solutions to the major trade-offs of a particular boat. The spiral design process will be used as a framework for discussing the major design trade-offs and iterations required by most designs and no single approach will be emphasized.

Basically there are four elements in ship design stages:

- The Design Statement
- Conceptual Design Phase
- Preliminary Design Phase
- Detailed Design Phase

Design Statement

It defines the purpose of the ship, quantifies and lists the major design attributes in decreasing order of importance and includes a measure of merit for the vessel, if needed.

The Conceptual Design Phase

This step determines whether the boat described in the design statement is feasible and how we need to modify the stated goals in the design statement to achieve a successful boat design. Principal dimensions, general arrangements, major weights items, and powering options are chosen and concept drawings are produced. This information is often included in a design proposal which is submitted to a prospective client. This step is often done on speculation in the hope that the client will select the design for construction.

The Preliminary Design Phase

This step determines the details of exactly how the boat will be designed based on the results from the conceptual design process. The hull shape is finalized and more exact calculations are performed, including stability, performance, and structural calculations.

The Detailed Design Phase

This step is concerned with producing the "deliverables" of the design project: a faired set of lines, a table of offsets, arrangement drawings,
structural drawings, construction details, and specifications.

**WORK BREAKDOWN STRUCTURES (WBS)**

It is a management approach that specifies what is to be done, where it is to be done, when it is to be done, and what resources are to be utilized. This specification generally takes the form of dividing the total divisions of the whole process into component parts. The system by which these components are divided in order to control the process is called a work break down structure (WBS).

A work breakdown structure is a classification system. Work breakdown structures commonly used in shipbuilding are either system or product oriented.

**PRODUCT ORIENTED WORK BREAKDOWN STRUCTURE (PWBS)**

Product-oriented work breakdown structure (PWBS) is a classification system to sub-divide work in accordance with an interim product work view. Parts and sub-assemblies are grouped by common permanent characteristics and classified by both design and manufacturing attributes. The classification system typically specifies parameters, such as form, dimensions, tolerances, material, types and complexity of machinery operations.

HBCM, wherein hull parts, sub-assemblies, and blocks are manufactured in accordance with the principles of group technology (family manufacturing) in organized production lines (process lanes or work flows). ZPTM is the surface preparation and coating which are treated as an integrated aspect of the overall construction process; integrating painting with hull construction and outfitting processes. Painting is treated as another assembly process accomplished at each manufacturing level.

**MULTI-SITES CONSTRUCTION**

In case of a large scale ship construction, some shipyards usually took the next step of building blocks at multiple shipyards, then transporting them to a single shipyard for assembly into a whole ship. This technique of assembling ships from large blocks produced at different locations is more common than might be expected, and it has both potential benefits and problems.

To construct large numbers of ships in a short timeline, conventional shipbuilding techniques are no longer practical. As the demand for naval ships grows, existing shipyard capacity could not keep pace. The use of welding and prefabrication delivered the solution of assemblies and pre-outfitting. Ship sections were pre-assembled and transported to an existing shipyard for final assembly and launching. Despite the huge publicity about the success of these methods, the costs were high and rework was common.
ADVANTAGES

The most compelling reason for shipbuilders to build portions of ships at multiple shipyards is the potential to reduce costs. Theoretically, it is possible to generate cost savings by concentrating specific blocks in one company so that duplication of skills and facilities can be eliminated. The result is lower overall overhead costs, as well as the benefits of learning extended over a longer production run. Some recent decisions on the subcontracting of structural blocks have been driven by this cost-saving focus. Some very efficient new facilities focused on building only blocks for other shipyards to assemble have been introduced in Japan and Europe. The basic motivation for this strategy is to achieve economies of scale and thus be able to better compete in the global commercial shipbuilding market. Concentration could create the economy of scale necessary to enable an investment in new fabrication/assembly technologies that would not be possible to justify at a lower economy of scale.

Another reason for multi-site construction is to most effectively utilize a shipyard’s existing assets as the global shipbuilding markets fluctuate. In shipbuilding, as in the other capital-intensive heavy manufacturing industries, efficient capacity utilization is a key driver of business effectiveness. To this end, partial outsourcing is an effective tool in Japan’s shipbuilding environment. What makes it feasible is the distributed nature of the Japanese shipbuilding industry itself. In Japan, for example, labor mobility is quite low, thus sub-contractors are more widely used than in the United States and United Kingdom, to avoid having to lay people off during cyclic slow periods. Some of this sub-contracting involves modules being built by other companies, including fabricators that are not themselves shipyards.

LIMITATIONS

Multi-site construction may also involve possible disadvantages such as additional costs. First, the problems of accuracy control become more acute because the design and build tolerances must be maintained at several shipyards. Common nomenclature, techniques, and software packages must be used to ensure that the blocks built at different shipyards align correctly during assembly. Problems with alignment can lead to potential significant rework costs. Blocks must be constructed or reinforced in a way to ensure that dimensional tolerances are maintained during transportation. They also may require additional bracing or structures for the transportation process, which will incur additional costs. Finally, since processes must be coordinated among several shipyards, managing the schedule for construction and delivery of the blocks becomes more difficult. Delays in block construction at one shipyard, or delays in delivery caused by transportation problems, can seriously throw off the schedule for the delivery of the whole ship.
Modular construction, quite common in building large vessels, is also being used in building smaller ones. The modules or blocks may vary in size from about 50 tons for small vessels and up to 400 tons for large vessels such as the very large crude carriers (VLCCs). Modular construction results in more advantages for assemblies that translates in higher productivity and lower labour costs. However, modular construction also has its draw backs. This method will continually require higher precision and highly accurate assembly, hence a larger investment cost in facilities, a very high reliance on control of accuracy and on-time delivery of materials will be required.

IMPLEMENTING MODULAR CONSTRUCTION

To effectively implement the modular construction concept the following approaches need to be considered and made available at a shipbuilding facility. The absence of these facilities would jeopardize the effectiveness of the whole concept:

- **Stockyard**
  It is a dedicated area where plates and sections are stored in the shipyard, ideally under cover to prevent atmospheric degradation.

- **Preparation zone**
  It is where plates and sections are prepared before welding, cutting, marking etc.

- **Sub-assembly**
  Sub-assembly that includes fitting, welding, fairing and many other similar processes are carried out.

- **Assembly**
  This section takes the products from the sub-assembly area and assembles them to fabricate a unit.

- **Fabrication**
  This facility includes marking, cutting, bending to fabricate the following:

  1. Deep transverse frames
  2. Watertight bulkheads
  3. Longitudinal bulkheads
  4. Shell panels
  5. Longitudinal double bottom panels
  6. Transverse double bottom panels
  7. Major and minor foundations.

- **Erection Berth (Modular Sectional Area)**
  This facility takes units from the unit’s assembly area to fabricate into modules.

- **Basin/Afloat**
  This is where ship is launched on a slipway and is ensured to float correctly.

Figure 1: Examples of Modular Construction process [2]
CONCLUSION

It is obvious that modular construction process is capable of helping a shipyard becomes a dominant player in a modern shipbuilding industry. The benefits of modular construction have demonstrated its capabilities to be more cost effective as compared to traditional methods, and have led to financial savings and reduced disruptions on site. These methods are being currently proven to be the most efficient technique to achieve the desired outcomes that satisfy both shipbuilders and customers.

Shipbuilders are less exposed to construction delays, as time constraints always represent their major concern in order to maintain the production momentum and reputation of the companies. Undoubtedly, while still maintaining a good balance between cost, work-force and quality control, modular constructions are preferably the best technique capable of increasing the growth of the shipbuilding industry.

REFERENCES

DEVELOPMENT OF LEGAL FRAMEWORK GOVERNING THE CARRIAGE OF LIQUEFIED NATURAL GAS (LNG) WITHIN COASTAL WATER FROM CARRIER ASPECT (DESIGN SPECIFICATION)

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ABSTRACT
The inevitable LNG evolution into coastal waters had reflected the lack and absence of clear guidelines on legal framework for governing the carriage of liquefied natural gas (LNG) within coastal water. IMO (Agenda item 21, MSC 83/INF.3/2007) does not pay much attention to sustainable coastal water transport development due to the novelty of such industry and the traditional procedures of UN developmental bodies, that normally needs sufficient time to consider new and emerging phenomenon in their agenda of work. Thus it is a major source of inefficiency and unsafe operation of the LNG carriage along the coast line. To date, there is no extension for LNG carriage within coastal waters on every established rules and regulation. The main purpose of this study is to develop a legal framework model for the LNG transportation and carriage by using the IDEF0 structured modeling technique. The modeling process is divided into three phases, (i) the information gathering, (ii) the model development and (iii) the experts’ evaluation and validation. In the first phase, information on existing current legal practices were obtained through the literature study from applicable rules, regulations, conventions, procedures, policies, research papers and accident cases. In the second phase, a process model was drafted through an iterative process using the IDEF0 and the questionnaire is developed. From the questionnaire pilot test, each question blocks has shown an acceptable Cronbach’s Alpha value which is above 0.70. In the third phase, the preliminary of legal framework model is tested through forty five (45) potential respondents from various fields in legal practices and thirty eight (38) responded. A promising result was obtained where data exhibit normal distribution trend, even through every group has their own stand on the legal framework. The ANOVA output has generated P-values of 0.000. If P is less than or equal to the a-level, one or more mean value are significantly different. Through data correlation test, the correlated element blocks show a range of 0.0 to 0.4. A legal framework model for the LNG carriage within coastal water was constructed in the stand alone mode covering each aspect.

Keywords: Legal framework model, LNG carriage, structured modelling technique definition, Cronbach’s Alpha, NOVA and Correlation.

INTRODUCTION
In tandem with the increasing Liquefied Natural Gas (LNG) production in the emerging market, the LNG is depleting fast and will be required on a major scale to feed the world’s biggest gas market. Therefore, attention is needed to focus largely on the safety and security of LNG transported by marine transportation at commercial facilities near populated areas. As the nation’s LNG facility become developed, there is no special framework for the LNG coastal transportation. In response to the overall safety and security environment requirement, it is wise to seek a coastal water legal framework covering a broader understanding of hazardous chemical marine shipments and efforts to secure them. Recognizing these fatal factors is important in promoting for a legal framework for LNG transportation in coastal water.

OBJECTIVE OF THE RESEARCH
The research on development of legal framework governing the carriage of LNG within coastal water is expected to derive:

- relevant element(s) for a legal framework on the carriage of LNG within coastal water

RESEARCH STATEMENT
In order to create relevant legal framework element (s), several situations identified are to influence factors for safe transportation. The situations are as follows:

- Liberalization of importers power and gas market
- Number of receiving or discharging
- Geographical topography that reduces the ability of LNG transportation.

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- The high cost of pipeline network and degasification area development and investment.
- As people keep pace with the development, energy plans face high resistance of NIMBY and BANANA which stand for Not In My Backyard (NIMBY) and Build Absolutely Nothing Anywhere Near Anything (BANANA), are being highlighted from the end user perspective where people perceive the LNG storage as a time bomb.
- Imbalance in demand and supply of the LNG.

