2019 VOLUME 2

SURVEYOR

AN ABS MAGAZINE

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ABS

MARICULTURE INSTALLATIONS GUIDE DRAWS ON SEVEN DECADES OF OFFSHORE ENERGY EXPERIENCE

Recognizing both humanity's need for open ocean fish farms and the aquaculture industry's need for practicable standards validated through experience, ABS converted its decades of offshore energy experience – in fact, ABS produced the world's first offshore energy construction standards and remains the global leader in that field – and produced its *Guide for Building and Classing Offshore Fish Farming Installations*. Virtually all of the known types of ocean fish farm design have predecessor technologies developed for offshore and gas use – examples being spars, column stabilized types, ship-shape units and non-buoyant installations. The Guide provides class requirements for the design, construction, installation and survey of non-self-propelled, sited offshore fish farming installations and addresses such major elements as hull structure, mooring, foundations and onboard equipment not related to the aquaculture systems.

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COVER

Oslo harbor, illuminated by the setting sun and the lights of commerce. The photo is taken from the side of the harbor where rests the Akershus Fortress, the medieval castle built by King Haakon V to protect the city, and looks on the strip of buildings occupying the former site of the Aker shipyard. The large brick building to the right of center once held the shipyard's production hall. This edition of *Surveyor* looks at a few of the many interesting issues enlivening discussions across the maritime industry during this exciting time of transformation and evolution.

FEATURES

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ALL FOR THE BEST

For maritime industry veterans, there is a very familiar ring to the clamor, concern and debate surrounding the 2020/2030/2050 emissions targets and the regulatory drive behind them.

The modern maritime world has largely been shaped by a series of regulatory revolutions over the past 30 years. Each was preceded by a long period of worry and debate and followed by an even longer period of worry and adjustment, but, in the end, OPA '90, STCW, ISM and MARPOL Annex V and VI collectively forced an evolution in design, technology, practice and procedure that transformed the maritime industry for the better.

Today's environment-centric legislative goals are more aspirational than their predecessors, and whether they leave a similar legacy will not be known for at least 30 years. That said, a perspective on the question can be gained from the experience of those who witnessed the hand-wringing, heard the laments and worked through the whirlwind as the old maritime world become something new. In that spirit, *Surveyor* caught up with Hans Tveitaskog, one of those industry veterans who, in terms of regulatory change, has seen it all. He began his career in 1978 as a shipyard engineer and retired in 2018 as Technical Director of Knutsen OAS, a leading operator of offshore loading tankers and LNG carriers. In many ways, the industry he left is unrecognizable compared with the one he joined – which, he says, isn't such a bad thing.

"You hear a lot of talk about the 'good old days' of the industry, but there never really were such days, in my opinion," Tveitaskog says, and shares a favorite anecdote he likes to bring up when that subject arises. "When our children were small, we spent a few summer holidays on the West Coast of Denmark, in a place facing the North Sea. Every evening when we went back to the house, we had to clean our children's feet because they were covered in small, sticky black dots," he recalls. "Those dots were oil droplets. They were in the sea because in the old days ships used their oil cargo tanks for carrying ballast water, and would just discharge them into the sea before coming into port. The traces of oil dissolved in the seawater

Hans Tveitaskog

and became invisible, until you saw it on your children's feet in the evening. This problem has completely disappeared today, to the point that nobody believes me when I tell them about it," he says. "That was just one step, but a very important one, in the same direction that we are taking today when we try to address environmental protection."

Many lawmakers today hope the initiatives they are promoting will have a similar effect in future generations, making tall tales out of present problems like plastic pollution, greenhouse gas and other emissions issues. Those hopes and initiatives are encouraged by the simple fact that great improvements in air and water health over the past thirty years prove the wisdom in the early pollution regulations, justifying the changes that, at the time of their implementation, were often seen as disruptive burdens on industry. It just underscores a fact of history, says Mr. Tveitaskog, that what is called a disruptive change today is often called a normal requirement tomorrow.

"In whichever historical period you examine, you will find the people of the time coping

with change being brought on by what were, for them, tomorrow's requirements," he says. "Those so-called disruptions brought many positive things into the industry, or the world, and I believe this will continue. It has to; when you stop pursuing change, you start heading the wrong way."

KEEP THE BIG PICTURE IN FOCUS

Of course, when change is pursued for its own sake, or with too narrow a focus, it rarely brings benefits commensurate with its heartaches. Those who remember industry's successful battle at the IMO to reverse Permanent Means of Access regulations will attest to that. They are also likely to agree with Tveitaskog's admonishment to "always remember that a positive change often has a negative effect that needs to be balanced in some way" – an especially important caution when one considers that sustainability goals and the higher environmental targets demand, and depend upon, fine-tuning the performance of entire systems.

"Discussions on environmental issues and sustainability often become very fragmented, focusing on only one part of a system rather than taking an overall view. This can lead to trouble, because a solution in one area very often causes a problem in another," he says. "For example, one way of lowering fuel consumption in ships is to use smaller engines. This has been done, with the result that today we see vessels that have great statistics because they have a smaller engine, but which are what I would call underpowered, with increased risks when it comes to fighting heavy weather or maneuvering in narrow waters," he explains.

Just as it is a mistake to focus too hard on a single issue within a complex system, it is equally erroneous to hope too hard that amorphous concepts will generate specific answers. Looked at that way, today's understanding of sustainability should be seen at most as a guiding light, providing one remembers that finding solutions and leading change takes the hard work of many people and a collective vigilance in maintaining perspective and honesty in assessing one's goals against reality as the journey progresses.

"Sustainability isn't a kind of nirvana, but it is leading us in the right direction," Tveitaskog says. "It's like having a zero-accident policy at work; it doesn't mean you will never have an accident, but it guides you forward as a basis for development."

In the same way, sustainable development goals will create continuous pressure for innovation, he says, and lead to new solutions for better efficiencies, enhanced pollution protection and reduced emissions. One such development he sees on the horizon is the concept of hybrid power systems for ships.

"A vessel has many operational modes – discharging or taking on cargo, sailing under ballast or loaded condition, slow-speeding and so on; one type of power system isn't ideal for all of them," he says. "An engine is normally designed for an operational load of 80-90 percent, which means you are propelling the vessel at a certain speed. If you are slow-speeding, passing the Panama Canal, for example, you may only be at 20 or 40 percent load; this is very inefficient. If, instead, you charge a battery during periods when the engine is operating most efficiently, then use the battery when the engine would be operating least efficiently, you will improve your overall energy consumption," he explains.

Many new technologies are sure to be developed on the voyage to 2050, which is shaping up to be rather like a ride around the Cape of Good Hope in winter. It is already generating turbulence, as some environmental targets lie beyond the reach of current technology and others strain industry's technical capabilities to the limit. Still, three decades of sometimes painful evolution did leave the maritime industry better for the effort, and Tveitaskog sees no reason why today's turmoil shouldn't likewise work out for the best.

"I believe that development, the desire to improve things, is part of human nature – there is a reason why we always strive to improve what we do, to make life better. Whatever we do, whether it's working or gardening or fixing the house, we have it in us to always try to do better. It's also that way in industry," he says. "We should all be glad for that part of our nature. It leads us forward; and if you stop going forward, you end up going backwards."

That may be why he chooses an optimistic view when asked whether history will deem the decarbonization movement visionary or foolish.

"Personally, I don't see how we can manage without carbon, but maybe a clever solution will come up in the future," he says. "I do believe that, when people look back on this effort 30 years from now, they will say that, although it didn't go how those people though it would, it brought the industry positive developments – maybe not the ones envisioned when the legislation was introduced, but positive nonetheless." ■

A LIFELINE FOR ALL IMPERILED AT SEA

Navy recovery teams approach a floating space capsule to bring its astronauts to safety. The Amver system has helped in the astronaut recovery phase of numerous space missions.

Few adventures stir the heart so deeply as rescue at sea, for nowhere else is the minuteness of man and even his greatest creations so clear, his essential helplessness against the full might of nature so obvious, as on the open ocean.

Mankind learned to live with loss of life at sea long ago, and countless families of sailors accepted the grim risks of their loved ones' romantic profession. The sailors, too, on their lonely floating islands accepted that they had only themselves to rely upon, and that ships must aid one another in distress, for to ignore a vessel signaling for help meant condemning its crew to disappearing along with their unanswered cries into the nothingness around them.

The advent of radio helped somewhat to pierce the veil of isolation surrounding ships at sea, but it was still hit-or-miss whether a ship near enough to help would hear the SOS. Even in the 1950s the world had no coordinated, full-time, global system for helping ships in distress. That is why the U.S. Coast Guard, determined to right the situation, introduced in 1958 a centralized, radio-based oceanic emergency reporting system named AMVER.

The acronym AMVER originally stood for the Atlantic Merchant Vessel Emergency Reporting system, because at first its scope was limited to the North Atlantic Ocean, well-known as a stormy, dangerous zone riddled with such hazards as icebergs and dense fog.

The basic idea behind AMVER was to use a computer (computers had just become available as business tools) to maintain a current record of vessel sail plans, position and routing, so that, when a distress call was received, the system could locate the ships nearest the stricken one and request they divert to go help. This was first accomplished on an IBM RAMAC (Random Access Method Accounting Control) computer – the world's first commercially available computer to use a moving-head hard disk drive – programmed to 'evaluate information and determine

the position of vessels through dead reckoning.' Its output was a 'Surface Picture' (SURPIC) of an area of the ocean showing the location of AMVER member ships. The messages would be relayed by an international network of radio stations. Fittingly, the system's first partner station was the world's oldest maritime radio station, Sweden's Gothenburg Radio.

