Twentyfour7.

Wärtsilä Stakeholder Magazine

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inno vation SPECIAL ISSUE

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*Wärtsilä Stakeholder Magazine**

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in detail

Around the globe

Sign off

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The quest for a better life

HOW ARE INNOVATIONS BORN? Out of different circumstances, I'd be inclined to say. Some out of necessity, some through frustration, some just out of pure creative joy. And, at times, even accidentally.

Regardless the origin, innovation takes the world forward every day. In the end, it's a quest for a better life that we're pursuing through our innovative efforts.

The pace at which we come up with new ideas seems to get faster with every passing day. One of the hottest buzzwords around innovation is 'disruption' – a revolutionary product, service or business model that turns the markets upside down. This puts us all under pressure. We are constantly looking for the next thing, whether it's a wearable gadget on our body, a nifty mobile app or revolutionary industrial design.

As our Willie Wågen says in his column (page 75), at Wärtsilä we have always been innovators. But today we need to be faster than ever in applying new ways to doing things in order to shape our markets. Speed and agility are inherent in the startup world, so we turned to this crowd to find some inspiring collaborators. We launched the Wärtsilä Marine Mastermind competition with the aim to find suitable partners to inspire us and thus to take our digitalisation further.

In these digital and disruptive times, it's easy to forget that usually innovation is born only after a great deal of hard work. At Wärtsilä, the lifespan of our products can be up to 50 years. So we invest a great deal of time in R&D to further increase their lifecycle performance. But what if we could speed things up a bit? We asked ourselves this question and organised Wärtsilä's first Hackathon event. A great deal of pizza was consumed during the 48-hour long stint, but it was well worth it. Many new ideas were born, and the seed of a startup mentality was planted in our minds.

Ship design has occupied man's mind as long as we've travelled by sea. And it's still very much on ours. We've recently created six new design concepts to challenge conventions with truly efficient and green solutions. In addition to our future-oriented approach, Wärtsilä aims to bring in practical solutions that are disruptive in our world. Recently, we have introduced two such projects in Norway. One is an electric ferry and the other a biogas plant that uses paper mill slurry and fishery waste as fuel. Not to mention our new solar hybrid energy solutions – truly a first of its kind.

Despite our lives getting better with innovations, they are not always welcomed with open arms. Such was the case with the new Tokyo fish market, powered by Wärtsilä. The new market will be much more energy-efficient and will use locally produced clean energy. Still, Tokyoites will miss their former fish market. Such is the nature of innovation: to give way to something new, you may need to say goodbye to something old and dear. But more often than not, things tend to get better with new innovations. That's why mankind is so keen on the next thing. As are we at Wärtsilä.

I hope you enjoy our stories!

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ASILY THE BEST

power generation.

WÄRTSILÄ

around the

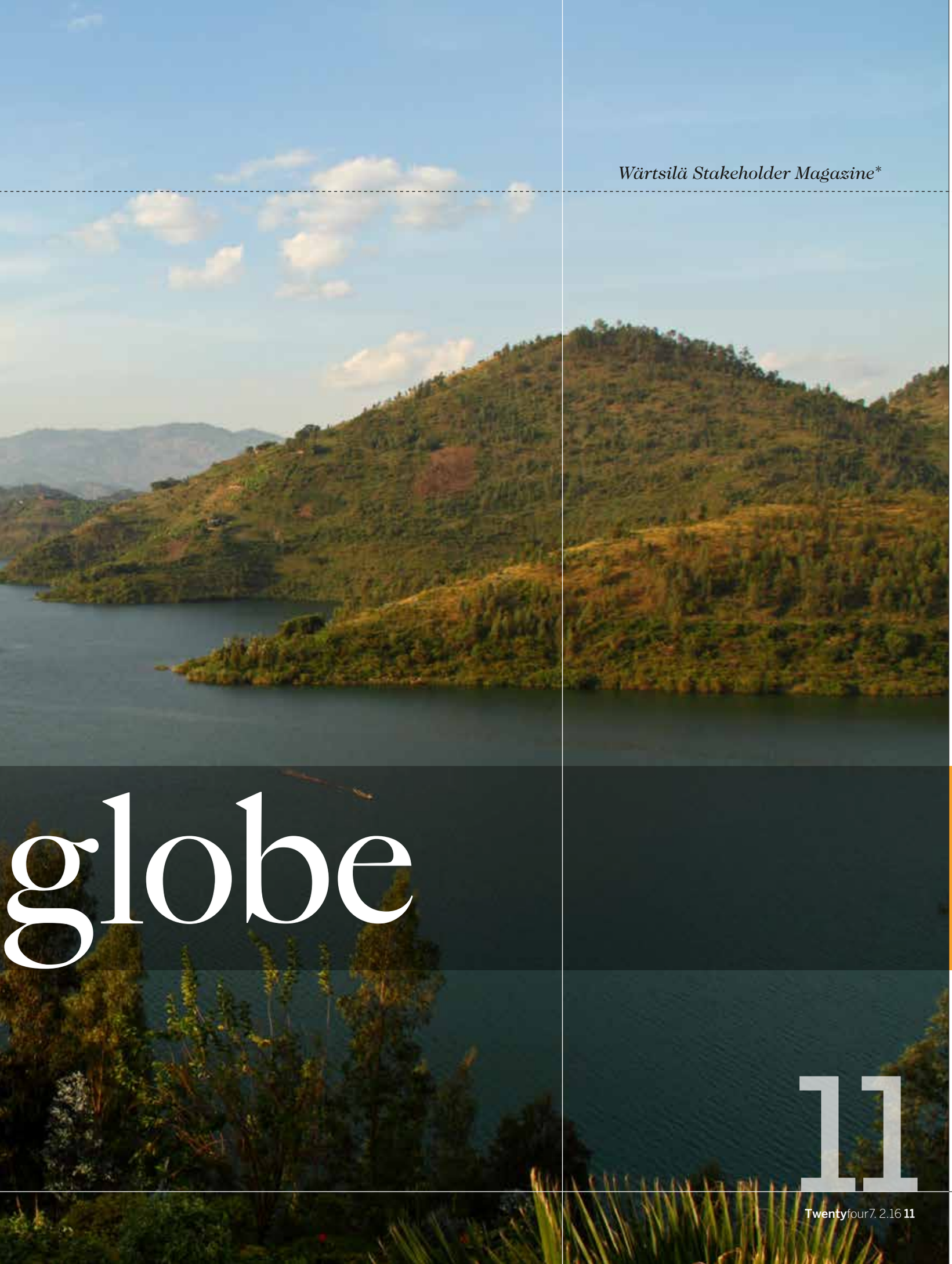
NEWS & ONLINE | GLOCAL WATCH | WORDS & NUMBERS | TRENDS & SCENARIOS | CORPORATE CITIZENSHIP

Fending off danger

PHOTO: iSTOCK / RYAN FAAS

LAKE KIVU, ON THE BORDER of the Republic of Congo and Rwanda, is a beautiful sight. But danger lurks below the water. At any time, there might be a limnic eruption, also known as lake overturn. In this rare type of natural disaster, a change in underwater pressure, temperature, or saturation of dissolved carbon dioxide (CO_2) causes a sudden gas eruption, bringing with it wide destruction. It can suffocate wildlife, livestock and humans. In Lake Kivu's case, there's also trapped methane, which contributes to the lake's nickname: The Killer Lake.

Luckily, the methane can be put to good use. Inaugurated in May 2016, KivuWatt, a 25-MW Smart Power Generation power plant, runs on methane from the lake. The plant, powered by three Wärtsilä 34SG engines, will not only provide much needed electricity – before KivuWatt, less than 25% of the Rwandans had access – but will also substantially mitigate the risk of a human and natural catastrophe. Future planned expansions to this project will increase the output by an additional 75 MW.



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globe

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News

BIG AND BEAUTIFUL

Royal Caribbean International's *Harmony of the Seas*, now the world's largest cruise vessel, launched into commercial operation from the French port of Saint-Nazaire on May 12. The 362-metre ship is a bonanza of Wärtsilä technology. Featuring Wärtsilä engines, propulsion equipment, exhaust scrubber systems, Wärtsilä Nacos Platinum navigation and dynamic positioning systems, as well as Wärtsilä CCTV systems and various electrical and automation solutions, the vessel also benefits from technical management and monitoring under Wärtsilä Genius Services.

The Harmony of the Seas is powered by six (four 12-cylinder and two 16-cylinder) efficient Wärtsilä 46F engines, and four Wärtsilä CT3500 transverse thrusters ensure effective manoeuvring. With the world's biggest marine exhaust scrubber installation so far, the vessel can use the latest in exhaust cleaning technology to minimise sulphur oxide (SOx) emissions and comply with emission control regulations around the world.

The Wärtsilä Nacos Platinum navigation and dynamic positioning systems feature highly advanced integrated navigation technology. Other Wärtsilä Funa electrical and automation solutions, including a house light dimming system for all public venues, a dimming system for the suites and a low-resolution LED wall for the theatre, make the largest vessel also a visually appealing one.

Wärtsilä GLOCAL WATCH

EXCITEMENT
RESPECT AND TRUST

BRAZIL:
The Olympic Games kick off in Rio in August, and Sailing Team Finland heads into competition better prepared, thanks to support from Wärtsilä. In a sport in which wind is the fuel, the winners are those who best adapt to the climate and sailing conditions. By providing a training and equipment storage location at its site in Brazil, Wärtsilä enabled the team to maintain a base close to the sailing venue in Rio and get more practice in the local conditions. Hopefully, this readiness will help propel them to victory!

ENERGY
MAKE THINGS HAPPEN

USA/NORWAY:
The world's first ethane-powered multi-gas carrier, powered by Wärtsilä main engines, completed its maiden voyage in mid-April from Marcus Hook, Pennsylvania, USA, to INEOS's facilities in Norway. The capability to efficiently burn ethane boil-off gas as engine fuel eliminates the need to bunker because the vessel can make the whole round trip without refuelling. The importance of this capability earned the CIMAC (the International Council on Combustion Engines) paper on this topic the President's Award, given on the basis of a practical contribution to the future success of the engine industry.

DO THINGS BETTER
EXCELLENCE

SENEGAL:
The new Cap des Biches power plant that was inaugurated in Senegal in June proceeded from concept to live generation of electricity in just 14 months. The 53 MW Flexicycle plant comprises three Wärtsilä 46 internal combustion engines and a combined cycle heat recovery system. The power plant will feed electricity to the national grid under a 20-year power purchase agreement (PPA) between ContourGlobal and Senelec, the national electricity company of Senegal.

[WORDS & NUMBERS]

USEFUL DEFINITIONS AND NUMBERS OF INTEREST.

HAPTICS
is the science of applying tactile sensation and control to interaction with computer applications. Together with a visual display, haptics technology can be used to train people for tasks requiring hand-eye coordination such as space ship manoeuvres. With haptics you get an additional dimension to a virtual reality.

ANTIREFLECTION COATING
is a thin coating of a material applied to a solar cell surface. It reduces the light reflection and increases light transmission.

45,000

The number of sushi restaurants in Japan. But surprisingly enough, your average Joe in Europe will probably eat sushi more often than the Japanese. Outside Japan it's regarded as convenient takeaway, while the Japanese feast on it for special occasions.

NEVER AN OPPORTUNITY WASTED

TEXT: VICTORIA VEACH

One of the problems with industrial waste is how to dispose of it in an environmentally conscious way. A new project in Norway makes it possible to turn some of that trash into treasure – in the form of biogas – and to make it accessible for use as a clean fuel for large vehicles.

CAN DECOMPOSED PAPER MILL slurry and fishery waste take on a new life as biogas? A project started in Moss, Norway, in 2012 looked into the process of cleaning and liquefying such biogas for use as fuel. "The demonstration project was an immediate success," says **Arne Jakobsen**, Business Development Manager for Wärtsilä Norway. "So we were contacted by the municipality of Oslo to scale this up and build a plant in Vormsund, outside Oslo, and we now have another contract to build an even larger plant."

The new plant will be located at the paper mill in Skogn, a small village approximately 75 km north of Trondheim along the shore of the Trondheim fjord, and it will be the largest of its kind in Northern Europe – and quite possibly the world. Currently, paper mill waste slurry at the Skogn plant is treated with electrolysis before being released into the Trondheim fjord. The new biogas plant will replace this energy-intensive process while repurposing the waste into a clean fossil fuel alternative.

After the waste is collected, digested and converted into clean biogas, it is liquefied and cooled to -160°C, then stored in insulated tanks for use as transport fuel. Much of the biogas produced will most likely fuel Norwegian public transit vehicles – a sector that is currently a large consumer of fossil fuels.

THE COMPONENTS USED IN the liquefaction process are not new innovations – in fact, they are readily available and proven to be effective. The novelty is in the highly advanced process design and control system that has been expressly built to liquefy small, methane-based gas streams. According to Jakobsen, "What makes this special is that we use traditional components and a unique mix of refrigerants that circulates in the system. This enables a short delivery time and high efficiency. The innovation is coming up with the idea of the concept, making it a commercial product and putting it into operation."

The cryogenic liquid biogas has two primary advantages over compressed gas biofuels: the distribution of the fuel to the customer and the usage of the fuel. Jakobsen explains that, "With compressed gas, the customers need to be within a 100- to 150-kilometre radius. But the liquid biogas can be transported 1000 kilometres and still be competitive, which is what makes this commercially viable."

This fuel has a variety of potential uses, strengthening its position as an advantageous fossil fuel alternative. One of the big advantages of liquid biogas is that it can easily be converted to compressed gas for gas buses, and the liquid biogas can be used directly as fuel, when a heavy vehicle or vessel would require too large a volume of compressed gas to store it onboard.

The fact that Wärtsilä is able to scale up this process significantly – to a capacity of 25 tonnes of liquid biogas per day – is also impressive. "It is a game-changer in the biogas fuel market," says **Øystein Ihler**, Development Director of Climate and Energy Programme for the City of Oslo.

SCALING UP THE PRODUCTION and use of liquid biogas will provide several environmental benefits. Perhaps the most important advantage is the replacement of fossil fuels with no net production of carbon dioxide (CO_2). Additionally, waste becomes an input rather than an output, thereby reducing overall waste treatment and storage. And finally, sulphur oxide (SO_x) emissions, a primary cause of acid rain, as well as emissions of nitrogen oxide (NO_x) and small particulate matter, which causes poor air quality, are virtually eliminated.

As new and tougher environmental targets continue to be set, especially after the landmark agreement resulting from COP21 in December 2015, the future of fossil-fuel-reducing alternatives like liquefied biogas is bright. Now that the biofuel can be produced economically and sustainably, plants like this one can pave the way for reductions in fossil fuel use and greenhouse gas emissions. The next step is to expand its use. As Jakobsen explains, "To meet the targets in time, we need to reach the largest users of fossil fuels and provide them with biofuel instead."

[TRENDS & SCENARIOS]

FUTURE PERSPECTIVES.

Don't touch my bicycle!

Just when you mustered the energy to bike to work you face another problem: how to keep it safe from thieves while you are inside the office? Bicycles equipment is among the most craved loot: easy to steal and sell to someone else.

Fear no longer: **Slava Menn**, an MIT alumnus, has developed a theft-proof and weather-proof bicycle. It's equipped with custom, theft-resistant components, including a U-lock, lights, handlebars, wheels, and seats, all attached with custom bolts that can only be removed with a special screwdriver.

THIS IS THE HOUSE THAT WÄRTSILÄ BUILT

[CORPORATE CITIZENSHIP]

Colleagues in the Wärtsilä offices in Argentina set out to support TECHO in building transitional housing outside Buenos Aires. But the volunteers also ended up building up each other, their self-confidence and their organisational unity in the process.

TECHO, A YOUTH-LED NONPROFIT organisation in Latin America and the Caribbean, aims to overcome poverty in slums through the joint work of impoverished families and individual or corporate volunteers. Several months ago, **Jean Paul Claisse**, SUANDES (Service Unit Andes), Contract Management General Manager at Wärtsilä Argentina, shared the idea of a volunteer project with TECHO with **Fernando Pascual**, the local Human Resources Coordinator. Coincidentally, Pascual knew is a passionate TECHO volunteer in the north, and he urged Pascual to get in touch with someone from their organisation in Buenos Aires.

Housing is an acute need in most slums, and building a concrete and achievable short-term solution helps create trust between the volunteers and the community to work together on future community interventions. So TECHO, through the participation of volunteers and community members, constructs prefabricated modular homes of 162 square feet that can be completed in two days.

Wärtsilä's volunteer team included staff from the office in Buenos Aires as well as two members from a Wärtsilä-operated plant in South Patagonia, which was a great opportunity to bring together employees from different places and backgrounds to work in a non-job-related activity. The team received lots of support from TECHO with logistics, prefabricated materials, tools and a project supervisor who led the construction.

AFTER TRAVELING 50 KM to the north of Buenos Aires, the team set to work. No one was idle. Everyone found a task to do, even if it was something he or she had never done before. In the process, some surprised even themselves by saying, "I didn't know that I could do this!" **Caro Chico**, GM Assistant, noted that women were on the roof hammering and doing all the same tasks their male colleagues were doing.

Andrés Gudiño, Sales Support Coordinator, just moved to Wärtsilä Argentina from Ecuador, through the job rotation programme, two days before the project began but had the opportunity to participate. Seeing how people encouraged and supported each other with new or difficult tasks, Gudiño was "impressed by all the positive effort and teamwork" displayed by his new Wärtsilä colleagues.