**BACKGROUND AND PROBLEM STATEMENT**

The paper (Industries Energy, Utilities & Mining, 2007) has highlighted as the following:

"Many companies are struggling to optimize their LNG portfolio of assets and contracts in a way that maximizes value. Opportunities for ‘arbitrage’ profits require ever more clever valuation and modeling. The companies that identify, assess and manage the increasingly complex interdependencies and uncertainties in the evolving LNG market will be the ones who take the profits. LNG relies on two vital ingredients – infrastructure and gas”

**METHODOLOGY**

- Identify LNG Operation System
- Identify Legal Element of LNG Operating System
- Propose Preliminary Legal Framework Model Governing LNG Carriage within Coastal water
- Literature Review
- Select Analyzing Component
- Data Collection
- Analyze Data
- Draw Conclusion of Minimum safe Transportation of LNG Carriage within Coastal
The situation has indirectly rerouted the existing LNG system into a new market regime especially on its facilities from onshore to the coastal trend. It has induced the market player to get into this particular regime as it requires no land requisition. Thus a real ‘new world gas market’ began to emerge. However a ‘world gas market’ should not be confused with the much more flexible world oil market (Jensen, 2004). The Industries Energy, Utilities and Mining (2007) also highlighted on the regulatory aspects follows:

“Taking account of regulatory risk, LNG operations are spreading to many new locations. The maturity and format of regulatory frameworks vary considerably. The economic viability of an LNG chain can be influenced significantly by national or regional regulation, particularly on regasification facilities.”

Although several frameworks have been developed by the LNG players such as Ball et al. (2006), who proposed a legal framework for the Taiwanese government. It is specifically for procurement activities in Taiwan. As in Notteboom et al. (2004), the only focused area in Snøhvit project Norway is on LNG port management. There is no formal framework to govern the carriage of this particular dangerous goods carriage. Hence, a special attention on the development of the Legal Framework on the Coastal Water for LNG transportation and application is required.

The immediate sign of market demand is the clear indication that LNG transportation will centre on the downstream activities as compared to the upstream. Product distribution which cover the following aspects:

- Overcoming problems associated with the transportation of LNG by land.
- Towards cost effective LNG transportation in downstream market activities.
- Provision of a healthy, safe and secure environment of LNG transportation / carriage within coastal water.

The future LNG export terminals will be larger as to cater the needs and supply, based in remote locations with no infrastructure and subjected to extreme weather conditions. Therefore, conventional construction approaches will no longer be cost and time effective. The direction for future development has been reinforced by the few inventions of sub-players of the Oil and Gas Company such as the following and in Figure 3:

- Proposed development of smaller scale regasification terminals.
- Proposed development of Liquefaction hubs.
- Alternative source and uses of LNG
- Gas storage for peak sharing
- Proposed development of Shipboard regasification

Traditionally, the regulation of maritime transport operations by seafaring countries has been motivated by the desire to establish and maintain:

- Standards as regards maritime safety and the protection of the marine environment;
- Participation of national fleets in the transport of its trade (although by and large in the OECD there exists unrestricted market access);

![Figure 1: LNG Trade Volume 1998, 2002 & 2006 (Nilsen, 2007)](image)

![Figure 2: Outlook for World LNG Demand (Morimoto 2006)](image)
• Commercial regulations aimed at facilitating the orderly conduct of business; and

• The ability of sea carriers to operate traditional co-operative liner services despite the presence of laws in many countries aimed at preventing anti-competitive behaviors.

As mentioned by Luketa, A. et al (2008); such, the risk mitigation and risk management approaches suggested in the 2004 report are still appropriate for use with the larger capacity ships. Proactive risk management approaches can reduce both the potential and the hazards of such events. The approaches could include:

• Improvements in ship and terminal safety/security systems,
• Modifications to improve effectiveness of LNG tanker escorts, vessel movement control zones, and safety operations near ports and terminals,
• Improved surveillance and searches, and
• Improved emergency response coordination and communications with first responders and public safety officials.

In this particular project research, the quantitative survey technique is being applied. The result from the quantitative input, will be tested through descriptive statistic and the interference statistic. The descriptive statistic will interrogate the sample characteristic and the interference will drill into sample population.

RESULTS ON CARRIER ASPECT – OPERATIONAL PROCEDURE

Table 1 shows the analysis on the survey data obtained from the block of questionnaire aim at confirming ‘Design Specification’ as an element of the legal framework. The table shows an overall mean of 4.0957 and an overall standard deviation of 0.239. Question 4, 5, 7, 8, 9 and 10 return with individual means above 4.0. Question 11 “Preservation of the coastal environment should be effectively translated into design specification for coastal LNG ships” scores the highest mean 4.4211 with standard deviation of 0.599. The rest of the questions (question 1, 2, 3, and 6) return with individual means lower than 4.0. Question 6 “Deep sea LNG is less suitable to operate in coastal area” returns with the lowest mean of 3.684 and with standard deviation of 1.165.

Figure 4 shows the graphic plot of the analysis on this block of data. It shows p-value is 0.778. As the level of significance, is above than 0.05 the data is in normal distribution. The variance is 0.0572. The skewness is -0.347708 indicating that the distribution is left-skewed. The confidence intervals at 95% confident level are:

• \( \mu \) (mean) is between 3.9350 and 4.2564.
• \( \sigma \) (standard deviation) is between 0.1672 and 0.4199.
• the median is between 3.8641 and 4.3201.
<table>
<thead>
<tr>
<th>No</th>
<th>Questionnaire</th>
<th>Strongly Not Relevant (%)</th>
<th>Not Relevant (%)</th>
<th>Quite Relevant (%)</th>
<th>Strongly Relevant (%)</th>
<th>Std. Dev</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Some aspects of the design and operation of the new coastal LNG ship are unique and specific.</td>
<td>0.0</td>
<td>5.3</td>
<td>31.6</td>
<td>39.5</td>
<td>23.7</td>
<td>0.865</td>
</tr>
<tr>
<td>2</td>
<td>The current LNG ship design specifications only focus on deep sea operating environment, therefore the new LNG coastal ship should be design to suit the coastal state environment and its regulation.</td>
<td>0.0</td>
<td>5.3</td>
<td>21.1</td>
<td>47.4</td>
<td>26.3</td>
<td>0.837</td>
</tr>
<tr>
<td>3</td>
<td>Structural strength of the new LNG coastal ships should be improved to ensure higher safety standard for coastal operation, hence to be able to suit with coastal state environmental issues.</td>
<td>2.6</td>
<td>10.5</td>
<td>18.4</td>
<td>34.2</td>
<td>34.2</td>
<td>1.095</td>
</tr>
<tr>
<td>4</td>
<td>Risk of catastrophic loss due to coastal LNG ships could be reduced through better design.</td>
<td>0.0</td>
<td>0.0</td>
<td>23.7</td>
<td>31.6</td>
<td>44.7</td>
<td>0.811</td>
</tr>
<tr>
<td>5</td>
<td>Risk to coastal habitat from LNG accidents could be reduced through higher safety standard.</td>
<td>0.0</td>
<td>5.3</td>
<td>10.5</td>
<td>31.6</td>
<td>52.6</td>
<td>0.873</td>
</tr>
<tr>
<td>6</td>
<td>Deep sea LNG is less suitable to operate in coastal area.</td>
<td>2.6</td>
<td>18.4</td>
<td>15.8</td>
<td>34.2</td>
<td>28.9</td>
<td>1.165</td>
</tr>
<tr>
<td>7</td>
<td>Ship’s draft is an operational limitation to coastal LNG ship and it could be solved by improved design.</td>
<td>0.0</td>
<td>0.0</td>
<td>15.8</td>
<td>50.0</td>
<td>34.2</td>
<td>0.692</td>
</tr>
<tr>
<td>8</td>
<td>Coastal LNG should be easily distinguished or differentiated so as to reduce risk of maritime collision/ fire/ disaster or mishaps.</td>
<td>0.0</td>
<td>0.0</td>
<td>15.8</td>
<td>55.3</td>
<td>28.9</td>
<td>0.665</td>
</tr>
<tr>
<td>9</td>
<td>Coastal LNG ship requires special maneuverability and hence it should be one of important design focus.</td>
<td>0.0</td>
<td>2.6</td>
<td>5.3</td>
<td>44.7</td>
<td>47.4</td>
<td>0.714</td>
</tr>
<tr>
<td>10</td>
<td>Deep sea LNG ship should only qualify to serve in coastal waters after some design improvements.</td>
<td>0.0</td>
<td>5.3</td>
<td>18.4</td>
<td>36.8</td>
<td>39.5</td>
<td>0.894</td>
</tr>
<tr>
<td>11</td>
<td>Preservation of the coastal environment should be effectively translated into design specification for coastal LNG ships.</td>
<td>0.0</td>
<td>0.0</td>
<td>5.3</td>
<td>47.4</td>
<td>47.4</td>
<td>0.599</td>
</tr>
</tbody>
</table>

Table 1: Carrier Aspect – Design Specification
DISCUSSION ON RESULT

The result discussion will cover on demographic of the respondents, data distribution and ANOVA and also correlation. The raw data is executed by using Minitab Software and SPSS Statistical Software

DEMOGRAPHIC

Significantly, the majority of the feedback by the respondents are on the ‘positive mode or positive inclination’ toward the research hypothesis. The returned status of the questionnaire is 84.4%. The respondents are 92.1% men which reflect oil and gas industry practice where they usually prefer male employees.

The 81.6% respondents are over 30 years of age, which indicates the respondents have enough experience to be involved in this survey and all of the respondents have formal education. It means that they have been equipped with relevant knowledge on the oil and gas operation. Above 75% said that
respondents have formal education. It means that they have been equipped with relevant knowledge on the oil and gas operation. Above 75% said that they are well aware of the LNG business development.

**DISTRIBUTION**

To expand the idea of a drawn up legal framework, every legal aspect needs to be verified through the survey. Questionnaires need to be developed from the hypothesis legal framework, then each of it need to be correlated. Before proceeding into the data collection, the questionnaires need to be subjected through pilot test so that only effective questionnaires are sent out. Selective target groups who have legal knowledge will be taken into consideration. Based on Kreijie and Morgan,(1970), Determine Sample Size for Research Education and Physiological Measurement, the author has selected the 45 number of sample size. Then as referred to Nazila (2007), she quoted Abdul Ghafar (1999), when samples came from one population it is categorized as case study sample. In relation with current project, selected group is being considered which have know how knowledge on the LNG carriage. The data collection and compilation is needed during the second phase of project. The data is collected according to requirement of the application where it is able to represent to the situation required.

From the result in Table 1 and Figure 4, it show that the mean value also have ‘Relevant’ status. The different between mean and variance is ± 0.239 which 5.83%. The result is slightly above the alpha value (5%). This is mainly due to Q1, Q2, Q3 and Q6. These questions are about ‘Deep Sea Design’ issue. The argument here is that the current Deep Sea LNG vessel also suitable to operate in the coastal waters.

