Subsea oil and gas production relies on some very large components. Riser bases, for example, are steel structures that can range in size to the dimensions of a small house and weights of several hundred tons. The photo above shows a riser base with a 24-inch lower vertical spool and riser connection system undergoing tests of its 20-tonne-capacity winches, which will pull down a rigid riser and connect it to the base.

Designed and built by EAB Engineering of Norway, the unit was supplied to Shell’s Draugen oil field offshore Norway under an engineering, procurement and construction (EPC) project run by FMC Technologies. The large, curved pipes seen on either side of the workers run from a T-joint below the riser connection to connectors that tie-in the two export lines feeding the riser. This pipe allows for round-trip 'pigging' operations (the use of in-line cleaning and maintenance tools, or 'pigs') in which the pigs are launched and received at the platform.

The photo was shot at a test facility belonging to One Subsea Processing Systems (formerly Framo Engineering) in Bergen, Norway.
COVER:
Teamwork makes it happen. The degree of success in projects small and large often depends on how well the people involved can work together to accomplish their part of the job. In one way or another, teamwork is a thread through most of the articles in this issue, from the opening views on the human factor in operational safety to the closing look at a personal side of an engineering profession.

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addition to being a morale-building exercise, the flag signing underscored a recognition of the deep connection between sustainability and the human factor.

“As an owner-operator, we take the big-picture view that good safety is good business,” says Bobby Khoo, AET’s Director of Fleet Management. “There’s a definite thought process in the tanker industry to raise the bar on safety and quality of operations, in ways that not only build the business, but also make sure that it is sustainable. HSSE is a key element of this approach – it is a subset of sustainability, in fact – and what makes the fundamental difference in the success of an HSSE program is the level of buy-in from the people,” he explains.

Examining the challenges of safety and operational excellence together, Khoo says, reveals that both puzzles share a common critical piece: people.

“In such a spirit, Malaysia-owned tanker owner AET laid out a roadmap to safety and operational excellence in 2012 that began with a broad HSSE rebuild. In introducing the initiative, CEO Hor Weng Yew expressed the company’s HSSE imperative by stating that “an exceptional safety record is our ticket to repeat business.””

At the rollout of the HSSE roadmap, AET ran a ‘safety flag and commitment campaign’ on all active vessels, in which the crews, from cook to captain, signed company flags and committed their names for display on the vessels in testament of a united will to improve operational safety. In addition to being a morale-building exercise, the flag signing underscored a recognition of the deep connection between sustainability and the human factor.

“How the ‘people piece’ holds the sustainability puzzle together.

As concepts of ‘workplace safety’ and ‘operational excellence’ evolve in the tankship sector, they are increasingly being viewed not as separate achievements but as related goals, connected to each other through the interweaving initiatives, programs and other elements making up the company health, safety, security and environment (HSSE) milieu. It is a thought trend that can be seen in the growing number of sustainability reports from major owners that highlight successes stemming from the HSSE aspects of their corporate cultures.

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Examining the challenges of safety and operational excellence together, Khoo says, reveals that both puzzles share a common critical piece: people.

“I believe the reason for our consistent good performance over the years is our treatment of people – operational excellence being not only a matter of training and competence, but also of attitude,” he says. “We want to link safety with the holistic development of our people. I believe the only way HSSE can win is to get the ‘people piece’ right. We honestly do recognize that ‘people make all the difference.’ You can have all good procedures in place, all the best equipment installed, all the support imaginable from the office, but, at
the end of the day, everything rests with the captain and his 21 men on a ship in the middle of nowhere.”

With this in mind, AET developed a vision for its marine personnel called the ‘star seafarer’, a concept comprising ten attributes ranging from technical competence and business acumen to physical fitness and a sound mind. The idea of the star seafarer program is to build up these elements within each person, for the betterment of the individual and, in turn, the betterment of the company. To complement this people vision, AET recently developed two publications for its marine staff, the Seafarers’ Wellness Guide and Wellness@sea: a seafarer’s guide to mastering well-being, each of which, in just over 100 pages, addresses in plain language a wide range of health-related topics and tips that are as useful ashore as at sea. The former publication covers basic biology, nutrition, exercise and lifestyle issues; the latter, developed in concert with a clinical psychologist, addresses mental and emotional health. Together, the guides contribute to developing the personal aspect of onboard safety.

One key to a safety culture: empowerment

“In terms of HSSE, we have evolved significantly over the past 25 years,” Khoo observes. “I would describe that evolution as a significant step towards safety leadership – moving from being base-compliant, satisfying the minimum regulations and providing basic personal protective equipment – to being above-compliant, in terms of satisfying our own higher safety and quality goals and exceeding customer expectations. From there we moved on to examining safety culture.”

Although a safety culture is unique to each company and difficult to measure, all safety cultures share at least a few common threads, one of which, he says, is empowerment. For Khoo, this empowerment comes not only from clear instruction on rights, responsibilities and shore support, but also from smaller encouragements like AET’s ‘buddy system’, in which experienced mariners mentor newcomers to the ship, or the little sticker in the corner of every mirror on every vessel that says ‘YOU are the safety champion’.

One of the challenges AET faced in building its onboard safety culture involved developing a sense for the right of intervention among junior officers and ratings – a reflection of the maritime industry’s long-recognized need to overcome the regimental hierarchy on board, which can inhibit crew members from speaking out when they perceive errors being made by the captain or senior officers.

“We considered empowerment to be the base when we rolled out our Safety and Operational Excellence program, but not only empowerment of the captain. Our idea is that everyone on the ship, be it cook, bosun or master, is responsible for safety on board,” Khoo says, “and one of the key elements we try to embed in all our employee seminars is that, whether you are junior or senior person, in the matter of safety all voices are equal.”

Of course, if one encourages people to speak up about workplace problems, one then has to deal with the fears of bias, retribution and termination that naturally arise as a result. In addition, many companies encouraging employees to act as safety watchdogs are finding a major challenge in overcoming the common reluctance to stand out as critical of one’s colleagues. To counter such issues, last year AET rolled out its Stop program, an initiative aimed at breaking down the interpersonal barriers, especially prevalent in hierarchal settings (such as the shipboard community), that can interfere with safety-related communication.

The key element of this initiative is the Stop Card. Today, every member of the AET fleet carries a red card bearing the word STOP in
large yellow letters. In both color and function, the Stop Card combines the two well-known penalty cards – yellow for warning and red for penalty – that for more than four decades have been used by referees in soccer matches around the world. The person perceiving a safety problem does not have to speak out to call attention to it, but needs only to raise the card. The person who has the Stop Card raised against him then needs to stop what he’s doing and correct himself, or ask the person holding the card what he is doing wrong.

Another key to a safety culture: fairness

“The Stop Card has been very successful because it gives a sense of empowerment,” says Khoo, explaining that the card is, effectively, a physical reminder that the company stands behind the individual who speaks out for safety. Along with the Stop Card initiative, AET rolled out two support programs, the ‘safety excellence broadcast’ and the ‘safe mariner’, whereby safety interventions are publicly recognized and appreciated.

When the Stop Card is pulled because of a near-miss, whatever work process that has the unsafe aspect is stopped and the near miss logged, but anonymously. “The log tells which ship, what area of work and what ranks were involved, but never names the person,” Khoo says. “We have made it absolutely clear from the start that it is anonymous and that there will not be any retaliation against any Stop Card.”

When the card is pulled for a severe safety violation – such as an open flame on a tanker deck, for example – AET ultimately removes the offender from the ship, but not from the company. Instead, he is brought to the office to stand before a panel that exercises ‘just culture’ consequence management, whose job is to determine the cause of the offense.

“The fundamental element of this process is to find out whether a serious error was malicious in intent; if so, it is very clear the person will be discharged,” Khoo notes. “But if not, then we look for other causes: was the company process not clear, for example, or is there a flaw in our system somehow. The final step is peer-to-peer comparison, which asks if a person of equal rank and similar experience in the same situation would have made the same mistake. After this, the offender would either be penalized, which can mean a demotion, or be sent to counseling. I believe it’s a fair, just and proper system. After all, we cannot allow one person to endanger a ship and its crew,” he explains.

“I’m amazed at the step change the Stop Cards have sparked in our safety behaviors,” he adds. “We see an increasing number of people using them, and I can see our safety culture improving as a result. I see a future day when we come to the stage where the people don’t need a red card, but talk directly to the senior officers; when, even if the CEO comes on board and does something unsafe, anyone will feel empowered to walk up and correct him, because their confidence has been built up,” he adds. “I have the impression that the crews are now talking about it to their friends, because I have begun receiving requests from other companies asking to learn more about the program.”

❖
Working to better an industry, informally

Many online communities make fine use of the internet as a tool for sharing useful information and holding up good ideas and best practices for inspiration and emulation. In the tankship industry, one such group of individuals, working to share their hard-won knowledge in health, safety, security and environment (HSSE) matters is the Informal Tanker Operators Safety Forum (ITOSF).

A low-profile club without a storefront or secretariat, the ITOSF is proving to be a productive arena for tankship professionals in oil, chemical, gas, liquefied petroleum gas (LPG) and liquefied natural gas (LNG) operations to share and discuss incident reports, near misses, best practices and lessons learned for the betterment of their industry. Topics discussed in ITOSF fora include strategies for regulatory compliance, tips for effective self-assessment, experiences with safety inspections and smart ideas regarding health and safety issues.

For example, one member shared a ship's practice for reducing personal injuries due to door collisions in accommodation areas: paint the outline of the door transit on the floor; another member noted that, on one vessel he visited, colored stickers were used to indicate which pieces of bridge equipment receive emergency power, and from where – yellow indicating power from battery backup and red from the emergency switchboard. “This has the potential to come in extremely handy during emergency situations,” he wrote. “During the unfortunate situation of loss of power, knowledge of equipment available for use could prove invaluable.”

This professional exchange continues in annual meetings that take place with the support of some of the industry's leading companies – the last gathering was hosted by ENI Shipping & Trading in Singapore, for example, and the one before that by MISC Berhad in Kuala Lumpur. The format of these colloquia center around tanker owners and operators sharing safety experiences in short presentations and discussing lessons learned. No vessel or company names are mentioned and no notes or reports are produced – hence the ‘informal’ tag – but the promotion of quality operations and positive change is nonetheless most tangible.
BUILDING BLOCKS OF A SAFETY CULTURE: 

The Training Investment

From the Maine Maritime Academy to the Manukau Institute of Technology, mariner training programs around the world are reflecting the shipping industry’s new focus on bridge management, leadership and situational awareness, which has grown particularly following the inclusion of those skills in the 2010 Manila amendments to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (the STCW Code).

