



GREENTECH FOR PORTS AND TERMINALS 2024



GREENTECH
FOR PORTS AND TERMINALS

7 - 8 MAY 2024
BARCELONA, SPAIN



moffatt & nichol

moffattnichol.com

CHARTING A COURSE TO NET ZERO

Optimising Green Technology Integration



THANK YOU TO OUR 2024 SPONSORS

SILVER SPONSORS



BRONZE SPONSORS



EXHIBITOR



FROM THE EDITOR

Margherita Bruno,
Editor



Welcome to the 140th edition of our maritime journal! We're excited to present this issue alongside our second-ever GreenTech for Ports and Terminals conference, taking place in Barcelona from 7-8 May.

Discussing sustainable practices is paramount in the maritime sector, especially with the ongoing rise in global shipping emissions. Projections indicate a tripling of maritime trade volume by 2050, highlighting the significant environmental impact of carbon-emitting fuels. Currently, maritime shipping alone contributes about 3 per cent of global greenhouse gas (GHG) emissions, emphasizing the urgent need for emissions reduction and full decarbonisation by 2050.

In this context, digitalisation emerges as a crucial tool in achieving decarbonisation goals within the maritime industry. Beyond boosting productivity, digital technologies facilitate smarter workflows, seamless communication, and environmentally sustainable practices.

In this edition, Dr. Zack Lu and Kaj de Groot from Portwise delve into the potential of autonomous vehicles (AVs) in terminal operations, stressing the necessity of a robust business case and feasibility analysis. AVs offer promising environmental benefits, such as route optimisation, reduced idle time, and minimised fuel consumption, leading to lower GHG emissions and increased eco-efficiency. Integrating AV technology enables ports to align with sustainability goals, reducing their carbon footprint and adopting resource-efficient practices.

Awake.AI presents a collaboration with the Port of Gothenburg on a "Digital Port Call" project aimed at optimising port-bound cargo flow. Through machine learning, prediction accuracy is enhanced, resulting in reduced waiting times and emissions. Karno Tenovuo, CEO of Awake.AI, advocates for digitalisation to enhance logistics' competitiveness and sustainability, encouraging stakeholders to explore the platform's advantages.

Carlos Losada explores Spire's contribution to advancing sustainable maritime practices, focusing on the transformative role of their Deep Navigation Analytics (DNA) platform. Leveraging space-powered data, Spire optimises vessel routes, mitigates risks, and improves operational efficiency. Solutions like Voyage Optimization provide insights into weather conditions and traffic patterns, enabling users to optimise routes for reduced fuel consumption and emissions.

We are pleased to welcome back Kalmar, introducing its Electric Straddle Carrier Charge Family, and expanding its electric equipment lineup for eco-friendly port operations. This new equipment offers two battery options with distinct charging capabilities, tailored to various operational needs. Enhanced by software solutions, it streamlines charging tasks, job scheduling, and data monitoring, ensuring efficient energy usage.

Next, we introduce Fjuel, leading the charge in revolutionising the maritime sector with sustainable energy solutions. Their platform integrates advanced digital technologies to optimise energy

infrastructure at ports, focusing on shore power, charging stations, and future sustainable energy production. Fjuel provides enhanced data insights, user-friendly interfaces, and collaborative data sharing, empowering ports to reduce emissions and enhance operational efficiency.

Next, academics from Åbo Akademi University contributed an article on the intersection of AI and co-simulation in advancing green shipping practices. They underscore the significant environmental impact of maritime transportation and discuss initiatives by the International Maritime Organization (IMO) and private enterprises to promote sustainability. The authors emphasize the institution's commitment to sustainable solutions, highlighting the importance of balancing technological advancement with ecological preservation in the maritime industry's transition towards sustainability.

Finally, Trelleborg Marine & Infrastructure identifies the top challenges that modern ports face, which include accommodating larger vessels, managing increased cargo volumes, and meeting safety and environmental regulations. The article emphasizes the significance of a dynamic approach that integrates traditional and digital solutions with safety measures, particularly through robust infrastructure like fender systems.

We hope this journal fosters interesting conversations and discussions on sustainability and the pressing need to address it for a better future for all. Wishing everyone attending GreenTech 2024 a successful and productive event!

CONTENTS

5. **GREENTECH 2024 SPONSORS**

9. **GREENTECH 2024 SPEAKERS**

18. **AUTONOMOUS VEHICLES: THE WAY FORWARD FOR AUTOMATION?** **Dr. Zack Lu**, Senior Project Manager, Portwise, and **Kaj de Groot**, Director of Automation Projects, Portwise

23. **DIGITAL PORT CALL PLATFORM ENABLING FULL SITUATIONAL AWARENESS, JUST-IN-TIME PLANNING AND DATA-BASED DECISIONS** **Karno Tenovuo**, CEO, Awake.AI

28. **NAVIGATING SUSTAINABLE MARITIME FRONTIERS: A DEEP DIVE INTO SPIRE'S SPACE-POWERED INNOVATIONS** **Carlos Losada**, Global Senior Product Manager, Spire

32. **KALMAR ENABLES MULTIPLE BATTERY TECHNOLOGIES FOR ELECTRIC STRADDLE CARRIERS** Kalmar

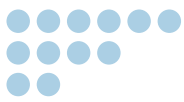
36. **FJUEL EMPOWERS THE MARITIME SECTOR THROUGH TECHNOLOGY AND EXPERTISE** **Svetlana Hansen**, CCO, Fjuel

