eMARINA
The quarterly newsletter of
The Hong Kong Joint Branch of The Royal Institution of Naval Architects
and The Institute of Marine Engineering, Science and Technology,
and The Hong Kong Institute of Marine Technology
皇家造船師學會暨輪機工程及海事科技學會香港聯合分會
及香港海事科技學會季刊
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HKJB & HKIMT Activities

GDSNAME Webinar on Marine Smart Technology

HKJB, HKIMT and HKIE-MMNC facilitated a webinar on 14 September 2022 in Hong Kong on "Marine Smart Technology". This webinar was organized by Guangdong Society of Naval Architecture and Marine Engineering (GDSNAME). It was physically held at Guangzhou Marine Engineering Corporation (GMEC) (GMEC is also known as CSSC 605 Research Institute). "Tencent Meeting" was used as the webinar platform. Other participating professional engineering institutes were able to interact with the participants and the experts in the field through this platform simultaneously.

The idea of developing autonomous ships was raised in the International Maritime Organization (IMO) for many years. It was not until 2017 that this subject was included in the agenda of the Marine Safety Committee (MSC). For the purpose of scoping the necessary developments in IMO, Maritime Autonomous Surface Ships (MASS) were classified as followed:

"Degree one: Ship with automated processes and decision support: Seafarers are on board to operate and control shipboard systems and functions. Some operations may be automated and at times be unsupervised but with seafarers on board ready to take control.

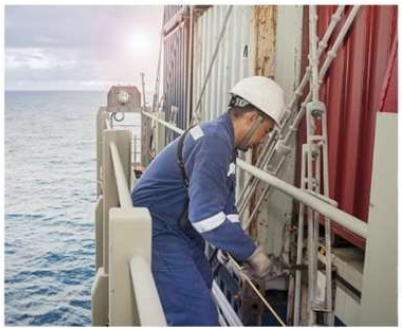
Degree two: Remotely controlled ship with seafarers on board: The ship is controlled and operated from another location. Seafarers are available on board to take control and to operate the shipboard systems and functions.

Degree three: Remotely controlled ship without seafarers on board: The ship is controlled and operated from another location. There are no seafarers on board.

Degree four: Fully autonomous ship: The operating system of the ship is able to make decisions and determine actions by itself."

Before the concept of MASS came into existence, unmanned Ships (UMS) had been around for more than 40 years and these were the forerunners of MASS Degree one ships. MASS Degree two ships were, however, still on trial and only operated on short voyages between ports. But why? It might be due to the fact that there was no imminent need to do so until now and/or the technology could not support such developments!

China's shipbuilding industry was at the top positions in the last three years based on the completed ship tonnage (47.2%), quantity of new ships order (53.8%) and ships in the pipeline to build (47.6%) in the global shipbuilding statistics for 2021. It's shipping transport capability only came second after Greece (which carried about 15% and 17% of the world cargoes respectively). Therefore, China is a strong shipbuilding and maritime nation!



Today, shortage of seafarers, tough international regulations to reduce air pollutants from ships and an increase in accidents caused by human behaviours are serious problems affecting the maritime industry on a global scale. According to BIMCO and ICS reports, the number of seafarers is 1.89 million but the shortage is 262,000 in 2021, and this will become 895,000 in 2026. CO_2 emission from shipping industry is about 0.82 billion tons in 2019, while it is required to be reduced to 0.6 billion tons in 2050 which means that such emissions will have to be reduced by 25% in the next 30 years. Accidents caused by human behavior was about 62% of the total. They were mostly due to workload and the harsh working environments of seafarers on ships and at sea. China being a strong maritime nation is facing these difficulties too! If it wishes to thrive in its shipbuilding and maritime transportation sectors, something has to be done now to address or alleviate these problems!

And the quest for MASS is the way forward!