Although a recent addition to STCW, the teamwork-centric concept of bridge resource management (BRM) training has been around for about 20 years, having migrated to shipping from the airline industry where it was developed as Cockpit Resource Management in the late 1970s. Skills imparted during BRM training include emergency preparedness, communications on the bridge, situational awareness, error chain analysis and managing the pilot-bridge team relationship. One of the notable applications of BRM techniques has been to improve safety at sea by breaking down barriers to communication stemming from the caste system on board – for example, helping prevent accidents that occur because junior officers are afraid to point out the navigational errors of their superiors. Over the years, BRM has become a staple in the training programs of companies engaged in coastal navigation and tankship operations.

“As tanker owners, we have always been proactive in building a safety culture, particularly in regards to training,” says Rakesh Lamba, Vice President, Technical and Operations, for Singapore-based Samco Shipholding. “For example, for years we have required that all our senior officers and masters complete a situational awareness course (SAC). We see value in situational awareness training for our shipboard staff not only in terms of building skills, but also in that it inculcates teamwork on the bridge.”

Today Samco conducts its SAC training in cooperation with Singapore-based Goodwood Ship Management, using the new bridge simulator at Goodwood’s training facility in Mumbai, India. Goodwood is the technical manager for Samco’s fleet.

“When we arrange for the SAC training, through our ship managers, we always make sure to include one master, one chief officer, one second officer and one rating. By doing this course together, they better understand the teamwork and dynamics that are needed between all ranks, particularly when, for example, the pilot is on board or the ship is maneuvering. We get some very enthusiastic feedback about this course from our staff,” Lamba says.

“Some trainees tell us that they came away from the course with a better understanding of teamwork on the bridge, as well as more effective communication and active listening skills,” he notes. “Young officers often remark that they appreciate being offered a chance to build their self-confidence and being encouraged to express themselves during any situation, while junior officers tell us that they appreciate learning leadership skills early in their career, and getting to practice them. Many of the officers also comment on the benefits of being able to practice under tight situations.”
Situational awareness and ship-handling in particular have been the subjects of specialized tanker crew training programs for decades. Bridge simulators are a critical part of such programs, of course, but some institutes supplement simulator work with an unusual training tool: manned ship models. In a manned ship model course, participants drive large models around a lake that has been structured to simulate various passages and port conditions around the world. Manned ship models are typically built on the order of a 1:25 scale, with most accommodating two people and weighing up to several tons.

Because manned models respond like real ships to wind, waves and currents – in a somewhat accelerated timeframe due to the size – they help sharpen the shipmaster’s ability to concentrate, hone reflexes and train up the senses of perception and anticipation, all in a ‘live’ navigational situation that has real consequences.

Manned model training has been around a long time, but is offered at only a handful of centers in the US and Europe. One of the oldest active facilities was built for tanker captains by Esso in 1966 near Grenoble, France; it is still in business as the Port Revel Shiphandling Center. Other longstanding manned model courses for shipmasters are offered by the Massachusetts Maritime Academy and England’s Warsash Maritime Academy.

Because only a fraction of the world’s shipmasters have undergone manned model training, it is a subject of some curiosity and regularly pops up for discussion on internet fora for mariners. After taking the manned model course at Massachusetts Maritime, Captain John Konrad, writing on the gCaptain website, reflected what seems to be a near-universal endorsement of the training. “Upon arrival at the Academy I was skeptical of the ability to learn advanced ship handling techniques on a model that is a fraction of the size and weight of the original; however, during my first ‘test drive’, I quickly realized the value of this,” he wrote. “The reason it’s the best option for this type of training is twofold. First, the alternative, bridge simulators, do not give you the ‘feel’ of the water and fail to project the sense of emergency when things start to go wrong. This class, however, uses real boats that happen to be very expensive and rare – knock one of these against a pier and real damage will occur that you will feel, both in the seat of your pants and in your gut.”

Manned models provide the unique opportunity of being able to push the limits of one’s abilities and improve by learning from failure – experiences that, particularly in the case of tankers, no one wants to gain on real ships.

“In addition to the training provided by our ship managers, we have our own set of training standards that include manned model courses in ship handling at the Warsash Maritime Academy and the Port Revel Shiphandling Center,” says Lamba. “Not many owners require this training, but we consider it a must. The hands-on nature of the manned model training gives our masters and chief officers the opportunity to carry out various maneuvers on the scaled models which we believe helps them develop into safe and competent ship handlers.”
A safety culture doesn’t come into a company by accident; it has to be developed, cultivated and paid constant attention,” says Captain A.R. Sabnis, Managing Director of Singapore-based Goodwood Ship Management. “Once the concept of a safety culture is developed, the management must make sure to instill its principles among the staff – beginning, preferably, from the time they join in the cadet and junior ranks, as we do – and make sure it practices what it preaches. As I see it, that’s the way to have safe ships today.”

The programs, process and initiatives that go into a company’s safety culture don’t have to form a perfect, seamless system from day one, he stresses; they simply have to be there. Once in place, they can be modified as needed; in this respect, a safety culture is analogous to the idea of the safety management system as a continuous work-in-progress that changes as the company evolves.

“In the past, a ‘safety culture’ definitely existed in good shipping companies, but it wasn’t as structured or as talked about as it is today,” says Sabnis, who came ashore in 1983 after 16 years at sea. “You didn’t hear the term, as such, but it was understood and practiced nonetheless. For example, when the ISM Code was introduced, it gave the master precise authority to overrule instructions and policies if he felt the ship to be in danger. It isn’t as if the captain didn’t have that authority long before the regulation came into being – he did, it just wasn’t written down. Likewise, in the past you had a sense for quality operations and knew what to do to achieve it; today, that quality is measured according to a number of specific factors and in a number of different ways.”

While the methods and technologies used to document and assess vessel operations bring benefits, such as having a tangible expression of quality, they also bring challenges. Some of those challenges stem from the communications technologies that allow shore staff to remotely monitor and contact the ship. In certain situations, instant contact can be of great benefit to the crew, but also introduces a temptation for shore staff to micromanage the vessel. Industry’s growing emphasis on safety culture is one recognition that heavy shoreside involvement
in vessel operations can have the unwanted effect of undermining both the master's authority and critical decision-making at sea.

Still, the human factor is prone to weakness and, occasionally, does invite a degree of micromanagement on board, as Goodwood found out when cases indicating internet addiction at sea started showing up.

"Internet use is like air to the younger generation; it seems they cannot live without it," says Sabnis. "About four years ago, we discovered, through shipboard audits on several vessels, that some of the younger duty officers, on finishing their watch, would go online for hours before heading to bed. For some it got to the point where they were allowing themselves very little sleep before the next watch; they were making themselves go to work fatigued. In this instance, the shore had to step in with some micromanagement," he recalls. To resolve the issue, Goodwood worked with Inmarsat to develop the Infinity Box, which limits an individual's internet use to two hours per 24-hour period.

On the other side of the coin, the modern ship manager has a greater challenge when it comes to technological restraint, confronting, on a daily basis, the difficulties of maintaining a healthy balance between the capability to control and the need to trust. With owners beginning to consider the installation of web-enabled video cameras on the bridge, questions about the impact of oversight technology and organizational trust on the human element on board are becoming important talking points across the whole maritime industry. Altogether, the question 'is the captain still the captain' – raised in the Viewpoint of our previous issue – seems to be rising as a defining query for ship management.

The amount of monitoring needed to satisfy safety regulations and industry quality standards, plus the ease with which managers onshore can intervene on board, make respect – and the clear communication of it – an increasingly important element of a company's safety culture, he adds.

"At one time, if the ship made it safely from Point A to Point B, everything was considered fine and few questions were asked. Today, the entire voyage is measured, tracked, trended and analyzed, and questions are asked about fuel consumption, navigation, performance, speed and so on," Sabnis says. "Between the controls, the documentation and the instant communications, it's not surprising that, from time to time, officers come to me with issues they should be addressing, and I have to reassure them that, for us, the master is the master and the chief is the chief – that we respect their competence and trust in their abilities," he adds. "One of the most important things management can do is let the crews know the shore staff is there to help when help is needed, but that their authority on board is respected and the company stands behind them."
Two bold moves lead one operator to fulfill the promise in its name.

S
ome companies really seem to know how to find a wave and ride it. Witness the adventure of Bumi Armada, which over the past nine years transformed itself from a local boat operator to a global offshore oilfield services provider.

Bumi Armada began as a family-owned operator of fishing boats based at Miri, a coastal town of Sarawak in the Malaysian portion of the island of Borneo. After an initial public offering on the Malaysian stock exchange in 1995, it added a small fleet of harbor tugs, acquired an onshore oilfield construction and automation firm and kept a modest business over the next seven years. Following a takeover by Malaysian billionaire Ananda Krishnan, the company de-listed in 2003, restructured, re-developed and re-listed eight years later. The entity that emerged for the second public offering was nothing like its initial incarnation. Now a high-profile international operator of offshore service vessels (OSVs) and floating production, storage and offloading units (FPSOs) headquartered in Kuala Lumpur, the company raised some $888 million in one of the biggest offerings in Southeast Asia of 2011.

Today, Bumi Armada has four main business units (FPSOs, OSVs, transport and installation, and oilfield services) and boasts a fleet of more than 50 OSVs and eight FPSOs. In a relatively short space of time it has come from nowhere to become the world’s Number Five FPSO owner-operator – and an ‘armada’, indeed.

The story of Bumi Armada’s turnaround and transformation begins in 2005, when its board of directors brought in as new CEO Hassan Basma, a three-decade offshore sector veteran who had spent the previous 16 years heading the Far Eastern operations of leading FPSO owner-operator SBM. When he came on board he found a company whose performance was “lying flat and threatening to sink,” he says.

“We solved our problem by adopting the philosophy of the American CEO Lee Iacocca: fix it, sell it or kill it,” Basma recalls. “We started out trying to fix it, but ultimately concluded that would be next to impossible; the company was quite bad structurally – it was, basically, a trading company with no vision or mission. So, in a very cold, calculated way, we identified where it was making money...
and where it was losing money, with the idea that, if you get rid of your losses you turn a profit ‘overnight.’"

