

shape

The Gurit Magazine for employees, customers and suppliers
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Dear Reader



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Gurit enjoyed a 35% business growth in 2019 and reported 576 CHF million in sales. The Wind Energy market growth was robust and is expected to grow further in 2020. Gurit undertook major initiatives with the PET capacity increase, like the creation of new manufacturing sites in Mexico and several product innovations.

We have rolled out our new Vision, Mission and Values statements which set the next exciting chapter in Gurit's future – serving a good purpose with renewable energy and lightweighting. Core to these statements is our unwavering commitment to sustainability and health and safety. We want to prevent accidents at our sites and make sure our staff find safe workplaces with best-practice procedures trained and implemented.

In terms of sustainability, we are proud to be part of a global wind energy mission, contributing to a solution tackling climate change. Our business is all about lightweighting, be it in aerospace, marine or rail. Saving weight of a moving object by applying advanced composites means saving energy.

Gurit has already taken steps towards a sustainable future with a remarkable size of the business built on the foundations of recycled PET bottles, which are then processed into our Kerdyn™ Green PET foam. This business line is so successful that we will add additional production capacities this year, both in China and Mexico. But the story does not end here; our sustainable footprint is continuously widening, for example with AMPRO™ BIO, our new all-purpose epoxy which is produced from 40-60% bio-based materials.

On the projects front, Gurit has been involved in some exciting developments over the past months. Some of these are featured in this edition of Shape. We are proudly collaborating on several sustainable initiatives, such as Oceanwings® and Norsepower Rotor Sails, which have great potential in revolutionizing the shipping industry. I wish you interesting reading and look forward to another exciting and successful business year.

Yours sincerely,

Rudolf Hadorn CEO
February 2020



With passion for a sustainable future

A mission in wind energy and lightweighting

Gurit's Mission is in wind energy and lightweighting. Gurit is a global player in renewable energy, a key aspect for a more sustainable world. Gurit wants to be a system partner and focuses its activities around the wind turbine blade, with a unique offering in tooling, kitting and materials. With an in-depth understanding of the blade production process and the value chain, Gurit helps to increase wind energy competitiveness and promote its sustainable growth.

Beyond wind energy, for lightweighting applications, Gurit has knowledge and expertise to provide high performance materials and engineering. This is a mission to be proud of, and it is a business that serves an honorable purpose. Wind energy is a key technology to replace fossil fuels and reduce the world's greenhouse gases emission levels to an acceptable level. 25 percent of Gurit is in lightweighting – making big and heavy things lighter, either for reduction of energy to get and keep things in motion or for additional payload; efficiency is the driving motive.

Gurit has redefined its Vision and Mission

A company's Vision, Mission, and Value statements are crucial in determining the direction for everything that happens within an organisation and beyond. They keep both staff and customers aware of where the organisation is going and what it is trying to achieve.

This year, Gurit has updated its Vision, Mission and Values, providing guidance for staff members in their daily work. Gurit's management has developed these in a workshop in December 2019 at the Gurit site in Albacete, Spain. A good vision gives inspiration and sets a foundation for a company. **With passion for a sustainable future** is Gurit's new Vision Statement.

Our Vision Our Mission

Our mission is in wind energy and lightweighting.

We are a system partner for wind energy customers globally, with focus on the wind turbine blade. With our unique offerings and in-depth understanding of the value chain, we help to increase wind energy competitiveness and promote its sustainable growth. For lightweighting applications, we use our knowledge and expertise to provide high-performance materials and engineering.

Values

Safety first

Furthermore, Gurit has defined five values that will guide its staff during daily work operations. First of all, this is the **health and safety** of our staff, partners and customers. **Safety first** guides the way when planning for new machinery and equipment, operations and business processes, and the way Gurit conducts its business with a view to health and safety. This means Gurit staff members follow protocols and procedures and will speak up and stop work if safety is compromised. In order to emphasize this value Gurit has launched a corporate initiative which will be rolled out in 2020 and will never end: it will become a permanent task and mindset.



Values

Customer focus

The second value of Gurit is **customer focus**. This means staff members are meant to orientate their work on the needs of customers - current and future, performance and innovation. It also means that Gurit wants to innovate and to be strongly competitive. A business without satisfied customers cannot exist.



Successful together

This brings us to our next value: **successful together**. An organisation can achieve great results if all talents, ideas, skills, energy, and resources are put to the best use for a common cause. Success is almost never the merit of one individual human being but is the outcome of a team collaborating effectively with passion. This means Gurit employees shall cultivate mutual respect and tolerance, act honestly, and walk the talk.



Resourcefulness

Resourcefulness is another guiding principle and value of Gurit. When working in very competitive industries, a company needs to take care of its resources, be smart and efficient and find the best way, not just the first obvious way. This is in the economic interest of competitiveness and profit. And while we do so, one does not want to compromise on any of the other values, particularly not on health and safety.



Sustainability

Last but not least, Gurit has defined **sustainability** as its fifth value, and it is also part of Gurit's Mission Statement. In all we undertake, we shall take care of the natural, environmental and social environment. Gurit staff members behave responsibly and employ, invest, and conduct business sustainably and ethically to the best standards.



Gurit CEO Rudolf Haddorn is happy to set a clear direction going into the future. *"Our new Vision, Mission and Value statements are a pathway for Gurit's intentions going forward. I am pleased that we have made great strides in sustainability already".*

40 Years of X-Yachts

Partnered for Success

With 40 years of experience producing high performance luxury cruisers, X-Yachts has developed an enviable reputation and built some stunning yachts along the way. The launch of their X-4⁰ in 2019 further cements this reputation as one of the world's top production yacht builders thanks to the X-4⁰'s perfect blend of luxury and performance.

“Corecell M Foam has been a valuable material for X-Yachts. We demand a high performance from our yachts and Corecell is an integral product in helping us achieve this. The foam performs well in sandwich panels and thanks to its versatility in both densities and processing techniques we are able to get the most out of it. We have been using the foam for a number of years and to date we have never had any structural issues with the core.”

Thomas Mielec,
Director of Design & Engineering at X-Yachts

The X-Yachts production yard was established in 1979 where the company designed and built its PureX range of yachts, which won International Offshore Rule (IOR) awards in world class racing. From here the company later developed the Xcruising range for sailors wanting to travel in style and comfort, and then came up with the Xperformance range for competitive sailing.

Gurit is proud to share a long history with X-Yachts, first collaborating in 2009 on the production of the X65, and later on the Xcruising and Xperformance yachts with engineering and materials as they were designed. Shape spoke with Piet Heydorn, Gurit's Regional Sales Manager EMEA who provided some insight into the history.

“Looking back over the last ten years X-Yachts have produced some outstanding yachts and we are excited to have such a strong partnership and to have had the opportunity to help contribute to their success story. X-Yachts and Gurit have collaborated very closely to implement the latest high-end technologies into their production yachts, including precise material pre-kitting and epoxy infusion to produce some

of the world's best cruising and performance yachts. Thanks to X-Yachts' skill and commitment to quality these yachts feature very light, very stiff, and very strong hull structures that deliver outstanding sailing performance in any weather condition.”

In 2019 X-Yachts celebrated its anniversary with the release of the new X-4⁰. Shape spoke with Thomas Mielec, Director of Design & Engineering at X-Yachts who describes the X-4⁰ as a “forty-foot performance cruising yacht that perfectly blends quality, performance, and styling with cruising capability.”

X-Yachts prides itself on the quality and performance of its yachts and one of the key factors in this performance is the materials used. The X-4⁰ was no different and features a high performance material package from Gurit including Corecell™ M Foam, PRIME™ 27 epoxy infusion system and Spabond™ 540LV.

Corecell™ M Foam is used throughout the yacht's hull to provide high performance and reliable processing through vacuum infusion. The foam provides particularly impressive energy absorption abilities making it ideally suited for slamming areas. This provides X-Yachts with the confidence that its yachts are capable of withstanding rough seas when cruising or racing.



Growth of Offshore Wind Energy

Global energy demand is now increasing at its fastest pace ever and this trend does not look to be slowing. Currently, this additional demand is met largely through energy produced by fossil fuels, but there is a growing awareness of the need to reduce global carbon emissions.

To date, most clean energy is produced from hydropower dams; however, this is set to change with wind energy experiencing strong growth and advancements. In the USA, according to North American Windpower, wind turbines have already overtaken hydropower dams as the largest single source of clean energy.

The majority of current wind power is produced by onshore turbines as they are initially cheaper to build and maintain, and energy is more easily transmitted. However, according to the International Energy Agency (IEA), offshore wind energy is experiencing strong growth, up 32% in 2017 and a further 20% in 2018 with strong results forecast for the following 5 years.

According to the Global Wind Report 2018, the total worldwide offshore wind power capacity was 18.8 gigawatts (GW) which represents around 4% of the total 591 GW produced from wind power in 2018. By 2025 the share is expected to exceed 10% with the total offshore wind power potentially reaching 100 GW.

UK as a pioneer in offshore wind

To date, the United Kingdom has been a key driver for offshore wind farms as it is surrounded by favourable shallow waters and consistent wind. Currently, five of the seven highest production wind farms are based here with the largest, Walney Extension, producing 659 megawatts (MW). This is however soon set to be eclipsed by both the Hornsea Wind Farm and Dogger Bank Wind Farm.



Walney offshore wind farm

The Hornsea Wind Farm is currently under construction in the North Sea off the coast of England. The farm is being split into 4 subzones with each producing between 1-2 GW of power for a maximum supply of 6 GW. Construction of the first zone started in January 2018, with the first turbines sup-



plying power to the UK national electricity grid from February 2019.

The offshore wind project “Dogger Bank” is similarly impressive and is set to power up to 4.5 million households through three connected wind farms, each expected to have a capacity of 1.2 GW, an equivalent to around 5% of Britain’s estimated power generation. The location is set to be around 130 kilometres off the British coast and will cover an area of 8,660 square kilometres with wind turbines 260m high, 70m higher than the largest existing offshore turbines.