The development and application on artificial intelligent (AI) and MASS to cargo Ships appears be the most suitable solutions. However, their developments in IMO are slow. IMO as a maritime safety regulatory body, it concentrates most of its effort in navigational, operational, seafarer safety and marine pollution. As communication of AI and MASS ships at sea and in port are important to avoid collisions, the standards for communication of these ships and their integrations have to be developed by the industry to guard against collisions at sea and in ports. A few years back, the China Government set these as its national priorities for the development in the industry in order to maintain and advance its position in these fronts. National Rules for AI Ships and Guidelines for MASS were published in 2015 and 2018 respectively. Different stake holders were motivated for the developing in AI ships and MASS. National institutions such as CSSC started the research and design on bulk carrier, oil tanks and ore carrier way back in 2015.

The half-day webinar covered a wide spectrum of topics about the application of AI technologies in the maritime industry. Knowing that a drastic jump to MASS Degree four ships is unrealistic. China had explored ways to create AI

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ships using the current technology. These are the building blocks in the making of MASS! The ideas on how vessels can be transformed from AI to MASS are also explored in the process. This is what this seminar is all about!

In this seminar, a number of recent researches and application experiences were shared. They include the application of AI systems used in ocean-going liquefied petroleum gas (LNG) carriers, the application of electric shaftless thrusters for ocean going ships and the development of AI propulsion machineries for MASS Degree four ships.

China's first AI ship "DaZhi" was launched in 2017. Another very large ore carrier (VLOC) "Ming Yuan", a large crude oil carrier (LCC) "Kai Zheng" and a river vessel "Zhi Fei" were launched between the period of 2018 to 2022. The national target is to develop and complete a system of comprehensive standard for the operation and management of AI ships through these proto-type trials.

AI application on ships are endless! The most notable one is the electric shaftless thruster which rotates around a stator in a submerged casing with inward propeller blades. Comparing this design to traditional screw propellers or azimuth thrusters, electric shaftless thrusters eliminate the gear box, water/oil seal, propulsion shaft and appendage (like the Kort Nozzle around the propeller). These eliminations ensure that the electric shaftless thruster has a lighter weight, lower noise and lesser pollution due to oil leaks. This design was originated from military submarines. The recent development in Guangdong makes it commercialized viable for civil applications. Such a thruster can provide power up to 3000kW, which is adequate for tug assisting the berthing of ultra large container vessel (ULCC) with a carrying capacity of 24,000 TEU.

无（桨）毂式，无桨毂无轴
适用于中小直径推进器

含（桨）毂式，有桨毂有假轴，
适用于大直径推进器

	传统推进器	无轴环推
效率	传动环节多，效率低	直接驱动，效率高
振动	有齿轮，振动大	无齿轮，振动小
噪声	有齿轮，噪声大	无齿轮，超静音
密封性	动密封易磨损，导致漏油进水	静密封，无泄漏风险
重量	机构复杂，重量大	结构简单，重量轻
体积	体积大	结构紧凑，体积小
可靠性	结构复杂，可靠性低	结构简单，可靠性高
维护便利性	结构复杂，备件多，维修复杂	结构简单，备件少，维护方便
螺旋桨保护	桨叶裸露，容易碰坏	桨叶被保护，不易碰坏
加减速	慢	快！

The quest for MASS Grade four ships has no bound! The first one to set internationally recognized standards for the operation of these vessels will dominate the market! Just visualize a ship without seafarers operating world-wide and makes its way from port to port loading and unloading its cargo without human intervention! It makes one wonder

what will a ship looks like without a navigation bridge, crew accommodation, hotel facilities, portable tanks and has a machinery space that can be located anywhere on the ship and be replaced instantly for maintenance! Most of the pollutions from sewage, garbage and ballast would be gone! Smaller ballast tanks can be built just to keep the ship stable at all draughts! The comfort of crew needs not be considered! The construction of such ships requires an entirely new design philosophy!