When investigation revealed the main loss center to be its construction arm, management made the painful decision to end that activity and focus on offshore markets. With the bleeding stopped, in 2006 Basma came up with a bold fleet renewal plan called Steel on Water I, a $320-million program to build 20 high-tech OSVs. At the same time, he sold off the company’s harbor tugs business, the idea being to change the company’s destiny by getting away from low-end work and low-value assets.

Steel on Water I was energized by a daring vision: the new vessels would be high-end 8,000 to 12,000-hp OSVs built to dynamic-positioned DPS-2 class standards, and all would be constructed in Malaysia.

"Up to then, Malaysian builders only had experience with low-end vessels," Basma recalls. "We decided to take the gamble and go with Nam Cheong in Miri to do the construction. At the time, Miri was developing, so we appointed ABS as the surveyors and partnered with Rolls-Royce for the vessel designs, the engines, the marine systems and the controls. We figured that, since we were going to compete with the big boys and build in Malaysia for the first time, we didn't want anyone alleging that our vessels were poor quality. My message to the market was simple: it's Rolls Royce and ABS, what more can you want?,” he says.

"At that time, no companies in Southeast Asia, and few worldwide, were going DPS-2 – OSVs were all azimuth thrusters and joysticks, especially in Asia," he adds. “People told us we were crazy and would never find the crews for these things. As it turned out, we read the curve very well and opened up a whole new market.”

To meet the crewing demands of its building effort, Bumi Armada worked with the Malaysian Maritime Academy (ALAM) in Malacca to develop the country’s first dynamic positioning (DP) training program, and supplied both the training equipment and course sponsorships that helped build the first generation of Malaysian DP masters. The company also runs a ‘conversion program’ at ALAM whereby its cargo vessel officers become DP-certified for OSV operation.

The first Steel-on-Water OSVs were delivered in 2006 and proved so successful that, during the next two years, the market rushed in with orders and caused the newbuilding price to double. Bumi Armada thus began 2008 sitting on a boom profit of almost $600 million, resulting from a combined book profit plus the competitive advantage of having paid half the current market price to build its assets.

**FPSOS: FROM HEDGE TO GOLDMINE**

The company’s next challenge was to develop a second business line that could offset the volatility of the OSV market. For this, Basma drew on his experience with SBM and brought the company into the FPSO sector. Pitching the excitement of joining a brash newcomer ready to take on the giants of a maturing industry, he drew expertise into the fresh venture from such leading companies as SBM and Modec, firming up his core technical staff before the company had a contract or even a finished vessel to market.

Meanwhile, he found a suitable vessel to get the ball rolling in Perkasa, a 1975-built tanker that had been converted to FPSO use in 1997 and been working offshore Vietnam and Malaysia for about a decade. Bumi Armada acquired the vessel in 2007, renamed it Armada Perkasa and sent it to Singapore’s Keppel Shipyard for refurbishment and life extension under ABS classification. While Perkasa was still in the shipyard, the company won a contract to supply a 30,000-barrel-per-day (bpd) FPSO to Nigeria’s Okoro-Setu field for Lagos-based Afren Energy Resources.
The project brought several tough challenges stemming from the fact that the vessel needed to be moored in a water depth of 13 meters – meaning the company would have to cut its teeth on the world's shallowest-moored FPSO. Mooring design was a particularly knotty problem, as the depth gave no room for a traditional catenary system. The solution Bumi Armada's engineers developed combined a taut mooring and wire above chain, with each mooring line totaling about 1.1 km in length. The shallow depth also complicated riser design, which the engineers resolved with flexible risers and a riser balcony standing some 50 meters tall. The hydrodynamics were also tricky because, even without high waves, the company's engineers calculated that the 100-year heave conditions would make the laden vessel miss the seabed by less than a meter. The solution for this involved limiting Perkasa's storage to about two-thirds of its 360,000-barrel capacity.

Perkasa took station at the end of 2007 and performed so well that, within a year, Bumi Armada could win its second FPSO contract. The new unit, an ABS-classed 45,000-bpd FPSO named Armada Perdana, took station in 600 meters of water offshore Nigeria in 2009. Realized as the ABS-classed Armada Perdana, the 45,000-bpd FPSO took station in 600 meters of water offshore Nigeria in 2009. The year the Perdana began producing, the company won a contract to supply an FPSO offshore Vietnam. With this third unit, ABS-classed TGT-1, the company's engineers met the difficult design challenge of remaining moored in a 45-meter water depth through 100-year cyclonic conditions.

In resolving the technical issues with these projects, Bumi Armada raised considerable in-house engineering capabilities. The experiences led to the creation of the company's Technology Center in Singapore, where today a staff of 120 engineers produces much of the technology for its FPSO projects, including all mooring, turret and swivel designs.

“When we started with FPSOs, we met a lot of skeptics who told us we were crazy,” Basma says. “Initially, as we went around knocking on doors, people would say things like ‘Bumi who?’ and tell us we would never make it. But, once we had our team in place, we managed to win the first contract in Nigeria. And that was it; once you get the first contract, you have entry.
Today, we are very well known and, for almost every major job being tendered out, Bumi Armada is on the bidders’ list.”

Today Bumi Armada has a fleet of eight FPSOs, with pre-qualifying bids on eight more that, collectively, represent a capital expenditure of between US $12 billion and $15 billion.

In May 2012, Bumi Armada turned attention back to the OSV fleet and embarked on Steel on Water 2, a build-and-buy program that began with the purchase of two 12,000-hp anchor handling tug supply (AHTS) vessels and another contract with Nam Cheong for four multipurpose platform support vessels (MPSVs). One feature of this latest fleet buildup is an emphasis on fuel efficiency.

“Whether or not you agree with global warming, environmental regulation is getting tougher and, I believe, Malaysia will not be too far behind in adopting some of these rules,” Basma says. “They are already in the Mediterranean, the North Sea, the Gulf of Mexico and Brazil. When they get to Malaysia, many of the vessels currently working in its waters might not fit any more,” he observes, adding that some markets are beginning to shift part of the fuel burden from the client to the operator, which makes fuel efficiency a matter of self-interest as well as marketing for OSV operators.

Looking to the future, Basma sees the company building a fleet of perhaps 15 FPSOs and adding floating gas assets like floating storage and regasification units (FSRUs) to service growing LNG markets. Further, as energy developers from the North Sea to Southeast Asia express growing interest in clustering marginal shallow-water fields to centralized production platforms as a way to mitigate development costs, he also sees a future for Bumi Armada in adding subsea umbilicals, risers and flowlines (SURF) capabilities to support these new development solutions.

SUCCESS STEMS FROM CORE VALUES

While daring moves and smart engineering solutions characterize Bumi Armada’s arc of adventure, the cornerstone of the company’s success is actually its core values, Basma says. Chief among these are two he has named ‘brutal openness’ and ‘people development’, neither of which mean exactly what one might think. The former refers to an empowerment principle and the latter to a two-part concept encompassing employee development and community giveback.

Basma likes to explain the idea of brutal openness through examples relating to work and to life. “When you run big projects, one thing you learn pretty quickly is that very few people want to be the bearer of bad news,” he says. “As a result, you have project managers coming to meetings, bringing in the famous S curve and saying everything is running fine and will be completed as estimated – until, one day, suddenly you’re six months behind and 10 percent over budget. These kinds of ‘surprises’ sneak up because no one wants tell the boss about problems. In this case, ‘brutal openness’ means ‘tell me the bad news first.’ The clearer we are about problems as they develop and discuss how they are being handled, the better everything will run,” he says.
“Now, say you are walking on a path and you come upon a wobbly stone; you lift up this stone and you see a cobra. What are your choices?” he asks. “Some people will put the stone back and try to ignore what they just saw. This helps no one, and actually endangers the next people to walk the same path. Others will try to do something about it, try to kill it or at least to warn people of the danger. That’s the right course. In work or in life, if you see something bad and you know it is bad, you have the same choices: you can run away and pretend it’s not there, you can try to fix the situation, or you can tell people about it. That’s the essence of brutal openness: anything unsafe or wrong is the cobra; the consequences of turning a blind eye to problems can be immense; and so it is to everyone’s benefit that you speak up,” he explains. “Brutal openness is a huge core value for us.”

The other leading core value, people development, refers to the company’s role in the lives it touches, inside and outside the organization. Like many organizations, Bumi Armada gives employees education and training opportunities to build skills, better themselves and advance their careers — all key elements in developing the workforce engagement and job satisfaction vital to the program of promoting from within as it grows. The company extends this concept to the communities encountered through its activities, enhancing the usual corporate social responsibility efforts with a bolder-than-usual take on the ideas of local content and community giveback.

Sometimes the company is able to lend a hand with social issues, as when, working through a church in Lagos, Nigeria, it picked up a group of young drug addicts, helped them through a rehabilitation program and guided them into building a team called One Nation, which brought a positive force in their lives and gave birth to a musical group that went on to win a national talent contest.

“We work in 19 countries on five continents and have a workforce made of 38 nationalities; we try to make a difference where we go by giving to the local communities what they need most: jobs, education, and someone to get the kids off the streets and into productive careers,” Basma says. So far, the company has drawn more than 100 Nigerians from local communities and trained them to man its FPSOs.

“In Nigeria, we went into the swamps, met with the elders and told them that, besides the money, we would bring them schools and, more importantly, good job opportunities,” he says. “Many people find it hard to believe that we hired so-called militants for our vessels, but we picked the right individuals, trained them and put them to work on the FPSOs — and have enjoyed a 95-percent uptime on both the Perkasa and the Perdana ever since,” he says.

“The needs that drove people to militancy are the same basic needs that everyone has — the need for food, jobs and education, the tools of survival,” Basma says. “I have heard presentations on effective local content and sustainable operations in Africa that sounded like encampments under siege — barbed wire, machine guns and so on. That’s not a sustainable approach. To have a sustainable operation, you need to respect the local communities and engage them. It is difficult with all the bad influences out there, and there are rogues that you don’t want to deal with, of course; but most people are genuine, and want to work with you. It’s much easier to achieve sustainable growth — and effective local content — when you approach things believing that human nature is basically good.”

One core value for Bumi Armada is to give its employees education and training opportunities through which they can better themselves and advance their careers.
Singapore-based shipyard group Sembcorp Marine marked its 50th anniversary last August in a unique way: honoring its past by revealing a bold vision of transformation for its future and unveiling the entirely new shipyard where that vision is now beginning to play out.