Vice-Admiral Alfred C. Richmond, Coast Guard Commandant at the time, called on all commercial vessels of U.S. and foreign registry over 1,000 gross tons and making a voyage of more than 24 hours to voluntarily participate in the program. Within two years, the AMVER database grew to 5,000 vessels, making an average of 770 ships 'on plot' during any 24-hour period. The system's effectiveness grew with the number of participant vessels, and by 1963 it was plotting vessels on voyages worldwide. By enabling international search-and-rescue (SAR) agencies to locate a ship in distress and identify the number and type of vessels in its vicinity, the system sent help to many ships suffering fire, disaster and medical emergencies.

Over time, the Coast Guard modified the system name to reflect its spreading coverage, first to 'Automated Merchant VEssel Reporting program' in 1967 and then to 'Automated Mutual-assistance VEssel Rescue system' in 1971, the year it went global for the first time and shifted operations from New York City to a mainframe computer in Washington, DC. Ultimately, the descriptive title was abandoned and the acronym became the system's proper name. Today it is simply called Amver.

Amver does more than locate ships at sea; it also locates objects that fall from the sky. In the 1960s and 1970s it played an important role in the U.S. space program, providing the National Aeronautics and Space Administration with a maritime support plan to assist space flight emergencies during the Mercury, Gemini, Apollo and Skylab programs. Today it helps SAR efforts for downed aircraft.

In 1980, Amver made world news by orchestrating the response to an engine room fire and flooding aboard the Dutch liner Prinsendam, which had 519 passengers and crew aboard. Four ships diverted to give aid and rescued all aboard. In recognition of Amver's role in that safe evacuation, the Government of Norway mandated that all its merchant ships participate in the Amver system.

Two years later, Amver integrated satellite communications and coordinated its first satellite-aided rescue. Then, when the Global Maritime Distress and Safety System (GMDSS) came online, Amver redefined itself to complement that emerging

An Amver participant ship pulls stricken sailors from the sea

Amver Director of Maritime Relations Ben Strong (right) bestows an Amver award in Iceland

The crew of the Amver participant vessel *Manukai* pose with the downed F-16 pilot (in shorts, far right) they rescued.

technology. Rescue coordination centers around the world then used Electronic Position Indicating Radio Beacons (EPIRBS), Inmarsat-C and Digital Select Calling terminal auto-alarms to locate ships, and used Amver as the means of organizing the rescue phase of the operation.

Amver underwent a complete UNIX/Windows software rewrite in the 1990s, to take advantage of evolving data processing technologies. In its new version it had greater capacity and better mechanisms for tracking and storing routings and location; better SURPIC plot depictions; and better analytical capabilities. Alongside the transformation, the Amver Center was moved to its present home in Martinsburg, West Virginia, an Operations Systems Center built specifically to consolidate many Coast Guard computer systems.

Today, over 21,000 ships from more than a hundred nations participate in Amver, and on average 4,000 of those ships are on plot each day. According to the latest Coast Guard figures, 6,227 lives have been saved by Amver-participant ships since 1999. That success is directly related to the extraordinary cooperation of ships, companies, SAR authorities, communication service providers and governments worldwide in supporting this international humanitarian program to protect life and property at sea.

"Amver represents the best of humanity in the worst of situations – and in the worst locations possible," says Ben Strong, Director of Maritime Relations for Amver. "It is a true partnership. It wouldn't work without the buy-in of companies and individuals around the world – and more than buy-in; it works because of their belief and dedication and willingness to put business on hold and go rescue someone in distress."

That thought raises an aspect of the system that, Strong says, doesn't always get due acknowledgment. "When you ask a ship to stop its voyage and spend ten hours or more looking for an emergency beacon or people in distress, it slows up commerce and becomes expensive for the shipping company; and the companies support this without question," he says. "One of the best thoughts on what Amver is all about was shared with me once by a shipowner named Nick Pappadakis. He said 'Hope is the last thing to die, and Amver provides hope.'"

At the heart of Amver, Strong says, is a service that seafarers have been willing to render since ships first went sea, which the Coast Guard sums up simply as 'mariner helping mariner' and which transcends the barriers that normally separate people. "People may have political differences or ideological differences, but when it comes to rescue at sea no one cares what those differences are," he says.

"As a civil servant for the U.S. Coast Guard, I think I can say on behalf of the entire Coast Guard that we are eternally grateful both to the companies that support us and to every individual seafarer willing to risk his or her life climbing down a pilot ladder in 50-foot seas and 20-knot winds to rescue a stranger," Strong says. "That isn't said enough, and can't be said enough."

Back in 1971, the Coast Guard created an annual Amver Awards Program to recognize the vessels that regularly participate in the Amver system and the crews, management and ownership that stand behind them and make the program a success. The awards are often given by embassies and consulates at industry events worldwide. This year the awards will be presented at Norshipping by Rear Admiral Kenneth J. Braithwaite, USN (Ret), the U.S. Ambassador to the Kingdom of Norway.

"As a former United States Naval Officer, I recognize how important it is that fellow seafarers look after each other on the open ocean," Braithwaite tells Surveyor. "We all have loved ones who expect us to return home safely. Every Captain and every crew member finds comfort in knowing that there is nearby assistance in the event of an emergency. Mariners helping mariners is the most effective and the most appropriate insurance. The U.S. Coast Guard's Amver Program is an invaluable example of international emergency and humanitarian cooperation for others to follow."

The Amver award consists of a letter of appreciation to the company, a certificate of merit to the ship, and a colored Amver pennant representing the ship's continuous years of participation in the program: blue for one year; gold for five years; and purple for ten years. After 15 continuous years of service, a ship receives a plaque, and for its 20th anniversary is awarded a plate engraved with a phrase that sums up the history of Amver and expresses a hope embedded in the seafaring adventure since the first vessels pushed away from shore to meet the unknown:

"Dedicated to the crews of (the ship) for their commitment to their fellow mariners at sea - THAT NO CALL FOR HELP GOES UNANSWERED." ■

Rear Admiral Kenneth J. Braithwaite, USN (Ret)

PURSUING PATHS OF SUSTAINABILITY

'Sustainability' and 'sustainable development' are terms often used interchangeably, but actually denote two distinct concepts that go hand-in-hand. Although each pursues a vision of civilization growing in harmony with nature, sustainability tends to focus on environmental health, ecology and renewable resources, while sustainable development focuses on responsible use of resources in ways that simultaneously foster industrialization, wealth creation and steadily improved human well-being.

While industry can contribute meaningfully to sustainability through respectful treatment of the environment, it can contribute immensely to sustainable development through responsible pursuit of its business objectives. That was the thrust of the Sustainable Development Goals (SDGs) the U.N. adopted in 2015 as part of its 'Agenda for Sustainable Development by 2030'. The 17 SDGs identified were intended to serve as the base of a global collaborative action plan for achieving environmental sustainability and economic development.

TAKING STEPS TOWARDS SUSTAINABLE DEVELOPMENT

Sustainability itself is not a new ideal for either the energy or maritime industries – leading companies in both sectors have tried to follow the theme with varying degrees of success over the years. Today, however, growing consumer awareness, public expectation and political attention are shaping a common view of what constitutes environmentally responsible corporate behavior, thereby driving an increasing number of companies to overtly embrace sustainability goals.

Three SDGs in particular affect both the offshore Oil and Gas and maritime industries: SDG 7, "Ensure access to affordable, reliable, sustainable and modern energy for all," SDG 13, "Take urgent action to combat climate change and its impacts" and SDG 14, "Conserve and

sustainably use the oceans, seas and marine resources for sustainable development." Of these, the focus on greenhouse gas emissions in SDG 13 is exerting an impact on all industries, and the first three key targets of SDG14 in particular stand out as relevant for those companies doing business on the sea: by 2025, to prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution; by 2020, to sustainably manage and protect marine and coastal ecosystems so as to avoid significant adverse impacts, which includes taking action that supports their restoration with the goal of achieving healthy and productive oceans; and, as a continual effort, to minimize and address the impact of ocean acidification through enhanced, scientific cooperation at all levels.

The rationale behind the SDG is explained in its introduction: "Oceans face the threats of marine and nutrient pollution, resource depletion and climate change, all of which are caused primarily by human actions. These threats place further pressure on environmental systems, like biodiversity and natural infrastructure, while creating global socio-economic problems, including health, safety and financial risks. In order to combat these issues and promote ocean sustainability, innovative solutions that prevent and mitigate detrimental impacts to marine environments are essential."

The next paragraph contains both a warning and an encouragement: "Businesses have a role to play in the area of ocean management as their practices and operations can greatly affect marine life and resources as well as generate waste and pollution. Beyond those industries that directly depend on marine ecosystem services and its biodiversity (e.g. aquaculture, food and beverage, tourism and hospitality, extractives and energy), all businesses share some responsibility for the conservation and sustainable use of ocean and marine resources."

At this point, it is well worth keeping in mind the historical fact that public perception eventually becomes political reality. This alone indicates that the SDGs merit a place on one's short list of imperatives – one does not have to look too far into the past to find instances where legislation was enacted when industry was perceived as acting too slowly in matters of public interest. If history is any guide, the phrase "innovative solutions" above should be industry's call to action, if only to ensure those solutions are rational as well as innovative.

