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Precision-made in China

A look inside a reduction gearbox used for a crane hoist reveals the often hidden high-precision work of the gear manufacturer. This unit was produced by the Nantong Heavy Gear-box Factory, a subsidiary of China's heavy machinery manufacturing giant ZPMC. The colored edges of the gear teeth are used to verify tooth alignment during testing.

Established in 1993, ZPMC moved to its present 333,000-m² factory in 2008. The new facility delivers about 20,000 gear sets annually and has capacity to produce 30,000. Applications for its gear sets range from container cranes and rubber-tire gantry cranes to heavy lift equipment, wind turbines and dynamic positioning systems. The company has delivered about 400 large winches and is looking to expand in that market – in preparation, it built the only 500-ton pull force tester in the country. Having completed development of its own-design reduction gearbox for climbing systems, the company is also looking to break into the jackup drilling rig market.

ZPMC's new factory, built at a cost of RMB 1.2 billion (about \$180 million), is fully outfitted with computerized milling, hobbing and machining centers from such leading manufacturers as Maho, Niles and Gleason-Pfauter, some of which can grind gears as large as 6.3 m in diameter. Seen by many in Chinese industry as a symbol of the high-quality equipment manufacturing possible in the country, the ZPMC Gear-box Factory has been visited by top Chinese leaders and praised as an example of what is possible to achieve by following with commitment the scientific path of development.



COVER:

Verifying the details, undaunted by weather. Sheltered from a coastal rainstorm, ABS Surveyor Lin Pang closely inspects a jacking system detail on a jackup drilling rig under construction at the DSIC Offshore shipyard in Dalian, China. This issue of *Surveyor* looks at some of the key links between shipbuilding, offshore energy and industrialization in China.

FEATURES:

- 2 Pursuing the Pearl of Great Price**
The key role that the shipbuilding and offshore sectors have in China's industrial evolution.
- 6 Transforming from Large to Strong**
China's national shipbuilding association guides its industry along a scientific path forward.
- 9 SWS: Teamwork Builds a Leader**
A top shipyard's view on how to become a leader.
- 12 Hudong-Zhonghua: High-Tech Symbol**
China's only LNG carrier builder symbolizes a new era of specialization.
- 14 NACKS: "Quality is Our Life"**
For China's first joint-venture shipyard, quality is the key to success.
- 16 Rosheng: Model of the Future**
This successful private yard symbolizes the evolution of Chinese shipbuilding.
- 18 DSIC: Ready for the 'Offshore Century'**
In Dalian, China's first offshore shipyard prepares for an energy-based building boom.
- 20 Yantai CIMC Raffles: Big Dreams Build Big Realities**
How one builder made amazing success from a seemingly impossible dream.
- 23 Leading China's March Offshore**
The past, present and continuing achievements of China's leading offshore company.
- 28 COSL's Decade**
Reliability is the key operational factor for China's top offshore driller.
- 31 Guiding Offshore Safety for 25 Years**
How China's Offshore Oil Operations Safety Office tackles a challenging future.
- 34 Six Decades in the Making: ABS Greater China Division**
ABS' new Greater China Division is the latest step up in a long, evolving relationship.
- 36 Viewpoint: See China in the Light of Her Development**
Chinese Premier Wen Jiabao offers a vision of his country's progress.

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ABS Plaza
16855 Northchase Drive
Houston, TX 77060 USA
Tel: 1-281-877-5800
Fax: 1-281-877-5803
Email: abs-worldhq@eagle.org
Web: www.eagle.org

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send a written request to:
ABSSurveyor@eagle.org

Joe Evangelista, Editor
Christopher Reeves, Graphic Designer
Sherrie Anderson, Production Manager
Jean Gould, Vice President

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PURSUING THE PEARL OF GREAT PRICE

The maritime and energy sectors have critical roles in advancing China towards its goal of building a moderately prosperous society by 2050.

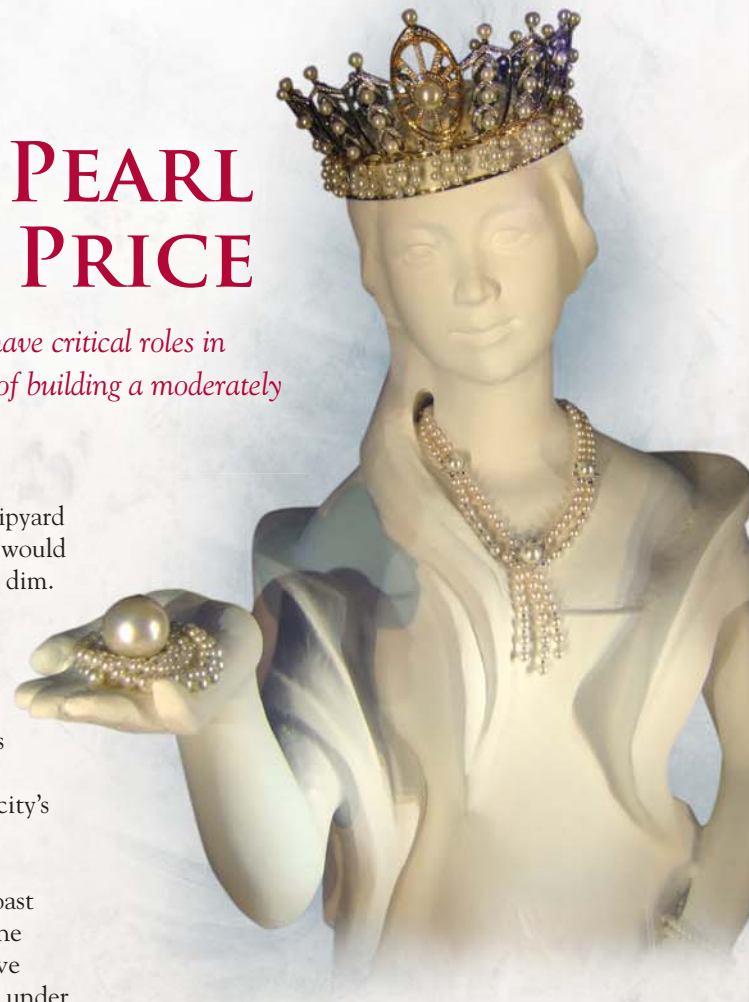
Not so long ago, when a big shipyard crane in Shanghai moved, it would cause the lights of the city to dim.

In today's neon-gilded metropolis, where bustling thoroughfares and traffic-packed streets cut through canyons of steel-and-glass monuments to prosperity, it is hard to believe that a space of only 20 years separates the city's bright future from its dark yesterday.

Located midway down the Chinese coast amid the waterways at the mouth of the Yangtze River, Shanghai was one of five Chinese ports opened to foreign trade under the 1842 Treaty of Nanking. The city's prime location soon made it a major stop for world shipping, which, in turn, developed an international business center there. By the 1930s, Shanghai was a world-class port and a cultural and economic center of Asia, with a style power like Paris and a financial muscle like New York. In those days the city stood for everything modern about China: the country's first rail line was laid there, its

first automobiles debuted there and the first Chinese motion pictures were made there. And when Shanghai was a hub of Asia, The Bund was the hub of Shanghai.

One of Asia's most famous urban landmarks, The Bund is a riverfront promenade lined with a mile-long stretch of grand 19th and early 20th Century architecture built by the top foreign enterprises then operating in the city.



The steel-and-glass forest of Shanghai's Pudong zone, seen from the promenade of The Bund.



◀ At the 2010 Shanghai Expo, displays honored China's historical legacies, its technology developments and mineral riches. A symbol of both natural beauty and resource wealth is the Pearl Goddess, the centerpiece of the Guangxi Province Pavilion. She wears the Crown of the Sea, decorated with 2,880 pearls and 1,880 diamonds. She holds in her hand the largest pearl ever found in China.

In its heyday, the gleaming structures of The Bund housed the city's elite businesses, banks and nightclubs, standing as a commercial lynchpin between China and the West and a symbol of the city's success.

Hit hard by World War II and its aftermath, China struggled on and Shanghai entered a half-century of decline. By 1990 the city was impoverished and run-down, although it had remained a center of heavy industry. Many of China's major shipbuilders packed the shores of a bleak industrial district of central Shanghai named Pudong, a grim, grey place that lay just across the Hudong River from the decaying grandeur of The Bund.

In 1992, Paramount Leader Deng Xiaoping made his famous Southern Tour, in which he galvanized the country to follow his plans for reform and modernization. Soon, Shanghai was restored as the entry port of modernity and a signpost of the country's capacity for success. Deng noted at the time that "some places will get rich first and then the rest of the country will follow," and Shanghai did not disappoint. One of the city's first achievements was in public transport.

At the time of Deng's Tour, the city was served by very old railways – including the occasional steam engine – and had no metro system. Its first subway station opened in 1995 and, by 2005, the city could claim the world's lengthiest metro system: between underground and light rail lines it runs some 420 km (262 miles) in total length. In 2003, the city opened the world's first commercial high-speed magnetic levitation train, connecting Pudong Airport with a city metro station. By 2010, Shanghai could also boast two high-speed inter-city train lines – moving up to 350 km (218 miles) per hour – and was working on a third, due for completion in 2011, that planners say will reach speeds of up to 380 km/h and allow travel to Beijing (800 miles away) in about four hours.

The biggest visible transformation in the city has been architectural. Amid the immense and sometimes unusual structures going up all



Roadside billboard of Deng Xiaoping at the entrance of the Lychee Park in Shenzhen.

over Shanghai, it is difficult to imagine that, in 1990, the most notable buildings in town were still those of The Bund. Today, nearly all the Pudong shipyards have been relocated and the squat workshops of the past have been cleared away for a skyward-reaching future. Along one stretch of Pudong's riverfront, the wharves and slipways of heavy manufacturing have been replaced by a vast public space that was recently home to the Shanghai Expo. The zone beyond the fairgrounds has been replanted with a forest of skyscrapers that form a genteel financial district named Lujiazui, where wide boulevards filled with fancy shops and stuffed with vehicular traffic thread among towering office blocks and upscale apartment buildings.

Altogether, the long struggling years of rationed light bulbs and limited electricity in the heart of China's financial center have become memories that parents mine for stories

An urban development model at the Shanghai Expo showed the planned transformation of Chongqing from inland backwater to industrial metropolis.





The Oriental Pearl Tower illuminates a rainy Shanghai night; its iconic architecture is a blazing symbol of modern China.

to tell their children in order to encourage hard work, thrift and personal achievement.

The showpiece of Pudong is the Oriental Pearl Tower, an iconic bit of architecture that raises a TV/radio antenna 468 meters (1,535 ft) above the manicured greenery and riverside walkways of Pudong Park. Completed in 1997, it is the world's third tallest TV tower and, for a decade, was also the tallest structure in China. In height it was surpassed in 2007 by the 492 m (1,614-ft) Shanghai

World Financial Center – among the world's tallest buildings and home to the world's highest hotel – but in power it still dominates the skyline.

By night, the Oriental Pearl Tower shines as a beacon of commerce. Its luminous spire and great glowing spheres, like the radiantly restored and electrically outlined buildings of The Bund, illuminate the night with blazing symbols of modern China – both its meteoric trajectory across the world stage and its skyrocketing need for electric power to further propel its journey of modernization.

Pudong has been a model for accelerated urban development that has transformed once-provincial towns into modern, throbbing cities. It is most noticeable along the coast – parts of modern Dalian and Yantai, for example, bear a striking resemblance to the newer areas of Houston or Berlin. According to the Council on Tall Buildings and Urban Habitat at the

Illinois Institute of Technology in Chicago, by 2012 China will have 34 of the world's 100 tallest buildings – a feat hitherto only achieved in the United States.

Spurred by such industry, China's real gross domestic product (GDP) has been expanding at 8 to 10 percent per year, making energy development an important focus in the country's next Five-Year Plan. Twelfth in the series of quinquennial economic instructions from the government that have guided the country's activities since 1952, the full Plan is not likely to be released before the annual assembly of the National People's Congress in March 2011. Its text, however, was drafted and approved in October 2010 at the Fifth Plenum of the 17th Central Committee of the Communist Party of China (CPC). The day after the assembly adjourned, the CPC released a communiqué about the proceedings that, in part, reviewed progress under the previous Plan and discussed concepts in the one to come.

“The plenum held that the 12th Five-Year Plan period is a crucial stage for building a moderately prosperous society in an all-round way and a time of difficult issues for deepening the reform and opening-up process while accelerating the transformation of the nation's economic development pattern.” The document notes that, “the promotion of scientific and technological progress and innovation should be taken as an important support to the transformation, while ensuring and improving people's livelihood should be the very aim and fundamental end of the move.”