Named the ‘Sembmarine Integrated Yard @ Tuas’, the new facility is located in western Singapore on a reclaimed land mass named the Tuas View Extension where it will ultimately occupy a total of 206 hectares (about 509 acres). The massive construction project is being developed in three phases. After wrapping up Phase One last year, Phase Two is now underway with scheduled completion in three to four years, followed by Phase Three which is expected to be ready in 2024. When fully realized, the integrated yard will be a one-stop hub providing the full range of ship and rig building, repair, maintenance and conversion services presently offered by the five Singaporean shipyards Jurong Shipyard, Sembawang Shipyard, SMOE, PPL Shipyard and Jurong SML in the Sembcorp Marine Group.

One of the main ideas behind integrating the company’s marine and offshore activities at one site is that the economic cycles of the two industrial sectors will balance each other over time, providing the yard with a steady flow of work over the long term. If all goes according to plan, the new facility will not only consolidate the operations of all five yards, but also significantly improve upon their collective capabilities and efficiencies.

The Phase One section of the integrated yard, now in operation, covers 73.3 hectares (nearly 180 acres) and features four large graving docks, one of which, measuring 412 x 66 x 16 meters, is said to be the longest and deepest in Asia. Able to handle the largest tankers and containerships afloat, the dock is equipped with an innovative ‘intermediate gate’ that provides flexibility for the docking of smaller ships in front while other works are carried out at the rear. Another graving dock, measuring 360 meters long by 89 meters wide, is designed to accommodate the largest vessels. The Phase One section also includes a large dry dock, a 120,000-ton floating dry dock, berthing facilities, and large warehouse areas.

Years of effort begin to pay off as a leading shipyard group starts living its blueprint for tomorrow.
to accommodate offshore projects including jackup and semisubmersible rigs. A specially reinforced section of the yard allows offshore structures to be built on land and launched from a dedicated load-out area that can handle weights up to 20,000 tonnes. The yard also has three finger piers and a basin that offer a total of 12 quaysides ranging from 200 to 400 meters in length and allowable drafts ranging from 9 to 15 meters.

Phase Two, a 34.5-hectare site adjacent to Phase One, has now started construction and is expected to be completed within three to four years. The new section will contain three additional graving docks, one of which, measuring 110 meters across, will be among the widest docks in the region. It is intended for large offshore structures such as semisubmersible rigs and tension-leg platforms.

According to Sembcorp Marine, its regular maritime customers and preferred partners account for more than 80 percent of repairs, with many of their fleet calling regularly at Singapore for repair and maintenance. With dramatic growth in vessel traffic and offshore oil and gas activity predicted for Asian waters in the near future, dock availability and turnaround time will be an increasingly important sales factor for the region’s shipyards.

With this in mind, completion of Phase Two will give the integrated yard an agility that few other shipyards in the region can match, according to Sembcorp Marine President and CEO Wong Weng Sun. “When Phase Two is completed, we will have seven dry docks in operation. This will give the yard great flexibility and enable us to keep work flowing,” Wong says. “Ships sometimes have to wait outside a shipyard for dock space to open up; with seven dry docks, there will be more room here than in most other yards to simultaneously support both long-term and short-term projects,” he explains.

Long Time in Planning
The concept for the integrated shipyard goes back a long way, as recounted by Singapore’s Prime Minister Lee Hsien Loong in his speech at the yard’s opening ceremony. “I remember, more than a decade ago, the President (of Sembcorp Marine), Mr. K.K. Tan, pushed for this and lobbied me for the project. He argued for bringing all the yards together at one consolidated site, designed from scratch, to re-engineer the processes and improve productivity. He was convinced it was the
right direction to go – a long way from where we were, but the direction where we needed to head. The government supported this; we reclaimed land at Tuas for the new yard and helped Sembcorp Marine upgrade its capabilities,” Lee said.

“Many years ago, we began considering what would be the main challenges for the shipyard business in the future and how we might meet them,” Wong says, recalling the development of the new shipyard plan. “We wanted to determine which businesses we should pursue, how to organize ourselves to pursue them, where we needed to become more efficient in managing resources, and what we needed to do in order to remain competitive into the future. The conclusion was that we needed to transform,” he says.

“To accomplish this, we determined that we needed a planned transformation into the offshore sector, and then to develop a new shipyard integrated for all resources and services,” he explains. “This became our vision for Sembcorp Marine: to be a one-stop service center for our customers that would be able to provide newbuilding, repair and conversion services for ships and offshore structures.”

Beginning the 21st century with what Wong describes as a short steep learning curve in the offshore sector, Sembcorp Marine developed recognized expertise in FPSO conversions and in the construction, repair and maintenance of jackup drilling rigs, semisubmersible platforms and drillships, in addition to its established ship repair and maintenance services.

“As part of this evolution, we are moving on from our inherited structures and founding a completely new facility, one designed for the needs of the future – and, especially, one that can deal effectively with the cyclical nature of the shipyard business,” Wong says.

**Big Yard, Compact Design**

With the integrated shipyard, Sembcorp Marine is taking full advantage of the rare opportunity for a mature shipbuilder to develop its own greenfield shipyard on its home turf. In many ways, the layout and outfitting of the yard reflect five decades of accumulated thinking on how to make things better. The new cranes selected for the Phase One space, for example, feature extended-reach booms that cover some 82 percent of the yard’s production area, including all land in way of the quays and graving docks. Other improvements over the company’s existing facilities include making more efficient use of work spaces and the application of robotic processes to some of the more labor-intensive jobs.

One of the more visually striking elements of the new shipyard is its efficient use of limited sea frontage.

“Our opening to the sea in the Phase One section is just 1.2 km across, but, using finger pier architecture, we were able to design the berthing facilities so as to get the equivalent of 3.9 linear km of sea frontage. This is in addition to our four VLCC-sized dry docks. This design is inspired by the human hand: the workshops and offices are located on the palm, the finger pier-type quay walls project into the sea, and in-between the piers are the dry docks,” Wong explains.

“Old-style or traditional shipyards tend to waste land; with the docks and quays lined up one after another, they do not make efficient use of their sea frontage,” he adds. “The workers often have to walk or bicycle several kilometers just to get to their ship. By contrast, land use in the integrated yard is very efficient. The Phase One yard is not a spacious facility, but it is intelligently designed and uniquely arranged.”

The yard’s compact layout is itself an efficiency booster, he says, because the distances between workers and their work is much shorter than in traditional shipyards – all work points are within a 15-minute walk of the yard entrance.

“With shorter point-to-point travel, the workers have an environment that is, ultimately, less tiring. The people are already experiencing this difference not only physically, but also psychologically,” he says, adding that shortening the trip to the job site reduces workforce fatigue and, in so doing, boosts the yard’s productivity.
One important change introduced with the integrated yard is the minimizing of vehicular traffic within the yard's premises, a move affecting both productivity and safety. Rather than continue current practices of employing multiple trucks and motorized transports to move equipment, assemblies and supplies, the integrated yard uses a train of up to five carts pulled by a single prime mover. In addition, automobiles are prohibited from entering the yard – with few exceptions – and those that do enter are held to a strict speed limit of 15 km (about 9 miles) per hour. Controlling the number and movement of vehicles in the yard not only relieves traffic congestion and improves the flow of materials to and from the workshops, quays and docks, but also reduces the risk of accidents and injury, Wong says.

New Strategies for Worker Health & Safety

Because the integrated yard puts a number of diverse businesses and industrial activities side-by-side under one roof, each with unique workload, staffing and risk profiles, its management was challenged to find a means of creating an effective, all-encompassing safety culture for this new, integrated environment. This was a challenge for which Wong was particularly ready due to his active involvement as a council member within Singapore's Workplace Safety and Health (WSH) Council. Wong – who currently chairs the Council’s Industry Capability Building Committee following his earlier appointment as Work at Heights Safety Taskforce Chairman from 2009 to April 2014 – has a close interest in and much experience with shipyard health, safety and environment (HSE) matters.

One way that Sembcorp Marine resolved its safety culture challenge, he says, was to approach the issue through the people themselves.

“In the earlier years, we faced challenges bringing down our safety statistics,” Wong says. “In recent years, using techniques of positive reinforcement, which are currently practiced in the company, we have been able to cultivate among the people a sense of ownership regarding their jobs; through this has come a feeling of engagement with the work, which, in turn, has helped greatly improve shipyard safety,” he observes. “In the past, when people talked about the performance of their work groups, it was always in terms of the number of lost-time injuries (LTIs) they had. Today they talk about how long they have gone with no accidents. That shows a big difference in approach; it reflects a positive change in their perception of their work environment, and of themselves.”

It is possible to develop a common safety culture in a facility housing many different industrial activities because, he says, despite their differences in staffing, workload and risk profile, all businesses share at least one goal: no one wants accidents.

“My philosophy is that, in order to achieve a zero accident rate a company must devote resources not only to prevention, but also to positive reinforcement, recognizing each day that goes by without incident and each person or group that helps you get there,” Wong says.

One way that Sembcorp Marine recognizes safe operation milestones is through the award of certificates during a quarterly ceremony. If a work group goes six months without an LTI, it is awarded a bronze certificate; nine months of safe operation earns a silver certificate and 12 months a gold certificate. The highest certificate award is the platinum certificate, after which the group is made a member of the prestigious million man-hour club.

In addition to certificated recognition, the company also awards ‘safety points’ to work groups according to the number of consecutive days the group operates without an LTI. The amount of points granted at each milestone reflects not just the LTI-free period, but also accounts for the relative risk profile of the work performed. So, for example, a large group operating safely in a high-risk environment will receive more points for hitting its safety milestones than a small group working in a relatively low-risk environment. One of the more attractive aspects of the scheme is that the safety award points a group collects eventually translate into cash. The money is
given to the group management, which then uses it as it sees fit – for example, in a direct award to a safety champion, or a welfare fund for workers.

Worker health is not just about operational safety, Wong adds, but also about quality of life. For this reason, the Phase One integrated yard contains new dormitory buildings for some 4,500 foreign workers. The buildings are designed to provide safe, clean living quarters equipped with social centers, health care facilities and recreation areas. Giving time and space for the aspects of life outside of work helps morale, he points out, which is an underlying, if sometimes under-appreciated, contributor to workplace safety. A second such dormitory will be added in Phase Two.

The People Challenge

“Technology means nothing without the right people to operate it,” Wong says. “Now that we are preparing for the next generation of work to be done, we are turning attention to the next generation of people that will do it.”

This, he says, means reaching out to Singaporean youth, to rouse their interest in maritime and offshore careers.

