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Maritime Engineering



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I am honored to be part of the backbone that supports Malaysia's transportation infrastructure. My 30 years at PLUS have not only enriched my engineering expertise but also allowed me to contribute to enhancing the efficiency and safety of our nation's mobility network.

Ir. Ts. Adam Junid
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Engineers carry a vital responsibility and commitment to public safety throughout design, construction, testing, installation, operations, maintenance and decommissioning phases. Beyond this fundamental duty, our team embodies MyPLUS Culture Practices of 'I Constantly Learn, I Collaborate, I Am Accountable, I Build Trust, I Care, and I Embrace Change'. These MyPLUS Culture Practices support professional growth, preparing them for long-term success in their careers.

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Maintenance and
Asset management

PLUS promotes the value of constantly learning with great appreciation for those who are willing to put their best efforts in gaining knowledge. I have obtained my Professional Technologist, my Chartered Professional Civil Engineer, my Professional Engineer and most recently the accreditation as Professional European Engineer from Engineers Europe Engineering Council. The accreditation received would be crucial in promoting the drive for PLUS in being the best in Highway and Transportation Asset Management within a fast-moving Malaysia's transportation infrastructure industry.

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CALL FOR ARTICLES

The Ingenieur is published quarterly by the Board of Engineers Malaysia. The following are the themes for the coming issues.

Vol. 104 Oct-Dec 2025

Construction Industry

Vol. 105 Jan-Mar 2026

Engineering Practice

Vol. 106 Apr-Jun 2026

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Articles and other contributions relevant to the themes are welcomed, but the decision to publish rests with the Editorial Board.

Advertising inquiries are also welcomed. Please refer to the BEM advertisement on Page 60 for the latest rate card and booking form.

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Maritime Engineering



Datuk Wira Ir. Roslan bin Ismail

**President
Board of Engineers Malaysia**

Malaysia's strategic geographical location, coupled with a coastline stretching over 4,600 kms and more than 30 major and minor ports, positions our nation as a vital maritime hub in the region. The maritime industry plays an indispensable role in driving the country's economic growth, facilitating global trade, energy exploration, and marine-based industries. As such, the development and sustainability of this sector is of strategic national importance.

The engineering fraternity contributes significantly to every facet of the maritime industry. From shipbuilding and repair to port design and operations, engineers ensure the efficiency, safety, and competitiveness of our maritime infrastructure. Mechanical and electrical engineers support vessel design and maintenance, while civil and structural engineers provide the expertise in developing resilient port facilities. Equally important are offshore engineering activities, where advanced solutions are required to meet the challenges of oil and gas operations, renewable

energy projects, and marine resource management.

Rapid technological advances, digitalisation, automation, and green innovations are transforming the maritime landscape. The emergence of smart ports, energy-efficient vessels, and sustainable dredging practices demand a new generation of engineers equipped with multidisciplinary skills and innovative thinking.

The Board of Engineers Malaysia (BEM) remains committed to supporting the growth of the maritime engineering industry through professional development, accreditation, and collaboration with industry stakeholders. Together, we must embrace innovation, enhance sustainability, and strengthen Malaysia's position as a leading maritime nation.

Let us continue to harness our collective expertise to drive the industry forward and contribute meaningfully to Malaysia's Blue Economy and long-term prosperity. 🌊

What We Can Learn from South Korea's Shipyard Production System

by
Ir. Roslin Ramli

PETRONAS

A breakthrough of the PETRONAS Floating LNG Satu (PFLNG1) project, known as the First Floating LNG in the world, was built using the South Korean Shipyard Production System. This paper outlines a general perspective of South Korea's Shipyards: Shipbuilding or Newbuilding (Hull Construction) and Offshore (Topside Modular Construction).

By constructing both PETRONAS Floating LNG Satu (PFLNG1) and Dua (PFLNG2) projects in South Korean shipyards, and now with ZLNG (PFLNG3) in progress, it is imperative to learn how its Shipyard Production System can sustain the demand of the shipbuilding and offshore business model up to date in comparison with other countries, especially in areas such as shipyard facilities, layout and logistic, construction engineering, procurement and material warehousing system, quality management, inspection and accuracy control, digitalisation in shipbuilding, research and technology, outsourcing establishment, and the partnership strategy, and also the appropriate and consistent of work volume and resources such as material, manpower and machinery (3M).

Background of Modern Shipbuilding

In May 1984, the Executive Committee of the Society of Naval Architects & Marine Engineers (SNAME) approved the recommendation of the Ship Production Committee and the Publication Committee that SNAME established the Journal of

Ship Production - The Beginning. The story of the modern shipbuilding establishment which uses industrial engineering principles, the newcomer Fabulous Henry Kaiser known best for heavy-construction projects other than ships, such as the Hoover, Bonneville and Grand Coulee Dams, and the San Francisco Bay Bridge.

Kaiser Revolution in Ship Production System

The Kaiser principle was to organise work to fit the workers instead of vice versa, such as facilitating the hull block system production lines and work volumes by producing concurrent steel cutting, pre-fabrication, fabrication, sub-assembly, assembly, pre-erection and erection, maximising the down-hand welding to permit the weld to flow gravity, minimising the over-head welding with shipbuilding methodologies - built ships bows sideways, deckhouses upside down and shell-sides of ships on the ground, rather than from high, relatively unsafe and costly scaffolding requirements.

In modern ship production, time means victory or defeat. With minimal time consumed on how to build the ship and deliver it, basically recount on the shipyard capabilities and workload will adhere to the following:

- To analyse newbuilt ship by hull blocks size and shape with refined drawing of each weldment, together with machinery,

equipment, piping, architectural, electrical and instrumentation, etc. to be installed or dress-up at assembly shop, area, slot or space.

- To coordinate the procurement and material control, delivery and required on site (ROS) dates.
- To allocate work volume, work front, etc. of labour and timeline, and schedule for each production line. Lean Construction and Just-In-Time (JIT) means high and low productivity control. Hence the modern shipbuilding adoption and disseminating knowledge about how better to organise and control the shipbuilding process and productivity such as welding in covered-workshop, optimisation of fabrication scope of works including equipment installation, pre-outfitting and outfitting items dressed-up effectively and efficiently.
- To maximise on ground (MOG) installation concepts for each discipline such as machinery, equipment, piping, architectural, electrical and instrumentation, pre-outfitting, etc. before hull mega or giga blocks pre-erection and erection stage.
- To reduce the staging to a minimum by introducing the system scaffolding erection standard and to comply with safety requirements.
- To apply inorganic-zinc coating on the steel plates and follow through in the assembly line production system.
- To control the welding distortion and shape of weldments or modules which defy or resist distortion especially when these affect the ship dimension or measurements, and locked-in stresses by the shipyard production quality management on the accuracy or dimension control inspection.
- To maximise the hull mega or giga blocks erection weights and number of hull quantities by reflecting the shipyard floating crane capacity and availability i.e.

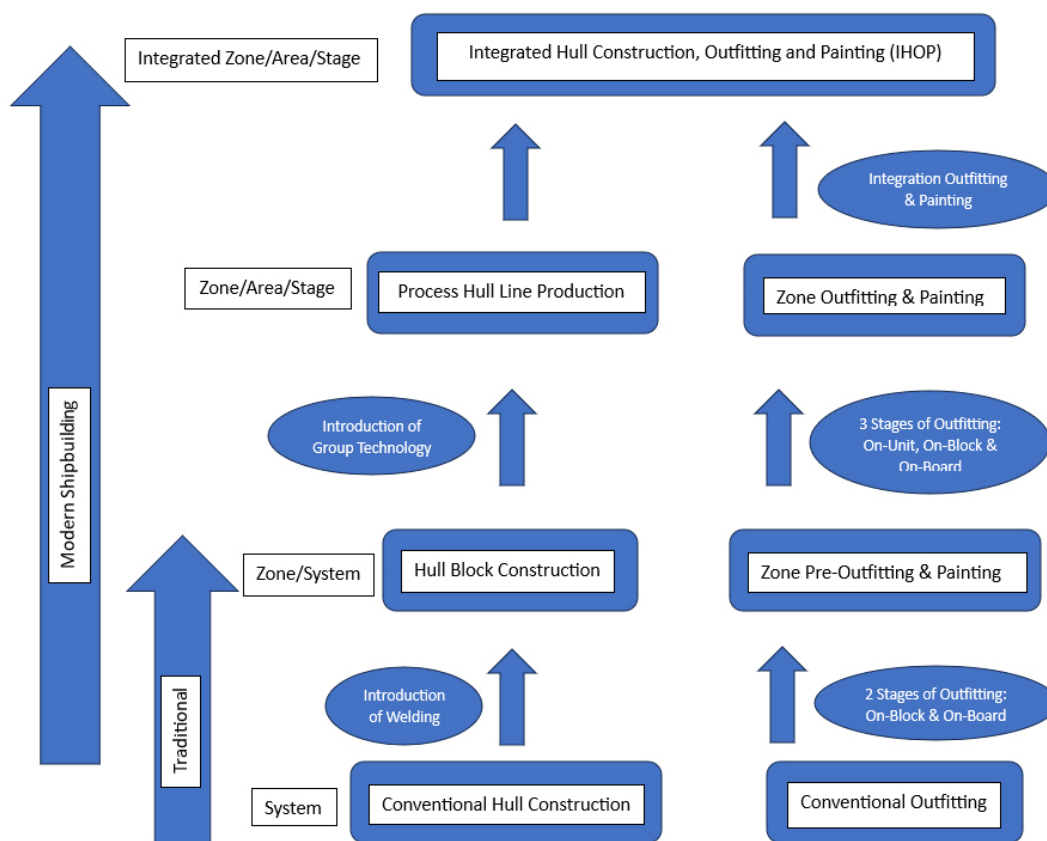
in ranging of 1,500 tons to 3,600 tons and 3,600 tons to 9,000 tons as the basis of the hull blocks shop production concept and design selection. By doing so, the shipyard production is able to produce and erect the hull mega and giga with full dress-up of the equipment and outfitting installation upon the hull launching thus shortening the delivery time effectively and efficiently.

Breaking With Tradition

Figure 1 shows the history of basic improvement in shipbuilding methods to achieve the hull production line, and zone outfitting and painting by applying the Product Work Breakdown Structure (PWBS) as a framework for change and as a truth not to be argued with. Realisation exploited the Statistical Control Methods (SCM) and production process flow is breaking with traditional into the modern shipbuilding is juggernaut which constantly “feels the pulse” of process lane, which constant problem solving by all levels of the workforce and management, and which is constantly and significantly improving the quality and productivity.

An Integrated Hull Construction, Outfitting and Painting (IHOP) and Design for Zone Outfitting addresses the improvement and advancement that the traditional shipbuilders have put in modern shipbuilding technology development.

With such application and dissemination of statistical methods where statistic is the branch of mathematics and a simple arithmetic that deals with the description and interpretation of variation. Hence, the statistical control “epoch making” improved quality, laid the foundation of modern ship construction methods and made it possible to extensively develop automated and specialised welding and also address systematised heating and cooling to accurately form even complex curvatures in hull plates cutting and assembly process.



Industrial manufacturing principles & modern shipbuilding methods

Figure 1: History of basic improvement in shipbuilding methods

Industrial Manufacturing Principles & Modern Shipbuilding Methods

The systematic nature of manufacturing is the ability to analyse any influence for its impact on the entire manufacturing system. The management dilemma with the problem statement and Standard Operating Procedures relies on the new methods and is now introducing innovations that will constantly improve an entire shipbuilding production system.

Nonetheless, the group technology addressed the problem inherent in its manufacture such as:

- Pipe Design - Classification Code and Standard on the pipe-run code each pipe spools or piece, and pipe shop fabrication, and straight pipe on-board erection

and installation, pipe load, pipe length against the welding joints against pipe fitting such as elbows, bends, valves, gasket, bolt and nuts, etc.

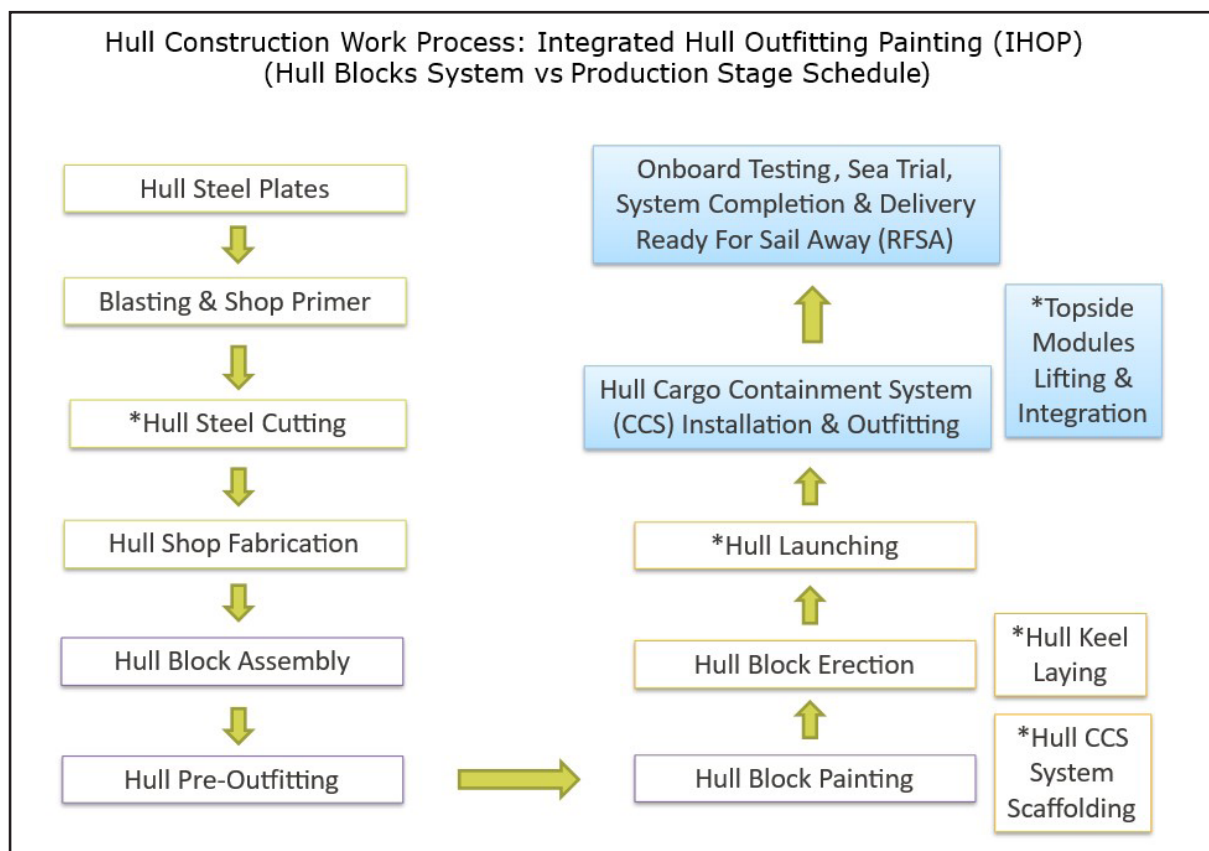
- Greater or optimum pipe length average means fewer field welds (FW) or erection welds (EW) but higher shop welds (SW) fabrication, and with the lower cost for both shop and field joints.
- To monitor productivity improvements by planning and scheduling on the production line statistically and implementing the accuracy or dimension control department in the ship production system.
- To predict how accuracy or dimension control variations per work stage merge or integrate, and impact on welding during the critical mega or giga hull blocks hull erection stage.

- To develop the ship design master deliverables list on the ship technical specification, detailed ship design and engineering, ship production work sequences and work methods before work starts including the rates for realisable improvement in bidding for ship construction.
- To promote the world's most effective shipbuilding methods with great emphasis on organisation of work and statistical analysis.
- To exposure the BSc degree in naval architecture to advanced ship production concepts including statistical methods, industrial engineering courses, shipyard resources employment, etc. indicates contraction of shipbuilding industries in all modern economics through the massive shipbuilding education programme.
- Constant shipbuilding technology and system are essential elements of shipyard production and adopting analytical means for constantly improving their manufacturing systems.
- To disclose the proprietary information such as lightship weight or hull lines, etc. as contract ship design of a shipbuilding system involving a ship performance, how it will be built and its cost or otherwise detract from a shipbuilder's need to control contract design during negotiation with a client/customer or shipowner.
- To procure and control the material and services are vital aspects of the ship production control including the volume of material, man-hour allocation, vendor data, subcontracting or outsourcing, expediting, logistic, warehousing services, purchasing activities, etc.
- To set up research consortiums such as National Shipbuilding Research Programme, being a cost-shared Government-Industry Programme, which has momentum and is successful.

Systematic and Structured

Based on two large and modern South Korea shipyards, we can see how the shipyard production is very systematic and structured in managing the production lines with the following basic requirements:

- Shipyard Management. The high-level shipyard management has a similar concept as other businesses in managing primary and secondary managements as follows:
 - o Primary Control - Quality Control (Better Product), Cost Control (Cheaper, Productivity and Competitive Products) and Production Planning Control (Earlier Delivery). Partly, the shipyard management also requires the ship project management team to manage each of the dedicated shipowner project team, the approved classification societies including the overall shipyard overhead facilities such as scaffolding management, blasting and painting, quay, space, floating crane and floating dock, marine operation as well as to avoid congestion and downtime within the shipyard area operation by optimising the resources available (manpower, machinery, material, manhours volume) effectively and efficiently.
 - o Secondary Control - Design Control (Technology Product), Material Control (High Standard Product) and Facility Control (Maintenance and Production Line System). Shipyard management also emphasizes ship technology design and engineering, research and development, ship basin model and study, construction engineering (shipyard production engineer), material management system and shipyard maintenance system which offer a better confidence level, competitive cost and good delivery track record to the shipowner during the shipbuilding and offshore projects bidding stage and execution stage.



- Master Production Planning and Scheduling. The overall shipyard workload against the individual project completion per day, per week, per month and per year to be tracked and controlled by Chief Shipyard Officer (CSO). By renaming from Integrated Hull Outfitting Painting (IHOP) to Integrated Structure Outfitting Painting (ISOP) Schedule, it is clearly a combination of the hull and offshore projects as “Structure” - Hull Structure and Topside Structure. Nowadays, the ISOP shipyard production schedule is the key driver to control the individual project in the Korea Shipyard that reflecting the real project schedule to Level 6 and Level 7 (resources, cost and manhours loading) with the right work volume, the right work productivity, the right work space arrangement, the right inspection control, the right material available and Required on Site (ROS)

Delivery with Just-In-Time Methods before the installation plan dates. Any gap that happens between the estimated shipyard production and awarded project manhours will require CSO level to approve, if any. Thus, the South Korea Shipyard Production is always referred to the global impacts of their business model such as the skilled and semi-skilled worker to support their production system.

- Layout. The overall shipyard production layout is well-established from the beginning so that expansion can be done with minimum impact to the current and forecast or projection workload or project such as the floating crane capacity, gantry crane capacity, floating dock capacity, workshop facilities including the pre-fabrication, assembly and pre-outfitting, scaffolding, blasting and painting, shipbuilding and offshore pre-erection areas. Normally, the concrete

Typical: Topside Block Erection & Integration Area

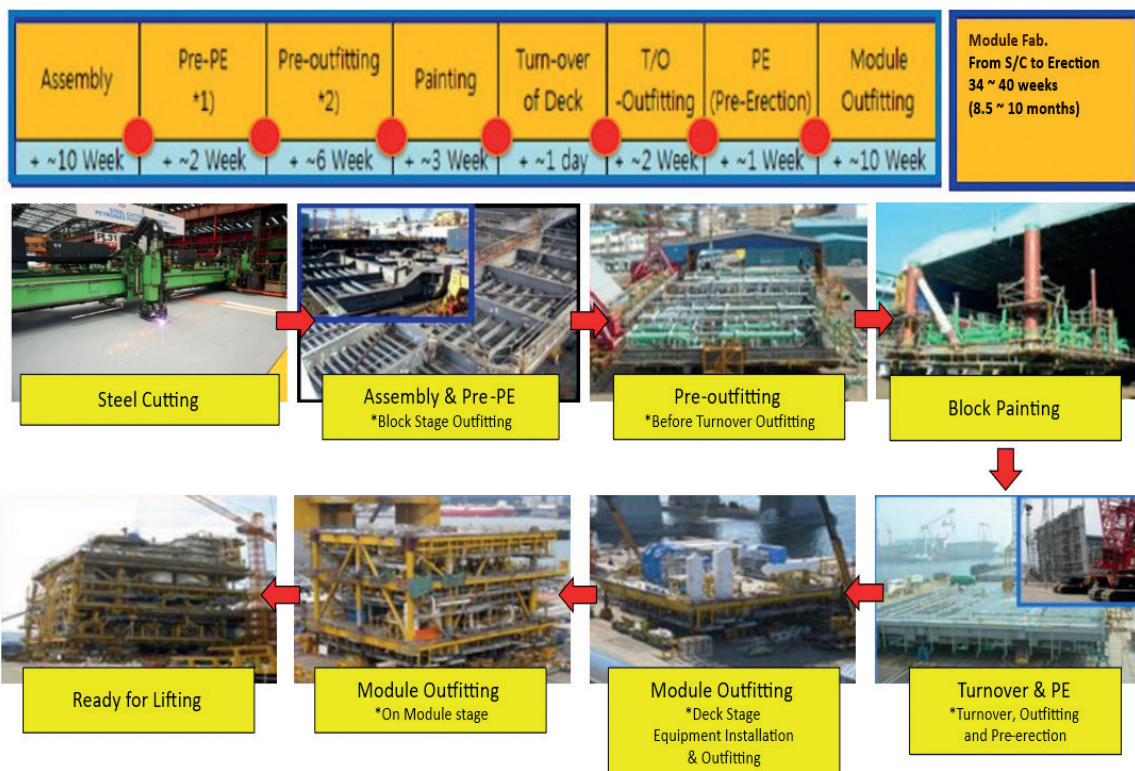


or ground base foundation for mega (weight under 3,000 tons) or giga (weight above 3,000 to 7,000 tons) hull blocks or topside modules are available and sufficient. It's good that the South Korea Shipyard layout is 100% concrete surface foundation for the heavy and light duty areas based including shipyard road and transportation to cater to any hull block and topside deck movement within the shipyard production workshop for fabrication and painting, and to the nearest quay pre-erection areas.

- Space and Area or Slot Arrangement (Shipbuilding and Offshore Projects). This is the key success factor where the South Korea Shipyard Production System is able to sustain until today, and will remain competitive in future if the application of the advanced inspection method is used, such as robotic welding, digital radiograph, special blasting and painting spray tool and equipment, etc. The limitation and congestion within the shipyard space and area due to the fact of production line system such as hull blocks system movement from the steel plate cutting workshop to the pre-fabrication to sub-assembly, and to assembly with pre-outfitting installation (called Indoor Production) workshop base activities with control environment and better production quality standard with increasing the shipyard productivity before transferring or moving the hull blocks to Outdoor Production, open area base activities which require a big space area for mega or giga hull blocks arrangement by using the road transporter within the shipyard or by using the shipyard floating crane to lift the hull blocks to the dedicated pre-erection area or into the floating dock for the hull blocks erection before hull is ready and complete for launching.
- Special Facilities and Services Workshop. The overall shipyard facilities and workshop include the maintenance workshop, machinery, tool, equipment, medical services, canteen and food services with shipyard subsidiaries for the workers, making the working hours and work productivity better and more consistent. Bus shuttle services and a route timetable allow the workers to work effectively and efficiently.