The communiqué also refers to continuing industrialization and its consequent need for energy and energy transportation:

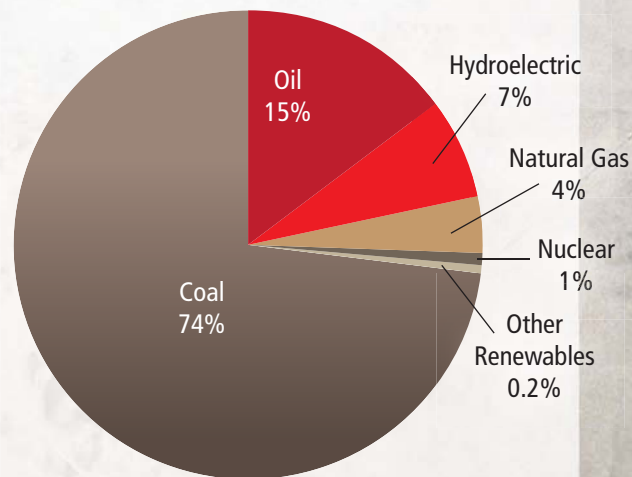
“The plenum underscored the establishment of a modern industrial system and enhancement of the core competitiveness of industries by transforming and upgrading the manufacturing sector, developing strategic emerging industries and accelerating the growth of the service sector. It stressed that the construction of the modern energy industry and the building of a comprehensive transport system should be boosted, while raising the level of information technology and encouraging the marine economy.”

One fuel of growing importance to the ‘modern industrial system’ and ‘modern energy industry’ mentioned above is oil. In 2009,

Crowded commuters heading home in Beijing. They all want cars, too. China expects to produce 16 million automobiles next year, all for domestic use, and is working hard to find the fuel for them and those to come.



Total Energy Consumption in China



China became the world's second largest oil consumer, importing about 32 percent of the 8.3 million barrels it used each day that year. Fifteen years earlier it was a net oil exporter. In response to this changing energy profile, China's major national oil companies have been building overseas resource portfolios with particular intensity the past five years. Between October 2008 and December 2009, for example, Chinese oil majors invested nearly \$17 billion for direct acquisition of international oil and gas assets. Its two leading energy conglomerates, CNPC and Sinopec, have bought into exploration and production projects in, among other places, Canada, Iran, Kazakhstan, Russia, Saudi Arabia, Sudan, Venezuela and West Africa – and in the United States. In October 2010, China National Offshore Oil Corporation (CNOOC) announced it would pay \$1.08 billion for a 33.3-percent stake in the 600,000-acre Eagle Ford shale oil and gas project owned by US-based Chesapeake Energy.

At home, China is pinning big hopes on its offshore oil and gas potential, the extent of which is promising but remains to be defined. China's main offshore developer CNOOC and its drilling subsidiary China Oilfield Services Ltd. (COSL) have been preparing the technology of a deepwater future for some time, while in 2010 Sinopec contracted fabrication projects around the country for a number of high-specification offshore units suited to deepwater operations. At the same time, the country's offshore safety authority China Offshore Oil Operations Safety Office (COOOSO) issued new rules governing safety for floating production, storage and offloading (FPSO) units and began reviewing all regulations for offshore drilling, with an eye towards applying lessons learned from incidents abroad to China's deepwater development safety regime.

As the CPC communiqué infers, the role of the country's 'marine economy' in all this is acknowledged at the highest levels – with shipbuilding facilities, which build the tools of energy development and energy transportation, receiving special attention. Shortly before announcing the Ship Industrial Restructuring and Revitalization Plan in 2009, Premier Wen Jiabao and other leaders visited several major shipyards and spoke publicly of shipbuilding's achievements and its importance to the future.

In response, China's major shipyards have been busy developing specializations and skills to support that future. Many are changing the

focus of their business plans towards production of high-value vessels and the construction of offshore rigs. Dalian Shipyard Offshore Company (DSOC), for example, has strengthened its name as a high-specification jackup rig manufacturer and is developing its own semisubmersible and drillship designs. Yantai CIMC Raffles, possessor of the world's only 20,000-ton capacity crane, is making a name as a producer of offshore vessels and sophisticated semisubmersibles. Hudong-Zhonghua Shipyard has become a specialist in the production of membrane-type LNG carriers. NACKS (Nantong COSCO KHI Ship Engineering Company Ltd.) and Rongsheng are among those staking themselves out as producers of pure car carriers, very large bulkers and the high-tech oil, gas and chemical tankships that will fuel the future, with Rongsheng emerging in the vanguard of the new generation of private Chinese shipbuilders.

Meanwhile, the big businesses of China are casting an ever-longer shadow across the world stage. In November, two Chinese banks (ICBC and CICC) joined the crew helping the new General Motors with its initial public offering, while Chinese automaker SAIC, a GM partner owned by the Shanghai City Government, announced its once unimaginable plan to spend \$500 million and buy 1 percent of the American automotive giant.

All things considered, the optimism expressed in the CPC's communiqué seems as firmly rooted in substance as in promise:

"After striving for five years, our country has achieved fast development of social productivity, drastic enhancement of overall national strength, remarkable improvement of living standards and a marked rise in international status and influence. The achievements of the five years are hard won, the experience accumulated is precious and the spiritual fortune created will last long."

TRANSFORMING FROM LARGE TO STRONG

China's national shipbuilding association guides its industry along a scientific path to the future.

Declaring shipbuilding to be a strategically important industry, an executive meeting of China's State Council in February 2009 granted approval-in-principal to a stimulus plan for the country's shipyards. The meeting, chaired by Premier Wen Jiabao, concluded that "shipbuilding is a modern, comprehensive industry providing technical equipment for transportation, maritime development and national defense." In addition, "supporting shipbuilders would also help other sectors, including steel, chemicals, textiles, light industry, equipment manufacturing and information technology."

The Ship Industrial Restructuring and Revitalization Plan became official in June 2009 and by the start of 2010, China's Ship Industry Investment Fund was in operation. By July it had placed some RMB 15 billion (\$2.2 billion) in vessel orders. A private equity fund akin to German KG financing, the Ship Industry Investment Fund is recognized as an important part of China's market economy. In addition to supporting growth of the national fleet, the fund's remit includes: funding scientific research and technology development; supporting industrial upgrades of key enterprises; and perhaps most significantly for the country's vessel builders, encouraging mergers and acquisitions.

With China's leaders addressing overcapacity concerns in industries ranging from foodstuffs to steel, it is not surprising that its shipbuilding

leaders see consolidations in the future. There is, in fact, widespread belief that the country's 12th Five-Year Plan (2011-2015) will challenge the shipbuilding sector, as a whole, to transform from large to strong.

The leading organization helping shipbuilders through the trials of this transformation is the China Association of the National Shipbuilding Industry (CANSI). Unlike most professional associations, CANSI is a nongovernmental organization with an administrative role in guiding the future of its industry. Serving as a bridge between government and industry, it helps government authorities develop plans and policies for the shipbuilding sector and then helps the builders develop ways to implement reforms and reach those goals.

In the 15 years since it was founded, CANSI has grown in scope and presence to meet the needs of the evolving industry that it represents. For nearly five decades, all Chinese shipyards were State-owned enterprises that belonged to a single industrial group, the China State Shipbuilding Corporation (CSSC). As the export shipbuilding business increased in the early 1990s, the government decided that a specialist administrative organization was needed to manage the builders, establishing CANSI in 1995 as a department of CSSC. Following the first increase in the number of shipyards in 1999, CSSC was split into two regional shipbuilding



groups: the newly-formed China Shipbuilding Industry Corporation (CSIC), representing builders in the northern part of the country, and CSSC, representing those in the south. To maintain impartiality in its dealings with them, CANSI was placed with the Commission of Science, Technology and Industry for National Defense of the People's Republic of China, the umbrella authority governing the country's maritime industries.

According to the latest data from CANSI, there are about 100 significant shipyards in China, 52 of which are considered major builders that, taken together, account for more than 80 percent of the country's shipbuilding output. Of the 52 majors, 15 are the big State-owned builders that, in some cases, have been known to the maritime industry for over a century.

There are many more shipyards outside this elite club, most operating on a small, local level and building inland waterway vessels. Data indicates that there are, in total, about 2,000 shipbuilders, equipment makers, suppliers and subcontractors currently active. The smaller maritime companies typically belong to their provincial builders' associations and, while there is no line of authority between CANSI and these associations, CANSI does exchange information, share resources and cooperate with them.

In addition to its representative, administrative and advisory duties, CANSI also aids in the application of new technologies and promotes understanding of new technical standards. It helps the builders comply with new requirements, assists with training and even employs leading yards in an

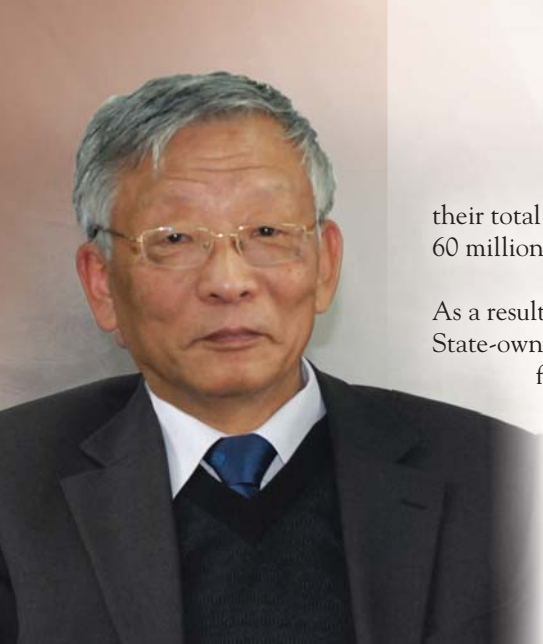
experimental capacity to test new technologies and build experience that is then shared with other shipbuilders.

In one recent project, Hudong-Zhonghua Shipyard was asked to experiment with advanced low-friction and anti-fouling coatings. The substantial investment was repaid with development of a new skills set that was then disseminated to interested shipbuilders. Working with Shanghai Waigaoqiao Shipyard, CANSI led a development effort in the application of the Common Structural Rules, which spread the experience to other yards. As such, not only members, but all builders are invited to share in the fruits of these endeavors.

Membership in CANSI is not compulsory, but the firms that join find themselves in good company. Its 530 members include all the major shipyards, equipment manufacturers and suppliers, as well as a number of universities, institutes and service providers; their collective industrial output accounts for more than 90 percent of the country's maritime sector productivity.

China's great leap in shipbuilding productivity brought clear benefits to its maritime sectors, but now brings challenges that CANSI has been working hard to resolve – a workload that increases as rapidly as the scale of the industry grows. Consider that, 15 years ago, Chinese shipyards were able to turn out about 3 million dwt of ships annually. In 2009, they produced 40 million dwt. According to CANSI, by September 2010 they had contracts for 50 million dwt – a 65 percent increase over the same period in the previous year – and could go further yet, as





Zhang Guangqin,
President,
CANSI

their total throughput capacity has climbed to 60 million dwt.

As a result of that startling growth, the two State-owned giant groups that once accounted for 80 percent of the country's merchant ship output now account for just 40 percent. The rapid threefold expansion in the number of major shipbuilders opened tens of thousands of new positions, but also strained the talent pool. In less than one generation, the industry has had to raise an army of young maritime professionals and pass on to them the technical and managerial skills to take this huge new shipbuilding machine smoothly into the future. The shipyards are meeting these challenges by revamping the workplace, upgrading equipment, improving management methods and reevaluating their relationship with the workforce to develop new ways to attract, train and retain high-value workers.

One way that CANSI supports its membership is with advice, he adds. The association's direct contact and communication with the government gives it a unique understanding of regulations, plans and requirements as they develop. For example, its meeting on how to prepare for the country's 12th Five-Year Plan concluded, in part, that members will best face the future by refocusing their business plans to tackle human factors issues and the management and quality aspects of their operations.

"The major yards are working hard on improving efficiency and production quality and will share their knowledge with the other yards," says Zhang. "We have already cleared the policies for the coming years; we are advising the shipyards not to spend more time and energy on improving production capacity; now is the moment for them to focus on management, efficiency, technology and quality."

CANSI expects that the coming five years will see Chinese yards continuing their focus on bulk carriers, tankers and containerships, but is encouraging members to look for new opportunities in emerging markets. "The majority of orders in China are still made up of bulk carriers, but we have been advising our members that it is time to look forward and develop high-specification vessels, to invest in new technologies and upgrade facilities," says Zhang. "The major yards in particular will go on to bring forth new, environmentally-friendly ship designs – like SWS is doing with its very large bulk carrier design, which was developed to be in compliance with the latest Green Passport requirements. We have also been advising members to get more involved in the offshore market," he says.

As China's merchant ship newbuilding orders approach capacity, CANSI is keeping a close eye on industry performance. "If all 60 million dwt can be delivered in good order, that means the industry's logistics are working," says Zhang. "The problem will come when the market drops again. Then there will be an overcapacity of shipbuilding, and it is doubtful that all the yards will be able to survive. Some builders have already begun preparing for that time by diversifying their output, producing blocks for other yards or taking up other activities," he explains. "The future is bright, but which shipyards survive to see it will, ultimately, be decided by market competitiveness."

