An Apprenticeship Journey – Charles Foo Chee Lee

Mr. Foo's delivered his lecture on 24 January 2006 at the 20th Chua Chor Teck Annual Memorial Lecture.

Mr. Charles Foo is a Chartered Engineer (UK), a Registered Professional Engineer (Singapore) and holds the Extra First Class Certificate of Competency (UK). He began his career in 1959 by serving a five year apprenticeship with the Singapore Harbour Board Dockyard. He went to sea with Blue Funnel Line and Fyffes Group (Steam time). He joined Lloyd's Register in 1970 and remained with the Society for the next 28 years. His last LR posting was Senior Principal Surveyor and Chief Representative for China. In 1998, he joined Keppel where he served several senior management positions.

Mr Foo is also a Fellow of the Institute of Marine Engineering, Science & Technology (UK), the Royal Institution of Naval Architects (UK) and the Society of Naval Architects & Marine Engineers Singapore. He is a member of Lloyd's Register Asia Shipowners Committee, ABS Southeast Asia Regional Committee, 2nd Maritime R&D Advisory Panel of Maritime and Port Authority of Singapore and NUS Centre of Offshore Research & Engineering Advisory Committee.

Synopsis

The journey would span almost half a century. The apprentice would give a brief history of shipyards and describe changes he saw along the way – including changes in maritime education, health, safety & environment (HSE), Singapore shipyards, shipyards in China, ships and classification societies. He sees the need for knowledge management & innovation. He saw the transformation of Singapore into an International Maritime Centre. He sees the current peak in the maritime industry with hindsight and believes that we must take this window of opportunity to be more innovative so that when the downturn comes we would be in a niche market providing solutions, not just services, to our international customers. He sees the need for innovative succession planning, not just to ensure the survival of the maritime industry but also to grow Singapore into a truly International Maritime Centre. He sees that Singapore is on the right track and that the next generation has a solid foundation to build further enhancement. This is the challenge for the future.

1.0 INTRODUCTION

It is an honour to be invited to deliver the 20th Chua Chor Teck Memorial Lecture. The President of the Society of Naval Architects & Marine Engineers Singapore (SNAMES), Mr Ernest Wee, in his invitation email requested that the lecture be targeted at the next generation of Naval Architects and Marine Engineers with a review of Singapore's maritime past and a vision of Singapore's maritime future. Mr Teh Kong Leong, Chairman of the CCT Memorial Lecture Committee, in his letter of invitation, asked that my experience be shared with the audience, in order to inspire and motivate the young to join the Industry. Both are tall orders. However, it does mean that there would be quite a number of young people in the audience. Salesmanship is not my forte but it is worth a try.

2.0 CHUA CHOR TECK

Chua Chor Teck was a giant in the marine field. My first encounter with him was in 1963 in the drawing office of the Singapore Harbour Board Dockyard (forerunner of Keppel Shipyard). He was a newly employed Naval Architectural Draftsman and I a fourth year apprentice doing six months engineering drafting. He was serious and hard-working. The following year he was awarded a scholarship by SHB Dockyard to study Naval Architecture in the United Kingdom. By then my five year apprenticeship had ended and was at sea with Blue Funnel. Chor Teck was delighted with his scholarship, hunted me down to see if his bags and books could travel with me to UK to save cost. Unfortunately the ship "Gorgon" was on the Singapore - West Australian run and Chor Teck's cost saving could not be realized. In later years, as a resident surveyor in Keppel Shipyard where Chor Teck was first General Manager, then Managing Director, my encounter was with a man who has plenty of time for everyone, genuinely warm and naturally at ease; a wonderful man and a great role model.

3.0 WHY AN APPRENTICESHIP JOURNEY

My career started with an apprenticeship and it would be good to title the lecture *"The Apprentice".* However, Donald Trump would not take kindly to this. The "*Ancient Mariner*" was considered but not adopted because the wedding-guest departed a sadder and a wiser man, as the Ancient Mariner, by example taught us love and reverence to all things that God made and loved. We should all depart here this evening a happier and wiser man. ***"An Apprenticeship Journey"*** came to mind. Apprenticeship implies "learning", and journey here means "a passage through life". Taken together it is intended to mean lifelong learning. And the journey would span almost half a century, from the late fifties to the present. The Apprentice would describe the things he saw along the way and gives an opinion of what the future would be for the next generation. It is noted that Chua Chor Teck also started life as an apprentice.

4.0 AUTUMNAL REFLECTION

This is a summary of my speech given at "Conversazione 2003". It is a light-hearted discourse to amuse those who have a sense of humour. It is also a compendium of tonight's lecture. It is hoped that members of the audience would share their experience, fill the gaps this lecture has created, so that when this paper is published the experience would be more complete. We would have left something for posterity. Some of the 'next generation' may be persuaded that the Maritime Industry is after all a challenging journey for the ambitious, the technically inclined, the believer in technology and innovation and last but not least for those who have faith in Singapore as an International Maritime Centre.

4.1 The Marine Engineering Profession

The past forty odd years have seen tremendous change in our profession. The sea going Chief Engineers will no longer be the majority and their influence will diminish. The Chief Engineer status has already declined. The future will be in the hands of Engineers who have taken the academic route, the Marine Scientists and Technologists. This is ironical because the Marine qualification, namely the Certificate of Competency, is the most accurate description of a professional requirement, more so than most professional qualifications. Ships are getting bigger, faster and more sophisticated. Future Chief Engineers will be better qualified in control engineering and IT, bringing a different dimension to the Certificate of Competency. We may operate ships the way airline operate planes, bringing a new status to the profession. There are also more opportunities for Polytechnic graduates to obtain a university degree instead of taking the tortuous route of the Extra Chief. So, all is not lost.