Webinars like this have been included in the Continuous Professional Development (CPD) Programme for engineers by HKIE-MMNC. Participants attending the webinar at HKIE would earn continuous professional development points for CPD. We trust such seminars in this format could encourage and widen the participation of members in their continuous efforts to upgrade their professional knowledge effectively. This is of particular importance when the COVID-19 pandemic continues to haunt us for many months to come. Seminar like this will increase the number of channels to exchange ideas and the sharing of knowledge amongst marine engineers and naval architects.

(Reported by Leslie LEE and Simon CHEN)

Applied Fundamental Research Summit at HKUST

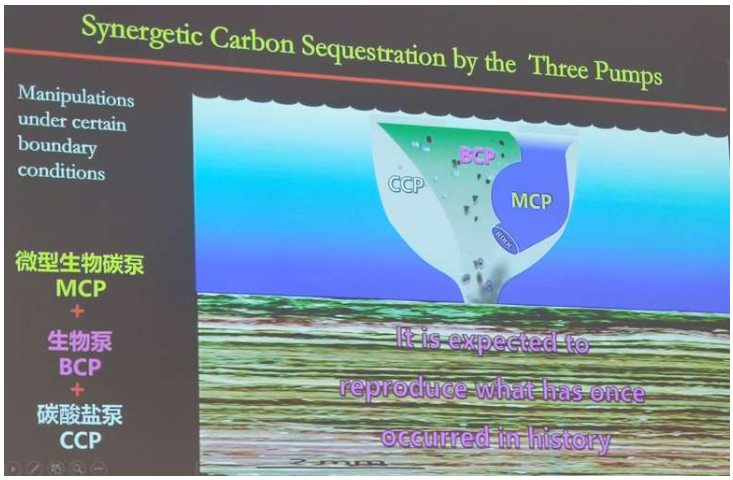
The Hong Kong University of Science and Technology (HKUST), the Hong Kong Branch of the Southern Marine Science and Engineering Guangdong Laboratory (Guangzhou) and Department of Ocean Science of the Southern Marine Science and Engineering Guangdong Laboratory (Guangzhou) jointly took the lead to coordinate the efforts in the technological development aspects for the conservation and sustainable use of marine resources on 17 September 2022 at Hong Kong University of Science and Technology (HKUST). This is the 2nd summit on the "Industry-University-Research" approach. Its theme is "Applied Fundamental Research". The details about the 1st summit held earlier can be reviewed in eMARINA Vol 2 2022.

HKIMT Chairman Capt. CHEUNG Tai Kee led other members from HKJB and HKIMT to this summit. Professor Tim Kwan-Ting CHEUNG – Vice-President for Research & Development HKUST, Mr. TSE Chin Wan – Secretary for Environment and Ecology HKSAR, Mr. Osvaldo Patricio Álvarez Peréz – Consul General of Chile in Hong Kong and Macao, Mr BAEK Yong-chun – Consul General of the Republic of Korea in Hong Kong and Dr Kenneth Kai Ming LEUNG – Assistant Director (Air Policy) Environmental Protection Department Hong Kong officiated the opening of the summit.

A wide variety of subjects were discussed in the summit. Those which may be of interest to members of HKIMT and HKJB of RINA & IMarEST are highlighted below for information.

Carbon sequestration is a long-term process to capture and store carbon in the atmosphere. Since China set its national targets to have CO_2 emission peaked at 2030 and achieved carbon neutral by 2060, negative carbon emission (NET) has been proposed as the solution. The ocean which plays an important role in carbon sequestration. is the focus of the study here.