However, the deep sea vessel is design to serve in specific port and operation area. It is contradict with the coastal shuttle operation where the carrier must be well design. The aim is to preserve the environment as the nature of coastal water is differ from one place to another. For example, the water depth is irregular distributed.

**CLOSING REMARKS**

The legal framework on the LNG carriage within coastal water is the extended version of the current legal guide. As it is a new revolution that LNG carriage will inevitable come to the coastal zones, there is no literature of what have been done previously. This is highlighting the new milestone of the legal development. Hence, this study was conducted to identify the legal framework component as to ensure safe and secure coastal water operation. This study shows that legal framework is required in term of carrier aspect – design specification as identified at Figure 6. However, from this study we also know that the most important factor...
is safe handling. The legal framework is expected to reduce the implication and impact to the surrounding in the event of mishandling or any mishaps.

RECOMMENDATIONS AND SUGGESTIONS

Based on the finding of the study, here are some recommendation and suggestion in the hope to assist future researcher and for the benefit of all LNG group of people. Based on the intended setting of the study, it would be fruitful for future researcher to get more elements included in the framework. It can be done with further research and conference involvement. Collaboration with oil and gas companies such as MISC, PETRONAS and SHELL would bring about greater point of view. Experience in admiralty cases would produce greater impact on the legal framework development. Future researchers have to look into the possibility to expand the components.

REFERENCES

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WAKE ADAPTED PROPELLER DESIGN BASED ON LIFTING LINE AND LIFTING SURFACE THEORY

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ABSTRACT
This paper is aimed at researching on the procedures of designing wake-adapted propellers. Priority is given to lifting line and lifting surface theories which produce good results in the incorporation of wake-adapted factors. In this paper the utilization of current theories of lifting line and lifting surface are explained. The evaluation of the results obtained will be further analyzed in this paper. Finally some conclusion to the results of the study will be made along with appendix which contains flow chart of the design method used in the calculation.

Keywords: wake-adapted propellers

INTRODUCTION
The main purpose of this paper is to demonstrate on the calculation of wake adapted propellers using lifting line and lifting surface theories. In the process leading to the calculation of the design of wake-adapted propellers, some literature review has to be done on the concept of the propeller theories presented by some prominent researchers.

It starts with the work of Prandtl, Betz and Helmbold in Germany led to the development of circulation theory of propellers and lifting line theory using induction factors. In 1955, propellers began to be designed on the computer, which enabled propellers to be designed using induction factors. These factors were a big advance because they make wake adapted propellers possible where the flow just before at the entrance of the suction of propeller is not always uniform due to the boundary layer around the stern region which is defined as wake.

RESEARCH PROBLEM STATEMENT
Many methods and theories about propellers have evolved over the past years, from initial design by imagination, to a systematic series of a wide range of propeller types. Progresses were made by Taylor, Troost and others with systematic series which derived from tests of model propellers in methodical series. However, the need of propellers for ever-increasing powers and speeds cannot be met satisfactorily by a few series of propellers with a limited number of variations. Cavitation, vibration, and noise cannot be properly solved by just referring to the charts.

The introduction of the vortex theory by Lanchester in 1907 enabled the evolution of the theoretical part of propeller design to progress with good results. Prandtl in 1918 developed a mathematical solution to the basic lifting line theory for extension of the theory to propellers. Helmbold (1926) and Goldstein (1929) further developed these concepts for practical application to propeller design. The incorporation of wake considerations into the propeller design resulted in a more accurate prediction of propeller characteristics. The introduction of the lifting surface theory further enhanced the credibility of the design process by taking into account the radial distribution of thickness of each propeller blade.

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OBJECTIVES

The objective of this research is to study the method for the calculation of the main characteristics of a wake-adapted propeller using the lifting line and lifting surface theories.

LITERATURE REVIEW

Propeller Lifting Line Theory

In the lifting line theory of propellers, it is assumed that besides the normal inviscid incompressible fluid assumption, each propeller blade can be replaced by a lifting line and the circulation varies along the propeller radius (Gomez et al., 1980). Referring to vortex theory, free vortices are shed from the lifting line. These free vortices form a general helical surface behind the propeller in a coordinate system which rotates with the propeller. Since the free vortices follow streamlines in the rotating coordinate system, the pitch of the helical vortex sheet is dependent on the free stream velocity, the speed of rotation of the propeller, and the velocities induced by the vortex system. The component of the force in the direction of motion (the drag force) is due to viscous and pressure forces. For a given velocity and fluid density, the lift force only depends on the value of the circulation, so that the geometry of each section could be replaced by a vortex element. The whole blade then can be replaced by a vortex line with a variable distribution of velocity (Gomez et al., 1980), as illustrated in Figure 1. Such a line is named a lifting line.

Suppose that a propeller is rotating with an angular velocity $\omega$ through a radially variable velocity field, then $V' = V_B(1 - w_r)$, where $V'$ = resultant axial entry velocity, $V_B$ = ship velocity and $w_r$ = wake fraction at radius, r. The induced velocities $aV'$ and $r\omega a'$ can be calculated when the radial distribution of circulation is known. This modifies the entry velocity if the fluid at each blade element as illustrated in Figure 2.
The following equation is established for each annular section of the propeller by using Kutta-Joukowsky theorem:

\[ dL = \rho V z \Gamma_r \, dr = \frac{1}{2} \rho V^2 C_L C_r z \, dr \quad C_L = \frac{2 \Gamma_r}{V C_r} \]

Where, \( \Gamma_r \) is the vorticity at a distance \( r \) from the axis, \( z \) is the number of blades, \( C_r \) is the chord of the annular section at radius \( r \), and \( dL \) is the lifting force produced by \( z \) differential blade elements, whereby \( V \) can be obtained through:

\[ V = \left[ \frac{1}{2} \left( 1 + \frac{a}{a'} \right)^2 + r w \left( 1 - \frac{a}{a'} \right)^2 \right]^{\frac{1}{2}} \]

Let \( C_D \) be the non-dimensional drag coefficient:

\[ C_D = \frac{dD}{\frac{1}{2} \rho V^2 C_r \, dr} \]

This coefficient can be expressed in terms of \( C_L \) and as a function of Reynolds’ number, for different types of camber and thickness distribution used (Gomez et al., 1980). The differentials of thrust and torque generated by an annular section of the propeller are:

\[ dT = \frac{1}{2} \rho V^2 z C_r (C_L \cos \beta_{io} - C_D \sin \beta_{io}) \, dr \]

\[ dQ = \frac{1}{2} \rho V^2 z C_r (C_L \sin \beta_{io} + C_D \cos \beta_{io}) \, dr \]

The values of the thrust produced by the propeller and the absorbed torque can be obtained by integrating these expression between \( r = r_h \) at the hub and \( r = R \),

\[ T = \int_{r_h}^{R} \frac{1}{2} \rho V^2 z C_r (C_L \cos \beta_{io} - C_D \sin \beta_{io}) \, dr \]

\[ Q = \int_{r_h}^{R} \frac{1}{2} \rho V^2 z C_r (C_L \sin \beta_{io} + C_D \cos \beta_{io}) \, dr \]

From equations 1, 3, 4, 5 and 6 it is possible to predict the thrust and torque of a propeller once the radial distribution of circulation is known. Because the propeller accelerates the flow and imparts a tangential velocity component to the slip stream, there are effects of slip stream contraction and centrifugal force on the streamline deflection. Furthermore, radial and axial velocity components will also be induced. These velocities are small as compared to the inflow velocities for a moderately loaded propeller but the mathematics involved is very complicated. So assumption is made that the inflow velocity is uniform and that the influence of the induced velocities on the shape of the vortex sheets, contraction of slip stream, and centrifugal forces can be neglected (Betz, 1919).

With these assumptions, it can be shown that for minimum energy loss the trailing vortex sheets form true helical surfaces; i.e., they have constant pitch. Goldstein extended Betz’s work to a propeller with a finite number of blades and formulated the Goldstein factor, which is the ratio of the circulation of a finite-bladed propeller to the circulation for an infinitely bladed propeller. The Goldstein function will be used in the calculation of thrust coefficients in this research. For this theory to be applicable the propeller must be lightly loaded; i.e., the thrust loading must be small.
Propeller Lifting Surface Theory

In this theory a lifting surface having the same outline as a propeller blade is used to replace the original propeller blade. The thickness of the blade was assumed to be zero. Vorticity distribution is then placed upon this lifting surface. A required thrust or torque distribution along the radius is then developed at a given advance ratio. As a starting point the lifting surface is first degenerated into a lifting line, from which the necessary information to establish the lifting surface representation is derived.

Based on the required thrust or torque distribution along the radius, a procedure to determine the radial bound circulation \( \Gamma(r) \) is given (Pien, 1961). The quantity \( \gamma(r)/\pi DV \), where \( \gamma(r) \) is the circulation, \( D \) is the diameter, and \( V \) is the advance speed of the propeller. For convenience the propeller radius is chosen as a unit, and \( r \) is the non-dimensional radial coordinate. Because of the variation of \( \Gamma(r) \), a free vortex sheet with a circulation distribution \(-\Gamma(r)/dr\) trails the lifting line and extends to infinity behind.

\[
\Gamma_c(r) = -\frac{d\Gamma(r)}{dr}dr
\]  
(7)

Combine (1) and (2)

\[
\Gamma_c(r) = \left[-\frac{d}{dr} \int_{\theta(r)}^{\theta(r)} \Gamma(r, \theta) d\theta \right] dr
\]

\[
= -dr \int_{\theta(r)}^{\theta(r)} \frac{\partial \Gamma(r, \theta)}{\partial \theta} d\theta - \Gamma(r, \theta) \int_{\theta(r)}^{\theta(r)} \frac{d\theta}{dr} dr
\]

\[
+ \Gamma(r, \theta) \int_{\theta(r)}^{\theta(r)} \frac{d\theta}{dr} dr
\]  
(8)

Equation (8) shows that \( \Gamma_c(r) \) consists of three parts. The first one, due to the change of the circulation \( \Gamma(r, \theta) \) with respect to \( r \), starts from various points within the lifting surface. The second part, due to the change of \( \theta(r) \) with respect to \( r \), starts along the trailing edge. Then, within the lifting surface the free circulation \( \Gamma_o(r, \theta) \) can be expressed as follows:

\[
\Gamma_o(r, \theta) = -\Gamma_o[r, \theta(r)] \int_{r}^{\theta(r)} \frac{d\theta}{dr} \int_{\theta(r)}^{\theta(r)} \frac{d\theta}{dr} dr
\]

for \( \theta(r) \geq \theta \) \( \theta \).