Growth in Asia

Asia is also experiencing growth with investments in supply chains and projects continuing. India and Vietnam are in early stages but according to the Global Wind Report 2018, have an offshore wind potential of 60 GW and 27 GW respectively, with India setting a target of 5 GW by 2022 and 30 GW by 2030.

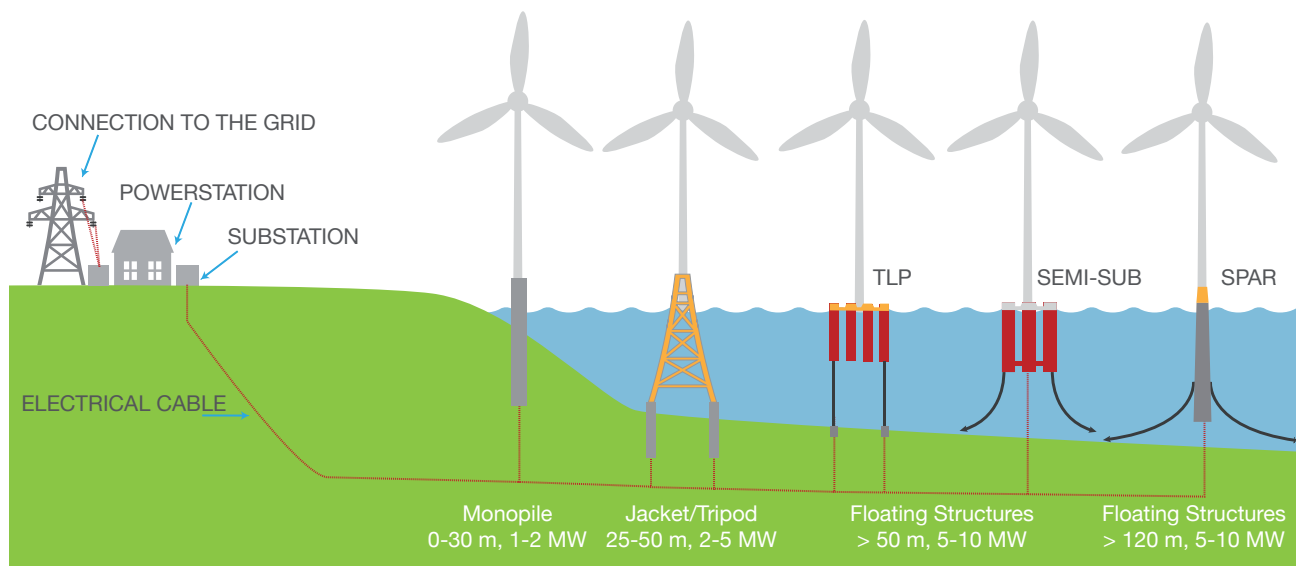
Japan is also showing potential for growth with a clear need to turn to offshore wind to meet an expected shortfall in power generation. The Japanese government have passed the Offshore Wind Law which provides them with a clear mandate to define several areas for offshore wind development.

Challenges for offshore turbines

Despite this predicted growth offshore turbines do face their challenges. Leading edge erosion of wind blades is well documented and caused by the combined effect of rain impact and general weathering of the blades. For an onshore turbine, maintenance is relatively much easier and more accessible facilitating the reconditioning of blades. However, when the turbine is 130km offshore like The Dogger Bank Windfarm, this becomes much more difficult. If blades are not maintained sufficiently this erosion diminishes the blades aerodynamic efficiency which reduces its operational output and can eventually compromise the blade’s underlying composite structure if left unchecked.

Another issue wind turbines face is the production of noise. The noise from blades comes from the tip vortex generation. This “hissing” sound is airborne and is dealt with by limiting wind blade tip speed to max 70m/s (ca 210 km/h) on onshore blades. Infrasound low-frequency noise is borne through the soil conditions and can be caused by machinery such as gearboxes. Inappropriate levels of infrasound are often cited as the source of a range of adverse health impacts; however, in 2019 the National Health and Medical Research Council found that there was no evidence that turbines directly affect health. The study did however call for further research on the effects within 1.5km of a turbine.

Early wind turbine designs in the 1980s produced large amounts of gear noise, however, modern designs are placing the rotors upwind of the turbine which has greatly reduced



the noise and made turbines suitable for widespread use. The use of offshore wind farms places these turbines far enough away from the land that noise is typically unlikely to be heard.

Offshore wind turbines require a greater cost to establish and maintain and the technology to bring the power ashore is expensive. However, as the industry matures and larger turbines allow for additional economies of scale, the costs per kWh of power produced will continue to decrease. The offset of this is that offshore turbines tend to be more efficient with more predictable wind speed, have less interference with land use, and potentially help benefit the marine ecosystem where it is constructed thanks to the turbines underwater structure acting as an artificial reef.

Comprehensive offering

Gurit is well placed to handle this growth, having positioned Wind as a strategic focus. Today Gurit offers a complete package for customers building both onshore and offshore turbines: Tooling for wind blade moulds, composite materials and kitting services.

Bing Chen, General Manager of Gurit's Tooling Business Unit states: *"Gurit is the largest independent mould maker worldwide and as a result can provide a comprehensive offering including the development of master plugs and moulds to over 100 m in length, as well as a range of additional services including wind blade mould automation systems, installation services and transport systems for wind turbine blades and tower elements."*

Gantry of a Gurit tooling mould





Workboat built with Gurit Corecell™, ferrying workers to and from the offshore wind farm

Core materials made from recycled PET

On the materials front, Gurit's Kerydn™ Green, which is produced from up to 100 % recycled PET bottles, is an environmentally responsible material in line with the goals of wind energy.

Workboats fulfilling their mission

One of the noticeable differences with offshore wind farms is the requirement to venture far offshore and brave the weather conditions to build, maintain and repair them. Working vessels are the mode of choice as they allow economic travel and provide a working platform for crews. These rough crossings demand high-performance materials and Gurit's Corecell™ M Foam is the perfect material to produce a high-performance boat subjected to the challenges the smaller near-shore workboats encounter.

Shape spoke with Gurit Engineering Manager APAC, Tony Stanton who advised Gurit has a huge range of capabilities in this area also: *"Gurit offers excellent materials and an unrivalled composite engineering service that complements the material package and can provide smaller nearshore work vessels with maximum fuel efficiency. Using a SWATH (Small Waterplane Area Twin Hull) design with Gurit engineering and materials, customers can expect a high-speed transport vessel capable of partially submerging for an ultra-stable work platform."*

Offshore wind generating green hydrogen

The engineering firm Tractebel has developed an offshore wind-to-hydrogen platform. It converts electrical power generated by offshore wind turbines into hydrogen using electrolysis. With a capacity of 400 MW the installation has an industrial scale and exceeds the output of other solutions currently on the market. It allows the production of green, CO₂-neutral hydrogen and can be used in existing gas

pipelines. This combines various advantages. The natural fluctuations of wind can be easily stored as the electrolysis to produce the hydrogen can be easily scaled to the electricity available at any given moment or season. Secondly, the existing infrastructure for fossil fuels, in particular natural gas, could be converted into the production and transportation of hydrogen. This provides relief for the existing electricity grid or saves the cost of building electricity transmission lines to offshore hydrogen-wind farms. The potential is huge and this is certainly a promising promising opportunity to fight climate change.



Source: www.tractebel-engie.com

Health & Safety

Implementing a health & safety culture

Health and safety is a top priority for Gurit and “Safety First” has become one of the company’s core values that guides employees in their daily work. In order to recognise and correct potential hazards before any accident or health issue may occur, Gurit launched a major initiative to implement a safety culture as a permanent mindset within the company. For this purpose, an internal workgroup has been formed with the objective to identify the most relevant areas of action, define standards, start a group-wide implementation, and establish reporting and governance practices.

Project Core Team

This workgroup is called the “Project Core Team” and headed by Hannes Haueis and Begoña Fernandez. Further Core Team Members are Per Olesen (BU Kitting), Emilio Esteban (BU Composite Materials), Kelvin Yao (BU Tooling), Salvatore Masi (BU Aerospace), Josep Fabregas (BU Balsa), Oscar Sanchis (Human Resources) and Thomas Nauer (Marketing-Communications).