Meanwhile, the damage done during the recent shipping slump, which cut even CCCC's 2009 profits by nearly 40 percent, remains both a fresh memory and a fresh worry – and one that raises particular concerns for medium and small enterprises, considering the implicit preparation for a wave of mergers and acquisitions in the Ship Industry Revitalization Plan. The larger builders are responding to future concerns by developing specializations in high-value vessel sectors ranging from leading-edge tankers and containerships to offshore oil and gas equipment.

"One big challenge facing China's shipbuilding industry is that many yards sprang up too quickly during the boom times of 2003 to 2008," says Zhang Guangqin, President of CANSI. "This development was very fast and it does not have a sufficiently strong foundation to continue and, thus, needs support."



SWS: Teamwork Builds a Leader

Construction of Shanghai Waigaoqiao Shipyard (SWS) began in 1999 in Shanghai's Pudong New District as a high-priority industrial project under China's Ninth Five-Year Plan (1996-2000). As announced at the time, the shipyard was intended to be a technology showplace for shipbuilding, drawing unique technical benefits from the specializations of its four owners – China State Shipbuilding Corporation (CSSC), Shanghai Baosteel Group, Shanghai Electric Group Company and China Shipbuilding Trading Company (of which CSSC is majority shareholder) – that was expected to make it a world-class shipyard within the decade. Today, in terms of output, SWS is the biggest shipyard in China and vying for the number three spot in the world.

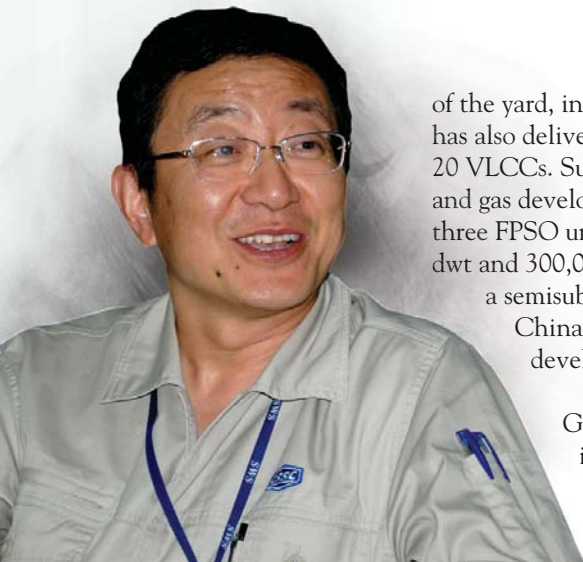
SWS delivered its first vessel in 2003 and within two years became the first shipyard in China with an annual output over 2 million dwt. In 2006 its output rose to 3.2 million dwt, nearly equal to the total ship production capacity of the country in the year its construction began. In 2009, SWS delivered 6.04 million dwt and expects the total for 2010 to top 7 million dwt.

Today SWS produces ships and structures at three facilities. Besides the original Pudong yard, it operates Shanghai Jiangnan-Changxing Shipbuilding Co. Ltd (CSC) on Changxing Island, where a shipbuilding center is being developed in the river near Shanghai. There, CSSC has made substantial investments in three large shipbuilding facilities. Production Line Number One is controlled by SWS, while Numbers Two and Three are controlled by Jiangnan Shipyard. Recently SWS also opened a new production line in the city of Lingang,

about 60 miles outside Shanghai, which is expected to build offshore equipment but, for the present, has begun block fabrication for the group's other yards. The three facilities cover a total of about 5 million m², more than three times the area of the original SWS facility.

During the past seven years SWS has delivered over 100 capesize bulk carriers, making that type the main product





Tao Ying,
Chief Engineer,
SWS

of the yard, in numbers at least. The shipyard has also delivered over 30 aframax tankers and 20 VLCCs. Supporting China's offshore oil and gas development, SWS has also delivered three FPSO units, of 150,000 dwt, 170,000 dwt and 300,000 dwt and is currently finishing a semisubmersible drilling platform for China's leading national offshore developer, CNOOC.

Getting to this point has had its challenges. For example, as things started up, management not only had to develop a unique shipyard philosophy that suited the new facility, but also had to figure out how to unite its workforce under a new and sometimes challenging banner.

"We have hundreds of people in administration, thousands of technical staff and tens of thousands of workers; because they came from a variety of places, the big challenge was how to make them work together as a team towards the same targets," says Tao Ying, Chief Engineer of SWS, who has been with the shipyard from its very beginning. "When the shipyard was founded, the staff came principally from Hudong and Jiangnan and, naturally, they brought their own ideas and methods with them. Inevitably, they had some conflicts. How we built them into a team was to get them to forget the previous ways of approaching the job. Because this would be the biggest shipyard in the country, we said, it needed a new concept regarding management, production and efficiency."

In developing the yard's philosophy, management looked to techniques employed by more advanced builders. From Japanese shipyards SWS learned detailed management

skills and imported the 'Five S' system of enterprise resource planning, a building block of industrial efficiency based on individuals maintaining an orderly workplace. Another of these teachers was a successful domestic importer of Japanese knowhow, Nantong-based NACKS. "We approached NACKS because they have about one-fifth the number of workers that SWS has, but their production output is half that of SWS," says Tao. "This high-efficiency operation is what the management set out to learn."

SWS' developers also studied the approaches that other builders took to yard layout, settling ultimately on a version of the design developed by a British consultancy for Korea's Samho Shipyard (now part of the Hyundai Group). The production line of the yard takes a C shape, in which the materials arrive from the sea at one end and the finished ship is released to the sea on the other end. "To us, this is one of the best shipyard designs we ever saw," Tao says.

Another significant startup task for SWS was to develop in-house design and engineering talent. With much of their technical staff fresh out of university, SWS initially relied on outside design houses, such as Shanghai Merchant Ship Design & Research Institute (SDARI) and Marine Design and Research Institute of China (MARIC), to help work out its designs and drawings. As the staff developed experience, they became a true design department that, today, employs over 500 engineers. They produce traditional vessels like bulk carriers, aframax tankers and VLCCs. Special vessel designs are still produced jointly with consultants in China or Korea. External companies have helped the yard in other aspects of ship production as well, says Tao. "ABS has had a very good relationship with

FRONT QUEEN, a 297,936 dwt VLCC tanker, built at Shanghai Waigaoqiao Shipbuilding Co., Ltd.



SWS from the start; in 2001, for example, ABS gave us a lot of help setting up our quality systems.”

Personnel development has been a major component of the yard’s progress, says Tao, with much of that effort centering on workforce education and training. That is a field where he has quite a lot of experience, for in addition to being the shipyard’s senior engineer he is also a part-time professor at Jiangsu Technology University, where he teaches courses in naval architecture. As an educator, Tao has had special insight into how one may bring up the next generation of engineers.

“The young people of China are very quick to accept new concepts, but, at the same time, their interests change very quickly,” Tao observes. “For this reason, the company rotates its new hires through various positions in engineering, production, quality assurance and so on, to give them exposure to the different kinds of jobs and situations in the shipyard in order to help them sort out their professional interests. Once they get this exposure they can decide their own career paths. Then the yard provides more detailed training in the chosen direction.

“To function at its best, the shipyard needs its people to have an understanding of how all its parts work together to produce a vessel,” he explains. “Once a person gets this broad exposure, even if he stays in one department for a long time he understands what the other people in the yard do and he knows the function of the other departments, which then leads to better cooperation with his colleagues. That, in brief, is our training philosophy – to have our staff develop themselves together with the company.”

This approach to training, he says, has raised many good engineers for the company and has helped its heads of engineering lead SWS into new ship markets.

“Management emphasizes that every staff member has to set a personal target and work towards it,” says Tao. “Once they analyze themselves and their performance they know what they are good at and what they are poor at, so they can correct their faults, advance themselves and help advance the shipyard towards its goal of becoming number one in China and a first-class shipyard of the world.”



OCEAN PEGASUS, a 108,926 dwt double hull crude and oil products carrier, built at Shanghai Waigaoqiao Shipbuilding Co., Ltd.

The Five S Method of Making a Better Workplace

One of the key management philosophies employed at Shanghai Waigaoqiao Shipyard (SWS) is the enterprise resource planning (ERP) philosophy known as the ‘Five S’ system, which originated in Japan and derives its name from its five principals, which, in the Japanese language, all begin with the sound of the English letter S:

◆ Seiri: Sorting

Physically eliminate all unnecessary tools, parts and materials from the workspace (mentally, do the same with instructions). Prioritize the necessary items according to the job at hand, keep them in reachable places. Store or discard what is not necessary.

◆ Seiton: Setting in Order or Straightening the Work Flow

Every item necessary to the job should have a clearly marked home place and should be arranged in a manner that promotes efficient work. Repetitive bending to access materials should be eliminated. Each item should be close to the work station where it will be used.

◆ Seiso: Sweeping or Systematic Cleanliness

The workspace must be kept tidy and organized. At the end of each shift, everything must be put in its home place and the work area cleaned.

◆ Seiketsu: Standardization

Work practices should be consistent or standardized throughout the plant, with all workers knowing exactly their responsibilities.

◆ Shitsuke: Sustaining the Practice or Self-discipline

Everyone should maintain focus on the first four S principles in order to prevent backsliding to less organized ways. In addition, workers are encouraged to think about improving their process and to contribute to workplace improvement.

Hudong-Zhonghua: High-Tech Symbol



Wang Yong,
President,
Hudong-Zhonghua
Shipbuilding Group

Formed in 2001 through a merger of two venerable Shanghai shipbuilders, Hudong (founded in 1928) and Zhonghua (founded in 1926), Hudong-Zhonghua Shipyard has a long history in its hometown as both a leading builder of ships and a major contractor for civil projects. In recent years the yard has contributed several unique elements to the modern Shanghai skyline: the Nanpu Bridge (and two others that also span the Huangpu River), the city's Stock Exchange building and the antenna mast of the Oriental Pearl Tower.

The only Chinese shipyard to have built LNG carriers, Hudong-Zhonghua has come to symbolize the kind of high-tech ship production and diversified activities that many of China's leading shipbuilders are targeting for their future endeavors.

"We are walking a path similar to that of Japan's shipbuilders – we have passed the point where it is commercially advantageous for us to build basic, lower-value ships," says Wang Yong, President of the Hudong-Zhonghua Shipbuilding Group. "It was already clear under our 11th Five-Year Plan, and will be even clearer under our 12th, that Hudong-Zhonghua's future is in high-technology, high-value vessels," he adds, stressing that what appears to be a new direction was already being contemplated more than a decade ago.

"We began investigating the possibility of building LNG ships back in 1998 and built a mock-up of a containment system to study the technology. When negotiations for the first Chinese LNG ships began in 2001, we were ready," Wang says. "Our development strategy going forward is to focus mainly on LNG carriers, large containerhips of 10,000-teu capacity and beyond, special-purpose vessels and offshore structures."

Among the special-purpose vessels on their target list are types that will support the energy sector development being addressed in China's next Five-Year Plan, including wind turbine installation ships, heavy lift ships, stainless steel chemical carriers and floating LNG production and storage equipment. The key to this future is in the yard's design, engineering and implementation capabilities, says Wang. There are currently 800 people in the company's Research and Development department.

"With very few exceptions, all the ships we build are to our own designs," he says. "As a matter of fact, we only bought the design of our first LNG carrier, from Aker Yards; the designs for the next series of ExxonMobil LNG carriers will be done in-house. Our first steps forward were to develop our in-house design and research and development capabilities; the second step is to build up our engineering skills. We believe that through engineering we will raise the efficiency of the yard significantly," he adds.

As the shipyard workforce expands, keeping its manufacturing capabilities in line with its evolving design skills is a task requiring constant attention, says Wang. "With many new workers in the shipyard, implementation is a major challenge and a key issue for us," he says. "Hudong-Zhonghua attaches great importance to implementation issues and is continuously working on them. We have made substantial advances in this area in recent years, particularly in the construction of LNG carriers. The most important measures we have taken are to have all the workers acquire some engineering competence before starting their work. In addition, strict requirements from



some shipowners, like ExxonMobil, have been very helpful in our implementation efforts, as is the support of our classification societies," he says.

The yard has also drawn upon input from the users of its products for development insights. "We have also received very valuable assistance from the people who will be the real operators of the equipment," says Wang. "Through such cooperation we have been highly successful in producing advanced engineering works. A good example of this is the fabrication of the Invar tubes and pump tower for our LNG vessels. When the first test pieces we produced failed completely, we were advised to buy them from our partners. Instead, as a result of intense study and hard work by our people, working with the operators, we were able to build up our skills such that the first Invar tube and pump tower we produced fully complied with international standards," he says proudly.

"Looking forward, we have divided its development plans for the upcoming 15 years into three steps. First, we will further develop ourselves in high-tech ship markets. Second, we will expand our shipbuilding capacity and production volume. The third step is to maintain our advantages in technology, in production efficiency and in our size. We want to be among the top three shipbuilders in China and in the top ten of the world."