After a really long day of very physical work, due to the rainy conditions, the exhausted team discussed their progress on the bus back to Buenos Aires. Although it was not originally planned, TECHO brought up the idea of providing the electrical installation in the house. Despite the short time to prepare, the Wärtsilä team asked for the supply list and installation instructions. **Federico Picchioni**, Contract Manager, Wärtsilä Argentina & Wärtsilä Uruguay, said, "I cannot leave this house without electricity. We are doers and a team of engineers, so why shouldn't we be able to do this for the family?" Undeterred by his exhaustion, Picchioni decided to go buy the materials that night. Finally, **Sergio Bauer**, Cerro Vanguardia Plant Manager, built the kit and spent all the second day installing the system.

IT IS TO WÄRTSILÄ'S credit that the house the team built is the only one – out of 12 houses in the neighbourhood built by volunteers – with electricity.

The family receiving the house reaped other benefits from having Wärtsilä on their side. Although there were some debates amongst the engineers about the best way to do certain tasks, they came up with their own improvements to the structure's design. For example, **Alberto Fernández**, Managing Director, Wärtsilä Argentina & Energy Solutions Regional Director, proposed a different way to install the windows that improved the insulation. **Gonzalo Romano**, Plant Operator, designed and built steps for the house entrance and **Marcelo Romero**, EHS Coordinator, wired a chandelier to the front porch so the house also would have some exterior lighting.

To celebrate the end of the construction, we shared with the family an *asado*, or Argentine grill, done by **Martín Pereyra**, Workshop Foreman, one of our barbecue specialists! **Gabriela Gómez**, Accountant, and Chico brought balloons for the kids, adding a festive vibe, and someone donated a wall hanging to bring some colour to the house's interior.

Although it was gratifying to work hard and complete the project, the greatest reward was the "customer" feedback. The children jumped enthusiastically around the house, and the parents gave thanks for everything the team had done but especially the electricity, which means they can heat their home in the winter. Even the TECHO team leader was impressed with the work Wärtsilä had done, saying, "Are you sure this is your first house?"

TEXT: ANNA AISTRICH **PHOTO:** TECHO

Teaming up with graduates in the lab

ENERGY IS ABSOLUTELY INDISPENSABLE for everyday life. Energy is also right at the heart of our core business. To be able to meet future demand and develop solutions that are right on target, we need to have the right-minded people on board with the right set of skills.

As energy is spanning over such a broad range and has a global reach, we have to meet our objectives through networking. We are fortunate to have a strong R&D hub in Vaasa, home to a big energy cluster. Energy Vaasa is the leading energy cluster in the Nordic countries with more than 140 businesses, many of them global leaders in their chosen fields. Together the companies boast a total turnover of more than EUR 4 billion and employ more than 10,000 people in the area.

A company's R&D unit is only as good as the people working there, and consequently we are very mindful of our R&D staff. We want nothing but the best minds. They are brewed already at university, and that is why we at Wärtsilä want to take an active part in co-investing and supporting the university sector. We are particularly happy to be part of the new energy laboratory that was finalised this summer. Housed in the Vaasa University, walking distance from our R&D premises in Vaasa, it boasts both a fuel laboratory and one focusing on engines. Our target is to conduct joint domestic and international R&D projects and together with young and innovative people build world-class research competence in the field of energy.

The energy markets are going through rapid change, and this calls for a flexible research facility where we can study and develop smart power generation concepts along with other future energy systems connected to wind, solar, energy storage and hybrid systems.

Although the world is changing rapidly and there are new types of energy sources available – we recently entered into the solar business – the combustion engine remains as relevant as ever. High efficiency, the possibility of using different types of gaseous and liquid fuels – including renewables – as well as a good fit with intermittent energy sources like solar and wind have given the combustion engine an even more extended dimension as an energy converter. With the brand new lab we will have the possibility to dig further into this together with the innovative attitude and fresh energy that comes with young university students.

ILARI KALLIO
Head of Engine R&D

ALTHOUGH THERE ARE NEW TYPES OF ENERGY SOURCES AVAILABLE, THE COMBUSTION ENGINE REMAINS AS RELEVANT AS EVER.

PHOTO: JUHA MYLLYMÄKI

TEXT ANNA AISTRICH **PHOTO:** JUN TAKAGI

Some critics worry that the fish market's move, from its present location near Ginza to the developing Toyosu area along the Tokyo waterfront (seen above), may cause the market to lose some of its traditional character. However, the new site will have an 80% larger facility, which includes more space for restaurants where visitors can sample the fresh sushi and sashimi.

REINVENTING TRADITION

When thousands of people descend on Tokyo for the 2020 Olympic Games, many will sample Japan's most famous food, sushi. What they may not realise is that the new, ultra-modern facility providing the highest-quality wholesale fish reflects Japanese society's changing attitudes about the ways power is generated and consumed.

THE NEW TOKYO FISH MARKET IS A PRIME EXAMPLE OF THE MOVE TOWARDS EFFICIENT AND LOCALLY PRODUCED ENERGY.

At the dock, the power plant's new giant engine is hoisted onto the transport truck. Securing it for the journey is critical.

It's 3 am Monday morning in Tokyo, a megacity nearly constantly in motion. Since most commuters are still asleep, traffic on the roads is light, but there is still plenty of activity. Moving slowly, an unusual sight appears – a hulking 70-tonne, nearly five-metre-tall figure cruising through central Tokyo. No, it's not Godzilla. This giant blue mass riding on a 16-metre-long flatbed truck is a huge mass of metal. It could pass for a reclining robot, but it's actually a gigantic engine destined for a new power plant.

With the enormous amount of sushi that Japanese consume, the amount of energy required to keep the supply going is significant. The same is true for other areas of Japanese life that outsiders consider iconic: neon signs, skyscrapers, endless vending machines and inventive gadgetry. However, the disaster at Fukushima following the Great East Japan Earthquake of March 11, 2011, sparked debate about the safety of nuclear energy and concerns around Japan's energy sector monopoly.

CHANGING ENERGY LANDSCAPE

Although Japan has made moves to deregulate its electricity market after the US. did so in the 1990s, it has been an uphill battle due to the strong political influence of monopoly power companies that had little incentive to improve. In fact, many government officials thought it was not possible to fully deregulate the sector.

But the accident upset Japan's reliance on nuclear to provide some 30 to 40% of the country's electricity and forced an increased reliance on fossil fuel imports, principally oil and liquefied natural gas (LNG). Depending on imports for nearly 85% of its energy mix has cost Japan up to USD 40 billion per year and made the energy prices among the highest in the world for consumers.

POWER TO THE PEOPLE

Taken together, these factors forced deregulation in April this year to create a way for municipal governments in Japan to find other ways to produce and supply clean energy, such as from locally generated renewables. This move makes Japan one of the world's largest-ever deregulated electricity markets, and the much-needed competition could force the energy sector to modernise and become more efficient, thereby lowering prices. In addition, Japan hopes the move will provide more flexibility in the energy mix and boost innovation and the economy by creating more business opportunities.

UPDATING AN INSTITUTION

The new Tokyo fish market is a prime example of this move towards efficient and locally produced energy. After operating for more than 80 years in the Tsukiji district of Tokyo's Chuo Ward, the market will move to the Toyosu district of Koto Ward in November 2016. Although the market facilities have undergone numerous improvements and expansions through the years, it was not feasible to entirely rebuild the ageing facilities at the current site due to the projected high cost and the challenges to adapt to an evolving distribution industry. Therefore, in 2001, the Tokyo metropolitan government decided to relocate the market to the new site, formerly the location of a Tokyo Gas Co. plant.

The Tsukiji fish market is one of 11 central wholesale markets

To ensure a safe passage to their new home, the engine components must travel in the stealth of night.

It's hard to say goodbye to the old fish market, but the new one will reflect a more energy-conscious Japan.

run by the Tokyo metropolitan government. As Tokyo's population has grown steadily since the 1960s, the demand for fresh food drove the expansions at Tsukiji and spurred advances in fishing and freezing technologies. For example, to deliver tuna to consumers without compromising freshness, the fish is frozen at sea – at the ultra-low temperature of -60°F (-51°C) – and kept as close to that temperature as possible through the processing and distribution process.

The market is now one of the largest in the world, in terms of its transaction volume of seafood, and the prices set at the Tsukiji market are said to serve as references for other fish markets across Japan. About 42,000 wholesalers and retailers work in or visit the market each day, according to the market's website. Although some critics worry that the move from its present location near Ginza to the developing Toyosu area along the Tokyo waterfront may cause the market to lose some of its traditional character, the new site (to be called New Toyosu Fish Market or Toyosu Shin Shijo in Japanese) will have an 80% larger facility. Included in that will be more space for restaurants where visitors can sample the fresh sushi and sashimi.

A NEW HOME

Toyosu itself is a large man-made reclaimed island originally created in the late 1930s. It is home to one of Tokyo's largest shopping malls, Urban Dock LaPort, opened in the 1980s, and Toyosu Park, a popular green space right on the waterfront where people can picnic, relax and play sports. As the former location of the Tokyo Gas plant, the island also houses the Gas Museum aimed at teaching kids about gas as a source of energy and heat.

The new fish market complex on the island will be within walking distance of the venues for the 2020 Tokyo Olympics. So the new power plant, called the Smart Energy Centre (SEC), may eventually power the Olympic village and Olympic game fields.

EFFICIENTLY FROZEN FISH

To use the most efficient and economical power generation sources to save energy and keep the fish at its freshest, the SEC will supply the market's needs. The SEC combines several power and steam generation technologies, including steam boilers, a dual-fuel gas turbine, a gas expansion turbine and a generating set from Wärtsilä. "The Wärtsilä 16V34SG engine, with an output of 7.2 MW, will be used for generating electricity, heat and cooling, and its multi-fuel capabilities will allow the plant even more flexibility for gas supplies," explained Wärtsilä Project Manager **Max Enegren**.

For this project, Tokyo Gas contracted Tokyo Gas Engineering Solutions (TGES) to establish the energy supply facility. Following the changes in the electricity market, "it was important that the engine could supply electricity independently and reliably," explained **Yutaka Shoji**, Senior Manager, Smart Energy Network System Department at TGES. "It is part of the TGES commitment to provide energy that is environmentally friendly," Shoji said, so the company sought a cogeneration solution from the beginning.

According to Shoji, the overall goal was to build a smart energy network that would improve energy security and reduce the environmental load. With the high-efficiency gas engine cogeneration system, power will be supplied to the fish

"You know, 13 years ago the authorities said the technology on board the Viking Energy was impossible to build. But people on this island are stubborn," says Lauritz Eidesvik.

TO DELIVER TUNA TO CONSUMERS WITHOUT COMPROMISING FRESHNESS, THE FISH IS KEPT AT AS CLOSE TO -60°F (-51°C) AS POSSIBLE THROUGHOUT PROCESSING AND DISTRIBUTION.

Although the market facilities have undergone numerous improvements and expansions throughout the years, it is not feasible to entirely rebuild the aging facilities at the current site.


エレトラック
東都小揚
No.2

FOLLOWING THE CHANGES IN THE ELECTRICITY MARKET, "IT WAS IMPORTANT THAT THE ENGINES COULD SUPPLY ELECTRICITY INDEPENDENTLY AND RELIABLY."

market and waste heat will be leveraged in the SEC. Then, in supplying electricity through private lines, the system power source can even act as a back-up electricity supply in case of a power failure. By employing a Smart Energy Network Energy Management System (SENEMS), real-time electricity and heat demand information would enable optimal control of the SEC. In addition, TGES hopes that the integrated information will allow customers to visualise their energy usage and to build their environmental awareness.

Not only has Wärtsilä collaborated with TGES (and its parent company Tokyo Gas, which owns the site) on several projects over the years – having installed 35 sets of Wärtsilä gas engines in Japan by the end of 2016 – its solutions could support the scale needed to power this critical Japanese institution and the surrounding area. Although "there are no buildings near the power plant and fish market currently, the plans are to build up a community once the electricity and heat production to the area are established," said Shoji.

HONOURING THE PAST

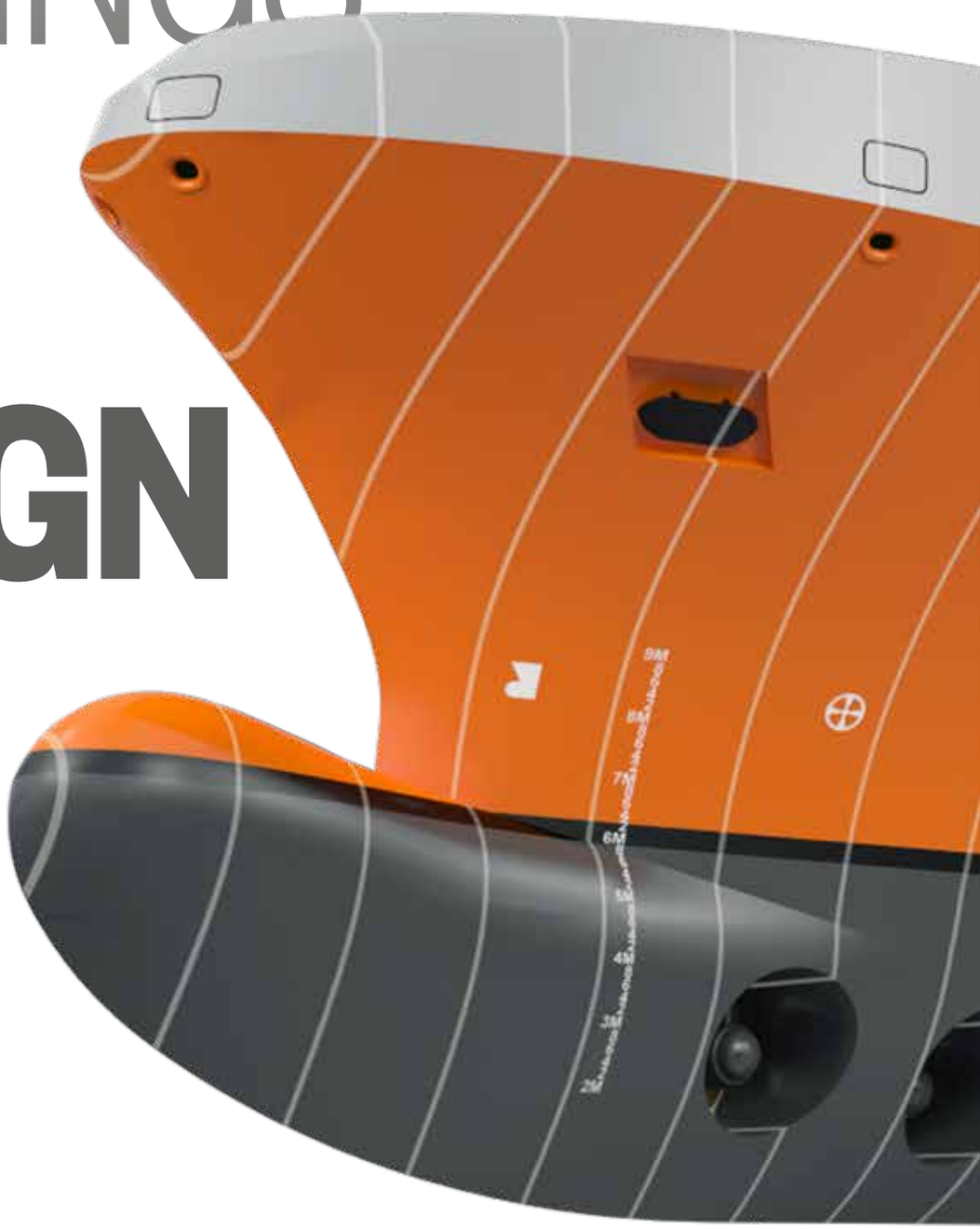
To say farewell to the beloved Chuo Ward site of the fish market, an estimated 150,000 people visited the site on May 3 for one last festival at the current venue. Workers at the market wore T-shirts reading "Thank you, Tsukiji" in Japanese while serving visitors seafood specialities from throughout Japan. Although it may be difficult to say goodbye to the past location, the new one promises to reflect the modern, energy-conscious Japan of today.