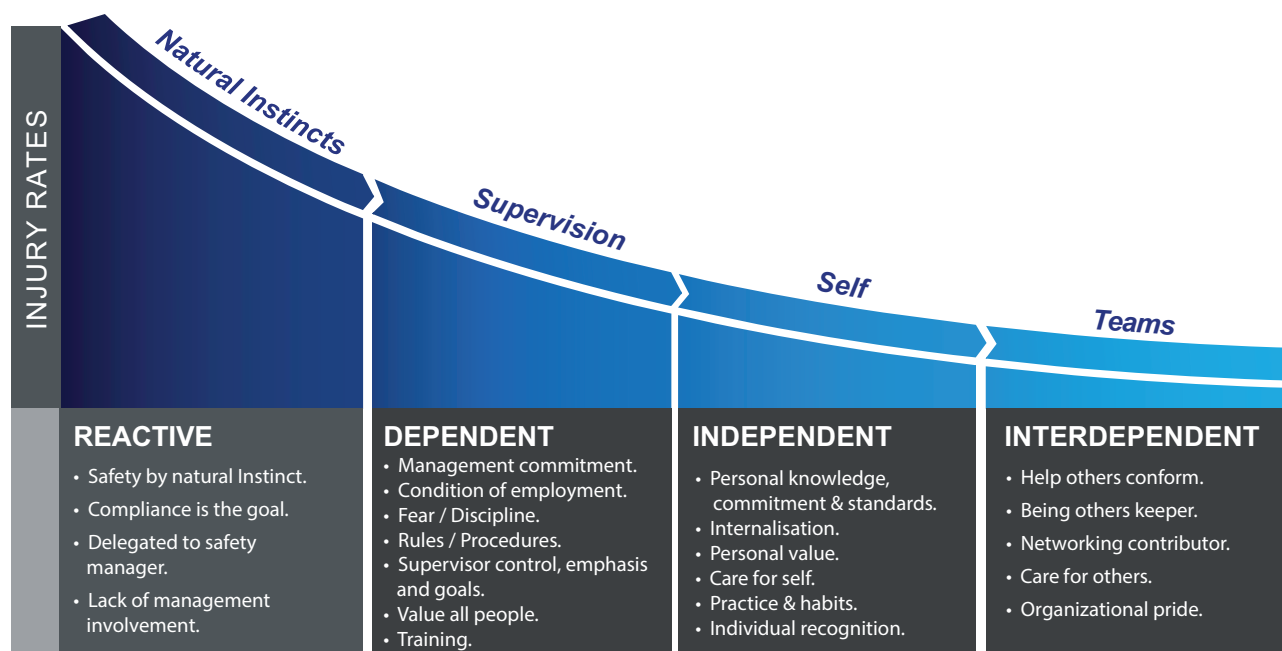
Safety perception survey

As a first step, at the end of 2019, all employees have been invited to participate in a safety perception survey. To make sure we gain access to learnings from other companies and quickly adopt the most efficient best-practice methods, Gurit has contracted an external consultant, Dupont Sustainable Solutions, for the part of the project establishing a safety transformation framework.

The Executive Committee and the Project Team held a kick-off workshop in December 2019 and the Senior Management of Gurit has been brought on board the initiative at the annual management meeting in January. Leadership will play an important role in supporting and driving the initiative, walking the talk, giving direction and sharing observations. However, ultimately the success of this initiative, the number of accidents, injuries and ill-health cases prevented will depend on the commitment, sense of urgency and support of every single employee.

Gurit Safety Transformation Framework

Ambition	Implementation		Results
Our ambition is to have zero work related injuries and illnesses	Internal process optimisations, alignment with industry-best practices, and change of organisational culture		1. Safe and healthy working conditions 2. Increased risk awareness by education, supervision and communication 3. Safer working methods
	Programme Management	Steering Committee Corporate Communication Change Management	
	Corporate Safety Governance	Standards Four core processes & reporting ISO standards and compliance	
	Cultural Transformation	Workshops Leadership “Walk the talk” Safety Observation Programm (“STOP”) focusing on supervisors and operators	



The Bradley Curve © 2020 DSS Sustainable Solutions. All rights reserved.

Bradley Curve

The DuPont™ Bradley Curve™ is an internationally recognized benchmark for safety performance. It has been established in 1995 by the company DuPont and helps to better understand the effectiveness of a successful safety culture of a company.

The Bradley Curve identifies four stages of safety culture maturity:

1. Reactive: People don't take responsibility and believe accidents will happen.

2. Dependent: People view safety as following rules. Accident rates decrease.

3. Independent: People take responsibility and believe they can make a difference with actions. Accidents reduce further.

4. Interdependent: Teams feel ownership and responsibility for safety culture. They believe zero injuries is an attainable goal.

More information is available in the following video:

 [www.consultdss.com/
bradley-curve-video](http://www.consultdss.com/bradley-curve-video)

5S

5S is a methodology to organize any workplace to improve safety and efficiency. It has been pioneered by the Toyota Motor Company. The 5S methodology is:

① Sort: find out which materials or items need to be removed by sorting them according to their frequency of use (daily, weekly, monthly).

② Set in order: have a good visual management, in terms of what items are needed to be where and how many of them.

③ Shine: do housekeeping and cleaning from dust and dirt. Remove any waste. Trace any activities that cause dirt or contamination. This way employees can focus on working safely, free of distractions.

④ Standardize: best practices should be **standardized** in workplace procedures and company culture.

⑤ Sustain: sustaining good practices is a challenge, it requires a lot of discipline, training, communication, and ongoing support from management and all staff members.

⑥ Safety: is actually the sixth "S" of the 5S principle. It means that all previous steps contribute to safety, and the focus of 5S should not be limited to keeping things clean and tidy, but also all aspects of safety.

Interview with Per Olesen

Chief Operating Officer (COO) of the Kitting business and member of the Safety First project core team

Per, what is driving you as a person and Operations Manager?

My driver is to make improvements together with a team.

What is your personal mission in life?

Do my best everyday to support my family and colleagues, but remember myself in the quote.

If you had three adjectives to describe yourself, which ones would you pick?

Honest; Teamplayer; determined

You have a lot of experience in both operations and the wind industry. What was your main motivation when you agreed to become a member of Gurit's Safety First Core Team?

When I joined the company as an Operations Manager nobody seemed to **prioritise** safety. I started the journey for JSB and to be honest, it is not an option for me to work in a company where safety is not a top priority. I want everyone to go home without injuries, and I want leaders to take responsibility.

How can a company implement a true safety culture, what do you think is most effective?

It is a top-level approach and not only in talking but more importantly as shown in managers' behavior. We must not always start to talk about how many deliveries we made yesterday but ask about safety.

What are the most important typical causes of accidents and health issues?

One tries to work quickly and take the easy way and not the safe way. It is possible to operate a dangerous machine with the right training and the correct procedures. Cars are a good example: they can be dangerous weapons to kill people. Drunk drivers or people using their smartphones while driving kill a lot of people every week. But, with good training, the right mindset, discipline and good maintenance, as well as some rules and consequences, driving a car can be made safer.

In terms of safety, what has been the most important experience in your career so far?

1. Ensure the organisation understands the safety pyramid and the Bradley curve.
2. Detect and understand the hazards and what needs to change before the incident happens.
3. Understand the true root cause behind every incident and take quick and thorough steps to mitigate any risks.

“Set realistic targets and support the team and then celebrate the achievements together.”

Per Olesen



Per Olesen, 59 years, Chief Operating Officer (COO) of the Kitting business, known as the company JSB, a member of Gurit Group since 2018. He lives in Denmark and has just moved to a new home outside the city. Per enjoys nature and often goes hiking or plays golf with good friends in Denmark and abroad.

What were your main learnings?

1. It is possible, but hard work to reach the “Independent” level of the Bradley curve. The difficulties appear when you want to reach the next step. People do not like to receive good hints from colleagues.
2. In 80% of the situations we do not find the true root cause. We jump to premature conclusions after the second “Why”. The method is remarkably simple: when a problem occurs, you drill down to its root cause by asking “Why?” **five** times.

How do you perceive the current safety performance?

I believe most of Gurit is in the level 1-2 in the Bradley curve. We still have a long way to go and also the management needs to change focus.

What is your recipe for success?

Set realistic targets and support the team and then celebrate the achievements together.

What would you prioritize to further improve the performance?

Continue to walk the talk and challenge the managers. Safety is the managers' responsibility and all risks can be managed.

What do you expect from a manager or team leader when it comes to safety?

Understand safety and always be a good ambassador. Never let an unsafe situation go by without follow-up action.

Is a safe workplace compromising profit?

I believe that safety, quality, 5S, continuous improvements and cost goes hand-in-hand. In all situations, we need to find the right level since everything can be overdone in a way that will cost us out of the market.

How can an employee contribute to a safe and healthy work environment?

1. Take care of yourself
2. Take care of your colleagues
3. Follow rules and instructions
4. If you are in doubt – stop



Solar Boat Racing



Enthusiastic pilots of the TU Delft Solar Boat Team

The Monaco Solar & Energy Boat Challenge has been an innovation platform for solar and energy powered vessels since 2014 where teams compete against one another using only clean energy sources to propel their vessels. It is the largest international competition for solar boats with 34 teams, including 22 universities which competed in the 2019 event during July in Monaco.

One of those university teams was the Solar Team from the Delft University of Technology in the Netherlands who competed in the Offshore Class. In a competition where speed, agility, and efficiency are crucial to a team's performance, lightweight composite materials are essential to the vessel's design. Gurit was proud to be able to support the TU Delft Solar Team with a material package as they competed for a place on the podium.

The Offshore Class has challengers competing in the open ocean. On the first day the boats raced from Monaco to Ventimiglia and back, a length of approximately 30km. The next stage doubled this distance, so the teams need to have high-quality materials that are not only lightweight but also provide excellent longevity to withstand any challenging conditions encountered.

On the first race, the Solar Team placed 3rd with a time of 1 hour and 10 minutes and set a new speed record for the boat of 35km/h. Unfortunately, after finishing the race the team discovered some issues with the connection wires of the solar panels and electrical systems. They had to make the tough decision to remove the solar panels for the next race to prevent further damage and ensure crew safety.

The next stage involved competing the same course twice over, back-to-back. However, this time the team had the extra challenge of being equipped with only the energy already stored on-board, no solar panels to generate extra during the race.

12 minutes, giving them a total time of 4 hours and 14 minutes, a full 1 hour in front of second place! With this performance, the team became the world champions in the overall competition of the Offshore Class!

In addition to smart engineering and design choices, Gurit high-quality materials certainly contributed to this success. The TU Delft Solar Team utilized a material package supplied by Gurit's distributor, Bouwmeester Advanced Composites in Amsterdam. The vessel was produced using Gurit's new Ampreg™ 30 wet lamination system, Spabond™ 340LV adhesive, SE 84LV high-performance prepreg, and Core-cell™ M80 foam for its exceptional impact resistance and low weight.



The TU Delft Solar Team got off to a great start, completing the first lap in first place but with stiff competition from the other top boats. Thanks to the boat's efficient propulsion and low weight from the composite materials a pit stop to charge the batteries was not necessary, allowing the team to continue onto the second lap and gain a vital time advantage over the competitors that needed a charge. The hard work over the past year and their design choices paid off with the team completing the second lap in 2 hours and

The TU Delft Solar Team's hard work, determination and design choices paid off as they returned from the challenge as world champions. Congratulations!