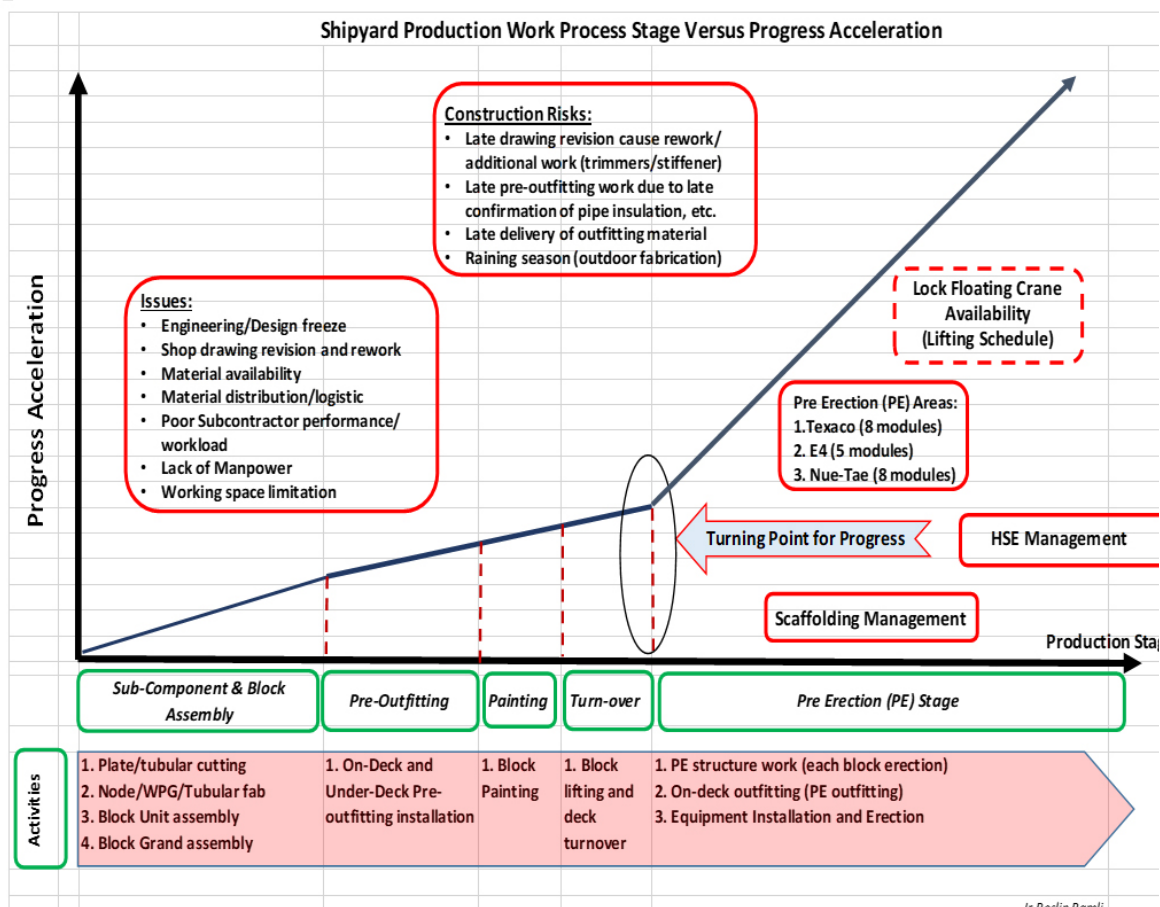
- Logistic. The overall location plays an important role in effective shipyard production system. Typically, South Korea Shipyard locations are easily accessible by land, sea and air from the nearest city, port and airport. Hence the business model and eco-system, and door-to-door delivery from the origin to the shipyard is well-established and efficient including accommodation, good infrastructure, security, etc. In addition, support services come from local suppliers and fabrication subcontractors' workshop for the steel platform and support, pipe spools and pipe support, cable support and ladder, etc.
- Scaffolding Management. The scaffolding for the shipyard helps cut costs, improves safety and increases efficiency. Introducing the scaffolding allows fast erection as well as pre-assembly of scaffolding segments for quick and safe access for repair or modification whether on the ship's curved hull, the propeller and rudder, the superstructure or inside the cargo area or tank.
- Quality Management (QM). The quality management section is responsible for making the shipyard production control in-process and final inspection is carried out in accordance with the project specification, classification societies, code and standard, and shipyard quality standard (SQS). The shipyard quality system is well-managed as follows:
 - o Quality Plan - Activities to manage the overall quality of the shipyard production planning.
 - o Quality Assurance - Activities to ensure the products meet the specified requirements and standards.
 - o Quality Control - Activities to improve the quality of products and overall production efficiency.
 - o Accuracy or Dimension Control - Activities to improve design or detailed engineering and work methods in order to maximise productivity.
- o Total Quality Management (TQM) - Activities to signify all-encompassing application to product, safety, cost, and sales including a board-quality of services, information, work processes, material control, construction engineering, etc.
- Construction Engineering (Production Engineering). This is major best practices supporting the roles and responsibilities of the South Korea Production System in control and competitive by producing the shop or fabrication cutting plan drawings from multi-disciplines detailed engineering (approved for construction) deliverables such as structural, piping, mechanical, electrical, instrumentation, and telecom and control including the pre-outfitting and outfitting, welding control, lifting study, weight control, hull launching calculations and inclining test, pre-commissioning, testing, sea trial, commissioning, and Delivery or Ready for Sail Away (RFSa). The production of the shop drawing schedule will determine the timeline of each production line system, either indoor or outdoor, or outsourcing or subcontractor, or within the shipyard production mass line and ready for pre-erection stage, and subsequently move to the Integration Phase and Delivery.
- Accuracy Control or Dimension Control. The objectives of the accuracy or dimension control are:
 - o Grasp, analyse and control dimensional errors generated in each work process.
 - o Reduce the standard deviation by improving methods of each work process.
 - o Determine offset of mean value aimed to place or allocate the distribution pattern within the approved tolerance as much portion as possible.
 - o Establish working procedure that minimise cumulative errors.
 - o Improve design practice in order to apply production methods in the most efficient manner.

Typical: Topside Block Erection Sequence



Typical: Hull Block Construction Sequence





- Procurement and Material Management. The work instruction or order, and purchase order of the material take-off (MTO) with the shop drawing follow the production line system by:
 - Material List by System (MLS).
 - Material List for Fittings/Zone/Area/ Stage (MLF).
 - Material List for Pipe Spools (MLP).
 - Material List for Component (other than pipe) (MLC).
 - Equipment Tag Items (Long lead Items and Critical items)
 - Material Availability Concepts - Just in Time (JIT).
 - Shipyard Center Warehousing Inventory System - Bulk Material and Storage Area.
 - Material Receiving Inspection (MRI).
 - Material Preservation Programme.
- Subcontract or Outsourcing Management. This area of strategy is the determination factor on how the South Korea Shipyard Production System is sustained up to date, and will continue to be competitive in global shipyard production. With the shipyard production planning and method, the integrated hull construction, outfitting and painting (IHOP) is able to carry-out parallel work activities by subcontracting and outsourcing the component work scopes to external shipyard fabrication workshop companies or abroad such as China, Vietnam, Malaysia, Singapore etc. The enterprise of the shipyard business model and relocation of the South Korea Shipyard Production System internationally makes the shipbuilding, offshore, oil and gas projects rapidly, globally and sustainability, so far.



Photo 1: PFLNG1 Topside Module Lifting

- Health Safety Environment and Security (HSES) Management. The enhancement of shipyard health, safety, environment and security management from the shipyard standard practice to the oil and gas, and offshore business standards make significant impacts in global safety compliance at the shipyard workplace. The safety best practices, lesson learnt, and control are now implemented in the South Korea Shipyard Production System such as the workshop safety hazard identification, job hazard analysis (JHA), permit to work (PTW), simultaneous operation (SIMOP), safety risk assessment (SRA), safety shipyard maintenance audit and programme, equipment and crane safety inspection checklist, as well as the worker safety induction training, health check, fit-to-work programme, etc.
- Number of floating crane capacity (ranging of 1000 ton to 9000 ton).
- Number of floating docks to cater the shipyard space congestion.
- Number of warehousing, storage and laydown areas.
- Number of resources, manpower, manhour and work volume.
- Number of shipyard utility supplies such as temporary nearshore power, marine operation, etc.
- Number of shipyard emergency response plan and crisis management such as fire truck, medical center, hospital, typhoon protection, emergency rescue team (ERT), etc.
- Number of shipyard security gates and accessibility routes for in-land or sea transportation material or block delivery.

The shipyard layout, logistic, location and selection must follow the shipyard production line:

- Number of quay-side with the right water level.
- Number of quay-crane and pre-erection gantry crane with the right heavy soil bearing load to cater to the mega and giga hull blocks and topside modules.

Marine Technology Education in Malaysia

The curriculum of marine technology education in Malaysia should focus on the following:

- Education Programme Outcome (PO1): Engineering Knowledge.
- Education Programme Outcome (PO11): Project Management and Finance.

With the focus on the engineering principles and knowledge, the shipyard production technology perspectives are very wide and not limited to the marine or ocean or oil and gas or ship or offshore but can also apply to in-land project modularisation and manufacturing, and pre-fabrication workshop. The combination of PO1 and PO11 will provide better employment in future for shipyard production.

Employment in shipyard production technology can be divided into two categories:

- Naval Architecture and Discipline Engineering. Degree and above. This group will also to be split into Detailed Design and Engineering, and Production Construction Engineering.
- Naval Architecture and Discipline Engineering. Diploma and Professional Certificate in Quality Inspection or Project Management. This group will focus on the skilled or semi-skilled worker, technician, general inspector, line quality control, welder, foreman, supervisor, shop drawing designer and draughtman/draughtswoman, etc.

PO11: Project Management and Finance will demonstrate knowledge and understanding of shipyard production management and entrepreneurial principles on how to manage the production projects in multi-disciplinary environments.

University and Industry Shipyard Production Partnership

A smart partnership programme of University and Industry (U&I) Shipyard Production can be developed and established:

- Internship Programme in ship design, including naval architecture fundamental and marine engineering system, ship classification and technical specification.
- Internship Programme in ship production including the hull structure, hull outfitting, hull machinery, hull cargo tank, hull painting, hull welding process

and technology, hull piping system, hull erection, hull material and corrosion, hull launching and sea trial.

- Internship Programme in shipyard shop drawing production including the construction engineering in the lifting study, crane specialist, weight control report, inclining test, etc.

The partnership should not be limited to naval architecture, marine or offshore engineering but must be opened to all engineering disciplines in order to optimise the shipyard production system output and productivity.

Malaysian Research Institute of Ship & Ocean Engineering

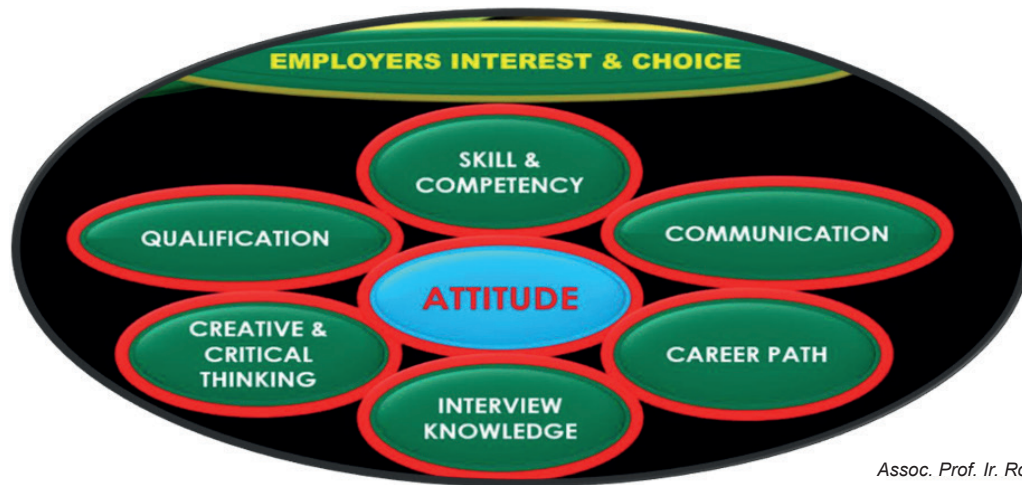
To set up or develop the Malaysian Research Institute of Ship & Ocean Engineering under a government high-technology agency that integrates local universities, colleges or polytechnics, ship and ocean design consultants, marine vendor, and local shipyard or marine or offshore heavy industries to contribute and participate in the shipyard production system with the future smart mobility research through IoT-based technology, ship digitalisation system through the workshop production, and shipyard welding production technology.

Typical: Job Descriptions of Naval Architect or Marine Technology Engineer (Hull and Marine)

- To liaise with consultants, classification societies and manufacturers for the development of design in accordance with the contractual requirements such as general arrangement, hull form design, hull structure and scantling, hull accommodation layout, marine system, etc.
- To initiate purchase of equipment and materials via quotation, procurement data base, etc.
- To study and compare various types of equipment and then recommend the most suitable.
- To prepare purchase order specification of equipment, materials and fittings.

Top Soft Skills...

- Versatile in turbulence economic and job crisis
- Move from engineering base to managerial skills as early as possible
- Multi-tasking skills in project engineering versus project management
- Venture in overseas job opportunity and gain the technology-know-how
- On-Job-Training (OJT) scheme provides the real job scope



Assoc. Prof. Ir. Roslin Ramli

- To calculate and design various system and installation according to contractual requirements and marine practice.
- To collect data and information for future work.
- To organise training courses for Operation & Maintenance crew training including preparation of syllabus and schedule.
- To attend equipment inspection, commissioning and sea trials to ensure that the performance of equipment is met.
- To attend the design problems encountered during construction or testing and to propose remedial action and field engineering support i.e. Site Technical Query (STQ), Field Design Change (FDC), Site Design Modification (SDM), and Technical Deviation.
- To study feasibility of constructing a new vessel for an enquiry.
- To estimate cost of building a new vessel, new offshore platform, new topside process plant, etc.
- To prepare tender plans, documents for submission for bidding, technical evaluation, etc.
- To prepare contract technical specification work scope for subcontract work and to participate in negotiation for selecting of contractors.
- To coordinate and liaise with contractors to ensure that quality of materials and workmanship meets specifications.
- To manage and monitor the field management, equipment installation and erection.
- To estimate conversion cost of existing vessel, topside module process plant, design change, etc.
- To develop work plan and shop drawings, and to delegate the job to draughtsman or draughtswoman.
- To inspect and check equipment receiving at warehouse/general store or premises of vendor, supplier, maker in accordance with contract and project technical specification.



Photo 2: PFLNG1 Sail Away

Conclusion

So why is the South Korea Shipyard Production System so successful?

- Disciplined workforce means higher productivity. Also, South Korea Shipyard Production maximises pre-assembly modularisation concept (on ground fabrication) for both shipbuilding (hull) and offshore (topside modules) production lines.
- System and structure are well established, resulting in shipowner confidence level and excellence track record to deliver projects.
- Machinery and equipment technology are ready and available regardless of the type of shipbuilding or offshore/oil and gas projects.

- Engineering marvels and innovation are key to the success of South Korea Shipyard Production in developing future marine technology including offshore, floating-wind, shipbuilding, oil and gas in nearshore and onshore. 🏆

Special acknowledgement to:

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Practical Approach to Subsea Vehicle Control and Communication

by
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A subsea vehicle refers to a broad category of systems, including Remotely Operated Vehicles (ROVs) and subsea trenchers, which are used extensively for underwater tasks such as inspection, maintenance, and seabed preparation within the marine and offshore industries.

Subsea vehicles are vital tools for underwater operations, particularly in offshore energy, marine infrastructure, and research applications. They enable safe, efficient, and precise work in harsh underwater environments which are often inaccessible to humans. These vehicles play a crucial role in supporting the operation, maintenance, and advancement of marine and offshore infrastructure.

Common tasks performed by subsea vehicles include:

- Subsea surveys. These involve activities such as seabed mapping, environmental assessments, and underwater inspections. Such surveys are essential for industries involved in oil and gas exploration, renewable energy projects (e.g. offshore wind farms), and marine research, where understanding the underwater terrain and environment is critical.
- Observation tasks. Subsea vehicles perform detailed inspections of underwater infrastructure, including

Christmas trees (subsea wellheads), vessel hulls, and pipelines. Such inspections are indispensable for shipping, offshore energy production, and marine transport industries, as they help detect corrosion, leaks, or structural damage which can interrupt operations or create environmental hazards.

- Repair and maintenance. Tasks such as subsea welding, mooring chain cleaning, and jacket leg cleaning are crucial for maintaining the integrity and reliability of offshore oil platforms, floating production systems, and other marine structures exposed to demanding underwater conditions.
- Pipe lay and cable lay operations. Subsea vehicles are used to install pipelines and fibre optic cables on the seabed. These activities are fundamental to marine industries, supporting the transportation of oil, gas, and electricity while enabling global communication through subsea fibre optic networks.

Equipped with advanced technologies such as high-resolution cameras, sonar systems, and robotic arms, subsea vehicles allow marine industries to perform underwater tasks safely, efficiently, and cost-effectively. As technology continues to advance, these vehicles are becoming increasingly capable of operating in deeper waters and under more

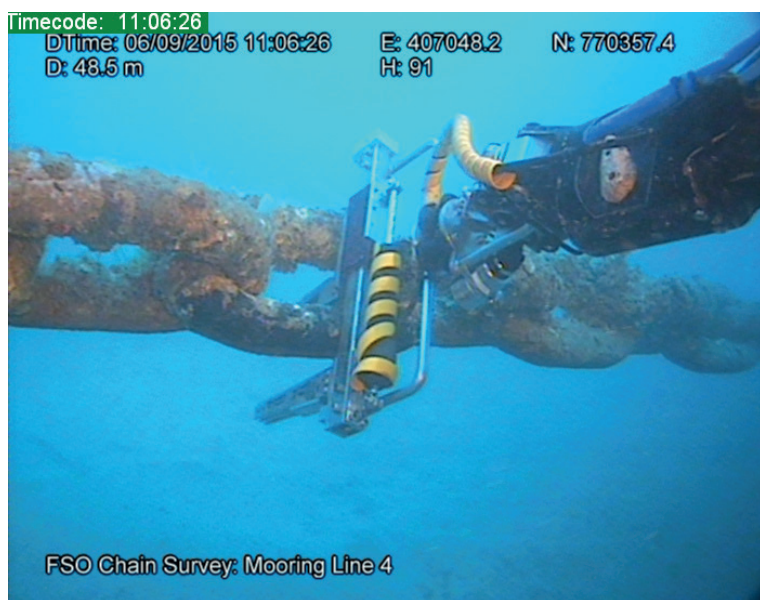


Figure 1: Chain measurement of the mooring line of an FSO. As shown in the photo, a measurement caliper is held by a 7-functions ROV manipulator to measure the thickness of the chain.



Figure 2: Subsea valve closing/opening using a subsea torque tool.

extreme conditions. This growing technological sophistication supports critical industries such as offshore oil and gas, renewable energy, telecommunications, shipping, and marine research.

Furthermore, the rising demand for sustainable energy solutions and improved communication networks underscores the growing importance of subsea vehicles. These systems are set to play a pivotal role in shaping the future of marine and offshore operations by enhancing safety, efficiency, and sustainability.

In IMCA's *Guidance for the Safe and Efficient Operation of Remotely Operated Vehicles* (IMCA R004, Rev. 6)¹, the classification of ROVs is outlined to distinguish the various types of ROVs based on their intended operational capabilities and depth ratings.

- Observation Class ROVs are typically light-duty vehicles with minimal tooling which are used primarily for visual inspections and monitoring at depths of up to 300m.

- Inspection Class ROVs support detailed inspections, such as those required for pipelines or underwater structures, and can operate at depths ranging from 300m to 1,000m. They are equipped with more advanced tools and sensors.
- Work Class ROVs are designed for more complex, heavy-duty tasks like maintenance and installation, typically operating at depths of up to 3,000m.
- Heavy Work Class ROVs are employed for complex and ultra-heavy tasks, with depth ratings extending up to 4,000m.
- Trenching and Burial ROVs are specialised vehicles used for seabed trenching and cable burial, often operating at 1,000-3,000m.
- Hybrid ROVs (HROVs) combine the capabilities of both ROVs and Autonomous Underwater Vehicles (AUVs), with capabilities extending to depths of 6,000m for dual-mode operations.

Specifically, trenching or burial ROV can be categorised into following:

Burial Systems	Available Configurations	General Characteristics
Sleds	• Jetting systems • Rock wheel cutters • Chain excavators • Dredging systems	Routinely deployed from jack-ups or barges and either possess subsea power or utilise power systems which are installed on the said barges.
Free swimming ROVs	• Jetting systems • Dredging systems	Generally conducted and controlled from a barge or a host vessel such as Dive Support Vessel (DSV). They normally work in post lay burial fashion, and are mainly suited for shorter distance with operating depths of up to approximately 2,500m.
Tracked Machines	• Jetting systems • Rock wheel cutters • Chain excavators • Dredging systems	Tracked machines are controlled via a tether connected to the host vessel. Interestingly, not all these machines operate in post lay. A few exceptions, such as the LT1, have the ability to achieve cables laying and burying process concomitantly. Their efficiency can be extended to water depths up to 2,000m.
Ploughs	• Conventional narrow cable ploughs • Advanced cable ploughs • Modular cable ploughs • Rock ripping ploughs • Vibrating share ploughs	Cable ploughs are towed systems usually operated from a host vessel with enough bollard pull to allow a continuous cable burial progress. In principle, the cables are buried along with the laying process. Cable ploughs are suited to a wide variety of soils and are typically deployed for longer distances of operation. Ploughs can operate in shallow and deep-water conditions (up to 1,500m).

Table 1: Overview of subsea trenching technologies (Data from BERR2).

Key Components of Subsea Vehicle System

The Vehicle. The subsea vehicle is the core component, designed for exploration, inspection, maintenance, or research. It can be either remotely operated (ROV) or autonomous (AUV). The vehicle typically houses propulsion systems, navigation sensors, cameras, manipulators, and mission-specific equipment.

Launch & Recovery System (LARS). Essential for deploying and retrieving the vehicle from the water, LARS may include:

- A-frame systems. Robust and versatile, ideal for handling operations in challenging sea conditions.
- Jib cranes. Suitable for deployments with less demanding weight and angle requirements.

LARS ensures smooth and safe vehicle deployment while minimising wear and tear.

Umbilical Winch. Responsible for managing the cable which connects the subsea vehicle to the surface, ensuring the transmission of power, data, and video signals. Its key components include:

- Rotating Junction Box. Provides a secure electrical and data interface while accommodating cable movement.
- Fixed Junction Box. Serves as a stable connection point for power and signal distribution.
- Slip Ring. Enables continuous electrical and data transfer without cable twisting or entanglement.
- Gearbox and Motor. These drive the winch drum, controlling cable deployment and retrieval with precise speed and torque management.

Hydraulic Power Unit (HPU). The HPU supplies hydraulic power for the umbilical winch and other mechanical systems. Most umbilical winches rely on hydraulic power due to its high efficiency and reliability in marine operations. The HPU consists of pumps, reservoirs, filters, and control valves, ensuring stable operation under high pressure.

Control Cabin. The control cabin serves as the command centre for operating the subsea vehicle, housing essential equipment such as:

- Power distribution systems which manage and allocate electrical power.
- Step-up/down transformers which adjust voltage levels to meet system requirements.
- Control panel and consoles which provide operators with tools to monitor and control the vehicle, tools, and sensors.

The cabin is also equipped with communication systems, live video feeds, and backup power supplies to ensure uninterrupted operation.

Power Supply Considerations. The primary power source for the system is typically a generator set or, in some cases, the ship's electrical supply. Power is first routed to the control container, then distributed to

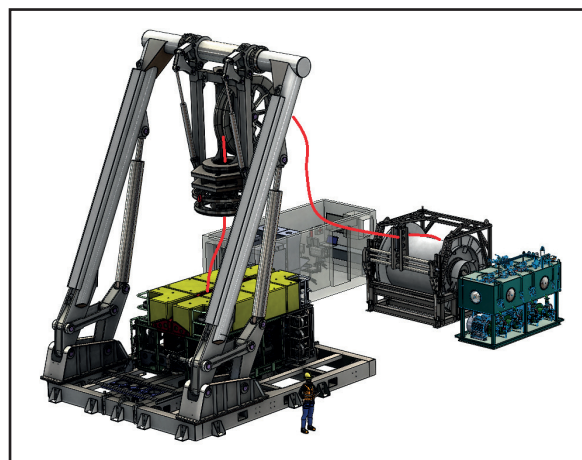


Figure 3: Complete deck arrangement of a subsea vehicle.