In that spirit, the London-based International Petroleum Industry Environmental Conservation Association (IPIECA) in conjunction with the American Petroleum Institute (API) and the International Association of Oil and Gas Producers (IOGP) published the 180-page Oil and Gas Industry Guidance on Voluntary Sustainability Reporting. Designed to dovetail with the efforts of the Global Reporting Initiative (GRI), the guide seeks to help companies decide: why to report (describing the reasons to do so), how to report (describing a six-step reporting process) and what to report. IPIECA followed that guidance

AI-BASED INSPECTION SERVES EFFICIENCY, SAFETY AND SUSTAINABILITY

Improving safety and efficiency are two key elements of sustainable development, and both goals are served in a new joint initiative between ABS, Google and software developer SoftServe. The partners recently completed a proof-of-concept for the project, the goal of which is to develop technologies for corrosion inspection and identification based on a new application of artificial intelligence (AI).

The project used a drone to capture multiple images (for example, inside a ballast tank) and AI to detect structural anomalies, levels of corrosion and coating breakdown on ships and offshore structures. The project successfully demonstrated the accuracy of AI in performing these functions, and further indicated that it can be used to analyze images over time to develop understanding and insight regarding corrosion and coating breakdown trends.

The technology can also improve efficiency and safety by reducing the preparation for entry of confined spaces and areas with hazardous atmospheres. Oil cargo holds or storage tanks, for example, are typically prepared for inspection by crude oil washing, cleaning, gas freeing and staging, all of which are time-consuming and expensive processes. Through use of camera-carrying drones and sophisticated data analytics, corrosion conditions in many of these areas can be assessed remotely, limiting human entry to cases where close-up visual inspection is required. In addition to enhancing overall safety and efficiency during asset inspection, these technologies can be further applied to increase the accuracy of scope-of-work planning and cost estimates.

two years ago in a document entitled Mapping the Oil and Gas industry to the Sustainable Development Goals: An Atlas, hoping to promote discussion on ways in which energy industry companies could work towards reaching the SDGs.

A joint project of the United Nations Development Program (UNDP), the International Finance Corporation of the World Bank Group (IFC) and IPIECA, the Atlas analyzes links between the oil and gas industry and the SDGs, maps the industry's progress towards the Goals and suggests ways in which it might approach their achievement. In this regard, it offers a variety of initiatives, from improving energy efficiency to transitioning from oil and coal to natural gas as fuel, and seeks to inspire action on minimizing environmentally damaging activities, e.g., the flaring of gas at sea – which, although long restricted in the Gulf of Mexico and the North Sea, is not very well-controlled in the developing world. In what may be a foreshadowing of possible future legislative action, the Atlas seeks to help establish a path for harmonizing the pursuit of profit with the management of environmental and social impact.

Another step in this direction was taken last year by the Paris-based International Energy Agency (IEA), which, in its World Energy Outlook 2018, notes that "oil and natural gas are set to remain part of the energy system for decades to come," but also focuses on the changing nature of fuel, power sources and consumer expectations. The report points out that, as recently as 2000, Europe and North America accounted for more than 40 percent of global energy demand while developing economies in Asia represented about 20 percent, but predicts that that profile will completely reverse by 2040. Considering the poor environmental record of the developing world, the prediction serves as both a warning and a call to action.

The Outlook also includes a "Sustainable Development Scenario" (SDS), which projects an increase in demand for natural gas such that oil and gas together will account for 48 percent of total energy demand in 2040. Folding into the mix the growing global concern over the availability of fresh water, it further includes a cautionary examination of the role of water in industry, both in terms of the energy required to provide clean water and the amount of water consumed in providing energy.

Fortunately, the digital technologies being developed to aid asset integrity management can also be applied in the pursuit of sustainable operations. The same smart sensors, data analytics, artificial intelligence, semi-autonomous machines and aerial and aquatic drones that help operators increase efficiency, productivity, reliability and predictability in the field can also monitor the environmental effects of those operations and help improve them.

A NEW SUSTAINABILITY INITIATIVE

Responding to the above basket of concerns, opportunities and awareness of industry's role in sustainable development, ABS established a Global Sustainability Center (GSC) in Singapore, an important global hub in both the energy and maritime industries. Led by Gurinder Singh, ABS Director of Global Sustainability, the GSC is structured to harness the talents of a worldwide network of professionals and expertise to bring to bear the various sustainability initiatives managed by the Center.

One overall goal of the GSC is to coordinate initiatives that advance innovation and technology development focused on safety, practicality and the commercial viability of proposed solutions. These projects presently include: studying the viability of alternative fuels and new energy sources in different shipping sectors; analyzing the impact on vessel design of IMO targets, changes in seaborne trade and environmental initiatives; using digital technology to simplify transactions and increase operational efficiency; certifying, verifying and validating new technology.

"The shipping industry is navigating a complex regulatory landscape and rapid technology change. In particular, the IMO Greenhouse Gas (GHG) reduction targets present an unprecedented challenge for industry," Singh told the press at the Center's opening. "The Center has a vital role to play in helping industry manage that transition safely," he added, noting that its future includes education programs, seminars and lectures designed to raise awareness of maritime sustainability technologies and carbon reduction strategies. ■

A VISION OF THE FUTURE

The regulatory changes set for 2020, and those expected for 2030 and 2050, will be at least as disruptive as any past environmental legislation, and their challenges to industry at least as great. Chief among these will be new rules that support the lower-carbon, cleaner-emissions goals of the IMO's preliminary greenhouse gas strategy. It is an aspirational goal with a decades-long vision, the specifics of which are likely to evolve alongside the changes they inspire in ship design, technology and practices. The overall challenge must be addressed in parallel, holistically, with mindfulness and intelligence, if the maritime sector is to emerge a more efficient, profitable and sustainable industry than it is today.

Recognizing that, ABS developed a new publication, *Setting the Course to Low Carbon Shipping*, which offers a Vision and Outlook on carbon-reduction strategies for 2030 and the technology gaps for meeting 2050 targets.

Two sections in particular make this document like no other today. In one section, ABS reports on its work with the Herbert Engineering Corporation on two visionary designs for a feeder and an ultra-large containership. The base models use conventional technologies and operational profiles and burn low-sulfur heavy fuel oil; the modified versions run on hydrogen fuel cells and liquid biofuels, based on current knowledge of the technologies involved.

In the other section, a report on speed reduction and just-in-time shipping, prepared for ABS by Maritime Strategies International, provides a deep analysis of the potential impact of these options on industry's carbon footprint.

Altogether, the booklet is designed to inform industry as it journeys into the unknown waters of the 2030/2050 emissions challenge, to help bring into focus the numerous issues surrounding the decarbonization movement as it evolves from today's ambitions to tomorrow's reality.

THE MARICULTURE REVOLUTION BEGINS

The world's first aquaculture millionaire, a Sicilian inventor named Sergius Orata, made his fortune around 95 BC with a groundbreaking seafood farm in the Bay of Naples that reliably delivered precious cultured bivalves to the tables of the rich and famous. Were Orata around today, he would almost certainly be eyeing entry into the emerging field of ocean fish farming, also known as marine aquaculture.

Aquaculture is defined by the United Nations Food and Agriculture Organization (FAO) as "the farming of aquatic organisms including fish, mollusks, crustaceans and aquatic plants." Seaweed aside, food fish aquaculture is a multi-billion-dollar international business that has been steadily growing in value and importance over the past three decades. World aquaculture expanded at a rate of 10.8 percent during the 1980s, 9.9 percent in the 1990s and averaged 5.8 percent between 2000 and 2016 (the last year for which statistics are available), according to the FAO. The latest edition of the FAO's State of World Fisheries and Aquaculture (SOFIA) report notes that, in 2016, global food fish production totaled 151 million tons, of which aquaculture accounted for 80 million tons, or 53 percent of all fish consumed as food. That year, per-capita global fish consumption passed 20 kilograms (about 44 pounds) for the first time ever, thanks to solid aquaculture supply, firm demand, record hauls for key species and reduced wastage overall.

Sounding a hopeful note, the SOFIA report states that "Since 1961 the annual global growth in fish consumption has been twice as high as population growth, demonstrating that the fisheries sector is crucial in meeting FAO's goal of a world without hunger and malnutrition."

Still, the report adds that, despite notable progress in some areas, the state of the world's marine resources has declined; almost a third of all commercial fish stocks that the FAO monitors are now fished at biologically unsustainable levels, a big drop from 40 years ago when just 10 percent were counted as unsustainable. Clearly, aquaculture has to pick up the slack – and is doing so. Aquaculture generated $232 billion in 2016, and the FAO estimates it will account for two-thirds of all food fish consumption by 2030.

That said, in recent years the industry appears to have begun to suffer from its success.

Presently, nearly all aquacultural food fish production is accomplished on inland farms or in pens installed in sheltered waters close to shore. The industry's growth rate slowed to 5.2 percent in 2016, due perhaps in part to a saturation of suitable inland and coastal spaces, conflicts and competition with the many other public and private uses for available land and water, and public perception of some negative environmental issues associated with its expansion.

For example, coastal fish-farming operations are known sources of parasites and disease for wild fish, as happened when farmed salmon infested with sea lice shared their problem with the native population in Norway and Chile; in addition, crowded coastal pens can become sources of water pollution due to fish waste, pesticides and antibiotics. Even more troubling to environmentalists is the issue of fish escapes. When non-native fish, such as Atlantic salmon being raised in Pacific waters, escape their pens and enter local rivers and oceans, they can threaten the health of native fish populations by competing for food and breeding partners. This has happened in Chile and British Columbia, and remains a serious concern among coastal communities because the fish don't escape in small groups, but by the thousands. This happened in 2017, when a company named Cooke Aquaculture lost 300,000 salmon into Puget Sound near Seattle, Washington. About two-thirds were caught, including 50,000 retrieved by a very upset Native American fishing tribe that took little comfort in the words of experts that, based on past experience, escapes do not pose a real threat to local Pacific Salmon stocks. In the mid-20th century, Canada's Department of Fisheries and Oceans introduced hundreds of thousands of Atlantic salmon into British Columbia's waters in hope of breeding a fish paradise for sport anglers, but they didn't thrive. And, although no one can say with absolute certainty that escaped fish pose no threat, there appears to be evidence that farmed salmon at least don't do well in the wild.