The second step of that development got underway in August 2010, when Hudong-Zhonghua announced it would begin construction of a mega-shipyard on Changxing Island, the island in the Yangtze estuary just outside Shanghai that is becoming a local shipbuilding center. The new yard will cover an area of 6.6 million m², more than four times the total size of the company's present facilities on the Huangpu River in Shanghai's Pudong zone. The new yard will feature four big drydocks suitable for the largest supertankers and containerships as well as a variety of equipment for offshore energy work. The construction project is a long-term effort that will be developed in stages, the first of which will install two of the drydocks – a large one measuring 660 m long and 132 m wide, which will be equipped with two 1,800-ton gantry cranes, and a smaller one measuring 480 m long that will be served by two 1,200-ton cranes.

Today's achievements and tomorrow's promise were barely imaginable when Wang joined



Hudong Shipyard in 1985. At the time, it had just begun exporting ships, was able to deliver two vessels per year and had a maximum annual output capacity of about 100,000 dwt. At the time of the merger with Zhonghua 16 years later, the group target was to increase annual output from 740,000 dwt to 1.2 million dwt by 2005. It nearly reached that goal in its first year as a combined organization, becoming the first Chinese shipyard to exceed 1 million dwt annual production. Its sales volume for 2001 reached the then-startling RMB 4 billion (about \$580 million). For 2010 the company expects to deliver 33 vessels totaling 2.2 million dwt, generating revenues of RMB 13 billion (approximately \$2 billion).

Wang, who started in Hudong's design office and worked long stretches in its workshops and production department before becoming Vice President of Production and then President, has seen the shipyard make many achievements, but takes greatest pride in its workforce. "The rapid development of Hudong-Zhonghua can largely be attributed to the development of our R&D capabilities; this has come thanks to the talented people of our various departments; without them, none of this would have been possible. This is what I am most proud of," he says.

"I grew up with the group and have a strong, heartfelt regard for the yard and its people," he says, noting that attention to personal aspects of the workplace is at the heart of at least one important element of the shipyard's future. "One of the most important steps we will take as we go forward is in the direction of safety – the safety culture is, in fact, a key component of our enterprise. Creating a sound environment that protects the health and safety of the workers is the duty of top management," he says emphatically. "For me, it is also a matter of conscience that workers' lives not be endangered in the pursuit of profit."

Hudong-Zhonghua has announced it will begin construction of a mega-shipyard on Changxing Island.



NACKS: “QUALITY IS OUR LIFE”

“Quality is our life,” says Xu Kai, President of Nantong COSCO KHI Ship Engineering Company (NACKS). “If we do not have quality, we have no face.”

Efficiency and quality were focal points for NACKS when China Ocean Shipping Company Ltd. (COSCO) and Kawasaki Heavy Industries (KHI) first partnered to create the company in 1995, sharing the RMB 3.6 billion (\$515 million) investment that launched construction of the yard.

As the first joint-venture company in China’s shipbuilding industry it was, from the start, planned to be not just another shipbuilder, but also a showcase for advanced technologies and management philosophies.

There are, he says, three main pillars of quality operation: people, preparation and equipment, in that order. “Quality comes from the workers, but the workers must be supported by management – and they must know they are supported,” Xu says. “Then come education and training, which are ongoing efforts from the organization. Third, you must install the best modern equipment – people must have quality tools in order to produce quality work.”

‘Having the right tools’ also means having good working conditions, he adds. So, for example, NACKS provides its welders with a kind of air-conditioned work suit to combat the summer heat. “You must not only

support the workers with ideas, but also with equipment that makes their working conditions better. Good-quality working conditions encourage good-quality work.”

All these steps contribute to developing pride, discipline and self-motivation in the workforce, the fundamental building blocks of a ‘quality culture’. “The last phase in developing a quality culture is to have everybody thinking for themselves about safety and about doing a good job – not to satisfy the inspectors, but to satisfy themselves,” says Xu. “If you need a foreman or a Quality Control guy to watch you, to look over your shoulder, to inspect you in order for you to do quality work, then I would say you do not have a quality operation. Quality is something you do for yourself because you believe in it,” he explains.

“Our job as management is to build workers’ confidence, to encourage them to learn at every step of the job, to be willing to follow the continuous path of training and education in order to better themselves and the shipyard. That is quality,” Xu affirms. “Yes, it is difficult, and not all yards can do it. Some shipyards ask us how many Quality Control inspectors we have and are shocked when I say that we have none. Of course, we have a QC department, but I mean that it is not like what you find in other yards. Some yards have hundreds of QC inspectors looking over the workers’ shoulders. We do not do this,” he says emphatically. “We have our people trained to be thinking about quality all the time, in a very natural way. Of course, we have problems from time to time like any other yard in the work, but we also have a system that encourages quality on an individual level.”



Xu Kai,
President,
NACKS

Quality will be a determining factor in the future of Chinese shipbuilding, particularly during the next market downturn, he adds. "Not every shipyard can be a quality enterprise. You need the right people, the right level of investment, and the right level of commitment from management. Over the next five years, we will see many medium- and small-size shipyards in China being absorbed or retiring from the industry altogether, because they will have too much difficulty keeping up with environmental protection regulations and the other demands of a quality operation."

Since its foundation, NACKS has been recognized as the entry point of an advanced management philosophy. For example, when Shanghai Waigaoqiao Shipyard (SWS) was getting started, it sent a team to study how NACKS was achieving half of the bigger yard's output despite being only one-fifth its size. "If we can help other Chinese shipyards be better, we should," says Xu, noting that NACKS received significant support from an experienced yard during its own evolution.

"From our very beginnings, Kawasaki helped us greatly," he explains. "When COSCO started the joint venture, we all recognized that the company, although one of the world's largest shipowners, had no experience in shipbuilding. We were well aware that we were complete rookies at the start and were very concerned about controlling the quality of our work, making sure everything we did would be correct," he recalls. "We took the approach that we are students in this and that we must study. We must have a shipyard that delivers high-quality vessels, on time and efficiently. We knew that we must learn a lot of things to survive in the shipyard business, and KHI came here and they taught us."

Cooperation with classification was also important during the yard's early days. NACKS launched its first ship in 1999, a 47,000-dwt bulk carrier named *Feng Hai* built to ABS class, as was its next milestone, the 5,400-teu containership *COSCO Antwerp*, launched in 2002.

NACKS joined the front line of boxship builders in 2008 with the delivery to COSCO of three ABS-classed 10,000-teu container carriers. NACKS is returning to the forefront in that field with a contract to start work on a 13,000-teu vessel in 2011.

The yard also has its eye on attaining the prestigious rank of LNG shipbuilder – not in competition with the membrane ships of Hudong-Zhonghua, but in offering as an alternative the world's second most popular containment system. In years past, KHI built many Moss-type spherical tank LNG carriers, and would be NACKS' technology support should such a project come their way. While the production of Moss spheres is demanding, Xu says the yard's manufacturing system and quality philosophy are ready for the challenge.

"Initially, Kawasaki sent 30 management staff here to instruct us in their methods and we sent many people to their shipyards to study, train and learn their work system," Xu recalls. "Of the 300 people presently on our engineering team, about 70 percent have studied with KHI. Today, there are only six Kawasaki management staff here, but we still send many workers to train in Japan. The reason: in quality shipbuilding, you never stop learning."

"A shipyard is not an enterprise with a lifetime of ten, 20 or even 50 years; it is an enterprise that can survive 100 years or more," he says. "If we are to have a shipyard, and if we want it to be the best, we must go forward keeping this in mind."

HANJIN BILBAO, a 10,000 teu container carrier, built at Nantong COSCO KHI Ship Engineering Co., Ltd.





Chen Qiang,
Executive Director,
Rongsheng Heavy
Industries

Rongsheng: Model of the Future

According to Chen Qiang, Executive Director of Rongsheng Heavy Industries, the evolution of the Chinese shipbuilding industry can be divided into three distinct phases, each represented by a shipyard: Jiangnan Shipyard, China's oldest builder, represents the first stage in the evolution of Chinese shipbuilding, that of acquiring the methods of building modern ships for export; Shanghai Waigaoqiao Shipyard (SWS), which began operation in 2003 and is presently the country's largest builder, represents the second stage, that of improvement through the establishment of standards; and Rongsheng represents the third stage, the rise of the private shipbuilder.

Chen has had a front-row, executive level view of this evolution. He started his career in 1982 as an engineer with Jiangnan and in 1996, became its Assistant General Manager. When the shipyard wanted to expand by building a new facility in 1997, Chen was appointed Director of the Preparation Committee for its construction. At the time, China's shipbuilding industry was burdened by a heavy bureaucracy that slowed every major construction project to a near-standstill. For Jiangnan, the process of going from the recognized need for a new shipyard to its groundbreaking ceremony took a full ten years.

"When they finally set up the construction team, I promised I would have the yard ready for work in three years time," Chen recalls. "No one believed it could be done – it had taken so long just to get the necessary permissions in place. But during the ten years it took to get all the approvals from the many government offices that were involved, we went abroad to learn about ship construction methods from the world's leading yards in Japan, Korea and Europe. The knowledge and experience we gained during that time helped us improve our own plans and enabled us to complete the yard as promised," he says proudly. "From driving the first pile to laying the first keel took just three years."

The new facility ultimately separated from its parent to become SWS, with Chen as its President. In 2004 he left SWS to join the Rongsheng Heavy Industries Group as the conglomerate entered the shipbuilding business. Moving quickly, he found profitable product lines that avoided direct competition

with the major State-owned companies. Rongsheng began operations by focusing on two types of ships, a 75,500-dwt ice-strengthened bulk carrier – first of its kind in China – and a 156,000-dwt suezmax oil tanker, which became the first ship of that type in China to meet the requirements of the classification societies' Common Structural Rules.

Today the Rongsheng Group employs about 22,000 workers. The shipyard itself employs about 9,000 people, of which about 1,500 are technical staff – including 400 engineers – that develop all its drawings and designs in-house. The yard has recently made a name for itself with a series of 400,000-dwt ore carriers and, for the future, will focus on energy transportation by marketing a 157,000-dwt suezmax of its own design and by developing new products for the offshore oil and gas sector, says Chen.

China's plans to seek out and develop its offshore oil and gas fields were emphasized when Rongsheng made its initial public offering (IPO) on the Hong Kong stock exchange in November 2010. Rongsheng specified to investors that a quarter of the IPO proceeds would go towards building a fourth drydock and to begin new projects in shipbuilding and offshore engineering.

For Chen, the key to the evolution of Chinese shipbuilding is steady implementation and upgrading of international standards. "In 1988, when Jiangnan took on its first export ship orders, Chinese builders had just begun learning modern production methods from Japanese shipyards," he recalls. "The learning curve in the beginning was quite difficult; they could build, but they found that China's standards were far off the international standards. We delivered ro/ros and LPG carriers and the ships were alright, but the owners were not pleased at all with the conditions or cleanliness of the shipyard – the workers wouldn't put their tools away when finished and just left things lying around," he says. "Back then the shipyards had no order, no organization."

Jiangnan received a lot of help in implementing international standards when it won its first export tanker order in 1990, Chen recalls. The company made much progress in

that early project thanks, in part, to a very experienced owner's representative and a very experienced ABS surveyor, Hirotoishi Kinoshita – one of the classification society's China pioneers, whose name is still spoken with respect in the yards where he worked. When Jiangnan began building the first Chinese-made FPSO in 1992, management realized that its standards still needed development and, with the help of its foreign clients and classification societies, began improving them. Recalling that lesson, when Chen was assigned to lead the construction of SWS he invited ABS and another classification society to set up their own shipyard standards, so as to help the new yard develop the discipline of implementation. "I wanted to have high standards in place from the start," says Chen.

With standards developing, Chen also had to figure out how to get his staff to embrace their sometimes difficult concepts. The method he developed is to have trainees study the standards and then work through a simulated construction project. "Having people do construction in a simulated project, going from the design on paper to a physical structure in the yard, gives them a deeper understanding of standards and quality," he says.

For Chen, the significant mark in the second phase of China's shipbuilding evolution was the implementation of ISO 9000 and 14000 standards and OHSAS 18000 standards. "SWS became the first State-owned company to pass all three ISO certifications, and in so doing opened a new phase for Chinese shipbuilding," he says. "Many yards learned from the SWS example. This is why I say that SWS is the origin point of China's State-owned-sector marine industry."

For this reason, Chen guided Rongsheng to becoming China's first private-sector shipyard to win all three ISO certifications. Today, as a listed corporation marketing high-tech ships on the world stage, Rongsheng is the flagship of the new-generation Chinese shipyard and the third stage of Chinese shipbuilding evolution, he says. He hopes it will continue to be a model for the future, leading the industry into its fourth phase.

That fourth phase, he says, will be marked by advanced capitalization and further presence in global markets. This will be accompanied by consolidation of the smaller shipyards that become noncompetitive or cannot maintain the standards and quality levels the international maritime community expects.

"In order to grow and succeed, a company needs to constantly reexamine and improve itself," he says. "Management must not only set up standards and discipline, it must also encourage the people to innovate, to develop new standards and processes. That's why we require Rongsheng to reassess the shipyard standards every two years, to prevent us from getting stuck at one level of performance."