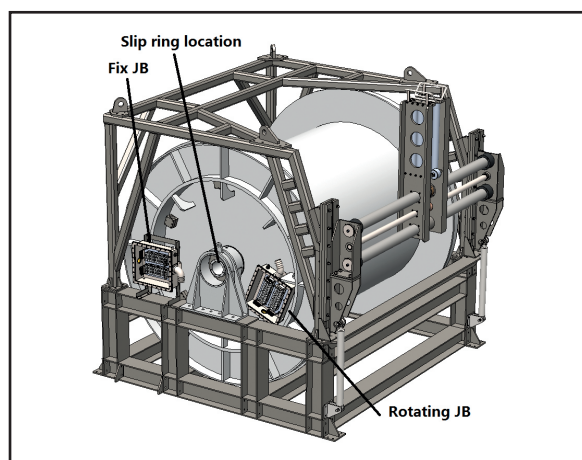


Figure 4: Typical view of an umbilical winch.

the hydraulic power pack and the umbilical winch. Since most winches operate using hydraulic power from the HPU, proper power management is essential to ensure efficient and reliable operation.

Communication System

Regardless of the subsea vehicle class, an effective method of control from the pilot control room is essential. Communication commands (telemetry) are typically transmitted to and from the subsea vehicle via an umbilical cable which may consist of hardwired connections (such as quad cables) or fibre optic cables, or both.

Telemetry data is transmitted between the surface and the subsea vehicle using the following methods to facilitate control.

1. **Hardwire Communication.** Commonly used for distances up to 1,500m, typically utilising the RS485 protocol. Reliable communication can be maintained at lower baud rates (e.g. 9,600 or 19,200 bps) with proper signal boosting or repeaters. The range can be extended further by incorporating repeaters or differential drivers without compromising signal quality.
2. **Fibre Optic Communication.** For longer distances, particularly in deep-water operations, fibre optic systems are the preferred choice as these offer higher bandwidth and extended range. However, the main drawback is the high initial cost of both surface and subsea equipment, as well as the fibre optical slip ring that is required for the umbilical winch. In fibre optic communication, the RS232 protocol is often used for interfacing between the surface computer and the subsea vehicle.

Note: AUVs operate without the need for an umbilical, relying on onboard power sources and sensors to perform their tasks. AUVs are

typically employed in applications such as seabed mapping, environmental monitoring, and scientific research, where continuous real-time communication with the surface is not always required.

For subsea vehicles which require a backup communication method, manufacturers or clients may opt to include additional quad cables within the umbilical. These hardwired quad cables serve as a contingency, allowing communication to continue in case the fibre optic system is damaged or inoperative. Figure 5 shows an example of umbilical cross-section.

The following are common cable assignments for subsea vehicles:

1. **Large Power Conductor.** Supplies power to the subsea electric motor, sized according to the motor capacity and quantity.
2. **Small Power Conductor.** Powers the subsea transformer, which steps down surface voltage (typically from 3,000VAC or 1,000VAC to 110VAC, 24VDC, etc.). The transformed power is then used for the subsea control pod, which distributes it to various sensors, tools, and subsea equipment.

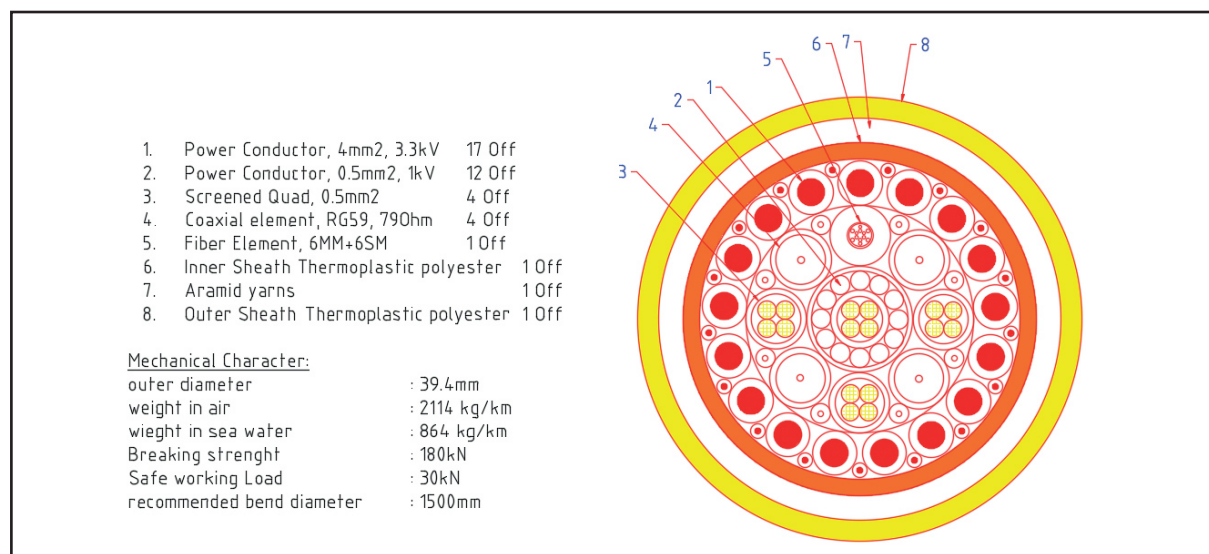


Figure 5: Example of a soft umbilical for a 100HP work class ROV with both fibre and quad cables.

3. Quad Cables. Used for telemetry and sensor communication when fibre optics are unavailable.
4. Fibre Optical Elements. Provide high-speed telemetry and sensor data transmission.
5. Coaxial Cables. Transmit camera signals.

The umbilical size must be carefully determined by calculating the total power, current, and voltage requirements of the vehicle. Subsea vehicles using a soft umbilical typically require a dedicated winch for deployment and retrieval. Conversely, those using an armoured umbilical do not need a separate lifting winch, as the umbilical itself is designed to handle the load. Key design factors for an umbilical include:

- Bending radius and breaking strength. These must be carefully evaluated to ensure safe handling during launch and recovery.
- Heat generation. Excessive heat build-up within the umbilical can cause severe and potentially fatal damage, so thermal management is critical.

Data and telemetry communication.

Figure 6 shows the flow diagram for the data communication for vehicle control from the control cabin to the subsea vehicle and vice versa.

The ROV PC functions as the primary user interface (UI) or human-machine interface (HMI) for the control system of the subsea vehicle.

It establishes communication with the Surface Control Unit (SCU) through RS232, RS485, or Ethernet protocols. The human operator or pilot issues commands via the control console, monitors system responses and, in some cases, directly activates subsea operations using the UI. The SCU, in turn, communicates with the subsea control pod through the umbilical cable, utilising RS232 or RS485 protocols over hardwired connections or fibre optic cables integrated within the umbilical.

Fibre Optical Multiplexer (FO Mux). The diagram below illustrates the communication flow between the control room and the subsea vehicle which is using umbilical cable from the surface to the subsea. Note that the amount of data and camera channels on the FO Mux will vary according to the specifications of the subsea vehicles. Some may have less and some will have more. The communication of surface control panel (control PC) and subsea vehicle (main control pod or MCP) may use any one of the data channels available on the FO Mux.

In order to make use of a fibre optical system, a pair of FO Mux is required, one on the control side (console) and one inside the control pod (remote) of the subsea vehicle. The console unit will convert the input signals into fibre optical signal and the remote unit will convert the signal back to the original input signals and vice versa. Typically, the fibre optical system uses the single mode option due to few advantages as stated below:

Feature	Single-Mode Fibre (SMF)	Multi-Mode Fibre (MMF)
Core Size	8 to 10 microns	8 to 10 microns
Light Propagation	Single mode (straight line)	Multiple modes (different paths)
Distance	Long (up to 100 km or more)	Short (up to 2 km)
Bandwidth	High bandwidth, fast speeds	Lower bandwidth, slower speeds
Cost	More expensive	Less expensive
Light Source	Laser (more expensive)	LED (less expensive)
Typical Use	Long-range (telecom, data centres)	Short-range (LAN, data centres)

Table 2: Summary of differences of single and multi-mode fibre.

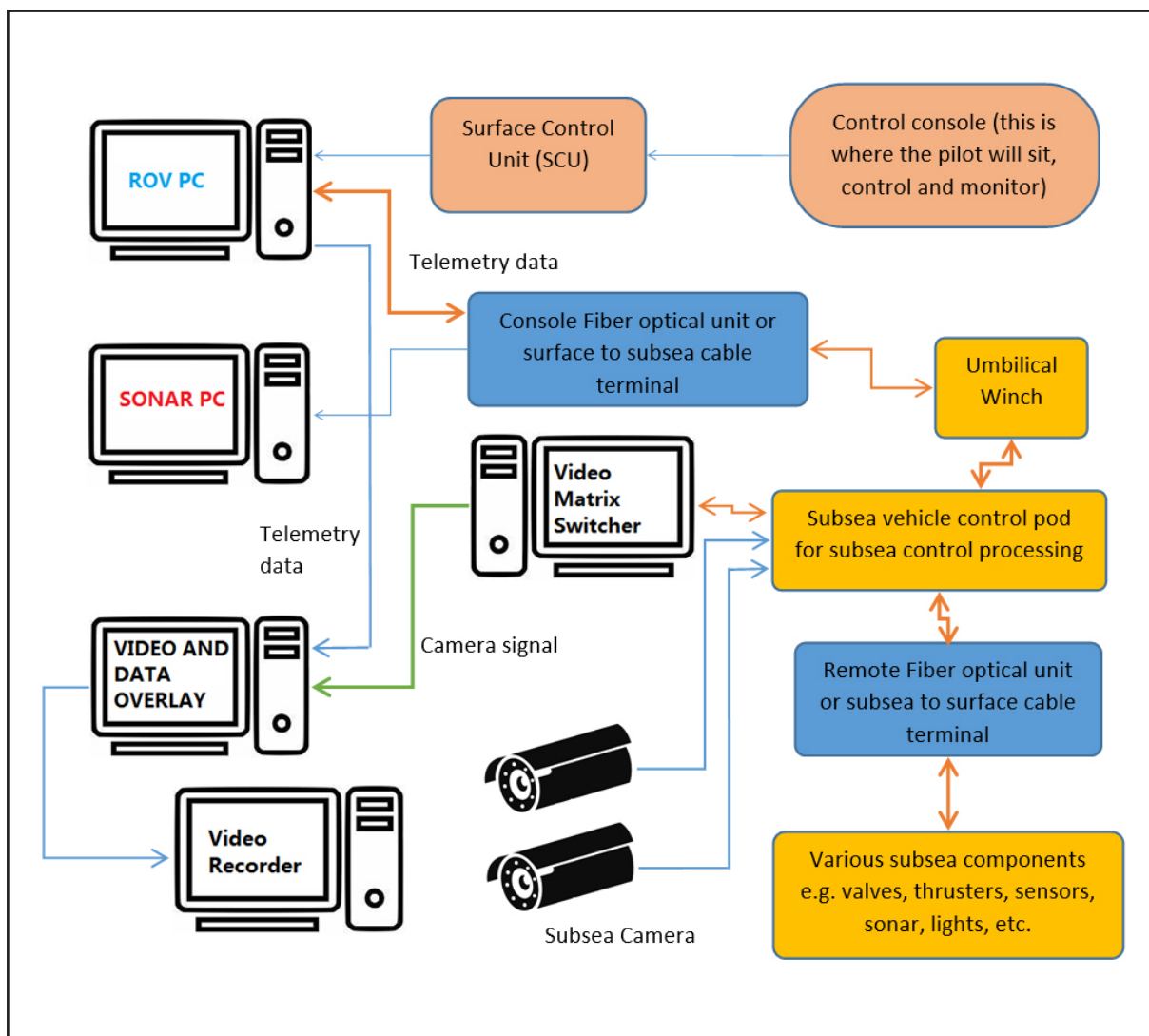


Figure 6: Telemetry and data flow diagram.

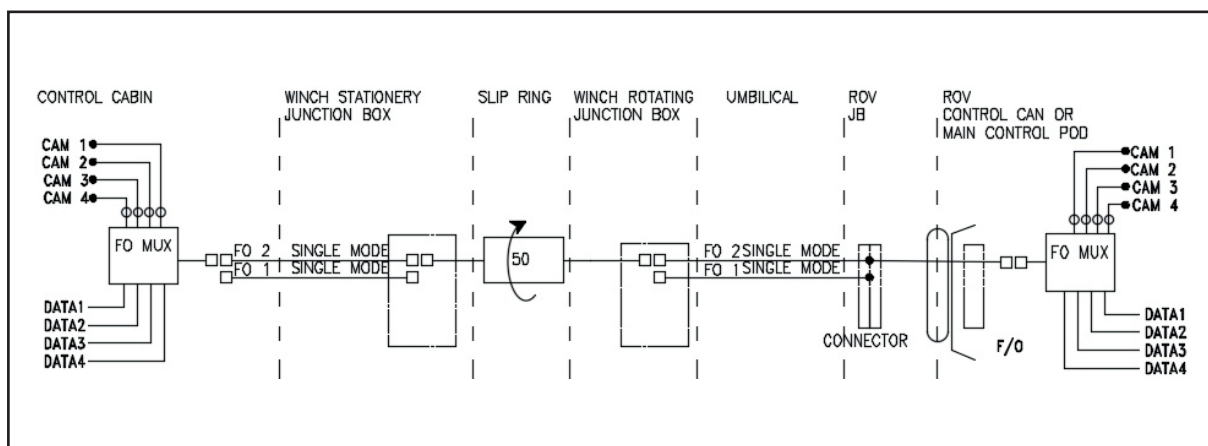


Figure 7: Fibre optical system flow diagram of a subsea vehicle.
This diagram is actually a line representation for Figure 6.

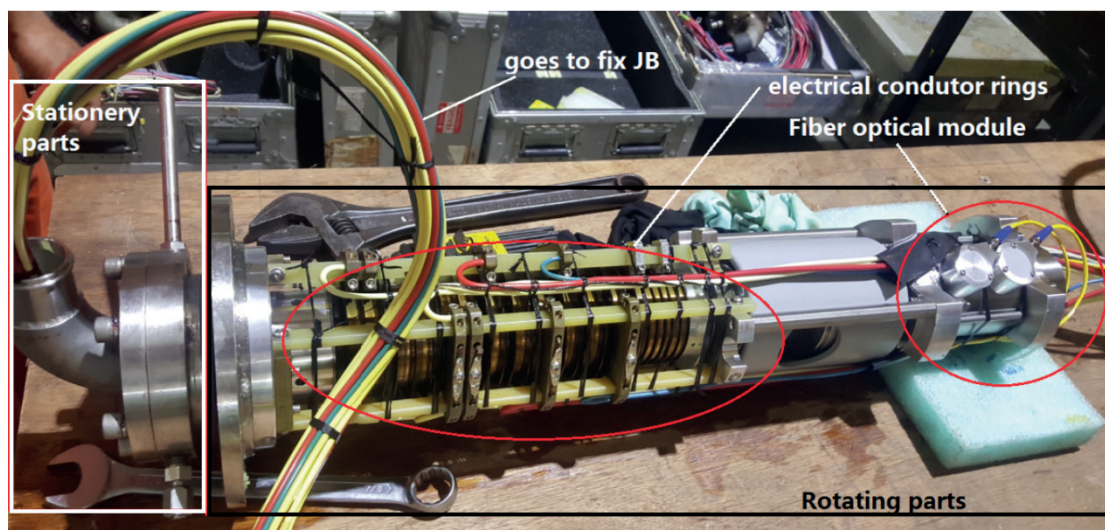


Figure 8: Example of a slip ring with fibre optical module (view without housing).

Rotary Slip Ring. A rotary slip ring, also known as an electrical slip ring or rotary electrical interface, is an electromechanical device which enables the transfer of electrical signals and power between stationary and rotating components. It is a critical component in systems where continuous rotation is required while maintaining an uninterrupted electrical connection. It has several key functions.

Power Transmission. Transfers electrical power (AC or DC) from a stationary source to a rotating assembly and ensures consistent delivery of power to components mounted on the rotating structure.

Signal Transmission. Allows the transmission of data, control signals, or other low-voltage electrical signals across the rotational interface and it can carry signals for sensors, communication systems, or instrumentation.

Seamless Rotation. Facilitates continuous rotation without tangling or breaking electrical cables, which is essential for rotating equipment like winches.

In an umbilical winch, the rotary slip ring is crucial for managing the electrical and signal connections while the winch drum rotates to reel in or let out the umbilical cable. The umbilical

cable typically contains multiple conductors which carry power, control signals, and data for the equipment at the end of the cable (e.g. ROV or subsea system). Here is how the slip ring works:

Stationary End. This part is connected to the external power source, control systems, or data acquisition systems.

Rotating End. Connected to the cables which lead to the drum, allowing the umbilical cable to unwind or wind during winch operation.

Electrical Interface. Inside the slip ring, brushes or contacts maintain a continuous electrical path between the stationary and rotating parts.

Main Control Pod (MCP). Also known as the Subsea Control Pod, this is the core of a subsea vehicle. It houses all communication boards required for data exchange between the vehicle and the surface control unit, enabling real-time monitoring and control by the pilot. The MCP serves as the interface between the underwater equipment and the HMI or UI.

Typical control boards inside the MCP manage thrusters, lighting, valve packs, and sensors. The MCP also includes a remote fibre optic card for high-speed data transmission.

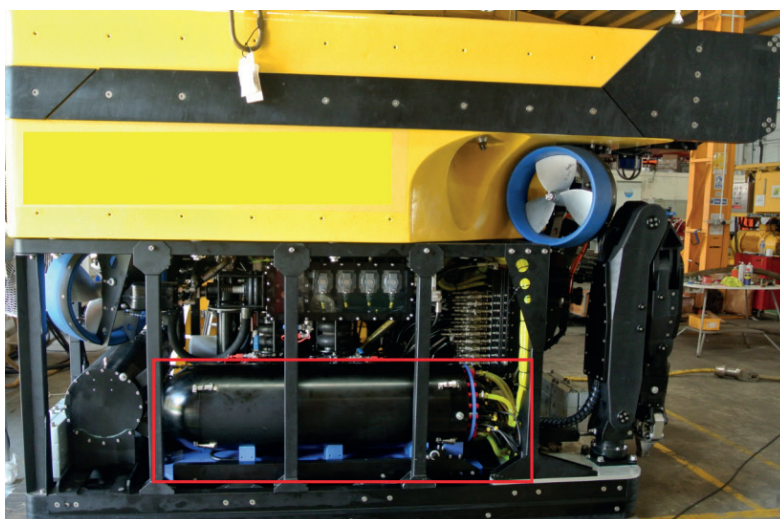


Figure 9: Work class ROV with MCP installed. Right photo shows the end cap of the MCP with all the subsea cables (whips) connected to various ROV functions.

The MCP housing is designed to withstand its rated operating depth and is typically constructed from stainless steel (SS316) for durability. If weight reduction is a priority, aluminum alloys such as Al6061-T6 or Al6082-T6 with anodising are used as alternatives.

In conventional systems, customised PCB boards are used to manage all control functions. However, in more recent designs, many manufacturers have begun integrating standard PLC modules from well-known vendors such as Omron, Mitsubishi, and Siemens. This shift enhances system reliability, simplifies maintenance, and allows for greater flexibility in programming and troubleshooting. Both systems require subsea and surface CPU to communicate with each other.

Special underwater bulkheads and cable connectors are used in subsea vehicles. These components are specifically designed to withstand high pressure and prevent water ingress into the MCP. Some commonly used subsea connectors include SubConn, SeaCon, and Burton, which are known for durability and reliability in underwater applications.

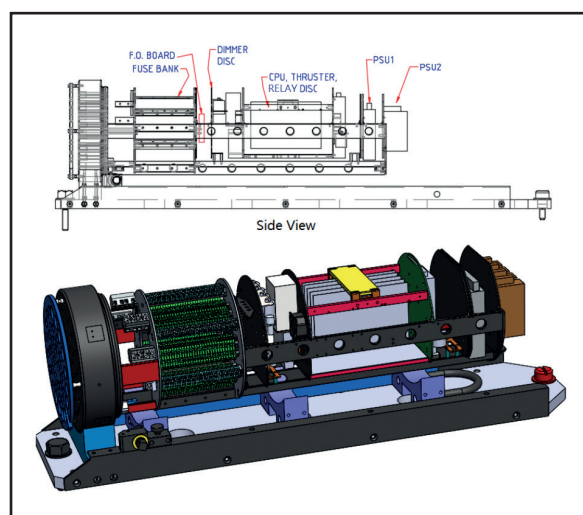


Figure 10: Internal view of MCP without housing.

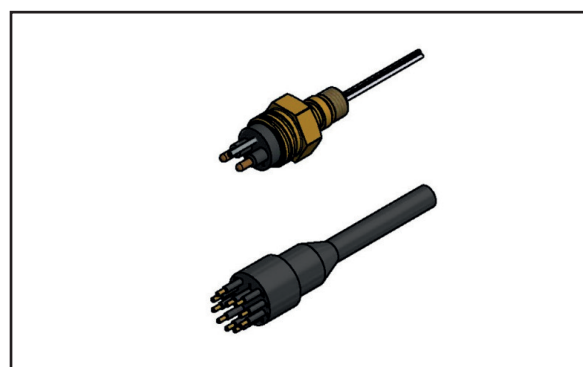


Figure 11: Examples of SubConn bulkhead and connector.

Human Machine Interface (HMI) or User Interface (UI)

Most subsea vehicles have dedicated UI developers who typically use programming languages such as VB.NET, C++, C#, and Java to design the interfaces. The UI (in this case, the ROV PC) must communicate with the surface CPU (console), which then interfaces with the subsea CPU (remote). Communication between the UI and the console CPU can be established using RS232, RS485, or Ethernet protocols, depending on system requirements and data transmission needs.

With advancements in artificial intelligence (AI) and the extensive range of HMI and SCADA solutions available from PLC vendors, ROV and subsea vehicle developers have created increasingly sophisticated UIs which vary from simple, functional designs to highly advanced, visually immersive layouts. Regardless of complexity, the UI serves as a graphical representation of the subsea vehicle, allowing pilots to interact with the system, send commands, and receive real-time data. It also provides critical feedback by displaying system status, alerts, and any malfunction for quick diagnosis and response.

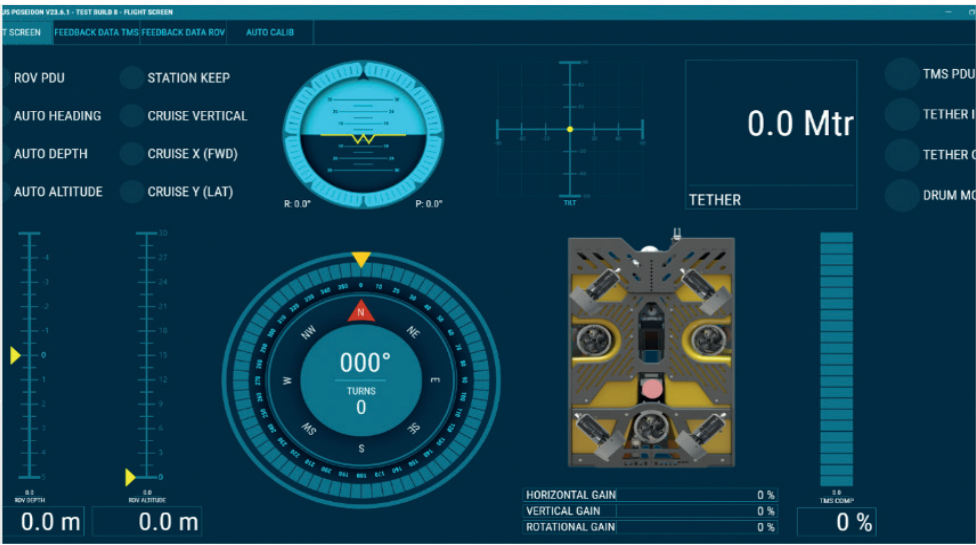


Figure 12: ROV UI by Argus Remote Systems showing the main page with the common control i.e. heading, pitch, roll, depth altitude, thrusters, tether out length, etc.