DEVELOPMENT OF THE ALGORITHM

Basic Consideration

With the assumption discussed earlier (no contraction of the slip stream), let us first consider the case of the propeller as a lifting line operating in a non-viscous fluid, Fig. 3. The radial component of the induced velocity can then be ignored. The other two components, tangential \( u_r \) and axial \( u_\theta \), must be calculated or approximated. By excluding the radial velocity component, the blade can be replaced by a lifting line. By using the momentum theory, it can be shown that the components at this lifting line are half their final value downstream.

Using the approximate method, \( u_r \) and \( u_\theta \) can be estimated. With the condition of normality assumed earlier, the resultant induced velocity \( u/2 \) is perpendicular to the resultant inflow velocity \( V_r \), Figure 3.
With this assumption the components can be expressed in simple trigonometric expressions that contain the Goldstein function, \( \kappa \). In addition Kramer’s curves can be used as a first approximation for the ideal efficiency of a propeller. This approximation will allow the first estimate of the hydrodynamic pitch angle \( \beta \), to be calculated easily.

It must be known that the condition of normally is only suitable for free running optimum propellers. An optimum propeller is one in which the losses due to non-viscous flow are minimum for the flow conditions at each blade section. For the optimum free-running propeller this results in essentially the same pitch at all radii. However, this research has reference to more practical classes of propellers, the free-running non-optimum and wake-adapted. According to Eckhardt and Morgan, research at the David Taylor Model Basin has showed that the assumption of normality is sufficient to produce good results.

The modification to the limitations of just referring the blade as a lifting line operating in a non-viscous fluid will then be done. The weakness in the application of the lifting line theory by itself considers only the angularity of the flow but gives no information about its curvature. Propellers designed from the lifting line theory alone are known to be under-pitched (Eckhardt and Morgan, 1955). This problem will be solved by complementing the lifting theory with lifting surface theory; that is, to go from a line to a curved twisted plate. This problem will need camber corrections.

Nevertheless, this correction to the pitch is insufficient. The change in curvature over the chord has resulted in the deficiency in pitch (Lerbs). Using Weissinger’s simplified lifting surface theory, the relations can then be used in conjunction with Ludwieg and Ginzel’s work to make the theory more complete.

Another limitation is the problem of propeller operating in a viscous fluid. The result is an increase in torque and a decrease in thrust as shown in figure 5. This effect is corrected in the final steps of the design by increasing the pitch at a certain amount at each section. This correction is based on a number of published airfoil data (Eckhardt and Morgan, 1955). In the use of the circulation theory for wake adapted propeller, the design approach is to assume optimum circulation over the blade radius and compute the pitch distribution. A relationship for the tangent of the hydrodynamic pitch angle \( \beta \), for an optimum wake adapted propeller has been developed by Lerbs (Equation 17). The pitch variation depends on the average radial effective wake for which each blade section is designed.
**Design Procedure**

Below are the design procedures suggested by Eckhardt and Morgan for the design of a wake adapted propeller as detailed in Appendix I,

1. Collection of the necessary design data.
2. Determination of the correct hydrodynamic pitch angle
3. Determination of the coefficient of lift $(L_i)$, blade sections, thickness ratios $(t_s/l)$, and camber ratios $(m_s/l)$ from cavitation considerations.
4. Correction to camber from lifting-surface theory (2)
5. Correction to pitch from lifting surface theory (3), from the mean line in ideal flow, and from viscous flow.

The necessary design data can be obtained from model tests or design specifications already done on the existing propellers. It is necessary to know the design shaft horsepower at a given rpm, resistance of the ship, wake, thrust deduction, diameter and the design speed. The calculations will then be made on the basis of thrust. Actually there are two methods of approach, one on the basis of thrust and the other on power. The calculation on the basis of thrust is preferable since the variation of thrust between non-viscous and viscous flow is from 2 to 6 percent, which if in the basis of power the variation will be greater (Eckhardt and Morgan, 1955).

A selection for a propeller diameter with a tip clearance of about 20 percent of the diameter will be preferable (Eckhardt and Morgan, 1955). From the diameter the optimum rpm can be calculated, and the machinery (the main engine with or without reduction gear) can be selected with the specified horsepower at this rpm. As for existing ship the optimum diameter should be calculated from the shaft horsepower and the rpm.

The calculation for optimum diameter or rpm can be made from Burtner’s formula, which is based on Troost four bladed B-series.

$$D = 50 \frac{(P_s)^{0.2}}{(n)^{0.6}}$$  \hspace{1cm} (10)

Where $D$ is the diameter of the propeller in feet, $P_s$ is the shaft horsepower and $n$ will be the revolutions per minute. The optimum diameter obtained from the Troost series should be reduced approximately 5 percent for single screw ships and 3 percent for twin screw (Van Manen, 1955). This reduction is caused by scale effect and also the fact that the Troost series is based on open water tests. Another important parameter is the number of blades. Considerations must be made for the natural frequencies of hull modes, natural shaft frequencies, and the wake field variations. Then the hub diameter must be set next. Its size depends on the shaft diameter and also may depend on the number of blades. The hub sizes usually vary between 15 and 25 percent of the propeller diameter and it should be as small as possible (Van Manen, 1955).

**Algorithm used in MATLAB programming**

Once the design data have been assembled, the hydrodynamic pitch angle $\beta_i$ must be calculated for each blade section. In this procedure the approximate method is used and calculated on the basis of thrust.

First the following coefficients must be determined:

$$V_A = \text{speed of advance of propeller in knots}$$

$$= V(1 - w_e)$$  \hspace{1cm} (11)

$$\lambda = \text{advance coefficient}$$
\[ C_T = \text{thrust coefficient} \]
\[ T = \frac{T}{\rho D^2} = \frac{\pi(1.688V_A)^2}{2} \tag{13} \]

\[ T = \text{propeller thrust} \]
\[ \frac{325.86 P_E}{V(1-\ell)\cos\psi} = \frac{R_i}{(1-\ell)\cos\psi} \tag{14} \]

For design purposes it is necessary to change the thrust coefficient into a coefficient for non-viscous flow:
\[ C_{Ti} = \frac{C_T}{1-\ell} = (1.06)C_T \tag{15} \]

In propeller calculation the approximations of equation (15) is used for \( C_{Ti} \) because \( \ell \) and \( \tan \beta_i \) are not known. However, the approximations should be checked after \( \ell \) and \( \tan \beta_i \) are calculated. A set of curves for determining the ideal efficiency of an optimum propeller in open water has been developed by Kramer (1939). Once \( C_{Ti} \), \( \lambda_i \), and the number of blades are known, the ideal efficiency is read from these curves. Further from figure 3, it can be seen that
\[ \tan \beta = \frac{101.27V_A}{mDx} = \frac{\lambda}{x} \]

then
\[ \tan \beta_i = \frac{\tan \beta}{\eta_i} = \frac{(P_i/D)_i}{x} \tag{16} \]

So for optimum propeller in open water, the uncorrected pitch ration can be obtained easily. When this propeller is designed for shock-free entry, equation (17) leads to a constant-pitch propeller.

It is advantageous, however, to modify the pitch distribution for cavitation considerations, such as reducing the pitch at the tip to decrease tip vortices and at the hub to decrease root and hub vortices. In the case of a non-optimum or wake adapted propeller, Kramer’s curves become unsuitable; but they are good for a first approximation. For the non-optimum free running propeller, the approximation is made that \( \tan \beta_i \), calculated from Kramer’s curves, is equal to \( \tan \beta_i \) at 0.7 radius. The coefficient of thrust is then calculated by the following formulae:

\[ C_{ni} = 8 \int_{x_h}^{x_i} \frac{x_k u_i}{2V_A} \left( \frac{x}{\lambda} - \frac{u_i}{2V_A} \right) dx \tag{19} \]

\[ \frac{u_i}{2V_A} = \frac{\sin \beta_i \sin(\beta_i - \beta)}{\sin \beta} \tag{20} \]

where \( \kappa \) is the Goldstein function, \( \lambda_i \) varies over the radius for a non-optimum free running propeller \( \lambda_i = x \tan \beta_i \), \( x_h = r/R \) at the hub and \( u_i \) is the tangential induced velocity. The above mentioned formula is calculated for \( dC_{ni} \) at a number of radii and then numerically integrated for \( C_{ni} \). If this value of \( C_{ni} \) does not correspond with that from the thrust, equation (15) then \( \tan \beta_i \) must be corrected and the calculation carried out again. The following formula applied at 0.7 radius will give a good approximation to \( \tan \beta_i \) :
For a wake adapted propeller only the principle of the preceding method applies, since the wake also varies with the radius. The following formulas were developed by Lerbs for wake adapted propellers,

\[
\lambda_s = \text{advance coefficient based on ship speed} = 1.0127
\]

\[
\tan \beta = \frac{\lambda_s}{x(1-w_x)}
\]

\[
C_{T_s} = \text{thrust coefficient based on ship speed} = \frac{T}{\rho \frac{D^2}{4} \pi (1.688V)^2}
\]

For non-viscous flow these become

\[
\tan \beta_i = \frac{\tan \beta (1-w_x)^{\frac{1}{2}}}{\eta_i (1-w_x)^{\frac{1}{2}}}
\]

\[
= \frac{\lambda_s (1-w_x)^{\frac{1}{2}} (1-w_x)^{\frac{1}{2}}}{x \eta_i}
\]

\[
C_{Tii} = (1.02 \text{ to } 1.06) C_{Tc}
\]

A first estimation of \( \eta_i \) for equation (23) is based on Kramer’s curves. To calculate the thrust coefficient, the following formula will be integrated.

\[
C_{Tii} = S \int_{x_l}^{x_h} \kappa x \frac{u_i}{2V} \left( \frac{x}{\lambda_s} - \frac{u_i}{2V} \right) dx
\]

\[
\frac{u_r}{2V} = \frac{(1-w_i) \sin \beta_i \sin (\beta_i - \beta)}{\sin \beta}
\]

To obtain the correct \( \tan \beta_i \) for free running non-optimum propeller, the procedure will be same as above. Next is the determination of coefficient of lift C\(_L\) using the following formula:

For propellers in uniform flow

\[
C_L = \frac{4\pi x \kappa}{z} \frac{u_i}{2V} \cos \beta_i
\]

For wake adapted propellers

\[
C_L = \frac{4\pi x \kappa}{z} \frac{2V}{\lambda_s} \cos \beta_i
\]

where \( l \) is the length of blade section, and \( z \) is the number of blades.
The cavitation number of each section of the propeller is calculated by the following formula:

For propellers in uniform flow with a blade in the top position,

\[
\sigma = \frac{\gamma}{\rho} \left( \frac{p + p_a}{1.688V_A^2} \right) \sin^2 \beta \cos^2(\beta - \beta_i) \tag{31}
\]

For wake adapted propellers

\[
\sigma = \frac{\gamma}{\rho} \left( \frac{p + p_a}{1.688V_A^2} \right) \sin^2 \beta \cos^2(\beta_i - \beta) \tag{32}
\]

At this stage the lift length thickness coefficient is calculated. The maximum thickness \( t_z \) of each section can be obtained from strength considerations calculations. From Taylor’s formula (1943) an estimate of the blade thickness fraction can be made.

\[
t_o = \frac{1}{D} \sqrt{\frac{C_i P_b}{4.123nS_c}} \tag{33}
\]

Where \( t_o / D \) is defined as the thickness fraction, \( C_i \), coefficient for estimating blade thickness and \( S_c \) is the maximum allowable stress. Then the radial distribution of maximum thickness is calculated from the blade thickness fraction using a formula given by Van Manen and Troost (1952)

\[
t_{z} / D = \frac{t_{up}}{D} + f \left[ \frac{t_o}{D} - \frac{t_{up}}{D} \right] \tag{32}
\]

Where \( f \) is a coefficient for radial distribution of maximum thickness of blade elements. Two sections of the NACA airfoil, the NACA 16 and the NACA 66, are considered here because they have low drag and good cavitation characteristics. The ordinates of the NACA series can be obtained from Abbott & von Doenhoff “Theory of Wing Sections”.