The process of self-improvement goes beyond technology development he says, pointing out that Rongsheng has put equal effort into developing a 'people-friendly' corporate culture in which the workers are encouraged to better themselves.

"Our slogan has four concepts," he says. "These are: passion – passion for your work; excel – exceed your current standards; innovate – jointly develop new concepts and processes; and share – when we profit, everyone shares the fruit."

Rongsheng stresses a 'people-friendly corporate culture' as critical to its success.





DSIC: Ready for the 'Offshore Century'



Li Cheng,
Vice President,
DSIC

The Dalian Shipbuilding Industry Corporation (DSIC) traces its roots to 1898, but one of the most interesting chapters in its history began in the year of 1990, when the operation split into two facilities, Dalian Shipyard and Dalian New Shipyard (DNS). The purpose was to accelerate capabilities development, with each yard making progress in the market with different types of vessels. When the two organizations merged back together in 2005 they formed the present DSIC Group, whose facilities occupy an area of 5.1 million m² and include ten drydocks, nine slipways, ten kilometers of pier and 59 massive workshops covering over 500,000 m².

DSIC today employs roughly 15,000 people and has an annual turnover of RMB 25 billion (almost \$4 billion). As a shipbuilder, the group is best known for a wide range of tankers, bulkers and containerships, ranging from 300,000-dwt VLCCs to 1,700-teu feeder vessels. Its diverse subsidiaries include: a research center; a nondestructive testing firm; a marine electrical engineering company; one of the China's three licensed marine diesel engine makers; and the country's first builder of drilling rigs for offshore oil and gas development.

The reunification of the two shipyards after seven years of evolution brought changes

to each facility and raised their collective competitiveness, says DSIC Vice President Li Cheng. "The old and new shipyards were well organized to merge, being that they were, originally, part of one shipyard," says Li. "Each brought something to teach the other. DNS focused on big vessels like VLCCs, so the 'Old Yard' learned about building these ship types. The Old Yard, meanwhile, had developed expertise in machinery and equipment installation. In coming together they raised each other's productivity. Twelve years ago, they could produce only about four to five vessels per year. This year the combined yard plans to deliver 38 vessels, for a total of about 5.8 million dwt."

While shipbuilding remains the major activity for DSIC, the company is taking particular care to nurture growth in the offshore oil and gas sector. The yard has long roots in the offshore sector, beginning as a jackup drilling rig builder in the late 1970s and progressing to rig upgrade and repair in the 1990s. In 1999, the facility built four Bingo 9000 semisubmersible hulls for Ocean Rig and two years later completed a 1.5-million barrel FPSO for a Chinese client. By 2003 the company had begun construction of high-specification jackups. Shortly after reunification, DSIC decided to spin off this expertise into a new subsidiary, the Dalian Shipbuilding Industry Offshore Co. Ltd. (DSIC Offshore).

"To meet the requirements and the growing desires of the offshore market, for new-generation, high-specification jackup rigs, we set up DSIC Offshore in 2006 and, so far, have delivered seven jackups from our new facility," says DSIC Offshore Vice President Guo Wei. "Jackups and semis are the main focus of this yard, although we are also prepared for other types of projects, such as drillships and wind installation vessels."

"This facility was designed to be a modern fabricator for all high-specification offshore projects, capable of delivering two semis and four jackups per year," says DSIC Offshore Chief Technology Engineer Wang Housheng. "We have a launching system developed specially for jackups and a drydock designed for semisubmersibles and drillships. We have built topsides modules for many FPSOs since 2000, and last year delivered a Friede & Goldman 9500 series semisubmersible to Noble Drilling."

DSIC Offshore operates a 40-person offshore engineering department and shares the 1,000-strong engineering staff belonging to DSIC. Using a combination of outside experts and in-house development, DSIC Offshore plans to build itself into a world-class rig designer, says Guo. "We are taking two parallel paths to further develop our design skills; one is through our own efforts, the other is through work with foreign companies," he says. "So far we have developed the DSJ-300, a new unit for water depths up to 300 ft, and are now working on a 400-ft unit."

The company's aspirations to build its name on the rig-building scene are putting it up against some big competition. "We are a world-class rig builder; the quality of our work has been favorably recognized by our clients and the classification societies" says Manfred (Guoqi) Qu, Senior Director of International Marketing for DSIC Offshore. "Our aim is to grow our presence in the jackup market and prolong our track record with semis and step into the market for drillships and other type offshore units. We have demonstrated to our clients that we can perform with a high level of quality and value – and with a good and reliable delivery schedule – like the yards in Singapore. We just need to open the eyes of the rest of the world to that."

"We are the most experienced rig builder in China and, as a company in the international market, we are competing against not only other yards in China, but also against the yards of the world. We cannot deny the fact that there is still a gap between us and the top builders in Singapore and Korea – but it's not that big a gap," says Guo. "We believe that, through our own efforts over time, we can close that gap. We are at the level where that competitive pressure is a motivation for us to grow and improve and proceed forward."

"Our goal is to continuously improve our shipyard, in productivity, in quality, in all aspects," he adds. "In that respect, having strong competition actually helps us reach our goals. The pressure is great, but we have broad enough shoulders to carry the weight," Guo says. "For us, the 21st Century is the 'Offshore Century.'"



Guo Wei,
Vice President,
DSIC Offshore



BW ZAMBESI, a 76,577 dwt double hull oil carrier, built at Dalian Shipbuilding Industry Co., Ltd.



Yantai CIMC Raffles: Big Dreams Build Big Realities

Back in 1998, Yantai Raffles Shipyard was a brand new place, building 30-meter tugboats. Owner Brian Chang was taking visitors around the yet-to-be finished facility, pointing out the different spots where, on some future day, he would build massive structures totally on the ground and use giant cranes to lift them into place, enabling the yard to produce huge constructions like semisubmersible drilling rigs with enormous savings in time and manpower. At the time he was also excavating for a massive drydock out of solid rock without having any obvious plans to mount a gantry crane over it. Altogether, his seemed like an impossible dream.

Today, the Yantai CIMC Raffles Shipyard – in 2010 the China International Marine Containers (CIMC) Group became majority shareholder in the company – operates three shipbuilding facilities and is indeed using the

world's most powerful crane to construct semisubmersibles. The yard mates the topsides and hull, after building them on dry land, as predicted 12 years ago. The yard calculates that it saves 20 percent of the man hours typically needed to build such a structure, making the additional bold assertion that it can deliver a semi two months faster than anyone else.

The giant Taisun gantry crane that was once a dream is now the centerpiece of the shipyard, a monument to vision and perseverance. The unique machine is actually two cranes in one, fully synchronized so that all the winches, the wires and the machinery of movement work together. Able to raise more than 20,000 tons, it is listed in the *Guinness Book of World Records* as performing the heaviest lift ever achieved by a crane – in fact, it also holds second and third place in that category.

There were many problems to solve to bring this vision to reality. It was more than a question of what kinds of hook, sling, pad eyes or shackles were needed to raise 20,000 tons. Nobody could even advise as to what kind of lift configuration would allow him to pick up a 20,000-ton module without adding another 3,000 tons of steel to reinforce it. Working with the crane experts at leading equipment manufacturer Huisman, Chang went through 30 different configurations before finding his solution.

The Taisun crane uses 384 lift points connected to two continuous beams that are welded directly to the structure being lifted. This spreads the load in a way that allows a 20,000-ton module to be lifted without adding even one kilogram of extra weight in reinforcement, Chang reports. To demonstrate that, he had the crane lift a barge by its deck, with 10,000 tons of ballast inside and no structural reinforcement. The 20,000-tonne lift was witnessed by ABS.

“It took us years to think through all the technical problems and, on the way to the final solution, we had to go through many interesting possible solutions” Chang recalls. “Even when we reached the conclusion, we weren’t 100-percent sure it was correct, simply because it had never been done before.”

Altogether, the Taisun crane took about seven years to think out and just over two years to design and build. The construction cost of \$50 million was entirely self-funded. Chang says that if they had tried to project fund it they would have failed, simply due to the noise of negativity.

“When we installed our big pedestal crane, people thought we were crazy,” he explains, referring to the 1,900-ton capacity turret crane whose main hook stands 95 meters above the quayside. “There was a lot of talk against it. If I had said I plan to build something ten times bigger, it would have been too much for people to absorb. The disbelief would have spread through the community and destroyed the project before it had started,” he says.

“Tell people you want to build a 20,000-ton crane and everybody will write you off as a nitwit,” he explains. “Say to your banker that you want to borrow money to build a 20,000-ton crane, or tell a crane company that you want to build one, or tell your engineer or



your production guys that you want them to prepare for one, and you won’t get attention from anybody – except maybe a big laugh.”

In fact, when he carved a hole 380 m long by 120 m wide into solid rock to make a drydock and didn’t also put up a gantry crane, his yard became something of a laughingstock. With many yards pursuing offshore work now building drydocks of similar proportions, the laughter has ceased. “People used to ask us, why have a drydock 120 m across? No ship is



that wide. Today they know. But we had to be willing to look stupid along the way,” he says.

“Now we have perfected the whole process,” he adds with satisfaction. “We can design and build a 20,000-ton module and use it as a building block. We have two other yards where we can build these modules and move them here on our own heavy lift ship for mating operations. That saves many man-hours, improves our efficiency and gives us a real economic advantage – and besides, it looks really good!”

If, today, Yantai CIMC Raffles takes on any job from yachts to ships to semisubmersibles,

what’s next? Chang isn’t talking much of the future, beyond saying that he is in discussions about putting up a shipyard in Vladivostok. No doubt, he has something else in mind that would sound absolutely mad but tomorrow will be staring us in the face and challenging everyone else to catch up. Whatever it is, it will surely exercise his in-house engineering staff, which numbers 750 and growing.

“As an offshore shipyard, we are still a ways behind the world leaders – but that is today; tomorrow, we shall see. It’s not the end of the day yet!”



Following a Dream

Brian Chang, Chairman of Singapore's Taisun Group and Deputy Chairman of Yantai CIMC Raffles Offshore Ltd., is known for dreaming big and doing big things. Recently he shared some thoughts with Surveyor about following dreams, in China or anywhere.

You don’t achieve success by long distance. If you want to accomplish anything in China, you have to move to China – it is probably the same for any country. If you want to succeed in a place, you have to show your face there, you have to show your commitment and you have to be willing to stay. You never know how long it will take to be successful. Look at the recent financial crisis and shipbuilding slump. Market depressions happen, and you have to have the staying power to get through. Above all, you need a passion for succeeding, the belief that nothing out there is going to make you fail.

When you’re doing something new, your target is never perfectly clear; your path getting there is never perfectly clear. So you need a flexible mind to be able to target your objective, which is gray at best, and then follow the path to it.

Your objective can change as you go forward – and sometimes it has to. Initially, for example, you could be targeting something that is totally impossible to achieve. When you find yourself failing, you have to be strong enough to look at what you’re doing realistically and to be able to adjust to reality, whatever it takes. Then you can set a target that is within your capabilities, within reality, and within your ability to believe it is feasible to achieve.

When you are doing something new, your initial target is gray. I did not start off saying I want to build a 20,000-ton crane. In fact, I started off wanting a 6,000-ton crane. People said that even that was too big a crane. Eventually, I saw that it was not impossible, but easy. In the end, when we tested the crane at 25,000 tons we found we could lift 30,000 tons if needed.

If you want to realize a big dream, you need to find the right people to help and support the work. Very often, you find support in young people, who aren’t burdened by preconceptions or negativity and who are ready to try to do something that hasn’t been done before. And, of course, you need the right technical assistance. My extremely good friends at Huisman have built over 500 cranes. They helped me think out the problems and see the way through to a solution.

‘Risking everything to follow a dream’ sounds romantic, but it is a very difficult path to follow. You need strength to confront the many problems of different size that you will encounter along your way. You need a creative mind to find the way through to your target. Most of all, you need the right partners.

LEADING CHINA'S MARCH OFFSHORE

New sources of energy are critical to China's future and CNOOC has a critical role in finding and developing them.

“Construction of a modern energy industry” is one of the top priorities listed for the 12th Five-Year Plan for China’s Economic and Social Development (2011-2015). Due to enter into force in 2011, the Plan also stresses energy conservation and improved quality of economic growth as essential to “laying a decisive foundation for building a moderately prosperous society,” according to statements released after the country’s leadership approved the draft text of the Plan at the fifth plenary session of the 17th Communist Party of China (CPC) Central Committee this past October. One critical component of this concept for the country’s continued development is increased energy production, from traditional and alternative sources, and one of the most important groups leading the nation’s march towards that goal is the China National Offshore Oil Corporation (CNOOC).

While renewable and alternative energy supplies also hold significant hopes for China’s future power portfolio, traditional hydrocarbons will remain the most important sources for a long time to come. Currently, most of the country’s electric power comes from plants driven by coal (74 percent) and oil (15 percent). While the presence of coal in the energy mix is expected to lower with time, that of oil is expected to increase.