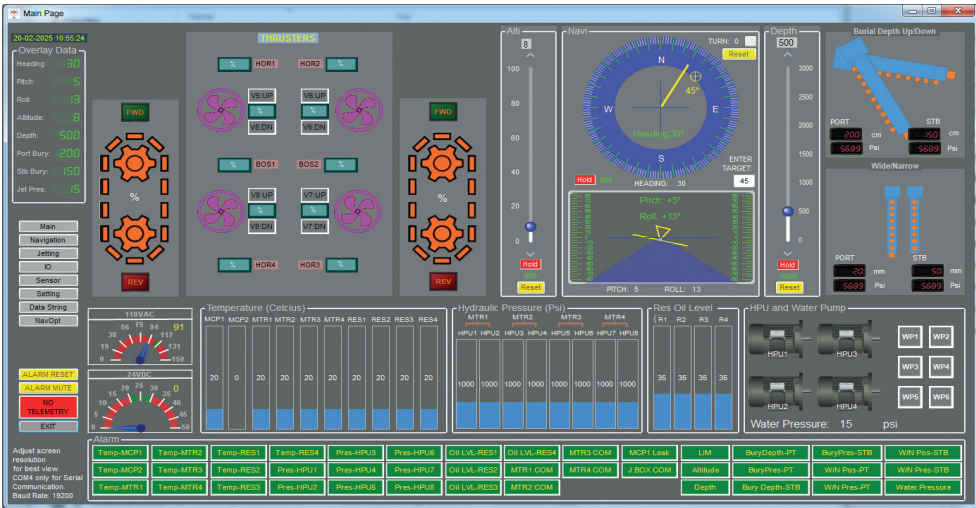


Figure 13: TC-1600 user interface main page.

Figure 13 illustrates a simple UI for the TC-1600, a 1,600 hp subsea trencher developed by WS Offshore Pte Ltd. Designed using VB.NET, the UI incorporates the RS232 communication protocol to interface with the surface CPU. The main page displays a range of critical controls, including:

- Navigation data. Heading, pitch, roll, altitude, and depth.
- Thruster controls and wheel tracks indicator.
- Jetting system indicator. Sword width/narrow mode and jetting depth.
- System monitoring. Voltages, MCP temperatures, motor and reservoir temperatures.
- Pressure readings. Hydraulic system and water jetting pressures.
- Alarm notifications. Status alerts for all onboard sensors.

The I/O page is a standard feature in most subsea systems. It provides real-time feedback from the control console, displaying joystick responses for vehicle manoeuvring. Additionally, it allows the pilot to control various subsea components, such as sensors, lights, cameras, and valve packs for hydraulic functions such as manipulator arms.

The settings page allows the pilot to configure minimum and maximum limits for all sensor displays and alarms. The pilot can also enable or disable specific controls based on operational requirements, providing greater flexibility in system management. To prevent unauthorised modifications, this page is typically password-protected, ensuring that only authorised personnel can make changes.

The most critical aspect of the UI is the telemetry data, which is essential for video data overlay recording. Different developers approach this in various ways. Some opt for a simple, single-line data string containing live telemetry data, transmitted via the computer's serial port, while others implement a more structured and sophisticated data format for enhanced readability and processing.

An example of a single-line telemetry data string: V1.0,16.35:02,28/12/17,0.3,0.0,159.1,7.8,0.7,0.9,237.3,1326.5,230.7,1285.8,19.7,1852.4

Where in this case, each value represents:

- **V1.0** – Data format version
- **16.35:02** – Time (HH:MM:SS)
- **28/12/17** – Date (DD/MM/YY)
- **0.3** – Depth
- **0.0** – Altitude
- **159.1** – Heading
- **7.8** – Pitch
- **0.7** – Roll
- **0.9** – Water Pressure
- **237.3** – Position 1
- **1326.5** – Position 2
- **230.7** – Position 3
- **1285.8** – Position 4
- **19.7** – Position 5
- **1852.4** – Position 6

The format and content of telemetry data vary depending on system requirements, ensuring that the necessary information is efficiently recorded and displayed in the video overlay.

Some developers use a formatted data string for video and data overlay processing, providing a structured and readable format for telemetry data. Below is an example of such a formatted data string:

Date	Time	Head	Pitch	Roll
0-02-2025	11:32:10	20	10	5
<i>PtBury</i>	<i>StbBury</i>	<i>JetPres</i>	<i>Alti</i>	<i>Depth</i>
100	12	123	23	500

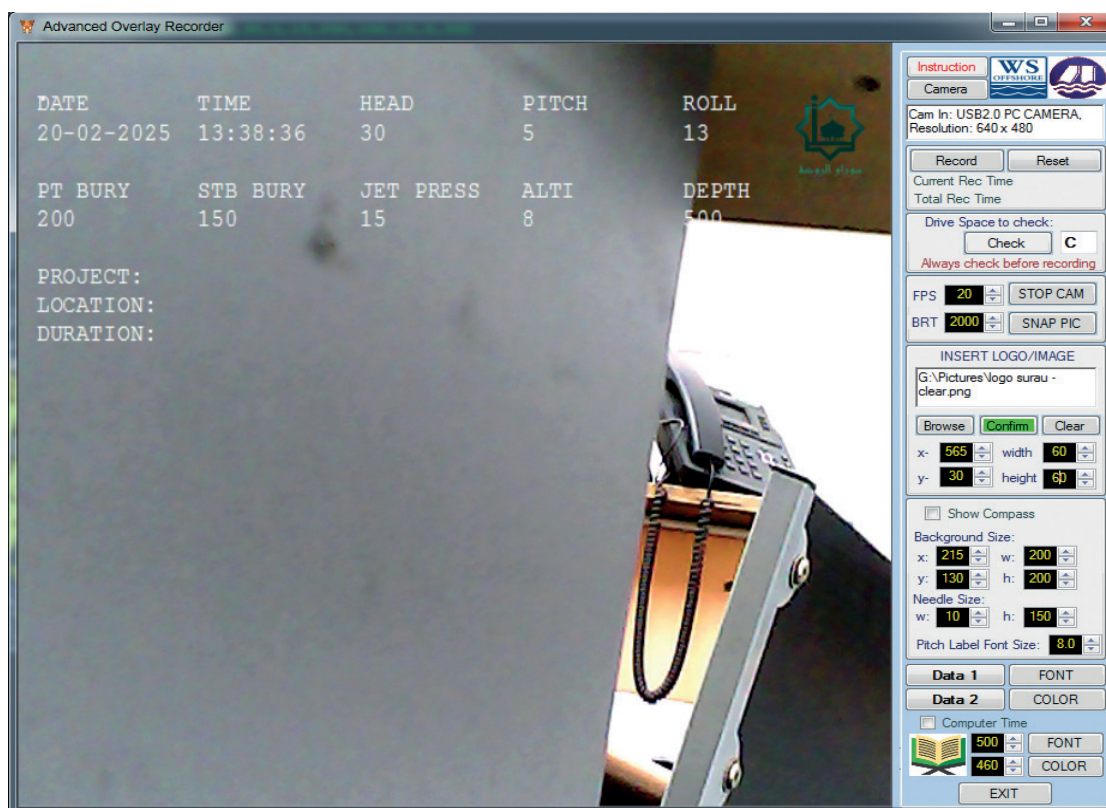


Figure 14: Video and live data overlay software developed by WS Offshore Pte Ltd complete with recording function.

This structured format improves readability and integration into video overlays, ensuring key telemetry data is clearly displayed for operators and recorded efficiently.

Summary

Although some sections in this article focus on a specific type of subsea vehicle, the principles and approaches can also be applied to other types of subsea vehicles. The key objective is to establish a reliable communication method between the pilot and the subsea vehicle, ensuring the interface is simple and user-friendly with minimal issues, and allowing the vehicle to be operated safely in any subsea environment.

It is important to remember that individuals responsible for maintaining the vehicles

offshore are not the design engineers who work in the office, but the pilots and their teams who face physical challenges and who interact with the clients. Therefore, it is crucial to create simple and intuitive systems which can address potential technical problems effectively. A user-friendly interface will ensure smooth operations and help the team overcome obstacles in real-world conditions. 🗺️

Reference

1. IMCA's Guidance for the Safe and Efficient Operation of Remotely Operated Vehicles (IMCA R004, Rev. 6 February 2024)
2. BERR. Review of Cabling Techniques and Environmental Effects Applicable to the Offshore Wind Farm Industry: Technical Report; Department for Business Enterprise & Regulatory Reform: London, UK, 2008; p. 159.

Maritime Engineering in Malaysia

by
Mohamed Mazllan
bin Abdul Manaf

Maritime engineering is the application of engineering analysis and principles to the design, construction and operation of floating assets. While some may also include ports and harbours, in practice these fall within the scope of civil engineering. Apart from floating offshore oil and gas platforms, floating assets primarily means ships and boats, or vessels of various types.

Maritime regulations and standards form the basis of engineering to ensure that vessels are designed and built to perform effectively, safely and efficiently. They are produced by various organisations and authorities based on real world and experimental data and are published as volumes of assumed loads, calculations methods, design criteria, equipment specifications, material properties, and requirements in terms of thicknesses, sizes and numbers.

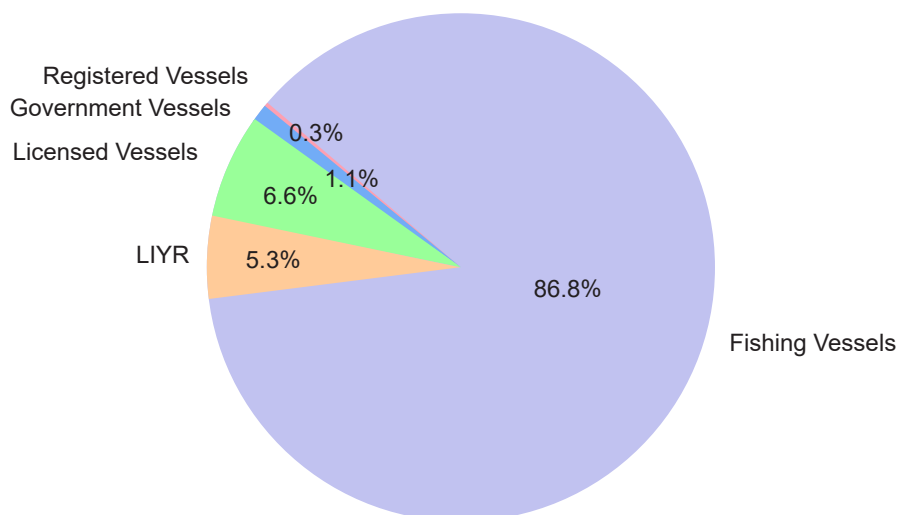
Despite Malaysia's extensive coastline, a vibrant maritime economy, and substantial local engineering resources, the engineering standards and regulatory framework governing the majority of the national fleet remain minimal or outdated. Maritime engineering is consequently applied only to a very small portion of vessels operating under Malaysian jurisdiction. This has adverse implications for safety, sustainability, economic development, and the employment prospects of maritime engineering graduates. This article will examine the reasons for this, and will propose measures to address the situation.

Malaysia's National Fleet

The existence and ownership of vessels which comprise the national fleet are recorded under five different registries.

Along with the number of vessels in each registry, these are as follows:

- a. The Marine Department maintains a registry of Malaysian flagged vessels under the Merchant Shipping Ordinance. As of 2023, there were 142 vessels under the Malaysian registry. These comprised various vessel categories, with tankers, offshore support vessels, barges and passenger ferries (MIGHT Report on the SBSR Industry 2024).
- b. Vessels owned and operated by various government agencies, including the navy and maritime enforcement agencies, are registered within the agencies themselves. The largest fleet owners are the Royal Malaysian Navy (45 large vessels plus a number of smaller craft), and the Agensi Penguatkuasaan Maritim Malaysia (74 patrol vessels and 257 patrol boats/auxiliaries). The other agencies (BOMBA, Polis Marin, Jabatan Laut, Jabatan Perikanan, Kementerian Kesihatan) have smaller fleets, totalling around 200 vessels, some of which are included in the licenced vessel category. Government agency boats total approximately 600 in number.
- c. Local port authorities license smaller vessels and maintain vessel and ownership details. The number stands



Registered Vessels		Government Vessels		Licenced Vessels		LIYR Vessels		Fishing Vessels	
142	0.25%	600	1.06%	3,744	6.61%	3,000	5.29%	49,173	86.79%

Vessel Registries and Numbers

at 3,744, comprising passenger boats, small cargo vessels, tugs and barges (Jabatan Laut Malaysia website).

- d. The Langkawi International Yacht Registry maintains a register of some 3,000 vessels and ownership details, consisting primarily of leisure craft and tour boats.
- e. By far, the largest number of vessels authorised to operate in Malaysia are commercial fishing boats. These are licensed by Jabatan Perikanan, and total 49,173 in number (Laporan Tahunan Perikanan 2023). About 12,000 are inboard diesel propelled and the rest are outboard powered.

Regulations and Engineering Requirements on Vessels under the Registries

Registered vessels: These are generally larger vessels serving domestic and international routes. They are subjected to engineering requirements imposed by

classification societies and international regulatory agencies. Most were built overseas with little involvement from Malaysian naval architects or marine engineers. Only 26% of the vessels under Malaysian registry were built locally with significant involvement of local engineers.

Government Vessels: These, including naval vessels, were designed and built to user-specified standards and requirements. Historically most were built locally but the design work had almost always been undertaken overseas due to insistence on “proven designs”, even for vessels with unremarkable performance requirements. Further aggravating the lack of local maritime engineering involvement is a discernible trend to procure from overseas yards, a consequence of the delays on the Littoral Combat Ship which has resulted in a loss of confidence in local capability.

Licensed Vessels: These are smaller, non-convention vessels (under 500 Gross Registered Tonnage) and approximately 70% are passenger boats. They are not subjected to international regulations and only domestic regulations apply. For these vessels, the focus is almost exclusively on the presence of safety, navigation and communications equipment on board.

A small percentage, more specifically those serving the oil and gas industry, are subjected to client-imposed engineering design and construction requirements. While most of these vessels are built locally, the lack of standards and regulations on design and construction has resulted in vessels built based purely on past practices, without any formal design process.

Langkawi International Yacht Registry: The bulk of vessels under the LIYR are existing vessels which had been built overseas. The regulations cover safety equipment and stability requirements, requiring minimal engineering input.

Commercial Fishing Vessels: These vessels are licensed by Jabatan Perikanan. The primary concern of the authorities is the controlled exploitation of fisheries resources to ensure sustainability. Most vessels are crafted by traditional wooden boat builders without any engineering design or construction drawing. Smaller open fibreglass boats for near shore fishing are built using moulds made from earlier vessels. Hull thickness, stiffener spacing and laminate schedules are determined by material availability and the builders' experience. Maritime engineering for commercial fishing vessels is thus not practised.

Findings: The undeniable conclusion from the above is that, for the vast majority of vessels under the Malaysian flag and jurisdiction, maritime engineering requirements are neither imposed nor practised. The vessels are built with neither formal design processes nor conformance with engineering and construction standards. Vessels which do require maritime

engineering input are mostly built or designed overseas. The current situation of the local maritime engineering sector is, by and large, fairly underdeveloped, even by Third World standards.

Proposed Actions

As licensed passenger vessels and commercial fishing vessels account for more than 90% of the national fleet, further elaboration and remedial actions on these two categories are proposed.

Licensed Passenger Vessels, Current Regulations and The Way Forward

A notable characteristic of regulations for passenger vessels in Malaysia is the dearth of published regulations and standards. The most complete are regulations by the Langkawi International Yacht Registry, which operates as a unit of Jabatan Laut. For passenger vessels licensed by the various port authorities, the applicable regulations are the pre-Independence Boat Rules 1953 which are very general in nature. In addition, the various regulatory recommendations issued by international agencies and which have been ratified by Jabatan Laut are also supposedly applicable. These ratifications are made known via the occasional issue of a Notice to Mariners.

Local regulations actually imposed on licensed passenger vessels pertain primarily to safety and communication equipment on board. For operators/owners seeking a passenger boat licence or passenger certificate, a list of required communications and safety equipment can be obtained from the local Jabatan Laut office upon request. For vessels permitted to carry more than 12 passengers, a passenger certificate must be obtained. For this, some additional safety equipment is required and an inclining test is mandatory. The inclining test has to be conducted by a recognised organisation. While the test is mandatory, the stability criteria to be met is unclear.

The lack of formal design and construction requirements has led to a number of catastrophic failures. These include structural failures, capsizes and fuel related explosions. Immediately following such incidents, the authorities will issue statements promising investigations and changes, though these are quickly forgotten until the next incident.

The need for a comprehensive set of design and construction standards has long been recognised. Malaysia, being an active member of the International Maritime Organisation, should comply with IMO resolution MSC 518 (105) which seeks the development of domestic ferry regulations among member countries. Model regulations and guidelines have been issued by the IMO for these. Malaysia's regulations could also be modelled on regulations and standards of the United States Coast Guard, the American Boat and Yacht Council, or the Australian Maritime Safety Authority. The existing LIYR regulations can also be a starting point. In its current form, the LIYR regulations are primarily intended for private yachts which also operate commercially. A fresh set of regulations should cover the needs of purpose-built commercial passenger vessels. The pre-Independence Boat Rules 1953 desperately needs to be replaced with fresh, up-to-date legislation.

Regulation of Commercial Fishing Vessels

The primary concern of the Fisheries Act 1985, under which fishing vessel licences are issued, is the controlled exploitation of fisheries resources to ensure sustainability. Fishing licences are issued according to operating zones A, B, C, C2 and C3, increasing in distance from the shore. Permitted fishing methods and equipment are specified in the licences.

The size of the vessels, measured by a tonnage formula, are also regulated and larger vessels are only permitted to operate at longer distances from shore. No design or construction or safety or health standards are imposed. Only navigation lights are mandatory. For context,

it is worthwhile to note that the capture fishing industry directly employs 112,344 people. This number excludes those in supporting activities such as processing, marketing and distribution, supplies and services, as well as boat building and repair. In 2023, the recorded total catch was 1,270,277 tonnes valued at RM11.4 bil. In comparison, oil palm plantations employ approximately 500,000 workers, producing 97.9 million tonnes of fresh fruit bunches valued at RM43.4 bil in 2023 (Malaysia Palm Oil Board Official statistics). The capture fishing industry is therefore around a quarter of the size of the oil palm plantation sector, both in terms of production value and employment.

The fishing industry is beset by well documented problems and challenges. Catch continues to decline due to unsustainable and environmentally destructive practices such as bottom trawling. Near shore fishing boats use polluting 2 stroke engines which are long banned in developed economies. Trawler encroachment into near shore fishing grounds deplete stocks and entrap near shore fishermen in the B40 segment dependent on fuel subsidies. Traditional wooden fishing vessels provide unhygienic, unsafe working conditions and depend mostly on foreign labour. Encroachment of foreign fishing fleets from Thailand, Vietnam and China is a daily, routine occurrence.

In response, Jabatan Perikanan has published comprehensive, well formulated, strategic plans in which specific steps have been identified. Not all these steps fall within the purview of the department. Support from other government agencies and participation of the private sector are required. In particular, the engineering profession can and should play a role in the implementation of these plans, as modernisation of fishing vessels has been identified as a key component.

The first attempt at crafting modern fishing vessels started as far back as 1987. Data collection and design was conducted by University Teknologi Malaysia, and construction



*Steel purse seiners and trawlers
being built at UniKL MIMET in 2008.*



*Fiberglass fishing boat recently built
to traditional design. (WMA Fiberglass).*



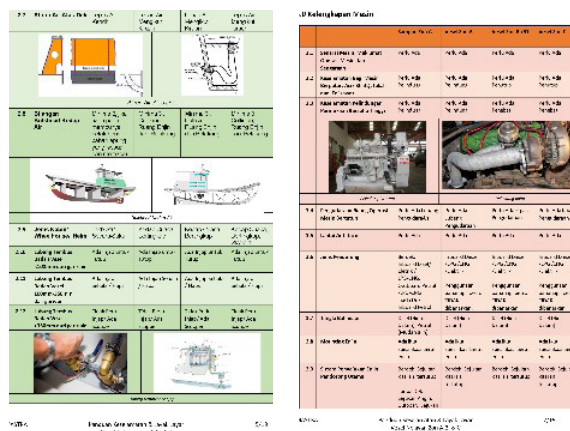
*Steel modern purse seiner
built in 2023 in MSET Terengganu.*

of a prototype was completed in 1993 (boat licence number TRF1010). Other notable efforts included the construction of 20 inboard powered fibreglass fishing vessels undertaken by Majuikan Sendirian Berhad in 2003/2004. In 2008, two steel purse seiners and two steel trawlers were constructed by WMA Resources for Koperasi Rakyat Pahang Bhd. at the UniKL MIMET yard in Lumut, Perak. In 2021, Jabatan Perikanan launched the Program Permodenan Nelayan, allocating RM150m as loans for modern fishing vessel construction and mechanisation of existing vessels. Most recently, in 2023 MSET in Terengganu launched a steel purse seiner of a modern design.

Despite all these notable and commendable efforts, the vast majority of fishing boat owners and operators have stuck to their traditional wooden boats. Traditional practices continue to be preferred over modern engineering. Clearly, isolated sporadic efforts will not result in the transformation of the industry. A more comprehensive approach is required. The entire industry and ecosystem need to be modernised.



*Fiberglass fishing vessel built for
Majuikan Sdn. Bhd. in 2003/2004.*



Design and construction standards for fishing vessels from MASTRA

As an initial step of a more comprehensive effort, the Strategic Maritime Association of Malaysia (MASTRA) has drafted design and construction standards for commercial fishing vessels. These standards will serve as a common reference for designers, builders, owners, surveyors, authorities, insurers, financiers and valuers of commercial fishing vessels. Standards will ensure the safety and comfort of the crew, the quality of the catch, and the preservation of the value of the vessel as it ages.

There are some 12,000 inboard powered commercial fishing vessels, of which the vast majority are traditional wooden fishing vessels. If 30% are to be replaced by modern fishing vessels over the next 10 years, 360 vessels will have to be built annually or almost one vessel per day.

For this to happen, boat building yards all over the country will have to be involved. Engineers will need to be employed to create designs that comply with the standards, and to ensure compliance during construction.

A modern fishing vessel design and construction industry will be amenable to having the vessels covered by hull and machinery insurance, not just protection and indemnity insurance. This in turn, will make vessel financing attractive to financial institutions. Currently, Malaysia lags far behind even its ASEAN neighbours in fishing vessel insurance.

“For this to happen, boat building yards all over the country will have to be involved.”

Conclusion

Malaysian have been studying naval architecture and marine engineering in overseas universities since the early 1970s. Many of these overseas graduates are still active in the profession. Some are professors at local institutions of higher learning.

Local institutions of higher learning have been producing graduates in naval architecture since the late 1990s. Today, approximately 500 students graduate from UTM, UMT and UniKL in this field annually. Local institutions are also very well equipped even by global standards. UTM has a large towing tank, while UniKL MIMET even has a 100m slipway on its campus. There is therefore no shortage of well-trained maritime engineering professionals here.

“

Tens of thousands of civil, mechanical and electrical engineers are thus employed by consultants, contractors, and manufacturers of building materials and equipment. This has resulted in a built environment rivalling that of even the most advanced countries.

”

Despite the abundance of these engineering resources, 90% of the national fleet are relics of a bygone era. The industry continues to be governed by pre-Independence legislation.

In sharp contrast, engineering requirements have long been imposed on land-based structures by multiple agencies and organisations. Drawings need to be produced, reviewed and signed off by engineers with professional accreditation. Tens of thousands of civil, mechanical and electrical engineers are thus employed by consultants, contractors, and manufacturers of building materials and equipment. This has resulted in a built environment rivalling that of even the most advanced countries.

The maritime sector needs to be fast forwarded to the 21st century. New, up-to-date legislation must be introduced. The industry must adopt

modern design and construction standards which are well documented and regularly updated.

Rather than insisting on “proven designs”, Government agencies should instead insist on rigorous analysis of locally produced designs. The analytical methods could include computerised fluid dynamics simulation, model tank testing, or even construction of scale model for open water testing.

Finally, the board of engineers and the profession must move to make it mandatory for maritime engineering to be practised in the design and construction of vessels, and that the engineering be practised by accredited professional engineers. Unless this is done, the Ir. or PE accreditation will continue to have little value in the maritime industry. 🏠

Case Study - Project Management Approach on Underwater Pipeline Repair Overview

by
Nadia Azmi
Ir. Teo Eu Jin

Essentially, all projects are unique, temporary efforts within a timeframe that comprises beginning and ending phases where the main objective is to generate value in terms of products, services, or results. Each project differs from standard routine operations in an organisation.