In the distribution of pressure the NACA \( a = 1.0 \) mean line is more desirable and it gives a section of minimum length for incipient cavitation. The \( a = 0.8 \) mean line has slightly greater suction at equal lift but the correction for viscous flow is close to zero. Nonetheless, experimental work at DTMB showed that both the \( a = 0.8 \) and \( a = 1.0 \) mean lines gave good results in viscous flow.

Next step is the determination of camber ratio \( (m_z / l) \) and thickness ratio \( (l_z / l) \) from the incipient cavitation charts corresponding to the selected section and mean line. The section lengths are calculated from the thickness ratios, and the blade outline is then determined. It is best to limit the thickness ratio from 0.18 to 0.22. An arbitrary blade outline can be selected and this can be obtained from Troost B-series.

If the outline is selected arbitrarily, the camber will be calculated from \( C_i \). The coefficient of lift is obtained from \( C_i l/D \) since \( l/D \) is now known. The camber is then corrected for the consideration of lifting surface theory. Two corrections are read from the camber correction coefficient chart and applied as follows:

\[
(m_z / l)_{\text{corrected}} = k_1 k_2 m_z / l \tag{33}
\]

To get both \( k_1 \) and \( k_2 \), the expanded area ratio \( (A_E / A_o) \) must be calculated. The correction for pitch follows with three corrections or additional angles of attack to be considered; i.e., friction correction, ideal angle of attack of the mean line (Abbott et. al., 1945), and correction from lifting surface effect (Lerbs, 1955). The first two corrections can be combined into one additional angle of attack \( \alpha_1 \), for a given mean line. This correction is made at each radius.
For a circular arc mean line, \( \alpha_i = 2.86 C_i \) degree, for NACA a = 1.0 mean line, \( \alpha_i = 2.35 C_i \) degree and for NACA a = 0.8 mean line, \( \alpha_i = 1.15 C_i \) degree. The effect of free and bound vortices must be corrected from lifting surface theory. The following formulas represented the values of \( \frac{l}{D} \) and functions of \( \beta_i \) at 0.7 radius.

\[
\alpha_2 = \alpha_b + \alpha_f - (\alpha_i + \alpha_o) 
\]

This correction is made in a few steps and the first step involves the bound vortices.

\[
\alpha_b = \frac{\sin \beta}{2} \sum \left[ \frac{1}{D} \sin \mu - 0.7 \cos \beta \cos \mu \right] G \]

(35)

where \( \mu \) = angular position of blade

\[
(P/R)^3 = \left[ x^2 + \left( \frac{l}{D} \right)^2 + 0.49 - 2 \left( \frac{l}{D} \cot \beta \cos \mu + 0.7 \sin \mu \right) x \right] \]

(36)

\( G \) = non-dimensional circulation per blade equal to \( (2 \pi x/2)(u_x / 2V_D) \) for a free running propeller and for a wake adapted propeller it will be as follows:

\[
\frac{2 \pi x u_x}{z} = \frac{1}{2V (1 - w_x)} 
\]

(37)

Calculations are made for a blade in the 90 deg position, and the effect of the other blades is determined on the bound vortex of this blade. For a four bladed propeller, calculations are made with \( \mu \) equal to 90, 180, 270 and 360 degree. Then the additional angle of attack \( \alpha_b \) is equal to the sum of the calculations of these four blade positions. The correction for the effect of the free vortices then follows,

\[
\alpha_f = \alpha_i \frac{2}{1 + \cos^2 \beta \left( \frac{2}{h} - 1 \right)} 
\]

(38)

where \( \alpha_i = \beta_i - \beta \), in radians. Then the additional angle of attack is obtained by the following equation,

\[
\alpha_2 = 57.3 \left( \alpha_b + (\alpha_i) \left[ \frac{2}{1 + \cos^2 \beta \left( \frac{2}{h} - 1 \right)} - 1 \right] \right) 
\]

(39)

This correction to pitch is made at 0.7 radius and for other radii the same percentage change is applied.

\[
1 + \frac{\Delta P/D}{P/D} = \frac{\tan(\beta_i + \alpha_2)_{0.7}}{(\tan \beta_i)_{0.7}} 
\]

(40)

The final pitch is then,

\[
P/D = \pi \tan(\beta_i + \alpha_1) \left( 1 + \frac{\Delta P/D}{P/D} \right) 
\]

(41)

The design of the propeller is now complete.

**RESULT**

A sample data from DTMB 5415 will be used to perform the calculation. A program written in MATLAB was run for 5 bladed propeller. The example of the output of calculation at speed of 21 knots and at advance coefficient of 0.257 is shown in appendix II. Comparison showed that the values agree very well. A comparison of the main values and percentage difference is shown in Table 1.
A comparison of the main values and percentage
Meanwhile the result of thrust and torque coefficient from the computation at each advance coefficient is shown in appendix III. Then the theoretical calculations from the computation were compared with the DTMB 5415 experimental results as presented in graphs in Figure 5. The predicted thrust and torque coefficient shows the tendency of over prediction especially at the lowest advance coefficient (off design condition). This includes the over prediction of the efficiency of the propeller. **CONCLUSIONS**

A lifting line and correction using lifting surface method for the design of propeller with wake adaptation has been presented in this paper. A calculation program written in MATLAB has been developed using the above method. The results obtained through the calculation agree well with the experimental KT-KQ-J curves particularly the DTMB 5415 propeller data. The over prediction were probably due to an over prediction of the pitch angle of the

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Calculated</th>
<th>DTMB 5415</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimum diameter, ft</td>
<td>21.1</td>
<td>21</td>
<td>0.48</td>
</tr>
<tr>
<td>Optimum rpm</td>
<td>101.6</td>
<td>102</td>
<td>0.39</td>
</tr>
<tr>
<td>Speed of advance, knots</td>
<td>16.8</td>
<td>16.8</td>
<td>0</td>
</tr>
<tr>
<td>Advance coefficient</td>
<td>0.252</td>
<td>0.253</td>
<td>0.40</td>
</tr>
<tr>
<td>Propeller thrust, lb</td>
<td>237321</td>
<td>237300</td>
<td>0.009</td>
</tr>
<tr>
<td>Thrust coefficient</td>
<td>0.858</td>
<td>0.856</td>
<td>0.23</td>
</tr>
<tr>
<td>Non-viscous thrust coefficient</td>
<td>0.884</td>
<td>0.882</td>
<td>0.23</td>
</tr>
<tr>
<td>Advance coefficient based on ship speed</td>
<td>0.315</td>
<td>0.316</td>
<td>0.32</td>
</tr>
<tr>
<td>Thrust coefficient based on ship speed</td>
<td>0.549</td>
<td>0.548</td>
<td>0.18</td>
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<tr>
<td>Wake-adapted thrust coefficient</td>
<td>0.565</td>
<td>0.565</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 1: Percentage difference of calculated values
free vortex in the wake. Further development is to validate the method with other types of propeller especially on high skewed propeller having a totally different camber distribution. The other recommendation is to use the method proposed by Kerwin, 1982 on the modified lifting surface theory by Vor- tex Lattice method.

REFERENCES

Appendix I: Flow Chart for the Design of Wake Adapted Propeller

START

1. Input of Principle Propeller Data

2. Calculation of Design Coefficients For Obtaining The First Approximation to Pitch Angle

3. Reading From Kramer’s Curves

4. Calculation of Desired Thrust Coefficients

5. Calculation of Pitch Angle For Wake Adapted Propeller At Each Radius Using The First Approximation From Kramer’s Curves

6. Input of Golden Section Function

7. Calculation of Thrust Coefficient Over the Radius

8. Is Thrust Coef Thrust Coef (Desired)?
   YES
   10. Calculation of Coefficient of Lift and Thickness Distribution
   11. Calculation of Cavitation Number
   NO
   9. Correction to Pitch Angle

12. Proceed With Calculation of Section Outline

13. Get Section Outline From Troost B- Series

14. Calculation of Section Outline

15. Calculation of Camber by Lifting Surface Theory

16. Correction to Camber

17. Final Correction To Pitch by Considering Angular Position of Blades

18. Print Output

END
Appendix II: Input and Output examples of the programme

MAIN PARAMETER INPUT

1. Speed of ship in knots, \(V\) = 21.00 knots  
2. Effective horsepower/kW, \(P_t\) = 13000.00 hp  
3. Effective wake fraction, \(w_n\) = 0.20  
4. Thrust-deduction fraction, \(t\) = 0.15  
5. Number of propeller blades, \(z\) = 4  
6. Ship shaft horsepower/kW, \(P_s\) = 17500.00 hp  
7. PS (Maximum) = 21000.00 hp  
8. Revolution per minute = 109 rpm

INITIAL OUTPUT

Optimum diameter = 21.1 ft  
Optimum RPM = 101.6 rpm  
Speed of Advance = 16.8 knots  
Advance coefficient, \(J\) = 0.257  
Propeller thrust, \(T\) = 0.858  
Non-viscous thrust coefficient, \(C_{ti}\) = 0.884

SECOND INPUT

From Kramer’s Curves, \(\eta_i\) = 0.76

MAIN OUTPUT

Advance coefficient based on ship speed, \(J_s\) = 0.315  
Thrust coefficient based on ship speed, \(C_{ts}\) = 0.549  
Wake adapted thrust coefficient, \(C_{tw}\) = 0.327

\[x \sin (\beta_i - \beta) \frac{1}{l/3} k ut/2V dCTsi SM FCTsi\]

\[\beta_i, \theta_l, \theta_t, \beta_i \text{ tan} \sin \beta_i \text{ tan} \frac{\beta_i}{\sin} (\text{new})\]

\[0.2 \quad 0.576 \quad 0.908 \quad 0.672 \quad 1.407 \quad 1.434 \quad 0.820\]
\[0.3 \quad 0.656 \quad 0.689 \quad 0.567 \quad 1.001 \quad 1.020 \quad 0.714\]
\[0.4 \quad 0.712 \quad 0.561 \quad 0.489 \quad 0.782 \quad 0.797 \quad 0.623\]
\[0.5 \quad 0.751 \quad 0.473 \quad 0.428 \quad 0.643 \quad 0.655 \quad 0.548\]
\[0.6 \quad 0.779 \quad 0.409 \quad 0.379 \quad 0.546 \quad 0.556 \quad 0.486\]
\[0.7 \quad 0.800 \quad 0.360 \quad 0.339 \quad 0.474 \quad 0.483 \quad 0.435\]
\[0.8 \quad 0.815 \quad 0.321 \quad 0.306 \quad 0.419 \quad 0.426 \quad 0.392\]
\[0.9 \quad 0.826 \quad 0.289 \quad 0.278 \quad 0.375 \quad 0.382 \quad 0.357\]
\[1.0 \quad 0.839 \quad 0.264 \quad 0.256 \quad 0.340 \quad 0.346 \quad 0.327\]
### Appendix III: Thrust and Torque Coefficients for each Advance Coefficients.