The Future of More Sustainable Aviation

Presently there is a large focus on reducing CO₂ emissions and creating cleaner, greener transport options. Many cars are now utilizing electric engines with some manufacturers soon to phase out or reduce the production of combustion engines. Freight shipbuilders are looking to harness the wind to aid efficiency (see the article on rotor sails on page 40) and passenger ferries are often featuring electric or hybrid solutions. So what are the possibilities for aerospace to become a cleaner means of transport?

According to the International Energy Agency (IEA), air travel is booming with the number of passengers set to double over the next twenty years. Currently, aviation accounts for 2.5% of global energy carbon dioxide emissions, and forecasts predict a significant increase by 2030.

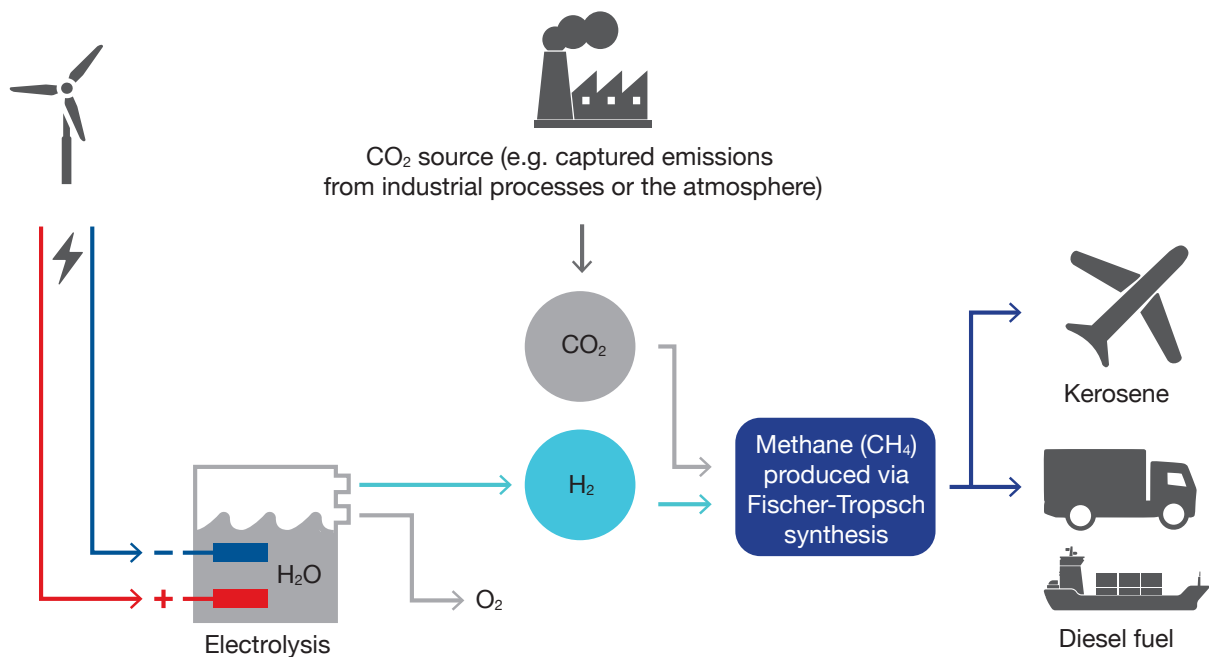
Biofuels as a viable solution?

The industry has committed to reducing emissions by 50% from their 2005 levels by 2050. One of the technologies aircraft could potentially use to achieve this is blended biofuels. The first flight using this technology took place in 2008 and since then over 150,000 more flights have used biofuels. Biofuels are considered by some to be the greatest means by which the aviation industry can reduce its carbon footprint. NASA has determined that this fuel is beneficial with a 50% aviation bio-fuel mixture enabling cutting of air pollution by between 50% and 70%.

The challenge, however, lies in the production and distribution of the fuel. Currently, only five airports have regular biofuel distribution and a few others only offer occasional supply. On the production front, around 15 million litres were produced in 2018 which accounted for less than 0.1% of total aviation fuel consumption and would need to increase significantly to become a realistic solution. Another issue with biofuels is the fact that it challenges food production since it is often extracted from the same sources, and that farmers could switch to producing biofuels instead of food. This risk needs to be actively managed and can be mitigated by using agricultural by-products or feedstock that grows well in the desert, irrigated with saltwater.



Synthetic fuels can be used in existing aircraft engines



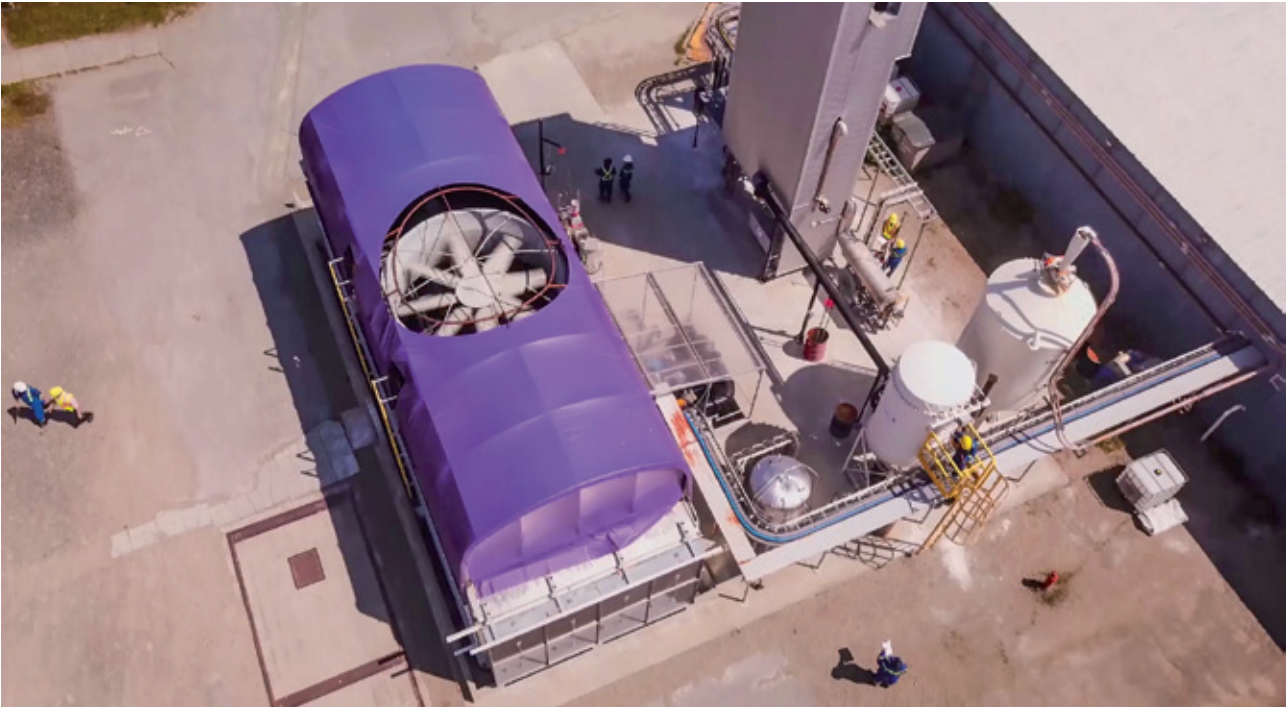
Production of synthetic fuels

Synthetic fuels capturing carbon during their production

Today, technological options exist to produce synthetic, carbon-neutral fuels, whose manufacturing process captures CO_2 . This technology, while still expensive, can make an important contribution to limiting global warming and the advantages are manifold. Synthetic fuels can be used in existing combustion engines, as part of the existing fuel distribution infrastructure, and even be mixed with conventional fuels. For the production process, a key requirement is the use of renewable energy, such as wind power, to convert water into hydrogen. To complete the process a liquid fuel is produced by adding carbon, captured from the air or industrial processes. The result is a synthetic fuel which can be kerosene, diesel, or any other conventional fuel.

Battery weight dragging down electric engines

Electric engines are another method the industry is considering. At the 2019 Paris Air Show, the world's first commercial all-electric passenger aircraft was launched in prototype form. The plane is relatively small for a passenger aircraft, capable of carrying nine passengers only. However, it demonstrates a step towards a new era. Currently, electric technology is not quite ready for large aeroplanes. Batteries are too heavy and inefficient. For cars, trains and boats this technology may be suitable; however, for aerospace, increasing its mass has a much more substantial impact on energy consumption. Regardless, we may see this technology implemented in short-range planes and as the electric and battery technology improves it might one day be incorporated into the larger, long-distance passenger jets, or as a hybrid system.



Direct air carbon capture pilot plant by Carbon Engineering

Lightweighting as a key innovation driver

With the mass of a plane having a significant impact on its energy consumption and emission levels, the importance of lightweighting these structures is something that can already be implemented now and continue to be implemented alongside future developments. Gurit's prepreg range is an excellent match for the high demands in aerospace, meeting fire, smoke, and toxicity requirements, while providing a light, efficient material.

Shape spoke with Michael Muser, General Manager – Aero, who advises that Gurit's expertise lies in reducing the weight of the interior of a plane. *"Our capabilities in and knowledge of aircraft interiors are second to none. We have been involved in this segment for several years and have developed a range of products specific to the market. Our expertise and product range allow us to be flexible and weight conscious with the ability to meet product variations, strict lead times, and demanding safety standards."*

Currently, the future of aerospace is set to continue with growth in the coming years; however, the technology to reduce the industry's carbon footprint is still up in the air. Perhaps in the short run, we are likely to see increasing use of biofuels with production capabilities increasing and as technology develops see a shift towards electric or hybrid engines. Only time will tell.