Projects usually have an allocated team, budget, and schedule to accomplish the set expectation, allowing stakeholders to reach a conclusion upon completion (benefit realisation). In simple language, project management uses specific knowledge, skills, tools, and techniques to deliver something of value, which can range from software development and engineering construction to social work or charity for the needy.

So, how can one approach a project effectively? Well, it all depends on the nature of the project. Fundamentally, there are various approaches to managing projects, such as Predictive, Agile and Hybrid.

Predictive Approach (Waterfall). Uses traditional methodology by sequencing the workflow in well-defined phases (e.g. initiation, planning, execution, monitoring and closure) where each later phase is dependent on the completion of earlier phase. It also emphasises heavily on upfront planning and is documentation driven in each phase. The nature

of the Predictive Approach makes it suitable for projects with stable requirement (fixed target) and minimal changes. However, it has limited adaptability.

Agile Approach. On the other hand, the Agile approach emphasises flexible planning that is subject to changes (moving target) based on emerging requirements and feedback. This approach used both Iterative and/or Incremental project life-cycle. The former divides the project into smaller tasks to refine the scope, and the latter delivers the product progressively. Moreover, the Agile Approach highlight is on a self-organised team which collaborates closely with the stakeholders.

Hybrid Approach. The beauty of this approach is that it combines both Predictive and Agile approaches, leveraging each other's strength. A Hybrid approach is tailored to balance structure and flexibility according to project needs.

Case Study of Pipeline Repair via Various Project Management Approach

In all projects, it is crucial to understand the project goals based on stakeholder expectation. Moreover, it is wise to produce a Rough Order of Magnitude in terms of scope, schedule, and cost to initiate discussion with the key stakeholders.

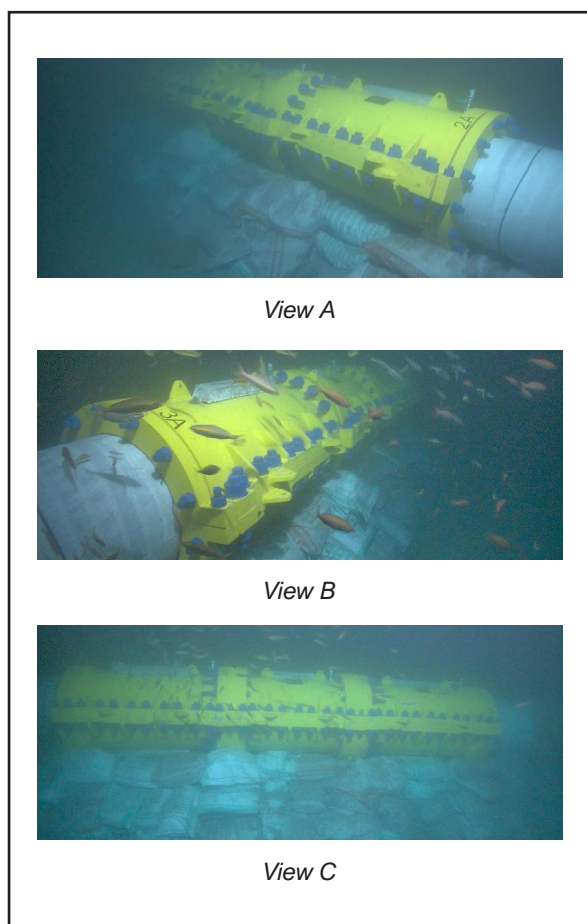


Table 1: Actual epoxy sleeve repair system used in this case study.

Source: Photo Courtesy of Merit Composite Sdn. Bhd (solution provider of the Epoxy Sleeve Repair System).

This allows them to have a brief project overview and enables two-way communication. Indeed, this will be helpful for the project team to collect useful feedback at the beginning of the project, minimising discrepancies in stakeholder expectations. It is equally important to ensure all key stakeholders are identified to avoid hiccups during the project.

For this case study, the key stakeholders comprise multiple parties, ranging from government agencies (such as the Department of Safety & Health, Department of Environment, and Marine Department), potentially impacted members of the public, and most definitely the Asset Owner and Asset Operator who intend to rectify and make safe a dented pipeline.

Though pipeline damage is undesirable in the Oil & Gas industry, it can and does happen sometimes. Most importantly, the response of the asset operator and asset owner in performing damage control and mitigating the consequences to the affected pipeline, as well as impacted parties and areas, is crucial. If the strategy is effective, there will be minimal or negligible safety, health, and environmental concerns.

This article will share a scenario management example of a dented pipeline (Problem Statement) that experienced roundness and straightness issue due to ship anchor drag and where the technical team assessed the damage and responded with proper engineering controls. Basically, the project objective was to understand the degree of damage and to mitigate the damaged area appropriately to prolong its service life.

This specific pipeline repair project was chartered and segregated into four stages:

1. Underwater Pipeline Inspection.
2. Engineering Damage Analysis.
3. Repair Option Selection.
4. Repair Preparation and Execution.

The team initiated each stage by first identifying relevant stakeholders and then planning each stage together with them. This was important to address the Triple Constrain in project management by ensuring the work scopes were properly defined, schedules established, and cost estimated. Since the nature of each stage differed from one another, a suitable project management approach should be utilised at each individual stage to effectively meet the project objective.

1. Data Collection.

- a. Underwater Pipeline Inspection.

Hybrid Approach with Waterfall Major:

Once feedback of pipeline damage was received, the pipeline owner must take immediate action as part of due diligence and regulatory compliance (Project Introduction Trigger). The goal

at this stage was to collect data and evaluate the extent of the damage. So, an inspection air diving barge was chartered for the purpose. Additionally, the planning and scope of work, including the type of underwater inspection and techniques, were refined and fixed after a few iterative sessions. This was done prior to developing the Gantt Chart for predictive execution, which defined the sequence and campaign duration with consensus from stakeholders.

Note: Interpersonal soft skills are essential to maintain the line of communication after the project kick-off meeting, ensuring the team has a clear picture and remains aligned.

b. Engineering Damage Analysis.

Pure Agile: Non-physical scope, as the team engaged an engineering consultant to evaluate the damage via software modelling and analysis. The goal at this stage was to urgently understand the impact of the dent on the pipeline, but the outcome was unclear and might be subjected to changes when more parameters were

input to the software. Therefore, the consultant needed to regularly present to the stakeholders to acquire feedback and refine the analysis. This Agile Approach consisted of a few iterations (cycle) addressing the Procurement of Service, Engineering Study, and Report Review to determine an accurate outcome.

Note: It is not necessary to always use the Hybrid approach. There are times when the team can use the pure Agile or pure Predictive approach; it all depends on the nature of the project itself.

2. Repair Method.

c. Repair Option Selection:

- Upfront Selection and Planning - Pure Agile.
- This stage started by collecting mitigation proposals from various potential repair vendors. Basically, the scope of work comprised team conceptual studies of each proposal in terms of technical reliability, installation practicality, operational feasibility, mitigation effectiveness, and material

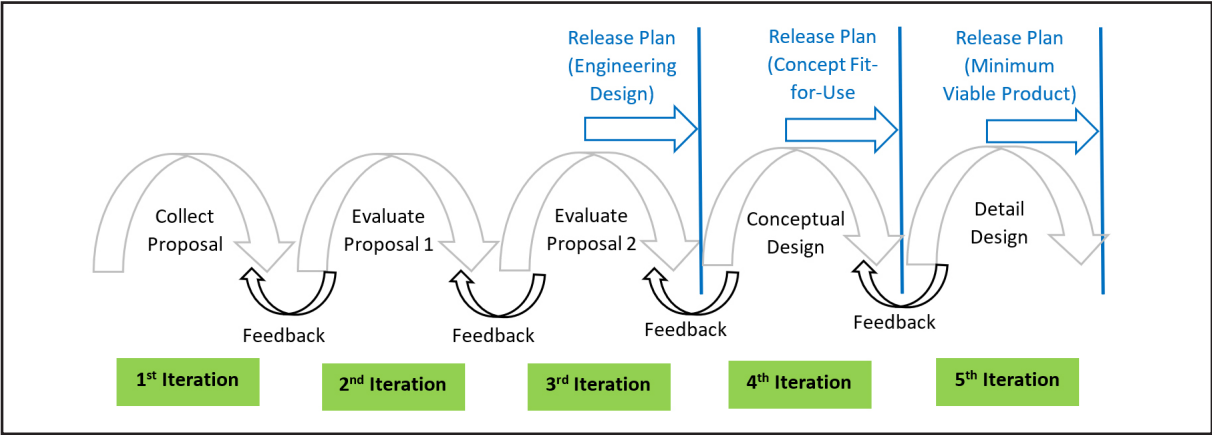
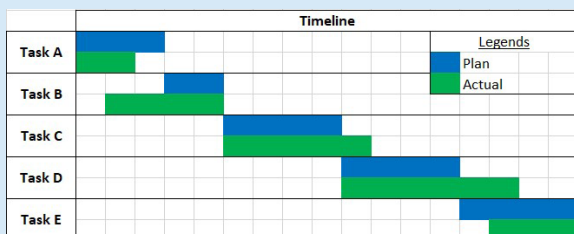


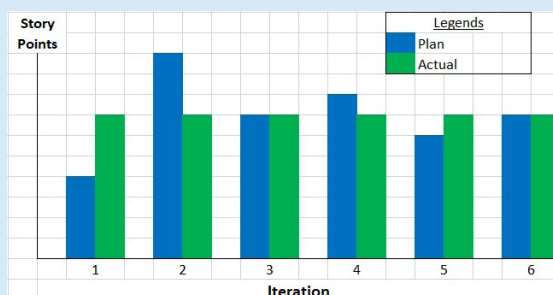
Table 2: Sample graphical presentation of Agile Cycle during Repair Option Selection stage

Sample Gantt Chart to Measure Work Progress (Normally for Predictive Approach)



Predictive methodology is commonly utilised on physical product. For example, fabrication of goods, construction work, etc.

Sample Velocity Chart to Measure Story Point (Normally for Agile Approach)



Agile methodology is typically preferred on non-physical product as it is a measurement of effort such as planning, designing, etc.

Table 3: Comparison between Gantt Chart and Velocity Chart

cost, including their pros and cons. Once the best option was finalised, the procurement process commenced, allowing the team to proceed with Engineering Design, including Finite Element Analysis to confirm the repair concept was fit-for-purpose. Engineering Design can be considered a form of progressive elaboration planning from Conceptual Design to Detail Design. Associated stakeholders were constantly engaged to obtain feedback, ensuring the outcome was desirable to all parties and would lead to the delivery of the Minimum Viable Product.

Note: For the Agile Approach, a Velocity Chart can be used to capture progress based on the job effort (story point) and time

factor (iteration). This approach emphasises flexibility, collaboration, and adaptability, allowing team members to refine or improve the design after collecting feedback from stakeholders.

- d. Repair Preparation and Execution.

Hybrid Approach with Waterfall Major:

Once all front-end engineering work was completed in the earlier stages, the repair mitigation plan and work schedule were developed by defining the requirement and sequence the activities to capture the critical path. It was vital to adhere to the company procurement process, conduct sufficient material control and monitoring, including perform necessary testing to ensure the final repair system met end-user quality expectation with timely delivery (Table 3).

Initiate	Plan	Execute	Control / Monitor	Close-up
Project Chartered and Stakeholder Identified for this final stage. (Company Management, Repair Diving Barge, Repair Vendor, etc.)	Addressed the Underwater Pipeline Repair Scope, Schedule, and Cost aspects based on earlier work and info. (Since this phase is non-physical, Agile Approach was used.)	Purchased repair material and engaged the barge. The Underwater Pipeline repair campaign is relatively high risk, and individual tasks need to be executed per the procedure (risk captured)	The Pipeline Owner assigned in-house representative to validate and verify the work done by the Contractors. Photos evidence taken as part of task completion.	After all the required repair tasks were completed with satisfactory results, the documents were signed-off by the customer, and lesson learned were captured for future improvement.

Table 4: Sample steps in Waterfall Methodology

During underwater pipeline repair campaign, resource management (in terms of manpower, equipment and material) was another crucial skill, indirectly addressing the budget. All jobs had a certain degree of risk, and to minimise hiccups, the teams needed to be proactive in risk identification, analysis and response adhering to the established project procedures.

Note: Since at this stage the project had stable requirement and timeline was certain, a Predictive Major Approach was well-suited for better execution, control, and monitoring.

lifelines in this industry is the underwater pipeline that transports crude oil and natural gas to onshore facilities for processing purposes. Despite a proper inspection programme in-place, there are unprecedented events where damage may occur due to external factors, requiring the pipeline owner and operator to respond appropriately.

Since scenarios may differ, it is crucial to have a tailor-made Project Life-Cycle to oversee the job whether it is Predictive, Agile or Hybrid. Moreover, both technical and intellectual aspects, together with Servant Leadership, are pivotal to project success, satisfying all stakeholder involved. 🌟

Conclusion

Our nation is rich in natural resources, with the oil and gas industry continuing to contribute significantly to the economy. One of the critical

Reference

1. PMBOK® Guide - Seventh Edition

Engineering the End of a Ship's Life: Challenges & Innovations in Global Ship Breaking

by
Peter Khoo Phooi Sen

Ship-breaking (also known as ship recycling or ship demolition) is the industrial process of dismantling ships at the end of their operational lives, recovering materials and components for reuse, remanufacture or disposal. Closely tied to global trade, technology cycles and environmental regulation, ship-breaking occupies a challenging intersection between opportunity (recycling of large volumes of steel and reusable marine equipment) and risk (worker safety, toxic waste, coastal pollution).

This article traces the evolution of the industry, describes the international protocol framework and engineering best practice that has developed, identifies the major countries active in ship-breaking, summarises site accident and safety records, reviews typical vessel ages at scrapping and how owners decide a ship is beyond economical repair as well as lists the valuable items recovered during dismantling.

Historical Background & Evolution

Industrial scale ship-breaking is a post-WWII phenomenon which migrated with economic and regulatory change. Early ship-breaking was carried out at established shipyards in industrialised countries, but since the 1970s, the industry shifted decisively towards lower-cost sites in South/South-East Asia.

This may be due to the rapidly growing volume of merchant tonnage and frequent vessel obsolescence, availability of low-cost labour and space on tidal beaches that simplify access to hulls and weaker environmental and occupational standards that lower immediate operating costs for recyclers. The beaching method - bringing a vessel onto a tidal shore and cutting it apart - was central to the South Asian model pioneered in places like Chittagong (Bangladesh), Alang (India) and Gadani (Pakistan). Chittagong's ship-breaking activities could be traced back to the 1960s, when stranded vessels were cut up and local demand for scrap iron fuelled an industry which gradually grew into major yards. Over subsequent decades, Alang, Chittagong and Gadani became global centres, while Turkey, China and, later, a handful of more regulated European and North American yards, adopted alternative methods such as dry-dock or shore-based facilities with impermeable floors and controlled waste streams.

The environmental and human costs of the beaching model became increasingly visible. There was contamination of intertidal zones, uncontrolled release of asbestos, PCBs, oils and heavy metals, and very poor worker safety records. Pressure from NGOs, the media and some governments catalysed a regulatory response at regional and global levels,

culminating in a body of legal instruments and voluntary schemes designed to raise standards and to embed life-cycle responsibility for ships.

International Protocol & Regulatory Framework

Three instruments dominate the international governance picture for ship recycling: The Hong Kong International Convention (HKC) for safe and environmentally sound recycling of ships, the European Union's Ship Recycling Regulation (EU SRR), and obligations under the Basel Convention on the control of transboundary movements of hazardous wastes. Each tackles overlapping aspects - hazard inventories, standards for recycling facilities, and controls on the movement of hazardous components.

1. HKC, 2009

Adopted in 2009 by the International Maritime Organisation (IMO), the HKC aims to ensure that ships are recycled without posing risks to human health and the environment. Its core elements include mandatory preparation and maintenance of an Inventory of Hazardous Materials (IHM) for covered ships, surveys (initial, renewal and final) that verify the IHM, and the requirement that recycling occurs only at authorised ship recycling facilities which meet standards and hold a Ship Recycling Facility Plan (SRFP). The HKC also requires ship-specific Ship Recycling Plans (SRPs) for each recycling project and certificates demonstrating readiness for recycling. After meeting ratification thresholds, the HKC entered into force in mid-2025, establishing a global minimum standard.

2. EU SRR

The EU acted regionally with stricter obligations: EU-flagged or EU-owned vessels must have IHMs and comply with tighter restrictions on hazardous materials and approved lists of recycling facilities. The EU regulation influenced market behaviour

because many shipowners trading with Europe preferred compliant yards or took extra steps to meet the stricter EU rules. The interaction between the EU SRR, HKC and the Basel Convention requires careful legal and operational alignment, especially on export and transboundary controls for hazardous waste.

3. Basel Convention

The Basel Convention governs the transboundary movement of hazardous wastes. Parts of end-of-life ships (or ship-derived wastes) qualify as hazardous and therefore fall under customs and disposal controls. The Basel framework is invoked when ships containing hazardous materials are sold for export to jurisdictions lacking appropriate hazardous waste treatment capability.

Together, these frameworks moved the industry away from a regulatory Wild West toward explicit life-cycle responsibility, technical standards for yards (impermeable flooring, waste storage and treatment, emergency systems) and required transparency.

Engineering & Good Practice for Safe and Environmentally-Sound Ship-Recycling

Engineering practice in ship-breaking is multi-disciplinary: Structural engineering, occupational safety engineering, environmental engineering, hazardous-materials management and logistics. Core elements of good practice, now reflected in HKC guidance and industry best practice, include:

- a. **Inventory of Hazardous Materials (IHM).** A ship-specific register (parts I-III) that identifies asbestos, PCBs, ozone-depleting substances, heavy metals and other dangerous materials. An accurate IHM underpins planning, permits, and safe removal sequences.
- b. **Authorised recycling facility design.** Yards should have hard standing (impermeable surfaces), bunded areas for

contaminated fluids, wastewater collection and treatment, secure hazardous waste storage, gas-free testing and certification facilities for safe hot work, firefighting systems, and controlled access points. These physical controls limit coastal contamination and worker exposure.

- c. **Ship-Specific Recycling Plan (SRP).** Derived from the IHM, the SRP sequences hazardous removals (e.g. asbestos abatement, fluid draining, tank cleaning) prior to cutting, prescribes safe access and rescue arrangements, and defines environmental controls and monitoring.
- d. **Gas-free and confined-space safety.** Engineering controls and testing protocols for flammable atmospheres and oxygen deficiency are mandatory before hot cutting or entry, supported by certified gas-testing equipment and trained personnel.
- e. **Mechanical and structural staging.** Planning to maintain hull stability while cutting, sequencing of heavy-lift removals (e.g. rudders, propellers) to avoid sudden shifts, and use of cranes, cutters and lifting gear meeting certification standards.
- f. **Personal protective equipment (PPE) and worker training.** Respiratory protection, flame-retardant clothing, eye and hand protection, and lockout-tagout procedures for equipment isolation reduce injury risk.
- g. **Waste management and off-site disposal.** Segregated collection of hazardous and non-hazardous waste, appropriate treatment (e.g. PCB destruction), and licenced disposal to prevent illegal dumping or secondary contamination.
- h. **Environmental monitoring and community controls.** Periodic sampling of sediments, intertidal biota and groundwater for contaminants to ensure compliance and early warning of pollution spread.

These practices are engineering-intensive and require capital investment, competent personnel and institutional oversight. The HKC and EU SRR provide the regulatory impetus and technical templates for implementation.

Major Ship-Breaking Countries & Methods

Global ship recycling is concentrated in a few countries and in two dominant methodological approaches.

1. **Beaching method.** A vessel is run aground on a rising tide and cut apart on the shore. This method remains prevalent because of low capital cost and simpler logistics and dominates sites in Bangladesh (Chattogram/Chittagong), India (Alang/Sosiya) and Pakistan (Gadani). NGO and industry datasets show South Asia accounted for the majority of ships dismantled in recent years, with Bangladesh and India taking a very large share of tonnage, though annual volumes fluctuate with market cycles.
2. **Shore-based and dry-dock methods.** Facilities with hard standings, workshops and controlled waste handling operate in Turkey (Aliaga), China, and some European yards (e.g. UK, Belgium) and the USA. These sites tend to comply more readily with HKC/EU SRR standards and have lower environmental risk but higher operational costs.

In the 2010s and early 2020s, Bangladesh rose to prominence in volume terms and India maintained a large share, while Turkey and China maintained more regulated, higher-cost alternatives. Recent annual demolition figures show hundreds of merchant ships scrapped each year but with cyclical declines, for example a reduced scrapping volume in 2024 compared with earlier years as market dynamics and regulatory changes played out.

Site Accident Rates & Worker Safety

Ship-breaking has a poor safety record in many yards. NGO analyses and academic studies have documented hundreds of fatalities and thousands of injuries over recent decades in South Asian yards, with gas explosions, falls, heavy-plate collapses and exposure to toxic materials being commonly reported causes.

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Conversely, regulatory changes
(emissions rules) may accelerate
demolition of non-compliant tonnage.
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For example, aggregated NGO tallies show hundreds of confirmed worker deaths over the last decade(s) at major beaching yards. Specific catastrophic events, such as the 2016 Gadani explosion, highlight the systemic vulnerabilities when hot work is undertaken without effective gas-free certification and protective systems. Independent reports emphasise poor PPE usage, lack of formal training, and economic pressure which can undermine safe sequencing of hazardous removals.

Improving the safety picture requires investment, training and regulatory enforcement which are precisely the aims of HKC compliance and capacity building.

Typical Vessel Age at Recycling

There is no single “scrapping age” for vessels; age at demolition varies strongly according to vessel type, market conditions, regulatory drivers and maintenance history. Two points are important:

1. **Fleet average and trend.** The average age of the global fleet by vessel count has been in the low-to-mid-20s (years), but the average scrapping age varies by segment. Bulk carriers and tankers are often scrapped in the late 20s to early 30s (although recent data show a drop in average scrapping ages for some bulk carriers). UNCTAD and

industry analysts report fleet age averages (e.g. global fleet average by vessel count was approximately 22 years in early 2023), and demolition-market analyses show segment-specific averages (e.g. bulk carrier scrapping ages around high 20s in recent years). Economic cycles (low scrap prices, strong freight markets) can delay scrapping and thus increase fleet age. Conversely, regulatory changes (emissions rules) may accelerate demolition of non-compliant tonnage.

2. **Economic decision:** Beyond Economic Repair (BER). Owners may decide to scrap when the cost of repairing/retrofitting a ship (including necessary capital investments to meet regulatory and operational requirements) exceeds the expected future earnings of continued operation plus the cost of alternative solutions. BER analysis is an economic/engineering appraisal which compares forecasted life-cycle costs (repairs, fuel, insurance, compliance) with discounted future revenues. If the repair/retrofit cannot be justified, the vessel is sold for recycling. Additional triggers include structural damage, catastrophic incidents, market rationalisation and prohibitive retrofit costs to comply with new regulations (e.g. emissions or ballast water rules). The BER concept is widely used in maintenance and asset-management practice.

Assessing Ship's Worthiness Before Breaking

A pragmatic appraisal includes:

- **Structural integrity assessment.** Hull surveys include ultrasonic thickness testing, fracture and corrosion mapping. If the global or local corrosion has reduced scantlings below safe margins, repair costs can be prohibitive.
- **Machinery and systems condition.** Evaluation of the main and auxiliary engines, boilers, pumps, steering gear and electrical systems. Major overhauls may be cost-prohibitive.
- **Regulatory retrofit costs.** This includes the cost of installing or upgrading ballast water treatment, NOx/SOx controls, or other required equipment.
- **Commercial value and future earnings.** Freight market outlook for a ship type, remaining charter value, and anticipated operating costs (fuel, crewing, insurance).
- **Availability of finance and alternative uses.** Possibility of converting the vessel for other uses (e.g. stationary platform) or selling to buyers in different markets.

If the sum of repair/retrofit costs plus projected operating costs outweigh expected net earnings and resale value, the BER decision favours recycling.

Valuable Items & Materials Recovered During Dismantling

Ship recycling recovers both bulk raw materials and higher-value components. Major recoverable items include:

- **Steel and ferrous metals.** The primary value stream - hull plates and structural steel constitute the majority of recovered tonnage and are melted into new steel products.
- **Non-ferrous metals.** Copper (from wiring), bronze (propellers), brass, and aluminium fetch higher prices and are carefully segregated.
- **Machinery and equipment.** Auxiliary engines, pumps, compressors, turbines, winches and gearboxes can be refurbished or sold as spare parts.