“The real future challenge is a people challenge,” he says. “The marine and offshore industries need more young, energetic people to join, more bright young students to study engineering. We need to be able to draw them into the industry, retain them and groom them for future leadership careers.”

Sembcorp Marine’s outreach efforts include cooperating with universities in Singapore – endowing laboratories, establishing scholarships and so on – and working with the ongoing educational programs sponsored by the Association of Singapore Marine Industries, the Singapore Maritime Foundation and the Maritime and Port Authority.

“Collectively, we are able to help create awareness of what the Singaporean maritime industry has accomplished in the past, and what it can accomplish in the future,” Wong says. “The bottom line is that we need to show our young people the great things our industry has produced for the world, and to make them understand that it all comes from engineering.”

Aside from programs with the larger goal of bringing local youth into the industry, Sembcorp Marine also devotes considerable effort to building its own technology army.

“When we talk with the young people, one of the important things we point out is that this company, like the industry, offers a good career path. The company is big, it is transforming, and it is expanding overseas. There are many opportunities – it is a multi-business environment,” he says. “This is the most important thing to communicate: we are creating new scope and depth in our company, which, at the end of the day, is a global business with global opportunities.”
Sembcorp Marine can claim a proud place in its home country’s industrial history through its early beginnings as Jurong Shipyard, the nation’s first commercial shipyard, which was founded in 1963 as a joint venture between Singapore’s Economic Development Board (EDB) and Ishikawajima-Harima Heavy Industries (IHI), Japan’s leading shipbuilder at the time. The new facility was located within Jurong Industrial Estate, formerly a swampy area on the southwest side of Singapore that was filled in and developed by the young Singaporean government as part of its industrialization strategy to bolster economic growth.

Over the next few decades, a series of mergers, acquisitions and restructurings took place (see milestones chart), including a name change to Sembcorp Marine in 2000, which paved the way for the Group’s transformation and expansion. Today, Sembcorp Marine has six shipyards in Singapore – Jurong Shipyard, Sembawang Shipyard, SMOE, PPL Shipyard and Jurong SML and the new Sembmarine Integrated Yard @ Tuas – with strategic global presence in Brazil, the United Kingdom, India, Indonesia and China. A global leader in the marine and offshore industry, Sembcorp Marine is a cornerstone of Singapore’s marine and offshore industry, which contributes an average of $13 billion SGD (about US $10.5 billion), or 1.6 percent, of the country’s gross domestic product annually.◆
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<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>1963</td>
<td>Incorporation of Jurong Shipyard as a joint venture between EDB of Singapore and IHI of Japan</td>
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<td>1968</td>
<td>Incorporation of Sembawang Shipyard as a commercial ship repair center after Singapore takes formal possession of the Royal Naval Dockyard following the withdrawal of British colonial rule</td>
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<td>1987</td>
<td>Public listing of Jurong Shipyard Ltd.</td>
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<td>1997</td>
<td>Acquisition of Sembawang Shipyard Pte Ltd. (total: 100%), along with its subsidiary company PT Karimun Sembawang Shipyard (Indonesia)</td>
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<td>1963</td>
<td>Acquisition of SML Shipyard</td>
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<td>2000</td>
<td>Name change of listed entity from Jurong Shipyard Ltd. to Sembcorp Marine Ltd. Incorporation of Jurong Shipyard Pte Ltd., which operates as a separate brand name alongside other shipyards in Sembcorp Marine’s network.</td>
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<td>2001</td>
<td>Sembcorp Marine takes up a 50% equity stake in PPL Shipyard and further increases its stake to 85% in 2003.</td>
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<td>2002</td>
<td>SML Shipyard merges with Atlantis Shipyard, following a shareholding increase by Sembcorp Marine, to form Jurong SML (total: 100%).</td>
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<td>2004</td>
<td>Acquisition of 30% stake in Cosco Shipyard Group (China)</td>
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<td>2006</td>
<td>Acquisition of SMOE Pte Ltd. (total: 100%), and its Indonesian subsidiary PT SMOE Indonesia</td>
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<td>2009</td>
<td>Development and groundbreaking of the new Sembmarine Integrated Yard @ Tuas</td>
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<td>Incorporation of a 19.9% shareholding in Sembmarine Kakinada Ltd. This stake was further increased to 40% in 2011.</td>
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<td>2010</td>
<td>Development of wholly-owned Estaleiro Jurong Aracruz (EJA) in the municipal of Aracruz, in the state of Espirito Santo, Brazil. The groundbreaking for EJA’s construction was held in 2011.</td>
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<td>2012</td>
<td>Acquisition of UK-based SLP Engineering Ltd [renamed Sembmarine SLP Ltd.] (total: 70%)</td>
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<td>2013</td>
<td>Commencement of Sembmarine Integrated Yard @ Tuas Phase 1 operations in August and official opening by Singapore Prime Minister Lee Hsien Loong in November</td>
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<tr>
<td>2014</td>
<td>Construction commencement of Sembmarine Integrated Yard @ Tuas Phase 2</td>
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INNOVATOR SNAPSHOT:
CONNECTED TO THE FUTURE
One engineering firm made its mark helping subsea infrastructure come to be.

Headquartered about two hours north of Oslo in Gjøvik, Norway, EAB Engineering belongs to a rather special club: the cluster of companies corralled by Statoil whose collective efforts in the 1990s made subsea oil and gas processing a practical reality. This year EAB celebrates not only its 25th anniversary in subsea engineering, but also six decades in business during which it has, quite literally, taken its activities from the top of the world to the bottom of the sea – and marked its path with a series of innovative equipment designs and solutions.

Founded in 1952 by engineer Even Andreas Bakke, whose initials it bears, the company’s main work for three decades was designing ropeways – cable-car transport systems similar to those used at ski resorts, – which Norway’s defense agencies and communications companies once used to access their many mountaintop relay stations. Eventually, satellite communications made the relay stations obsolete and, when Even’s son Harald Bakke took the helm in 1978, the company was in need of a new direction. Throughout the course of the next decade, EAB took on the role of engineering generalist, designing all manner of equipment from cranes and ship unloading systems to helicopter decks and industrial tooling. In 1989 Bakke led the company into the fledgling subsea market and there found its focus; since 1995, the subsea sector has been its exclusive realm of activity.

EAB entered its new industry supplying tooling and pipe connections to the pioneers of subsea architecture, Kongsberg Offshore (now FMC Technologies), ABB Offshore Systems (now GE Oil & Gas) and Kvaerner Oil & Gas (now Aker Solutions), forging strong bonds with these companies that persist to this day. It built a particularly strong bond with Framo Engineering (now OneSubsea Processing Systems), another pioneer from the subsea cluster that eventually became the company’s main shareholder.

“In the beginning, we developed equipment including subsea winches, cleaning and inspection tools, seal replacement tools and tools for installation of flowlines and risers – I daresay we participated in the development of nearly all the subsea connection systems that were produced during the 1990s,” says Bakke. “We also developed and delivered the FlexConnect tie-in system to Technip, which started a long-term relationship with the company.”

By 2000, the company was delivering small structures for the infrastructure between the wellhead and the export flange, such as branches, jumpers, in-line modules (subsystems and equipment that plug into larger systems, such as for distribution or manifold functions) and tie-ins (connections that link wellheads...
into systems and link systems into infrastructure). It soon extended its product range to include permanent subsea installations such as trawlable frames (slope-sided structures that allow fishing trawls to safely pass over seabed equipment), pipeline end manifolds (PLEMs), riser bases and pigging stations.

In pipeline talk, ‘pigging’ refers to the use of any of a number of cleaning, inspection and maintenance tools having a generally cylindrical envelope (‘pigs’), which, launched and received by ‘pigging stations’, are forced through a pipeline typically by fluid injection. As the story goes, this use of the term ‘pig’ was coined by oilfield pioneers who cleaned early pipelines using tightly-bound bundles of straw, which, besides having a vaguely porcine shape, often made a squealing sound as they worked their way through the pipe.

In 2003, when Norway’s State-owned oil company Statoil began subsea development of the Ormen Lange field in the North Sea (which today provides about 20 percent of total UK natural gas consumption), EAB was brought in to supply in-line T-connections, the main PLEM and the pigging loop – the curved traverse where the pig turns around for its trip back to the shoreside pigging station – for the two 30-inch pipelines that run the 120 km distance between the wells and the shore facility. Design of the Ormen Lange pigging loop, which is installed at a depth of 850 meters, was challenged by both the large pipe width and the effects of thermal expansion.

As water temperature at the bottom of the sea is very low (down to 4°C) and the temperature of well fluids is very high (up to 178°C), subsea system designers must contend with the phenomenon of ‘well growth’ due to thermal expansion. Heated by the well fluids, the piping expands and moves upwards while, over time, the wellhead itself settles into the seabed. To safely absorb these contrary motions, designers need to build flexibility into the connections – a complicated job because the great pressures of the depths prohibit use of flexible hoses and joints; subsea systems can only use steel pipe.

“The pigging loop for Ormen Lange needed to be very flexible because the pipelines are connected directly to the system’s two PLEMs, each of which can move up to 2.5 meters due to thermal expansion. This expansion can differ for each structure, which called for quite an advanced system,” Bakke says, explaining that the solution involved enhancing the flexibility of the pipe loops by having the system slide on rails. “We had to perform about 200 load cases to be sure the design would work,” he adds.
Inventive Tooling

Besides structural solutions for specific projects, EAB also offers a range of tools and equipment for performing work on subsea installations. Some are standalone units lowered from a surface vessel and others are devices, like torquing tools, that are brought in and controlled by a remote-operated vehicle (ROV). These include, for example, the Flowline Lifting Tool, which is used during launching and retrieval of pipe or flexible lines, and the Spool Connection System, designed to enable tie-in and connection of a wide range of pipe sizes without advanced tooling. The Actuator Retrieval Tool is a large unit lowered from a surface vessel that can pick up large valve actuators weighing up to 25 tons, and the Active Pipe Support system aligns very large pipes for connection through the use of hydraulic jacking and manipulation equipment sited at the open end in combination with a monitoring system at the flange.

Another alignment tool developed by EAB aids assembly of the biggest and heaviest infrastructure components. Because large subsea structures and assemblies can weigh over 1,500 tonnes and cost several hundred million dollars to build, operators are naturally concerned about the potential for damage due to a crash landing during installation. To reduce the risk of damage during subsea fit-up, in 2004 EAB introduced its patented soft landing cylinder, a telescoping type shock absorber that uses water flow to provide a controlled, damped landing for almost any structure that needs to be lowered onto another.