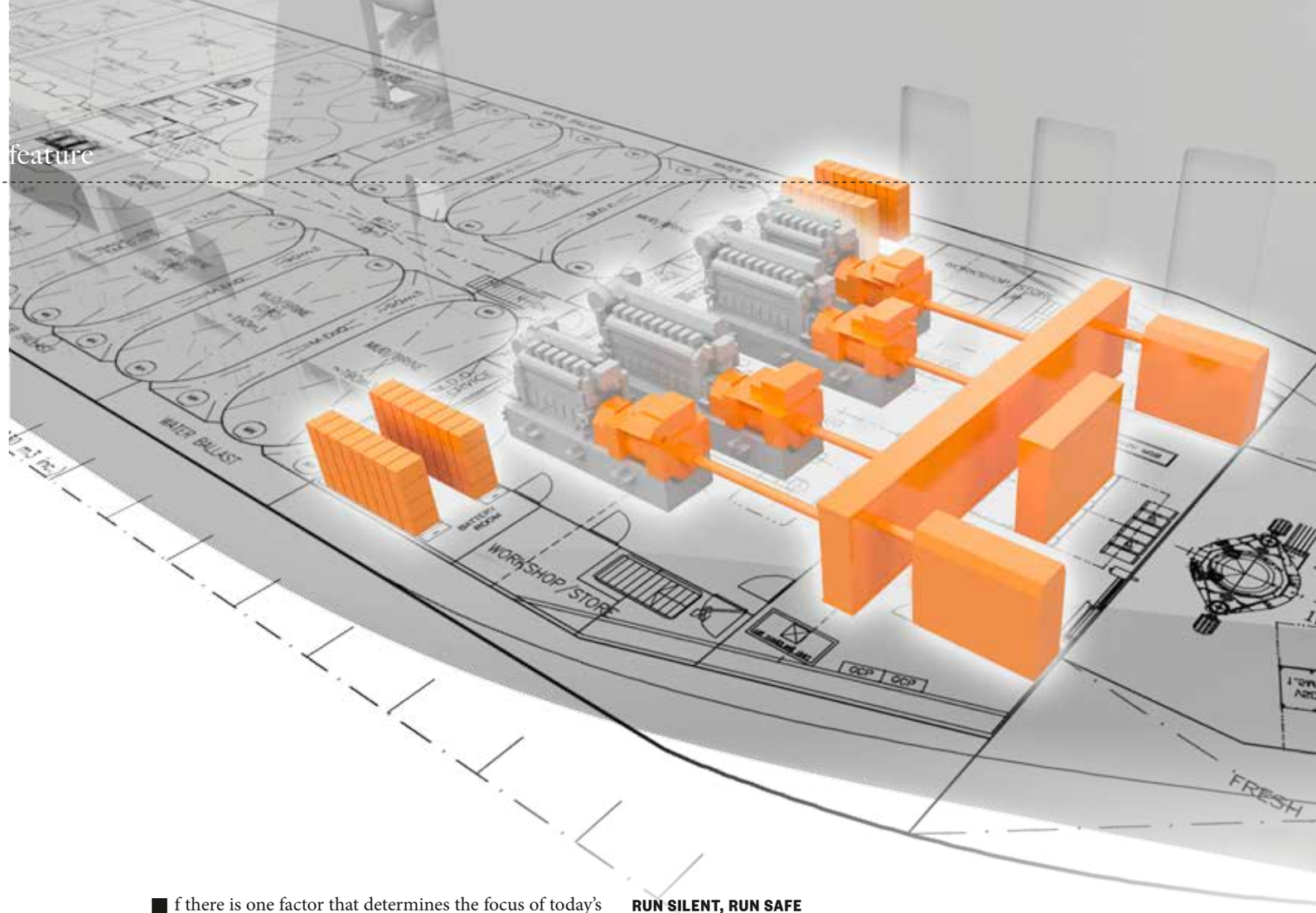
The Tsukiji market is one of the largest in the world, and the prices set there are said to serve as references for other fish markets across Japan.

TEXT: STEVE ROMAN **ILLUSTRATION:** WÄRTSILÄ

NEW HEADINGS IN SHIP DESIGN

Ship design is undergoing a period of full-throttle advancement, thanks largely to new-generation software tools and smarter approaches. The latest innovations are bringing about vessels that run leaner, cleaner and safer than ever.





If there is one factor that determines the focus of today's innovations, it is customer preference, says **Ove Wilhelmsen**, General Manager Sales at Wärtsilä Ship Design. And on this score, ship owners have made their demands crystal clear: "What we have now is a big movement towards more environmentally friendly solutions and lower fuel consumption."

An obvious place to start is the ship's fuel type, and here Wilhelmsen notes the growing shift from systems relying on diesel or HFO to cleaner alternatives such as LNG, not to mention the migration to dual-fuel options. He also predicts that hydrogen fuel cells could become a favoured choice in about a decade once the safety and regulatory issues have been tackled.

A farther-reaching improvement, however, has been in the power configurations of the ships – namely, the electrification of both the propulsion systems and the on-board machinery. Unlike a traditional setup where a large diesel engine drives the propeller, the newer systems are configured much like hybrid cars. An electric motor drives the propulsion system, either alone or as a boost function along with an optimised diesel engine, and there is an on-board battery bank that is charged when the ship has an excess of power and fills in when extra power is needed.

"We have seen different power configurations, but what we have seen lately is a lot more batteries. We evaluate batteries for most of the vessels we design now," Wilhelmsen said. Critically, this approach can lead to even more savings when traditionally hydraulic machinery like winches and fish pumps are replaced with electric equivalents – a trend that is picking up pace as new equipment is being developed. "Every time you convert from one power source to another, you will have some loss, so if you can make as much as possible electric, you will have less loss," Wilhelmsen explained.

RUN SILENT, RUN SAFE

Ship owners and designers have also become aware of the strong link between crew comfort and work performance, particularly in how better sleep can reduce accidents. The latest approaches in design put more emphasis on noise reduction.

"A lot of it is about the arrangement," said Wilhelmsen, "where you put the wheelhouse and the cabins in relationship to the engine room and bow thrusters." Some ships are using their bow thrusters constantly to stay in position. So switching to a new type of RPM-controllable thruster can go a long way in dampening the sound.

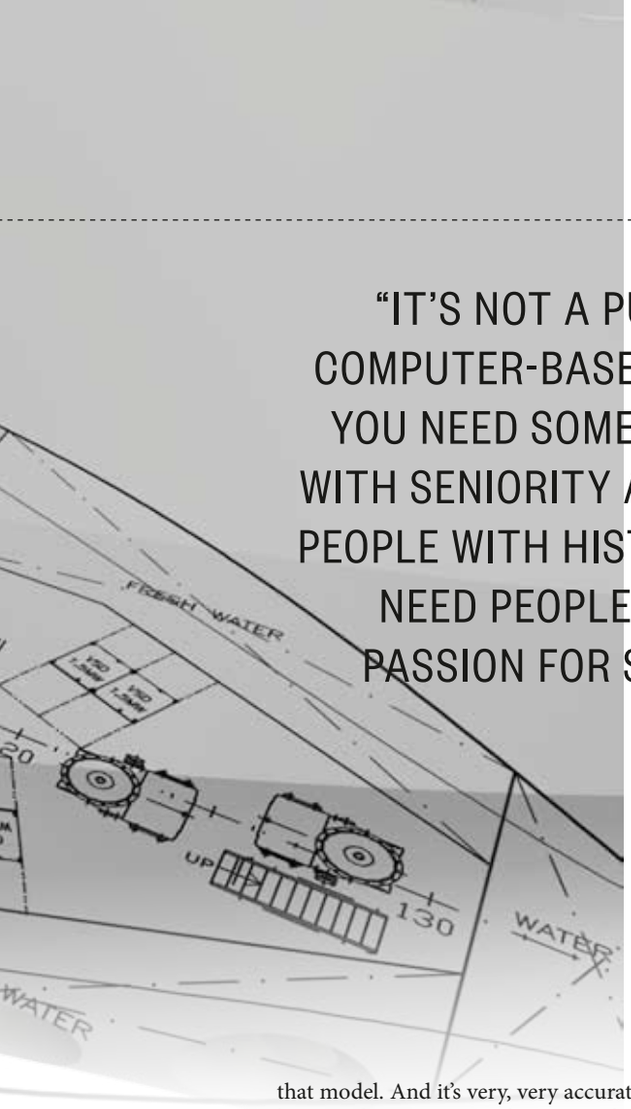
Material choice can also help. Using concrete, floating floors and insulating materials while avoiding steel can further reduce vibrations and improve the quality of life on board.

THE GAME OF COMPROMISES

One of the most fundamental – and complex – areas of ship design has always been finding the right hull shape for the specific need. This process of 'hull optimisation', as it's called, is critical for efficiency and performance. With a cargo vessel, for instance, having a larger vessel will let you haul more containers, but it will require more installed power and consume more fuel. You can make the hull long and narrow to increase speed, but then you lose stability. You can make it deeper to increase cargo capacity, but you won't fit it into shallower harbours. It's all about compromising to find the optimal shape.

"You need to evaluate this versus that all the way through," said Wilhelmsen. It's here that software advances in Computational Fluid Dynamics, or CFD, have been making an enormous impact.

"Earlier, when you designed a hull, you made a lot of assumptions. You did a lot of manual work, and then you tested the performance in a model tank. Today we analyse, we simulate and more or less build a model in the computer and test



"IT'S NOT A PURELY COMPUTER-BASED THING. YOU NEED SOME PEOPLE WITH SENIORITY AND SOME PEOPLE WITH HISTORY. YOU NEED PEOPLE WITH PASSION FOR SHIPS."

that model. And it's very, very accurate," he said, adding that because the computerised testing is done on 1:1 scale, it's actually more accurate than the model tank and takes two or three days as opposed to a month.

It's this ability to optimise hull lines, aided by the latest software tools, that helped Wärtsilä land a contract last year to build what will be the world's largest krill fishing factory vessel for China-based Jiangsu Sunline Deep Sea Fisheries, as well as the world's most efficient pelagic trawler for a Scottish customer.

CRAZY IDEAS

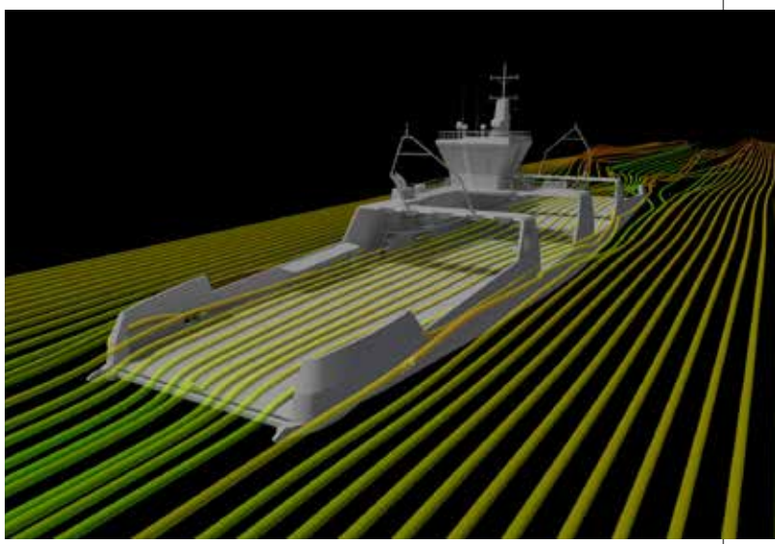
Computerised testing also gives engineers the ability to push design parameters to their ridiculous extremes in hopes of gaining new insights.

"It gives you the freedom to test out more wild and crazy ideas," said Wilhelmsen. For example, his team have toyed with the idea of fishing vessels that look like submarines, with only a bit of superstructure above the surface and the rest fully submerged.

"Of course, it's not really going to happen, but you can find out something really interesting by being able to do this," Wilhelmsen said. Like the concept cars at auto shows, these models will never make it into production but can provide interesting ideas and improvements later down the line.

As helpful as the design software is becoming, it still has its limits, Wilhelmsen cautions. "Of course, the new tools have made it much easier to see if you're on the right track and you can get the feedback much more quickly, but it's not a purely computer-based thing. You need some people with seniority and some people with history. You need people with passion for ships.

"It's like an architect when he designs a new house. Some people have it. Some people make square boxes. Some people do a little bit extra. And that really makes the difference."



DIGITAL EVOLUTION

Speciality software has been propelling the shipbuilding industry ever since the early 1960s, when automated plate cutting first came to shipyards. In the decades that followed, programs were developed for other design applications like steel structure engineering, piping, electrics and automation, stability, hydrostatistics, hydrodynamics and placement of deck equipment.

This set-up has historically been problematic, according to **Sigurd Underhaug**, General Manager IM and Process Development at Wärtsilä Ship Design. "To make a ship, you needed 10 different kinds of software, and transferring information from one system to another has been a challenge."

But the industry is now undergoing a tidal shift. In the last five years or so, integrated systems that cover multiple disciplines have become all the rage. Wärtsilä uses Siemens' NX, a popular choice for its strong core technology, and is in the midst of switching from 2D to 3D modelling in its architectural design phase. Though creating the models in 3D is far trickier than in 2D, Underhaug says the payoffs, especially avoiding costly, late-stage design fixes, are well worth the extra effort.

Further integration seems to be on the way: Siemens recently bought CD-adepco, the industry standard program Wärtsilä relies on for Computational Fluid Dynamics (CFD). Replacing weeks of work in testing tanks, CFD technology has already led to significant improvements in hull design, and the pace of change keeps picking up as the software itself becomes more advanced. The latest strategy being developed involves running tests in batches of about 100, each with hull parameters slightly altered. The process requires an enormous amount of computing power, but it provides the best shot at quickly optimising a hull to customer requirements.

TEXT: CAMPBELL BLACK **PHOTO:** HELGE HANSEN **ILLUSTRATION:** WÄRTSILÄ

ANOTHER HUNDRED YEARS

Willie Wågen, Director, Market Innovation, Wärtsilä Marine Solutions, heads the team of innovators responsible for the latest concept vessels.

A visual of the EXERGO, the first of the six new revolutionary vessel concepts.

A team of futurists have spun gold from global trends that threaten to disrupt the marine market. But disruption's not really a threat – it's a good thing when it saves money and is kinder to the environment. Wärtsilä's six new marine concept designs are now set to sail into the future.

When **Willie Wågen** met colleagues from across Wärtsilä in late 2015 to discuss nothing less modest than the future, people could barely contain their imagination. "It made me confident that this company will be around for another hundred years," says Wågen, who now heads a team of innovators that works as a complement to the traditional R&D department.

The team had summed up three trends that can't be ignored: green energy, digitalisation and the sharing economy.

"You read about these very general trends in the paper every day, and a normal reaction is to stick your head into the sand and wait for them to go away," says Wågen. "But we need to pull our heads out from the sand and ask what can they mean for us, and what they can do for us."

The assembly gave the team fuel for thought, and they headed back home to the drawing board. They then crystallised ideas rather than fully fledged blueprints: designs meant to stir the imagination, whet the appetite and make the market want to fill in the blanks because the possibilities are endless.

So what's in a name? Quite a lot of tech appeal, to start with,

as Wärtsilä unfolds its new concepts: Exergo, Zero, Z3, Liitos, Bean to Cup, and Convoy.

EXERGO

Described simply, the Exergo is a remote-controlled, battery-powered ship with a hull streamlined for greater efficiency and a crew on-shore. The Exergo could become the go-to for the cruise industry, for example. As ships grow larger, this would be a way to keep noise and emissions low, not least in ports where many residents have started to grumble about this swelling industry.

ZERO

Zero grumbling is also in the cards if you move the on- and off-loading of goods out to a nearby artificial island rather than keep large and noisy container ports on land. And that artificial island would run on seawater, no joke. Or rather, on hydrogen produced from seawater with a helping hand from solar and wind power.

Excess hydrogen can also be sold to visiting ships as fuel, keeping them clean and emissions-free, too, while small battery-powered ships ferry the goods to shore. These artificial islands could then also work as fuelling stations along the main trade routes.

Z3

Can Wärtsilä enter the value chain of shipping in a new and radical way? The key would be to provide propulsion power that's reliable and green, and, crucially, doesn't require that customers come up with a huge upfront investment.

LIITOS

Imagine joining up old and new ship operators (both Amazon and Huawei have plans to ship their own stuff) with a digital tool that makes sure no container ship sails cargo-free. Sharing assets saves money.

A few years ago, it would have seemed ludicrous that an online bookshop such as Amazon would buy its own ships, but nowadays the only rule is that there are no rules. The marine market needs to wake up and smell the coffee.

BEAN TO CUP

And if that coffee was ground just before the beans from far, far away arrived in your local port? That morning coffee, so beloved in so many places, is the best way to illustrate Wärtsilä's new concept of working with raw materials while en route. A floating factory, in essence.

"The salmon farmers in the North Sea have already picked up the same idea," points out Wågen. "They are designing a ship that picks up the fish at the farm, prepares them on board, then starts to pre-process on its way to continental Europe, saving five days of transportation time and saving them millions of euros."

CONVOY

Another real money saver is transforming wakeboarding from sunny Sunday sport to a Convoy of ships. Travelling in a peloton formation saves fuel because there's less resistance when you tailgate the ship in front. The lead ship would probably be manned, including an anti-piracy crew, but would also carry spare parts.

ON TOUR

As Twentyfour7. went to print, Wågen's team had hit the road to get feedback from and bounce ideas around with colleagues around the world. They've found that similar thoughts have been percolating in the minds of even the most conservative of marine market players.

"When we think of radical innovation, maybe my best example would be the iPad," Wågen says. "When it was made, it was not a radical technology. There was nothing new in the technology, and any of the big players could have made a tablet. But when it hit the market, it was completely new because it disrupted the Palm makers, the PC makers and the other market players."

THE DESIGNS STIR THE IMAGINATION, WHET THE APPETITE AND MAKE THE MARKET WANT TO FILL IN THE BLANKS BECAUSE THE POSSIBILITIES ARE ENDLESS.

Loading and unloading goods on an artificial island limits noise pollution and also provides an opportunity to produce clean fuel.

WINNOBOOSTER

Green energy, new business models and digitalisation are set to disrupt the marine market's whole value chain as we know it. So at Wärtsilä we have decided to increase our speed of reinvention. Not just in-house: we are now inviting our customers and partners to help disrupt the disruptors.

If you have a challenge, insight or an idea that you can't develop by yourself, come to us and let's discuss it. With our brand new **Innovation Board** model in Wärtsilä Marine Solutions – which we have called the Winnobooster – we are ready to collaborate on radical marine market innovation.