Gurit prepreg materials help aircrafts to become lighter and more fuel efficient

Innovations in Tooling Automation

Gurit Tooling is the largest independent manufacturer of plugs and moulds for wind turbine blades worldwide. These capabilities, however, stretch beyond wind turbine blade moulds to provide a complete system of support to wind customers and mould making capabilities for other industries. Today, Gurit Tooling employs over 600 skilled workers dedicated to design, engineering and manufacturing of composite tooling. The team's vast experience working with international blade manufacturers has provided Gurit Tooling with competencies and solutions for efficiency improvements in manufacturing automation for the wind energy sector.

A modular hinge system

Two of the new products that have been developed based on these insights are the V58 and GTA500 hinges. These modular hinge systems provide manufacturers with great efficiency and allow the fastest setup within the industry. The modularity enables the hinges to be installed on existing systems and develop alongside changing markets. Longevity has been considered with the hinges featuring simplified hydraulics, improved debris covers, comprehensive technical support and a two year warranty with global assistance.

Automation benefits for wind blade manufacturers

The new automation features benefit the wind blade manufacturers by enabling repeatable, precise and reliable process times, while simultaneously reducing the requirement for their own personnel to perform specialized tasks and the specific trainings related to them. These tasks can instead be assigned to our specialized operators with the relevant competence and expertise within the area, facilitating around the clock operations in remote areas with limited availability of staff.

It is not only the hinge systems that can be vitally optimised by automation features but the same goes for mould clamping and alignment systems as well as for the shear web gantry system. All of these are product developments that facilitate the manufacturing processes and are available through the Gurit service network worldwide.



How do the new hinges work?

The new hinges feature the same user interfaces as the previous ones and therefore the handling is similar; however, they employ more advanced sensing and feedback systems to simplify troubleshooting, thus reducing potential downtime. They offer higher levels of supervisory controls and are capable of industry 4.0 data sharing as well as process data gathering for analysis and enhancement of processes, for example, to allow process time optimisations.

Another aspect is the fact that the wind turbines are constantly increasing in size, hence also increasing the demands on the hinge system itself. These new hinge systems are modular and therefore allow hinges to be added which in turn enables expansion to accommodate larger moulds. The current systems can be configured to work effortlessly on moulds with a size of up to 150 meters. One of Gurit's strengths has always been to adapt solutions to customer requests and requirements through special features and other forms of customisation, which has also been done this time.

Tooling automation – the way forward

Historically, the main developments within the Tooling sector have been in regards to the automation of mould turning, clamping and alignment systems, shear web gantries, root end sawing and drilling systems, root plate implementation, or sectioned blade coupling systems. However, in the coming years, the trends are expected to shift towards pick and place automation for fiber and core materials, shell retention systems as well as the integration of systems through industry 4.0 with data-rich analytics allowing for optimisation.



“Compared to non-automated mould closing techniques, these hinge systems will reduce the closing time from 45 minutes to approximately 6 minutes which is an extensive leap. In addition, the new design also focuses on reducing commissioning time, cost, and complexity.”

Soren Hauch Groth, Site Manager of Gurit Tooling operations in Montreal, Canada.



SPABOND™ – the Adhesive of Choice





Wind turbines have been rapidly growing in both size and power in recent years, requiring builders to use materials and adhesives with superior mechanical properties to support the additional weight and length. Toughened epoxy is quickly becoming the adhesive technology of choice for the manufacture of wind turbine blades thanks to its notable advantages over glass-filled epoxy, Methyl Methacrylate (MMA) and Polyurethane (PU) adhesives. With the release of Gurit's Spabond™ 800 Series, these advantages stretch beyond mechanical performance alone.

Gurit's Spabond™ 840 is the first system in the new series and is ideally suited for bonding large structures such as wind turbine blades. It is a high performance, cost-effective, toughened adhesive system that features good thermal and mechanical properties. One of the unique features of Spabond™ 840 is that whilst affording builders a long working time for adhesive application, the innovative chemistry enables a rapid 2 hour cure at a processing temperature of 70°C, improving efficiency and ultimately reducing wind turbine blade production time.

Another of Spabond™ 840's key advantages is the significant improvement in health and safety properties over comparable products. Alongside this, it is formulated with Gurit Light Reflective Technology which allows users to easily detect droplets as small as 1mm using a basic UV light. This can be an effective health and safety tool to detect contamination and can also enable bond-line inspection to ensure sufficient adhesive has been applied and detect any gaps.

Since its release the new adhesive has been well received by wind turbine blade manufacturers, clearly acknowledging the advantages it offers over legacy glass filled adhesives as well as other toughened adhesives available on the market today.



www.gurit.com/adhesives



“Spabond 840 allows a significant reduction of wind blade production cycle times.”

Paul Pfitzer, Technical Support Engineer



Skyscrapers: Metallic Appearance with Composite Performance

Canopies at One Blackfriars, London



One Blackfriars, the iconic new residential tower in Bankside, London, is informally known as 'The Vase' due to its shape and competes for attention with 'The Shard', 'The Gherkin' and 'The Trellis'. Thanks to composite technology and Gurit Composite Engineering the building has other features to make it stand out more at ground level – three unique 14m long entrance canopies, each standing on a slender leg.

Ian Simpson from SimpsonHaugh, the award-winning architects responsible for the design, best sums up the three canopies, *"it announces the entrance and provides cover for users of the drop-off. In addition, it offers protection from the wind for pedestrians on Blackfriars Road. The canopy is seen as a piece of street furniture and stands as an independent element. It is conceived of as an aero foil wing made from highly polished metal."*

The canopies, however, are not produced using "highly polished metal" but by using composite materials and designing them to provide the metallic appearance sought by the architect, with added advantages. The composite materials provide a very smooth and corrosion-resistant finish while weighing very little in contrast to traditional materials. This allows the supporting columns to be very slender without risk of the canopies vibrating in strong winds.

Gurit Composite Engineering used advanced Finite Element Analysis (FEA) software to predict the natural frequencies of vibration of the structure including the column and its connection to the concrete foundation. These frequencies were then compared with wind tunnel measurements and aero-elastic theory in conjunction with a specialist consultant.

Construction of the canopies was done using glass fiber composite with a structural foam core infused with resin. The metallic appearance was achieved by using a metal coating consisting of 95% metal powder and a resin binder being sprayed onto the moulds.

Careful consideration was given to joining the upper and lower mouldings to ensure each canopy appeared as an intact single-piece metal structure with special fittings designed to enable each canopy to be installed separately. This saved the builder, Norco GRP, time onsite and provides a very convincing one-piece metallic appearance. The three canopies provide a fitting entrance to this prestigious development.

This project is another successful example of how composite materials can be used in place of traditional materials in architecture. In this case composites have provided a number of benefits over a metal structure while retaining the designer's metallic vision.



Canopies being built at Norco Composites



Counting Down to the America's Cup



The America's Cup is the pinnacle of yacht racing with teams sparing neither effort nor expense in the hunt to win this prestigious trophy. Each regatta attracts the world's leading sailors, engineers, and yacht designers, each vying to improve their team's performance. In 2021 the teams competing are set to converge in New Zealand to begin the challenge for the 36th America's Cup.

Founded in 1851

The competition has a rich history first dating back to 1851, making it the oldest trophy in international sport. Over the years the yachts have changed significantly in both design and construction. Most recently the advent of foiling has perhaps been the largest change, with the America's Cup AC72's being the first to feature foils in 2013. This technology has continued to develop as materials have become lighter and design has improved to what we have today: foiling monohulls capable of speeds as high as 50 knots.

Monohulls are back

The 36th America's Cup marks the return to monohulls. Each of the 75ft monohulls is set to feature twin canting T-shaped lifting foils, two skinned mainsails, and no keel. As always with America's Cup regattas, teams are pushing the design and technology to the absolute limits. At the time of writing, American Magic, Luna Rossa Prada Pirelli (Italy), INEOS TEAM UK and Emirates Team New Zealand have all launched an AC75 and initial videos show this regatta is going to be exciting!





Race yachts relying on Gurit materials

To produce an ultimate racing yacht, teams need the ultimate materials. Gurit has a longstanding history supporting several of the teams with the latest in composite technology to meet their requirements. One of these teams is Emirates Team New Zealand whose relationship with Gurit dates back to 1995, partnering with and naming Gurit as an Official Supplier for the 36th America's Cup Defence campaign. Gurit's Regional Sector Lead for Marine APAC, Sean Jeffery, is excited to be part of this collaboration: *"This partnership with Gurit's advanced composite materials gives Emirates Team New Zealand, the ability to build these high-end racing boats and allows Gurit to showcase our ability at the pinnacle of yachting."*

One of the key materials Gurit is supplying to high-end racing yachts and several of the America's Cup teams is carbon fibre prepreg. Gurit's SE 84 high-performance prepreg is well known within the marine industry as a material that provides an excellent balance of mechanical properties and minimum weight. Some of the teams competing are using this technology to minimise the weight of their vessel in the hopes to shave off valuable time during the race.

Shape spoke with Emirates Team New Zealand's Construction Manager, Geoff Senior, who voices his support for Gurit's prepreg. *"Emirates Team New Zealand is thrilled to be*

working with Gurit as we look ahead to the 36th Americas Cup Defence in 2021. Gurit carbon fibre prepreg is widely regarded as the go-to product amongst the boatbuilding industry. The range of additional products and support offered by Gurit staff is a crucial part of the complex boatbuilding tasks which lie ahead for Emirates Team New Zealand as materials, engineering and boatbuilding timelines are pushed to the limit."

Innovative teams like these participating in the America's Cup are paving the way forward for new designs and technologies. These developments often foreshadow those that appear in the next generation of yachting and foiling and Gurit is proud to be part of this development.