In practice, the shock absorber is mounted on the receiving structure and extended. As the new structure is lowered in place the cylinder compresses, cushioning the structure’s descent through counter-pressure created by forcing water through a set of nozzles in the device. The pattern and size of the nozzles can be designed to achieve any desired retardation curve.

Between 2011 and 2012, EAB delivered more than 70 soft landing cylinders to GE Oil & Gas for the Gorgon project offshore Australia, where they are being used to help install structures weighing in the range of 1,000 tonnes. The cylinders, each of which weigh approximately two tonnes, measure three meters in height when fully extended and offer 400 tonnes breaking force. To date, the company has delivered more than 600 cylinders internationally in diameters ranging from 80 mm to over 450 mm, with braking capacities of up to 450 tonnes.

“On big projects like Gorgon or Pazflor in West Africa, you have a number of subsea modules and intermediate frames being stacked one atop another. Even with heave compensation and expert operators, there is always the chance of losing control of the load and, with a structure weighing a thousand tons on the end of the hook, a slight movement at the wrong moment could have disastrous consequences,” Bakke says. “Over the past ten years our shock absorbing cylinder has become practically an industry standard, with most of the larger players incorporating it into their systems as a matter of course.”

A Connected Future

When Framo Engineering was fully integrated with the newly-formed Cameron-Schlumberger subsidiary OneSubsea in 2013, EAB became part of a very large organization through which it gained access to a new world of international projects and opportunities to market its inventions.

One invention getting particular attention in its new family is the pipe connection system EAB introduced in 2010. Developed after 20 years of experience with subsea tie-in systems, the product, named the EAB Connection System (ECS), is a clamp connection method designed for horizontal and vertical connections on pipe ranging from six to 24 inches in diameter.
“The world market for subsea connections is very large and there are only a few players, which are, basically, the subsea system suppliers; we saw the opportunity to serve the installation contractors as well and decided to develop our own technology – competing with our customers, in a way, which is why it took some time before we dared do it,” Bakke says. “Now the ECS will become part of OneSubsea’s product portfolio. That’s a tremendous opportunity for EAB. The market for these systems represents somewhere around $2 billion – just a small share of that is more than enough for us!”

While association with OneSubsea has brought EAB expansion in several international markets including Africa, Egypt and Australia, it is in the home market where some of the most interesting opportunities have shown up. For example, EAB became part of OneSubsea’s tender to Statoil for development of the Johan Castberg oilfield, an Arctic reserve in the Barents Sea originally planned for development entirely by subsea wells. The scope of supply is 14 manifold templates (large frames wherein up to eight wells are connected to a central wellhead), with slots for 54 wells. EAB was given responsibility for the design of the manifold templates, part of an international effort in which the trees would be designed in England, the control systems in Germany and the wellhead in Houston. EAB will also supply an ECS for the project handling some 250 connections.

“This represents a new situation and a great opportunity for EAB, in that we will be not only in the infrastructure, but also on the wellhead,” Bakke says.

The Castberg development was recently put on hold while the project partners reconsider its economics, but OneSubsea has already brought EAB into other groundbreaking efforts. As Framo Engineering, OneSubsea Processing won a Statoil contract in 2012 for the design and construction of the subsea gas compression plant for the Gullfaks South oilfield in the North Sea. The $500-million plant is scheduled to be online sometime in 2015, which would make Gullfaks one of the first installations worldwide to employ subsea gas compression. This year, EAB worked with OneSubsea to complete design of the main structure and protection structures for the system. Currently, the two companies are performing a front-end engineering design (FEED) study on application of the manifold template design to development of the North Sea’s Johan Sverdrup field. According to Statoil, Sverdrup is expected to begin production in 2019 and peak at about 550,000 to 650,000 barrels per day, accounting for 25 percent of production on the Norwegian Shelf.

While EAB’s reputation is based squarely on demonstrated technical capabilities, another quality shares the foundation of the company’s success, according to a comment Bakke made during an interview shortly after being brought into the OneSubsea family.

“We have gained trust in the marketplace,” he said. “We have shown that we are able to act discreetly, which is important when you consider that we have often provided solutions for competing service suppliers and installation companies, so in this respect being trustworthy has been vital.”
As subsea oil and gas development evolves in scope towards the goal of having full processing facilities on the ocean floor, risk management specialists are finding their work complicated by the increasing reliance of these projects on equipment, technologies and procedural approaches that have little to no track record for analysis. An additional challenge to managing risk in subsea projects is understanding the risk role of the human factor in an industrial scenario where no humans are present.

While no people ever enter 'the factory on the sea floor', there are important human factors to consider in the risk management of subsea processing systems, according to Linda Martens Pedersen, Manager and Specialist Engineer at Safetec, a Norwegian risk management firm in the ABS Group of Companies, an affiliate of ABS.

"Basically, we try to help our customers understand their total risk picture and then help them implement measures, technically and organizationally, to minimize that risk. Using our knowledge and experience in industry, technology, human behavior and organizational factors, we work with clients to help them design their technical systems in such a way that they don't cause human failures," Pedersen says.

"Regarding subsea systems, the human factor enters into things in several ways, one of which is through people in the control room topsides, whose job is to monitor and control this equipment. Because subsea technologies are becoming increasingly complex, control room operators need to have equipment that gives them a very good understanding of what is happening with these systems that they can never see first-hand," she explains.

One of the concerns regarding control room operations is actually one of the oldest questions in industrial safety: how to be sure the operators understand what the monitoring equipment and safety alarms are telling them, particularly in a hot situation where several devices are calling for attention simultaneously.

"We ask questions like, if alarms start to sound, in what ways and how quickly must the people respond, and what is the effect of responding one way versus another. The important thing to establish is that the people..."
who interact with the monitoring and safety systems have very clear procedures in place and an understanding of what’s happening,” Pedersen says. “From the human perspective, I believe these questions are, in a way, more complex for subsea than for topside systems. Because you can see everything topside, you can catch a mistake while it is still a near miss, or quickly mitigate the consequences; with subsea systems, on the other hand, you may not know the consequences until after the failure becomes a big issue. In that respect, the human factor in the control room is critically important,” she explains.

“We are working with a couple of companies in this area; like many manufacturers, they are trying to develop control systems that let the operators know what to do without overwhelming them; there are many psychological factors at work in this.”

Besides perception and behavior issues during an emergency, another aspect of the human factor enters subsea risk scenarios via technology development and system planning. For example, while the system integration process ensures the various subsystems and equipment all ‘talk’ with each other, it tends to not examine how well they collectively communicate with people.

“Large projects have a number of design teams working on individual parts of the various complex systems, with few if any of the people considering how these systems work together until it is time to integrate them,” Pedersen explains. “We are usually brought in at an early stage of this process to help them see the complete system as a whole. We bring together the people who are developing the system designs, who form the operating philosophies, and who perform the actual engineering, and then we start asking them questions. It is always very interesting to see how we can reveal incident scenarios that they did not see before.”

“Very often, people tend to lose sight of the overall system when they are designing only one part of it,” she points out. “They tend to start thinking that a failure of one component

in some other part of the system won’t affect the part they designed, when in fact one failure can start a chain of unwanted events that leads to a major problem. Most of the time, they just need to get an integrated view of how all the parts work together. We facilitate this with our multidiscipline workshops, where we go systematically through the system with the client, focusing first on technical matters – failure modes, for example – and then on human factors perspectives, looking at how people respond to emergencies and contribute to failure,” she explains.

Altogether, then, the ‘biological software’ of the human factor exerts several levels of influence on subsea operational safety, from design decisions at the drawing board to emergency actions in the control room. Besides determining technology-centric risks, one very important contribution made by risk consultants is to help reveal how well the whole human-machine mixture achieves the desired level of safety.

“After 30 years in risk management, the clients know that we go beyond giving numbers and an analytical evaluation of risk,” Pedersen adds, “but also, through our questions and exercises, help them raise questions that they did not previously ask, and reach an understanding of how their whole system works that they did not previously have.”

Subsea equipment, whether familiar like the systems on the facing page or newly developed like the gas compression module undergoing testing below, have a ‘human element’ aspect through the people who design and monitor them.
Cultivating an Engineering Culture

Technology may be forever changing, but mentoring remains the cornerstone of professional development for the engineer.

A generation ago, large commercial ships would routinely spend about 12 months in design and 18 months in construction. Today those timelines have been cut in half. Over the same period, the hull structures for such major offshore equipment as jackups, semisubmersible rigs and drillships have experienced similar schedule compressions. Meanwhile, the regulatory umbrella broadened significantly in technology, environmental matters and areas that were once the sole interest of the owner and designer – like operational efficiency – and, as a result, contributed greatly to the expansion of classification Rules from a single volume of some 400 pages to more than 200 Rules and Guides. While all this was going on, computer-aided design and engineering technologies leapt ahead to the point where once-impossible structural refinements became commonplace. The upshot of all this fairly rapid evolution is that the work of the classification engineer has become more intense, more challenging and more critical to a project’s outcome than ever before.

Over time as opportunities for noncompliance multiplied, the offshore sector in particular started seeing classification services in a new light. In meeting the challenges of keeping compressed schedules on track, owners, designers and shipyards began inviting classification engineers into the early phases of design and recognizing a value added to the project by that participation. The reasoning is that, if design aspects like basic scantlings and arrangements can be brought within classification Rules during product development, then the chance of compliance-related delays during procurement and construction will be reduced.

The trend for early classification involvement dates back to the late 1990s and an ABS program called Preliminary Planning and Advice in which plan review engineers were embedded with project teams early in the design process. The initiative was launched largely to assist groundbreaking offshore energy projects by helping point designers in the right direction for Rule compliance and, thereby, minimizing comments during formal plan review.

Nowadays, the advantages of such early involvement are also being noticed in the marine sector. As an increasing number of marine as well as offshore projects call for advanced technologies, industry has begun referring to classification as a colleague in design, in the sense that, through application of the Rules during the design spiral, class contributes value to the development of the final product.

“Offshore projects, particularly those for production, are often ‘one-off’ custom-designed solutions, in which a large amount of up-front engineering is applied to investigate the feasibility of various development alternatives,” says Joseph Rousseau, Corporate Chief Engineer, Offshore, for ABS Pacific. “When ABS is involved in the FEED [front-end engineering design] and pre-FEED stages, we can assist with such efforts – the idea is that time spent in early design evaluation could reduce project execution problems and lead to cost and schedule savings down the road.”