TEXT: SAMI J. ANTEROINEN **PHOTO:** KARL VILHJALMSSON

ELECTRIFYING **INVESTORS**

Wärtsilä's IR communications is going strong – thanks to transparency and killer visuals.

Investors are a demanding bunch when it comes to their daily dose of data. Providing fast, accurate, diverse information to investors has always been a strong priority at Wärtsilä. **Natalia Valtasaari**, Director, Investor Relations, comments that boosting IR communications is a long-term development effort that is rooted in the idea of constant improvement. For example, as the overall website of the company was completely retooled in the spring of 2015, the IR section also went through a dedicated renewal process.

"The most important thing in all this is fully understanding the needs of the stakeholders and finding ways to provide added value to that target group," says Valtasaari.

NUMBER ONE!

The strong focus on IR communications has paid off, too. For instance, Wärtsilä's Investor Relations website was selected the best in Finland in the large listed companies' category in April 2016. Organised annually by the Finnish Foundation for Share Promotion and the Finnish Society of Financial Analysts, the competition takes stock of the Finnish-language IR websites of all Finnish listed companies.

The competition jury decided to award the distinction to Wärtsilä, since the company's Investor Relations website has "a modern look, images are used successfully for visualising, and the pages work well also with a smartphone."

Furthermore, the jury found that it is easy to search for information on the site, thanks to the detailed navigation. The informative insider register, as well as the daily updates of large owners, were assessed to be "delightful" by the jury.

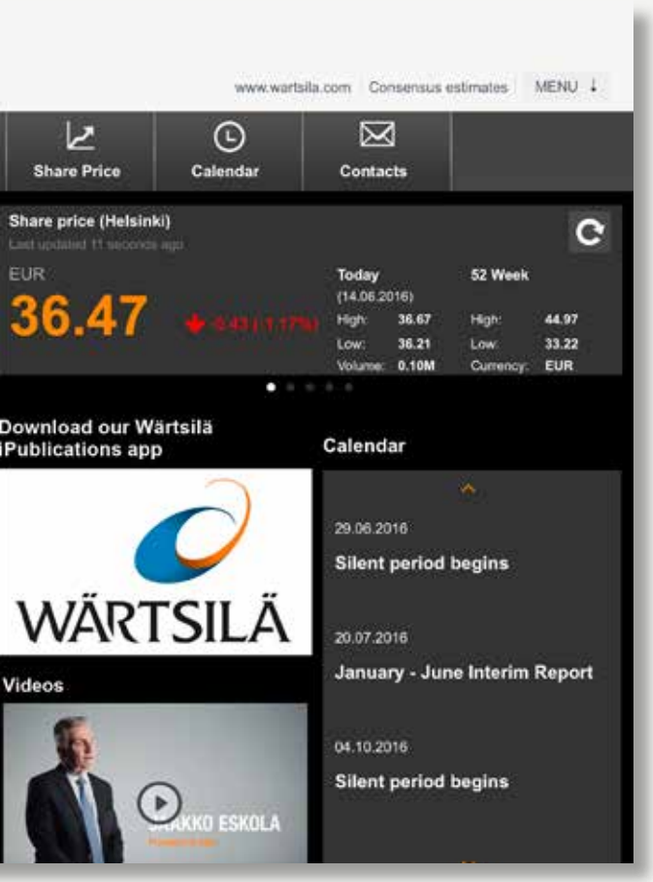
BUILDING ON SUCCESS

According to Valtasaari, the new platform allows for a more user-friendly website on all devices as well as a stronger focus on visualisation. That's not to say that Wärtsilä had somehow been ignorant of these issues before – last year, for example, the company placed second in this very same competition – but now Wärtsilä made the extra push for the top spot.

"We're finding that we can take data and make it more visual in a variety of ways, for example via pictures, videos, charts and info graphs. This new visual approach resonates well with the users," she says. And that's not limited to the website, either: the e-annual report, for instance, is placing even more emphasis on the dynamic, visual portrayal of data.

MAKE IT TRANSPARENT

As the attention span of people keeps getting shorter and shorter, Valtasaari and her cohorts are in a constant race to first grab the reader's attention and then keep it. In order to do this, transparency is needed – along with the great visuals – to make sure that the investors get the information they need.



"Starting with making navigation more easy to use, we have really paid attention to presentation. There is so much information we can put out, but we have to keep asking ourselves, is the information useful from the point of view of the target group? The other thing is finding a clear, concise way of delivering the message."

LEARNING PROCESS

The new analytical tools are, of course, quite handy here. The Wärtsilä IR team monitors traffic on the site and is quick to take action, if adjustments need to be made to either content or its delivery. For example, if there is a key piece of information on the site somewhere that is not attracting the estimated number of viewers, the IR team will find a better place for that information and make sure it's duly noted.

But how about "hardware" that the investors now use to browse the site? Have smartphones taken over IR communications, too? Valtasaari replies that the great majority of traffic to the IR site still comes from desk PCs, meaning that it's mostly professionals in their offices who pore over the data. Looking at the traffic data, there is something, however, that has surprised Valtasaari and her crew:

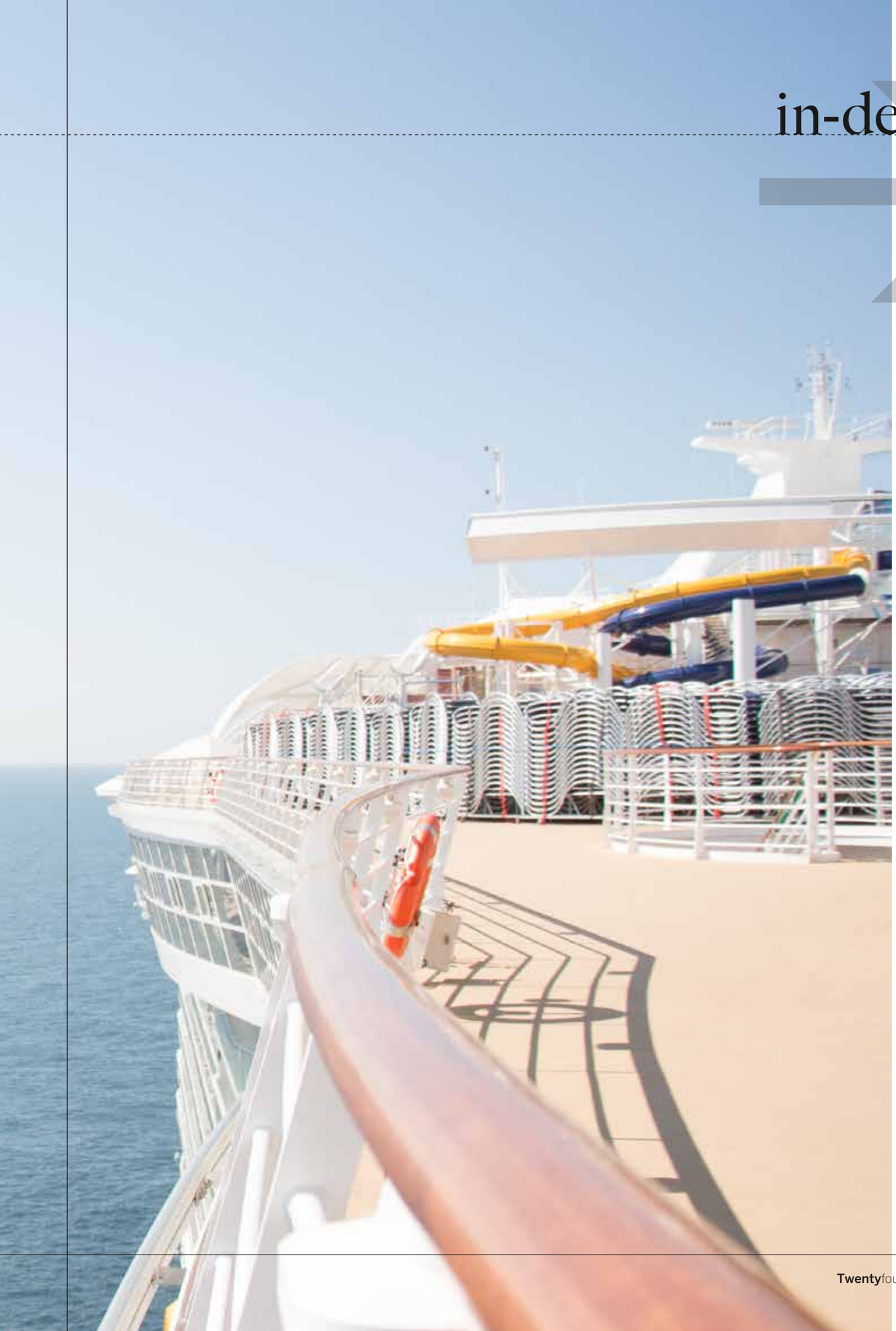
"Smartphones have grown in popularity so much that they have overtaken tablets."

"THE MOST IMPORTANT THING IN ALL THIS IS FULLY UNDERSTANDING THE NEEDS OF THE STAKEHOLDERS AND FINDING WAYS TO PROVIDE ADDED VALUE TO THAT TARGET GROUP."

TEXT: PAUL CONNOLLY **PHOTO:** WÄRTSILÄ

CRUISING THE WORLD

Over the past year, three huge and highly sophisticated cruise ships have entered into service. They are all crammed full of the latest in ship navigation and entertainment technology. While one might expect that of the latest and greatest in cruise liners, the potentially surprising aspect is that these apparently disparate technologies are all provided by Wärtsilä.



"MODERN CRUISE VESSELS ARE HIGHLY COMPLEX WITH UNIQUE OPERATIONAL NEEDS, AND OUR TECHNOLOGIES MEET THESE DEMANDING REQUIREMENTS."

The latest, and world's largest, ship from Royal Caribbean sports the latest in Wärtsilä technologies.

The name Wärtsilä evokes big engines and power plants driving the world's ships and cities with thrumming efficiency.

It may not readily spring to mind when you think of sipping a cocktail as you watch the sunset in a blaze of colour on the deck of one of the world's most luxuriously appointed cruise ships or find yourself curled up below deck watching a just-released movie on a vast, brilliant LED screen.

Yet, just as Wärtsilä engines help new cruise ships slice through the ocean, so Wärtsilä expertise and technology assist ship officers with navigation, and Wärtsilä Funa International provides cutting-edge entertainment systems to keep thousands of passengers happy and amused.

According to **Maik Stoevhase**, Director, Automation, Navigation and Control in Wärtsilä Marine Solutions , this is not as surprising as it first seems. "The synergy created by these various disciplines coming together under one ship roof demonstrates Wärtsilä's prominence as one of the world's major suppliers of state-of-the-art equipment for the cruise and ferry industries."

Franc Polte, Sales Manager in Wärtsilä SAM Electronics, concurs. "Modern cruise vessels are highly complex with unique operational needs, and Wärtsilä has developed its technologies accordingly to meet these demanding requirements."

Polte suggests that Wärtsilä's contribution to the new 4248-passenger capacity Norwegian Escape cruise liner, the 2790-capacity Mein Schiff 4, and the monumental 6410-capacity Harmony of the Seas is indicative of the company's 360-degree approach to ship technology.

"The Harmony of the Seas is powered by three 18,860kW Wärtsilä 46 16-cylinder main generator diesel engines and three similar Wärtsilä 46 12-cylinder engines producing 13,860kW each. Manoeuvring is assisted by four 5500kW Wärtsilä CT 3500 tunnel thrusters."

This is the blockbusting technology we're used to seeing Wärtsilä provide – huge engines that are four storeys high and improbably powerful tunnel thrusters.

Wärtsilä is continuously innovating. Polte is very excited when he talks about the new Wave Monitoring System, developed for the Harmony of the Seas and used in commercial shipping for the first time on the vessel. "This system has detectors on the bow and on each side of the vessel to monitor the actual wave height and to calculate the path and progress of the ship. This is a Wärtsilä development and is used for the first time on this ship, and this is fully integrated in all our Nacos Platinum software."

"WÄRTSILÄ IS NOT JUST ABOUT ENGINES; IT'S CONCERNED WITH THE WHOLE VESSEL."

THE TECHNOLOGY ON the Harmony of the Seas also includes the Wärtsilä Platinum Dynamic Positioning (DP) System, which provides a simple and efficient solution for vessel control, manoeuvring and station-keeping applications.

But it will also feature another brand new development, according to Polte. "After a few short cruises, the vessel will go to the Mediterranean area, and there we'll also install another new system which is based on weather data and sea conditions and is designed to improve efficiency. Taking into consideration detailed weather and sea information, an optimised speed profile for the planned route is calculated to provide a smoother cruise for customers and decreased fuel consumption for the ship owners. This, too, will form part of the Wärtsilä Nacos system.

Last but not least, the Harmony of the Seas is also included in a service agreement, between Wärtsilä and Royal Caribbean, covering technical management and monitoring under Wärtsilä Genius services.

"On the Norwegian Escape, we have also used the Nacos Platinum navigation system. The workstations on the bridge allow the vessel to be navigated, controlled and monitored from various onboard positions, and they combine displays of radar, ECDIS (Electronic Chart Display and Information) and conning information, as well as automatic steering and voyage planning operations."

Wärtsilä technology doesn't just make its way onto the super-cruise ships. Smaller 600-passenger-capacity cruise ships, the Seabourn Encore and Seabourn Ovation, have also been fitted with Wärtsilä electrical propulsion systems as well as the Wärtsilä Valmatic Platinum integrated automation system, which has additional capabilities to optimise vessel power management.

It's not just smart, money-saving technology that Wärtsilä is providing. Wärtsilä can provide fun too, courtesy of Wärtsilä Funa.

THE CRUISE LINER MEIN SCHIFF 4 has not only been kitted out with Wärtsilä's advanced Nacos Platinum integrated navigation system, but it also features the latest entertainment technology.

Wärtsilä Funa helped build the Klanghaus, the first philharmonic concert hall at sea. Wärtsilä Funa built the hall's acoustic control and also engineered and installed all the entertainment systems for the theatre, including an 11-metre-wide by five-metre-high LED wall onstage to project films and live events.

As Stoevhase says, "Wärtsilä is not just about engines; it's concerned with the whole vessel."

Wärtsilä, it seems, is about power AND fun.

TEXT: LENA BARNER-RASMUSSEN **PHOTO:** KARL VILHJÁLMSSON

GETTING A BIT FIT FOR FUTURE

Startups and big corporations can live in a perfect symbiosis. Wärtsilä found great collaborators through the Marine Mastermind contest.

The jury is getting ready to hear the five finalists' pitches at the Marine Mastermind finalist event.

Digitalisation is becoming indispensable in everything we do. We have watches that can measure our heartbeat, check whether we've gulped down enough veggies and alert us if our blood sugar is alarmingly low. Digitalisation has also become a vital part of big corporations' R&D efforts. IoT in engines can warn the crew of danger lurking and help in planning the route as efficiently as possible.

As with our personal gadgets, the hottest feature ever can be replaced by an even hotter one in less than two months. The pace is not much slower in an industrial set-up. This sets a big corporation's R&D teams under pressure; how can you adapt and react fast enough?

Speed, agility, the willingness to change course – that's inherent in the startup culture. That's why Wärtsilä Services decided to turn to the startup crowd to get help propelling its digitalisation efforts.

"Startups are really good at getting under the customer's skin and being agile, and that is something that every big corporation could – and should – learn from," says **Tero Hottinen**, General Manager, Business Innovation at Wärtsilä.

In an effort to scout out relevant startups, Wärtsilä Services launched the Wärtsilä Marine Mastermind contest. So last November, Hottinen took the stage at the startup conference Slush in Helsinki. Initially a quaint gathering for a couple hundred people, it has since evolved into one of the mega events in the industry – with more than 11,000 people attending last year and hundreds of startups pitching in the hope of catching investors' interest.

At Slush, Hottinen had one mission in mind: to challenge the startup community to come up with ideas that would speed up the marine industry's digitalisation efforts. And so the Wärtsilä Marine Mastermind contest was launched, and soon the applications flooded in: 47 of them from 17 different countries, far more than Hottinen had expected.

"We faced a positive problem: choosing only five finalists, even though we saw interesting opportunities in almost every participant," says Hottinen.

Of the five finalists, the jury saw the most potential in Tallinn-based Marina Ahoy. The company was founded in Estonia less than a year ago and is looking into changing the marina business once and for all by making it possible to manage a harbour automatically around the clock.

'INSTANT FEEDBACK PLEASE'

What Marina Ahoy entrepreneurs **Relika Metsallik-Koppel** and **Hannes Koppel** like about being a startup is the instant feedback from users.

"We release a feature and show it to our customers. If the new feature gets positive feedback we continue the development. If the feature needs tweaking we'll do it before adding more features."

In a big corporation, adding new features might be a process of several months or even years. But there is no guarantee that customers will like it and be willing to pay for it. So instant feedback from customers is something that Head of Engine R&D **Ilari Kallio** would like to see more of at Wärtsilä too.

"Validating the concepts as early as possible with customers is key in reaping the rewards of digitalisation. We need to move towards a trial and error mentality. Sometimes this is a better approach than heavy-duty analyses because tomorrow everything might be all different anyway."

THE INTELLIGENT HARBOUR

Tallinn-based Marina Ahoy was the winner of Wärtsilä's Marine Mastermind contest. The company was founded in Estonia less than a year ago.