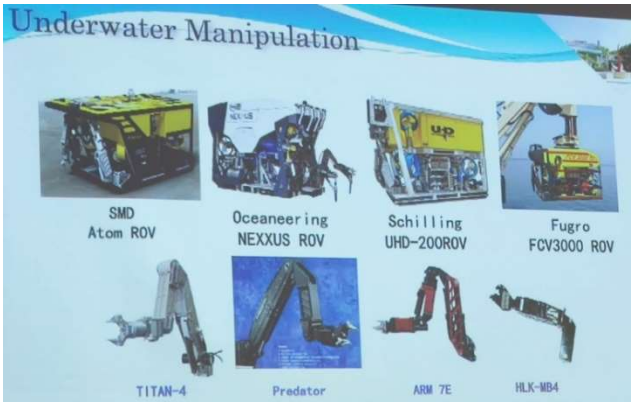
There are a number of approaches to carbon sequestration by the ocean, namely: (i) *land-ocean integrated eco-engineering* - The Land–ocean Interactions in the Coastal Zone (LOICZ) project was established in 1993 to assess the coastal seas as net sources or sinks of atmospheric CO2 for river discharge to the ocean. A biogeochemical model has been developed for governments to understand where do the nutrients (carbon, nitrogen and phosphorus) go in their coastal regions thus helping the planning and development of their society; (ii) *enhancement of seawater alkalinity* - When CO_2 dissolves in water, it forms a mild acid. In nature, this mild acid dissolves minerals in rocks on land to form carbonate solutions and drain to the ocean. Thus, the oceans are the largest storage space for carbon on earth. An increase in ocean alkalinity can be achieved by dissolving rocks and minerals directly or indirectly through engineered systems. This process is also applicable to atmospheric CO_2. As a result, there will be a build-up of calcium, magnesium, or sodium ions in seawater thus turning CO_2 in seawater into bicarbonates. Millenniums later, the carbonates end up at the bottom of the ocean where they form carbonate rocks; (iii) *seaweeds culturing* - The cultivation of seaweed provides habitat for fish and crayfish, causing a reduction of ocean acidification and nutrients. Carbon sequestration can be achieved through photosynthesis. However, seaweed is a nuisance which may entangle propellers and choke cooling systems on recreational boats. It also blocks the sunlight to the fauna at the bottom of the ocean causing them to die; (iv) biomass dumping - Biomass is plant-based materials such as wood and wood residues, energy crops, agricultural residues and wastes from industry, farms, households etc. Bioenergy is extracted from the biomass and carbon is captured and stored, thereby removing it from the atmosphere. As the biomass is utilised through combustion, fermentation, pyrolysis or other conversion methods, some of the carbon in the biomass is converted to CO_2 or biochar which can then be stored by geologic sequestration or landfill; (v) *CO_2 seafloor burial* - Residual organic carbon from dead marine phytoplankton and other oceanic life can follow two pathways: It can be deeply buried in seafloor sediments or it can be oxidized, either in the water column or in shallow sediment layers.

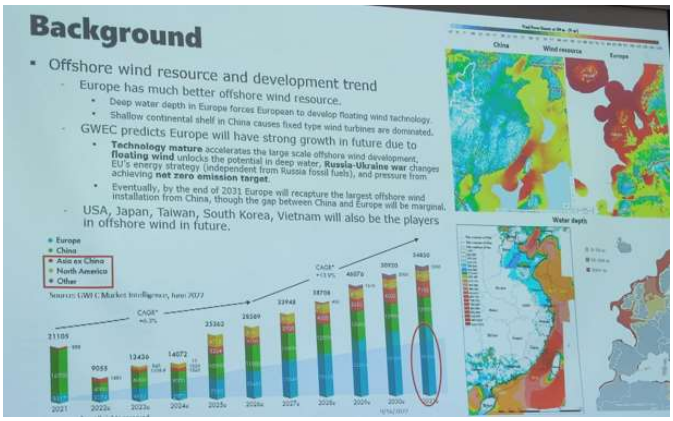


The ocean is a climate regulator because it captures ⅓ of the CO_2 emitted into the atmosphere each year. It regulates it in two processes: a physical process and a biological process. The physical process is related to the dissolution of carbon dioxide in deeper waters. While the second involves biological carbon pump (BCP), carbonate counter pump (CCP) and microbial carbon

pump (MCP). Both BCP and CCP depend on vertical transport; MCP depends on microbial transformation and can take place at any depths. It is possible to apply the second process in Hong Kong waters to achieve NET.