- **Propellers and shafts.** Large components often sell for significant value.
- **Electronics and navigation equipment.** Radars, autopilots, GNSS units, and other electronics, if functional and legally transferable, can be salvaged.
- **Furniture and outfitting.** Galley equipment, fixtures, valves, and piping may have resale value.
- **Hazardous materials as avoided costs.** Removing and safely disposing of asbestos, ODS and PCBs come at a cost but are necessary to unlock the value of other materials and to comply with regulation. Good recycling processes maximise valuable recovery while controlling hazardous streams.

Trajectory & Priorities

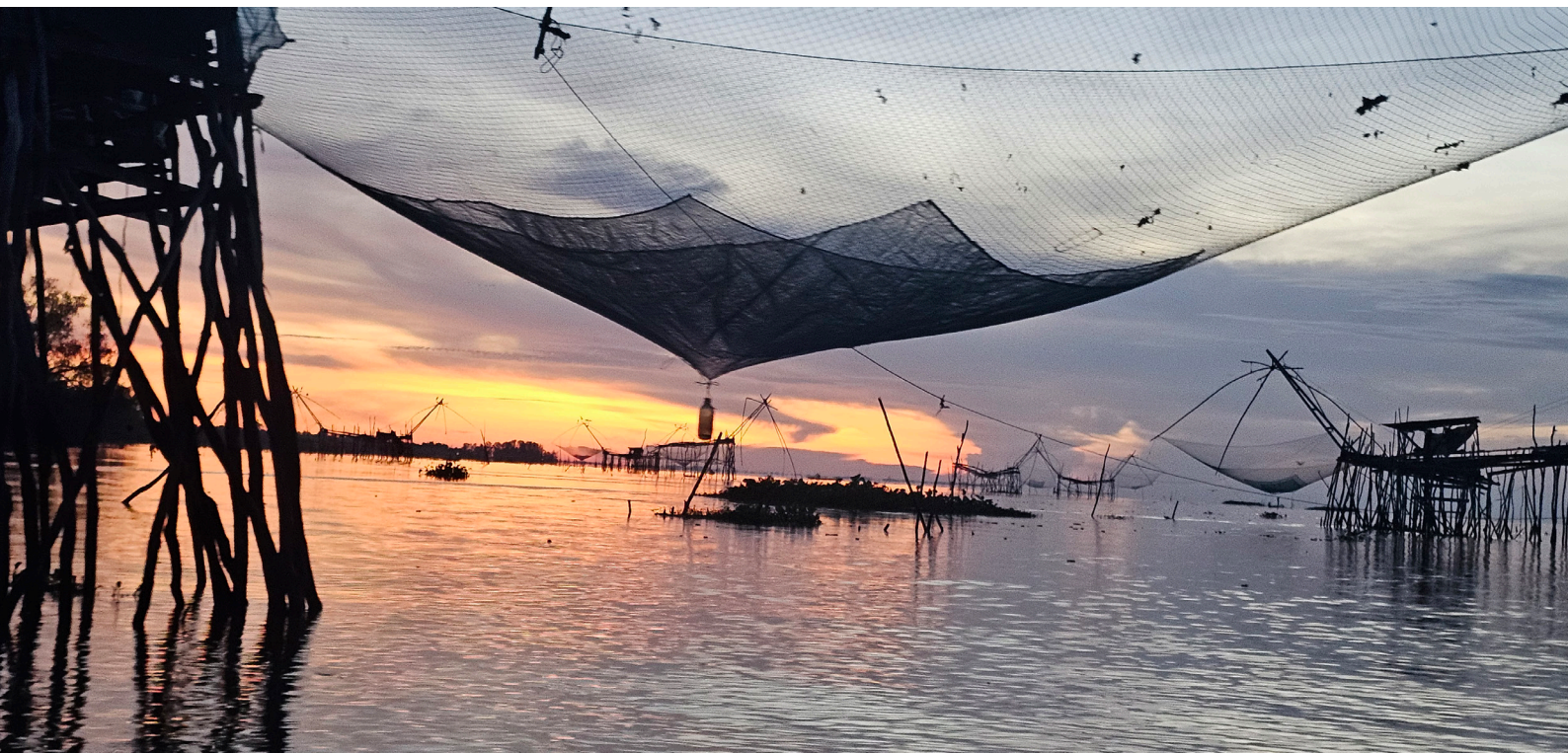
Ship-breaking is a classic circular-economy activity where a vast, distributed stock of steel and equipment returns into industrial supply chains. Yet the environmental and human costs of low-standard recycling pathways are unacceptable. The HKC entry into force in mid-2025 and regional rules such as the EU SRR mark an inflection point. More yard infrastructure will need upgrading, IHMs and SRPs will become standard and owners and recyclers will face stronger compliance expectations.

To reconcile cost, safety and sustainability, the industry needs continued investment in engineered facilities (hardstanding, treatment plants), skills and governance, alongside market mechanisms (certification, insurer and charterer requirements) that reward safe, traceable recycling.

For shipowners and engineers, the task ahead is to integrate life-cycle thinking into ship design and operation, minimising hazardous materials at build time, maintaining accurate IHMs, planning for end-of-life reuse and recovery as well as ensuring the economic calculus internalises environmental and social costs. For regulators and yard operators, the challenge is to translate international protocols into enforceable national systems and to expand capacity building so that developing-country yards can adopt engineered, safe recycling without losing livelihoods. 🌱

Gliding Through a Sea of Lilies: Ingenious Southern Thailand Boats with Special Rudder Blades

by
Ng Li Li



Sunrise over Thale Noi Lake with sights of local fishing nets, YOR in the foreground

Hidden in the southern province of Phatthalung, Thailand, is Thale Noi, a mesmerising wetland where time seems to slow down. Stretching across thousands of hectares, the lake transforms into a vast floating garden during the blooming season, with pink, white, and purple water lilies blanketing its surface.

The scenery is so enchanting that it has earned Thale Noi recognition as part of the Ramsar Wetlands of International Importance, a protected ecological treasure admired by visitors from around the world.

But beyond its natural beauty, Thale Noi is home to a community of skilled boatmen who have learnt to live in harmony with the fragile



The vast expanse of lily plants with stems and leaves covering almost all of the surface of the lake

ecosystem of the lake. Their ingenuity is showcased in a unique rudder blade innovation, which allows them to glide across dense clusters of lily leaves and blossoms without damaging the plants beneath.

Each morning, Thale Noi awakens to a breathtaking scene: Thousands of lily blossoms unfurling their petals on the water surface, their petals glowing in the soft morning light. Green leaves overlap like natural mosaics, while reflections of pink and white blossoms dance on the lake surface.

Navigating Lily-Dense Waters

Moving a boat through Thale Noi's lily-filled waters is no simple task. Beneath the breathtaking beauty is a delicate environment where thousands of lily stems intertwine just below the surface. Ordinary propellers would cut and damage these stems, destroying the flowers and disturbing aquatic life.

To solve this, local boatmen developed a special metal blade to be fixed beneath the rudder. Instead of slicing through the lilies, this blade presses the leaves and stems downward as the boat moves forward, creating a temporary, narrow pathway. Once the boat passes, the lilies naturally float back up, undisturbed.

This innovation showcases the boatmen's deep respect for nature and their intimate understanding of the lake's ecology. The technique also allows visitors to experience the magic of drifting across a lily-covered lake without causing harm to its fragile ecosystem.

Ingenious Special Rudder Blade System

Thale Noi Lake. The special rudder design with its curve metal blade allows the boat to move through the lily plants.

Unlike conventional boat rudders, which simply steer the vessel, the rudders used by Thale Noi boatmen are specially modified for eco-friendly navigation through dense vegetation.

- **Metal Blade Attachment:** A sturdy, flat metal blade is fixed just below the rudder, extending slightly downward and backward.
- **Pressing, Not Cutting:** Instead of slicing through the lily stems, the blade gently presses them downward beneath the water surface, creating a temporary path for the boat to pass.
- **Minimised Environmental Impact:** Because the lilies are not cut or uprooted, they spring back to the surface after the boat passes, ensuring the ecosystem remains intact.



View of the skill boatmen moving the boat by pressing down rudder blade on the lily plants with just sufficient depth of water to enable the boat to move forward.



L: Migratory birds resting on tree branches in this lake sanctuary.



R: Another view of the special rudder blade lifted above the lily plants when not sailing

- **Manoeuvrability in Shallow Waters:** The lightweight, long-tailed wooden boats commonly used in the lake have shallow drafts, making it easy for boatmen to glide over submerged plants without disturbing the sediment below.

This clever engineering solution marks the harmonious coexistence of local communities and the fragile wetland ecosystem, balancing the need for mobility with ecological preservation.

Ramsar-Recognised Wetland Ecosystem

Thale Noi is part of the Songkhla Lake Basin, South-East Asia's largest natural lake system. In 1998, it was designated as Thailand's first Ramsar site, acknowledging its global ecological importance. The lake supports:

- Over 180 species of resident and migratory birds, making it one of Thailand's premier bird-watching destinations. Migratory birds from as far as Siberia, China, and Europe arrive between November and April, filling the sky with flocks of graceful movement. Beneath the surface, fish thrive in shallow waters, feeding local communities for generations.
- Vast aquatic plant diversity, including water lilies, lotuses, and bulrushes.
- Numerous fish species that sustain local fishing communities.

The boatmen often describe their home as a place where "water, flowers, birds, and people live as one". This harmony is not accidental but the result of centuries of adaptation and care for the environment.

Thale Noi is part of the Songkhla Lake Basin, one of Thailand's most important wetland ecosystems. In 1998, it was declared a Ramsar Wetland of International Importance due to its unique biodiversity, cultural heritage, and ecological significance.

Today, conservation efforts are aimed at balancing tourism, fishing, and protection of the environment. Local boatmen play a key role in preserving the wetlands, adapting their livelihood methods to ensure Thale Noi's beauty endures for generations to come.

Traditional Fishing & the Yor Nets

Among the many cultural highlights of Thale Noi is the traditional fishing method using Yor - large, square fishing nets suspended from bamboo frames. These are large lift nets - bamboo frames supporting expansive nets which are lowered into the water and then lifted up with the catch. These structures are iconic symbols of south Thailand's fishing heritage and can often be seen silhouetted against the sunrise.



YOR fishing nets are a local symbol of Thale Noi's fishing heritage.

- Yor nets are operated using a counterweight system which allows fishermen to raise and lower them efficiently.
- The nets are placed strategically at shallow areas of the lake, where fish naturally migrate.
- The method is sustainable, designed to avoid overfishing and to minimise disruption to the aquatic ecosystem.

The primary catch is “pla look brae” (sometimes spelled “look bre”). These are small transient fish, highly valued in the local cuisine; they’re usually marinated in turmeric and deep-fried or cooked in sour curry and widely consumed across Phatthalung and Songkhla provinces.

The sight of multiple Yor nets silhouetted against the horizon has become one of the lake’s most photographed attractions, showing the blend of traditional livelihood and scenic beauty.

Life of the Boatmen

For the boatmen, Thale Noi is not just a workplace - it is their home, heritage, and identity. Many families live in small stilt houses along the edge of the lake with wooden walkways connecting the homes. Boats are an extension of their lives and most men learn to handle them from childhood, mastering the art of manoeuvring through the tangled lilies and shallow waters.

Daily life begins before dawn. As the first light spreads across the horizon, boatmen prepare their long-tail boats, either to guide visitors through the lily fields or to prepare the Yor nets for the day’s fishing. Despite growing tourism, fishing remains central to their survival, and many families rely on both to make ends meet.

Tourism & Cultural Heritage

Tourists visiting Thale Noi are treated to a unique experience unlike anywhere else in Thailand. A typical boat journey begins at the Thale Noi Waterfowl Reserve Pier, where wooden boats are waiting to take passengers into a dreamlike world.

As the boat glides through clusters of lily leaves, the scenery unfolds like a living painting: Pink and white blossoms sway with the ripples, migratory birds sweep across the sky, and the distant silhouettes of Yor fishing nets rise elegantly against the horizon. The journey is quiet, peaceful, and deeply immersive - a reminder of the delicate balance to be maintained between humans and nature.

Thale Noi is not just a haven for biodiversity but it is also a cultural landmark. Visitors are drawn to its:

- Floating carpets of lilies, best experienced during early morning boat tours.
- Traditional fishing villages, where techniques like Yor net fishing have been passed down through the generations.



The well-preserved wetlands and serene surroundings are gaining popularity with tourists seeking to relax in a natural setting.

- Wetland bird sanctuary which attracts nature enthusiasts and researchers from around the world.
- Annual Thale Noi Bird Festival, celebrating the region's environmental and cultural richness.

The lake has become an exemplary model for eco-tourism, where conservation and community coexist in balance. With the increasing popularity of Thale Noi, concern over environmental sustainability is growing. More boats, visitors, and fishing activities risk disturbing the fragile ecosystem if these are not carefully managed. Local communities, conservation groups, and the Thai government have joined hands in their efforts to regulate boat traffic, protect migratory birds, and restore damaged wetlands.

The boatmen, once seen only as guides and fishermen, are now recognised as guardians of Thale Noi. Their knowledge of the lake, from understanding water currents to protecting lily roots, is invaluable for ensuring its survival.

Conclusion

Thale Noi is more than just a tourist attraction; it is a living masterpiece of nature and culture. Here, lilies bloom endlessly, birds migrate across continents, and traditional fishing practices like Yor nets coexist with innovative boat techniques designed to protect the environment.

The boatmen of Thale Noi embody the essence of this harmony. With their ingenuity, resilience, and deep-rooted respect for nature, they have created a way of life where people and wetlands thrive together.

The local boatmen's ingenious innovation of using a metal blade beneath the rudder to protect the lilies as the boat glides across the sea of lilies in Thale Noi not only retains its beauty but an intimate connection with Thailand's ecological and cultural heritage. 🌿

Closing the Loop: Engineering Pathways for a Circular Economy in Ship Dismantling

by
Cheo Hong Keyong



The maritime industry has long been a cornerstone of global trade and economic development, carrying over 80% of the world's goods across oceans. Yet, as fleets are modernised and newer, more efficient vessels take to the seas, a critical question arises: What should be done with ageing ships reaching the end of their operational lives?

Traditionally, ship dismantling was fraught with environmental hazards, social injustices, and engineering inefficiencies. In the past, most vessels were sent to poorly regulated shipbreaking yards where environmental pollution, exposure to toxic materials, and unsafe labour conditions prevailed. However, in the 21st century, this linear “take-make-dispose” model of ship decommissioning has become increasingly unsustainable.



The concept of a circular economy offers a promising alternative. By prioritising reuse, recycling, and resource recovery, circular approaches can transform ship dismantling from a waste-intensive process into one that contributes to sustainable resource cycles.

Engineering lies at the heart of this transformation, guiding both the design of ships for disassembly and the safe recovery of valuable materials at end-of-life. This article will examine how circular economy principles can be integrated into ship dismantling, the engineering practices that enable this transition, the challenges facing implementation, and Malaysia's unique opportunity to lead in sustainable maritime innovation.

Circular Economy in Maritime Context

The circular economy represents a paradigm shift in how industries view materials and waste. Rather than treating end-of-life vessels as liabilities to be discarded, this framework envisions ships as reservoirs of valuable materials which can be reintegrated into industrial cycles.

In the maritime sector, circularity begins with ship design and continues throughout the lifespan of a vessel. Retrofitting, repurposing, and eventual dismantling are conducted with resource

efficiency in mind, ensuring that steel, copper, aluminium, electronic systems, and machinery are recovered instead of simply discarded.

Ships are particularly well-suited for circular strategies because of their material composition. A single large vessel contains tens of thousands of tons of high-quality steel, along with significant quantities of non-ferrous metals, polymers, and specialised components. When recovered responsibly, these resources can drastically reduce demand for virgin material extraction, lower carbon emissions from steelmaking, and support industries such as construction, motor vehicles, and energy. In this sense, the dismantling of ships is not simply an end-of-life activity but a critical node in global resource management.

Engineering Phases of Circular Ship Decommissioning

Engineering plays a decisive role in translating the circular economy theory into practice. The process of dismantling ships within a circular framework can be understood through several interconnected phases.

Design for Disassembly

The journey toward circular dismantling begins long before a ship touches water. Forward-looking engineering practices emphasise “design for disassembly,” where vessels are constructed with modular components, standardised fittings, and non-toxic materials. Ships designed in this manner can be dismantled more efficiently and with reduced risk to workers and the environment.

The emerging concept of a “material passport” is central at this stage. By cataloguing the materials used in shipbuilding (types, quantities, and potential recyclability) engineers can ensure that future dismantling processes are guided by transparent documentation. This innovation reduces uncertainty and waste while improving safety.

Pre-Decommissioning Assessment

Before dismantling, a thorough engineering assessment is necessary. This involves surveying the vessel structure, cataloguing hazardous materials, and identifying components suitable for reuse or refurbishment. The Inventory of Hazardous Materials (IHM) is particularly important, detailing substances such as asbestos, polychlorinated biphenyls (PCBs), and heavy metals. Structural assessments ensure that dismantling can proceed safely without risking collapse, while component inventories highlight salvage opportunities. International frameworks, such as the Hong Kong International Convention for the Safe & Environmentally Sound Recycling of Ships (2009), set global standards for these assessments, requiring interdisciplinary collaboration between marine engineers, environmental consultants, and safety officers.

Safe Dismantling & Material Recovery

The dismantling phase itself demands precision and innovation. Engineering choices dictate recovery rates and environmental impacts. Techniques such as cold cutting, abrasive water jetting, and the controlled use of cranes and hydraulic lifts are employed to prevent fire hazards, minimise accidents, and protect structural stability.

During this process, the segregation of materials - ferrous and non-ferrous metals, electronics, fluids, and cables - ensures efficient recycling. Engineering design also extends to environmental safeguards: Containment systems, drainage controls, and spill-prevention infrastructure are necessary to prevent contamination from oil residues, fuel, or chemicals.

Component Refurbishment & Reuse

Circular dismantling goes beyond recycling raw materials. Many ship components retain

high functional and economic value. Diesel generators, propulsion engines, pumps, and navigational systems can be removed, tested, refurbished, and re-certified for secondary use. Engineering oversight is critical in this phase, as components must meet operational standards before re-entry into the market. Facilitating reuse not only reduces waste but also supplies affordable equipment to smaller operators and developing markets.

Material Processing & Closed-Loop Recycling

Finally, the extracted materials enter broader industrial recycling systems. Steel, the most abundant ship material, can be melted and reformed for use in construction or even in new vessels. Copper, aluminium, and synthetic materials similarly re-enter manufacturing cycles. Engineers ensure these processes adhere to responsible recycling practices, minimising energy use and emissions. The development of local recycling infrastructure further supports circularity, reducing the carbon footprint associated with transporting scrap materials to distant facilities.

Emerging Technologies Supporting Circular Ship Dismantling

Recent technological advancements are making circular ship dismantling more feasible and efficient. Three-dimensional scanning and digital twin technology enable precise mapping of a vessel's structure, allowing engineers to plan dismantling sequences with accuracy and safety. Artificial intelligence (AI) and machine learning algorithms enhance decision-making by predicting material recovery values and identifying the most cost-effective salvage strategies.

Robotics and automation represent another transformative development. Traditionally, dismantling was labour-intensive and dangerous, exposing workers to toxic materials and structural hazards. Now, robots can be

deployed for tasks such as cutting, lifting, and handling of hazardous materials, significantly improving safety.

Similarly, blockchain-based systems are emerging as tools for tracking materials from dismantling to recycling, ensuring transparency and accountability across the supply chain. Together, these technologies create a more efficient and verifiable circular economy in ship recycling.

Challenges to Implementation

Despite its promise, the transition to circular ship dismantling faces significant challenges. Regulatory enforcement remains inconsistent, with many ships still being dismantled in substandard facilities in South Asia, where environmental degradation and unsafe labour conditions persist. Older vessels, constructed without consideration for disassembly, present engineering difficulties due to complex structures and toxic materials used.

Financial investment is another barrier. Establishing modern, environmentally sound ship recycling yards requires significant capital for infrastructure, waste treatment systems, and worker training. Many developing nations, where dismantling industries are concentrated, lack the resources or incentives to undertake such reforms. Furthermore, circular dismantling requires specialised expertise. Training marine engineers, environmental specialists, and technicians in advanced dismantling methods is essential but often neglected.

Malaysia's Role & Opportunity

As a maritime nation strategically located along key global shipping routes, Malaysia has the unique opportunity to position itself as a leader in circular ship dismantling. Facilities in Lumut and Port Klang already engage in ship servicing and repair, offering a foundation upon which certified green recycling yards can be developed. By aligning with international conventions such as

the Hong Kong Convention, Malaysia can attract global contracts from shipowners seeking responsible end-of-life solutions.

Investing in engineering education and research is equally important. Collaboration between the Marine Department Malaysia, local universities, and learned societies can produce a skilled workforce trained in state-of-the-art dismantling practices. Malaysia can also serve as a regional knowledge hub in South-East Asia, sharing expertise in sustainable maritime engineering with neighbouring countries. Economically, such a transition will generate green jobs, strengthen the country's maritime sector, and reinforce its reputation as a responsible actor in global trade.

Conclusion

The dismantling of ships represents both a challenge and an opportunity for the maritime industry. Historically associated with environmental damage and human exploitation, it is now being reimagined through the lens of the circular economy. By emphasising design for disassembly, safe dismantling, component reuse, and material recycling, engineering plays a central role in transforming end-of-life ships into valuable resources. Emerging technologies such as digital twins, AI, and robotics further enhance the safety, efficiency, and transparency of this process.

Yet, realising the full potential of circular ship dismantling requires overcoming regulatory gaps, technological limitations, and financial barriers. Malaysia, with its strong maritime tradition and strategic location, has the capacity to lead in this field by investing in green recycling infrastructure, skilled workforce development, and regional collaboration. Ultimately, closing the loop in ship dismantling is more than just an environmental necessity but is also a strategic pathway toward sustainable resource management and maritime innovation. 🌱

Navigating the Intersection of Two Disciplines

by
Surindran Govalen

The relationship between engineering and law is increasingly significant in today's complex technological landscape. As engineers innovate and develop new technologies, they must also navigate a myriad of legal frameworks that govern their work.

This article explores the critical aspects of this intersection, focusing on regulatory compliance, liability issues, intellectual property rights, and ethical considerations that engineers must address. The growing integration of legal principles into engineering practice underscores the need for a comprehensive understanding of both fields to ensure responsible innovation and societal benefit.

Regulatory Compliance in Engineering

Regulatory compliance is a cornerstone of engineering practice. Engineers must adhere to the various laws and regulations that ensure safety, quality, and environmental protection.

Key areas include:

- **Safety Regulations:** Engineers are responsible for designing systems that comply with safety standards established by governmental agencies. These regulations often encompass building codes, electrical codes, and industry-specific safety standards (Koshland et al., 2016). Ensuring compliance not only protects public safety but also mitigates potential legal liabilities for engineering firms.
- **Environmental Laws:** Compliance with environmental regulations is essential for minimising the ecological impact of engineering projects. Engineers must consider environmental assessments and sustainability practices in their designs to meet legal requirements (Lee et al., 2019). Failure to adhere to these laws can result in significant penalties and harm to a company's reputation.

- **Quality Assurance Standards:** Many industries require adherence to quality assurance standards (e.g. ISO 9001) to ensure that products meet specified criteria for performance and reliability (Rathi et al., 2018). Implementing rigorous quality control processes helps prevent defects and ensures customer satisfaction, thereby reducing the risk of legal disputes.