SEA FARMS PLANNED TO FEED A HUNGRY WORLD

Given the growing global demand for seafood, space constrains on traditional aquaculture and environmental issues, it appears the only way to sustainably increase the world's fish supply is to build new fish farms offshore in the open ocean. That at least is the rationale through which many nations have come to believe that the future of seafood production lies in open ocean marine aquaculture, or mariculture.

Mariculture proponents say that moving fish farms offshore would eliminate many of the environmental issues raised by coastal and inland farms, while also providing a real opportunity for sustainable growth and expansion of the industry. Recognizing this, coastal countries around the world are now either contemplating or acting on the desire to capitalize on that potential. One of the leaders in this movement is China, which is presently in the first stages of a massive mariculture program. In November 2017, China's Ministry of Agriculture announced a 'national offshore aquaculture demonstration zone construction plan' in which 178 offshore pilot farms are to be built throughout its Exclusive Economic Zone by 2025.

One notable project in that effort is an ABS-classed open ocean fish pen being built by De Maas SMC at the Mawei Shipyard, a mid-sized

MARICULTURE INSTALLATIONS GUIDE DRAWS ON SEVEN DECADES OF OFFSHORE ENERGY EXPERIENCE

Recognizing both humanity's need for open ocean fish farms and the aquaculture industry's need for practicable standards validated through experience, ABS converted its decades of offshore energy experience — in fact, ABS produced the world's first offshore energy construction standards and remains the global leader in that field — and produced its *Guide for Building and Classing Offshore Fish Farming Installations*. Virtually all of the known types of ocean fish farm design have predecessor technologies developed for offshore and gas use — examples being spars, column stabilized types, ship-shape units and non-buoyant installations. The Guide provides class requirements for the design, construction, installation and survey of non-self-propelled, sited offshore fish farming installations and addresses such major elements as hull structure, mooring, foundations and onboard equipment not related to the aquaculture systems.

facility on the banks of the Min River in Fuzhou, a city in Southeastern China's Fujian Province. This pen, designated the SSFF150 design, is a spar-type, unmanned unit that measures 140 meters in diameter and has a net 12 meters deep, and is set for deployment in 35 meters of water offshore Fujian.

While De Maas is a newcomer to the field of aquaculture, it is not new to engineering structures for the open ocean. The company has operated for years in the offshore energy sector, providing technical services engineering, management and supervision services for the design and construction of vessels and platforms. It is one of many firms adapting offshore energy knowhow to the development and construction of offshore fish farms.

In the West, open ocean farms typically focus on high-value fish, such as salmon and sea bass, but in China the vast majority of farmed seafood is in low-value varieties such as yellow croaker and golden pompano. Costs must be tightly controlled to make low-value mariculture economically viable, which is why De Maas designed its pens with a focus on minimizing steelweight and, thereby, capital expenditure.

Among the key strategies De Maas is employing to achieve the required structural strength at low steelweight is to reduce the 'sail area', the part of the structure above water that incurs wind resistance, and to have the unit submerge during a storm. By sinking sufficiently far below the wave zone, where storm forces are strongest, the structure will be able to ride out a tempest in the relatively calm subsea environment and thus enjoy a long service life in the open ocean.

The SSFF150 will submerge by pumping water into a 70 meter diameter 'floater' tank that is mounted on the central spar. When the storm has passed, the tank is deballasted and the pen rises back to the surface. These operations will be activated by control systems located inside the body of the spar.

The first SSFF150 will be powered by two onboard Caterpillar diesel gensets supplemented by solar panels mounted on top of the unit. The solar panels will provide electricity for lower-power consumers like lighting and bridge equipment, while the gensets drive the higher power consumers such as the feeding system and ballast pumps. The company hopes to incorporate wave power generators or other sustainable electricity sources in future units.

PURSUING SEAFOOD SUSTAINABILITY IN THE U.S.

While China aggressively pursues its mariculture goals, the United States, the world's third largest seafood consumer, is unable to do so – not because there isn't sufficient will to see ocean fish farms in Federal waters, but because a glass wall made of red tape stands between those who wish to build them and the permits that make it possible.

As a result, there is just one ocean fish farm in the entire 3.4 million square miles of the U.S. Exclusive Economic Zone, the band of Federal waters that extends 200 miles from the country's coastlines.

Seeing in mariculture an untapped treasure chest and potential seafood independence – a mirror, perhaps, of the shale gas revolution and energy independence – in 2017 several leading U.S. seafood producers formed an advocacy group called Stronger America Through Seafood, an industry-academia alliance dedicated to rallying support for legislation that would break through that glass wall.

"You would think that the U.S., which sent a man to the moon 50 years ago this year, could figure out a way to grow fish in the open ocean," says Margaret Henderson, campaign manager for Stronger America Through Seafood. "Although we have the second largest Exclusive Economic Zone in the world, we are

16th in world seafood production and we import 91 percent of the seafood we eat."

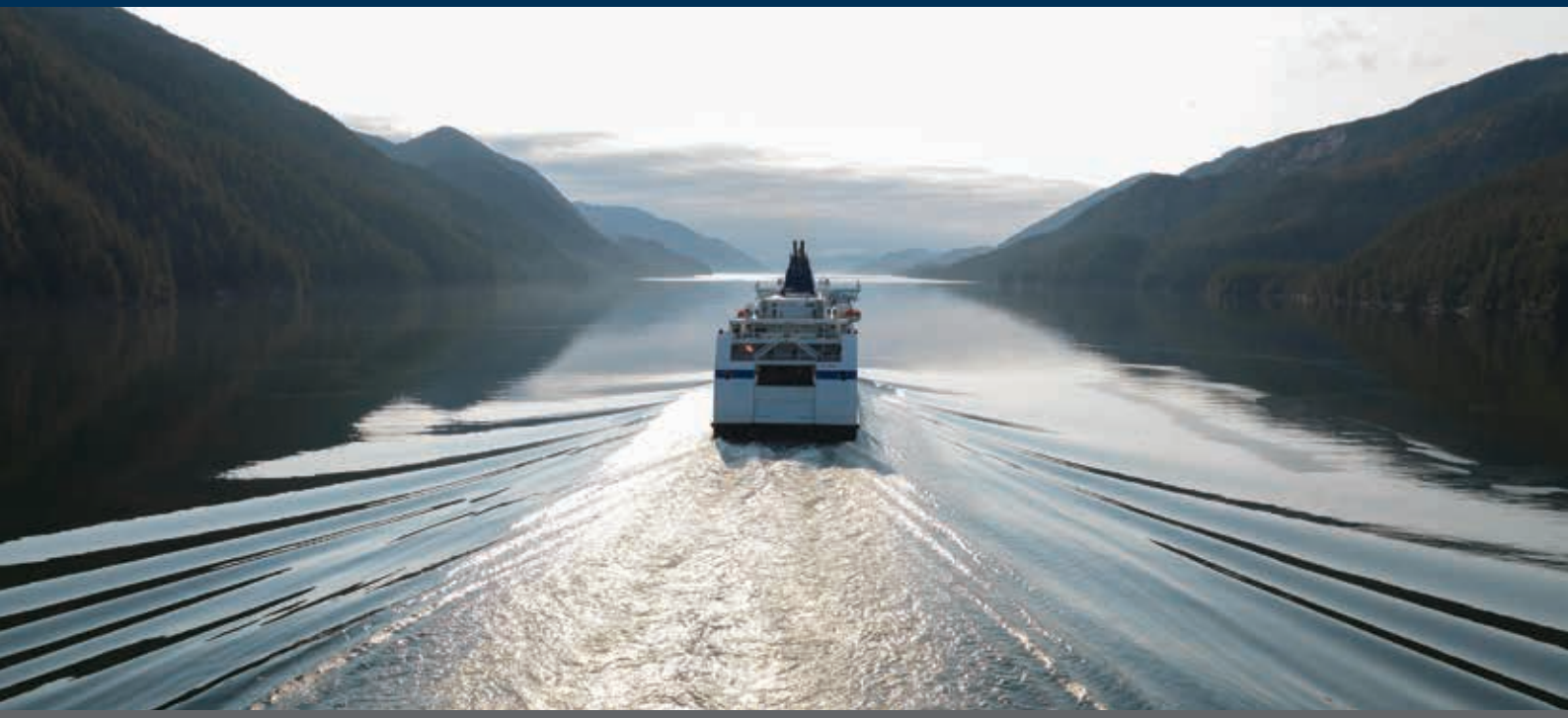
The problem, she says, is that no clear pathway exists to obtain a permit to operate a fish farm in Federal waters. The process is a complex web of overlapping authorities shared by a number of Federal, state and local agencies. Further, despite general agreement that the National Oceanic and Atmospheric Administration (NOAA) is the appropriate agency to manage fish farming in Federal waters, attempts to get proper legislation in place have been frustrated by what Henderson characterizes as "misperception and concerns about environmental risks" and a lack of understanding as to global progress in mariculture technologies – many of which, ironically, are being developed in the United States but monetized elsewhere.