4.2 Five Year Apprenticeship

When my five year apprenticeship started in 1959 it was the traditional way of training Marine Engineers. The pay was $14.96 a week. We were paid on Friday evening and would normally be broke by Monday. The training was supplemented by day release study at the Polytechnic. The first year of my apprenticeship left me with an everlasting impression of the surveyors' job. The expatriate surveyor would come to the machine shop dressed in white boiler suit, with his torch, hammer and gloves. He would use his hammer on shafts, spindles, liners, castings, forgings etc and listen to the ringing tones to decide the fate of all these items. The foreman and owner's superintendent would diligently take note and carry out the surveyor's instructions. The surveyors were like gods and all of them were qualified

Chief Engineers with the more respected ones with Extra Chief Engineer qualifications. There were stories of yards in UK which flew a special flag on the flagstaff when the Lloyd's surveyor was in the yard. The thought of being one of the gods and a respected one at that was appealing. That started the quest for knowledge, qualifications and sea going experience. Looking back there are no regrets except that now you find surveyors are no longer gods and few go for the respected qualifications. Shipyards no longer hang up bottom end bolts or spindles for the surveyors. The UK shipyards that flew the flags are no longer around.

4.3 Fun Days

Apprenticeship days were also fun – like trying to learn to set slide valves on steam engines, and just at the critical moment the old fitter would send the apprentice away to buy coffee. When he came back the valves have been set and the smile was on the fitter's face as he said thank you for the coffee. Working on steam turbines and triple expansion steam engines was challenging but working on double ended Scotch boilers and fixing leaky tubes was a nightmare, not to mention repairing distorted furnaces. Pushing back shifted shrink fit on B & W crankshaft was an art, putting back the bottom end of Doxford engines required great skill. All these and many more are now memories, something which the young engineer now will have little opportunity to experience.

4.4 Apprentice to Senior Management

The five year apprenticeship soon came to an end as the apprentice waved goodbye to Keppel Shipyard, then known as Singapore Harbour Board Dockyard, in 1964. Little did he know that nine years later he was to return to the yard as a surveyor and even more unexpected to return to the same yard as an employee some 34 years later and to a yard eventually known by a more exotic name of The Caribbean. As has been said before things tend to go round in a circle but when the circle is complete it is lifted to a higher plane. So the apprentice found himself in Senior Management all because in 1959 some expatriate surveyors played god. It is true that foreign talents create jobs for the locals even in those days. The problem with management is that you get grey hairs very fast because you are man-aging, as you try not to say the right things at the wrong time and do the wrong things at any time!

4.5 Sea-going Engineer

In 1964 the apprentice found himself a junior engineer with the Blue Funnel Line and for the first time in his life someone called him sir. He must have heard wrongly because he was sea sick the whole voyage from Singapore to Fremantle and back and couldn't possibly know who called him what. In between pumping bilges he was vomiting into the bilges. The ship Gorgon (Blue Funnel ships got their names from Greek Mythology) was carrying two legged and four legged passengers, all living. Taking temperatures of refrigerated holds involved going round the accommodation of both creatures. Complaints only came from the two legged passengers because they paid for the voyage and they can talk. The sheep and cattle were dumb and some died on the voyage. It was also the first time the Junior Engineer witnessed a burial at sea and stood at the attention although no last post was played. It was sheer determination because he was still seasick.

Four years later and after several voyages between the Far East and Europe the former apprentice was a proud engineer with three rings on the sleeve of his jacket. Liverpool became his home away from home. It was also home for the Beatles and two great football teams, Liverpool and Everton. Another year later he was to leave Blue Funnel for his steam time with Fyffes Group in Southampton. The ship Golfito carried passengers on a round trip to the Caribbean and on the voyage home also carried bananas. Both were hard to please. The passengers could be demanding and the bananas threatening, threatened to ripen if the temperature was a shade too high. Once in the Caribbean some passengers and crew hit the rum bottle leaving a few stone drunk. On one of the voyages the ship could not leave Southampton because there was no qualified Second Engineer on the ship. The former apprentice was rudely awakened one morning to go down to the Examiner's office for a dispensation which consisted of an oral examination. So he sailed as a Dispensation Second on a passenger ship with only three months steam experience. It was not fun when the main boilers started losing pressure; the vacuum started disappearing, the turbines slowed down and the evaporator packed up all at the same time and almost immediately. There was very little time for anyone to react. So you hit the panic button and all hands are in the engine room to your rescue. The Captain put the telegraph on standby and the passengers screamed for water because they were caught in the shower full of soap. How can one not be passionate about the job! On completion of his steam time the motorman returned to Liverpool to do the necessary. Rumours had it that the Examiner of engineers in Liverpool was an old Steam Engineer and in his time as Examiner had never passed any motorman trying to be an engineer first time. Even the College advised that one should be prepared to fail first time for Steam endorsement. The Examiner was pleased to pass one motorman at his first attempt to be an engineer before he retired. So the apprentice finally became an engineer, got married and joined Lloyd's Register. A year later he was to attend fulltime study in London to qualify for the Extra Chief Engineer.