The quest to win the ultimate prize, the America's Cup, begins with the Prada Cup in January-February 2021 in Auckland, New Zealand, where the challengers will compete to determine which yacht club will take on the Defender of the America's Cup, Emirates Team New Zealand. The winner of the Prada Cup will then compete in a head-to-head race with Emirates Team New Zealand with the first to win 7 races crowned the winner of the 36th America's Cup.

Gurit wishes the teams competing all the best with their developments and looks forward to following the races.

Center of Excellence for Gurit's Formulated Product Range

Interview with Newport (UK) Site Manager Matthew Muhlenkamp

Before joining Gurit in 2010 Matthew was already very familiar with composite materials and their benefits as both a keen sailor and on a professional level as a yacht spar builder. In 2018, Matthew Muhlenkamp was appointed Director of Formulated Materials and is currently managing Gurit's production site in Newport on the Isle of Wight. Shape had the opportunity for an interview with him.

Matthew, can you tell us a bit more about your background?

Before moving into the Composite Materials Business Unit in July 2018, I had been working in the Tooling Business Unit since May 2010. I spent time in several locations doing a variety of roles including Project Management, Sales, and Operations. Prior to joining Gurit, I was working in the marine industry as a spar builder using prepreg materials.

What drives you?

Professionally, I am driven by satisfying the customers' needs, this must be reminiscent of my time in sales. On a personal level, I am driven by learning new skills, encountering different cultures, and experiencing new things.

As an avid sailor have you always been interested in competing and trying to go faster?

It's impossible to get on a sailboat and not compete! There is always a way to go a little faster. Even when having a relaxing sail, you're always working hard trying to catch the next boat.

When was your first regatta?

I was 13 for my first regatta. It was on Lake Michigan in late October. It was also my first time sailing in snow and having the water go to the horizon.

What keeps you awake at night?

More recently the political environment and how to manage the changing trade conditions has kept me awake several times.

Coming from a wind energy and tooling background, what role has sustainability played for you over the years?

Sustainability has always been important to me. Originally this came from my sailing background, either sailing past a floating refrigerator near New York City or noticing the difference in air quality between 200 miles offshore versus in the city. This is what pushed me towards working at Gurit and

within the wind energy sector.

Can you tell us more about the Newport site at which you are based?

The Isle of Wight site has a long history from when it was founded in the 1970's and later experienced rapid growth. Many employees have been working for the company for 20+ years and the entrepreneurial spirit from those early days is still ingrained in the team. As the site has simplified its manufacturing portfolio, this entrepreneurial spirit is coming to the surface once again and allowing the smaller team to perform at high levels. I am proud of their ability to continue to deliver strong results and adapt to changes. Recently the site won Environmental and Innovation awards from the Isle of Wight Chamber of Commerce and on a national scale at the Composites UK awards. This industry recognition for our work over the last 2 years is something we are very proud of.

What are the main challenges and strengths of your site?

Aside from being on a small island, the main challenge for the site is adapting to the changes in our key markets. As the use of Formulated products becomes more prevalent in the industry, they have become commoditized and available globally. However, the team here has risen to this challenge to ensure that we remain competitive in this global marketplace. A definite strength is our dedication to innovation here in Newport. A full 28% of our people and 30% of the space is designated for innovation activities.

How do you take care of Health & Safety at Newport?

The site has been OSHA 18001 certified since 2003 and is



Matthew Muhlenkamp
Director CoE Formulated Materials

in the process of converting to ISO45001 which will be completed in September 2020. Environmentally, the site is also ISO14001 certified since 2002 and we have introduced a number of local sustainability initiatives, such as recycling and solar power.

What developments have you observed within the formulated market?

The formulated market is growing as composites are becoming accepted and more widely used in conservative industries. The shift towards lower toxicity products as REACH (EU regulation on Registration, Evaluation, Authorisation and Restriction of Chemicals) re-classifications take effect and people become more aware of the chemicals they are using. Our low toxicity products (Ampreg 3X series and Ampro Series) have gained traction in the market and are now being adopted by large industrial users as well. Being ahead of REACH re-classifications means that we are increasingly taking on the role of educating our customers and the wider market regarding safer chemicals and working practices which really gives us an advantage over competitors.

What do you see as Gurit's strengths in the market?

For large industrial users, Gurit's formulated offering is focused around smaller niche areas of their manufacturing process that the large commodity companies are not focused on. While lower volumes, these are important materials for their manufacturing process and they value the focus that Gurit places on these products. For smaller users, specifically in the marine environment, Gurit offers a high-quality product with a large well established distribution network and competitive pricing.

Where do you expect the market to grow most?

The significant growth in terms of volume will continue to be in wind for the foreseeable future. In terms of percentage, the



An AMPRO hands-on session for employees in the application centre

large growth areas will be in transportation and potentially ship-building as electric drive systems, the associated light-weighting, and government emission requirements begin coming into effect. We also see real potential to increase our market share in the Marine retail and Distribution market through our introduction of products with superior health and safety.

Are there any new developments on the horizon?

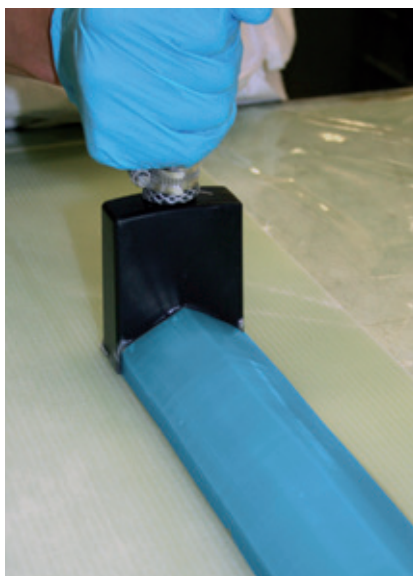
The past 24 months have been focused on rejuvenating our liquid systems offering with Ampreg™, AMPRO™, and PRIME™ systems. The new wind adhesive system, Spabond 840, was also recently launched, which allows blade builders to significantly reduce their blade curing times. In 2020, we will focus on rejuvenating the adhesive range for Marine & Industrial applications. The innovation team are working on several exciting new technologies, which we look forward to sharing with you soon!



Gurit's Newport site

On Track for Innovation

Gurit's Formulated Centre of Excellence is concentrated in Newport, with extensive competencies in research & development, testing, production, and warehousing facilities.



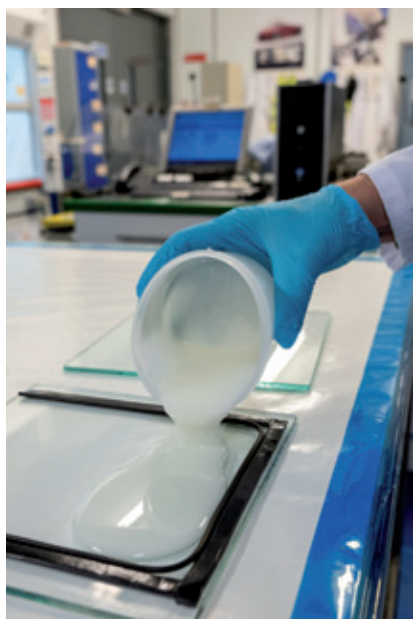
Extensive trial and testing of the new Spabond adhesive



Spabond™ 400 adhesive with collapsible cartridge reducing single use plastics



One of the Tri-shaft mixers in the formulated production



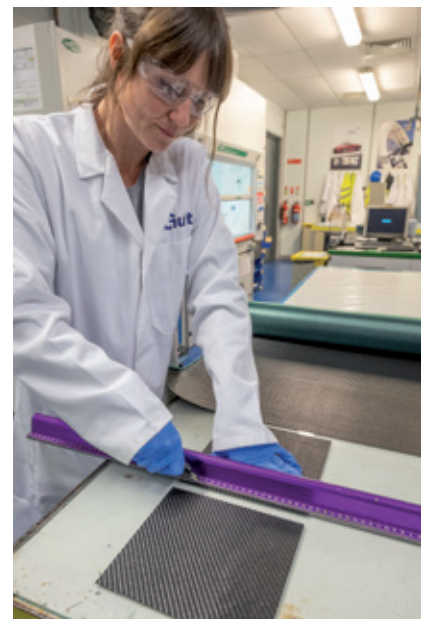
Development and test phase of a new Prepreg resin



The new AMPRO™ range in recyclable packaging



AMPRO BIO multi-purpose epoxy with >40% BIO content



Preparation of prepreg laminates for testing



Analysing test results to optimise Fire, Smoke and Toxicity (FST) performance



Sag testing of the new Spabond adhesive



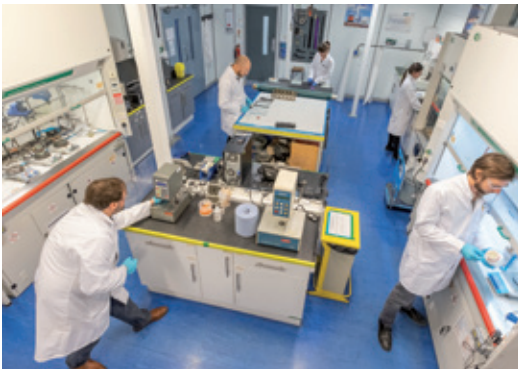
Fire test lab used for the development of FST materials



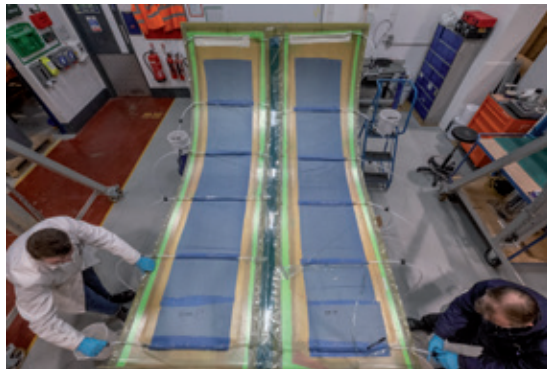
Getting the formulation right



Quality control checking fluorescence of light reflective technology



Over 30% of the Newport facility is dedicated to Innovation



Technical support team conducting infusion tests



Warehouse facility



A low-toxicity resin introduced in 2019 for laminating a new natural-fibre reinforcement



Analytical test lab with the latest microscopy techniques

Corecell™

Ten Years of Excellence and Slamming Performance

Crucial to the design of high-performance structures within any industry is knowing how the materials will perform under various conditions. Gurit's Corecell™ M Foam is one of these materials that has been rigorously tested by Gurit engineers to provide marine customers with an assurance of its capabilities and helping optimise their structures.