The bill, known as the "Advancing the Quality and Understanding of American Aquaculture" (AQUAA) Act, is meant to establish an office within NOAA that would coordinate and clarify the permitting process for aquaculture farms in Federal waters and fund research and development to advance the aquaculture industry. As this issue went to press, the AQUAA Act, which was introduced in June, 2018, was being modified for re-introduction in spring 2019. While its champions acknowledge that the road ahead is long, they remain optimistic that the modification process, which seeks to incorporate input from all stakeholders in the issue, will eventually succeed. Henderson says they expect to see the first permits being approved within five to seven years.

Margaret Henderson, Campaign Manager for Stronger America Through Seafood

"We're doing a lot of work with the traditional fishing community and a number of stakeholders as we work with Congress to rewrite the legislation, we have no intent to put wild-capture fishing – a great American historical industry – out of business, but to compliment it through farming – and I believe we're making great strides," Henderson says. "The science is on our side and the economics are on our side. There has been great technological progress in ocean fish farming over the past ten years. It can be done cleanly, safely and sustainably; it's just not being done here – not yet," she says. ■

CHANGE MANAGEMENT FUELS AN LNG SWITCHOVER



HOW ONE FERRY OPERATOR INTRODUCED DISRUPTIVE CHANGE BY SIMULTANEOUSLY ADDRESSING TECHNOLOGY AND HUMAN FACTORS

Canadian ferry operator BC Ferries is in the midst of the biggest capital improvement program in its near 60-year history. The decade-long, multibillion-dollar asset renewal and replacement plan will see at least a portion of its ro-ro/passenger (ro/pax) ferry fleet adopt natural gas as a marine fuel, bunkering on board as LNG.

BC Ferries has been striving for cleaner overall emissions since at least 2007, when all its vessels began burning ultra-low-sulfur diesel fuel oil (having less than 15 ppm sulfur content) or a five percent blended biofuel when available. The company currently operates 35 vessels out of 47 terminals on 25 routes covering 1,600 km of coastline. Which of them will switch to gas as fuel is a decision that depends on the particular details of each route.

The latest gas-fueled ferry to enter the fleet is actually a company veteran, the ABS-classed *Spirit of British Columbia*, a 548-foot-long ro/pax built in 1993. The vessel was converted for gas fuel usage – outfitted with four dual-fuel Wärtsilä 8L34DF main engines and a cryogenic fuel tank – as part of a comprehensive $140-million upgrade, renewal and life extension at Poland's Remontowa Ship Repair Yard. The rejuvenated vessel returned to service in June 2018, to be followed later this year by its sister, the *Spirit of Vancouver Island*, which completed a similar conversion at Remontowa in February. Able to carry 2,100 passengers and 358 vehicles, they are the largest vessels in the BC Ferries fleet, and were preceded in service by three smaller gas-fueled newbuilds in 2017.

The technological highlight of these vessels, one which could very well become a ferry industry standard, is the onboard fueling system jointly developed by BC Ferries, engine maker Wärtsilä and British Columbia energy utility FortisBC. What makes the technology noteworthy for ferry operators around the world is that it eliminates the need for any shoreside LNG infrastructure.

In this novel fueling scenario, an LNG delivery truck drives up onto the vessel, plugs a hose into a fill port and refills the ship's bunker tanks, similar to how home heating oil is delivered. For the three newbuild LNG-fueled ferries that entered service in 2017, the supply trucks refuel on an open vehicle deck. For the *Spirit of British Columbia* and its sister, refueling is done on a fully enclosed vehicle deck – the first vessels in the world to do so. According to BC Ferries, this bunkering innovation saved the company more than $100 million by eliminating the need to build a shoreside refueling facility.

At the end of 2017, BC Ferries President and CEO Mark Collins noted in a public letter that the company had spent $2.1 billion on renewal and improvement between 2004 and 2016, and announced that it is "committed to doing more. Over the coming 10 years, BC Ferries will independently raise and invest a further $3.2 billion in British Columbia's coastal ferry service," he said. "Coastal communities have high expectations for the ferry system and rebuilding infrastructure is one way we strive to meet them."

THE HUMAN SIDE OF TECHNOLOGY EVOLUTION

The adoption of gas as marine fuel involves significant, even disruptive, change affecting not only a company's technology, processes and procedures, but also the people who have to implement and live with them. For that reason, successfully bringing LNG into an organization as a marine fuel requires both a good technical plan and a good change management plan.

Corrine Storey, Vice President and COO, BC Ferries

According to Corrine Storey, Vice President and Chief Operating Officer of BC Ferries, the company's successful adoption of LNG as a fuel went smoothly in great part thanks to a good change management program, the basis of which was partnership and teamwork.

"The foundational piece of our change management process was collaboration, working with the various entities from the LNG industry that were part of our project: the regulator, Transport Canada; our classification societies, the manufacturer, Wärtsilä; and the natural gas supplier for British Columbia, FortisBC. These companies brought to the table a wealth of knowledge and understanding about LNG, and helped us develop the right solutions in terms of both technology and the human factor," she says.

"Change management often starts with the unknown. People get nervous when dealing with an unknown entity; in change management, you move them out of this state of mind by means of education and training, to a place where the unknown becomes familiar, normal and accepted," she explains. "Education is the key – you take all the information from all parties that have come to work on the project, develop a knowledge base and put together a training plan and a communication plan. That's how you move through the change management process."

BC Ferries approached its own change management through a process of tiered training, in which every department received general education about LNG followed by training related to the particular needs of their work. For example, although everyone, from catering to cargo handling, received basic LNG training and education, the engineering teams and engineers on board received more in-depth technical training specifically related to their jobs.

"The basic training informed the staff company-wide about LNG itself; that's where the utility and the regulator provided a tremendous amount of insight," Storey says. "When dealing with the unknown, you always encounter myths and misinformation, so we made sure to provide clear information about the composition of LNG and how it is produced, managed, treated and transported safely. After that, we got into the specifics of each person's skill set – whether that was terminal operations, engineering, deck and so on – and how those pieces fit into the overall picture. Then we developed the plan with input from the staff and input from the parties that worked with us on this."

LNG being a hazardous cargo, the change management process for adopting it as a marine fuel must be more than a mere academic exercise. For BC Ferries, change management included a company-wide outreach to understand and allay staff concerns, anxieties and nervousness. For that part of the endeavor the company established a new position, Director of LNG Operations, and hired for the job an expert in the field whose task was to develop training materials in a way that brought the entire staff, marine and shoreside, into the process.

To do this, he convened an extensive working group and personally brought the change management process to each company location.

"Our Director of LNG Operations went around from location to location, working with the staff in each place, teaching them about LNG, listening to their concerns and explaining the processes we intended to put in place – to help them truly understand LNG and move it from the unknown to the normal," Storey says. "He engaged all the different areas of BC Ferries, through the formal working group and a very interactive process, going out to talk with people on the deck plates, as we say here, to understand and resolve their concerns through practical examples and by working through various procedures with them – it was a real hands-on, boots-on-the-ground approach. He did a great job in communicating to them, clarifying their concerns and helping them develop a clear understanding of how we could manage this process safely and efficiently. He would inform the people, receive questions, clarify, receive more questions, then re-clarify and adjust policies as needed, based on their responses," she explains. "We went through several iterations before we landed where we did, based on that back-and-forth communication."

As a result of this collaborative approach, she says, concern was replaced by acceptance and LNG as a marine fuel was embraced company-wide.

"Our change management program was so successful because – and I know these terms are over-used, but they really do sum it up – it was based on transparent, two-way, closed-loop communication," she adds. "There wasn't a group of people at the top developing policies and rolling them out; it was a very collaborative approach with employees that sought not only to dispel concerns, but also to develop policies and procedures based on our knowledge of our operations and the combined expertise of our partners in this journey."

LOOKING FORWARD TO A CLEANER FUTURE

Although it is still early days for BC Ferries' LNG adventure, the company already sees indications that the new fuel will have a significant impact on its overall energy expenditures.

"We're still learning, still monitoring, still doing the analyses," says Storey, "but overall, depending of course on how the price of fuel fluctuates, we're looking at a 50 percent reduction in annual fuel costs. That is our goal and that's what we're looking forward to."

The company also expects to see a reduction in asset management costs relating to the use of LNG as fuel.

"We are monitoring the effect on life-cycle costs in the asset management process, but it is still too early to commit to what that impact will be," Storey says, "but our expectations are that we will be able to reduce our life-cycle costs on our assets going forward."

Altogether, then, the switch to LNG as fuel is shaping up as a positive move not only for BC Ferries' bottom line today, but also for its legacy to tomorrow – a step towards the overarching goal of building a business model that combines environmental sustainability and commercial viability.

"LNG is moving BC Ferries further towards its goal of being a sustainable operator; it's one part of the global vision expressed in our sustainability report," says Storey. "We are reducing our emissions, recycling the waste we generate, improving our energy efficiency – doing everything we can to reduce our impact on the environment."

This means participating in broad initiatives with other industry stakeholders. For example, BC Ferries partnered in a program with energy supplier BC Hydro in 2008, through which it has completed efficiency studies of its five major terminals and initiated energy management projects that will result in a power savings of approximately 2.67 GWh annually. Since 2014, the company has voluntarily participated in the Enhancing Cetacean Habitat and Observation (ECHO) Program, an effort led by the Port of Vancouver to better understand and manage the impact on whales of coastal BC shipping activities.