4.6 Twenty Eight Years As A Surveyor

A career of 28 years with Lloyd's Register in London, Newcastle, Singapore, Taiwan, Hong Kong covering China, Singapore and culminating in Shanghai in the exalted position of Senior Principal Surveyor & Chief Representative for China. The former apprentice has achieved his ambition but he is no god. He remembered very well the words of a former Chief Surveyor who said that the Rules are for the guidance of wise men and the application of fools. Times have changed. When he entered the shipyard only the yard's QA was aware and there was no flying of flag. It was a myth and maybe this is precisely what we need now to encourage our young people to become marine engineers – to spin a myth but with both feet on the ground. When he left Shanghai in the summer of 1998 to return to Singapore the Marine Community in Shanghai presented him with a painting. It was a painting of autumn. Autumn depicts trees shedding their golden leaves and ushering in the cold weather. It was also a time that make newcomers from tropical countries feel homesick as they go to school or work in darkness and return home in darkness. The painting was also appropriate in launching the Surveyor into the next stage of his life and career.

5.0 DEFINITION

The term Engineer in this paper includes both Naval Architects and Marine Engineers and the term "marine" includes Offshore and Marine. "Maritime" would include offshore, marine and shipping.

6.0 BRIEF SHIPYARDS HISTORY

6.1 Fifty years ago

Fifty years ago there were no Container ships, no LNG ships, no offshore support vessels, no FPSOs, no VLCCs, no Jack-ups, no semi-submersibles in Singapore. There were Passenger ships, cargo ships of less than 10,000 horse-power, small tankers no more than 30,000 dwt, tugs and barges, fishing trawlers, dredgers and livestock carriers.

6.2 The shipyards

The biggest ship-repair yard was the Singapore Harbour Board Dockyard (forerunner of Keppel Shipyard) with the King's Dock, Queen's Dock, No 1 and 2 Docks in Telok Blangah and the Albert Dock and Victoria Dock in Tanjong Pagar. The oldest drydock was No 1 Dock which was opened in 1859. The other yards were Singapore Slipway, United Engineers, Vosper Thornycroft and Kwong Soon in Tanjong Rhu and smaller boat yards like Ho Ah Lam in the Kallang area. The boatyards built wooden boats. Yards like Vosper and Slipway built steel ships. Sembawang Naval Base Dockyard was not open to commercial ship repairs until it became Sembawang Shipyard in 1968.

6.3 The marine industry

Singapore Marine Industry tends to go back to 1960s as the starting point to coincide with the industrialization of Singapore and the opening of Jurong Industrial Estate. In this era we saw firstly the founding of Jurong Shipyard, followed by Hitachi Zosen, Mitsubishi Shipyard and in the mid 1970s the relocation of Keppel Shipyard in Tuas and other shipyards relocated from Tanjong Rhu and Kallang. In 1968 the British withdrew their forces east of Suez and Singapore commercialized the Naval Base into Sembawang Shipyard. This era also saw the establishment of Singapore Shipbuilding & Engineering (forerunner of ST Marine), and other medium sized yards like Pan United, Jaya, Singmarine, Sing Koon Seng and Labroy.

6.4 The offshore yards

The 1970s also saw the opening of several offshore yards like Far East which became Far East Levingston which eventually became Keppel Fels in Shipyard Road, Marathon Le Tournea which became Singmarine and now Keppel Gul, Bethelhem in Sembawang, Promet in Pandan now PPL and Robin Shipyard in Pioneer Road. Mitsubishi Shipyard closed in the 1980s and eventually became Keppel Fels Pioneer Yard.

7.0 MARITIME EDUCATION

7.1 Singapore Polytechnic

In the 1950s there were no engineering courses in Singapore University, then the only English Language university in Singapore. Nanyang University which started in 1955 was a Chinese Language University which also did not offer any engineering courses. Now we have four universities with two offering many disciplines of engineering. Singapore Polytechnic (SP) did not start till about 1954. The first batch of marine engineering students was taken in around 1961, the navigating students a little earlier in 1957. The graduates of these courses together with the apprentices of Singapore Harbour Board Dockyard and Sembawang Naval Base Dockyard were the local pioneers of the maritime industry in Singapore. Earlier local pioneers were mostly at trade levels with limited education due to lack of facilities and opportunities. Expatriate pioneers were mostly educated in the United Kingdom.

7.2 Ngee Ann Polytechnic

The founding of Ngee Ann Polytechnic (NP) in Tank Road did not offer any marine courses until the college moved to Clementi Road. NP offered Marine & Offshore Technology courses with the first intake in 1975 under the Mechanical

Engineering Department. In addition NP pioneered the full-time one year Advanced Diploma in Ship and Marine Technology jointly with the University of Strathclyde in 1997 which enables graduates of ADSMT direct entry into the final year of B Eng (Naval Architecture/Small Craft/ Offshore Engineering) course conducted by the University of Strathclyde. The Singapore Maritime Foundation (SMF) offers the final year of the B Eng course conducted by the Universities of Glasgow & Strathclyde in Singapore with effect from October, 2005. It is understood that the Marine & Offshore Division, to achieve economy of scale, had since July 2004 internally re-merged with the Mechanical Engineering Division in the School of Engineering. Therefore, whilst SP trains students for the Shipping Industry, NP trains students for work in the shipyards.