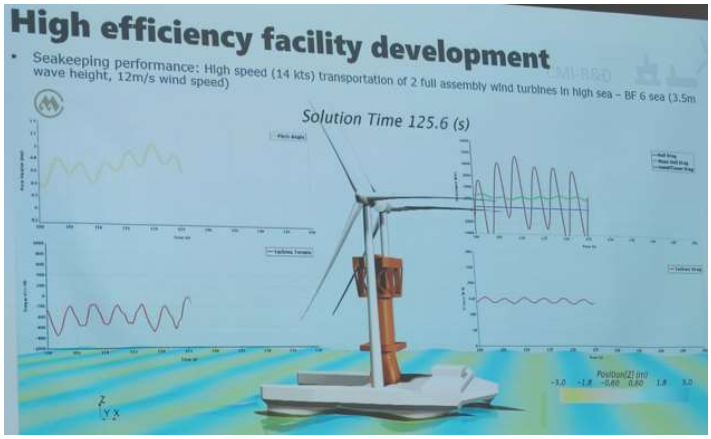
Marine Robotics provide answers to the challenges in blue economy. Their applications are of great importance in the offshore oil/gas production industry. However, radio signals will not work under water because of its limited propagation distance in water. Some other systems like acoustic system has to be developed for this purpose. The difference of communication media for the operation of remotely operated vehicles (ROVs) and their power requirement in deep sea makes them much more complicated to build and operate than robots ashore. The researches for marine robotics are new and few in number but are rising steadily. These new challenges are for the younger engineers in Hong Kong!





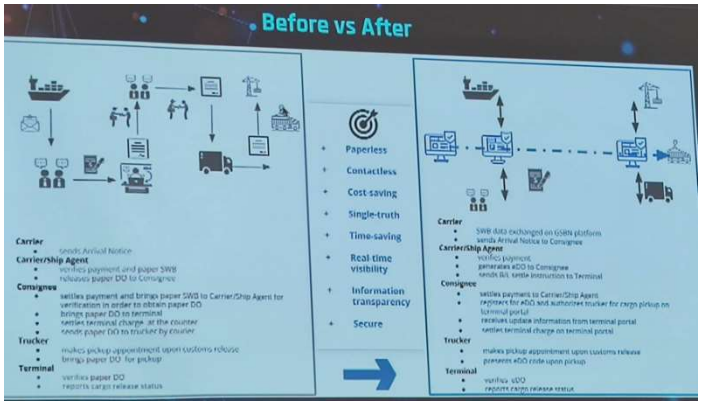
Offshore Wind Power Generation is growing fast due to the consciousness of the effect of climatic changes of fossil fuel. In 2021 alone, new installations of wind turbine in the word was 21.1 Giga Watts while the total installations of wind turbine before that was 55.9 Giga Watts. European Union (EU) and China were the two main contributors to the increase.

EU has a much better offshore wind resource. The deeper water in EU has also prompted the European countries to develop floating wind power generation technologies. Global Wind Energy Council (GWEC) estimates that EU will have stronger growth in wind power generating capabilities in view of the following factors: (i) matured technological infrastructure which will accelerate the large-scale offshore wind power generation development; (ii) floating wind power generation technologies unlock this power generating potential in deep water; (iii) Russia-Ukraine war changes EU's energy strategies and (iv) the recent draughts and floods are warning signs of drastic climatic changes ahead to the European Union that they have to achieve the zero emission target in order to life better.



China, on the other hand, has a relatively shallower continental shelf which allows the installation of fixed type wind turbines only. A "split installation method" has been developed and used to transport and assemble wind turbine

components in-situ. To complete the installation of one wind turbine at sea takes only 3 days! The development of special designed Wind Turbine Trimaran Shuttle (WTTS) allows integrated wind turbine to be transported on land and upload these components on vessel for transportation and installation offshore. WTTS can also reduce the installation time from days to hours on land. Offshore is a new frontier for engineering talents. Offshore wind hydrogen generating plants and fishing farms are lurking in the horizon for them to explore and innovate!