Other environmental efforts include: working to understand and improve the underwater noise profiles of its vessels; reducing the use of landfill and plastic disposables on board, replacing them with environmentally-friendly alternatives; and using biodegradable hydraulic oils and environmentally-acceptable lubricants in vessels and terminal infrastructure where practical. The company is also a member of Green Marine, a voluntary environmental certification program for the North American marine industry that was founded in 2007 by the major marine industry associations in Canada and the U.S. The program, whose participants are shipowners, ports, terminals, Seaway corporations and shipyards based in Canada and the United States, addresses key environmental issues through 12 performance indicators.

"It's always good to find the larger perspective in what you do," says Storey. "That's why one part of our vision is to make our operations as clean as we possibly can." ■

FROM THE FRONT LINES:

MANAGING THE DIGITAL REVOLUTION

WITH KRIS VEDAT, HEAD OF IT, TOPAZ ENERGY AND MARINE

Digital technologies and data analytics have helped companies around the world make dramatic improvements in operations, administration, general efficiency and even aspects of human resource development. So profound and widespread has been the impact of these improvements that, in virtually all industries, the buzzword 'digital transformation' has now acquired the air of an incantation for raising a one-size-fits-all answer to questions of enterprise sustainability, cost control and competitiveness in the 21st century.

Companies that have progressed into the implementation phases of their digital journey are quick to caution that the reality of 'digitalization', as it is sometimes called, is rather the opposite – that it is far from a 'plug and play' solution, and that its effects can range from transformation to enhancement to nothing much at all, depending on how well the digital transition is conceived and executed.

Such is essentially the counsel of Kris Vedat, Head of IT for Topaz Energy and Marine, an owner/operator of approximately 120 offshore support vessels (OSVs) of various type that is active primarily in the Caspian, MENA (Middle East-North Africa) and West Africa regions. In the maritime industry and particularly the OSV sector, digitalization is, apart from the activities of a few early adopters, still in its earliest stages. As Topaz begins to reap the rewards of data analytics and digital technologies – notably, higher efficiency and better performance aboard certain of its vessels – Vedat has emerged as an advocate of the OSV sector's digital future.

"Digitalization and smart technologies offer a vast range of opportunity for the shipping industry across all sectors and disciplines," Vedat says. "There is a lot of optimization to be had, and it is just a matter of time before data analytics becomes the norm moving forward in the day-to-day working of the OSV sector."

Topaz began its digital journey about four years ago and is now, in certain areas, moving from vision and strategy into implementation and execution. One prominent example of this progress is a data collection program now being enacted on 20 new MCVs (module-carrying vessels) navigating the Volga River under contract to Tengizchevroil (TCO) for work in the Tengiz oil field in Kazakhstan. In this program, Topaz makes use of the Internet of Things (IoT) to transmit real-time data from each vessel and analyze it with an eye to improving efficiency onboard. Every 15 minutes, each vessel sends a packet of 15 data points on speed, routing, fuel usage and other aspects of its operation. This data is parsed, crunched, trended and analyzed with an eye to boost vessel performance in a variety of ways, ranging from better use of fuel to better use of downtime.

"Applying the IoT on board allows you to move to far more efficient planned maintenance and condition-based maintenance models, in which you can be predictive rather than reactive in repair and maintenance," Vedat says.

Predictive maintenance is one of the signature goals of the digital revolution; ideally, it would help increase availability of individual vessels by managing their downtime, thereby yielding the cumulative effect of improving overall fleet efficiency. It is on achieving such operational enhancements, rather than simply cost-cutting, that Topaz focuses its digitalization efforts.

"The cost of replacing a component is the same whether you do it predictively or reactively, but if you are able to predict when a failure is likely to happen, you can plan the replacement or maintenance instead of dealing with it in firefighting mode; that alone creates better efficiency," he explains. "Although one effect of greater efficiency is a reduction in operating expenses, I wouldn't say that cutting costs is a main driver of the digital revolution; for me, at least, it's more about trying to increase uptime and become more efficient."

Vedat foresees a time in the not-too-distant future when OSV operators regularly employ route optimization techniques, combining speed and location information with weather and wave data to lower fuel consumption and deploy assets more efficiently.

Kris Vedat, Head of IT, Topaz Energy and Marine

"Most OSV operators are still in the initial stages of their digital journey, but some – like Topaz – have the equipment and systems in place and are beginning to reap the rewards of having access to real time data," he says. "The next stage of the journey will be to establish the quality and accuracy of the data before identifying patterns and applying this knowledge intelligently across the business."

The technologies on which this digital future will be built are becoming increasingly common, but the path forward remains unique to each company and, depending on how well one starts out, can either be fairly straightforward or long and tortuous, he warns.

"Any digital initiative will fail without the proper prerequisites in place," he says. "First you have to decide what, exactly, you are after – operational excellence, cost control, asset management, customer satisfaction, attracting and keeping talent, improved sales, or something else – and then determine the related key performance indicators (KPIs) and their specific enabling technologies, and build a structure around them," he advises.

"Most of the mistakes that I see in this area occur when people gather data without having a structure or strategy to guide them – and you do see that, because digitalization is a big buzzword at the moment and many people get caught up in thinking they must embark on a digital voyage because everyone's doing it. You need to know the reason why you are gathering data and how you want to use it," he advises.

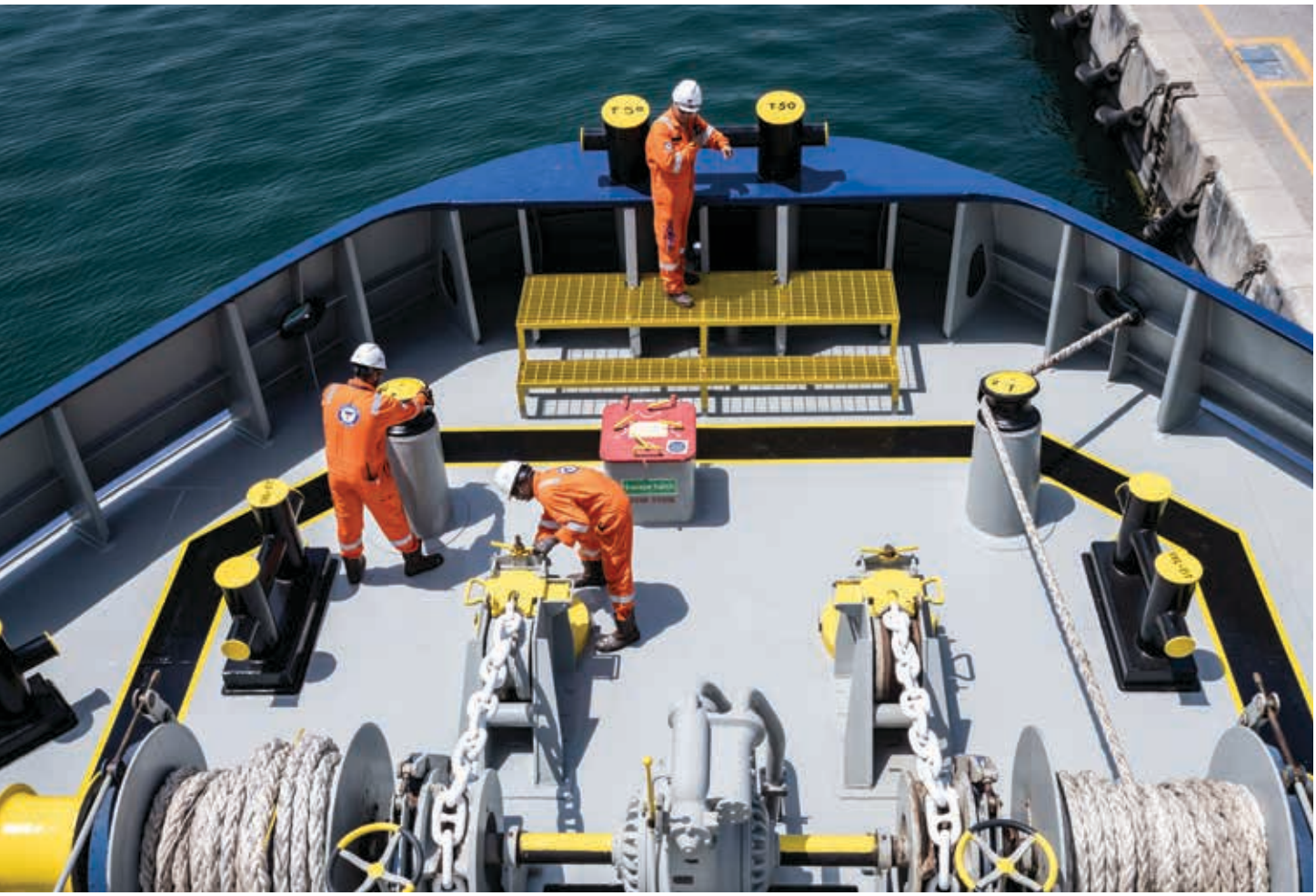
"Once you have a clear vision and an objective, you can then find the enabling digital technology. This is what we did at Topaz," he says. "We began by looking at the distinct areas of our business and operations in which we wanted to make improvements, then developed a clear vision of where, exactly, within those areas we wanted to improve – for example, do we want a five percent increase in uptime, a five percent improvement in fuel efficiency, etc. – and then looked for the technologies that would enable us to reach those goals."

Thus, before implementing its digital vision, Topaz first needed to install the communications infrastructure to support it. In 2017 the company rolled out the new system, a voice and data service that brings the internet to every vessel and integrates the fleet with the corporate network. The company then developed supporting technologies for field use, including a smart phone application that creates paperless vessel visit reports as they occur and feeds the data to a dashboard for visualization. This dashboard also displays key performance indicators and other important information, and helps generate leader boards for recognition of higher-performing vessels and teams.