Long-term reliability for Marine applications

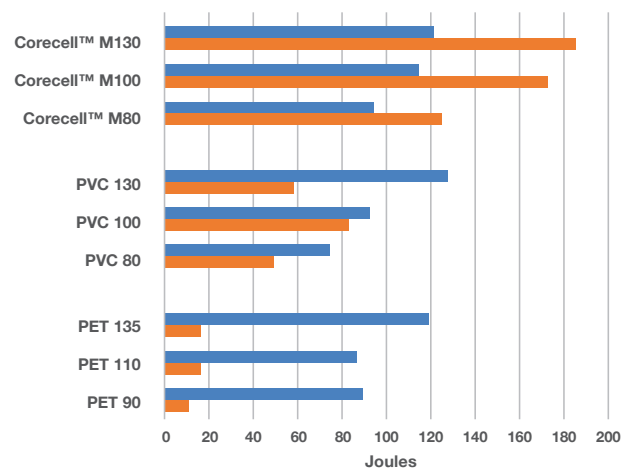
Corecell™ M Foam was first launched over ten years ago and quickly developed a reputation for itself as the go-to foam for marine applications. It is a structural foam core using a SAN polymer base developed to deliver one high performance product for all marine applications, and is ideally suited to slamming areas, superstructures, and hull and deck areas. Since its launch, the material has proven itself over and over again with unmatched toughness, long term reliability, proven quality, and excellent thermo-formability.

Today the foam features in numerous boats around the world from high performance racing yachts to superyachts and its capabilities have been proven with extensive testing showcasing its benefits for the marine industry.

Advanced testing at the University of Auckland

In Auckland, New Zealand, Gurit engineers worked closely with the academics at the University of Auckland Centre for Advanced Composite Materials and at Gurit's own internationally accredited mechanical testing laboratory to undertake static and dynamic testing on SAN, PVC, and PET foam cores. The team discovered that dynamic energy absorption rather than shear elongation is the most suitable measure to determine a core material's ability to survive a slamming impact.

The testing conclusively proved that Corecell™ M Foam has superior performance when involved in an impact. It was able to absorb more than twice the dynamic energy absorbed by the generic PVC foams of equal density, and more than ten times that absorbed by PET foam.



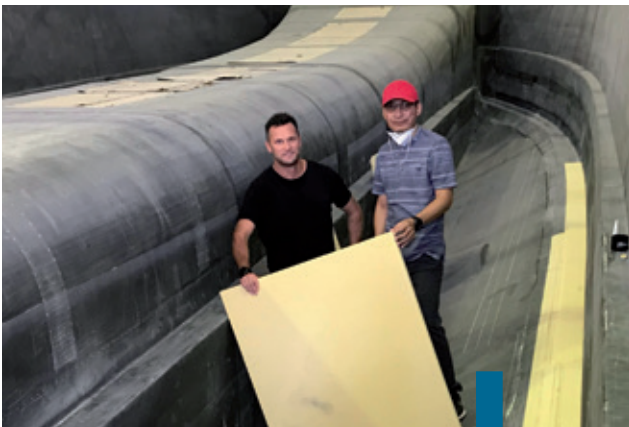
Testing speed: ■ Static 6mm/min ■ Dynamic 210,000mm/min

Energy absorption impact test results

Resin-savings by thermoforming

Another benefit of using Corecell™ M Foam is the ability to thermoform the foam to fit. Gurit engineers worked closely with the team at Curve Works who specialise in thermoforming using their adaptive mould technology. Together they evaluated the resin uptake of thermoformed Corecell™ versus Corecell™ with both single cut and contour scrim. Using Corecell™ M100, 30mm thermoformed to 1200mm radius, the team found the material had a similar resin uptake to a flat plain sheet. This means that a 73% resin saving is achieved when compared with single cut foam and 138% savings compared with contour scrim foam. Dynamic testing of the thermoformed core also confirmed that it was able to absorb the same level of dynamic energy as virgin material. Thermoforming is thus the process of choice to fit the core in the forward slamming areas that are typically curved.

After ten years in the market, the benefits of Corecell™ M Foam are well known and appreciated. Shape spoke with some of the shipyards that are benefitting from the material.



“North Sea Boats trusts in Corecell™ for all our products for its high shear strength, elongation, and compressive performance, which is especially critical in our high-speed RIB production.”

Warrick Yeoman, Shipyard Manager
at North Sea Boats Indonesia



“Gurit has been a long-time supplier and partner of Sabre Yachts. We believe to build the best boats you have to use the best materials, which is why Corecell™ M Foam is the only core material used in our hulls. Corecell™ provides the strength, durability, and longevity that our customers expect.”

Aaron Crawford, President at Sabre Yachts USA



“We have used Corecell™ in the manufacture of our luxury motor yachts for years. Corecell™ is chosen due to its superior performance and cosmetic benefits. We trust it.”

Mark Richards, CEO at Grand Banks Yachts & Palm Beach
Motor Yachts Australia.

Natural Fibres Innovation

Gurit has initiated a partnership with the Swiss-based high-tech startup Bcomp. The company specializes in the development of natural fibre composites. Shape had the opportunity to speak with Bcomp's CEO Christian Fischer about the original idea, exciting ongoing projects and new developments for the future.



Christian, what inspired the idea of these innovative and natural composite solutions?

Bcomp started with ultra-light skis. The construction, based on a natural fiber reinforced balsa wood core, required two years of hard engineering work. During the development phase we also realised that this lightweight material had great potential and could be expanded far beyond the sports segment.

Which areas benefit from these solutions?

Today our target markets include automotive, acoustics, electronics and design, but sport and leisure remains a big market where we currently focus on surfboards. In motorsport applications we successfully replaced carbon parts with our natural fibres, with the same performance and weight but at a lower cost. In addition, our material offers increased safety on the racetrack by avoiding the risk of fragments. Furthermore, we have been developing satellite panels with the European Space Agency (ESA) that are designed for demise¹ and are finalists in the JEC Innovation Award.

¹ "Design for Demise" refers to space debris mitigation to minimise the risk to humans.

What is the difference between using natural fibers and traditional materials for these types of applications?

Natural fibres like flax combine the best mechanical properties with a low density which creates an exciting basis for a lightweight material. If you reinforce a synthetic material with natural fibers, you can save a lot of weight while still maintaining the same performance and create a stronger solution.

Can you tell us about your company vision "PLAY NATURALLY SMART"?

It is important for us that every employee come to work with a smile and enjoy working with us – that is what "play" stands for. We are positive, share the same vision, and believe that we can make an important contribution to a sustainable society. "Naturally" is our ambition to make the world a better place. Development and production of sustainable products is the core of our business. We guarantee locally grown, renewable, recyclable natural fibre production, which is less harmful to the environment, people and our future and supports a circular economy. "Smart" refers to our research and development and our partnerships with instances that can help us achieve the best possible result and integrate bio-based materials into advanced technologies.

A sustainable partnership

Gurit is Bcomp's official distributor for the marine industry and now sells ampliTex™ and powerRibs™ reinforcements, complementing Gurit's bio-based and low toxicity resin solutions. Gurit has also developed SPRINT™ and prepreg solutions that combine Bcomp natural fibre reinforcements with Gurit's proven resin systems.

Bcomp's proprietary powerRibs™ technology is an award-winning, extremely lightweight natural fibre reinforcement. Inspired by leaf veins, it creates a 3D rib structure on one side of a thin-walled shell element, thus providing maximum stiffness at minimum weight.

The ampliTex™ range of technical fabrics enable innovative, composite material solutions, incorporating different technologies: non crimp, low twist, no twist, braids. In addition to excellent technical performance, these tactile materials are also ideal as visual layers in design, marine and sports applications thanks to their stunning finish.

Lowering the CO₂ footprint

A layup of ampliTex™ plus powerRibs™ can match the performance of carbon fibres for semi-structural parts while reducing the CO₂ footprint by 75% and raw material costs by up to 30%. Standard production techniques and moulds can be used, and consumables are reduced as no bleeder/breather is needed. Stefan Gautschi, General Manager of Gurit's Business Unit Composite Materials states: *"Bcomp share our core values in placing sustainability at the forefront without compromising on performance. Together, we now have all of the key ingredients to deliver a bio-based composite panel solution for multiple industries."*



"Our collaboration with Bcomp has formed the perfect partnership, complementing our low-toxicity and bio-based products to deliver more environmentally friendly composite solutions. This unique offering opens up a wide range of opportunities and applications that we are looking forward to exploring together."

Kevin Cadd, Product Manager, Gurit





Energy Observer – a pioneer and ambassador for sustainability: a hydrogen vessel aiming for energy autonomy with zero greenhouse gas emissions

Oceanwings

The environmental impact of shipping is huge with ships responsible for more than 3 percent of global carbon dioxide emissions according to Oceana, which is expected to increase twofold by 2050. As shipping is relatively efficient in comparison to air freight it currently handles 90% of world trade and will continue to carry the lion's share into the foreseeable future. As a result, the industry urgently needs to find innovative solutions that drastically reduce emissions as well as provide cost benefits to encourage uptake.