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<th>KT</th>
<th>KQ</th>
<th>10KQ</th>
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<td>0.3984</td>
<td>0.0511</td>
<td>0.5114</td>
</tr>
<tr>
<td>0.0859</td>
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<td>0.2576</td>
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### Table: x, tan(β_i − α_i)

<table>
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<th>J/D</th>
<th>tx/l</th>
<th>c.l.</th>
<th>mx/l</th>
<th>k1</th>
<th>k2</th>
<th>mx/l (corr)</th>
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<td>0.2</td>
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SEVEN WAYS TO MASTERING A COURSE

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ABSTRACT
The current scenario of the students pursuing studies, either locally or abroad, shows their standard of knowledge especially in the concept understanding for such course or program have deteriorated. The major factors contributing to this phenomenon may be the lack of suitable approach when attending to such course and the lack of appropriate method of study in ensuring the smoothness of the students’ learning process. This paper attempts to magnify the ways in tackling and handling the related issues to help readers adopt the means for better enhancement of knowledge that could be applied as an added value for the benefit of graduating students.

Keywords: Mastering a course, pounding, panting

INTRODUCTION
Tertiary education nowadays has become a norm to everyone in Malaysia. Students after the Sijil Pelajaran Malaysia (SPM) level continue their studies in various colleges, institutes and universities either locally or in other countries such as the United States of America, United Kingdom as well as Australia [4]. Unfortunately their level of understanding of the concept of such programs or courses could be below the level that is normally expected in the higher education sector. This so called ‘phenomenon’ or ‘syndrome’ has been manifested upon their completion of study in the way of their conduct especially during interviews and presentations. The reasons behind this are still subject to further research and analysis and yet to be identified. Are the students really undertaking the course because of their interest or being forced by their parents? We leave this answer to the readers who are directly or indirectly involved in the psychology of education. Through observation and experience gathered it could be summarized that there are seven ways in mastering a program or course either in a university, an institute or a college. The writer will focus and magnify one after another to enable the reader especially students to look into and utilize further in their learning process.

UNDERSTANDING THE CONCEPT
What is meant by concept? A concept is a common feature, characteristic, an idea or a common notion. Every course has its own concept. As an example, the “Fluid Mechanics” course which is a fundamental to any other course in engineering either mechanical, civil, chemical, naval architectural or biochemical. Students should be able to understand and uphold not only the concept of fluid but also the concept of mechanics. Definitely to understand the concept is not that easy as students need to relate to what they have seen or have experienced to the idea behind the course. Occasionally, the synopsis and the learning outcomes provided in the Module Descriptor or Lesson Plan assists the students in understanding the concept. This is not necessarily true to all as the level of education and fundamental understanding for such individual may not be the same. Different perception and wrong interpretation on the outcomes of such a course adversely affect the understanding of the correct concept and its application.

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The logical acts of the understanding by which concepts are generated are divided into three operations:

1. **comparison**, i.e., the likening of mental images to one another in relation to the unity of consciousness;
2. **reflection**, i.e., the going back over different mental images, how they can be comprehended in one consciousness; and finally
3. **abstraction** or the segregation of everything else by which the mental images differ.

In order to make their mental images into concepts, students must thus be able to compare, reflect, and abstract, for these three logical operations of the understanding are essential and general conditions of generating any concept whatever. For example, we see a fir, a willow, and a linden. In firstly comparing these objects, we notice that they are different from one another in respect of trunk, branches, leaves, and the like; further, however, we reflect only on what they have in common, the trunk, the branches, the leaves themselves, and abstract from their size, shape, and so forth; thus we gain a concept of a tree. Not like a story of the six blind men in understanding the concept of an elephant. In which one of them happened to describe elephant as having a long trunk as a snake, whilst the others’ perceptions on the elephant as a tree, a fan, a spear, a wall and a rope. Is it wrong with their perceptions? The answer to that is they are correct in their respective reflection but wrong in the actual concept. The writer elucidates again the story of “The Six Blind Men and the Elephant” for the reader to profound the knowledge in concept understanding.

**THE STORY OF THE SIX BLIND MEN AND THE ELEPHANT**

Once upon a time there were six blind men. They lived in a town in India. They thought they were very clever. One day an elephant came into the town. The blind men did not know what an elephant looked like but they could smell it and they could hear it. ‘What is this animal like?’ they said.

Each man touched a different part of the elephant. The first man touched the elephant’s body. It felt hard, big and wide. ‘An elephant is like a wall’ he said. The second man touched one of the elephant’s tusks. It felt smooth and hard and sharp. ‘An elephant is like a spear’ he said. The third man touched the elephant’s trunk. It felt long and thin and wiggly. ‘An elephant is like a tree’ he said. The fourth man touched one of the elephant’s ears. It felt thin and it moved. ‘An elephant is like a fan’ he said. The sixth man touched the elephant’s tail. It felt long and thin and strong. ‘An elephant is like a rope’ he said.

The men argued. It ‘s like a wall! No, it isn’t! It’s like a spear! No it isn’t! It’s like a snake! They did not agree. The king had been watching and listening to the men. ‘You are not very clever. You only touched part of the elephant. You did not feel the whole animal. An elephant is not like a wall or a spear or a snake, or a tree or a fan or a rope’. The men left the town still arguing. A little girl heard them and said ‘Each of you is right but you are all wrong … but I know what you are talking about’.

Conclusively from the story to understand concept one need to deploy his or her brain either left or right or both in balance. We ought to have good knowledge in maneuvering our brain. The left brain is concerned more to logic, language, linearity, mathematics and analysis in comparison with the right brain which is focusing towards the arts and imagination.

Perhaps in mastering the course the educator must first understand the concept then he must convey his understanding to the students under his supervision. This may require strong effort and esteem determination not only on the students but also on the lecturers themselves.

**ENHANCING THE VOCABULARY OF TERMINOLOGY**

Terminology is derived from the word ‘term’ which defines as the study of terms and their use. Terms are words or compound words that are used in the specific contexts. Terminology therefore denotes a more formal discipline which systematically studies
the labeling or designating of concepts particular to one or more subject fields or domains of human activity, through research and analysis of terms in context, for the purpose of documenting and promoting correct usage (Temmerman, 2000).

Terminology is not connected to information retrieval in any way but focused on the meaning and conveyance of concepts. "Terms" (i.e. index terms) used in an information retrieval context are not the same as "terms" used in the context of terminology, as they are not always technical terms of art.

As the medium of instruction is in the English language students must be proficient in English. Improvement either in the listening skill, reading skill or writing skill in English should become first priority to the students. Otherwise students would not be able to smoothen their learning process in mastering such a course if their language skill is so limited.

Terminology for the one field of study to the other field may be distinctive. For example, if we study naval architecture or marine engineering the terms ‘port’ and ‘starboard’ define the left and right positions of a ship respectively. The words ‘ship’ and ‘shipping’ are also different in their definitions.

Thus, enhancing the vocabulary of the terminology in such a course is of prime importance to enable the student to master the course effectively. Combining these two factors of understanding the concept and enhancing the vocabulary of terminology partly builds a strong foundation of knowledge for the course undertaken. The writer concisely illustrates two of the terminologies in the naval architecture course which to the other student or layman may not be familiar with as shown in Figure 1 and 2. Students therefore need to increase their vocabulary in the terms related to their course of study as well as each subject under the program. Under the terminology ‘Pounding’ three other terms may relate to the whole situation of the ship condition during the severe blows from the sea namely heaving, pitching and slamming. Panting is one of the many terminologies in naval architecture and marine engineering for the students to implant in their mind in mastering the course. This term ‘panting’ is a stress, which occurs at the end of a vessel due to variations in water pressure on the shell plating as the vessel pitches in a seaway. The effect is accentuated at the bow when making headway (Dokkum, 2003).

ABILITY TO DEFINE

A “definition” is a passage that explains the meaning of a term (a word, phrase or other set of symbols), or a type of thing. A difficulty in managing “definition” is the need to use other terms that are already understood or whose definitions are easily obtainable. The use of the term in a simple example may suffice.

In mastering any course, enhancing the vocabulary of the terminology and ability to define the terms must be carried out concurrently. Students must ensure the familiarization of the related terminology as well as its definition. Failing to grasp either one of these two factors may affect the smoothness of their learning process.
The problem may occur during attending the question related to either a technical, mathematics or even the management course whereby students are not able to comprehend the phrase subtly. Hence, they will end up solving the problem without knowing the exact requirement of that particular question. Defining set of symbols either alphabetically or illustratively is also another part of learning process that need to be acquired by the students. The negative attitude of most of students in denying the important of defining symbols may jeopardize their knowledge not only during the learning process in mastering the course but it may lead to failure to survive in the real world upon graduation. Perhaps the most astounding thing to some of the students is the apparent inability to remember what they see or hear. Inability to remember will create an obstacle in defining such a term.

How to improve the ability to define? In defining the term one must acquire knowledge. Without proper guidance and strategic approach students may not be able to give meaning to the various terminologies that they have learned through learning process. They need skill in enquiring and asking during lectures. This skill of enquiry is a skill of listening that has been categorized under seven headings as listed below.

- paying attention
- treating the lecturer or speaker as respectable incumbent
- cultivating ease
- encouraging
- asking quality question
- rationing information
- giving positive feedback

Although all of the above is beyond the objective and scope of this article the readers could improve their communicating skill at their discretion according to their level of weakness. The positive value of this write up is to propose ways how to master or to become expert in such course undertaken by the students as an added value to the piece of diploma or degree certificate they gained.

**RECOGNIZING THE PRINCIPLES OR LAWS**

A principle is a law or rule that has to be, or usually is to be followed, or can be desirably followed, or is an inevitable consequence of something, such as the laws observed in nature or the way that a system is constructed. The principles of such a system are understood by its users as the essential characteristics of the system, or reflecting system’s designed purpose, and the effective operation or use of which would be impossible if any one of the principles was to be ignored (Annual Survey of International and Comparative Alpa Guido, 1994)

Examples of principles may be:

- a descriptive comprehensive and fundamental law, doctrine, or assumption
- a normative rule or code of conduct,
- a law or fact of nature underlying the working of an artificial device

In the Engineering Science or Physics courses, we will learn a lot of principles and laws like Bernoulli’s Principle, Pascal Principle and Hooke’s Law. Could the students easily recognize each of the laws they have learned through the learning process in such a program? The answer is “yes” if they really understand the concept and be able to relate with surrounding factual phenomenon. However, if they do not understand the concept, moreover with poor terminology and definition disability, the probability to recognize the principle would be nullified.