Although the implementation phase of the company's digital transformation is still ongoing, a large amount of data is already streaming from some of its vessels and being put to a variety of uses. This allows Topaz to make operational data accessible by the client, and to take advantage of what Vedat identifies as a unique opportunity for increased transparency offered by digitalization. In the case of the MCVs working for TCO, data from vessel systems and subsystems is sent via an Electronic Data Interchange directly to the client without the intervention of the vessel owner.

"At the end of the day, we are, in effect, operating our vessels on behalf of a client," Vedat says. "Therefore, we ought to show the clients how well the vessel is performing – if we're doing well, we should let them know we're doing well; and if we're not doing well, we should admit it and go on to improve, and be able to demonstrate that we are working to improve," he says. "If we share data – that is, if we are transparent to the client, and the client transparent to us – we will have mutually beneficial results."

Meanwhile, although nearly all the talk about digital transformation today centers on business results and



Even in this Digital Age, teamwork and a good crew are the keys to success

technology, there is a critical human element aspect to this adventure that must not be forgotten, he warns.

"A digital journey isn't only about data and processes; it is also about people," he says, pointing out that digital transformation comes with a built-in challenge to many corporate cultures. "Digitalization affects the way people do their jobs, the procedures they use, and the workings of the organization as a whole. This means that communication and management of change are critical to the development of an effective digital transformation," he advises, noting that employee empowerment is likely to be a key concern in the Digital Age.

"As the digital journey begins, the message from the top should be that digitalization is a business enabler designed to replace paperwork, not a craftsman at sea. Investing in onboard technologies, as Topaz has done, will empower onshore and offshore teams to make faster decisions in closer dialogue with clients. At the same time, we maintain a high-performance mindset in our organizational culture, meaning we empower our employees," he says.

"All the things that I am trying to do, from the digital transformation perspective, are actually intended to improve day-to-day life for our crews and shore staff – not to replace people with automation, but to assist them, to make them more efficient, and to help them do their work in better ways," he explains. "We continue to invest in the development and the well-being of our employees, and do what we can to enable them to better service our clients in this ever-changing environment."

Asked for a word of advice to those still contemplating digital transformation, Vedat says it is most important to remember that the digital roadmap for each company is different, that the digital journey must be carefully planned, and that digital technologies are just tools in a toolbox to be used when relevant, but not simply for the sake of using them.

"Every initiative on the digital journey must have a clear objective, a well-understood reason and a means of measurement for success," he says. "For us, it's about improving operational efficiencies and making things safer – in other words, to be better at what we do, and to enable everybody to be better at their jobs." ■

EARLY WINS IN THE WAR ON OCEAN PLASTIC WASTE

In February this year, a dream came true and a symbol was born when a unique 9 meter boat called *FlipFlopi* reached the beaches of Zanzibar after a 14-day voyage that began 500 km up the African Coast on the shores of Lamu Island, Kenya.

FlipFlopi is a dhow, a type of cargo and passenger vessel that in various forms has worked the waters of the Middle East, India and East Africa since at least the late Middle Ages. Dhows are common throughout these regions today both as cargo carriers and pleasure crafts. What makes this dhow so special is that it is the world's first seagoing sailing boat made entirely of recycled ocean plastic waste. Except for its single mast and boom, which for engineering reasons are wood, the entire vessel from stem to stern was created out of 10 tons of mixed plastic waste gathered from Kenya's beaches and byways.

The raw beams and planks were formed by a local recycler, then carved and assembled using traditional wooden shipwright tools and techniques by a construction crew under the leadership of master dhow builder Ali Skanda, a Lamu Island native whose artistry has been exhibited in museums worldwide. Skanda worked closely with the recycling company through much trial-and-error experimentation to develop a method for producing defect-free components with sufficient flexibility and stiffness to replicate the behavior of wood. Because recycled plastic is not a visually appealing material, the finished hull and deck were sheathed in colorful panels made from the squared-off soles of some

30,000 discarded flip-flop sandals, also recovered from Kenya's beaches. The result is a charming, colorful vessel whose rainbow hues recall the radiant optimism of African folk art, and give no hint of the tremendous challenge there was in turning low-end plastic waste into a true structural material.

FlipFlopi was the brainchild of Kenyan tour operator Ben Morison, but the vision could only become reality through a team effort. Various parts of the project were led by Morison, Skanda, Project Manager Dipesh Pribari and Project Chief Engineer Leonard Schürg. Their collective goal was to demonstrate that poor coastal communities with limited resources could nonetheless conceive and execute an innovative method of recycling and reusing plastic waste. With the completion of its demonstration voyage, the cheerful little vessel proved that ocean plastic waste need not be an ecological tombstone, and that with some determination it can be reclaimed and transformed into a useful product.

EMBODIMENT OF A U.N. VISION

After its voyage, the now-famous boat was transported overland from Zanzibar to Nairobi, where in the following month it became the centerpiece monument for the Fourth United Nations Environment Assembly, the world's highest-level environmental forum. The vessel was hailed as both a symbol of African creativity and a powerful example that anyone, no matter their means, can achieve something meaningful in the fight against plastic pollution of the world's waters.

The connection between *FlipFlopi's* trip and the UN meeting was not accidental. The voyage was supported by the Clean Seas campaign, an initiative of the United Nations Environment Program (UNEP) that since 2017 has been urging governments, businesses and citizens around the world to reduce marine litter and ban single-use plastics by the year 2022.

High-tech plastics have changed life on earth for the better, making miraculous medical procedures and life-changing technologies available to everyone; but low-end disposable plastics, carelessly discarded and forgotten, become marine (and soil) pollution that is now a health threat to sea creatures, birds and people globally.

How much plastic really is in the ocean is anybody's guess, but it is clearly a tremendous amount and present everywhere – afloat on the surface, suspended in the water column and lying on the sea floor. Plastic bags have even been found in the Mariana Trench, the deepest part of the ocean, at depths over 10,000 meters (nearly 6.5 miles).

The UNEP estimates that more than eight million tons of plastic waste enters the world's seas and waterways each year, and that as much as 80 percent of all litter in the oceans is some form of plastic. UNESCO (the United Nations Educational, Scientific and Cultural Organization) further estimates that plastic pollution kills some 100,000 sea mammals each year – one recent dramatic example being the young beaked whale found dead in The Philippines' Davao Gulf in March, which died of starvation in an ocean full of food because its stomach was blocked by 88 pounds of shopping bags, rice sacks, nylon rope and other plastic waste.

The situation is only getting worse, as developing nations in Asia and Africa have become world leaders in plastic pollution. According to the UNEP, fully 60 percent of all plastic that ends up in the ocean is generated by just six countries in Asia.

Plastic waste in its original size entangles, injures and chokes sea creatures, but over time breaks down into microparticles (below five mm in size). These are joined by microplastics, or microbeads, intentionally produced for use in such products as exfoliating body scrubs and cosmetics, which get flushed down the drain and wind up in the sea.

Investigating this issue, the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP), a U.N. advisory body, issued its Guidelines for the monitoring and assessment of plastic litter and microplastics in the ocean, a new set of publicly-available guidelines for monitoring plastics and microplastics in the oceans, with an eye to harmonizing the ways scientists and others sample, record and assess the scale of the marine plastic pollution problem. GESAMP previously produced Sources, Fate and Effects of Microplastics in the Marine Environment, a two-part microplastics report released in 2015 and 2017 investigating the origins and impact of microplastics pollution.

Microplastics have been found with increasing frequency in tiny sea creatures at the bottom of the food chain and in the fish that eat them, and thereby have doubtlessly entered the human population through the dinner table, although no hard facts are available on that penetration nor any threat to human health posed by micro-plastic ingestion. Still, the possibility that the human race may be slowly poisoning itself, as well as the planet, has been enough to garner growing global support for the Clean Seas campaign and other ocean health initiatives.

INITIATIVES FOR THE MARITIME INDUSTRY

Although discharging plastics into the sea is already prohibited under the antipollution regulations of

the International Convention for the Prevention of Pollution from Ships (MARPOL), the problem persists. The situation has drawn action from the International Maritime Organization (IMO), the U.N. body that regulates the maritime industry, and is also its leading force combating ocean pollution.

Among its many activities, IMO is a member of the Global Partnership on Marine Litter, a program managed by UNEP, and co-leads various efforts to shut down sea-based sources of marine litter in cooperation with the U.N. Food and Agricultural Organization (FAO). Efforts undertaken by this initiative include development of training packages and a review of plastics in waste streams. IMO has also contributed to the development of the Massive Open Online Course (MOOC) on Marine Litter, which was created in order to stimulate leadership and provide opportunity for actionable and change-oriented learning related to marine litter.

In 2018, IMO's Marine Environment Protection Committee (MEPC) adopted the IMO Action Plan to Address Marine Plastic Litter from Ships, which recognizes the wide range of land and sea-based activities through which marine plastic litter enters the marine environment and provides IMO with a mechanism to identify specific outcomes, and actions to achieve these outcomes, in a way that is meaningful and measureable. The Action Plan, which supports IMO's commitment to meeting the targets set in the U.N.'s 2030 Sustainable Development Goal No. 14 (regarding the oceans), notes that marine plastic litter enters the marine environment as a result of a wide range of land- and sea-based activities, and that both macroplastics (large plastic items such as plastic bags, bottles and fishing gear) and microplastics persist in the marine environment and produce negative effects on marine life and human health. The plan builds on existing policy and regulatory frameworks, and identifies opportunities to enhance these frameworks, and introduce new supporting measures to address this problem.