One example of this deep early involvement can be found in the increasing number of projects where operators, wanting to minimize shutdown times due to safety inspection, have begun looking to demonstrate reliability to justify longer survey cycles, some seeking up to ten years; pursuing this goal has led to the need for more class involvement at both the FEED and procurement stages.

“A piece of equipment designed for a five-year maintenance cycle is not likely to last ten years without intervention; on projects trying for longer inspection cycles we work closely with owners to help identify potential issues for equipment reliability at the procurement stage,” says Bret Montaruli, Vice President, Offshore Technology for ABS.
Learning & Understanding

Chi Chiu, Senior Staff Consultant for Energy Project Development in Houston, shares a mentor’s perspective on helping engineers realize their potential.

Our goal as classification engineers is to follow the Rules, not blindly, but with understanding. Understanding is the basis of judgment.

Learning without understanding is like eating without tasting. You can learn how food is made, but only by tasting will you understand how all the ingredients and procedures go together to produce the dish; only then will you be able to suggest improvements. It’s like that with the Rules. If you don’t digest them – understand them – you won’t be able to help clients use the Rules to make their designs better, or to help Rule development.

Understanding follows learning. It begins with the inner person. We on the outside can only give hints, provide instruction and teach principles. The people we try to help need to think and digest the information for themselves. This is why I tell our engineers that nobody can make you better but yourself; you need to have the desire to learn and to push yourself to improve.

For example, when a new engineer comes to me with a question on the Rules, or about a design clients have submitted, I ask him to tell me in one sentence what they are trying to accomplish. That will tell me where he stands – the more you need to explain, the less you really know. Then I usually ask five questions and tell him to come back when he has the answers. When he comes back and says ‘Chi Chiu, I can answer you’, I say ‘don’t answer those questions; I have another five for you.’ This goes on until, one day, he suddenly blinks and says ‘I got it.’ That’s when I tell him, ‘yes; you have taught yourself. I just gave you the hints to link together the things you already know.’

Most of the time, younger engineers understand each individual topic but cannot link them together. When they read and study in order to answer my questions, they learn. When they come back I know they have those answers, so I pose more questions, and they keep learning; then one day they link all the answers together and develop understanding.

Every day you face different clients, different designs, different rules and regulations, all of which challenge you. You learn from these challenges, from working on many different designs, and many similar designs by different companies taking their own approach. And one day, the things you learn link up and you have the big picture of understanding.

There are plenty of new technologies and new designs that you can read about, study and learn from every day. If you enjoy learning, working with ABS you can learn your whole life – like me: I am here 34 years and I am still learning.”

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Chi Chiu with a group of ABS Shanghai’s offshore engineers.
“With structures, it is very difficult to achieve a ten-year cycle because of statutory requirements, but it is still possible to look at the design early on in light of future survey requirements and try to reduce the intrusiveness of those surveys. So, for example, if you have to check the internals of a tank every five years to satisfy regulations, and the location of the opening of that tank requires you to shut down drilling, you can address that issue at the FEED stage by relocating the opening so it isn’t intrusive to the drilling operation,” he explains.

Still, even as massive evolutions in technology, regulation and technical options have greatly increased the scope, impact and intensity of the classification engineer’s job, the age-old practice of mentoring remains the cornerstone of the engineer’s professional development.

It’s All About Mentoring

While formal training is vital to the development and reinforcement of the expanding engineering skills set, the actual work of engineering is largely individual experience, meaning much of the engineer’s professional development occurs on the job, through the tutelage of mentors and consultation with colleagues.

Surrounded by an office full of experience, young engineers undergo a kind of group mentoring, which, in the sense of accumulating shared knowledge, is the beginning of what many senior engineers describe as a career-long educational adventure.

“Mentoring is a personal experience, and involves far more than just answering someone’s questions and showing him the ropes; you take the person under your wing and actively foster his development,” says Montaruli, who in 33 years with ABS has mentored many young people, including some who are now his colleagues in corporate leadership.

“There was, for example, a chemistry professor I had in my second year of college. One day, I turned in a report and it came back failed, even though much of it was correct and other people doing the same work had passed. When I asked why, the professor told me, ‘You failed because you put no effort into it; you can do a lot better than that.’ I asked if I could go back and do it again and he said yes. So I redid it, handed it in and received a barely passing grade. This happened four times, until, finally, it came back with an ‘A’. I was very proud of that; I worked harder on that report than on anything else before,” he recalls. “That experience had quite an effect on me, not just for the rest of my time at school but also in my career. I consider that professor a mentor because he recognized that I had talent and he pushed me to excel,” he says.

“That’s been our culture in ABS engineering: to try to recognize people’s talents and the people who want to excel, and then to help them grow,” he adds.

“Then, when I started at ABS, I worked with a more experienced engineer named Stavros Karatzas; whenever I asked him a question, his answer was always the same: ‘read the Rules’. So I’d read the Rules, and when I’d get stuck I’d go back to Steve and say, ‘I did read the Rule, this is what it says, and I still I don’t see how it applies to this drawing’, and would give my reasoning. When he was sure that I had done the homework, did understand the Rule, had analyzed the drawing and still had questions about whether or not to accept it, only then would he sit down with me and work through it. He was a lot like that chemistry professor – and, I would say, the person who helped me along more than anyone else.”

“Now, you can’t take that kind of approach with everybody; some people would just get discouraged after being sent away several times,” he adds. “That’s why I say mentoring is personal and can’t really be formalized. It has to fit both the mentor and the person being mentored.”
Rewarding Work

There’s more to being a classification engineer than meets the eye. Lucio Trevisan, Senior Managing Principal Engineer for ABS Genoa, offers thoughts on some of this technical job’s more personal aspects.

During interviews, young people often ask what we do as classification engineers. I like to explain with a personal example. Before joining ABS, one of my jobs in industry was as a service engineer for gas turbines, heading a unit dedicated to resolving issues with their use. It was engineering, but I was not designing; I was helping solve problems, which is what we do here much of the time.

When we review plans we don’t just tell the designer “you have to make this change because the Rules say so.” We go further – and this is where industry appreciates our service – and tell them why the change is necessary, give the reasoning behind the Rule and then, based on our experience, suggest ways they can satisfy the requirements.

You build this experience by studying your books, looking at drawings in detail and absorbing knowledge from your trainers, mentors and colleagues. You will have formal training courses, certainly, which are fundamental to your development, but, in my opinion, 80 percent of what will make you an autonomous engineer comes on the job – through the regular work you do, through your supervisor’s assistance, and through your colleagues sharing their various experience. You will learn from all these sources, and you will use the wealth of knowledge you acquire for years to come.

From one point of view, plan review engineering is a solitary job, but from another point of view it is not. At a minimum, you discuss your work with your supervisor or your mentor, so you are never completely alone; and with problems that are out of the ordinary, you confront the challenge not alone, but with help from your colleagues in the office and around the world.

This brings up one of the best things about classification engineering: at ABS, at least, you become part of a real collaborative global environment. You have colleagues – and, at the end of the day, friends – all over the world. By the middle of your career, you belong to a really special community of many different people who respect each other, speak the same language (with different accents!) and understand each other.

Along the way you learn different ways of thinking. You learn to think ‘outside of the box’, as the expression goes. This is a very valuable asset that will serve you your whole life. There is not just one box, and not just one way of thinking outside of the box; you have access to many different ways of looking at things that help you grow not only as an engineer, but also, eventually, as a person.”

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On-the-Job Training
At one time, mentoring through apprenticeship was the only means by which the classification society’s accumulated engineering experience was preserved and handed down through the generations.

“When I joined ABS 40 years ago, we had no formal courses for training engineers; it was all on-the-job training and personal study,” recalls Ken Tamura, Director of Technology and Business Development for ABS’ Northern Pacific Region. “My first day at work, the supervisor handed me a drawing and the Rule book and told me to start reviewing plans, and that if I had questions or met with difficulty I could ask my senior colleagues for help. The supervisors advised us and checked our work often, looking over each drawing at first and then, over time, checking the work less often as we became more skilled.”

“Today we have formal training programs for new hires and experienced engineers, which, along with classroom education, group study, exposure to the building sites and attending shop tests at the manufacturers, are important and valuable to the training of new engineers. But the most valuable training comes through your work, through encounters with real problems and solutions and consultation with your colleagues. The transfer of knowledge from senior colleagues during this process is critical to developing your engineering sense,” Tamura says. “Then, when a designer presents new ideas or believes he has an alternate way to comply with the Rules, you can draw on this background to understand his approach, visualize the concept and reach a decision.”

The transfer of knowledge and inspiration doesn’t only flow in one direction, according to Alessandro Bergonzi, Managing Principal Engineer, ABS Italy.

“I like working with young engineers; their suggestions and ideas are often very interesting, and they bring new perspectives that I can learn from – like when you walk through your city with friends from abroad and they start pointing out things you never noticed before. This is a job where learning is constant,” Bergonzi says.

“In helping our engineers develop, the supervisors and mentors spend a lot of time by their side, guiding them to use the right methods, explaining the procedures and teaching them how to deal with the different kinds of plans we review. The diversity of work is very important in this development,” he adds. “In our office, for example, a person will work on offshore vessels, mega-yachts, high-speed craft, chemical tankers, oil carriers and a wide variety of machinery. Through exposure to many kinds of design solutions, and learning from colleagues, you expand your mind as well as your technical capabilities.”

The overall goal is not only to make everyone capable of doing his job independently, but also to encourage interdependence as well, he says.

“No one can know everything, which means that no one, no matter how senior, should be shy about raising a hand when help is needed,” he explains. “I too ask my group for discussion when I encounter a difficult problem. By catching the best ideas from the people around you, you can find the best solution to the problem in front of you.”

Talking Helps
For the novice engineer, the result of being cooked in this technical milieu is the sudden awareness, one day, of being ‘experienced’. The magic moment is nicely summed up by engineer Cristina Generale, six years with ABS Genoa.

“There is a day when you review a drawing and find a problem, then figure out a solution and suggest to the client a different way to see the correct interpretation of the Rules, without having first asked the opinion of your colleagues,” Generale says. “At that moment your eyes open and you say to yourself, I am an experienced engineer; I am confident; I can talk with the client and help him find a solution.”

This observation leads her to the subject of communication skills, something rarely included in a university’s engineering curriculum.