"In a yacht marina, 15 minutes of man-hours are spent on each visitor, and the load of paperwork accounts for about 30% of the harbour management's time. Simple tasks like check-in and -out, together with booking and billing, require a lot of attention from the visitors. And every harbour has their own way of working, making it even more difficult as you need to find out how things work," says **Hannes Koppel**, CEO and one of the founders of Marina Ahoy.

WIN-WIN

Pierpaolo Barbone, who's leading the Services division at Wärtsilä, sees startup collaboration as a win-win for both parties.

"The combination between startups and more structured companies is a fantastic one. What we can bring to the table is a structured way of working, specific competencies and of course financial strength. The startups bring speed and a wish to challenge themselves and the market."

The Marina Ahoy founders, **Relika Metsallik-Koppel** and **Hannes Koppel**, appreciate the different perspective a big corporation like Wärtsilä can shed on their business.

"What we've learned from Wärtsilä so far is the big thinking. When talking to Wärtsilä guys we get a whole different perspective. We think of local harbours, they think of Rotterdam and Shanghai. It's a very different insight", says Hannes Koppel.

As the winner of the Wärtsilä Marine Mastermind contest, the Marina Ahoy team got a 30-day lean innovation lab with Helsinki-based Swift Action and Wärtsilä. It was held in June and both Hottinen and the Koppels are excited about the outcome.

"This has the potential to reach very high scale," says Hottinen.

JUST THE BEGINNING

For Wärtsilä, the Marine Mastermind contest was just the beginning of a new way of working. Teaming up with startups is becoming the new normal.

"We are now tapping into a new area when it comes to startup collaboration, and we might be looking at transforming entire business models with the help of open innovation," says Hottinen.

How, when and what disruption will look like is a anyone's guess.

"Digitalisation has disrupted everything. It's difficult to predict what will happen but for sure digitalisation will create turbulence, but also new opportunities. Human life and behaviours will be different, everything will be different. And the startups that participated in the Marine Mastermind contest will all be part of this thrilling journey", says Barbone.

Apart from collaboration with Marina Ahoy, Wärtsilä is also in talks with nine other startups that took part in the Marine Mastermind competition, of which one is in the testing phase with Energy Solutions.

TEXT & PHOTO: ANN TÖRNKVIST

Cragside conservation manager Andrew Sawyer in the front room where arc lights were the first to use hydropower, thanks to Lord Armstrong's passion for technology, engineering and sustainable energy.

The modern magician

A brilliant idea was born in this beautiful north England house. As Lord Armstrong's new light bulbs flickered into action, they turned him into the father of hydroelectricity.

When you phone Cragside, a polite and perfunctory recording lists several options: "Dial three for rhododendron flowering times." That's the thing, arrive at the wrong time of year, and you'll miss the incandescent rhododendron, their pink and lilac splendour spilling across the grounds of this gorgeous 19th century house.

Yet, there's another kind of incandescence that's equally spellbinding if you know the history of the house. And which works any time of year. To best effect, actually, during the long dark winters: light bulbs. But what's so brilliant, apart from literally, about light bulbs? Well, this was in the late 1800s – first were arc lights in 1878 and then incandescent light bulbs in 1880 – and Cragside was thus the first place to use hydropower to generate electricity.

That meant that the house, at the flick of a switch, became a harbinger of the future. For while mills had ground flour for centuries upon centuries with wheels turned by the force of the river below, this was a new chapter entirely. The water was used to generate electricity to light up the house. Energy remained a passion of the house owner, **Lord Armstrong**, for all of his life.

"He had great foresight and, in 1863, predicted the coal reserves of Britain would be exhausted within 150 years and knew that alternative methods of motive power should be found," Cragside's current conservation manager, **Andrew Sawyer**, tells Twentyfour7.

Coal's still an apt topic on this drizzly day. "Rain's just liquid sunshine," says Sawyer with low-key but infectious enthusiasm. As we tour the grounds, local environmentalists await news about a proposed open cast coalmine down the road from Cragside. That the Brits still rely on coal may have upset Lord Armstrong.

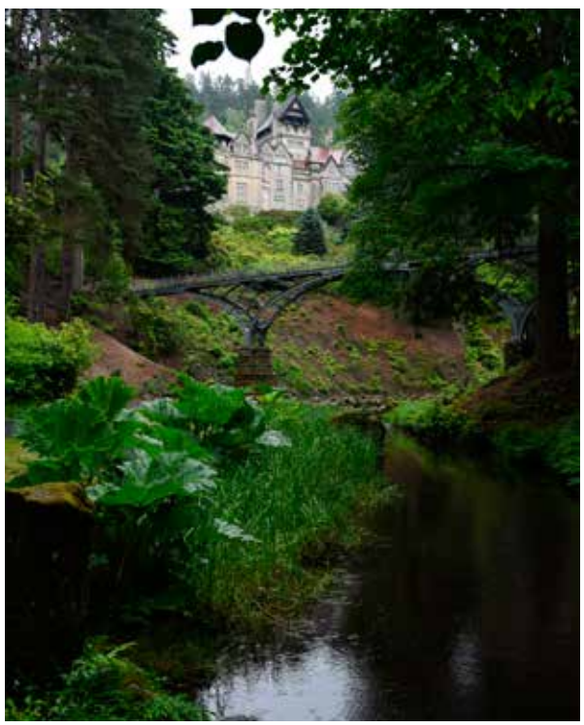
"He thought every stream and river should be put to use. Along with friends like **William Siemens** and **William Thompson**, who later became **Lord Kelvin**, they were considering not only waterpower, but solar, wind and tidal, but did not know how to achieve it at that time," Sawyer notes.

It's fitting that the word incandescent doesn't just apply to rhododendron or light bulbs but also a certain kind of intellectual brilliance. Lord Armstrong had been a sickly child, consigned to pensively playing with toys indoors and then sent to recuperate in the countryside, where he became an avid angler and learned to love water.

"Lord Armstrong was very thoughtful and could, in fact, go into a trance-like state when he was trying to solve a problem," says Sawyer. "He revolutionised the movement of goods with his hydraulic cranes, which could be found in every dock, railway and warehouse."

NEAR THE LITTLE POWER STATION tucked into a valley below the house, the original hydroelectric system is still intact, with the turbine and dynamo on display. Lord Armstrong, thinking ahead to dry summers, also installed a backup gas engine, which stands to one side of the mechanism, its huge black wheel ready to kick into action.

Outside, there's an old, rusty jigger lying in the grass. Lord Armstrong's invention revolutionised hydraulics, providing the money to build Cragside and plant millions of trees on the barren crag. He and his wife, **Lady Armstrong**, also commissioned magnificent interiors designed by **Norman Shaw**. Stained glass designed by Rosetti and made by William Morris Co. set the tone in this home that exemplifies the best of the arts and crafts movement. Paradoxically, some may feel



Cragside mansion tucked in by trees, all planted by Lord Armstrong as he built and landscaped the family's country retreat on what was once a barren Northumberland crag in England's far north.

"RAIN'S JUST
LIQUID SUNSHINE."

A backup gas engine was connected to the hydroelectricity system in case dry summers drained the reservoirs of water.

An image, in a display cabinet, of Lord Armstrong.

Conservation manager Andrew Sawyer walks through the gallery, which was the first place in the world to see hydroelectricity power incandescent light bulbs in 1880.

The original control switches in the hydroelectric power house down in the valley.

A light switch in one of the bedrooms of the arts-and-crafts family home.

Left below: Vintage isolators being cleaned and restored.

The new Archimedes screw welcomes visitors as they pull into the grounds of Cragside.

for such a forward thinking couple, the Armstrongs went on to make even more money from armaments.

In the front room, Lady Armstrong's portrait hangs above the two arc lights, which were remodelled from porcelain oil lamps. Yet electric lighting was just one of the cutting-edge inventions in the house. In 1880, the telephone was installed. There's an early version of a dishwasher in the kitchen, as well as fire alarm buttons, still on display. Plus, a passenger lift, not to mention central heating, underfloor heating and a Turkish bath suite.

IF THE MANSION ILLUSTRATES anything, it's that trade not just in things but also in thoughts are a good thing indeed. In the gallery, where the first incandescent light bulbs powered by hydroelectricity were turned on, the family's collection of shells sit in display cabinet, as does a stuffed bird of paradise, looking as fluffy as on the day it died. The displays are a reminder that the late 19th century was a period of exploration and wonder but also of the desire to tame and possess the unknown.

The house was soon dubbed "the palace of the modern magician." Cragside is now run by the National Trust, which means it's open to the public, and so too are the magnificent gardens, which include a rockery and the many millions of trees and shrubs planted by Lord Armstrong himself. Plus, an Italian logia.

Not all of Lord Armstrong's life was charmed, however, as he and his wife never had children, something Sawyer called "the very modern couple's great sadness." In 1887, Lord Armstrong became Baron Armstrong of Cragside, which – and the politics of titles are confusing even to Brits – meant he joined parliament's House of Lords, becoming the first engineer to do so. Not bad for a man whose corn merchant father had wanted him to be a lawyer, because, as Sawyer points out, "engineering didn't have the same status then as it does now."

Today, the National Trust calls Cragside House "the wonder of its day." But what about now? The last time Brits cared as much about light bulbs as they did back then was probably when the EU banned the old classic kind to usher in low-energy, green ones. And in that interim of more than a century, Brits and many other residents in the industrialised world have come to take light bulbs and electricity in general for granted. The wonder of electricity lost its shine. So how do you make what is truly a wonder seem wondrous again?

A FEW YEARS AGO, the keepers of Cragside decided to install an Archimedes Screw and connect the house once again to the lakes that Armstrong built for the purpose of harnessing the power of water.

"It was poor to be the first house in the world to be lit by hydroelectricity and not have a working example of it," jokes Sawyer as he explains the decision a couple of years ago to introduce a new working system. "We introduced the Archimedes Screw as a new way of generating hydroelectricity at Cragside, making it our turn to reinvent the story in a very visual way. Visitors love the way we have brought this story to life with a new intervention with Cragside's historic context."

Sawyer adds that the public's renewed interest in the environment has made the house more relevant than ever. "People understand it through the knowledge of alternative energy being talked about more and more, especially in terms of renewable energy and climate change," he says.

"Children are growing up with this knowledge, and to have a working example, which was made to be very visual in the landscape, is a great connection between the past and the future," Sawyer concludes. "We have events where children can make their own Archimedes Screw and understand the magic of turning water into electric light – it is as magical today as it was then."

TEXT: RICHARD ORANGE

THE DIGITAL ENGINE
THE INTERNET OF EXTREMELY BIG THINGS

Sensors on Wärtsilä engine:
A modern Wärtsila engine can have more than 250 sensors recording parameters such as pressure, temperatures, flow rates, RPM, oil levels, produced energy, and control set points. On a typical cruise ship, the engine generates 5% to 10% of the volume of data created.

Engine Control System:
An array of control modules installed on the engine collects raw data from the sensors, displaying it in real time. The raw data generated remains stored on the vessel.

Sensors picking up ambient data:
A typical cargo vessel will have a weather station recording outside temperature, wind speed, humidity, and rainfall, a depth meter, and other sensors measuring parameters such as water flow over the hull.

Trim and propulsion sensors:
A modern vessel will have shaft torque and thrust meters, an inclinometer, sensors measuring hull tension, and sensors for dynamic trim optimisation.

Sensors on ship infrastructure:
On a cruise ship, there are other sensors monitoring everything from doors opening and closing, to air conditioning, to lighting, to the condition of pizza ovens.

Ship Automation System:
All raw data generated on the ship, including from the engine control system, is sent via a system of Ethernet cables to the ship's automation system. A typical cargo ship generates some 2.5GB of data a day. A set of on-board PCs then carries out a set of automatic calculations on the data, averaging it out, simplifying it, and typically discarding about 90%. This processed data is presented on screen to the vessel's crew, and can be also accessed remotely.

Satellite Connection:
New broadband satellite technology, such as Inmarsat's Global Xpress (GX) constellation, which went into service globally in December 2015, is bringing a step change in the amount of data sent from ships. GX enables upload speeds of 5Mbps via a 60cm antenna, enabling transfer of approximately 10 times as much data as was possible previously.

Wärtsilä Data Acquisition System:
All data relevant to engine functioning is sent to a PC alongside the Ship Automation System, which automatically filters the volume of data down to as little as 10MB, of which about 2MB comes from engine sensors. Using "dead band functionality", which strips out all data that stays within the band of normal functioning, can reduce data volume by a factor of up to a hundred. The system further pre-processes the data to strip out any numbers which are not valid or relevant. The system sends filtered data back to Wärtsilä, either as a continuous stream or, to save bandwidth, in a single daily email. The system also has a screen presenting processed data in real time for the crew.

INCREASING BANDWIDTH ON SHIPS' SATELLITE COMMUNICATIONS IS INCREASING THE AMOUNT OF DATA ON ENGINE PERFORMANCE THAT CAN BE SENT TO WÄRTSILÄ, WHILE ADVANCES IN ANALYSIS PROMISE TO MAKE PREDICTIONS OF FUTURE MAINTENANCE NEEDS AND PERFORMANCE EVER MORE RELIABLE.

Wärtsilä Data Lake:
Wärtsilä's Data Lake holds the totality of data generated by Wärtsilä's marine, power and oil and gas equipment since 2001. The volume of data runs into thousands of TB, or several PB. Every vessel worldwide running on a modern Wärtsilä engine sends information, usually daily.

Vessel, Remote Services:
Wärtsilä has developed a new digital tool that allows field service personnel or ship crew to contact technical support online and share with them the same view of the ship's controls, which allows Wärtsilä experts at service centres to remotely monitor and advice the ship's equipment. Wärtsilä remote support engineers can also access the raw, unfiltered engine data stored on the vessel.

Wärtsilä Condition Based Maintenance (CBM):
Every 30 minutes, Wärtsilä's custom-built diagnostic tool RPA accesses the Data Lake and searches for any new data sent in from customers' vessels. The data is automatically processed, and a health check report is generated and sent to the responsible CBM engineer. It includes both predictions of upcoming issues and alarms for any likely dangers or faults. The engineers use their expertise to interpret the RPA data and carry out further analysis, if required. The CBM teams for four-stroke engines are based in Vaasa, Finland; for propulsion equipment in Drunen, The Netherlands; and for two stroke engines in Winterthur, Switzerland.

Vessel Owner, Daily Report
If the customer has a remote monitoring contract, CBM engineers will contact them when and if issues are identified. From June 2016, owners of vessels running modern Wärtsilä engines can receive a daily notification from their CBM representative. Most vessel owners opt to receive reports monthly. These reports, which runs to as little as 100KB, contains advice on operating the vessel more efficiently, alarms, and recommendations for further investigation. Services include Wärtsilä's engine efficiency monitoring service, propulsive efficiency monitoring service, propulsion condition monitoring service, and cyber security patch service.

Wärtsilä R&D and Sales teams:
Wärtsilä's R&D and Sales teams contact CBM frequently, requesting statistics on equipment's performance in the field. CBM has shared resources within the teams able to handle these requests.

Wärtsilä Online Services:
Wärtsilä Online Services, launched in November 2014, allows onshore personnel to access ship data through the web. It also collects together the data visualisations and trend analyses created by Wärtsilä's CBM expert so they can be accessed by the vessel's owner, onshore personnel or crew at any time. Crew and onshore personnel can also identify and contact Wärtsilä experts through the portal.

TEXT: ISABELLE KLIGER **PHOTO:** SHUTTERSTOCK/GENCHO PETKOV, MANA PHOTO & iSTOCK/ JAAP-WILLEM

SOLAR TRAILBLAZER

The solar energy market is expected to undergo rapid growth in the coming years, and Wärtsilä is forging a new path for an engine-solar synergy. The company has already started work on the world's first utility-scale solar hybrid plant in Jordan.

solution

"ENGINE-SOLAR PV HYBRIDS ARE ALL ABOUT SAVING FUEL – BE IT OIL, NATURAL GAS OR BIOFUEL. AND WHEN YOU SAVE FUEL, YOU REDUCE COSTS AND CUT EMISSIONS."

Solar power is a hot topic these days. According to Bloomberg New Energy Finance, the installed base of large-scale solar photovoltaic (PV) power systems will grow from about 100 GW to 450 GW between 2015 and 2025.

Solar power plants come in the form of pure solar PV power plants or as engine-solar PV hybrids. Wärtsilä is the first company in the world to offer large-scale solar hybrid power plants, by combining Wärtsilä's engine-based Smart Power Generation (SPG) concept operating alongside a dedicated solar PV system. Wärtsilä does not manufacture solar modules, but acquires them from leading suppliers and includes them in the complete power plant offering.

CUTTING COSTS AND EMISSIONS

Javier Cavada, President of Wärtsilä Energy Solutions, explains that a solar hybrid plant makes perfect sense – from the perspective of both cost and the environment.