7.3 National University of Singapore

At University level the National University of Singapore (NUS) offers final year specialisation in offshore engineering. NUS also conducts short courses in offshore and marine related subjects under the Keppel Professorship. The Centre of Offshore Research & Engineering (CORE) was established in 2004 in NUS. Last year the International Maritime Carrier (IMC) Group provided a donation to NUS to kick start the Centre for Maritime Studies (CMS). In December 2005, two professorships were set up in another step towards developing Singapore as a premier centre for Maritime R&D. Lloyd's Register and the Maritime & Port Authority each committed $3 million to the Lloyd's Register Professorship and the MPA Maritime Technology Professorship.

7.4 Nanyang Technological University

Nanyang Technological University (NTU) in 2004 started the final year marine option for mechanical engineering students. NTU also started a degree course in maritime studies as well as a Masters course. NTU also has a Maritime Research Centre.

7.5 Others

Nicholas Koh brought the University of Newcastle-Upon-Tyne Master of Science in Marine Technology Degree course to Singapore in 2004. This two year part-time course has seen its first batch of students completing the 10 module programme. Two other batches are also on the programme.

The Maritime Port Authority of Singapore (MPA) provides funding for maritime research. Of great significance is the establishment of the Singapore Maritime Foundation last year.

Complementing education and research, the Singapore Chamber of Maritime Arbitration and the Singapore Registry of ships promote Singapore as an International Maritime Centre.

8.0 HEALTH SAFETY & ENVIRONMENT (HSE)

8.1 Then and Now

Fifty years ago the term HSE was unheard of in Singapore shipyards. We had no personal protective equipment (PPE). We used to just wear an old T-shirt and trouser, soft cloth cap, old pair of shoes and if lucky a pair of gloves. The expatriate foremen and managers had white boiler suits, safety boots and gloves. Today all workers have PPE supplied to them.

There were no safety belts with lifelines and safety helmets. We now provide all these to all workers and in the case of scaffolders even safety harness. Scaffoldings were of wooden poles or bamboo lashed together. We now use steel pipes with metal clamps with the scaffolding design approved by professional engineers.

There were little safety procedures for tank entry, relying solely on the port chemist. This was the same for hot work. We now have frequent monitoring of tanks' atmosphere and detailed procedures for not only entry into tanks and confined spaces but also for boarding ships under repairs.

There were only ladders and gangways which rise and fall with the tide for boarding ships. We now have tower gangways. Of course the ships were a lot smaller then.

8.2 Environment

We used sand blasting which caused sclerosis. Sand blasting has been banned for many years in Singapore. We now use copper slag which is non toxic. We also have proper procedures for disposal of spent grits. NUS is also researching the use of spent grits, as a substitute for sand, in concrete non structural panels for building construction. We are also using high pressure water blasting (> 30,000 psi) in selected locations.

Many ships were then still repaired by riveting and the noise caused hard of hearing. No wonder shipyards people speak loudly. It was louder then. Ear plugs are available on request.

Chemicals used for cleaning heaters and coolers were drained into the sea. We now treat this used chemical and disposed off in accordance with approved procedures.

8.3 Changes in Safety Philosophy

We knew nothing about accident statistics or key performance indicators or care for the environment. We now record accident frequency rates and accident severity rates. We are now certified to ISO14001 for the Environment. We now partner our customers in many safety programmes. We even get bonuses from our customers for working safely.

Singapore shipyards have come a long way in the past fifty years in term of HSE. In the seventies and eighties we relied heavily on safe machines, tools and equipment to prevent accidents. In the nineties we implemented safety management system. The present decade sees safety shifting to a risk based approach.

8.4 Future Safety

However, the marine industry must take a good hard look at human factors and fatigue. The shipping industry have done a lot of research in these areas in order to understand the root cause of accidents The adoption of a 'no blame' culture would help to identify root causes. Safety is such an important topic which was addressed by several CCT Memorial Lecture speakers – Dr Helmut Sohmen, who delivered the fourth CCTML spoke on "The Human Element in Shipping", Prof Richard Goss who delivered the eighth CCTML spoke on "The Future of Maritime Safety" and Frank Larossi who delivered the seventeenth CCTML spoke on "Marine Safety – Perception & Reality".

9.0 SINGAPORE SHIPYARDS

9.1 Revenue

According to the Association of Singapore Marine Industry (ASMI) Singapore yards employ 37,716 workers in 2004 with a total turnover of S$5.3 billion. Of the S$5.3 billion 58.6% are for ship repair & conversion, 24.6% for rig building and 16.8% for shipbuilding. The S$4 billion mark was breached in 2001 and the S$5 billion mark in 2004. The numbers for 2005 are not yet available but would not be less than that of 2004.

9.2 Accident Rates

Accident Frequency Rates or number of accidents per million man-hours worked fell steadily from 9.6 in 1994 to 3.0 in 2004. Accident Severity Rates or number of man-days lost per million hours worked fell from 2,174 in 1994 to 830 in 2004 although the industry has recorded figures lower than 830 in the intervening years.

9.3 Ships calling in Singapore

In 2004 a total of 6,687 ships called in Singapore for repairs and 97 new ships launched. 175,886 ships called in the Port of Singapore.

9.4 Marine Cluster

In the fifties and sixties the big shipyards tend to be self sufficient in that they have their own machine shop, copper shop, piping shop, electrical shop, pattern shop, foundry, forging shop, hull shop, etc with minimal outsourcing or sub-contracting.