Liability Issues

Liability is a critical concern for engineers, as they can face legal action for various reasons:

- **Negligence:** If an engineer fails to meet the standard of care expected in the profession, resulting in harm or damage, he/she may be held liable. This includes design flaws or inadequate safety measures (Sachan et al., 2020). Engineers must exercise due diligence and maintain thorough documentation to defend against potential claims.
- **Breach of Contract:** Engineers often work under contracts that stipulate specific obligations. Failure to fulfill these obligations can lead to legal disputes and financial penalties (Bakshi et al., 2021). Clear communication and detailed contracts are essential for managing client expectations and reducing the risk of litigation.
- **Product Liability:** Engineers involved in product design may be liable for defects that cause injury or damage. Understanding product liability laws is crucial for engineers to mitigate risks associated with their designs (Gallardo et al., 2020). Regular testing and adherence to safety standards are vital components of risk management in product development.
- **Patents:** Securing patents for new inventions is essential for protecting intellectual property and maintaining a competitive edge in the market (Wang et al., 2019). Patent protection encourages innovation by providing inventors with exclusive rights to their creations for a defined period.
- **Copyright:** Engineers should understand how copyright law applies to software, technical drawings, and other creative works produced during their projects. Proper copyright management ensures that creators retain control over their intellectual output.
- **Trade Secrets:** Maintaining the confidentiality of proprietary processes and formulas is critical for safeguarding competitive advantages. Companies should implement robust security measures and confidentiality agreements to protect their trade secrets from unauthorised disclosure.

Ethical Considerations

Ethics play a significant role in engineering practice and are closely tied to legal obligations. Engineers are expected to:

- **Adhere to Professional Standards:** Following ethical guidelines set by professional organisations (e.g., ASCE, IEEE) is essential for maintaining public trust and credibility. Ethical conduct ensures that engineering practices align with societal values and legal expectations.
- **Report Unethical Practices:** Engineers have a duty to report unethical behaviour or violations of law within their organisations, fostering a culture of integrity. Whistleblowing mechanisms should be in place to protect individuals who expose wrongdoing.
- **Consider Public Welfare:** Engineering decisions should prioritise public safety and welfare over personal or corporate interests, ensuring that projects do not

Intellectual Property Rights

Intellectual property (IP) rights are vital for protecting innovations in engineering. Engineers must be aware of:

adversely affect communities. Ethical engineering practices contribute to sustainable development and enhance the quality of life.

Case Studies

To illustrate the intersection of engineering and law, consider the following examples:

- **Construction Industry Compliance:** A civil engineering firm faced legal challenges due to non-compliance with local building codes during a major infrastructure project. The resulting fines highlighted the importance of regulatory adherence in engineering practices. This case emphasises the necessity of thorough project planning and regular inspections to ensure compliance.
- **Product Liability Case:** An automotive engineer was held liable for injuries caused by a design flaw in the braking system of a vehicle. This case underscored the need for thorough testing and compliance with safety standards. Comprehensive risk assessments and iterative testing phases are essential to identify and mitigate potential hazards.
- **Intellectual Property Dispute:** A software engineer developed an innovative application but faced legal action from a competitor claiming patent infringement. This scenario illustrates the complexities of IP law in the tech industry. Navigating such disputes requires a strong understanding of patent law and proactive legal strategies to protect intellectual property.

Conclusion

The intersection of engineering and law is multifaceted and crucial for ensuring safe, ethical, and innovative practices within the field. By understanding regulatory compliance,

liability issues, intellectual property rights, and ethical responsibilities, engineers can navigate the complexities of their profession effectively. As technology continues to evolve, ongoing education in these areas will be essential for all engineering professionals to adapt to new challenges while contributing positively to society.

This exploration into Engineering & Law emphasises the need to integrate legal knowledge into engineering curricula and professional development programmes, preparing future engineers for the challenges they may face in their careers. Collaboration between legal and engineering professionals will foster a more holistic approach to problem-solving, driving progress while safeguarding public interests. 🌐

Reference

1. Koshland, C. P., White, R. H., & Garfinkel, R. (2016). *Occupational health: Recognizing and preventing work-related disease*. Oxford University Press.
2. Lee, S. Y., Chang, J. E., & Chang, Y. M. (2019). Green semiconductor manufacturing and sustainability: Practices, challenges, and opportunities. *Sustainability*, 11(19), 5329.
3. Rath, A. K., Kim, K. J., & Lee, J. Y. (2018). Sustainable development in semiconductor manufacturing industry. *Journal of Cleaner Production*, 176, 312-324.
4. Sachan, S., Modgil, S., & Singh, R. K. (2020). Sustainable supply chain management practices in the semiconductor industry: A systematic literature review and future research directions. *Journal of Cleaner Production*, 258, 120854.
5. Bakshi, S., Dutta, P., & Khan, F. (2021). Energy management practices in electronics industry: A comprehensive review. *Journal of Cleaner Production*, 314, 127950.
6. Gallardo, A., Rodríguez, A., Ordoñez, J., & Fernández, C. (2020). E-waste management in the electronics industry: A life cycle assessment approach. *Science of The Total Environment*, 729, 138773.
7. Wang, H., Huang, R., & Zuo, J. (2019). Occupational health hazards in electronics manufacturing: An overview. *Safety Science*, 111, 15-23.

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Penang Ferry: Heritage Sea Transportation

by
Ir. Dr. Oh Seong Por



Photo 1: Iconic double deck ferry crossing the Penang Strait in 2018



On the 4th day of Chinese New Year (Year of Dragon) in 2025, my family and I revisited the Penang Ferry. The last time I boarded it was in 2018 when the iconic double deck ferries were still busy plying the Penang Strait to transport passengers and vehicles (Photo 1). However, this time, all the double deck ferries had been retired. I saw two old ferries abandoned at the pier with some parts dismantled and hulls rusted away (Photo 2).

It was a sad sight, considering that these ferries had been used to transport thousands of passengers and vehicles across Penang Strait for many decades and had contributed to not only the economy but also the tourism industry. I felt that the old ferries should be preserved and turned into a floating museum. Probably the relevant authority could emulate the noble work by the Perak State Government which preserved the last tin dredge, *kapal korek Tanjung Tualang* or TT5, in Batu Gajah.

Double deck ferries were completely decommissioned in 2021, and were temporarily replaced with fast passenger ferry, *Kenangan*. In August 2023, a permanent new single deck *Damen Ferry 3508* was introduced. (Photo 3).

Brief History of Penang Ferry

The Penang Ferry is the oldest sea shuttle service in the country. It was established in 1894 by a wealthy Chinese businessman, Quah Beng Kee. The ferry or boat used had undergone various stages of transformations, beginning with the humble Chinese junk or rowing boat which was propelled by wind or humans. Next was a steam engine ferry generating sufficient propulsion for transporting heavier payloads such as passengers and small vehicles. From 1930 to 1940, four steam ferries, codenamed *Seberang*, *Kulim*, *Tanjung* and *Bagan* were put in service.



Photo 2: Two abandoned double deck ferries at the pier in 2024.



Photo 3: New Damen Ferry 3508 introduced in 2023

However, the service was interrupted when the Japanese invaded Malaya. All the ferries except Bagan were destroyed to prevent them from falling into the hands of Japanese. Immediately after the war, the British quickly converted four Z-type tank landing crafts for cross strait transportation. They were renamed *Senangin*, *Lidah*, *Talang* and *Tenggiri*. From 1945 to 1947, there were another three rail steam boats named *SS Violet*, *SS Elizabeth* and *SS Pelangi* plying the strait. These boats, together with the four converted landing crafts, helped to restore the ferry service after the war.

The invention of the diesel engine offered powerful propulsion for ferrying more passengers and vehicles including heavy vehicles which were greatly needed to meet the exponential growth in cargo. Besides powerful engines, new designs were incorporated such as the double deck steel structure to maximise payload for passengers and heavy vehicles. Double ended loading capabilities were also added at both sterns to reduce embarkation and disembarkation time.

In 1959, five diesel ferries - *Pulau Pinang*, *Pulau Aman*, *Pulau Langkawi*, *Pulau Pangkor* and *Pulau Tioman* - were commissioned. With the growing demand, more diesel ferries were constructed till 2002. The latter fleet consisted of *Pulau Lumut*, *Pulau Redang*, *Pulau Labuan*, *Pulau Undan*, *Pulau Rawa*, *Pulau Talang Talang*, *Pulau Rimau*, *Pulau Angsa*, *Pulau Kapas*, *Pulau Payar* and *Pulau Kenangan*.

With the opening of Penang Bridge in 1985, the ferry service lost its prominence. To protect the heritage of Penang Ferry, the cross strait service was retained by using newer but smaller design single deck *Damen Ferry 3508*.

New Experience

For now, the Damen Ferry fleet consisted of only four vessels, named *teluk* (Malay word for bay), a practice breakaway as the old ferries were named *pulau* (island). The new ferries were *Teluk Bahang*, *Teluk Duyung*, *Teluk Kumbar* and *Teluk Kampi*. The Damen Ferry still operated between the Sultan Abdul Halim Terminal on the mainland (Butterworth) and Raja Tun Uda Terminal on the island (Georgetown). However, it docks at a new design pier landing bridge. The new ferry had double docking platforms at both ends which could be lowered and raised as gates when embarkment was completed (Photo 4).



Photo 4: Docking platforms fitted to the new ferry. These functioned as gates when raised upon complete embarkment.

This was a new experience. For the old ferry, a hydraulic docking bridge mounted at the terminal pier was lowered down to the ferry for passengers and vehicles to embark and disembark (Photo 5). I found that the new docking system worked faster and was more stable. The *Damen Ferry* had double end openings, shared and used by passengers and small vehicles. For safety purposes, priority was given to vehicles before passengers. In the old double deck ferry, embarkment and disembarkation platforms for passengers and vehicles were separated. Passengers used the upper deck end opening while lower deck end opening was dedicated to heavy vehicles.



Photo 5: For old ferries system, docking platforms were mounted at the terminal. Passengers used the upper platform and vehicles used the lower platform.

The new ferry was designed only for smaller payload of 250 passengers maximum and 50 motorbikes/bicycles per trip. It had a length of 35.63m, far shorter than the average length of 56m in old double deck ferry. The old ferry could also transport motorbikes, cars, vans and buses.

The new ferry had an air-conditioned cabin for passengers, a convenience not available in the old ferry (Photo 6). There were a few seats located outside the cabin for passengers who prefer to enjoy the sea breeze. Inside the cabin, TV display panels run a video on safety precaution measures as well as a historical documentary of the Penang Ferry (Photo 7). Parallel to the passenger cabin was an open area for motorbikes and bicycles. It was commendable that motorcyclists and passengers stayed in their designated areas (Photo 8).



Photo 6: Air-conditioned cabin for passengers.



Photo 7: TV display panel running the Penang Ferry History documentary.



Photo 8: Inside the new ferry, passengers and vehicles are separated by the cabin wall.

In the old ferry, passengers stayed in the upper deck and vehicles were in the lower deck (Photo 9). Often, drivers and motorists who parked their vehicles on the lower deck, will climb a staircase to the upper deck to join with passengers for an elevated viewing. Vice versa, some passengers would climb down to the lower deck to listen to the splashing of waves.



Photo 9: In the old ferry, the upper deck was solely for passengers and the lower deck for vehicles.



*Photo 10: L - Azimuth Thruster
R - Vertical Rotating Blades.*

The new ferry ride was relatively smooth with less vibration and noise. This was probably due to the new propulsion system which used the horizontal Azimuth thruster. The old ferry used an engine with vertical rotating blades design. This generated powerful omni-directional thrust to propel the heavier ferry but at a higher vibration level (Photo 10).

The new ferry took 10 minutes to cross the strait while the old ferry took 15 minutes. However, one thing remains unchanged. It was the thrill of crossing the Penang Strait. 🚢

With deep sadness, we mark the passing of Ir. Dr Oh Seong Por, a dedicated writer and contributor whose insights will long be remembered by fellow engineers.

An Engineering Student's Voyage by Cargo Ship from Penang to Taiwan, 1964

by
Ir. Wong Koh Sang



Penang port in the 1960s showing the city of George Town in the background

I was born and raised in the old mining town of Taiping in the 1950s, a place where the thunderous rumble of tin dredges and the rhythmic clatter of mechanical workshops filled the air. Those sounds fascinated me. As a boy, I would stand near the workshops to watch mechanics disassemble and reassemble machines with precision, their oil-stained hands working like magic. It was there that my childhood dream took root - I wanted to become a mechanical engineer.

That dream became possible after I completed my secondary education at Hua Lian Chinese Secondary School, earning a Senior High

School Certificate. Back then, completing secondary school itself was a privilege. Many of my peers had to leave school early to help support their families, especially those with large households like mine.

As a graduate of a Chinese-medium secondary school, my choices for further studies were limited. In those days, aspiring students like me had four options:

- United States universities cost around US\$600 (Malayan dollars) per month.
- United Kingdom universities cost around US\$800.

- Nanyang University, Singapore costs around US\$200.
- Taiwan universities cost around US\$60.

With my modest background, the U.S., U.K., and even Singapore was beyond reach. Taiwan, considered the most affordable, was still financially challenging. Many students had to work several years to save enough to pursue their further studies.

For me, the decision was clear. I would take the leap and head to Taiwan, despite the uncertainties.

Setting Sail for a New Chapter

In August 1964, after my family scraped together their hard-earned savings, I joined about 200 high school leavers, including 20 female students, and left for Taiwan. Most of us came from humble, working-class families scattered across Malaya, from Penang, Taiping, Kuala Kangsar, Ipoh, Alor Setar, Kuala Lumpur, and other smaller towns in between.

We chose the cheapest possible route available which was to board a 6,000-ton cargo ship named DaBaoLai (大宝来). It set sail from Penang Port and was bound for Singapore and Hong Kong, carrying rubber, tin, and sawn timber from northern Malaya before arriving in Taiwan.

This was no passenger liner. The DaBaoLai was a working bulk carrier, hastily retrofitted to accommodate a limited number of students as passengers. Instead of grand gangways and comfortable cabins, we climbed a simple timber ladder onto the deck, carrying our modest belongings - mostly small suitcases, mats, and bedding.

The fare was Malayan \$60 for the entire 20-day journey, inclusive of meals and basic lodging. Our “accommodation” was an empty cargo hold, hastily converted into a dormitory-style sleeping deck. There were no beds, just thin mats laid side by side and crammed so tightly that when one person turned, the rest were forced to turn as well.

The air was thick with the pungent smell of engine oil, diesel fumes, and damp timber. It was uncomfortable, noisy, and hot but for most of us, it was our only chance to chase a better future.

Life Onboard: Hardship & Camaraderie

The first few days aboard the DaBaoLai were the hardest. Many of us had never set foot on a ship before, let alone sail on open seas. The constant rolling of the vessel caused seasickness among some students. The sound of vomiting became a common background noise, and the narrow passages often smelt of saltwater and sickness.

Despite the discomfort, we quickly developed a sense of camaraderie. We came from different towns and dialect groups - Hokkien, Cantonese, Hakka, Teochew - yet on that ship, we were equals. We all carried the same dream: To obtain a university education and improve the lives of our families.

Queueing for the Toilet

One of the toughest challenges was the toilet situation. The ship facilities were designed for a crew of 20-30 men, not 200 students. We could only use four small cubicles and these were constantly occupied. At peak times, the queue stretched along the corridor, with everyone clutching soap and buckets of water.

We took turns to shower in tiny cubicles meant for sailors. If it was any consolation, the water supply was considered abundant under such conditions. Some days though, when the seas were rough and water supply had to be rationed, we resorted to wiping ourselves down with damp cloths. But despite these challenges, we learnt patience and discipline, respecting each other's space and turn.

Passing Time Together

With no modern distractions - no smartphones, no internet, no television - we had to create our own entertainment. When the weather was calm, we gathered on the upper deck, where

the salty breeze offered relief from the humid cargo hold. We sang songs together, mostly Mandarin pop songs and old folk melodies. Some students had brought along harmonicas or guitars, filling the evenings with music that lifted our spirits.

We also spent long hours talking - about our hometowns, our families, our dreams, and our fears. Friendships formed naturally, cemented by shared hardships. Some students taught others basic English phrases while others shared snacks brought from home which included dried plums, peanuts, and homemade biscuits. These small luxuries were rationed out carefully.

For students who felt homesick, the group became an emotional anchor. We comforted one another, reassured those missing their parents, and encouraged those who doubted their decision to leave home. That moral support was what kept many of us going.

First-Time Encounters with the Sea

The South China Sea was unpredictable. When the weather was calm, the ship glided smoothly across turquoise waters. But when storms rolled in, life onboard turned into a nightmare.

I remember vividly one evening near the Vietnamese coast when the sea was unnaturally still, like a vast sheet of glass. A sailor warned us that such stillness was an omen of an approaching storm. Sure enough, the next day, towering waves pounded the ship. We were ordered to remain below deck, and every creak of the hull made our hearts race.

Some students clung to their mats, praying silently while others huddled together in small groups, trying to distract themselves with stories. The bond between us strengthened in those moments as we faced fear together.

Stopovers Along the Way

Singapore: After two days at sea, we reached Singapore, docking at Collyer Quay. For many

of us, it was our first visit to the bustling city. We spent two days exploring the streets of Chinatown, sampling hawker food, and marvelling at shopfronts packed with goods we couldn't afford.

However, our excursion was cut short when news broke of unrest in Geylang. A sudden curfew was imposed, and we hurried back to the ship for safety.

Hong Kong: On the 14th day, we arrived in Hong Kong where we transferred our belongings to a smaller cargo vessel, the Anqing (安庆). For many of us, this was our first taste of a truly international port city. The neon lights, bustling Whampoa Docks, and towering apartment blocks overwhelmed us. Most of us had only seen such scenes in Hong Kong movies or calendar covers which were popular during the 1960s.

For three days, we wandered through the narrow lanes, rode old-fashioned elevators for the first time, and watched cargo ships unload goods from all over the world. It was an eye-opening experience that broadened our horizons.

Taiwan: On the 17th day, the Anqing set sail from Hong Kong. It served like a ferry service between Hong Kong and Taiwan. Unlike the DaBaoLai, the Anqing had no proper berths. We spread our mats in any corner we could find and endured three cramped days at sea.

Finally, on the 20th day, we reached Keelung Port in Taiwan. The busy harbour was alive with fishing boats, traders, and freighters from across Asia. To our relief, volunteers from the Taiwan Student Union greeted us and arranged temporary hostel accommodations while we awaited university registration.

Student Life in Taipei

In November 1964, I enrolled at Taipei University to pursue a degree in Mechanical Engineering. Life as an overseas student was modest but fulfilling.

Textbooks were U.S. editions, written in English, while lectures were conducted in Mandarin.



*Penang port in the 1960s
showing the city of George
Town in the background*



*Graduating students
walking past the main
block of Taipei University*

Examinations, however, were set in English, posing an extra challenge for students such as myself who came from Chinese-medium schools.

My monthly expenses were about US\$60, covering tuition, lodging, and simple meals of vegetables, rice, and occasionally meat. To ease our burden, the Taiwanese government offered financial assistance to overseas Chinese students from South-East Asia. One blessing was the availability of Asian Edition U.S. textbooks, printed on cheaper paper and sold at a fraction of the original price - an average engineering book cost just NT\$50, roughly \$1.50 Malaysian dollars.

Graduation & Return

After four years of hard work, I graduated in 1968 with a Bachelor's degree in Mechanical Engineering. Unlike my journey to Taiwan, I returned home aboard a Malaysia-Singapore Airlines (MSA) flight, finally able to afford the airfare after years of living frugally.

In 1975, I registered with the Institution of Engineers, Malaysia (IEM), and in 1980, I became a registered engineer with the Board of Engineers Malaysia (BEM), fulfilling the dream born in the workshops of Taiping decades earlier.

Reflection

Looking back, that 20-day cargo ship journey remains one of the most defining experiences of my life. Together with 200 fellow students, we endured hardship, seasickness, homesickness, and uncertainty, but we also discovered resilience, friendship, and hope. We came from different towns, spoke different dialects, and carried different family stories, yet we shared one thing: A belief in education as the path to a better future. That shared dream forged a bond among us - one that has endured to this day.

For me, the voyage marked the beginning of a lifelong journey, one powered by determination, sacrifice, and the unbroken dreams of a generation seeking a better tomorrow. 🌟

Current Challenges Faced by Global and Local Companies in Complying with ESG

by
Cheo Hong Keyong

In recent years, Environmental, Social, and Governance (ESG) has gained significant traction as key metrics for assessing the sustainability and ethical impact of investments, business practices, and policies. ESG considerations are reshaping the global economy, influencing investment decisions, business practices, and policy agendas. While significant progress has been made in integrating ESG principles into mainstream discourse, addressing challenges faced in foreign and local companies such as data quality, greenwashing, resource constraints, and regulatory fragmentation remains paramount. By fostering collaboration, innovation, and stakeholder engagement, the way forward for ESG involves building a more resilient, inclusive, and sustainable future for generations to come.

Challenges on Global Scene

1. Global Direction

- a. **Increased Focus on Sustainability:** In response to global challenges such as climate change, resource depletion, and social inequality, there has been a notable shift towards sustainable development. ESG principles have emerged as a guiding framework for businesses, investors, and policymakers seeking to balance economic growth with environmental and social responsibility.

- b. **Regulatory Momentum:** Increasingly, Governments and regulatory bodies worldwide are recognising the importance of ESG considerations. Many countries have implemented or proposed regulatory frameworks mandating ESG disclosure and integrating sustainability criteria into corporate governance and reporting standards.
- c. **Investor Demand:** Investors are placing greater emphasis on ESG factors in their decision-making processes. Institutional investors, asset managers, and pension funds are integrating ESG criteria into investment strategies to mitigate risks, enhance long-term returns, and align portfolios with sustainability objectives.
- d. **Corporate Commitments:** Companies are making public commitments to ESG goals, driven by pressure from stakeholders, including customers, employees, investors, and communities. Corporate sustainability initiatives encompass environmental stewardship, social responsibility, ethical governance, and transparency in business operations.

2. Achievements Between Regions & Countries

- a. **Regional Variances:** ESG progress varies significantly across regions

and countries, reflecting differences in regulatory environments, cultural norms, socioeconomic conditions, and levels of awareness. While some regions are leading the way in sustainability practices, others are facing challenges in implementation.

- b. **European Leadership:** European countries, particularly those within the European Union (EU), have been at the forefront of ESG initiatives. The EU has set ambitious climate targets, including becoming climate-neutral by 2050, and has implemented regulations such as the EU Sustainable Finance Taxonomy and the Non-Financial Reporting Directive to promote sustainable finance and corporate transparency.
- c. **Emerging Market Engagement:** Emerging economies are increasingly recognising the importance of ESG considerations in driving economic growth and development. Countries like China, India, and Brazil have made commitments to address environmental and social challenges, with initiatives ranging from renewable energy investments to poverty alleviation programmes.
- d. **Collaboration & Knowledge Sharing:** International collaboration and partnerships play a crucial role in advancing ESG goals. Platforms such as the United Nations Sustainable Development Goals (SDGs), the Task Force on Climate-related Financial Disclosures (TCFD), and the Principles for Responsible Investment (PRI) facilitate knowledge sharing, capacity building, and best practice exchange among governments, businesses, investors, and civil society organisations.

3. Challenges Faced

- a. **Data Quality & Standardisation:** One of the primary challenges in ESG

integration is the lack of consistent and reliable data. ESG information is often fragmented, incomplete, or is subject to varying reporting standards, making it difficult for investors and stakeholders to assess and compare performance accurately.

- b. **Greenwashing & Integrity:** There are concerns voiced about greenwashing, whereby companies exaggerate or misrepresent their ESG efforts to portray a more favourable image. Greenwashing undermines the credibility of ESG investing and hinders efforts to drive meaningful change towards sustainability.
- c. **Resource Constraints:** Many companies, particularly small and medium-sized enterprises (SMEs), face resource constraints in implementing comprehensive ESG strategies and reporting systems. Limited access to funding, expertise, and technical resources poses barriers to ESG integration, especially in developing countries and emerging markets.
- d. **Policy & Regulatory Fragmentation:** Differences in ESG regulations, reporting requirements, and disclosure standards across jurisdictions create compliance complexities and hinder global comparability. Harmonising ESG frameworks and aligning regulatory approaches are essential for promoting consistency and transparency in ESG practices.

Challenges by Malaysian companies

Companies in Malaysia, like those in many other jurisdictions, face challenges in complying with elements of governance under ESG. These may vary depending on factors such as industry, size, and level of maturity in ESG integration. Here are some main challenges faced by companies in Malaysia:

1. Regulatory Complexity & Compliance Burden

Multifaceted Regulations: Navigating through a complex regulatory landscape, which includes various laws, regulations, guidelines, and reporting requirements related to ESG, can be challenging.