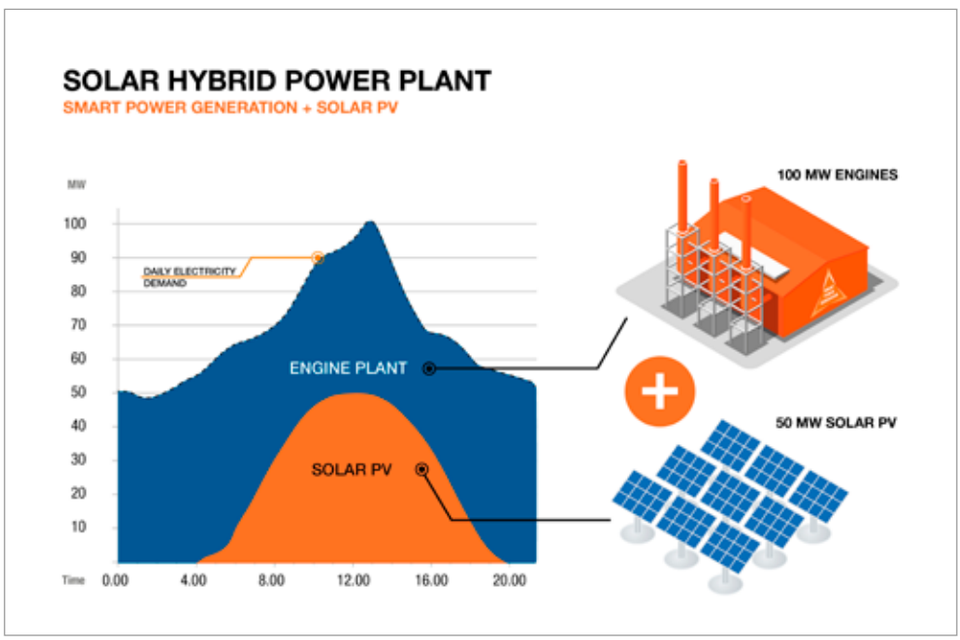
"Engine-solar PV hybrids are all about saving fuel – be it oil, natural gas or biofuel. And when you save fuel, you reduce costs and cut emissions at the same time," he comments.

Cavada goes on to explain that the engine and solar PV units of the hybrid work in synchronisation, with the solar modules taking priority but receiving backup from the engines. Whenever there is sufficient solar irradiance for the PV modules to produce electricity, the engines are ramped down or stopped, only to ramp up again when clouds cover the sun or once the sun has set. This all happens automatically.

FULL EPC DELIVERY

Wärtsilä already has an installed power plant base totalling 60 GW in 176 countries in its portfolio, making it ideally qualified to offer utility-scale projects with full EPC (Engineering, Procurement and Construction) delivery. In an EPC project, the customer avoids dealing with multiple players and works with only one supplier who takes full responsibility for the project management, budget, schedule, guarantees, civil works and so on. Moreover, Wärtsilä has a strong presence in the regions that show the greatest promise for solar power solutions, including Africa, the Middle East, Latin America and Southeast Asia.

"Whereas most other power plant developers work either nationally or regionally, Wärtsilä is the only major



global player in this segment," continues Cavada. "We have the expertise and experience needed to offer EPC delivery anywhere in the world, including areas that are challenging in terms of logistics, weather conditions and security."

EUR 300 MILLION BY 2020

Wärtsilä expects its solar business to grow rapidly, with annual sales of EUR 300 million forecast as early as 2020. Cavada notes that the target customers for these solutions are primarily those with larger-scale requirements, including utilities, independent power producers (IPPs) and industrial customers.

"We specialise in the delivery of utility-scale projects with a full EPC scope. This know-how has been developed from the experience of building hundreds of engine-based power plants of this size in more than 100 countries. Wärtsilä also has a strong global sales and services network and a decades-long presence in many of the countries with the best growth potential for large-scale solar power plants," he adds.

THE WORLD'S FIRST SOLAR HYBRID PLANT

One such example is Jordan, where Wärtsilä has been present since 1980. In 2014, it delivered a Smart Power Generation plant, comprising 16 Wärtsilä 50DF engines, to Amman-based AES Jordan, and in April this year, the two companies signed a contract to retrofit the existing plant and combine it with a solar PV farm. Wärtsilä's EPC scope includes 46 MW of solar modules, covering an area of 81 hectares, as well as inverters, switchgear, control systems and overhead transmission lines.

"The solar unit will reduce the carbon footprint of the power plant by saving fuel during the daytime. Experience has shown that we can trust Wärtsilä's EPC capability. We consider Wärtsilä to be a partner with a reputation for quality," says **Meftaur Rahman**, President and CEO of AES Jordan.

"We're excited to expand our portfolio with new sustainable innovations and help our customers reduce their carbon emissions. Large-scale solar is a big business, with the installed base expected to grow four-fold to 450 GW by 2025," concludes Javier Cavada.

"WE CAN OFFER EPC DELIVERY ANYWHERE IN THE WORLD, INCLUDING AREAS THAT ARE CHALLENGING IN TERMS OF LOGISTICS, WEATHER CONDITIONS AND SECURITY."

THE EVOLUTION OF WÄRTSILÄ ENGINES FOR FLEXIBLE POWER GENERATION

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SEALED AND DELIVERED
THE WORLD'S FIRST IN-WATER SERVICEABLE SEAL

Twentyfour7.

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THE EVOLUTION OF WÄRTSILÄ ENGINES FOR FLEXIBLE POWER GENERATION

TEXT: MICHAEL LEVITIN **ILLUSTRATION:** WÄRTSILÄ

WÄRTSILÄ'S SMART POWER Generation power plants enable existing power systems to adapt to changes in energy production and energy markets.

"WHEN WE DEVELOP OUR ENGINES, WE LOOK BACK AT THE THREE CORNERSTONES AND SEE HOW WE CAN DEVELOP AND IMPROVE OUR SOLUTIONS."

According to **Erik Jungner**, General Manager of Engine Portfolio at Wärtsilä Energy Solutions, Smart Power Generation technology is built on three cornerstones: 1) operational flexibility, which allows power plants to quickly shut on and off, catching peak loads as needed; 2) energy efficiency, which keeps costs and emissions at a minimum; and 3) fuel flexibility, which allows power producers to use the cheapest and cleanest fuel available.

"When we develop our engines, we look back at the three cornerstones and see how we can develop and improve our solutions," Jungner says.

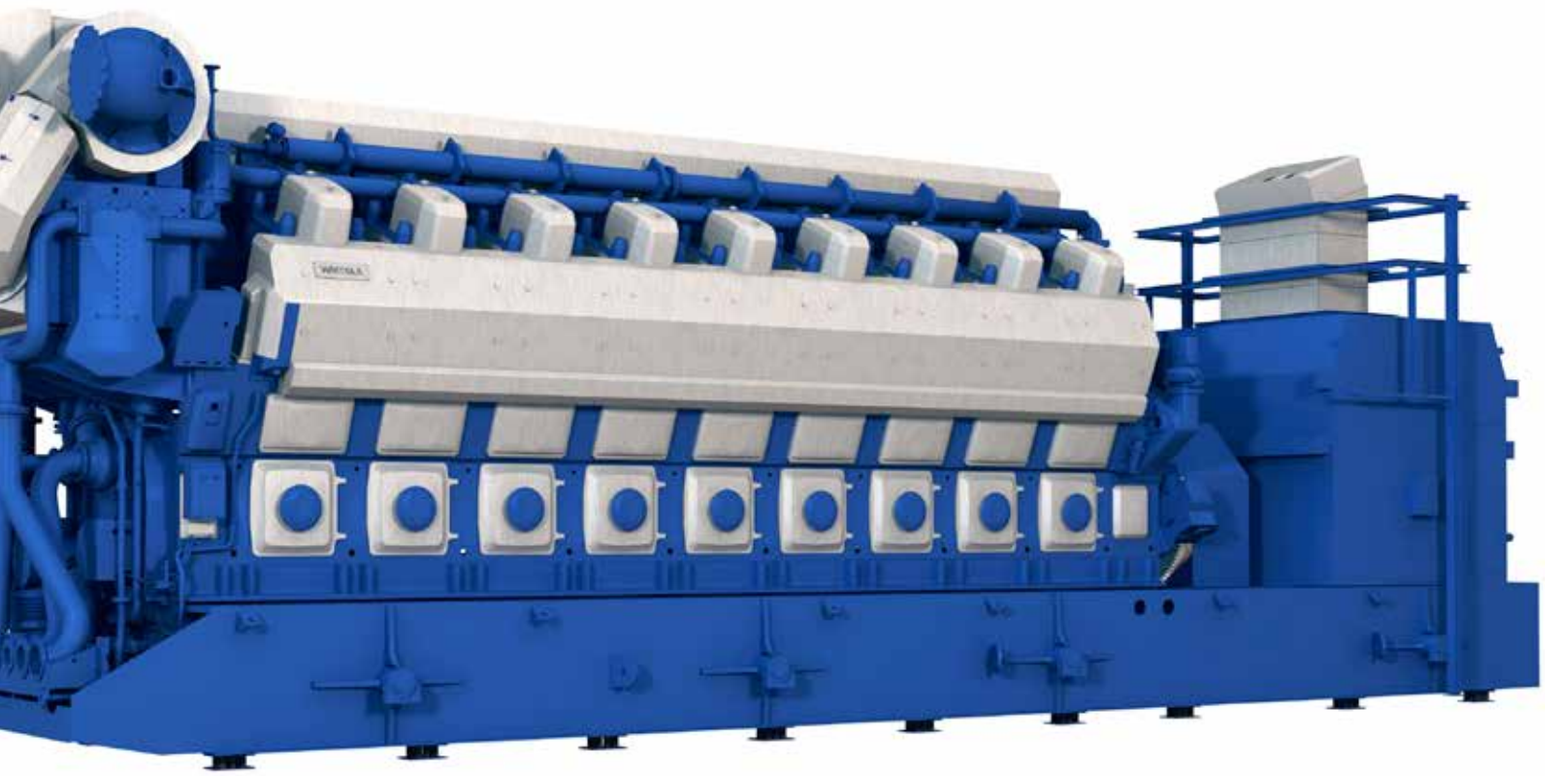
Wärtsilä's engine portfolio for power generation is based on two main platforms: the Wärtsilä 32/34 series for the 10 MW unit segment of the market and the Wärtsilä 46/50 series for the 20 MW unit segment. Both engine platforms are available in three different fuel variants: spark-ignited gas (SG), diesel and dual-fuel (DF). And both engine platforms, including all their variants, have gone through and are going through numerous upgrades and improvements.

One key development is with the latest generation of turbo chargers, which enable higher power output and better efficiency. Another enhancement is portfolio streamlining. This enables greater commonality between the three variant fuels, says Jungner, which "minimises the difference between [the fuels] so that, if a customer in the future wants to convert his engine from diesel to gas, it's easier."

According to **Andrea Nobile**, Wärtsilä's General Manager of Wärtsilä 46/50 engine development, the company applied the latest generation of single stage turbo charging with increased boost pressure and, at the same time, increased charger cooling capacity. "What we are achieving is more firing pressure and optimisation of valve timing," Nobile says. "We have taken some design actions to strengthen the head, the cylinder and the crank shaft, and also [improved] combustion chamber components."

ANOTHER SIGNIFICANT DEVELOPMENT is the extended load range, enabling engines to operate within a wider load range while still maintaining a high level of efficiency. Now, spark gas engines can operate all the way down to a minimum of 10% when used together with a functional exhaust treatment system, says Jungner.

In addition, an increase in fuel flexibility for the 34SG engine has enabled it to run on propane and



ethane; a similar transition will soon be possible for the 50SG.

Wärtsilä's first 34SG engine using liquefied petroleum gas (LPG) as fuel went into operation early this year in Central America. The plant was delivered turnkey, as a so-called Gas Cube, which consists of all the components of a 34SG gas power plant in a compact, pre-engineered package to speed up delivery time and minimise site work. Wärtsilä is also under contract to install another 28 MW-capacity plant, using the same engine type and fuel, by the end of the year.

Soon, Wärtsilä will release a new version of the Wärtsilä 34 engine, which is optimised for diesel or HFO but can more easily be converted for gas use in the form of SG or DF. "This capability creates value for customers who know they'll have gas available in a few years," even if it's not there yet, says Jungner. An example of this are islands where LNG terminals and infrastructure are under construction, but gas hasn't yet reached the site. In these cases, the need for electricity generation is already there, and the producers can invest in a power plant that currently runs on heavy fuel or diesel oil, knowing that it can easily be converted to gas later on. When gas is available on site, Wärtsilä's Services can assess the actual plant's condition and tailor a competitive conversion package for the customer.

NOBILE ASSERTS THAT FUEL flexibility technology has grown tremendously in the five years since the release of the 50SG, the first generation of spark gas engine. "First we had diesel, then dual fuel, and finally released spark gas. This has enabled us an improvement in terms of efficiency and more flexibility for the customer," says Nobile. "Now we're releasing an upgrade with more efficiency and more altitude allowance – meaning you can install the engine at a certain altitude above sea level, about a half kilometre high, without losing any power."

This factor is especially important in the US, where energy projects developed at higher altitudes can bring additional benefits. In other parts of the world as well, such as the Caucasus region, the altitude allowance is key to providing more power. "If you can maximise the altitude without minimising power, the project can be more attractive, with more efficiency and more competitive advantage for the customer," he says.

And that's not all. Due to the advanced technology employed in the upgrade of the 50SG engine, "we now also have an opportunity to apply [it] on the sister products – meaning the dual fuel and the diesel power plants – to maximise commonality benefits and streamline the whole platform. So we started with the upgrade on the gas, and now we have an opportunity to apply it to diesel and dual fuel," says Nobile.

As Jungner says, the steady developments of the engines are achieving Wärtsilä's goal: to "match the increasing global demand for flexible power generation."

DYNAMIC DISTRICT HEATING BRINGS BALANCE

TEXT: ISABELLE KLIGER **ILLUSTRATION:** WÄRTSILÄ

THE EUROPEAN ELECTRICITY market is in the midst of a transition. While the increasing use of renewable energy is good for the environment, it has led to other challenges such as unpredictable supply peaks and dips. In these volatile times, Dynamic District Heating (DDH) is emerging as one of the most promising ways to balance the grid.

As we continue to seek ways to reduce our dependence on fossil fuels, some of the best news is coming from the European Union, which is on track to meet its target to reduce its 1990 CO_2-emission levels by 20% by 2020, and 40% by 2030. This is good news for the environment but, for energy companies, it has brought some complications.

The ability to produce wind and solar power depends on the presence of wind and sunshine. Sometimes there is plenty and, at other times, not. The challenges arising from this are twofold: During periods when a lot of power is available but consumption is low, the spot price of electricity may become negative. However, when there is no wind or solar power but demand is high, the price rises dramatically. To maintain balance in the power system and make the most of price peaks, more flexible electricity production is needed.

COMBINED HEAT & POWER

The most promising solution is known as cogeneration, or combined heat & power (CHP), a highly efficient technology that uses fossil or renewable fuels to produce energy. Wärtsilä's CHP power plants, which typically vary in size from 10 MW to 500 MW – although their modular set-up means there is no upper limit in power output – are based on an engine technology with high fuel flexibility that mainly operates on natural gas on the European mainland. CHP plants typically supply electrical power, heat and cooling energy to users ranging from individual homes to large industrial sites or even entire cities.
In the past, the main role of CHP plants was to produce heat, while electricity was considered a by-product and often sold to local utilities at flat prices. This was done based on operations at baseload during the heating season. However, this is all about to change as a result of the evolving electricity market.

Dynamic district heating (DDH) is a concept based on the utilisation of CHP plants according to the demands of the national power system. The DDH plant supports the power grid, while continuing to fulfil its primary mission of heat generation.
Heat is stored in heat accumulators, and at the weekend, when the electricity price drops, district heat is provided by the accumulators. In winter, plants will often run at full power, while still remaining adaptable in case of fluctuations in the electricity market. In summer, they operate according to the electrical price, mainly at peak times.

HOW DDH ADAPTS TO THE MARKET

"Unlike traditional coal-fired, nuclear and combined-cycle gas turbines (CCGT) plants, which were slow-moving, non-flexible and unable to adapt to sudden peaks and dips, dynamic district heating adjusts its output to the fluctuations in the power systems as signalled by the electricity price," explains **Melle Kruisdijk**, Vice President Europe, Wärtsilä Energy Solutions.

While DDH is still comparatively new in many markets, some countries, such as Denmark, have been using CHP in this way for some time. The Skagen plant, commissioned in 1998, has three Wärtsilä engine-generator units, while the small plant at Ringkøbing dates back to 2002. Wärtsilä has also supplied CHP plants to Hungary that are operated according to dynamic principles.

We can expect to see more DDH plants across Europe in the years to come.

COST-EFFECTIVE AND SUSTAINABLE

Johan Bertula, Development Manager for Engine Power Plants at Wärtsilä Energy Solutions, explains that a power plant operated in this way makes sense for both the environment and commercial reasons. "The benefits of DDH are best captured in dynamic markets, where price signals represent the actual supply/demand situation in the power system," he says. "As the Wärtsilä gas engines can be started and stopped extremely quickly, the power plant can catch the electricity price peaks. By operating the DDH plant when the electricity price is high and stopping it when it's not feasible, customers are able to save fuel and reduce emissions," continues Bertula, adding that DDH is a particularly good option in times of economic uncertainty.

"Times are tough for the big utilities and nobody wants to make major investments. One of the main benefits of our solution is modularity, which allows customers to make a series of smaller investments that are easier to handle from the point of view of both financing and risk," he says.

According to Bertula, DDH has an important part to play in extending the use of renewable fuel in Europe and, in particular, in Germany – a country that is building more and more wind turbines and solar photovoltaic (PV) power systems, while closing down its nuclear power plants.

PROMISING IN GERMANY

"It goes without saying that the German electricity market will need more flexible natural gas power plants as the wind doesn't always blow and the sun doesn't always shine," says Bertula.

In fact, Germany has already set a target to increase the volume of electricity from CHP plants from the current level of approximately 12%, up to 25%.