By the late sixties, sub-contracting gathered pace and together these specialist sub-contractors and vendors gravitate to forming a marine cluster. The Singapore Association of Shipbuilders and Repairers (SASAR now ASMI) was formed in 1968. By the late seventies and eighties, there was a critical mass in the shipyard sectors to sustain a very strong marine cluster which withstood the very bad downtime in 1985 in which the phrase "sunset industry" was given prominence by politicians. This strong marine cluster together with Singapore's geographical location is our competitive advantage.

See section on "shipyards in China" below for competitive advantage of Singapore yards vis-à-vis China yards.

9.5 Rig Building

Singapore currently builds more than 80% of the world's jack-up rigs. Also see section 10.9.

9.6 Interesting Repairs

Singapore shipyards are among the first in the world in doing some very interesting work.

Orange chockfast found marine applications in the 1970s and the first ship to have its main engine re-chocked with orange chockfast was the "Talabot". The job was done in Singapore around 1974 or 1975.
Another interesting use of orange chockfast was for the repair of a ship that ran aground in 1975. The sternframe of the four pintle rudder had its skeg bent 18 inches to starboard side. It would have taken more than a year to cast a new sternframe. An innovative repair solution was proposed and adopted. The stern frame was heated up evenly and the bent skeg jacked back into position. The whole sternframe was then dye-penetrant checked for cracks. The four pintle gudgeons were by now all out of alignment with the steering gear. The gudgeons were machined oversize. A plumb line was dropped from the steering gear and gudgeon bushes were centralized against the plumb line. The annular space between the bushes and gudgeons were filled with chockfast. The ship went back to service until she was scrapped many years later.

In the 1970s, the large B+W two stroke double acting engines had several crankshaft fits slipping. These slippages had to be restored to prevent the oil passage from being choked. The normal procedure was to heat up the

webs and shrink the pins with liquid nitrogen. The pins and webs were then jacked back into position. The jacking was erratic and pin movement not easily controlled. The shipyard, together with B+W, came up with a solution. The top piston was removed and a dummy piston machined to suit. The space between the main piston and dummy piston was used as a hydraulic jack controlled by an electric driven hydraulic pump. The pin movement was accurately controlled to jack the pin back into position.

In recent years, Singapore shipyards carried out the unusual job of renewing main engine bedplates. A number of large diesel engines had cracks in the bedplates although relatively new. The engine, weighing about 1,000 tons had to be dismantled and detached from the bedplate. The cracked bedplate was than skidded out via the shipside and the new bedplate skidded in place. The main engine was then re-assembled. The sheer sizes of the various components demanded extra caution in material handling. For example, a cylinder cover weighs 8 tons, a piston 4.5 tons, a connecting rod 7.5 tons and the crankshaft more than 300 tons. There were more than 100 pieces of cylinder liner lubricators. Several strand jacks and spreader beams were used for the job. The whole operation, including commissioning and sea trial took three months.

10.0 SHIPYARDS IN CHINA

10.1 China's competitive advantage

Why do we talk about China in this memorial lecture? Because China is a bigger 'threat' to Singapore's marine industry than South Korea or Japan. China has an unlimited supply of labour which Japan and South Korea do not have. Economists estimate that there is an annual migration of some 18 million workers from the inland provinces to the coastal cities. Therefore China's competitive advantage, cheap labour, will be around for a long time. This 'threat' is also an opportunity for Singapore. Please read on.

10.2 China's shipyards in 1980

In 1980 China's shipbuilding yards opened their doors for the building of foreign ships. Four state shipyards, Dalian, Hudong, Jiangnan and Guangzhou under the Sixth Ministry of Machine Building were selected. The first lot of new building orders, consisting of handy-size bulk carriers went to these four yards. These orders were placed by Hong Kong's shipping magnate, Sir Y K Pao and his associated companies.

10.3 Change in name

There were about 26 state shipyards and the rest, about one thousand were small provincial yards. The Sixth Ministry of Machine Building changed name to China State Shipbuilding Corporation (CSSC) and the Minister-in-charge became the Chairman of CSSC. In the 1990s CSSC became two entities with CSIC covering the north and CSSC covering the south.

10.4 Old and inefficient

Twenty five years ago the shipyards were self-contained with their own slipways/docks, all kinds of workshops, schools, soft drinks factories, hospitals and even universities. Dalian Shipyard, for example, employed more than 20,000 people. The shipyards were old and largely inefficient. Jiangnan, the oldest shipyard in China, was founded in 1865 and has an underground museum.

There was a case when a stainless steel pipe was required. The yard did not have the pipe of the required dimension so they machined a pipe from a solid piece of stainless steel. A ship was built in which the stern tube casting was about 75mm thick. They decided to fabricate the stern tube instead, which was good, but they did not revise the design and maintained the scantling at 75mm. They have since replaced the child-like honesty with commercial savvy.

10.5 Largest shipbuilder in the world

By 1996 China was the third largest shipbuilder, albeit a distant third, in the world. At that time shipyards leaders were saying that China's ambition was to be one of the leading shipbuilders in the world. In 2005 shipyards leaders in China are saying they will be the largest shipbuilder in the world by 2015. They are now capable of building not only bulk carriers but also oil tankers, LPG carriers, container ships, chemical carriers and Hudong has just received a domestic order for LNG ships.

10.6 China's shiprepair

China's ship repair yards did not seriously go for international customers until about 1995.Now they have taken away almost all the bulk carriers and any repairs requiring a lot of steel renewals from Singapore yards.