Specific identified measures include: a proposed study on marine plastic litter from ships; improving the availability and adequacy of port reception facilities; making the marking of fishing gear mandatory, in cooperation with the FAO; encouraging the reporting of lost fishing gear and the delivery of retrieved fishing gear to shore facilities; reviewing provisions related to education of seafarers and fishing vessel personnel on the impact of marine plastic litter; enhancing public awareness of the plastic pollution problem; and strengthening overall international cooperation on the matter.

The MEPC agreed on actions to be completed by 2025, which relate to all ships, including fishing vessels, the concrete measures and details of which will be further considered by the Committee when it meets in May 2019.

Amid this growing global awareness and activity, the success of the *FlipFlopi* demonstration voyage stands as an encouraging symbol that even the seemingly most far-fetched dreams in the fight against marine pollution can bear fruit, if the right spirit and cooperation are behind them.

Project Manager Dipesh Pabari says this victory is just the start of their true voyage, and hopes it will help realize the team's original dream of building a full-size 20 meter dhow and sailing it around Africa and throughout the wider region to spread their message of environmental mindfulness, recycling and the elimination of single-use plastics.

"For people to see her now in the flesh, so to speak, and to know that she sailed 500 km and back untouched, will, I hope, inspire other innovations and make people less skeptical about joining us to make a full-size boat," Pabari says. He estimates this would require around U.S. $1.5 million and hopes industry might now be persuaded to support the project.

The spirit of the voyage was captured by Siim Kiisler, Minister of the Environment for Estonia and President of the Fourth UNEP Assembly, when the *FlipFlopi* reached the shores of Zanzibar.

"The Clean Seas/*Flipflopi* expedition inspires citizens from Africa and around the world to become more aware of one of the most urgent environmental issues that we face," Kiisler said. "By undertaking this heroic journey, the team has proven what is possible when we apply innovative solutions to the challenge of plastic pollution." ■

AN INNOVATIVE SOLUTION ACCESSIBLE TO ALL

The great vision behind the FlipFlopi project was not to build a boat out of garbage, but to prove that a high-tech concept can be achieved with low-tech means, and that anyone, anywhere who is drowning in plastic waste can create industrial potential from their problem and bring their homeland a little closer to the ideal of sustainable development. Readers may naturally be wondering whether the boat really performs, and on that account Surveyor recently took the opportunity to have a brief question-and-answer session about the vessel's performance with Project Chief Engineer Leonard Schürg.

Surveyor: ***When sailing, how robust did you find the boat to be?***

LS: The boat felt very stable in the water, as solid as a wooden dhow. Due to the relatively high empty weight of the boat, it feels like a dhow with some cargo in it.

S: ***The flipflop paneling is glued together. Did it hold up during the voyage?***

LS: It did hold up very well, no panels were lost during the trip. The issue that we see is the fading of the colors due to the UV light.

S: ***What was the biggest challenge in getting to this point?***

LS: That depends on whom you ask. Finding financial support for a quest such as ours has proven difficult. Working with the variable quality of recycled plastic products was also not easy. And, strangely enough, finding a fully recycled plastic sail has also proved difficult and quite complex; we are still pursuing options to make one from plastic waste. For now, we are using a traditional cotton sail, just as has been used on dhows for centuries.

S: ***Is it fair to say that the parts are simple to manufacture and assemble, and that anybody who is drowning in waterborne plastic waste can make a FlipFlopi?***

LS: It is and was always our intention to use low-tech methods to enable others to freely copy our model and build their own constructions. There is definitely some knowhow to it that helps get it done. We are working on documents to share this information in a structured way. Recycling the plastic into parts requires a bit of machinery — but these machines that are available in larger cities – and assembling those parts into a boat still requires the knowhow of traditional boat builders.

S: ***Would you share some hopes for FlipFlopi, as a boat and as a concept, for its role in growing the consciousness about ocean plastics?***

LS: For us the boat is a vessel for communication. We have seen, with the worldwide attention in the media that we got, that it works. We have successfully brought this topic to the attention of people that did not engage with it before. We believe that, if we with our low-tech approach have found a way to give single-use plastics a second life, it can be done over and over again. If you can build a boat, you can build a walkway, a table or anything you can think of. We hope to build a fully seaworthy boat that can spread this message to all corners of the earth.

VIEWPOINT

BUILDING THE FUTURE ON THE EXCHANGE OF IDEAS

George Bernard Shaw once said, "If I have an apple and you have an apple and we exchange them, we each have one apple; but if I have an idea and you have an idea and we exchange them, we each have two ideas." That fine thought succinctly sums up the spirit of trade exhibitions such as Nor-Shipping, which for more than a half-century has fostered the exchange of ideas and the sharing of information in the service of inspiring innovation and bettering its industry.

Among the big topics of discussion today are digitalization, automation, machine learning and big data analytics, technologies on which we will build stunning achievements. As stakeholders in the marine and offshore industries simultaneously pursue both near- and longer-term technological, business and sustainability objectives, they must necessarily place increasingly stringent performance demands on marine and offshore assets. The new tools of the digital revolution will be the core capabilities enabling those achievements.

Building the future requires constant advancement in computing and digital technologies – a challenging task because our best efforts can be hindered by cyber threats, dangers that are simultaneously formless, intangible, unpredictable and, potentially, devastating. For this reason, cyber security is the foundation of safe and sustainable operations in the Digital Age, and should be at the heart of any digitalization program. Unfortunately, business leaders often view cyber security as a technical matter requiring technical solutions. The reality is that cyber security requires continuously self-improving comprehensive solutions – and that these solutions are only part of an overall safety regime that, although built of computer technologies, is made effective only through the vigilance of its users.

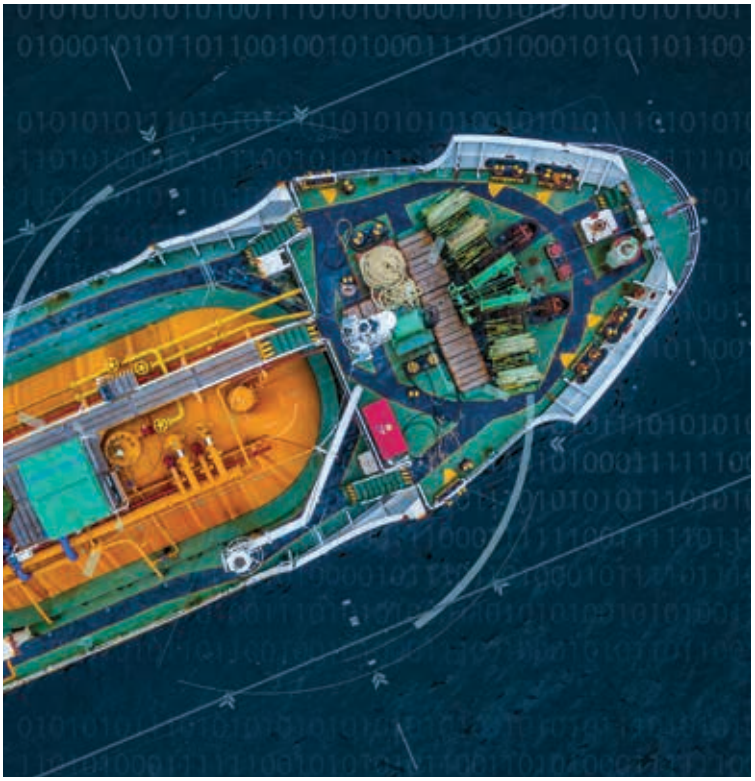
As vessel technologies advance, they require an increasingly vast array of functions to support the complexity of their operations, using such technologies as smart sensors and even smarter analytics to decode and understand the secret messages within the oceans of data they collect, and to derive from them the insights that will inform the future.

That said, we must strive to ensure that these technologies, which are certain to direct the evolution of our operations, will not distract from but only enhance our common concerns for environmental protection and workplace safety.

Going forward, our concerns and needs will evolve with our capabilities and successes, and as a result we will turn increasingly to technology for solutions. Many technology initiatives will support our journey toward a sustainable future: using digital technology to simplify transactions and increase operational efficiency; assessing alternative fuels and new energy sources in different sectors; developing new designs that accommodate the building of our businesses while achieving the relevant Sustainable Development Goals.

Christopher J. Wiernicki,
Chairman, President and CEO, ABS

The goals of operational efficiency and emissions reduction require improvements in quality and consistency, great attention to change management and, above all, an unrelenting focus on safety. In terms of carbon reduction, industry faces regulatory, operational and technical obstacles that will demand the very best of our engineers, designers, strategists and regulators. Altogether, this new future which we are trying to design will require collaboration, a unity of purpose that transcends all differences, whether commercial, geopolitical or personal.



There is a long way to go in a comparatively short time, but if we proceed mindfully, we can ensure that digital technologies will be a key enabler in our quest to build a cleaner, better, safer, more profitable and more sustainable future – but they will not be the prime movers of that future. Whatever course forward we take, we must never forget the people whose hands run the machines, so to speak, and must endeavor to ensure that health and safety are never compromised as we proceed.

History shows that our legacy to the future will not be measured by the extent to which we advanced technology or bettered our businesses, but by the extent to which we improved the human condition and protected the environment while we did so.

And on the distant day when Nor-Shipping celebrates its centenary, I believe that it will also celebrate our having reached that goal in a safe and sustainable manner as our greatest collective achievement. ■

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