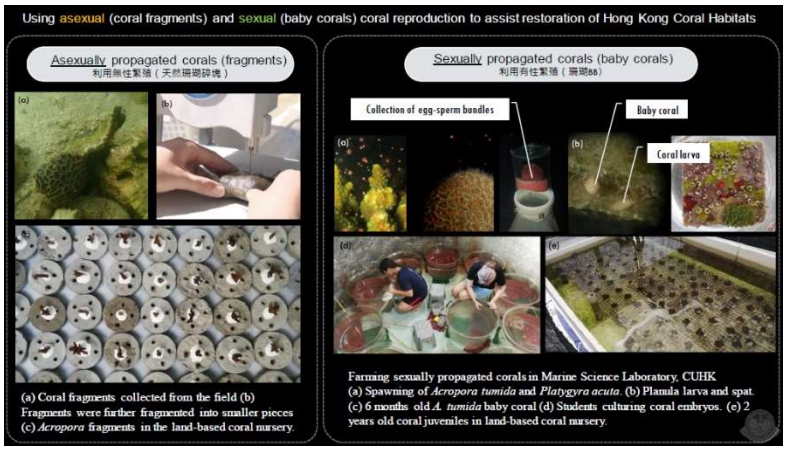
Blockchain, a digital ledger technology that consists of a growing list of records called blocks that are cryptographically linked together. The information in these blocks are distributed. Therefore, blocks do not require a central data bank for storage. Blocks can be read, interpreted, broken down and stored by the various computer systems in the companies joining the chain. This is going to transform the shipping industry! With founding members from major shipping lines and global terminal operators like COSCO, Hapag-Lloyd, OOCL, Hutchison Ports, Qiangdao Port, Shanghai Port and PSA Singapore. The Global Shipping Business Network (GSBN) enables and accelerates the digital transformation of the shipping industry. Currently, there are three banks in Hong Kong that support the system e.g. HSBC, Bank of China and DBS. A cargo consignment traditionally takes a few days to process and involves a lot of paper documents. With blockchain, all transactions are carried out electronically. The process time can be shortened from 2 - 3 days to only 1 - 2 hours. This technology shall be more user friendly and flexible so that it can be within the capability of companies who are willing to join to include it in their systems, thus making it an international standard per se.

Floating Solutions is pursued in recent years. It does not mean that it is aimed to harvest wind, wave and fossil energy from the ocean and for food and water production. This is a development to protect the fragile shorelines, beaches and port from tsunamis, freak waves and winds. Floating infrastructure can be built to accommodate for economic growth and to provide relief for land shortage.

To fulfil Hong Kong 2030+ Vision, 3,000 hectares must be found. More than one third of which will have to be realised by land reclamation for urban development. However, this solution has attracted many criticisms in the past for their threats to the marine environments and their high construction costs due to the shortage of durable filling and construction materials that can be used for land reclamation and the lengthy time to complete the projects.

A comfortable living environment requires 20% to 30% of land space to carry out recreationally activities and to accommodate the communal facilities. The buildings on these areas are generally not high. Floating structure solution can be used to satisfy this requirement and serve as a buffer zone for the land and sea (green and blue approach). This green and blue approach may also alleviate the problem of rising sea levels that has already threaten the existence of 90% of the world's mega cities.