10.7 China's modern shipyards

Dalian New Shipyard is China's first modern shipyard. Now they have Waigaoqiao in Shanghai, Cosco-Kawasaki JV yard in Nantong (NACKS), and they are developing yards in Changxing Dao both by CSSC and China Shipping Group, Longxue Dao in Pearl River delta by the Guangzhou Shipyard Group, Zhousan in Zhejiang Province, along the Changjiang in Qingdao in Shandong Province and Mazhou Shipyard off Shekou by China Merchant Group.

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10.8 Opportunity for Singapore

How is China's 'threat' an opportunity for Singapore? China is well placed to be a shipbuilder. Singapore is not. China builds engines, pumps, all sorts of fittings, castings, forgings, steel plates, chain cables, anchors, pipes, winches, windlasses, etc which eventually go into a new ship. Singapore build none of the above apart from some winches and electric cables and switchboards. Here is an opportunity for Singapore yards to procure components from China at a much lower cost. There is also opportunity for Singapore's yards to participate in China's shipyards or start their own yards in China.

10.9 Singapore's competitive advantage

For ship repairs Singapore will always have a place because of geographical location so long as we maintain our competitive advantage of quality, on time delivery and within budget. However, we must not increase capacity and close down old, inefficient yards when the time comes. Technology foresight would require us to foresee increase in ship sizes (e.g. 15,000 TEU container ships and 250,000 cu m LNG ships) and make sure that our docks are big enough to accommodate them. For FPSO/FSO conversions we have to move to providing solutions rather than just conversion service. This will require process knowledge.

For rig building, especially jack-up rigs, Singapore yards have a commanding lead, currently building more than 80% of the world's order. Not only China, but also South Korea is eyeing this lucrative sector. In fact South Korea is building semi-submersibles. It is possible that Singapore's strategy would be to hang on for as long as possible and see how the scenario plays out.

There is no doubt China will build rigs for domestic orders.

11.0 CHANGES IN SHIPS

11.1 World Fleet

There are about 93,500 ships of 100 gross tons or more in the world fleet and in 2004, a total of 175,000 ships called at our port. Statistically, this means every ship in the world fleet has been to Singapore at least once in the year and some 80% have been to Singapore twice in this time. Singapore is therefore in a unique position to see the many changes in ships. It is not possible to describe all the changes so an attempt is made to describe some of the changes.

11.2 Changes

The last fifty years saw the change from riveted ships to welded ships and the increasing use of high tensile steel as ships get bigger. The demise of the steam reciprocating engines and the near demise of the steam turbines bring the steam era almost to a close. Fifty years ago we would have described a 10,000 horsepower main engine as big. Today we see 8,000 horsepower in one cylinder and could possibly see 10,000 horsepower in one cylinder of the main engine for the very large container ships. Up to 20 years ago steam still found favour in Passenger ships and container ships. Passenger ships gave up steam first, in favour of diesel-electric propulsion followed by container ships which prefer the big two stroke engines. Holding on to steam turbine are LNG ships but the lack of steam engineers to man such ships saw recent new building orders going for diesel engines capable of dual gas/diesel combustion. The past decade saw concerted effort by all engine makers to reduce NO_X and SO_X emission. This is good for the environment.

11.3 Oil tankers

Oil tankers are one of the main sources of revenue for Singapore ship repair yards. The past fifty years saw tanker sizes grow from 30,000 dwt to VLCC (quarter million dwt) to the larger ULCC. The biggest tanker ever built was the 450,000 dwt "Jahre Viking". The million dwt tanker was on the drawing board but never took off. Of significance is the emergence of the double hull tankers. It would be interesting to see the extent of repairs required when these ships are more than twenty years old. The double hull tanker has yet to prove the benefit it is supposed to bring. Double hull tankers came about for the wrong reason. The grounding of the "Exxon Valdez" gave rise to the unilateral requirement of OPA 90 which eventually led to the adoption of double hull by IMO. Another unnecessary IMO requirement is the permanent means of access. It is difficult to maintain and could be unsafe.

11.4 Bunkering tankers

Bunkering is a multi-billion dollar business in Singapore, one of the largest bunkering ports in the world. Singapore should allow single hull bunkering tankers as there is no real benefit in insisting on double hull. The US have the Jones Act to allow this flexibility, we should have the same flexibility for the benefit of the bunkering community, which contributes to making Singapore an International Maritime Centre. The hiccup caused by the bunkering scandal is under control.

11.5 Container ships

Singapore is the transshipment hub for container ships. The first container berth in Singapore was completed in 1972. The main line container ships then were about 1500 TEU and would today be described as Feeder Container Ships.

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The Albert and Victoria dry docks were filled and the whole shipyard area became Tanjong Pagar Container Terminal. Today 8,000 TEU container ships are being built with 15,000 TEU container ships on the drawing board. The largest container ship currently in service is the 9,2000 TEU "MSC Pamela". Container ships bring about the drastic reduction of cargo ships which used to be alongside the godowns all the way from Tanjong Pagar to the SHB Dockyard, either discharging or loading. One could drive almost right up to the godowns and that was extremely convenient for surveyors and shipping agents. This is not the case with container berths.