Recognizing principle or law is not just able to know but to further define, understand its concept, knowing the historical background, and able to relate with the application. Therefore in mastering the recognition of principle students should be able to:

- state the principle
- relate the factors affecting the principle
- understand the available experiment or natural phenomenon
- perform calculation or problem solving through specific methodology
- describe its application
The writer highlights herewith the Archimedes Principle as an example of how the students could follow step by step ways to recognize the principle wholly. Historically this principle is incidentally discovered by the well known Greek mathematician during the 3rd century BC during his bath taking. According to history at that particular time he noticed that as he lowered himself into the bath tub the water displaced by his body overflowed to the sides. He then realised that there was a relationship between his weight and the volume of water displaced.

It is said that he ran naked into the street yelling "heurEka" which is where we get the word "eureka"! The Greek word "heurEka" means "I have found", from "heuriskein" which means "to find". Archimedes was not thinking about ship at the time, he was on a mission to solve a question that was asked by King Heron II of Syracuse, Greek city at that time. The question that the king had asked was about his crown. Was it pure gold or partly silver? Archimedes reasoned that if the crown had any silver in it, it would take up more space than a pure gold crown of the same weight because silver is not as dense as gold. He compared the crown's volume by measuring the amount of water displaced with the volume of equal weights of gold and then silver, he found the answer. He then informed his king that the crown was not pure gold.

Archimedes principle states that if an object is fully or partially immersed in a fluid the buoyant force is equal to the weight of the fluid displaced. Relating the factors affecting the principle such as density, mass and weight will surely enable the students to understand further on the buoyancy and stability concepts. In addition to the experiment carried out as shown in Figure 3 it helps the students to capture the principle directly onto their mind.

By observing the natural phenomenon of the specific principle students should be able to perform calculation based on the derived formula. Only by this approach they could solve problems and determine the results for further interpretation and conclusion.

![Figure 3: Water Displacement Method](image)

**DERIVING A FORMULA**

Formulas are broadly used in mathematics, science as well as the engineering field. In mathematics it is defined as an entity constructed using symbols and formation rules of a given logical language. In science, a formula is a concise way of expressing information symbolically (as in a mathematical or chemical formula), or a general relationship between quantities. Colloquial use of the term in mathematics often refers to a similar construct.

Such formulae are the key to solving an equation with variables. For example, determining the volume of a sphere requires a significant amount of integral calculus; but, having done this once, mathematicians can produce a formula to describe the volume in terms of some other parameter (the radius for example). This particular formula is:

\[ V = \frac{4}{3} \pi r^3. \]

Having obtained this result, and knowing the radius of the sphere in question, we can quickly and easily determine its volume. Note that the physical quantities \( V \), the volume, and \( r \) the radius are expressed as single letters.

Knowing only the formula and performing the calculation using that established formula is quite simple. For students in mastering the course they must be able to perform beyond this secondary level of knowledge.
They ought to understand the concept, especially the principles and related laws together, to be able to derive the formula. With this deriving skill they may achieve the standard level of cognitive domain of evaluating and creating. Formulae are now given to the students directly during their learning process. Seldom, in tertiary education, the lecturers or educators provide derivation to the formulae or teaching the students to derive themselves even with the students’ learning time concept as a learning approach. This factor may seem trivial in modern education with the availability of the latest versions of program software where the data simulation can produce results intrinsically while maintaining the principles, laws and formulae concepts.

Comparatively we may observe the products of education today with the last three decades that reveal quite a huge gap in terms of the level of knowledge in understanding the fundamental concepts and recognizing the related principles. The writer emphasizes this phenomenon for the sake of nation building to reveal the root cause why the students end up being unemployed even with excellent examination results. Posing this global issue in this article may not be effective in convincing readers especially whose works are related to education to take remedial action collectively in eliminating this syndrome but at least the issue can be further analyzed for future benefits.

**CORRELATING WITH APPLICATION**

Throughout the students’ learning process they have acquired a lot of information to help them survive their journey in this world. Are they ready to overcome the ever changing cutting edge technology? An understanding of fundamental concept, enriching in terminology vocabulary, expertise in defining, laws recognition and excellent in deriving formula are the five probable solutions that the writer have elaborated above that are sufficient in helping students master such a program provided they could correlate all these five with application.

We could collect many research data, insert them into a program and finally we would get the results. This application is called direct application of the software. But we must be aware that all concepts have their related principles and branches of laws, especially in engineering. They must be interrelated and correlated with the intended application or appropriate usage. For example, in football or soccer a lot of concepts have been applied. Most footballers apply plenty of impulsive force concepts. While kicking a ball, they need to shorten the time of impact to produce bigger force. Thus they can kick the ball with powerful shots on goal.

Even some boots are designed to give better impact during a shot on goal. Moreover, while passing the ball they use the inside of the foot and provide the largest surface area to contact the ball. This gives them a better control of where the ball should go. Meanwhile the keeper should always increase the time of impact while catching the ball. By doing this the ball will exert minimum force, in the end he can catch the ball easily. Thus the application of a pair of glove is needed to suit this purpose. Heading the ball also applies some physics concept. We can make full use of the ball’s momentum. When our head collides with the ball, we share our momentum with it. The more momentum the ball gets from us, the faster and farther it will move. The bigger we are and the faster we are moving, the greater our momentum will be, and the more momentum we will have to share with the ball.

Those examples proved that concepts and principles correlate to application. Figure 4 showing the Archimedes principle correlates with the application of submarine in which Archimedes himself was not thinking of even a ship at the time he discovered the principle.

Another example is the Magnus Effect which describes the curved path that is observed by spinning projectile as shown in Figure 5. It correlates the Bernoulli’s principles with the application of jumping serve in the volleyball game.

The writer insists to express further with a short evaluation of the so called "Bend it like David Beckham" phenomenon. In football a free kick taker should at least learn Bernoulli’s principle so that he can bend the ball like David Beckham or Christiano
Ronaldo. Therefore to bend it like David Beckham the ball should be simply kicked slightly off center, causing it to spin horizontally. When the ball travels, air moves over the ball. The air will move more quickly around one side, making less pressure on that side of the ball (referring to Bernoulli’s Principle faster speed of air means lower pressure) [3]. On the other side of the ball, the air moves more slowly, as the spin is going directly against the flow of the air, causing more pressure on that side of the ball. The ball is pushed in the direction from high pressure to low pressure, making the ball curve. The spinning ball produces different speed which produces difference in pressure. Thus a resultant force is produced which causes the ball to be bent with a curvy motion.

Nevertheless the ability to master such a course would not be possible if the final way has not been acquired by the students. Blending all the other six ways with the ‘guided practicing’ which will be discussed later in this article would make the students develop their skills in mastering the course undertaken by them.

GUIDED PRACTICING

We always hear the phrase ‘Practice makes Perfect’ throughout our learning process. However do the students really apply and utilize this motivational quotation during their learning time? If they do, how effective would be their practicing? Actually, it is not adequate to just doing repetitively without being guided by any lecturer or mentor in such a course or program. The students themselves must ensure to acquire knowledge on how to practice effectively and efficiently to enable them to master in any course they undertake and the lecturers or mentors are responsible to guide systematically through the process. How well the student improves with practice depends on several factors, such as the frequency it is engaged in, and the type of feedback that is available for improvement. If feedback is not appropriate (either from an instructor or from self-reference to an information source), then the practice tends to be ineffective or even detrimental to learning. If the students do not practice often enough, reinforcement fades, and they are likely to forget what was learned. Therefore, practice is often scheduled, to ensure enough of it is performed to reach one’s training objectives. How much practice is required depends upon the nature of the activity, and upon each individual capability. Some students improve on a particular activity faster than others. Practice in an instructional setting may be effective if repeated only one time (for some simple verbal information) or three times (for concepts), or it may be practiced many times before evaluation (Morreti, 2009).

Given that practice is merely the reinforcement of actions that serve to generate an outcome or outcomes, it is believed that by improving the type of practice the students do, they could in turn generate results at a faster rate. But all of these are interdependent within the level of knowledge, creativity and analytical skills as well as attitude possessed by the students.
According to the blog author of ‘Practice Made Perfect’ Roberto Moretti (2009) has identified five key processes for efficient practice namely:

- Identification: building an awareness of what you are practicing to ensure you know how to do it perfectly
- Isolation: the selection and focusing on something that is the proper size for one’s focus to process and execute with a high degree of perfection.
- Reinforcement: the action of consistently and continuously repeating the above-selected action so it becomes autonomous.
- Integration: the practicing of interrelated actions either one after each other or together to construct and train in more complex actions or sequences of actions.
- Escalation: consistently selecting new practice material congruent with one’s goals in skill acquisition as previous material is mastered.

Thus, guided practicing is primarily essential to the students pursuing their study either in the university, colleges or institutes for better mastering of their course. Apart from that the mentor or lecturer should be equipped with relevant skills to inculcate into the students to achieve perfect performance throughout their learning process.

**DISCUSSION AND INTERPRETATION**

Every course has its goal and objective. Every individual has his aim and ambition in life. Each of us has to undergo training and educate ourselves in achieving what we have planned for. As for students they go through a formal learning process with the aim of prospering their future life. However, prior to being accepted by an organization, locally or internationally, they should be prepared mentally and physically in realizing their vision. Their level of knowledge should commensurate with their diploma or degree obtained. How conversant are they in their course could not be verified unless they have been tested not only with the formal assessment evaluated during their learning process but during their working life. The first stage is to pass the interview. Upon recruitment they may escalate through their employment to proceed to the highest level attainable depending on their attitude and aptitude.

In interpreting the ways in mastering such a course the students could possess the higher level of knowledge if they are able to manage themselves and ability to work as a team, apart from following the seven ways as discussed by the writer. Towards better understanding of the article the writer affixes a flowchart on the ways to mastering a course as shown at Figure 6 below.

![Flow Chart on Ways to Mastering a Course](image)

**Figure 6: Flow Chart on Ways to Mastering a Course**
CONCLUSION

Mastering a course is either an art or a science and may be considered as both. It depends on the individual level of knowledge, good attitude and as well as the right aptitude. They are interrelated and influenced by the imperfections of human weakness. However, if the students equip themselves with seven appropriate ways as been listed and elaborated in this article, with proper guidance throughout the learning process together with the adequate resources to facilitate them mentally and physically, surely they would achieve a positive imprint on their minds. They would then ready to be tested, to give constructive views, to propose new designs and ever willing to go the extra mile.