Twenty years ago, China was a net oil exporter, but by 2009 its race towards the future had made it second in thirst only to the United States. That year, the country consumed

an estimated 8.3 million barrels of oil per day (bopd), over 50 percent of which was imported. By 2035 China could require 17 million bopd and need to import nearly 72 percent of it, according to estimates from the US Energy Information Administration. With an eye on such a petroleum-dependent future, the country has mounted an aggressive exploration and production effort to increase domestic oil and gas supplies.

梦想

DREAMS

勤奋

DILIGENCE

机遇

OPPORTUNITY

China has made considerable investment in developing new onshore oil and gas sources in interior provinces such as Xinjiang, Sichuan, Gansu and Inner Mongolia, but is now placing particular emphasis on unlocking the secret wealth of its offshore energy treasure chest. The government recently underscored the future importance of subsea oil when it announced that it would spend \$40 billion to boost offshore production under the next Five-Year Plan.

China’s two largest national oil companies – the China National Petroleum Corporation (CNPC, parent of PetroChina) and the China Petrochemical Corporation (CPC, parent of Sinopec) – are gearing up to produce oil from under the sea, but for the foreseeable future most of the country’s offshore energy plans rest on the shoulders of CNOOC.

引进

IMPORT

消化

LEARN

集成

CONSOLIDATE

创新

INNOVATE



Zeng Hengyi,
Deputy Chief Engineer,
CNOOC

Established in 1982, CNOOC evolved from a purely 'upstream' firm (involved in oil and gas exploration, development, production and sales) into today's integrated energy corporation. Its portfolio of activities includes: upstream; mid- and downstream (gas, power, chemicals and refinery operations); technical services (offshore engineering and construction, logistics and oilfield services); financial services; and development of alternative energy sources. In 2009, CNOOC posted revenues of RMB 209.6 billion (\$31 billion), a total profit of RMB 52.4 billion (\$7.8 billion) and total assets of RMB 518.3 billion. Oil and gas production for the year reached 47.66 million tons of oil equivalent and

the company produced 32 million tons of refinery and chemical products. The largest offshore oil and gas producer in China and third-largest national oil company, CNOOC currently has over 65,000 employees worldwide and a registered capital of RMB 94.9 billion (about \$14 billion).

DEEP ROOTS

CNOOC is a relatively young company, but has deep roots and a long history of technology development and problem solving in the pursuit of increasing the country's oil and gas wealth.

China made its first steps offshore in the early 1960s, exploring the shallow waters of Bei Bu Gulf by the South China Sea. Their first exploratory wells were made using impact hammers installed on a barge. The pioneers soon switched to a small barge with a land drilling derrick on board to drill a well of only 26-m depth. With this primitive equipment they drilled China's first offshore well in a water depth of 15 meters, reaching a well depth of 388 meters, obtaining 10 kg of crude oil. The results they obtained were small but significant, and set China on the long adventure of offshore energy.

By 1966, exploration activities in Bohai Bay indicated a promising future and the country switched its offshore focus there, erecting the first fixed jacket rig in the region. As its offshore engineering teams built their geophysical skills they moved from dynamite to compressed air guns to generate the acoustic waves for their seismic tests, soon uncovering more riches in Bohai

Bay. China built four fixed platforms there, drilling 14 wells and discovering three oil-bearing structures. Its young offshore engineers accumulated much experience in those early years, through both triumph and trial – as when Bohai Bay iced up heavily in 1969 and caused the original jacket to collapse.

In 1974, China imported its first jackup rig *Bohai-2*, a Japanese-built unit originally named *Fuji*. In 1979, the rig capsized during towing operations in Bohai Bay. Of the 74 crew only two survived the incident, causing a Minister in the Ministry of Petroleum to resign and the head of the Offshore Oil Investigation Command to be jailed.

"Investigation revealed that the main cause of the tragedy was not following standard procedures during operations" says Zeng Hengyi, who as a young engineer headed the accident technology investigation team that examined the *Bohai-2* tragedy. Today one of CNOOC's elder statesmen and among China's most highly respected offshore experts, Zeng joined the Offshore Oil Investigation Command in 1972 and, over the years, has led many research and development groups whose collective efforts have helped fuel China's progress in its pursuit of offshore energy.

"We learned several important lessons from that accident, the most important being that all workers must follow 100 percent the procedures in the operations manual and that the organization must monitor this," Zeng recalls. "Our analysis also revealed that there were some design flaws in the *Bohai-2* rig. Coincidentally, work was just then beginning on the first Chinese-designed jackup, and we were able to apply our discoveries to the design of that rig."

OPEN DOOR OPENS ON OPPORTUNITY

China's offshore energy development got its first big boost following implementation of its Open Door Policy, which, in 1979, initiated contact with US and foreign companies. Growing international interest in the country's oil producing potential inspired the China State Council to issue its "Regulation of the People's Republic of China on the Exploitation of Offshore Petroleum Resources in Cooperation with Foreign Enterprises" on 30 January 1982, creating CNOOC as the authorized agency that would assume overall responsibility for developing offshore oil and gas resources with foreign partners.

“When the Open Door Policy began, the offshore business was put out in front as an industrial pioneer. In general, the Open Door Policy gave excellent opportunities for all Chinese industry; for us, our scope of work grew wider through communication and cooperation with foreign offshore companies,” says Zeng. Energized by interaction with foreign experts, China began an offshore technology boom that sometimes slowed but never stopped. Working beside foreign experts, CNOOC learned many new skills that, in some cases, developed into world-class capabilities.

One of the first benefits of that international cooperation came in 1982, through an in-house-designed project by CNOOC to construct a small FPSO unit, the ABS-classed *Bo Hai You Yi Hao* (*Bohai Friendship*). It began with optimization of preliminary designs by a foreign company but led CNOOC to a path of independent research and development. The 50,000-dwt FPSO was installed in Bohai’s BZ-28 oilfield just five years after the first FPSO. The *Bo Hai You Yi Hao* was not only the first FPSO in Chinese waters, but also was among the world’s first ten FPSOs in service.

The FPSO soon became China’s favorite production solution offshore. Today, 70 percent of China’s offshore oil comes through FPSO-based developments and CNOOC’s fleet of 17 FPSOs is the largest of any energy company in the world. “China now possesses some of the most advanced FPSO technology in the world,” says Zeng. A Chinese project

was first to use an FPSO in what he refers to as a ‘serious ice area’ and, he adds, “first proposed the idea of a ‘shallow-water-effect, large floating structure,’ which enabled a large FPSO to operate in the shallowest waters yet achieved. Even under the severe environmental conditions of 100-year return period for furious wind and wave, it won’t hit the seabed,” he says. “All these are contributions that China has made to the world of FPSO technology.

“Cooperation became the spirit and the practice of the Chinese offshore industry, and we made tremendous advances and improvements working with foreign experts,” says Zeng. “In the early 1980s we completed the design of the first ice-resistant jacket platform, under the guidance of foreign companies, and later we developed ‘ice-resisting cones,’ which are slope-sided structures attached to the legs of a fixed jacket to prevent ice sheets closing in around the platform. By the 1990s, CNOOC had become a world leader in ice-resistant platforms and ice-resisting technology.”

The company has also made its mark in the pipeline technology field. CNOOC designed its first underwater pipeline in the 1980s under the guidance of an American company. Today, China has an underwater pipeline system totaling about 4,500 km (over 2,800 miles) in length. CNOOC has gone from student to expert in that area as well, earning recognition through success in some very tough applications. One of the most intriguing examples of CNOOC

ABS-classed BO HAI YOU YI HAO (BOHAI FRIENDSHIP), China’s first FPSO and one of the first ten FPSOs in the world.





'Ice-resisting cones' attached to the legs of a fixed jacket to prevent ice sheets closing around a platform.

problem-solving was getting a subsea pipeline to traverse an 'underwater desert' and preventing the seabed from being flushed and tunneled by strong sea bottom currents.

A very rare patch of subsea geography, an underwater desert is an area of shifting sand dunes that move under the influence of ocean currents the way sand dunes on land move due to winds – this can have a very dangerous impact on a pipeline. The impact of strong sea bottom currents were jeopardizing a new 134 km-long underwater pipeline installed at a water depth of 200 m. During routine inspection by remotely-operated vehicle, more than 1,500 places were discovered to have been flushed and tunneled, with the depth of the spaces varying from 20 mm to 5 meters, and the lengths of the abscesses varying from hundreds of mm to more than 10 m. "We have effectively mitigated these potential risks, which are very rare in the world," says Zeng.

Meanwhile, Bohai Bay has proven to be both a rich oil resource and a technology incubator. It is the country's leading source of offshore oil, producing 30 million metric tons of oil annually. About 70 percent of that oil is rated API 11, making it some of the thickest regularly produced heavy oil in the world. But CNOOC determined it just couldn't leave the resource there, says Zeng. "Because we have so much of this very thick oil, we decided that

we simply had to develop it. It was a difficult problem. Onshore oil fields have successful experiences in this but it can't be adopted in offshore because the cost would be too high," he explains. "Ultimately, we developed a solution based on a seawater injection system, which is a significant breakthrough."

TOWARDS A BRIGHT FUTURE FUELED BY NEW ENERGY

Offshore fields presently deliver 15 percent of China's domestic oil supply and, with so much space yet to explore in Bohai Bay, the South China Sea, the Pearl River Delta and the East China Sea, are expected to become increasingly important to the country as time and technology development march on.

There are, says Zeng, four principal areas in the future of offshore China. The first is deepsea oil and gas development. Even though China has relied heavily on FPSOs until now, it is likely to pursue subsea solutions for its deepwater developments, particularly in the part of South China Sea known as Typhoon Alley. CNOOC has paid close attention to the last five years of Gulf of Mexico hurricanes, taking careful notes as to the vulnerabilities they revealed in fixed and floating structures.

The second area of future focus is developing technology to make use of combustible ice (or

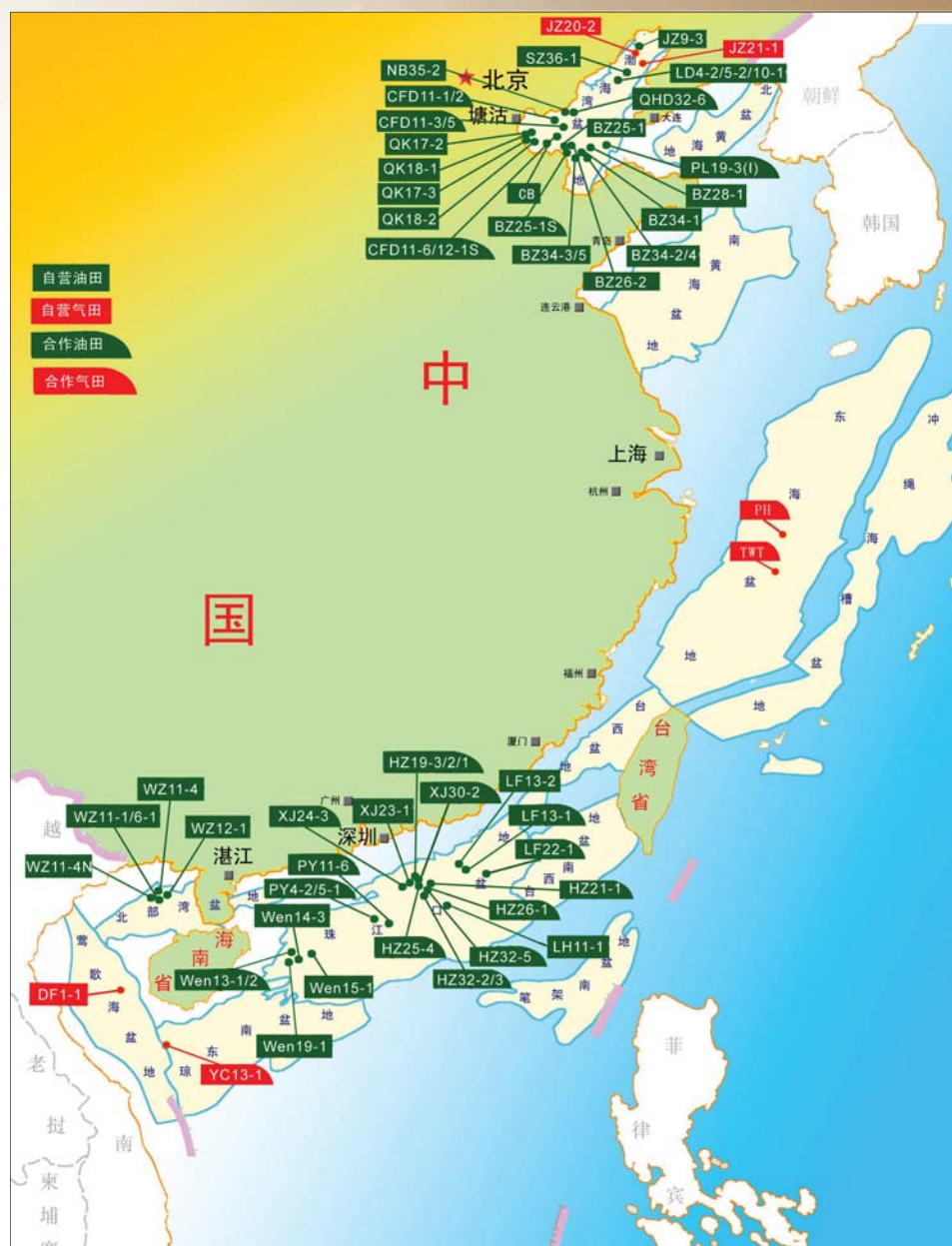
methane ice), which exists in great quantities beneath the South China Sea under low-temperature, high-pressure conditions. CNOOC is in the experimental stages with this resource, and Zeng says offshore energy production from methane ice could be possible to achieve in the near future.