11.6 LNG ships

LNG (liquefied natural gas) ships are in Singapore for dry docking, not for loading/discharge. In fact Singapore is the largest repairer of LNG ships outside of Japan. The Energy Market Authority (EMA) could change all these if the recommendation to build a receiving LNG terminal in Singapore materializes. This could also lead to LNG trading and would further enhance Singapore as an International Maritime Centre. LNG ships first came into being some fifty years ago with the conversion of the "Methane Pioneer" in 1958. In the seventies the 75,000 cu m ships were the largest. Ship size grew steadily to 135,000 cu m until recently when 150,000 cu m ships have been ordered. The projection is for the size to increase by a quantum jump to 200,000 cu m and 250,000 cu m. Singapore shipyards will find these new vessels too long for most of our dry docks, which will have to be lengthened if we wish to remain in this sector of the business.

CNG ships are set to complement LNG ships. CNG ships are technically feasible but currently not commercially viable. This is because of the weight of the containers resulting in such ships carrying more steel than gas. The alternative is to use composite materials. Once the weight problem is resolved, CNG ships will be able to exploit stranded gas which LNG ships are not quite suitable. Such ships afford good opportunities for Singapore yards, whether it be a conversion project, integrating CNG tanks and systems in new hulls or even equity participation.

11.7 FPSO & FSO

FPSO (Floating Production Storage and Offloading and FSO (Floating Storage and Offloading) conversions are the forte of Singapore Ship Repair yards. Singapore yards have done more conversions (well over 100) than any other country's yards. The first conversion to FSO by a Singapore yard was around 1976 for the West Natuna field. However as the 1970s built tankers are no longer available and the 1980s built tankers not preferred by operators because of the extensive use of high tensile steel, new buildings would appear to be the option. Also multi-phase FPSOs could be a feature in the near future. Singapore yards are not equipped for the efficient construction of large new hulls. No doubt, Singapore yards will come up with a strategy to retain the conversion /integration work in Singapore.

11.8 Offshore Support Vessels

The other ship type which has an impact on Singapore is the Offshore Support Vessels (OSV) which Singapore yards have been building since the seventies. Quoting James Liebertz of ABS Pacific – " The origin of today's OSVs can be found in the Gulf of Mexico, when oil exploration moved offshore in the 1950s. Then surplus world war II vessels , wooden fishing boats, and shrimp trawlers were used to supply offshore rigs with cement, mud, spare parts, crews, fuel and food. In 1955 Alden and John Laborde developed the first purpose-built vessel to supply offshore rigs and platforms. It featured bow wheelhouse and a long flat after deck that became the standard for offshore supply vessels. The pioneers may have modeled OSVs on a pickup truck – rugged, versatile and capable of delivering goods and people to the frontiers".

Today's OSVs are complex ships with dynamic positioning and in the case of large anchor handlers with bollard pull of 250 tons. Diesel electric propulsion would appear to be the future choice for more and more OSVs. These are high value ships for Singapore ship builders and a sustainable niche market if we also work with low cost area like Batam and China.

11.9 Livestock Carriers

These are interesting ships which we now seldom see in Singapore. Yet these ships are part of Singapore Maritime history. Singapore shipyards have converted several ships into livestock carriers in the seventies and eighties and even a few in the nineties.

The ships used to come alongside the godowns not far from St James power station. After midnight, the sheep and cattle would come off the ship in drove, turned right into Keppel Road and headed for Serangoon to the slaughter house. No cars were allowed during this time for this stretch of roads.

A lot of livestock was imported by the Middle East from Australia, hence the ship owners found it convenient to do the conversions in Singapore. Now the importer countries send the Imam to Australia to say the necessary prayers before the animals are slaughtered. So the importer countries, including Singapore, now have frozen meat and this spelled the near demise of the livestock carriers. Chilled meat is flown and you pay more.

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The favourite candidates for conversions were the twin deckers. Sheep pens were erected in the various decks, including the upper decks. For pens below the main deck, the issue was ventilation. Both forced and induced ventilation were adopted. The author knew of the conversion of two large tankers to livestock carriers, where all sheep pens were erected on deck.

The other issue was animal's urine, which is very corrosive. The urine tanks in the cargo holds were eventually made portable so that they could be renewed periodically. Pipings from the urine tanks were not permitted to be joined to the bilge lines. The RSPCA in Australia had a big say on the urine issue. Sheep pens were laid out on top of one another. We used to use perforated platform for ease of cleaning. The RSPCA objected as urine from the top pens dropped on to the sheep on the lower pens, causing blindness. The platforms were subsequently fully plated with proper drainage to the urine tanks.

11.10 Disruptive Technology

The last fifty years saw the transition of riveted ships to welded ships. The next revolutionary use of technology could be the use of the Sandwich Plate System (SPS). SPS is a method of using composite material comprising of two metal outer plates and a solid elastomer core as an alternative for ship construction and ship repair. SPS is already gaining acceptance in ship repairs and civil engineering and the inventor company, Intelligent Engineering (IE), is currently looking into its application in shipbuilding. When SPS is fully developed for new ship construction it would make more sense to have a SPS hull than a double hull tanker.

12.0 CHANGES IN CLASSIFICATION SOCIETIES

12.1 Class in Singapore

Classification societies are repositories of knowledge accumulated well over a hundred years, and in one case 246 years**.** Fifty years ago Lloyd's Register was the only Classification Society with exclusive surveyors in Singapore. The other major class societies were represented by consultants or non exclusive surveyors. The most prominent then was Ritchie & Bisset who represented many class societies. Now all major class societies are represented by exclusive surveyors.