REFERENCES

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Four of UniKL MIMET delegates consists of Mr. Asmawi Abdul Malik, Mrs. Syajaratunnur Yaakup, Ms. Fadzilah Adnan and Mrs. Nurshahnawal Yaacob attended a Seminar on WPC Technology and Memorandum of Understanding (MoU) Signing Ceremony at SIRIM HQ, Shah Alam on the 26th November 2010. The program started with Welcoming Remarks by YBhg. Dato’ Ir. Hj. Yahaya Ahmad, President & Chief Executive of SIRIM Berhad. Then the Keynote Address entitled “Bio-composite in Malaysia” was delivered by YBhg. Dr. Jalaluddin Harun, Director General of Malaysian Timber Industry Board (MTIB). The signing ceremony took place just right after the speech and the event ended with a Project Presentation entitled “Introduction to Bio-composite ‘Green Furniture’ ” by En. Nor Azlan Mohd Ramli of SIRIM Berhad. After the Q&A session, all delegates were taken to Exhibition Area to witness the Green-Furniture made from Rice Husk Bio-Composite which is used as an alternative to natural wood. Bio-composites (Wood Plastic Composites – WPC) are composite materials that contain natural fibers (in various forms) and thermoplastic materials.
The 2nd Brainstorming Session was successfully done on the 10th December 2010 with 10 participants. The session which was the continuation of the 1st brainstorming session was able to deliver at least 41 research interests. The session serves as a platform for the academicians to generate ideas for UniKL MIMET research development.
Field Emission Scanning Electron Microscopy (FESEM) and Energy Dispersive X-Ray Spectrometer (EDS) Seminar was held on the 13\textsuperscript{th} April 2011 at Advance Technology Training Centre (ADTEC) in Kamunting, Taiping, Perak. The half-day seminar was attended by more than 100 participants and was sponsored by Hi-Tech Instruments Sdn. Bhd.

UniKL MIMET was invited to participate in the half-day seminar and UniKL MIMET delegations includes Head of Campus, Prof. Dato’ Dr. Mohd Mansor bin Salleh, Head of Section of Marine Construction and Maintenance Technology Section, Mr. Kamarul Nasser Mokri, R&D Coordinator, Mrs. Nurshahnaval Yaacob, lecturers from Applied Science and Advance Technology Section, Mr. Zulzamri Salleh, Mrs. Syajaratunnur Yaakup, Mrs. Syarmela Alaauldin, Ms. Fadzilah Adnan and Ms. Leanna Ismail along with one lecturer from General Studies Section, Mrs. Norazizah Che Mat.

The half-day seminar was officiated by ADTEC Director, Tn. Hj. Nik Othman bin Daud. Two papers were presented by the Application Section Head of Hi-Tech Instruments Sdn. Bhd., Ms. Seow Siew Siew: The Principle of SEM-FESEM and its Applications as well as The Principle of Energy Dispersive X-Ray Spectrometer (EDS). The technical papers presented are useful for those involved in research work especially in the analysis part.
Fundamental Research Grant Scheme (FRGS) is a research grant offered by Ministry of Higher Education (MOHE). In Phase 2/2010, UniKL submitted 10 applications whereby four of the applications were from UniKL MIMET in the month of July. After a long wait, UniKL was finally informed of the good news regarding the approved application and the application was from UniKL MIMET.

‘Thermomechanical Properties of “Komeng” Coconut Enrichment with Activated Carbon Filler Polypropylene Composites’ was the approved research project submitted by Mr. Zulzamri Salleh who is the Main Researcher and also a Lecturer from Applied Science and Advance Technology (ASAT) Section. Another two researchers involved in the project are Dr. Mohd Yuzri Mohd Yusop, Deputy Dean (Academic) and Mr. Ahmad Azmeer Roslee, Head of Section of ASAT.

A total of RM43,800 was approved from the initial amount applied which was RM96,200. The official letter from MOHE was handed over by the Dean of Institute of Research and Postgraduate Studies (IRPS), Assoc. Prof. Dr. Mohd Azzizan Mohd Noor during Research Seminar (Grant Under MOHE) held on 28th April 2011 at Dewan Bestari, UniKL City Campus. The handover of the FRGS Letter of Offer was witness by Mrs. Nurshahnawal Yaacob, R&D Coordinator, Ms. Fadzilah Adnan and Mr. Asmawi Abdul Malik, both lecturers from ASAT and MCMT Section who participated in the seminar.
Made in UniKL – The Final Year Project Competition 2011 18th -19th MAY 2011

The Final Year Project Competition 2011 was successfully held on 18th till 19th May 2011 at UniKL City Campus and was officiated by Y.Bhg. Prof. Dato’ Dr. Abdul Hakim Juri the President of UniKL. Five Final Year Projects from UniKL MIMET participated in the two-day competition and compete with a total of 31 projects from various UniKL Campuses.

The first day started with exhibition by the participants at the UniKL City Campus lobby. Each project was evaluated by 4 professional judges led by Assoc. Prof. Dr. Mohd Zahit Ali, Senior Lecturer from UniKL Malaysian Institute of Chemical and Bioengineering Technology (UniKL MICET), En. Ridza Ramza Ramli from SME Bank, Ms. Khairul Mazwan Ibrahim Pati from Multimedia Development Corporation (MDE) and En. Ritakamal Sadiman from e2B Consulting. The projects were assessed based on the originality, uniqueness and commercial values of the inventions.

The top 10 Final Year Projects were announced on the next day at Dewan Bestari, UniKL City Campus. Winners of the competition will represent UniKL to the 2011 National Research and Innovation Competition (NRIC 2011) which will be held at Universiti Sains Malaysia (USM) in June.

UniKL MIMET participation was done at the very last minute of the competition. Even though none of UniKL MIMET projects were selected as the top 10, the participants gave a very good cooperation and put a lot of effort for the exhibition.

The projects that represented UniKL MIMET to the competition were:

1. Steering Gear System by Mohd Zaki bin Yahya, Azrul Effendi bin Alias and Ahmad Farez bin Yacob. The project is supervised by Mr. Faisal Ikram Abd Samad.
2. Miniature Model for Electrical Power Generation, Transmission and Distribution System by Muhammad Asyraf bin Mustaffa, Samsul Anuar bin Ibrahim and Amirul Ridzwan Ramli. The supervisor for the project is Mr. Azhar Othman.
3. Design Assessment: Structural Analysis on Tanker Conversion by Tengku Hamdan bin Tengku Mohd Hanafiah and Mohd Hanis @ Mohd Fadhil bin Mohd Nor. The project is supervised by Mr. Zaimi Zainal Mukhtar.
4. The Investigation of Manoeuvring Test 67.8 m Anchor Handling Tug and Supply Vessel (AHTS) by MATLAB Simulink Software by Joe-Na Thean Chee Yee. The supervisor for this project is Engr. Iwan Zamil Mustaffa Kamal.
5. The Development of a Computer Programme to Calculate Laminating Schedule for GRP Hull according to Class Rule by Mohamad Ashik bin Abdul Kadir and Adawiyah binti Abdul Rahim. The project is supervised by Mr. Asmawi Abdul Malik.
Mr. Asmawi Abdul Malik, Mrs. Nurshahnawal Yaacob and Mrs. Azura Ahmad Radzi were among the lecturers who accompanied the participants for the competition. Head of Campus, UniKL MIMET, Prof. Dato’ Dr. Mohd Mansor Salleh also visitedUniKL MIMET booths during the exhibition.

The competition act as a platform to expose final year student to the line of Research and Development since the criteria looked by the assessor is innovation in the project. The participant accommodations were arranged at UniKL BMI and each participant was given RM 15 allowances per day.
On March 11th, 2011, UniKL MIMET delegations participated in the 18th program of the Malaysian Toray Science Foundation (MTSF) Promotional Road Show which was conducted at Universiti Tunku Abdul Rahman (UTAR) at Kampar Campus.

MTSF under Toray Malaysia group is a privately funded charitable organization with the primary objective of advancing science and technology in Malaysia. The Malaysia Toray Science Foundation was established in 1993 through a RM4 million endowment by Toray Industries, Inc. Japan.

The foundation offers three types of grants: Science and Technology Award, Science and Technology Research Grants and Science Education Award.


The road show had motivated the academic staff to apply for more external grants which is in line with the university mission. UniKL MIMET delegations consisted of four lecturers, Mrs. Syajaratunnur Yaakup, Ms. Fadzilah Adnan, Ms. Norazlina Abdul Nasir, Mr. Asmawi Abdul Malik and R&D Coordinator, Mrs. Nurshahnawal Yaacob.
To inculcate the research culture amongst academics, Universiti Kuala Lumpur Malaysian Institute of Marine Engineering Technology (UniKL MIMET) is publishing the Marine Frontier@UniKL Research Bulletin. For a start, the bulletin will be published four times a year, in January, April, July and October. Original research papers, which have not been published or currently being considered for publication elsewhere, will be considered.

**Accepted Types of Research**
The papers accepted for the bulletins must be based on any of the following types of research:

- Basic research (pure basic research and strategic basic research)
- Applied research
- Experimental development
- Critical review

Pure basic research is experimental and theoretical work undertaken to acquire new knowledge without looking for long-terms benefits other than advancement of knowledge.

Strategic basic research is experimental and theoretical work undertaken to acquire new knowledge directed into specified broad areas in the expectation of useful discoveries. It provides the broad base of knowledge necessary for the solution of recognised practical problems.

Applied research is original work undertaken primarily to acquire new knowledge with a specific application in view. It is undertaken either to determine possible use for the findings of basic research or to determine new ways of achieving some specific and predetermined objectives.

Experimental development is systematic work, using existing knowledge gained from research or practical experience that is directed to producing new materials, products or devices, to installing new processes, systems and services, or to improving substantially those already produced or installed.

Critical review is a comprehensive preview and critical analysis of existing literature. It must also propose a unique lens, framework or model that helps understand specific body of knowledge or address specific research issues.

**Condition of Acceptance**
The editorial board considers all papers on the condition that:

- They are original
- The authors hold the property or copyright of the paper
- They have not been published already
- They are not under consideration for publication elsewhere, nor in press elsewhere
- They use non-discriminatory language
- The use of proper English (except for manuscripts written in Bahasa Melayu-applicable for selective only)

All papers must be typed on A4 size page using Microsoft Word. The complete paper must be approximately 3,500 words long (excluding references and appendixes). The format is described in detail in the next section.

All papers are reviewed by the editorial board and evaluated according to:

- Originality
- Significance in contributing new knowledge
- Technical adequacy
- Appropriateness for the bulletin
- Clarity of presentation

All papers will be directed to the appropriate team and/or track. The papers will be reviewed by reviewer(s) and/or editor. All review comments and suggestions should be addressed in the final submission if the paper is accepted for publication, copyright is transferred to the bulletin.

Please submit your paper directly to the Chief Editor- drmansor@mimet.unikl.edu.my or the Executive Editor-myuizi@mimet.unikl.edu.my for publication in the next issue of the Marine Frontier@UniKL.