“At school you learn about technology and, for example, how the Rules are applied, but nobody tells you that you also have to be able to communicate with and relate to different parties; this, I find, is one of the most interesting parts of the job,” she says. “Your client is the shipyard, but in the meantime you have to talk with the flag State about different aspects of the design that are not in compliance with the Rules, and sometimes you also have to discuss this with the owner, because the shipyard is the entity submitting the drawings but is not the one paying for the changes,” she explains.

“Communication is really the key to our work,” she says, “and the skills you learn serve you in normal life as well as on the job.”
Be the Master of the Machine

Tamiki Takagi, Director of Engineering for ABS Japan, shares an insight on a challenge common to all fields of technical endeavor.

"It is said that the engineer should have an idea of the answer before doing a calculation. This preliminary idea comes from what is called 'engineering sense', which, in my opinion, is the engineer’s most important 'analytical tool'. Guided by your engineering sense, you will, for example, be able to identify the critical areas of a design just by looking at the drawing.

You develop this sense through the daily experience of plan review, through training you receive from the company, through your own pursuit of learning about the background and the logic of the Rules, and through transfer of knowledge from colleagues and clients when solving problems.

Transfer of knowledge from senior colleagues is a very important part of development for an engineer, a source of wisdom that informs your engineering sense. There is much about this work that you learn only through experience, things that cannot be written in the books or process instructions. This is why we in the Yokohama office ask retired engineers to come back as trainers of our young engineers, to share with them their knowledge and cultivate their minds about ship design.

If you do not cultivate your engineering mind, you risk intellectual surrender to the computer.

If you can find the answer to a problem only after computer analysis, it is not engineering that you are doing, but just operating the machine. Never let computer calculation substitute for thought. Be confident in your engineering sense.

If the computer result differs from your preliminary estimation, don’t immediately believe it is you that is wrong. Put the doubt on the computer. It is easy to make a mistake in modeling, for example, when setting the boundary conditions and the loading; then, even if the calculation is good, the results will be useless. Without a sense for what the result should look like, you won’t know for certain if the computer is correct.

I sincerely encourage all young engineers: maintain your curiosity and intellectual ambition; learn always and try to fully understand the Rules; through experience, cultivate your engineering mind and develop your engineering sense. You are an engineer; don’t let yourself become only a computer operator. Be the master of the machine."
Communication skills, strengthened by the right attitude, enable the engineer to deliver the full benefit of his technical capabilities, says Kang Mui Wong, Senior Vice President, Engineering, ABS Pacific.

"Review engineers do not create plans, but have to have a deep understanding of them," Wong says. "They develop this understanding through exposure, over time, to a wide variety of plans and systems and designs, and familiarity with many ways of achieving design objectives. As they accumulate this experience, they get better at understanding the intent of a design and at suggesting ways to remedy conflicts with the Rules," he adds.

"Today's clients want to know the reasoning behind the engineer's comments. When they ask why another class society accepts a design and ABS does not, for example, you can't just say 'because we're better than them'; you have to understand the intent of the Rule and the reason for its existence, and to be able to pass that understanding to the client," he says.

"This means the attitude of the individual is of the greatest importance. I believe a good engineer is a person that is keen to learn and has a passion for the profession. Every day you'll be challenged with different problems, some of them very difficult. To resolve them, you must have not only good skills and an understanding of the Rules, but also the heart to persevere in helping people achieve compliance with the Rules. When China was getting started in shipbuilding, for example, we assisted the yards quite a lot in this way. We conducted thousands of lessons, and numerous lectures, seminars and workshops, which they appreciated very much," he recalls.

"So, a combination of technical capability and a good human touch really helps you flourish in this work," Wong adds. "Engineers need very strong evaluation and judgment skills, but must also be able to communicate well - and I don't mean by email. I always tell our engineers that to really communicate means meeting the clients personally, talking and reasoning with them. You can actually waste a great amount of time emailing back and forth, whereas a simple meeting between clients and colleagues can often resolve the issue."

A Lifelong Adventure
As a practical matter, one of the major challenges for the modern engineer is mastering the technological tools of the trade, says Hai Gu, Director of ABS' Singapore Innovation and Research Center (SIRC). As an example, he brings up the challenge of using ABS' well-known and widely applied dynamic loading approach (DLA) to the finite element method of analysis.

"The engineer has to be smart enough to generate the input to the software, of course, but being smart isn't sufficient by itself," Gu says. "In order to use DLA confidently, you have to understand the theory behind the software, which is the most difficult part. You need to understand the finite element method, of course, but also many technologies like seakeeping or hydrodynamics, wave theory, wave statistics and how to apply loading to the structure so as to determine stress and fatigue. With DLA, as with any sophisticated analytical technology, if you don't really know what the computer is doing, you won't have the confidence to integrate the results and solve larger problems. You can get into a lot of trouble treating software like a black box," he explains.

"This is why we have a strong mentoring tradition in SIRC," Gu says. "I came to ABS from academia, and did not have much relevant industrial experience. I was coached by the director, Jer-Fang Wu, in how to perform analyses of offshore structures. When I became the leader of the floating structures team, and today as Director of SIRC, I coach new members of our group in the same way."

Reflecting on this mentoring tradition leads Gu into a thumbnail sketch of the three stages of an engineer's evolution. "In the first stage, the relationship between senior and junior engineer is more like teacher to student," Gu says. "Once the junior becomes familiar with the technical theories and how to use the software to make real models, he then can have confidence to use the software on a real project. In the second stage, the senior still has the responsibility of making sure that what the junior is doing is correct, but the relationship becomes more of a two-way street. In the third stage, they become true colleagues, working and improving together."

Whatever the specific department or discipline, he adds, there is so much to know and so much one can do as his capabilities grow that an engineering career in classification can be one long adventure in learning.

"Classification engineer is actually a very interesting and challenging job," he says. "If you apply yourself, it could be a job for life that is never tiresome."
REFLECTIONS ON ENGINEERING

From Design to Plan Review

Jing-Dong Sheng, Director of Engineering for the ABS Greater China Division, shares a perspective on a question that’s as old as classification itself.

“Some people say the plan review engineer ought to know more than the designer. I can say from experience that this is, in a sense, true. Before I joined ABS I worked for six years as a designer for a very respected design house in Shanghai named SDARI.

As a design engineer, my approach was to develop a system to perform a function. We focused on the specifications, which reflect the owner’s desires – what type vessel, which onboard systems and so on – and designed the vessel, system by system, to satisfy those desires. We reviewed our drawings for function and, if the design achieved the required goals, we considered it, therefore, good.

As a classification engineer, my approach is quite different. We look not only at function, but also at safety and reliability. This means that, when we review a plan, we should know the purpose for which it was designed. Then, when there is a problem, we can say – as our engineers do quite often – while the design is good in terms of functionality, from the Rules perspective it is not safe. We then explain why, and help find a solution.

On this job we see many different designs by many smart people, we analyze their solutions and we come to understand their methods. With self-motivation, we learn from our colleagues and through our work we develop a very broad view of design. Each of us becomes a living library of experience.

So, we can know more than the designer in this way: with this wider view, having seen many different solutions and advanced designs, knowing also the history and the background of the Rules, we may be able to offer a new way of thinking about a problem; such a contribution is very valuable to the designer.

At the end of the day, if you look at the work as simply reviewing drawings, then it’s no fun. But if every day you look for new ideas, try to absorb new knowledge and learn new things, then you will see that it is very interesting. This job is different every day, but not always in obvious ways. You make it different every day by what you put into it.”

Jing-Dong Sheng, ABS Director, Engineering
Sustainable Leadership
Hassan Basma, CEO of Bumi Armada

Hassan Basma led Bumi Armada through a total transformation over the past nine years, guiding its growth from local operator of small vessels to global service provider for the offshore energy sector and the world’s fifth-largest FPSO owner-operator. Recently, Surveyor asked him to share some insights on leadership, which we present in this Viewpoint.

Q: Bumi Armada took great risk in committing to the first dynamic-positioning offshore service vessels ever built in Malaysia – and not a few, but 20. That move, and your even bolder foray into FPSOs, sparked remarkable turnaround and expansion. What does it take to lead a company into growth and ascendancy today?

The main thing to remember is that most of us go out into the world with a desire at heart that can be expressed as ‘notice me, make me feel important’ – the need to be acknowledged and appreciated. Therein lies the first trait of good leadership: notice your people, acknowledge their importance and work to help them achieve their goals as well as yours.

That’s easier said than done, because your ego gets involved. Survival in our industry increasingly depends on management being financially savvy, embracing enterprise risk management and dealing effectively with a very rapid speed of technology change. As leader, that means you need to hire people to work under you who are experts and leaders in their own right; who, in their respective areas, are far better than you – and you have to be comfortable with that.

In managing such people, you have to be able to get across the idea that, while they can take care of themselves very well – and this is the key point – together you can do better, together you can be great. That’s the second leadership trait.

All of this calls for a certain skill in communication. As leader, you need to have a compelling vision and also the ability to convey it, to invigorate that vision so as to stimulate, align and motivate your people; to ‘sell’ your vision in the sense of making them see that this team can do great things together. At the same time, you must also let them know what’s in it for them. In this way, we drew together the expert team that helped us break into the FPSO business.

This kind of leadership is not easy to achieve. If you want to let people know they are valued, you have to make time for them even in a busy schedule. You have to ‘be there’ for them, which means that, at various times, you may have to take on the role of coach, advisor, friend, drill sergeant or judge. To be able to give so much of yourself, the main quality you need is to feel comfortable in your own skin. That’s what Jack Welch, former CEO of General Electric, meant when he said, about leadership, ‘you’ve got to be genuine’: Your strength has to come from within, and you must believe in what you say. People figure out pretty quickly when you’re being fake.

When you do all this properly, you achieve what I call ‘the multiplication effect’. Each of us can only effectively manage a finite number of people; let’s say the number is six. If each of the six under you also manages six, then you actually end up managing 42 people. In that way, your vision spreads and your influence multiplies. That’s how you lead.

Good leadership is all about respect – gaining it and giving it. You gain respect by standing with your people, being the situational leader, communicating with them and always being genuine. You give respect through recognition, clear communication, sharing your core values, being there to help and always meaning what you say.

Ultimately, sustainable leadership comes from just one place – your inner strength – and from just one source: your core values.
What seems nasty, painful, and evil can become a source of beauty, joy and strength, if faced with an open mind. Every moment is a golden one for him who has the vision to recognize it as such.”

– American Author Henry Miller (1891-1980)