The third area of focus for CNOOC is LNG. China plans to import quite a lot of LNG for clean energy in the coming years, but first needs to solve problems related to receiving and regasification facilities, says Zeng. Current CNOOC research is focusing on the possibility of using the energy produced during regasification in some kind of cogeneration power plant.

The fourth sector under development is ocean energy – a field of great potential for China, which has approximately 3 million km² of ocean area. In the coming five years, CNOOC will be developing ocean energy – including wave energy, current energy, tidal energy, temperature difference energy and salinity gradient energy among other technologies – and establish an ocean energy research and development base on an island near Qingdao.

“In developing ocean energy technology, you have to consider four aspects to make it a realistic possibility,” says Zeng. “First, it must be reliable; second, the electric power generation must be efficient and effective; third, your structures must be anti-corrosion and anti-fouling; and fourth, it must come at lower costs. In you want to use ocean energy you have to solve these four problems.”

Chinese authorities have expressed a goal of generating at least 15 percent of the country’s energy needs from alternative sources by 2020. Currently, renewables and alternatives deliver 12 percent of China’s energy mix: hydroelectric (7 percent), natural gas (4 percent), nuclear (1 percent), and other renewables (0.2 percent). Under its previous Five-Year Plan, China became a world leader in renewable energy investment, having designated around \$120 billion to developing new fuel sources between 2007 and 2010, and is expected to direct even more towards this goal under the next Plan. Whatever problems are encountered, developing its energy future can be conquered using the same philosophy with which CNOOC has approached all its challenges, says Zeng.



Current map of offshore fields in China.

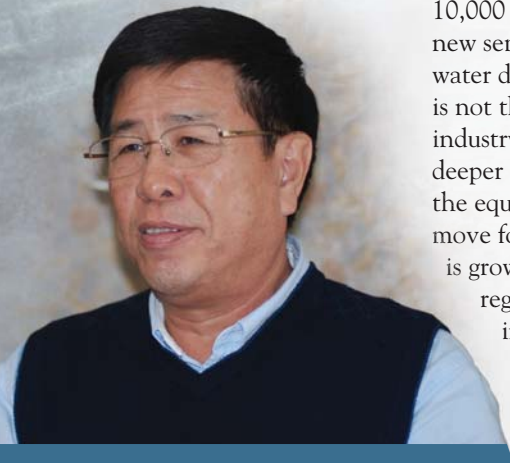
“All the difficulties that we have passed through have built our knowledge base, built our capabilities and built our confidence,” he says. “The way of success is simply stated: first, you bring in knowledge from outside – you have to learn from people with more experience; then, you digest what you have learned and consolidate it; finally, you take all this and employ your creative mind – you innovate and create on your own. That has been the way of success for the Chinese offshore industry.”

For him, the approach that has guided CNOOC’s development reflects a general philosophy about life and achievement.

“I believe that there are three major parameters in our lives: dreams, diligence and opportunity,” says Zeng. “Diligence can make your dreams come true because, through diligence, you can find your opportunities. It is important to have dreams, to have vision, but the core of it all is diligence.”

COSL's Decade

China's top offshore driller builds a future based on reliability.



Liu Bao Yuan,
Drilling Equipment
Director,
COSL

Drilling capability is not about how deep you can drill, but how deep you can drill with good safety and reliability,” says Liu Bao Yuan, Drilling Equipment Director for China Oilfield Services Limited (COSL). “We work comfortably in water depths of up to 500 meters and we can drill wells to 10,000 ft without a problem – and with our new semisubmersible we will have working water depths of up to 3,000 m. Technology is not the big challenge facing the offshore industry,” he says. “As the industry moves into deeper and more difficult waters it develops the equipment it needs; however, as we move forward, health and safety awareness is growing and regulations, particularly regarding the environment, are becoming increasingly strict,” he explains. “This means that the big challenge facing offshore companies today is to set and maintain high standards of reliability.”

For COSL, 2011 marks ten years as China's representative driller on the international scene. Although it is a young organization, it is by no means a young company, with origins

that date back to 1964 and the drilling of China's first offshore well. In those days, all oil and gas development was performed by specialist industrial units working under the Ministry of Petroleum Industry. By the time cooperation with Western companies began in the early 1980s, China's offshore industrial units had drilled 110 wells in Bohai Bay, Beibu Gulf in the South China Sea and the areas near Hainan Island, obtaining hydrocarbon flows from 30 of them and developing three small oil and gas fields.

With the creation of the China National Offshore Oil Corporation (CNOOC) in 1982, offshore drilling, support and technology services continued to be provided by the same industrial units, but as individual companies under the CNOOC umbrella. From that time forward, Chinese drilling, well and geophysical services were provided primarily through five wholly owned CNOOC subsidiaries: China Offshore Oil Southern Drilling Company, China Offshore Oil Northern Drilling Company, China Offshore Geophysical Company Ltd., China Offshore Logging Company Ltd. and CNOOC Petrotech

NAN HAI 5





Services Company. As China's industrial development began shifting the country from oil exporter to importer, new attention focused on offshore energy and, in December 2001 CNOOC brought these five companies together to form a single offshore services group, COSL. Soon after, it added marine support capability to the new group by bringing in two offshore vessel operators, the China Offshore Oil Southern Shipping Company and China Offshore Oil Northern Shipping Company.

Today, COSL is China's leading offshore services company, operating a fleet including 27 drilling rigs (23 jackups and four semisubmersibles), two accommodation units and six land drilling rigs. The company also owns and operates a fleet of over 90 service vessels – including three oil tankers, five chemical carriers, eight seismic vessels, four surveying vessels and more than 50 anchor-handling workboats – and provides logging, cementing, seismic interpretation, underwater engineering and well workover services.

"It will be many years before alternative sources are fully developed; petroleum will remain an important pillar of economic development in every country for a long time, and offshore energy will be an increasingly important part of world petroleum supply," says COSL Vice President Cao Shujie. "Drilling equipment, energy facilities and support services will evolve to accompany the world's petroleum needs, and it is up to the offshore companies to make sure that progress is made

safely. For example, the waters near Canton and Fujian Provinces have the strongest typhoons in the country," he explains. "As we have seen in the Gulf of Mexico, severe storms are challenges to the entire offshore industry. CNOOC and COSL fully understand this and we devote great energies towards improving operational safety and reliability."

The heart of reliable operation, says Liu Bao Yuan, is in a company's safety culture. Once COSL was established and its component groups began pooling their knowledge and experience, the company's lost-time injury rate began to decline immediately, he says, adding that it has decreased every year since due to the company's focus on its people.

"As our President has told us, in China today, whatever you do should be done according to a 'scientific outlook' – you have to develop an objective understanding of the causes of things so that you can develop solutions to your problems on the basis of science and technology," Liu explains. "Objective analysis of the offshore sector tells us that, even if you have the best hardware in the world and comply fully with all technical regulations, if you ignore the human factor you are lost," he says, adding that, in these increasingly complex times employee outreach is not a luxury, but a necessity.

"If the workers think management doesn't care about them, then they will not respect the established procedures or really believe what management says, and you won't have good



Cao Shujie,
Vice President,
COSL



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operational safety. Thus, when formulating safety and operational procedures, the human factor must be taken into account. It is most important to develop a system that can be understood and followed by the inexperienced as well as the experienced workers and, once developed, those systems need to be supported by continuous programs of training and education.”

Education and training is the core of industrial safety, he says, pointing out that it is not enough to just know the requirements and regulations. “If you give me an instruction and I follow it blindly, I really do not know what I have just done or why I have done it – and thus I cannot apply the principle elsewhere. In order to get the full benefit of a rule, you must apply it with intelligence. To do that, you have to digest the rule and its meaning so that it can be applied with true understanding.”

Liu started his career as a driller in 1970. The progress the industry has made since then makes those days seem like ancient history. “In the old days, the technology used and the general state of industrial safety was

primitive compared to what we now have. Conditions offshore were harsh, the work was very hard and dangerous and just about everything was accomplished through the power of human strength,” he says. “Modern rigs are automated and the driller sits in an air conditioned drilling cabin, watching the equipment work under computer control. As time goes on, working conditions will become even more comfortable and safe,” he adds, noting that the great technology advances they now enjoy have brought with them their own unique challenges.

“One good thing about the tough old days was that they trained you up to survive and taught you how to handle any emergency,” says Liu. “The drawback of modern technology for the younger generation is that the job no longer automatically teaches them how to endure hardships and deal with the unexpected. It is easy to become too comfortable with the technology, to believe that, because it’s all automatic, the machines will take care of everything. This is not so; no automatic equipment is 100 percent foolproof. Anyone who works on board a rig will tell you that even the most advanced equipment can fail and cause an incident. So we have developed special programs for the new generation, to train their minds for emergency problem-solving and survival.”

What hasn’t changed in the four decades since Liu started out is the importance of establishing good procedures and making sure they are followed – in a word, implementation. COSL has a group of first-generation rigs built in the 1970s and a growing group of fifth-generation rigs built within the last few years. The company rotates workers through both fleets, helping them acquire not only an appreciation for the modern systems, but also the discipline and awareness needed to follow the company’s management and safety systems and make everything run smoothly.

“It is possible to handle your problems and operate safely without extensive procedures, as was done in the past, but that is accomplished by individuals applying their experience,” Liu says. “Today’s environment is much more complex and it is best to have objective, scientific systems that anyone can understand and follow. Once you have such a system, it’s all about implementation – and if you don’t forget the human side of your business, implementation will be no problem.”

Guiding Offshore Safety for 25 Years

For China's offshore operations safety authority, health and safety are social responsibilities.

Many foreign enterprises entered through China's Open Door in the early 1980s, including a number of energy companies seeking to find and develop new sources of oil and gas. These searchers soon began looking seawards, and in 1985 the Ministry of Energy created the China Offshore Oil Operations Safety Office (COOOSO) to develop and promulgate rules for the safe exploration and development of China's offshore oil and gas resources – one of a family of safety authorities regulating the developers, vendors, manufacturers and other links in China's energy chain. For 25 years, COOOSO has established rules, regulations and safety codes, reviewing project designs to ensure conformity with safety standards, monitoring structural fabrication and issuing safety permits for offshore structures, installations and operators.

Until fairly recently, all offshore energy work in China was done through the China National Offshore Oil Corporation (CNOOC), which was founded for that purpose in 1982. When the Ministry of Energy was dissolved in 1992, COOOSO focused its attention on CNOOC and continued independently. The State Administration of Work Safety (SAWS) was founded in 2005 and the Safety Office was brought under that organization's umbrella authority. China's offshore scene was heating up at that time as the country's two largest national oil companies, the China National Petroleum Corporation (CNPC) and the China Petrochemical Corporation (CPC), began formulating plans to develop their own offshore oil and gas reserves. In response, SAWS determined that national interests would be best served if CNPC, CPC and CNOOC each were attended by a separate division of COOOSO.

"Production efficiency is foremost in the mind of a field developer, but, on the other hand, safety cannot be ignored," says Song Lisong, Director of the COOOSO division headquartered at CNOOC. "This is particularly true as China begins looking at deep-sea oil and gas projects." Song joined

the Safety Office in 1988 and has been its Director since 2003. Today he is both COOOSO Director and General Manager of the Quality, Health, Safety and Environment (QHSE) department for CNOOC and, as such, when conflicts between regulator and industry arise he is well-positioned to help resolve them.

"We can minimize conflicts and misunderstandings regarding regulations because we understand the culture and interests of CNOOC as well as those of the government," says Song. "This enables us to act as a bridge between the two



Song Lisong,
Director,
COOOSO



Surveyor Jun-xi
(Kevin) Cai inspects
a jackup leg under
construction at
Yantai CIMC Raffles.



PIPER ALPHA
disaster in 1988.

and makes it easier to communicate and implement safety regulations.”

COOOSO developed its initial rules through cooperation with UK, US and Norwegian authorities and the international oil and gas industry. “In the beginning, we didn’t have any special regulations for offshore activities, so developing them was a big challenge,” says Song. “After the *Piper Alpha* disaster in 1988, we visited the UK to discuss offshore safety and other issues. We learned a lot from the Lord Cullen report,” he says. “We translated it into Chinese to spread the word. Today we have more than 40 volumes of best practices and standards for safety management and have made many comparative studies of safety management among the world’s leading offshore regimes.”