One of these innovations is Oceanwings®, a technology that has been developed by VPLP Design in partnership with CNIM and in collaboration with Gurit Composite Engineering.

Harnessing wind power

Oceanwings® harness the wind to improve ship's efficiencies. They have been designed primarily for superyachts and large vessels like merchant ships and were created to be used in conjunction with the vessel's propulsion system. Simulations have been undertaken using real world data which backs this up with savings shown to be as high as a 42% reduction in fuel use.

Oceanwings® are a reefable and furlable automated wingsail which can be controlled through a phone or tablet, enabling non-sailors to benefit from the system. The wingsail features an adjustable camber and twist feature which provides the sail with twice the efficiency of a standard sail the same size.

Proven efficiency of the wingsails

The effectiveness of wingsails was first realized in 2010 when VPLP Design collaborated with BMW Oracle to win the 33rd America's Cup. Since then their superior aerodynamic efficiency has been proven, but until now the rigidity they require to perform has prevented the sails from being reefed or furled like fabric sails which limit commercial usage.

Gurit Composite Engineering was involved from an early stage. Collaboration with VPLP Design began in 2016 with the production of Oceanwings® 2.1. This 8m fully functioning prototype was equipped to a 7m trimaran to validate the feasibility and ensure functionality alongside acquiring data to fine-tune the performance models.

Following the successful implementation, the development of the Oceanwings® 3.2 began in 2018 with the intention of equipping the boat 'Energy Observer' with two of these. Being a larger catamaran at 30.5m long and 12.80m wide it required a larger wingsail than the prototype, and as a result features two systems each with a wing sail of 32m².

Successful collaboration

In designing the Oceanwings® 3.2, Gurit was in charge of the structural design for the masts, the boom, crane and ribs which were all produced from carbon fibre laminate. Based on the initial concept and wind loads provided by VPLP design, Gurit engineers developed a geometry and then a laminate which ensured the structure complied with the strength, stiffness and stability criteria.

The secondary mast provided some challenges as it was required to be stiff but also flexible enough to generate a twist in this mast allowing the flap to be

opened to generate superior wind force. As the wind speed at deck level and 15m above is generally not the same, the upper level needed to be able to deform and twist under load.

The use of 3D numerical models was necessary to confirm that the overall structure (including the boom and crane) behaves according to plan. Also undertaken was Finite Element Analysis Shell Model which confirmed the wall thickness of the mast and boom was enough not to buckle under load.

Due to the smaller size/weight of the ribs and the solid experience of Gurit engineers for this type of component, analytical calculations were undertaken for the ribs which were sufficient to ensure the laminate developed was strong and stiff enough.

Mission accomplished

The project has proven successful with 'Energy Observer' reporting greater boat speeds with use in conjunction with their electric motors as well as reduced energy consumption (between 50% and 80% on average, depending on sailing conditions) and loading on the engines. A win-win.

In assisting with this project, Gurit provided not only structural engineering but also manufacturing support in assisting VPLP Design and CNIM with finding manufacturers and by providing technical support. Due to the complexity of the project, 5 different builders were involved with the construction and being a prototype the details changed quickly, so frequent communication between the parties was essential to the success.

Shape spoke with Nicolas Sdez, the engineering lead on the project at VPLP Design who was happy with the collaboration and results mentioning, "It has been a pleasure to collaborate with the Gurit engineering team.



Nicolas Sdez (left) with Marc van Peteghem (founder of VPLP Design)



Oceanwings sails and solar cells of the Energy Observer

Regular communication with Gurit's experienced composite engineers helped us produce a simple and efficient design within a tight time frame. Thanks to their in-depth composites understanding, Gurit's support extended beyond the structural engineering of the wingsails, assisting us in finding manufacturers and providing technical support during the construction & assembly phases."

The Oceanwings® have so far proven a success for both the 2.1 prototype and the 3.2 equipped to 'Energy Observer' and Gurit looks forward to watching this technology develop and assist other large and offshore vessels to reduce their energy consumption.



Two rotor sails
on cargo ship

Rotor Sails Reducing the Environmental Impact of Shipping



Lightweight composites as enabler for rotor sails

Norsepower Rotor Sails are a new solution for the growing need for more sustainable shipping. These rotor sails do not share any similarities with traditional sails you might find on a yacht. Instead, they are a modernised version of the Flettner rotor, which takes advantage of the Magnus effect to generate aerodynamic force and assist in propelling the vessel forward.

A Flettner rotor is a smooth cylinder with disc end plates which is spun around on its long axis. It works to generate aerodynamic force through the effect of the wind. As the wind meets the rotor the airflow accelerates on one side of the rotor sail and decelerates on the opposite side. This change in the speed of airflow creates the Magnus effect which results in a pressure difference. This difference in turn creates a lift force

perpendicular to the wind flow direction helping to propel the vessel, increasing its fuel efficiency.

Taking advantage of the Magnus effect

The Magnus effect can be seen in many sports. For example, in tennis, topspin rotates the ball forward causing the ball to swerve downward; conversely, a slice with backspin causes the ball to lift. Norsepower's use of the Magnus effect, however, is much more significant with its goal in reducing the shipping industry's carbon footprint.

Lightweight composites reviving the Flettner rotor

The idea of a Flettner rotor on a ship is not new, first being trialled in 1924. The concept was proven viable but back then it took an inefficient amount of energy to turn the 15m tall metal cylinders and was largely discontinued. Today, thanks to the much lower weight of the cylinders due to cutting edge advanced composite materials and technology, Norsepower has revisited this concept, proving successful in reducing fuel costs by 5-30% and CO₂ emissions by the same.

The rotor was produced using Gurit's environmentally friendly structural PET core, Kerydn™ Green, which is produced using up to 100% recycled materials, as well as PRIME™ 27 epoxy infusion system, Spabond™ 340LV adhesive, and the Ampreg™ 31 epoxy laminating system.

Norsepower's mission is "to reduce the environmental impact of shipping through the commercialisation of innovative and modern sail power." At the time of writing, this technology features on three commercial vessels: a tanker, a cruise ship, and a dry cargo vessel. These three boats have clocked over 45,000 hours combined and show a total fuel saving of over 1,500 tons and reduced CO₂ emissions by over 4,500 tons. This is a fantastic effort and a strong start to reducing the impact of global shipping.

"It is great to be involved with this innovative project which provides a commercially viable solution for the shipping industry with tangible fuel savings as well as a significantly reduced environmental impact. Gurit has worked hard to create a range of environmentally friendly materials with properties that respond to our customers' requirements and it is good to see commitments to our environment growing and spreading across industries."

Piet Heydorn, Gurit's Regional Sales Manager





A winning team: awards ceremony in Amsterdam's Maritime Museum

Boat Builder Awards in Amsterdam

METSTRADE is one of the world's largest marine tradeshows and provides a forum for Gurit to demonstrate its capabilities, expertise, and product offering within the marine industry.

Each year the METSTRADE Boat Builder Awards are an excellent opportunity to celebrate the success and innovations within the industry. At the November 2019 awards event in Amsterdam, Gurit was proud to share in the accolades with Royal Huisman, Rondal, and Com&Sens, being awarded the best "Collaborative Solution between a production Superyacht Builder and its supply chain partner". The award was received based on the collaboration between the partners to produce the biggest composite rudder to date within the superyacht industry. The rudder has over 10 square metres plan area with over 5 metre blade span and has been designed to withstand a load well in excess of 100 tons.

It has been a rewarding team experience to celebrate this joint achievement with Royal Huisman, Rondal, and Com&Sens. Gurit's Rudy Jurg stated *"The project was an enormous undertaking with the rudder's size subjecting it to terrifying loads. The success of the project is a true testament to the hard work and strong collaboration between each of the businesses involved and is an excellent reflection of the high performance that is achievable with Gurit materials and engineering."*

Royal Huisman is building the world's largest aluminium-hulled sailing yacht. It is scheduled for delivery in 2020 and with its length of 81m it will feature the rudder for which this award was presented. Rudder manufacturer, Rondal, used Finite Element Method simulation to engineer its design and has collaborated with Gurit for composite materials and structural engineering support, as well as with Com&Sens for incorporating optic fibres into the rudder, allowing for real-time monitoring of performance and forces applied.



Dutch shipyard Royal Huisman: largest superyacht rudder ever built.



Gurit was also involved with sponsoring the Rising Star award which celebrates those aged 35 and under who have been making a growing impact on any aspect of their business. The award was won by both Angela Pernsteiner (Dominator Yachts) and Kyle Davison (Riviera Australia) for their hard work and dedication.



Angela Pernsteiner of Dominator Yachts is one of the winners of the Rising Star award



Rising Star awards ceremony sponsored by Gurit

Events Agenda

2020

March 3-5	JEC World Paris, France
March 31 - April 1	AIX Aircraft Interiors Hamburg, Germany
April 21 - 23	Advances in Rotor Blades for Wind Turbines Hamburg, Germany
May 13 - 17	ILA, International Aerospace exhibition Berlin, Germany / www.ila-berlin.de/en
May 18 - 19	Maritime Transport Efficiency Conference Geneva, Switzerland
September 2 - 4	China Composites Expo Shanghai, China / www.chinacompositesexpo.com
September 22 - 24	CAMX Orlando, Florida, USA / Booth M72 / www.thecamx.org
September 22 - 25	InnoTrans International Trade Fair for Transport Technology Berlin, Germany / www.innotrans.com
September 29 - October 1	IBEX Tampa, Florida, USA / Booth 3-942 / www.ibexshow.com
November 17 - 19	METSTRADE Global Leisure Marine Industry tradeshow Amsterdam, Netherlands / www.metstrade.com
December 7 - 9	Wind Turbine Blade Manufacture Conference Dusseldorf, Germany



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