"There is a huge potential for DDH in Europe," continues Bertula. "District heating is common in many cities and natural gas is the best fossil fuel there is, so we can expect to see more DDH plants across Europe in the years to come."

"DYNAMIC DISTRICT HEATING ADJUSTS ITS OUTPUT TO THE FLUCTUATIONS IN THE POWER SYSTEMS AS SIGNALLED BY THE ELECTRICITY PRICE."

HYBRID TECH GETS A JOLT OF SEA AIR

▶ **TEXT:** ALEXANDER FARNSWORTH **ILLUSTRATION:** MAGNE LANGÅKER

WIRELESS POWER TECHNOLOGY and vacuum docking are the latest buzzwords in coastal shipping lanes, and Wärtsilä is right in on the action.

Wärtsilä Marine Solutions is currently prototyping the world's first inductive power charging system (wireless), as opposed to conductive (a physical cable), to charge a hybrid-powered car ferry in Norway.

"During recent years, wireless inductive charging technology has been introduced for cars, buses and trains. Wärtsilä has now made this possible also for marine vessels, and we are ready to implement this on a real ship," says **Ingve Sørfonn**, Chief Expert, Electrical & Automation, Wärtsilä Marine Solutions.

In the past four years, the company has developed and standardised the technology to charge ship batteries without connecting cables. In January 2016, Wärtsilä joined forces with engineering and automation firm Cavotec to offer a combined induction charging and automatic vacuum mooring solution for coastal ferries via Cavotec's vacuum mooring pads that are recessed into the dock.

From a connection on the superstructure of a ship, to a power outlet on a dock, the new Wärtsilä inductive power system can transfer 1 MW of power within a range of 15-50 cm, which is 300 times more than that of current chargers used by electric cars.

"The system eliminates physical cable connections, thus reducing wear and tear caused by seawater, snow and ice, and enables charging to begin immediately when the vessel arrives in port. Renewable energy, battery solutions and performance are improving and getting cheaper all the time. There is no reason not to implement them in coastal shipping," continues Sørfonn, adding that the company has several patents pending for its unique solutions.

The technology is currently in the prototyping phase in the Wärtsilä lab in Stord, Norway, and it is due for full-scale implementation in the first half of 2017. According to Sørfonn, the system could play a role in future autonomous coastal transportation systems, not unlike what Google is testing with self-driving cars.

"Getting everything automated as much as possible is definitely the target," says Sørfonn.

FOLGEFONN IS A DOUBLE-ENDED, 85-metre-long, ro-ro hybrid-powered passenger ferry servicing Jektevik-Hodnanes, Norway. It carries 76 cars and 300 passengers and is owned by Norled, which operates 45 car ferries across Norway. Folgefonn was built as a diesel powered ferry in 1998 and retrofitted into a hybrid diesel/electric vessel in 2014.

In technical terms, a hybrid power system such as this one combines conventional diesel motors with batteries. Its integration into a hybrid system offers significant overall energy efficiency by running the engines on optimal load and absorbing many of the load fluctuations through batteries.

"The vessel makes frequent and short stops along its route. With batteries being what they are today, the ferry cannot operate a whole day on just one charge. So the key is to get as much energy onshore as fast as possible, and traditional methods of connecting, charging and disconnecting cables is very time consuming. The Folgefonn's docking times are no more than five minutes so saving a few minutes can be

Folgefonn was built as a diesel-powered ferry in 1998 and retrofitted into a hybrid diesel/electric vessel in 2014.

critical. A fast and wireless induction battery charging system is not just a time savings. The safety benefit of avoiding clumsy and heavy cable connections is obvious as well," says Sørfonn.

WÄRTSILÄ'S CONTRIBUTION TO THE Folgefonn project is the concept development, including the inverter systems, the hybrid control, battery package and systems, power transfer and land-based energy storage system as well as the integration of the onboard systems. The partnership with Cavotec's vacuum mooring system, thereby eliminating ship to shore lines, or ropes, will enable even more automation of the ship's basic functions.

"The environmental challenge has been the starting point for Wärtsilä's work in developing battery/hybrid technology for marine vessels. By making wireless charging of ship batteries possible, the electrification of coastal shipping is enhanced, resulting in major reductions in harmful exhaust emissions," says Sørfonn.

"DURING RECENT YEARS, WIRELESS INDUCTIVE CHARGING TECHNOLOGY HAS BEEN INTRODUCED FOR CARS, BUSES AND TRAINS. WÄRTSILÄ HAS NOW MADE THIS POSSIBLE ALSO FOR MARINE VESSELS, AND WE ARE READY TO IMPLEMENT THIS ON A REAL SHIP."

SEALED AND DELIVERED
THE WORLD'S FIRST IN-WATER SERVICEABLE SEAL

TEXT: STEVE ROMAN **ILLUSTRATION:** WÄRTSILÄ

OUTBOARD SEALS ARE one of the most critical parts of a vessel's operations. These vital pieces of equipment can be damaged by fishing lines and nets, and repairing them can mean weeks of downtime for dry docking or underwater habitat repairs. That all changed last summer, when a handful of ships began using Wärtsilä's revolutionary new Sternguard In-Water Serviceable Seal, the first seal that can be fully serviced when wet.

Engineering-wise, it's easy to see why a seal of this type is such a critical part of a ship's propulsion system. The seal sits just outside the stern tube right at the point where the propeller shaft passes through the hull. Its job is to keep seawater out and stern-tube lubricants in, all the while allowing the propeller shaft to spin freely.

Damian O'Toole, Director of Wärtsilä's Seals and Bearings Sweden, explains, "Stern tube seals are relatively small items to think about when you're building a ship. However, it can be extremely serious if something does go wrong."

If a vessel is unfortunate enough to have such a failure, usually the first reaction is to immediately look for the first available dry dock. Whilst docking facilitates the repair, you could be facing weeks of downtime.

"Furthermore, if it's a fully laden vessel, then you would probably also have to offload any cargo. So you can imagine that if it's a container carrier or an LNG carrier, it could take up to five days in port simply to offload," says O'Toole. Then, if the ship uses an oil-lubricated stern tube, that would have to be drained as well. A stern tube can hold up to 2,000 litres of oil, so changing it out can be quite a pricey prospect, especially when the more expensive bio oil is used in place of mineral oil," he points out.

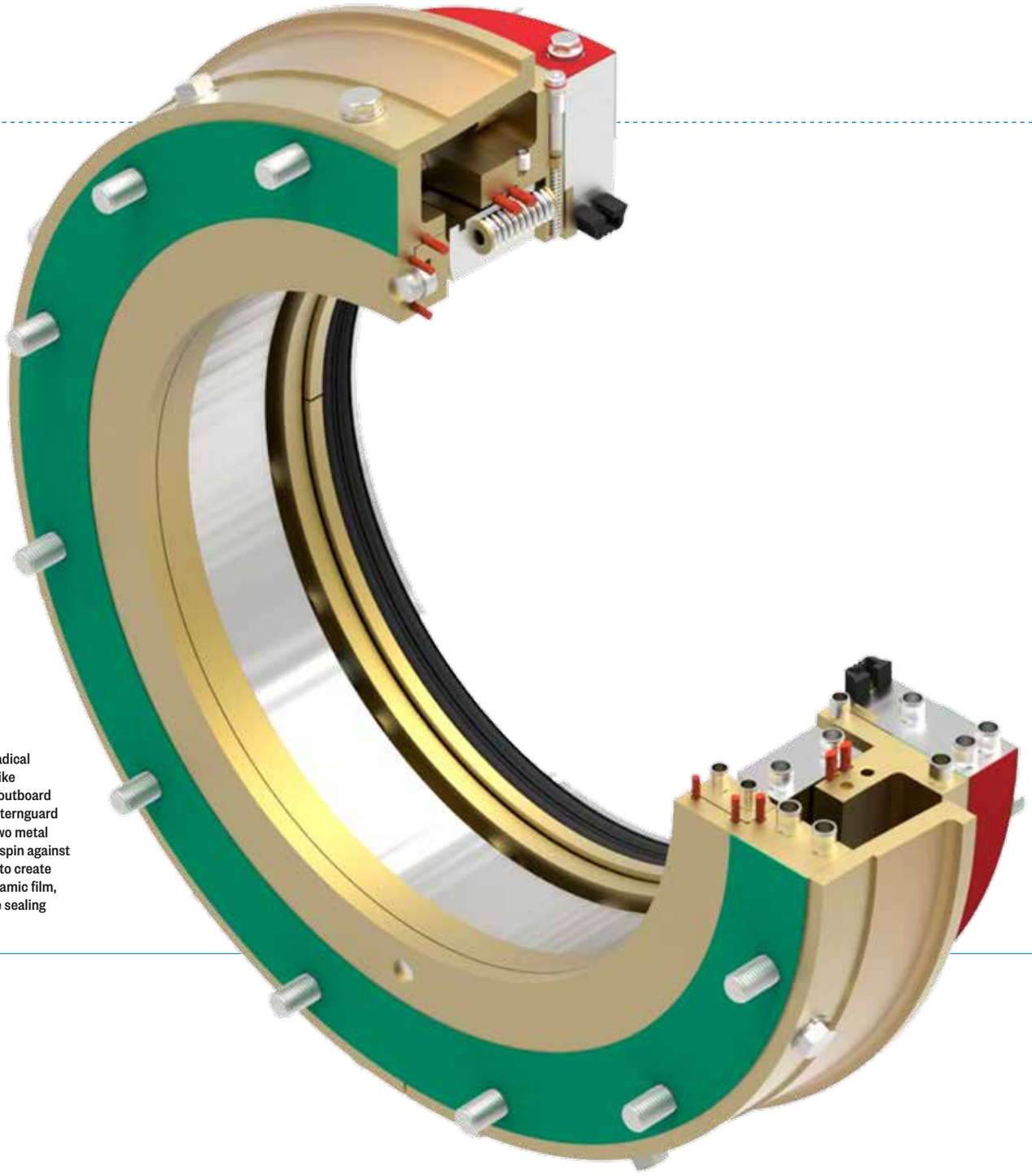
Given the amount of potential risk associated with this one piece of equipment, it's no surprise that customers around the globe, who were polled by O'Toole and his Seals and Bearings colleagues, were expressing a need for an alternative seal solution.

So, in 2015, after some months of engineering and testing, the group came up with the answer: the Wärtsilä Sternguard In-Water Serviceable Seal (Sternguard IWSS). Unlike traditional seals, the Sternguard IWSS can be fully serviced by a team of three to four divers. There's no need for a custom made habitat, no need for dry docking, no need for off-loading and no need to drain the stern tube, thus dramatically reducing repair times and costs.

This innovation marks a tremendous leap ahead of what's currently available on the market.

"There are some seals out there that are repairable underwater," O'Toole explains, "but they use a habitat, which is a custom-made-to-measure air bag that

"STERN TUBE SEALS ARE RELATIVELY SMALL ITEMS TO THINK ABOUT WHEN YOU'RE BUILDING A SHIP. HOWEVER, IT CAN BE EXTREMELY SERIOUS IF SOMETHING DOES GO WRONG."



"This is a radical design. Unlike traditional outboard seals, the Sternguard IWSS has two metal plates that spin against each other to create a hydrodynamic film, forming the sealing solution."

is built around the aft of the vessel. It's a chamber that divers would climb into. They can be expensive and it takes time to put them up and take them down."

KEEP CALM AND MAKE FOR CALM WATERS

The Sternguard In-Water Serviceable Seal is designed to be resilient, but when service is needed, the first step is to call in the Wärtsilä dive team.

"The divers will meet the vessel wherever it is. It could be in a harbour or anchored just out, and ideally it needs to be relatively calm," O'Toole says.

Service can usually be done by three to four divers, depending on the size of the propeller shaft. The divers' first task is to lock off the propeller shaft and inflate the emergency/maintenance seal. At that point, they can assess the maintenance or repair requirements.

The next task is to unbolt and remove the inner and outer rope guards. Now the moving parts of the seal can be compressed and removed, half by half. Divers will take the parts topside, where they can clean, repair or replace them. Then they're back in the water, essentially performing the same operation in reverse. Once the seal has been tested, the vessel can be on its way. All this is done without draining the stern tube oil.

THE RADICAL SPLIT

Inventing a system that allows these kinds of on-the-spot repairs, which is still as robust and functional

Unlike traditional seals, the Sternguard IWSS can be fully serviced by a team of three to four divers.

as other seals, required a major rethink of how these seals operate and how their components fit together.

"This is a radical design. For one, unlike traditional outboard seals, the Sternguard IWSS is a mechanical face seal. Simply put, there are two metal plates that spin against each other to create a hydrodynamic film, forming the sealing solution," he explains.

More critical to the removability aspect is the fact that the seal is fully split. That means all the parts that go around the propeller shaft are made up of two C-shaped halves, like a ring doughnut sliced down the middle. Once unbolted, they can be taken off and put back on with ease.

None of this removal would be possible without another key innovative application – the addition of an inflatable, maintenance/emergency backup seal. It closes off the stern tube before repairs begin, effectively acting as the new barrier between the oil-filled tube and the outside water, meaning stern tube oil does not need to be removed.

"Furthermore, should there ever be a catastrophic failure of the seal, you could lock off the propeller shaft and inflate the emergency seal," O'Toole says.

The inflatable seal is currently used in other seal designs in the Wärtsilä range, particularly for inboard, water-lubricated applications. The Sternguard IWSS is an oil-lubricated application which uses it as an outboard backup seal. "So we've taken an existing concept and adapted it for this new seal," O'Toole says.

Other Sternguard IWSS features include an inner and outer rope guard to protect the seal from the hazards of fishing lines and nets. Critically, though these are bolted on, whereas in a traditional setup they're welded on. This particular innovation was developed with input from the Wärtsilä dive team.

"They said we can save up to 40% of the time in water by not cutting off the welded rope guard, and bolting it makes sense. This is the type of product development we strive to achieve, as it offers the customer a significant benefit," O'Toole says.

LIVING, FLOATING PROOF

The Sternguard IWSS was officially launched in December 2015 at the Marinetec expo in Shanghai, but O'Toole and the Seals and Bearings marketing team have been discussing the concept with customers since the previous February. Needless to say, interest has been high.

"One customer didn't even want to wait for the Sternguard IWSS's official launch and had the seal installed on nine of their vessels over the course of the summer," O'Toole says.

The Sternguard IWSS has also been acknowledged by the marine industry at the European Marine Engineering Awards, held in Amsterdam in April, 2016. It came runner-up in the Auxiliary Equipment Category.

O'Toole notes that the Sternguard IWSS is compliant with the December 2013 Vessel General Permit (VGP) rules because Environmentally Acceptable Lubricant (EAL) oils can be used. And with proper maintenance using certified teams and Wärtsilä parts, they can support a seal that could last under water for up to 15 years.

But the biggest selling point, he says, is the fact that the Sternguard is comparable in price to traditional lip seals, and that it negates the need to dry dock for maintenance and emergency repairs. The cost savings argument carries a lot of weight given today's economic picture.

"The market has changed a lot in the last year. Now more and more operators are very conscious about their operational expenditure. So when you go in and offer a seal that gives significant cost savings, and is guaranteed to run in water for 15 years, if operated and maintained according to Wärtsilä standards, suddenly you've got them interested."

"THIS IS THE TYPE OF PRODUCT DEVELOPMENT WE STRIVE TO ACHIEVE, AS IT OFFERS THE CUSTOMER A SIGNIFICANT BENEFIT."

"It's a no brainer for certain owners," he says. "We have also been approached about putting this in some new builds, some propulsion units and aft thrusters."

O'Toole says he believes most orders for the Sternguard will initially come from the retrofit market, and as more customers gain familiarity with the product and its capabilities, the new builds will come into line.

Given the buzz around the Sternguard, there shouldn't be too long of a wait.

"It's proving itself more and more," O'Toole says, "and the more we work with it the more exciting it becomes."

PHOTO: WATTWAY

Streets paved with solar gold

Global energy needs are forecast to double by 2050. To meet such a huge increase in demand, we have to get even more creative with mechanisms of generating clean energy to provide the supply. One such concept, created by a company called Wattway, is to pave roads with photovoltaic (PV) cells. Given the amount of roadway across the world, just imagine the solar resources of this huge surface area facing the sky. Besides, vehicles actually only occupy the pavement about 10% of the time.

The panels are made of a composite material just a few millimeters thick with PV cells inserted in superposed layers to ensure resistance and tyre grip. To guarantee durability and safety, panels can be adapted to thermal dilation in the pavement and vehicle loads, and they can be applied directly to the current pavement, avoiding any need for civil engineering work.

A one-kilometre stretch of road paved with Wattway panels can provide the electricity to power public lighting in a city of 5,000 inhabitants. That means that panelling all the roads in the US, which has one of the world's longest and biggest road networks, would provide power for 21.5 billion people – or three times the current number of the world's inhabitants!

*Sign off

TEXT: ANNA AISTRICH **PHOTO:** HELGE HANSEN

Giving form to user experience

[AT YOUR SERVICE]

AFTER WORKING FOR A DESIGN FIRM in Helsinki, making everything from sauna ovens to door handles, **Davide Lamparelli** joined Wärtsilä in 2010 as a Senior Industrial Design Engineer for Marine Solutions and began designing user experience products. Now Lamparelli is co-authoring the Wärtsilä User Experience Guidebook to define a consistent process for the entire company.