Compliance Burden: Ensuring compliance with evolving regulatory requirements while also meeting internal governance standards can be resource-intensive, particularly for small and medium-sized enterprises (SMEs) with limited resources.

2. Limited Awareness & Capacity

Lack of Awareness: Many companies, especially smaller firms, may lack awareness of ESG issues and their importance for long-term business sustainability.

Capacity Constraints: Limited human and financial resources may hinder the ability of companies to implement robust governance structures, conduct ESG risk assessments, and integrate sustainability practices into their operations.

3. Data Availability & Quality

Data Availability: Accessing reliable and comprehensive data on ESG factors, especially for non-financial metrics such as environmental impact and social performance, can be challenging.

Data Quality: Ensuring the accuracy, consistency, and reliability of ESG data, particularly in areas such as carbon emissions, water usage, and supply chain transparency, remains a significant challenge.

4. Stakeholder Engagement

Limited Engagement: Engaging with diverse stakeholders, including investors, regulators, customers, employees, and local communities, to understand their ESG expectations and concerns can be challenging, especially for companies with limited communication channels.

Managing Expectations: Balancing conflicting stakeholder interests and expectations while maintaining transparency and trust can pose challenges, particularly in controversial sectors or during periods of crisis.

5. Integration of ESG into Corporate Strategy

Alignment with Business Objectives: Integrating ESG considerations into corporate strategy and decision-making processes requires a shift in mindset and culture, which may encounter resistance from traditional business models and short-term profit priorities.

Long-Term Perspective: Balancing short-term financial pressures with long-term sustainability goals can be challenging, particularly in industries with high capital intensity or cyclical market dynamics.

6. Cultural & Behavioural Challenges

Change Management: Overcoming resistance to change and fostering a culture of accountability, transparency, and ethical behaviour across all levels of an organisation can be challenging.

Ethical Dilemmas: Addressing ethical dilemmas and conflicts of interest, especially in industries prone to corruption or unethical practices, requires strong leadership and a commitment to integrity.

7. Reporting & Disclosure

Quality of Reporting: Ensuring the accuracy, completeness, and relevance of ESG disclosures in corporate reports and communications requires robust governance processes and internal controls.

Standardisation and Comparability: Achieving consistency and comparability in ESG reporting, both within the company and across industry peers, remains a challenge due to the lack of standardised frameworks and metrics.

8. Health & Safety

Occupational Health and Safety: Ensuring a safe and healthy work environment for employees, contractors, and visitors, and complying with occupational health and safety regulations to prevent workplace accidents, injuries, and illnesses.

9. Supply Chain Management

Supply Chain Transparency: Ensuring transparency and accountability in the supply chain, including monitoring suppliers' compliance with labour and human rights standards, ethical sourcing practices, and environmental regulations.

Supplier Diversity: Promoting supplier diversity and supporting local businesses, SMEs, and minority-owned enterprises to create inclusive and resilient supply chains.

10. Environmental Regulations & Compliance

Complex Regulatory Environment: Navigating through a complex regulatory landscape, including environmental laws, regulations, permits, and reporting requirements, which may vary across federal, state, and local jurisdictions.

Compliance Burden: Ensuring compliance with environmental regulations while balancing operational efficiency, cost considerations, and business continuity.

11. Pollution & Resource Management

Air and Water Pollution: Managing and mitigating air and water pollution from industrial activities, including emissions, effluents, and waste disposal, to protect public health and the environment.

Waste Management: Implementing effective waste management practices, including recycling, reuse, and disposal of hazardous and non-hazardous waste, to minimise environmental impact and comply with regulatory requirements.

12. Climate Change & Carbon Emissions

Climate Change Mitigation: Reducing greenhouse gas emissions and mitigating climate change impacts through energy efficiency measures, renewable energy adoption, and sustainable transportation practices.

Carbon Disclosure and Reporting: Reporting and disclosing carbon emissions and climate-related risks in accordance with international standards, such as the Task Force on Climate-related Financial Disclosures (TCFD) recommendations.

13. Natural Resource Conservation

Water Conservation: Managing water resources efficiently and responsibly, including reducing water usage, improving water quality, and mitigating the impact of water-intensive activities on ecosystems and communities.

Energy Conservation: Promoting energy conservation measures, including energy-efficient technologies, conservation programmes, and renewable energy adoption, to reduce carbon footprint and reliance on fossil fuels.

14. Access to Finance & Investment

Cost of Capital: Accessing affordable capital for ESG-related investments and initiatives may be challenging, particularly for companies perceived as high-risk or lacking a track record of sustainability performance.

Investor Expectations: Meeting investor expectations for ESG disclosure and performance metrics, including through engagement with socially responsible investors and ESG-focused funds, requires ongoing dialogue and transparency.

“Leveraging innovation and technology can enhance ESG data collection, analysis, and verification processes.”

The Way Forward

1. Harmonisation & Standardisation

Efforts to harmonise ESG reporting standards and enhance data quality are critical for improving transparency, comparability, and credibility. Collaborative initiatives such as the Sustainability Accounting Standards Board (SASB), the Global Reporting Initiative (GRI), and the International Integrated Reporting Council (IIRC) aim to develop globally accepted ESG frameworks and metrics.

2. Stakeholder Engagement

Continued engagement with stakeholders, including investors, regulators, civil society, and communities, is essential for fostering accountability and driving ESG progress. Dialogue and collaboration among diverse stakeholders can promote consensus-building, knowledge sharing, and collective action towards shared sustainability goals.

3. Innovation & Technology

Leveraging innovation and technology can enhance ESG data collection, analysis, and verification processes. Blockchain, artificial intelligence (AI), and big data analytics offer opportunities to improve the accuracy, timeliness, and reliability of ESG information, enabling better decision-making and risk management.

4. Capacity Building & Education

Supporting capacity building initiatives and providing education and training programmes can help overcome resource constraints and promote inclusive ESG practices. Investing in skills development, knowledge transfer, and awareness-raising efforts is crucial for empowering businesses, investors, and policymakers to embrace ESG principles and drive positive change.

5. Long-Term Perspective

Emphasising the importance of a long-term perspective is essential for embedding ESG considerations into business strategies and investment decisions. Recognising the interconnectedness of ESG factors and their impact on financial performance and societal well-being can foster a culture of responsible stewardship and sustainable development.

Conclusion

Addressing these challenges requires a concerted effort from companies, regulators, investors, and other stakeholders to foster an enabling environment for ESG integration and governance in Malaysia. By overcoming these obstacles, companies can enhance their resilience, competitiveness, and long-term value creation while contributing to sustainable development in the country. 

From Goals to Gains: Evaluating Asean Plan of Action for Energy Cooperation (APAEC) on Phase II: 2021-2025

by
Chin Fong Yin

The 28th Energy Efficiency & Conservation - Sub Sector Network Meeting of the ASEAN Energy Cooperation was held in May 2024 in Vientiane, Lao to review strategies for achieving the milestones of the ASEAN Plan of Action for Energy Cooperation (APAEC) Phase II: 2021-2025.

On the global scene, energy conservation related initiatives are gaining attention and traction. The ESG initiative devotes a large part to energy issues under the environment segment of ESG. The World Bank, in developing Business Ready or B-Ready criteria and indicators to gauge the ease of doing business for a particular country, has placed emphasis on energy conservation as an important element.

In the ASEAN region, which is expected to continue to be one of the fastest-growing regions of the global economy and an increasingly important growth engine for the Asia-Pacific, energy consumption will correspondingly accelerate. It is thus important to revisit the APAEC strategy.

The ASEAN Plan of Action for Energy Cooperation (APAEC) is a series of guiding policy documents which aims to promote multilateral energy cooperation and integration

to attain the goals of the ASEAN Economic Community (AEC). It serves as the platform for deeper cooperation within ASEAN as well as with Dialogue Partners (DPs) and International Organisations (IOs) towards enhancing energy security, accessibility, affordability, and sustainability within the framework of the AEC.

Under APAEC Phase II, ASEAN will enhance its efforts towards building an ASEAN Power Grid by expanding multilateral electricity trading to provide affordable and resilient electricity, while accommodating higher shares of renewable energy towards the energy transition and a sustainable energy future.

In the gas sector, ASEAN will pursue the development of a common gas market by implementing the recommendations of the 2018 Gas Advocacy White Paper (GAWP), which includes developing communication strategies to promote gas advocacy and strengthening regional cooperation to improve commercial and infrastructure readiness.

In the acceleration of energy transition and sustainability, ASEAN will optimise the role of Clean Coal Technology (CCT) and Carbon Capture Utilisation & Storage (CCUS) towards a low carbon economy. On energy efficiency and conservation, market transformation initiatives



in favour of energy efficient technologies will be implemented in buildings, transport, and industry sectors to achieve the 32% energy intensity reduction aspirational target by 2025 based on 2005 levels. On renewable energy (RE), ASEAN will work to achieve its aspirational targets of 23% share of RE in total primary energy supply and 35% share of RE in ASEAN installed power capacity by 2025 through deploying large-scale RE systems, accommodating higher shares of RE in the APG, increasing RE investments, and exploring new and emerging energy technologies such as hydrogen and fuel cells.

Under the Regional Energy Policy & Planning, ASEAN will expand partnerships with Dialogue Partners (DPs) and IOs, as well as advance energy policy and planning to accelerate the region's energy transition and resilience. In the civilian nuclear energy sector, ASEAN will promote regional initiatives to enhance human resource capability on nuclear science and technology for power generation.

The key strategies of the seven programme areas of the APAEC Phase II: 2021- 2025 are:

1. ASEAN Power Grid. To expand regional multilateral electricity trading, to strengthen grid resilience and modernisation, and to promote clean and RE integration.

2. Trans-ASEAN Gas Pipeline. To pursue the development of a common gas market for ASEAN by enhancing gas and LNG connectivity and accessibility.
3. Coal and Clean Coal Technology. To optimise the role of clean coal technology in facilitating the transition towards sustainable and lower emission development.
4. Energy Efficiency and Conservation. To reduce energy intensity by 32% in 2025 based on 2005 levels and to encourage further energy efficiency and conservation efforts, especially in transport and industry sectors.
5. Renewable Energy. To achieve aspirational target for increasing the component of RE to 23% by 2025 in the ASEAN energy mix, including through increasing the share of RE in installed power capacity to 35% by 2025.
6. Regional Energy Policy and Planning. To advance energy policy and planning to accelerate the region's energy transition and resilience.
7. Civilian Nuclear Energy. To build human resource capabilities on nuclear science and technology for power generation.

APAEC Phase I: 2016-2020 focused on the short-to-medium-term strategies with the theme Enhancing Energy Connectivity & Market Integration in ASEAN to Achieve Energy Security, Accessibility, Affordability and Sustainability for All.

APAEC Phase II: 2021-2025 is the continuation of Phase I but with higher aspirational targets and new initiatives to enhance energy transition and resilience towards a sustainable energy future. The theme is maintained as in Phase I with a new subtheme, Accelerating Energy Transition & Strengthening Energy Resilience through Greater Innovation and Cooperation. APAEC Phase II takes into account the impacts of COVID-19 pandemic and its recovery plans, recent global economic and energy trends, cross-cutting issues such as climate change and decarbonisation, energy investment and financing projects, inclusion of private sectors through business forum activities, new and emerging energy technologies, and digitalisation in the energy sector.

Under the ASEAN Power Grid (APG) programme, the first multilateral power trade was successfully initiated under the Lao PDR-Thailand-Malaysia Singapore Power Integration Project (LTMS-PIP). A total of 30.2 GWh of electricity traded under LTMS-PIP Phase I and LTM-PIP Phase I and II, as of August 2020. Moving forward, the 3 countries agreed to further increase the maximum committed energy capacity trading of the LTM-PIP up from 100 MW to 300 MW. Lao PDR, Thailand, Malaysia, and Singapore have initiated the discussion on the next phase of the LTMS-PIP which will further expand the electricity trading to Singapore post-2021. Several notable studies have been published on multilateral power trade in ASEAN, including:

- Study on Establishment of ASEAN Power Grid Transmission System Operator (ATSO) and ASEAN Generation and Transmission System Planning Institution (AGTP).
- Study on ASEAN Primary Energy Resources for Power Generation.
- Study on Harmonisation of Legal & Regulatory Framework for bilateral and cross-border power interconnection and trade.
- ASEAN-China Power Cooperation Report by ACE and China Renewable Energy Engineering Institute (CREEI).
- Study on Taxation on Cross Border Power Transaction.

- Study on Guideline for PPP Financing Modalities in ASEAN Power Project.
- Feasibility Study on Multilateral Power Trade and the ASEAN Renewable Integration Analysis Study on integrating renewable energy into cross-border power trade.

The Trans-ASEAN Gas Pipeline (TAGP) programme links 6 ASEAN Member States through 13 interconnection pipelines with a total length of 3,631 kms and 9 LNG regasification terminals (RGT) with a combined total capacity of 38.75 MTPA as of 2020. ASCOPE also successfully completed the following:

- Model LNG Sales and Purchase Agreement (SPA) without destination restriction.
- The Master LNG SPA, Gas Advocacy White Paper (GAWP).
- Study on small-scale LNG (ssLNG).
- Study on LNG bunkering.

Under the Coal & Clean Coal Technology (CCT), the ASEAN Member States have endeavoured to increase the deployment of cleaner coal technology, with a total combined installed capacity of 10,021 MW of super critical and ultra-super critical coal-fired power plants in 2019. Several capacity building activities and workshops on CCT were held to enhance information sharing on environmentally responsible practices on coal development and utilisation as well as to assess the new role of coal in the energy transition and sustainable development. The ASEAN Forum on Coal (AFOC) conducted a High-Level Policy Dialogue in 2018 in Malaysia and launched the 1st ASEAN Coal Business Roundtable Dialogue in 2020. Several studies were published such as:

- ASEAN CCT Handbook for Power Plans by ACE and Japan Coal Centre (JCOAL).
- ASEAN Energy Equation: The Role of Low Emission Coal in Driving a Sustainable Energy Future by ACE and World Coal Association (WCA).

- Feasibility Study on Coal Upgrading.
- CCT Financial Model Study.
- Study of Cleaner Coal Utilisation Road map by ACE and China Energy Technology & Economics Research Institute (CETRI).

In the area of Energy Efficiency & Conservation (EE&C) programme, ASEAN achieved an Energy Intensity (EI) reduction of 21% by 2018, surpassing its aspirational target of 20% in 2020 (over 2005 levels). Three policy documents were endorsed by the ASEAN Ministers on Energy Meeting (AMEM), namely:

- Regional Policy Road map on Harmonisation of Minimum Energy Performance Standards (MEPS) for Air Conditioner in 2017.
- Regional Policy Road map on Harmonisation of MEPS for Lighting in 2019.
- Guidelines of Integration of Energy Efficiency into ASEAN Electrical and Electronic Equipment (EEE) Mutual Recognition Arrangement (MRA) in 2019, which is the first cross-sectoral initiative by the ASEAN Energy sector.

Major efforts in the promotion of green building codes, zero energy building awards, and EE financing were also initiated in Phase I. Additionally, 54 Energy Manager Trainers were certified under the ASEAN-Japan Energy Efficiency Partnership (AJEEP). The ASEAN SHINE Project for Lighting Phase I was completed in 2017. The ASEAN+3 Mitigation Cooperation Programme Phase I was implemented in Cambodia, Lao PDR, and Myanmar. Several publications on EE&C were completed, namely ASEAN Regional Efficient Lighting Market Assessment, ASEAN ESCO Report, and ASEAN Best Practices in EE&C.

The steady progress in the deployment of RE projects has enabled ASEAN to increase the share of RE in ASEAN's total primary energy supply (TPES) mix to 13.9% as of 2018. However, more needs to be done under the RE Programme Area to achieve the aspirational target of 23% RE share in the TPES by 2025. An MOU was signed between ACE and the National Science and Technology Development Agency (NSTDA), Thailand at the 37th AMEM to support the higher

utilisation of biofuels, bioenergy, and human resource capacity development. Several capacity building workshops and studies were carried out with the support of ASEAN-German Energy Programme (AGEP) including the RE Research and Development (R&D) Outlook in ASEAN, Levelised Cost of Electricity (LCOE) for Selected RE Technologies Part II, Insurance & Guarantee Schemes of RE in ASEAN, and Review of Grid Codes for Variable Renewable Generation in the ASEAN Region (Malaysia, Thailand, and Indonesia). Other notable studies included the ASEAN Feed-in-tariff Mechanism Report by ACE and China Renewable Energy Engineering Institute (CREEI) and RE Investment Series by ACE and Norwegian Institute of International Affairs (NUPI) through the ASEAN Climate Change & Energy Project (ACCEPT).

To better profile the ASEAN energy cooperation internationally and to aid AMS in policy and planning processes, multiple initiatives were launched under the Regional Energy Policy & Planning (REPP) programme. ACE published the 5th and 6th ASEAN Energy Outlook (AEO5 and AEO6) in 2017 and 2020 respectively, with the support of AGEP. These highlighted the key trends in the region's energy landscape and policy directions to enhance energy security, energy transition, and energy resilience. A key milestone was the signing of the MOU between ASEAN and the International Renewable Energy Agency (IRENA) at the 36th AMEM in October 2018 in Singapore, with the first AMEMIRENA dialogue held during the 35th AMEM in September 2017 in Manila, Philippines. In addition, the first ASEAN Energy Cooperation Report (AECR) was published in 2017, showcasing the key achievements of the APAEC and strategic directions going forward for ASEAN's energy stakeholders. Also published in 2017 was the ASEAN Energy Statistics Report. In 2018, a Capacity Building Roadmap on Energy Investments and Financing for ASEAN was developed during Singapore's chairmanship of 36th AMEM.

The Civilian Nuclear Energy (CNE) programme has made progress in increasing the capacities of AMS in the policy, technology, and regulatory aspects of nuclear energy. In 2018, the

ACE-Canada Nuclear Radiological Programme Administrative Support (NRPAS) was completed, which provided regional approaches to build capacities in nuclear and radiological security for the long-term development of nuclear power programmes. Under NRPAS, several publications were released, such as the PreFeasibility Study on Establishment of Nuclear Power Plant in the AMS and Study on Nuclear Legal and Regulatory Framework in AMS. On capacity building, through the ACE-Japan Atomic Energy Agency (JAEA) Programme, a series of seminars on Nuclear Security and Good Practices of Regional Cooperation on Nuclear Security were conducted in April 2017 and May 2019, respectively. The Civilian Nuclear Energy Factsheet and ASEAN Nuclear Energy Portal were developed in 2020.

Global Energy Trends

There are a number of global perspectives that can shape the energy landscape of ASEAN during the Phase II implementation of APAEC 2016-2025.

1. Global energy transition is gradually shifting from a carbon-intensive to a cleaner energy system. Furthermore, the transition is accelerated by the volatility of global oil and gas markets and the increasingly competitive prices of RE such as solar photovoltaics, geothermal, and hydropower. According to IRENA, new solar and wind farms are becoming increasingly cheaper to build when compared to the operating costs of existing coal plants, making the cost of RE more attractive.

ASEAN sees this as a crucial development in shaping the regional energy development plan and will continue to pursue its ambitious RE and EE targets under the APAEC Phase II. Rapid transition to decentralised and decarbonised power generation are among the challenges of the ASEAN energy transition. To this end, the APAEC Phase II aims to identify strategies

for balancing the energy trilemma of energy security, energy equity and environmental sustainability.

2. The impact of the COVID-19 pandemic on global energy demand and supply can change how ASEAN approaches the energy transition over the next few years.
3. The UN SDG 7 on access to affordable, reliable, sustainable and modern energy for all. The APAEC Phase II will play an important role to support the AMS in achieving the 5 main targets of UN SDG 7.
4. The Fourth Industrial Revolution, which is fast transforming the energy sector in the region. Key developments include digital technologies such as internet of things, artificial intelligence, big data, and cloud computing in generation, distribution, consumption, and smart production of cleaner and more efficient energy.
5. Emerging low carbon technologies such as hydrogen and fuel cells are potential alternative energy options for the future that ASEAN should keep abreast of.

Conclusion

APAEC 2016-2025 is a dynamic and living document to guide the implementation of the outcome-based strategies and action plans to accelerate energy transition and strengthen energy resilience in ASEAN to achieve energy security, accessibility, affordability, and sustainability for all under the framework of the AEC.

As the continuation of APAEC Phase I: 2016-2020, APAEC Phase II: 2021-2025 comprises comprehensive strategies to meet the challenges of ASEAN's energy transition and resilience in view of the changing landscape of global energy trends. 🌐

Reference

1. ASEAN Centre for Energy (ACE)
2. World Bank on B-Ready direction

Prai Bridge 1965

by
Cheo Hong Keyong



The Prai Bridge, officially named Jambatan Tunku Abdul Rahman Putra, was one of the earliest major river-crossing structures in Penang state. Completed in 1965, it was built across the Prai River (Sungai Perai) to provide a vital road link between the town of Butterworth and the industrial and port areas developing around Prai.

At that time, the area around Prai was beginning to transform from a largely rural settlement into an emerging industrial

hub, spurred by the government's push for industrialisation under Malaysia's First and Second Malaysia Plans. The bridge was essential in improving transportation efficiency, reducing dependence on ferries, and connecting the Butterworth-Ipoh trunk road to the newly planned industrial estates.

It was constructed under the supervision of the Public Works Department (JKR) with involvement from international contractors and consultants for design and piling works. 🏗️

KYODO PIPE STANDARD GALVANISED STEEL CONDUIT



BS 31 CLASS B (SCREWED) / MANUFACTURER'S STANDARD

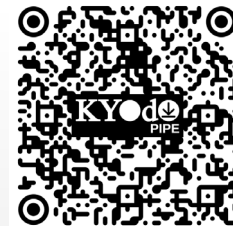
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	MINIMUM		MAXIMUM		MINIMUM		MAXIMUM						MINIMUM		MAXIMUM	
in	mm	in	mm	in	mm	in	mm	in	kg/m	kg/ft	lb/ft	PER INCH	mm	in	mm	in
¾	18.76	0.7387	19.05	0.7500	1.52	0.060	1.63	0.064	0.713	0.217	0.479	16	12.70	0.5000	14.29	0.5625
1	25.11	0.9887	25.40	1.0000	1.52	0.060	1.63	0.064	0.972	0.296	0.653	16	15.88	0.6259	17.46	0.6875
1¼	31.46	1.2387	31.75	1.2500	1.52	0.060	1.63	0.064	1.240	0.376	0.830	16	17.46	0.6875	19.05	0.7500
1½	37.80	1.4880	38.10	1.5000	1.73	0.068	1.83	0.072	1.680	0.511	1.130	14	19.05	0.7500	20.64	0.8125
2	50.50	1.9880	50.80	2.0000	1.93	0.076	2.03	0.080	2.510	0.765	1.690	14	22.23	0.8750	23.81	0.9375

MS 275 / BS 4568 CLASS 3 (SCREWED) / MANUFACTURER'S STANDARD

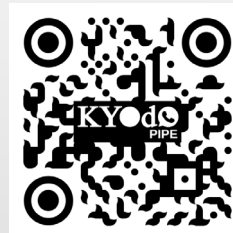
NOMINAL SIZE	OUTSIDE DIAMETER		WALL THICKNESS	CALCULATED WEIGHT WITH COUPLER		PITCH	LENGTH OF THREADS	
	MINIMUM	MAXIMUM		MINIMUM	MAXIMUM		MINIMUM	MAXIMUM
mm	mm	mm	mm	kg/m	kg/m	mm	mm	mm
20	19.7	20.0	1.6 ± 0.15	0.643	0.783	1.5	13	15
25	24.6	25.0	1.6 ± 0.15	0.811	0.995	1.5	16	18
32	31.6	32.0	1.6 ± 0.15	1.069	1.301	1.5	18	20

MS IEC 61386-1 / MS 61386-21 CONDUIT SYSTEM FOR CABLE MANAGEMENT

NOMINAL SIZE	OUTSIDE DIAMETER		INSIDE DIAMETER	EXTERNAL THREAD LENGTHS
	MINIMUM	MAXIMUM	MINIMUM	MINIMUM
mm	mm	mm	mm	mm
20	19.7	20.0	1.6 ± 0.15	13
25	24.6	25.0	1.6 ± 0.15	16
32	31.6	32.0	1.6 ± 0.15	18



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