12.2 International Association of Classification Societies

All major class societies have their own rules for the construction and maintenance of ships and offshore structures. The rule making procedures involve industry players and are well documented. The founding of the International Association of Classification Societies (IACS) leveled the playing field to a certain extent. Class societies came under heavy criticism during the 1990s mainly because of the loss of many bulk carriers and the resultant loss of lives.

12.3 The Business of Class

The business of Class is safety and if Class is caught in between regulatory authorities and owners there is no simple solution to ensure safer ships. Despite this dilemma, Class has made some headway using IACS. The bulk carrier studies and the new tanker rules are good examples. However, the unified IACS requirements are not always implemented for commercial reasons – e.g. steel plates and engines, to name just two items. They have also developed good programmes like ShipRight, SafeHull and Nauticus Shipbuilding.

Arguments have been made in favour of a single set of unified rules for all IACS members. Are the new tanker rules the start of this process? The good thing would be that it creates a level playing field and competition among Class would be on services provided and not on "easier rules and requirements" versus "stricter rules and requirements". The bad thing is that it will stifle innovation in the framing of rules and requirements. There is little incentive in a Class investing in rule making procedures. R & D however should not be affected as these could be translated into services provided. Should the International Maritime Organisation (IMO) make classification a statutory requirement, just like underwriters requiring a vessel to be classed for insurance purpose?

After all the load line regulations assume the strength of ships to be adequate based on classification.

12.4 Goal based standards

Goal Based Standards (GBS) have been on the IMO agenda for the past couple of years on the premise that IMO should govern all shipping regulations. It may be the result of the "Erika" and then the "Prestige" which gave the impression that Class is unable to control the condition of ships. It made no difference that maintenance of the ship was the primary cause of the problem. GBS is a five tier system in which class rules are in tier four. Class will still control the issue and update of rules but they will need to be verified as complying with the goals set in tiers one and two. Tier three is the verification and nobody has any idea how that will be done yet. GBS regime may take many years to be viable because the mechanics of making and sustaining rules are not present in IMO as in Class.

12.5 Alternative to Class

Is there an alternative to Class? Seemingly not. The IMO is too political to assume the role. It has no worldwide

representation and if the various government regulatory authorities were to be the worldwide representatives of IMO there would be more chaos and disparity of standards. IMO's Goal Based Standards and the independent IACS unified rules will influence the future of classification.

13.0 KNOWLEDGE MANAGEMENT & INNOVATION

13.1 State of innovation

Last year, global consultancy Monitor Group and the Institute of Policy Studies conducted a survey on the state of Innovation in Singapore. The survey found that Chief Executives sincerely believe that innovation is the way forward, but that they have a narrow understanding of what innovation is and focus on short-term, cost-reducing or incremental projects.

In the marine industry we have to decide what drives innovation. A case is made here for knowledge management and technology foresight. There is a need for knowledge management, not just for knowledge retention but also for the generation of ideas and innovative succession planning. The twin pillars of knowledge management are learning and sharing. How do we translate individual learning into organizational learning? Sharing is one way.

13.2 Training & Learning

Training, if it does not go far enough has no learning. Our industry is labour intensive in that about 65% of the workforce is skill or semi-skill based not knowledge based. In most of our training programmes, whether on-the-job training or class room instructions we impart the necessary skills to the trainees. For example, if in imparting the skill of renewing an air-pipe on deck we tell the trainee to make the air-pipe exactly the same as the old one we do not impart any knowledge. Just imparting welding and cutting skills would be sufficient for the job at hand. However, if training goes far enough, in this instance, we would explain that the air-pipe diameter is related to the inlet pipe by a ratio of 1.25 and that the height of the air pipe is governed by load-line regulations and damage stability there would be learning. The same thing applies when we tell trainees that for lignum vitae sternbush we must re-bush when the clearance reaches 7 mm. All we need is to impart fitting and re-bushing skills for the job at hand. If training goes far enough there would be learning and we would explain that clearance decides the fulcrum of the shaft resting in the sternbush and the bigger the clearance the more inboard the fulcrum shifts thus increasing the bending moment for the propeller. There would be an increase in torsion and bending in the tailshaft.

13.3 What drives innovation

Presently innovation is driven by customer feedback, health safety & environment (HSE), innovative Quality Circles (iQC), Total Quality Process (TQP) and lessons learnt . These initiatives give us incremental improvement. If innovation is driven by technology foresight which may consists of R & D, industry expertise and market trends, improvement could be quantum.

14.0 FINALE

14.1 The next generation

The next generation refers to young people now in schools, colleges and universities. Maritime education in Singapore now provides ample opportunities and options for the next generation We need to see how to put in place a nation-wide succession planning to ensure that we have different talents in place to operate a truly International Maritime Centre.

14.2 Better education

The scope of the maritime industry is wide and caters to the different aspirations. Better education is key. We have to match the Chinese and Koreans in educational profile, especially if we aspire to provide solutions for our customers. A lot more knowledge is required than providing services.

14.3 Knowledge based

We may have to shift from skill based to knowledge based if the niche market we elect to be in demands so. And there is no doubt that we have to find a niche market for the various sectors we are in.

For a knowledge based strategy we need to move up the technology ladder which requires us to be a lot more innovative.

14.4 Conclusion

It is my humble opinion that Singapore has the facilities, talents and future leadership to make Singapore a successful International Maritime Centre. The question is – does the next generation have the will? The road ahead will be hard and long, frustrating at times, always challenging but finally rewarding. In the next fifty years someone in this audience may stand up and describe his journey. And it will be a better journey than mine. If so this lecture has served its purpose.

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