Hong Kong's local agricultural industry is limited by its space. It contributed only about 0.1% to its GDP. However, its rugged coastline has harboured many fishing ports around its territories. The population of Hong Kong are generally seafood lovers! There is a great potential market for producing seafood products locally. The fishing industry flourished in the 50's and 60's. Many of these fishermen had retired. The younger generations have also found better working opportunities and better living ashore. The majority of them left the sea! However, the fish and fishing knowledges are still held by this older generation of fishermen. In the past, some fishermen had tried for centuries to breed fish in floating fish farms but without much success. Agriculture, Fisheries and Conservation Department (AFCD) of Hong Kong saw the potential to develop fish farming. Fishermen from old and new are drawn into the demonstration mariculture farm at Tung Lung Chau floating fish culture zone on June 2021. With the technical support from the Hong Kong Polytechnic University, a project on promoting modernised and sustainable mariculture at the demonstration farm is carried out at the site. It provides hands-on training and lectures to conventional mariculturists and those who intend to try.



Coral Conservation or Fight for Our Coral is the mission of the Coral Academy Lab (CAL) which located in Simon F.S. Li Marine Science Laboratory, CUHK. Corals are very sensitive to environmental changes such as pollution. Coral health is a clear indication of water quality in a region.

CAL have monitored the changes of the coral community in Hong Kong for more than 30 years following the anthropogenic disturbances in Tolo Harbour and Channel in the 80's. The coral coverage in the region decreased rapidly from 80% to less than 5% from 1980 to 1986 due to sewage pollution from shore. The main thrust of CAL's work were on coral nurseries and on the development of coral propagation techniques to save corals and restore them back in Hong Kong waters.

Corals can carry out asexual (coral fragments) and sexual (baby corals) reproductions. For asexual reproduction, coral fragments from the field were collected and cut into smaller pieces and placed them in the nursery. For the sexual reproduction, egg-sperm bundles were collected in the wild and they were cultured in the coral embryos in the laboratory. Rejuvenated coral fragments and coral juveniles in the coral nursery were replanted back into the Tolo Harbour. Data shown that the overall rejuvenation of coral and coral juveniles were about 90.67% and 88% survival rates respectively.

CAL had successfully raised the public awareness through their work. They had organized training many programs and workshops for schools, education tours in

recreational areas and presented in many TV interviews to educate and promote the public awareness on the values of our coral reefs. Public behaviour and perception towards our environment had been changed. While they enjoy themselves in these recreational areas, precaution and cautions were taken to protect the marine environment!

After closing the summit, Dr Shin Cheu KIM – Associate Vice-President for Research and Development (Knowledge Transfer) HKUST stayed on with us for further discussion and experience sharing in the dinner area of HKUST campus. This event had broadened our knowledge and understandings in advanced researches and widen our horizon in the development of the Greater Bay Area. Any member who wished to know about the summits and learn more about its contents should visit the website at https://hkbgsp.hkust.edu.hk/project.

(Reported by Leslie Lee and Simon Chen)

Joint Chairmen Cocktail Party

During the last two years throughout the course of the COVID-19 pandemic, many regular social events of HKJB and HKIMT came to a standstill. The Joint Chairman Cocktail and Annual Ball had not been organized in the past two years. It was very fortunate this year that Hong Kong's social distancing measures and dining restrictions were relaxed at the right time for us to host the Joint Chairman Cocktail reception at the Royal Hong Kong Yacht Club on 15th September 2022.

THE RECEPTION

We should be very grateful to our organizing team! The preparation, organization and planning of which were spot on! They had chosen the Hong Kong Yacht Club for the venue not only because of its maritime background but also for their spacious hall and outdoor spaces.

Special rules were set to ensure the safety of the guests during the course of the event. Only 120 persons could be invited to the event (A Government set dining person limit). All guests were required to wear masks at all times during the event. Group gatherings were limited to four. They were required to spread out in the hall and in the outdoor verandah areas. Prior to joining the event, all guests were required to show a negative Rapid Test result before entering the venue. The precautionary measures appeared to have paid off. No guests were reported to have caught the virus after their participation to this event.

Regardless of all the restrictions and apprehensions, many companies and persons sponsored the event. And the limit of 120 was reached in a flash.