The Safety Office keeps in close contact with the international offshore industry and, through conferences and meetings with offshore industry organizations, stays abreast of new concepts and best practices in the search for insights on improving safety. That effort has brought China’s offshore sector some beneficial results, as when, soon after becoming Safety Office Director, Song introduced explicit risk management techniques into drilling rig safety requirements.

In one form or another, mitigating risk has been an essential task for COOOSO since its earliest days. The first major act by the Safety

Office came in 1989, when it established the system by which it would recognize and authorize certifying survey agencies (CAs) to perform inspection and certification of offshore oil and gas facilities, a function much like what certified verification agents (CVAs) do for energy projects in US waters. In 1992, COOOSO issued China’s first set of offshore safety regulations, Safety Rules for Fixed Offshore Platforms, which were developed with assistance from ABS, among others. Its most recent act was to formally release China’s Safety Rules for FPSOs in 2010. Rules for floating drilling and production platforms will come at a later time.

A member of the UN Global Compact initiative, which encourages businesses to adopt sustainable and socially responsible policies and to report on their

implementation, COOOSO also keeps an eye on the larger impact of offshore developments. Offshore operational safety, says Song, is as much a matter of social responsibility as of workplace safety.

“A big offshore project can change the life of a region, bringing jobs, education and a lot of opportunity to the people. But we have to consider the effects that operation has on the environment and the area around it, so that we leave the area safe and healthy for the local people,” he says.

Today COOOSO has four regional branches along the coast: Tianjin (the port of Beijing on Bohai Bay), Shanghai, Shenzhen (near Hong Kong) and Zhanjiang (near Hainan Island in the south). The Safety Office has also established seven oil spill response stations along the coast and expects to build another seven as the locations of future offshore developments become known. In the meantime, COOOSO has been training its responders. In October 2010, it ran a simulation of a blowout offshore Shenzhen, which is where the country’s first deepwater development is expected to take place.

While the drilling rigs themselves are in another equipment category and, thus, governed by another agency, the Offshore Operations Safety Office is looking into developing stricter requirements for drilling

contractors and their rigs, keeping in mind the Macondo blowout and oil spill in the Gulf of Mexico.

“This office grants the safety permits for offshore drilling systems, and we are always looking for better ways to be sure everything is safe,” says Song. “At the moment, we are studying the Macondo incident, working on issues related to carrying out rig inspections and reviewing third-party inspection and certifications of deepwater operations. Considering the incidents of recent years, we have been thinking about mandating more detailed inspections of the rigs working offshore China, and about requiring a Certified Drilling System (CDS) certificate from the drillers.

“Many drilling contractors come to China and we need to know that they, and their equipment, are following all regulations,” he explains. “If a rig has limitations according to weather conditions, water depths, technology and so on, we need to know. Because the CDS certificate demonstrates that a rig passed a third-party safety examination of its drilling system, it could be a basis on which to grant a drilling permit.”

Whether those third parties will have to be recognized CAs is yet to be determined, he says. Another item on COOOSO’s long to-do list is to develop a set of regulations for offshore service vessels in Chinese deepwater energy projects.

For COOOSO, deepwater drilling and production systems occupy the most important place of future regulatory focus. “Deepwater represents a big challenge for us. Around the world, more than 14,000 deepwater drilling projects have safely been completed. But the fact that an incident like this could happen in America, taught us that, when a problem like a blowout occurs, even people extremely experienced in deepwater drilling may be unprepared.”

Adding the Macondo incident to the damage done during Hurricanes Rita, Katrina and Ivan, which destroyed

dozens of fixed platforms and caused floating drilling rigs to break moorings and drift away, Song finds a lesson about human nature, technology and safety.

“In deepwater development around the world there has been tremendous focus on technology and great effort spent on figuring out how to drill in deepwater and how to recover the oil efficiently – but not on how to handle disasters,” he says. “We must never forget that safety does not stand outside of technological development, but must be considered part of it and must progress along with it.”



FOLLOWING THE SCIENTIFIC PATH OF DEVELOPMENT:

ABS Establishes its Greater China Division



Adam Moilanen,
President & COO,
ABS Greater
China Division

ABS' connection with China began more than 60 years ago in a small postwar office in the Neo-Renaissance-style Union Building overlooking The Bund, the wharf-lined mile of architectural patrimony on the Huangpu River in central Shanghai that was once a hub of Asian maritime trade. ABS reestablished itself in China in 1982 by returning to Shanghai, stationing its people in room 1006-1 of the Hengshan Hotel until returning to The Bund four years later. The classification society's principal surveyors operated from rooms 707 and 708 of the landmark Peace Hotel until 1991, when, with Chinese

yards stepping up their efforts in export shipbuilding, the small but growing ABS staff was welcomed into the premises of the Shanghai-based Marine Design and Research Institute of China (MARIC).

China officially opened the door for foreign classification societies to have Representative Offices in the country when the Ministry of Communications issued the "Administrative Procedures for Establishing a Representative Office in China by Foreign Ship Survey Organization," which took effect on 15 April 1992. Accordingly, ABS received the Registration Certificate that made ABS Shanghai a Recognized Organization on 13 May 1993. As ABS' relationship with the developing Chinese maritime industry grew and deepened, the classification society increased its support of Chinese shipbuilding activity and it too began to grow. In 1994, ABS began a long expansion in both size and presence as it moved through a series of increasingly larger offices until locating its headquarters in the Silver Tower of Shanghai's Luwan District in 2008, a little over a mile from its original home in the city.

In October 2010, ABS announced an evolutionary leap in its relationship with China: the formation of its Greater China Operating Division, with over 500 employees operating from more than 30 offices across the country and in Hong Kong and Taiwan.

Greater China will be responsible for the society's activities in the People's Republic of China, the Hong Kong Special Administrative Region and Taiwan. Carved out of the existing ABS Pacific Division, Greater China will operate in coordination with the Pacific, Europe and Americas Divisions of the society and with the Nautical Systems fleet management software division. The new division will continue operating out of its present headquarters in Shanghai, where ABS maintains a large engineering, survey and administrative office. The existing China, Hong Kong and Taiwan senior management teams remain in place and will form the nucleus of the new divisional executive team.

China's rapid diversification into the gas and offshore sectors helped spur the decision to establish the new operating division. "The level of offshore and energy related activity in China, both in relation to China's own needs and also in terms of major new construction projects for a wide range of offshore exploration and production units, is growing at a very rapid pace," says Adam Moilanen, President and COO of ABS Greater China Division. He points to the massive Liwan 3-1 gas field development in the South China Sea as an example of such projects. ABS and the China Classification Society (CCS) are cooperating on the classification and certification services for the project, which is China's largest offshore natural gas discovery yet and will be its first deepwater development project.

"We have been spending a lot of time and effort working with all sectors of the energy community in China and in the shipyards assisting them with this very ambitious and rapid level of expansion," says Moilanen. "We see the need for this close cooperation increasing and we will be establishing a very active department within the new division to provide the support and service that will be needed."

One longstanding pillar of that support has been the collaborative association between ABS and CCS. This relationship began in 1982 (when CCS was known as ZC) with the "Protocol to Agreement between

ABS and ZC on Cooperation in Ship's Technical Survey," which was superseded by a formal Cooperation Agreement in 1993. In November 2010, ABS and CCS strengthened these ties by forging a new Cooperation Agreement, which, while comprehensive, makes the offshore industry a priority area of focus for the two societies. CCS and ABS will also expand their collaboration in other areas, such as software development for large and technologically-advanced ships. The societies will continue to host training and industry seminars in areas of mutual interest including deepwater activities.

"China is growing and will continue to grow, and we will continue assisting their efforts to establish a quality shipbuilding industry," says Richard Pride, Vice President of Operations for the ABS Greater China Division. "There are yards that have quality systems in place and are well on their way to that goal, but many others need help. On the front line of this relationship is the surveyor, and one key to the surveyor's effectiveness is the ability to communicate. Many issues, whether with newbuildings or surveys after construction, can be resolved through good communications – and good cooperation – between the surveyor, the shipyard and the shipowner," says Pride, who joined ABS as a surveyor in 1992. Over the years he has worked in the US, Europe and Asia, with the bulk of that time spent in China.

"Wherever you are in the world, it takes effort to communicate the reasoning behind classification Rules and to demonstrate how and why they are as they are," Pride says. "At the heart of the relationship between ABS and the maritime industry is our understanding of the operations, technical and commercial sides of the business; maintaining the rapport we have with the shipyards and the owners, we can help resolve problems as they come up during projects."

The surveyor's unique combination of technical and interpersonal skills are of central importance to efficient, quality vessel construction, says Li Feiyu, Manager of Offshore Technology and Business Development for ABS Greater China Division. An engineer by training – he received a degree in naval architecture from China's Huazhong University of Science and Technology, and a master's degree in



Richard Pride,
Vice President
of Operations,
ABS Greater
China Division

Sin Lim Chiu,
Deputy General
Manager,
ABS Greater
China Division

mechanical engineering from the National University of Singapore – he joined ABS as a surveyor in 1996.

"China is hungry for offshore knowledge and, as the best offshore classification society in the world, many clients look to us for expert assistance as they try to develop offshore engineering capabilities," Li says. "Having been a surveyor helps me tremendously in transmitting basic offshore knowhow, helping yards execute their assignments and, of course, in resolving class-related issues as those projects proceed. Surveying is a challenging job; you need to know many things to do it well – structures, electrical systems and machinery operation as well as all the Rules and regulations – and you need to be able to communicate that knowledge.

"As a surveyor, you face clients every day; you meet many kinds of people in many kinds of situations and you pass along both good news and bad news to them. When things go wrong is when you really have to apply the art of explanation – that's when your ability to communicate becomes extremely important to a project," Li explains. "You pass on your experience and your understanding to your clients, you explain why a Rule exists and why it must be followed, and then you help them see how it can be applied."



Li Feiyu,
Manager of Offshore
Technology & Business
Development,
ABS Greater
China Division

See China in the Light of Her Development

Excerpts from a speech by Chinese Premier Wen Jiabao to Cambridge University in 2009, in which the leader shared some thoughts that relate to subjects addressed in this issue and illuminate a vision for the country's future.



The key element of China's reform and opening-up is to free people's minds and the most fundamental and significant component is institutional innovation. Through economic restructuring, we have built a socialist market economy, where the market plays a primary role in allocating resources under government macro-regulation.

A quote from a Tang Dynasty poem describes what is happening in China: "From shore to shore it is wide at high tide, and before fair wind a sail is lifting." The Chinese people are working hard to modernize their country. This is a great experiment in a large developing country both ancient and new. The Chinese people, with destiny in their own hands, are full of confidence in their future.

Over the millennia, the Chinese nation has weathered numerous disasters, both natural and manmade, surmounted all kinds of difficulties and challenges, and made her way to where she proudly stands today. The experience of the Chinese nation attests to a truth: what a nation loses in times of disaster will be made up for by her progress.

With hard work over the past half century and more, China has achieved great progress. Its total economic output is now one of the largest in the world. However, we remain a developing country and we are keenly aware of the big gap that we have with the developed countries. There has been no fundamental change in our basic national condition: a big population, weak economic foundation and uneven development.

To basically achieve modernization by the middle of this century, we must accomplish three major tasks: first, achieve industrialization while keeping abreast of the latest trends of the scientific and technological revolution; second, promote economic growth while ensuring social equity and justice; and third, pursue sustainable development at home while accepting our share of international responsibilities. The journey ahead will be long and

arduous, but no amount of difficulty will stop the Chinese people from marching forward. Through persistent efforts, we will reach our goal.

Today, 300 million Chinese are learning English and over one million of our young people are studying abroad. The cultures and arts of various parts of the world are featured daily on China's television, radio and print media. Had we not learned from others through exchanges and enriched ourselves by drawing on others' experiences, we would not enjoy today's prosperity and progress.

For many years in the past, China practiced a highly centralized planned economy and regarded planning as being absolute. This hampered the development of productivity. The financial crisis made it clear to us, however, that the market is not a cure-all, either. A totally laissez-faire approach will inevitably lead to economic disorder and unfair social distribution, and will eventually take its toll. A credible market-oriented reform should never set the market against government macro-regulation. The invisible hand of the market and the visible hand of government and social supervision should both act, and act vigorously. Only in this way can resources be distributed according to market rules and distributed in a reasonable, coordinated, fair and sustainable manner.

The international financial crisis showed how dangerous a market economy without regulation can be. Since the 1990s, some profit-driven financial institutions in economies lacking effective regulation raised massive capital with a leverage of dozens of times. While they reaped huge profits, the world was exposed to enormous risks. To effectively meet the crisis, we must fully recognize the role of morality. Nothing is greater than morality. It shines even more brightly than the sun.

We should call on all enterprises to take up their social responsibilities. Within the body of every businessman should flow the blood of morality.

“If truth is on your side I will bow to you,
no matter your status.

If truth is on my side, although thousands
stand against me I will march on.”

— Mencius