1 WHAT ARE THE KEY STEPS OF THE DESIGN PROCESS?

For example, when designing the propulsion control panel system, I joined captains on the bridge to learn how they saw the interface. I asked them, "How do you pilot your vessel? Tell me your needs." I also factor in the user environment: What kind of lighting is there? Is it noisy? Are they wearing dirty gloves? I process and map the input to the various interfaces by how they interact and how the equipment will be used. First I look at functionality but also map *all* opportunities for improvements before proposing concept alternatives. Our core team discusses the proposals, integrates any new ideas and approves the concepts. Then we sketch out the visual look, create prototypes and show them to the customer to get feedback.

2 WHY SYNCHRONISE ALL USER INTERFACES ACROSS WÄRTSILÄ?

Creating a familiar look and feel for how you control, monitor and service Wärtsilä equipment ensures that everything behaves in the same way for the user. There's a common logic of user interaction across all equipment. Also, building interfaces that look alike helps identify them as Wärtsilä products and creates a brand identity.

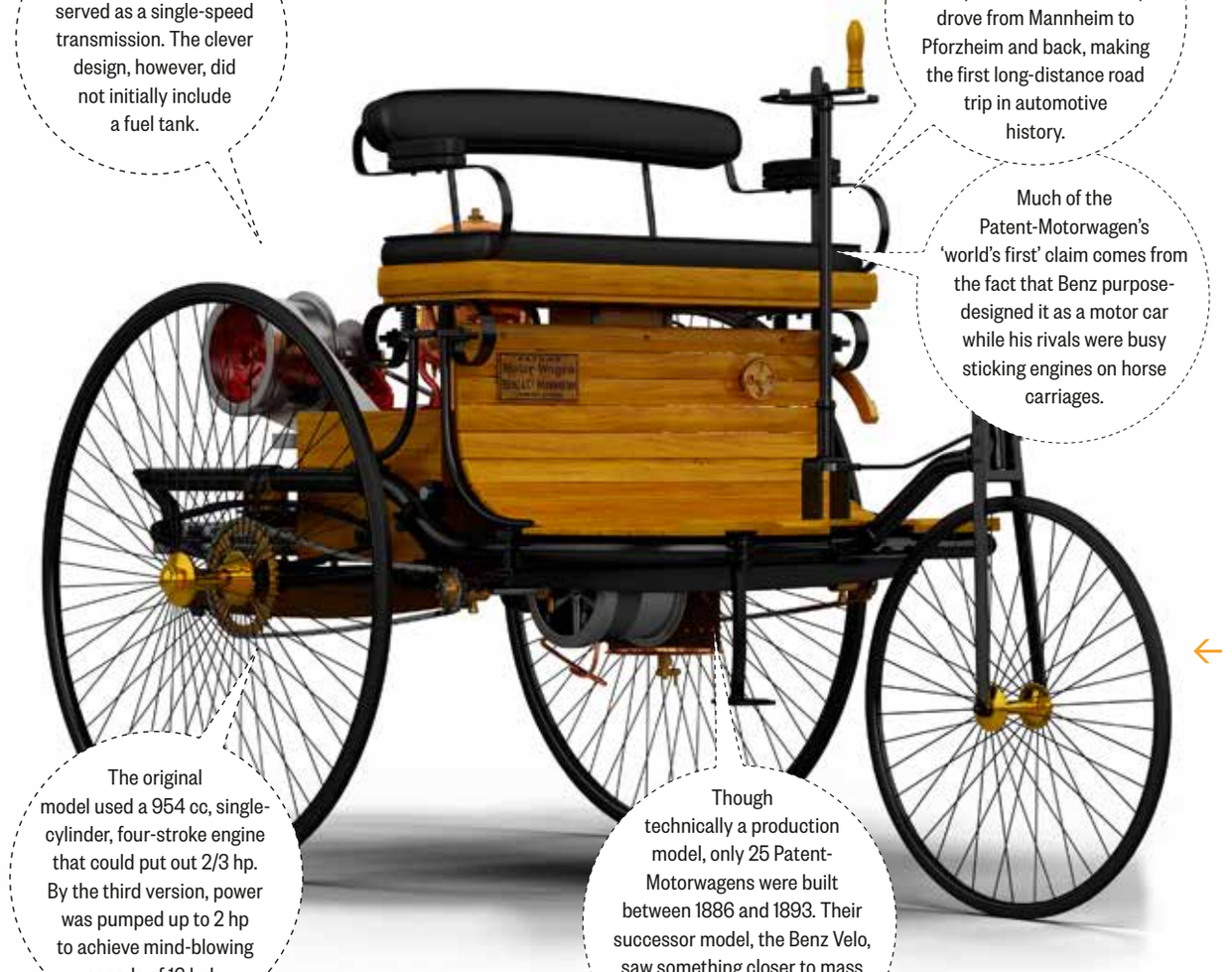
3 HOW DID THE USER EXPERIENCE GUIDEBOOK COME ABOUT?

In ship design, we have worked on projects that enabled cooperation and inspired "connecting the dots" across the organisation, such as having Industrial Design on board in R&D projects to help visualise the ideas. This work helped our internal processes so we wanted to document that. I'm documenting the elements related to Marine Solutions, Ship Design and user-centred design of physical machinery control. **Mikael Leppä**, the Lead UX Designer in Wärtsilä Services, handles the other big aspect of digital user experience design, which is customer service and portals. Together we're setting a consistent look and feel across the digital Wärtsilä product offering. The guidebook is still quite academic so it needs to evolve to be more practical. But it's an "enabler" in translating and concretely documenting the blessing from the top down, and it is a good reference for explaining the "design thinking process".

A FAMILIAR WAY TO CONTROL, MONITOR AND SERVICE WÄRTSILÄ EQUIPMENT ENSURES THAT EVERYTHING BEHAVES IN THE SAME WAY FOR THE USER.

[CLASSIC]

Innovation rolls forward



No gear-shifting was needed – a belt system served as a single-speed transmission. The clever design, however, did not initially include a fuel tank.

In 1888, to publicise the invention's capabilities, Benz's marketing-savvy wife Bertha famously drove from Mannheim to Pforzheim and back, making the first long-distance road trip in automotive history.

Much of the Patent-Motorwagen's 'world's first' claim comes from the fact that Benz purpose-designed it as a motor car while his rivals were busy sticking engines on horse carriages.

The original model used a 954 cc, single-cylinder, four-stroke engine that could put out 2/3 hp. By the third version, power was pumped up to 2 hp to achieve mind-blowing speeds of 16 kph.

Though technically a production model, only 25 Patent-Motorwagens were built between 1886 and 1893. Their successor model, the Benz Velo, saw something closer to mass production, with 1,200 made between 1894 and 1902.

ORIGIN

Don't let the wacky looks fool you. What you probably mistook for a Victorian wheelchair hauling a tea kettle is in fact the famed **Benz Patent-Motorwagen**, the world's first production automobile. Unveiled by its inventor Karl Benz in Mannheim, Germany, in 1886, the petrol-powered beast would prove to be the spark that ignited global car culture, eventually giving rise to everything from Hong Kong traffic jams to fuzzy dice.

TECHS & SPECS

Inventor
Karl Benz

Production
1886–1893

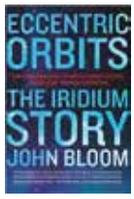
Components
Rear-mounted engine, steel tubing, wood panels

[CULTURE WATCH]

[SCIENCE]

Using non-invasive techniques, Italian and Egyptian researchers have confirmed that an iron dagger entombed alongside Egyptian pharaoh Tutankhamun more than 3,300 years ago was in fact fashioned from a meteorite. The scientists were able to match the material to a known meteorite with similar high levels of cobalt and nickel. Its unrusted blade had previously baffled scientists as similar metalwork was rare in ancient Egypt.

[LITERATURE]



Remember Motorola's 1990s Iridium project, the direct-to-satellite phone network that was supposed to revolutionise global communications? It nearly went down in flames as an USD 11 billion flop. In his new book, *Eccentric Orbits*, investigative journalist **John Bloom** tells the thriller-like story of how former Pan Am chief Dan Colussy managed to turn around one of the biggest blunders in business history.

[TECHNOLOGY]

Researchers at the Massachusetts Institute of Technology have developed an ingestible robot that could one day be used to mend internal wounds. Made primarily from dried pig intestines, the bots unfold and move accordion style, are controlled by an external magnetic field and decompose without a trace once their task is done. No word yet on a vegan version.

TEXT: ANNE KYTÖLÄ **PHOTO:** JOHANNES TERVO & MIKKO LEHTIMÄKI

[AMBITION]

Pizza and programming

Wärtsilä's CIO Jukka Kumpulainen is convinced that Wärtsilä needs to bring the spirit and atmosphere of Silicon Valley hackathons to its software development.

"IT'S VERY INNOVATIVE. IF YOU HAVE A CHALLENGE IN MIND BUT AS YET NO SOLUTION, THEN A HACKATHON IS A GOOD TOOL TO FIND THAT."

The winning team, and the one travelling to San Francisco, is the Lead Winners. Winning team got the chance to visit Salesforce headquarters and were introduced to Salesforce Marketing strategies.

"This will be your home for 48 hours," says **Paavo Kotinurmi**, one of the organizers of Wärtsilä's first ever hackathon, the Digisauna event, as a group of people steps out of the elevator into a room lit with red and blue strips of lights.

For inspiration, a photo of San Francisco is projected on the wall. The team with the most innovative, productive and applicable idea will travel to California in June.

At the event held in Vaasa, Finland, in April, seven teams raced to develop new, creative ideas and digital solutions to help improve the company's competitiveness and create added value for customers. Fundamental to the approach was seeing the problem through customers' eyes.

IDEA BORN IN OCTOBER

The idea for Wärtsilä's first hackathon was born in October, when **Eero Tuomikoski** and Paavo Kotinurmi met Salesforce representatives. Salesforce, whose programs support Wärtsilä's functions, already had experience in hackathons, and an idea arose. What if Wärtsilä could speed up its digitalisation with a new way of working?

The application process yielded thirty-five finalists, selected based on their skills, motivation and topic of interest, who were invited to the Digisauna. Seven mixed teams, diversified in terms of background, experience and gender, were created to boost the collision of ideas.

The teams came up with catchy names: Team SärMä, ChattsUpp, SF 46ers, Lead Winners, Team Sun, SunForce and Hotel California. Each team consisted of a business topic owner, whose real-life problem the team needed to solve, and a business end user, or client. There was also a Team Lead and two coders, the citizen developer and the alpha developer.

SPEEDY SOLUTIONS

Hanna Carlson, member of the SF 46ers, thought that the hackathon is just what Wärtsilä needed.

"In order to keep Wärtsilä competitive, we need to change our ways of working. We need to make our inner processes easier so we can manoeuvre faster."

The experts from Salesforce and Wärtsilä's own Salesforce architect helped the teams with technical issues, and by evening, everyone had advanced their prototypes to a suitable stage. In a short time, several mobile apps, client portals and analytics tools were created.

On the hackathon's last day, the teams presented their ideas to a panel of judges. Each team had five minutes to answer some tough questions: How will the client benefit from the solution? How will the tool generate money? How quickly can the prototype be turned into a real tool?

AND THE WINNER IS...

After tough deliberation, the jury selected the winner, and the team travelling to San Francisco, the Lead Winners.

The winning pitch at DIGISAUNA tackled a real business problem. And so did the others, which keeps the teams moving forward. The teams have continued to work together after the event, giving final touches to their solutions and working out the detailed deployment plans. Pleased with the outcomes of Wärtsilä's first hackathon, the organisers plan to continue it in one format or other.

MORE WÄRTSILÄ WINNERS

When a team from Wärtsilä and its supplier Bilot (WESAP team) won SAPSyke ¬– the 36-hour hackathon arranged by SAP's Finnish User Group – it convinced them that hackathons could play a useful role in Wärtsilä's future software development.

"It's very innovative," said **Kati Helenius**, a member of the winning team. "If you have a challenge in mind but as yet no solution, then a hackathon is a good tool to find that."

The winning AirSpare concept foresees using, as a complement the global logistics system, an Uber or Airbnb-like model to handle individual shipments of smaller spare parts and components and an Internet-of-Things-based solution for connecting shipments, couriers and customers.

The idea is to let ordinary travellers bid for a courier job on a website or app, pick up small spare parts/components using "parcel hubs" (lockers at selected airports), carry the parcel with them on flights, and then deliver it to an airport locker at the destination site.

At the award ceremony on May 19 in Helsinki, the team picked up the EUR 2,000 prize, which it donated to the Finnish Cancer Foundation.

Helenius said the experience showed her that hackathons work best when business people as well as programmers are involved, as they are better able to define real problems.

"I think, at this point in time, I wouldn't use it for major projects. I would concentrate on something that is not only technical but also involves the business side," she said.

[TRAVELLERS' GEAR]

If gigantic files are a concern or you just want to pack 50 hours of HD films for your next long flight, the ultra-stylish **Seagate Seven Portable** can help. At just 7mm, it's touted as the world's thinnest 500GB external hard drive and its USB 3.0 capability makes file transfers lightning fast.

Scoot from terminal to terminal and be the coolest 'grownup' in the airport at the same time with Micro Luggage designed by American electro house musician Steve Aoki. The hard rubber carry-on features a kickboard as well as integrated **Sound2Go** speakers that work via Bluetooth.

Travelling far from civilisation or on a super-tight budget doesn't have to spell dirty laundry thanks to the **Scrubba Wash Bag**, a lightweight, pocket-sized kit equipped with a flexible washboard. With just two to four litres of water and some washing liquid, you can have your clothes daisy fresh in under three minutes.

[LITTLE ENGINEER]

Spooky Action at a Distance

TEXT: STEVE ROMAN

IF ARTHUR C. CLARKE turns out to be right about sufficiently advanced technology becoming indistinguishable from magic, the Internet of Things might just be what finally pushes humankind into a high-tech fairyland. At the rate things are moving, though, it'll be up to our kids' generation to work out exactly how to unleash IoT's full potential once anything and everything is net-connected.

Luckily, today's Little Engineers can get a head start with the help of SAM Inventor, a deceptively simple kit from London-based SAM Labs. Recommended for ages 7 to 12, the kit comes with four wireless blocks – a buzzer, a light sensor, a tilt sensor and a DC motor – as well as a Bluetooth dongle and chargers.

But it's in the free app (available for Windows and OS X) where the real alchemy happens. This is where you drag and drop the blocks and draw lines between them with your mouse, hooking them together in various ways to start inventing. The five included projects let you master Morse code, create an alarm system for your pocket money, bring drawings to life with sounds, make electronic songs and build a mini drum machine. Loads more project ideas can be found online.

The app not only controls the SAM Blocks, it also integrates your computer hardware, allowing the blocks to control your mouse, keyboard, speakers and camera. There's also an external services function where you link your SAM Blocks to Twitter, Facebook, IFTTT and MIDI, and even a 'custom code' module that lets you add custom features and practise JavaScript.

While SAM Inventor is relatively basic and moderately priced, those who want to spend a bit more can opt for SAM Labs' more complex kits all the way up to SAM Family, which comes with a full 24 blocks – more than enough for any budding magician... um, engineer.

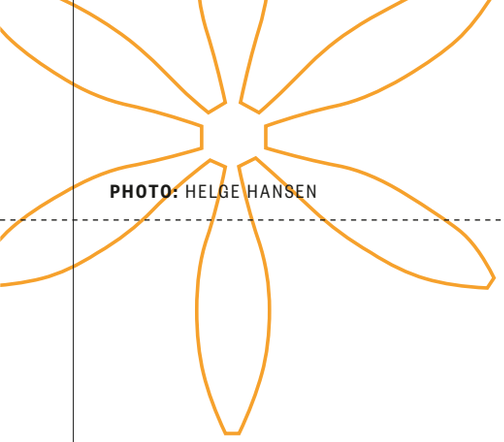


PHOTO: HELGE HANSEN

Radical innovator

THE WORD "RADICAL" HAS TWO MEANINGS. The most commonly used means drastic reform, but radical also means something that relates to the very origin of something.

The origins of the marine market remain its raison d'être today: the transportation of goods and people as swiftly and cheaply as possible. Yet it's how you do it that is yet again going to change. The marine market's not immune to greater changes afoot in the world – it never has been – but today an entire industry (taxis, hotels, airlines) can change so fast that the shift truly feels radical.

And for those left behind, the future's not that bright. Which is why we at Wärtsilä have put together a team that asks what the main trends might and should mean for our industry. Those trends are green energy, the sharing economy, and digitalisation.

Did you know, for example, that every second container ship leaving the US does so empty? That's not green, nor is it making use of digital tools to share space.

In my team, working as a complement to R&D, we discuss daily that if we don't have our finger on the pulse, one of our competitors will. What is the one product or service that will rewrite the game? Disrupt the rules? Make other market players bend their offering around ours? Companies have lived and died depending on their ability not just to peer into the future but to tell consumers what they want before the consumers themselves know that they want it.

At Wärtsilä, we have always been innovators. That's why we've kept ourselves afloat for so long. But today's world demands that we think and imagine faster than ever before. Since my team assembled about a year ago, I've been delighted at the knowledge and ideas across Wärtsilä. In many ways, we are already working with those three main trends, yet we will go further. We have to, and we will, and we're enjoying the process. Wärtsilä has now come up with six entirely new marine applications that meld existing and upcoming technology with the trends of today. The concepts aren't specific; there's enough room to allow our colleagues and customers to fill in the concepts with their imagination. And then we can move into the future together.

Willie Wågen
Director, Market Innovation
Wärtsilä Marine Solutions