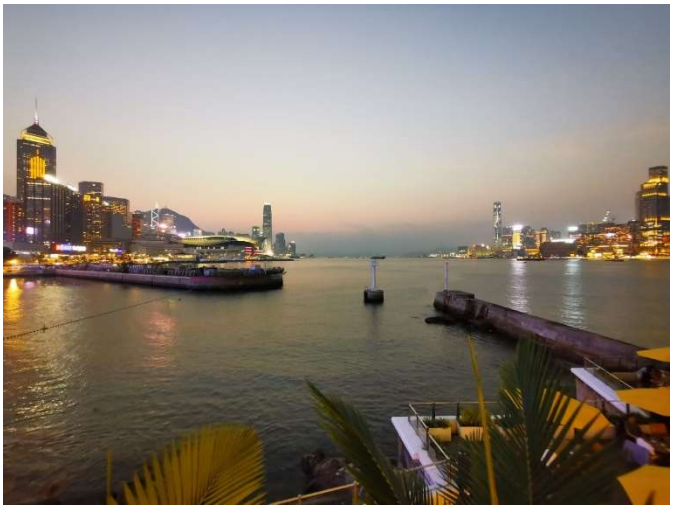
THE OPENING

Chairmen of HKIMT and HKJB, Capt. T.K. Cheung and Mr. Simon Chen, took turn to deliver a short message to the sponsors and guests thanking them for their participation and their contribution to this event and to the industry as a whole. On a final note, HKJB Chairman thanked all the past Chairmen for their leadership, hard work and endeavor in making the HKJB and HKIMT prospered and maintained their recognition in the professional community in Hong Kong during all these years. He pledged his commitments and continued these age-old traditions as Chairman of HKJB.

To reduce the risks of the spreading the virus, only drinks and snacks would be served throughout the event. Guests from the government, ship owners, ship management companies, classification societies, shipyards, ship builders, marine suppliers of the maritime industry in Hong Kong participated in the event. It was a very enjoyable night! Old friends met and acquainted new faces in the industry. This was the first time in two years! Taking a glass of wine or a glass of beverage and sitting or leaning by the balcony, chatting with your friends

THE DRINKS & SNACKS

HELLO MY FRIENDS



while sipping your drinks was a wonderful experience. The view overlooking the balcony into the Victoria Harbour was stunning!

All participants appreciated HKJB and HKIMT for organizing the event. Sponsors, guests, members and guests were grateful for the occasion. Congratulatory letters were received from our counter parts in China. The senders included Shanghai Society of Naval Architects & Marine Engineers (上海市船舶與海洋工程學會), Fujian Society of Naval Architects & Marine Engineers (福建省船舶與海洋工程學會), Guangdong Society of Naval Architecture and Marine Engineering (廣東造船工程學會) and Liaoning Society of Naval Architecture and Marine Engineering (遼寧省造船工程學會).

This event would not be so successful without the hard work of a dedicated team behind the scene! On behave of the members in HKJB and HKIMT, we would like to thank the Chairman of the organizing committee, Ir Dr. Nelson Yu and everyone in the organizing committee, who were able to complete the preparations and arrangements for the event on time within such a short notice! A job well done!

Special vote of thanks to the following sponsors for their generous support to the event (Names arranged in alphabetical order):

The Chairman of HKIMT, Chairman of HKJB, and Chairman of the organizing committee expressed their heartfelt gratitude for generous supports of all sponsors as follows:

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(Reported by Leslie Lee and Simon Chen)

HKJB & HKIMT Coming Activities

Date	Event
3 Nov 2022	HKIE – MMNC Annual Dinner
15 November 2022	Committee Meeting
22-23 Nov 2022	Asia Logistic, Maritime and Aviation Conference
23 Nov 2022	2022-23 STEM x Marine Vehicles Design/Construction Competition Launching Ceremony
26 Nov 2022	Green Shipping and Maritime Technology
6 Dec 2022	Incubation and Commercialisation Summit

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