41. **NAVIGATING THE FUTURE: AI AND CO-SIMULATION FOR GREEN SHIPPING** **Bogdan Iancu**, University Lecturer, Åbo Akademi University, **Sébastien Lafond**, Professor in Software Engineering, Åbo **Akademi** University, and **Hergys Rexha**, Researcher Phd Candidate, Åbo Akademi University

47. **PIECING TOGETHER THE FUTURE OF SAFE, EFFICIENT, AND SUSTAINABLE PORT OPERATIONS** **Richard Hepworth**, Business Unit President, Trelleborg Marine & Infrastructure

 info@porttechnology.org
 [@PortTechnology](https://twitter.com/PortTechnology)

 www.porttechnology.org
 [linkd.in/porttech](https://www.linkedin.com/company/porttech)



kunak **air** PRO

Air quality monitoring in
ports with accurate and
reliable data

BENEFITS

- Multiple pollutants
- Near-reference data
- Real-time data visualization
- Proven accuracy



www.kunakair.com

SPONSORS

SILVER SPONSORS



Awake.AI

Awake.AI is a Finnish optimisation platform company whose solutions are focused on developing customised AI/ML models to optimise cargo flow through ports and reduce waiting times and emissions. Awake's AI-driven Logistics Platform is developed to bring together all maritime actors at sea, ports and land, making port operations more efficient, safe and sustainable. For Terminal Operators they optimise port calls with AI insights, for Port Authorities Awake.AI maximises the use of their existing port capacity, for Ship Operators they enable Just-in-Time (JIT) arrival and faster turnaround times and for Cargo Owners they bring full transparency to cargo flow in sea-port-land.

www.awake.ai



GE Vernova's Power Conversion

GE Vernova's Power Conversion business applies the science and systems of power conversion to help drive the electric transformation of the world's energy and industrial infrastructure.

Designing and delivering advanced motor, drive and control technologies that help improve the efficiency and decarbonisation of energy-intense processes and systems, helping to accelerate the energy transition across marine, energy and industrial applications. Power Conversion is at the heart of electrifying tomorrow's energy.

www.gevernova.com/power-conversion



Stillstrom

Stillstrom, a business venture owned by A.P. Moller - Maersk Group is a leading global provider of offshore power and charging concepts, designed to eliminate offshore vessel emissions and facilitate clean offshore charging across the maritime sector.

Founded in Copenhagen Denmark, Stillstrom's offshore power and charging technology delivers clean energy to vessels of all shapes and sizes, acting as an offshore charging point for hybrid and electric vessels, or as a green parking lot to the thousands of vessels idling outside of ports on any given day.

www.stillstrom.com



Wärtsilä

Wärtsilä is a global leader in innovative technologies and lifecycle solutions for the marine and energy markets. They emphasize innovation in sustainable technology and services to help customers continuously improve environmental and economic performance. Their dedicated and passionate team of 17,800 professionals in more than 280 locations in 79 countries shape the decarbonisation transformation of industries across the globe. In 2023, Wärtsilä's net sales totalled €6 billion (\$6.4 billion). Wärtsilä is listed on Nasdaq Helsinki.

www.wartsila.com/marine/products/port-optimisation

SPONSORS Continued

BRONZE SPONSORS



Brunel University London

Brunel University London is the birthplace of the Green Yard Scheduler (GYS), an innovative solution to promote the sustainability and productivity of container terminals in their transition to net zero. As a dynamic and research-intensive university with global ambitions, Brunel University London fosters far-reaching networking, global collaborations, and research impact. Following the successful implementation of the GYS at the Port of Vigo in Spain, Brunel University London seeks to promote its reach and impact through pilot testing and implementation in other ports.

www.brunel.ac.uk



Ericsson

Ericsson enables communications service providers and enterprises to capture the full value of connectivity. The company's portfolio spans the following business areas: Networks, Cloud Software and Services, Enterprise Wireless Solutions, Global Communications Platforms, and Technologies and New Businesses. It is designed to help their customers go digital and decarbonise as they increase safety, efficiency, and security and find new revenue streams. Ericsson's innovation investments have delivered the benefits of mobility and mobile broadband to billions of people globally.

www.ericsson.com/en/industries/ports



Kalmar

Kalmar is the global leader in sustainable cargo and material handling for ports, terminals, distribution centres and heavy industry. With their extensive electric portfolio and global service network, they help their customers move towards safer, more eco-efficient and productive operations. Together, they develop innovative solutions that shape the future of our industry, improving our customers' every move.

www.kalmarglobal.com



Moffatt & Nichol

Moffatt & Nichol is a multidisciplinary, full-service professional services firm that has expertise in structural, marine, and waterfront facilities; civil, coastal, mechanical, and electrical design; marine construction cost engineering; and inspection and rehabilitation. Moffatt & Nichol provides creative and practical solutions in the field of port engineering. Moffatt & Nichol, a recognised leader for over 75 years in the planning, design, and operations of ports and maritime infrastructure, has played a vital role in developing terminal and waterfront facilities worldwide.

From the advent of containerisation to today's complex goods movement trends, environmental regulations, and sophisticated technologies, Moffatt & Nichol has built an international reputation for providing innovative solutions to support virtually any port, maritime, or freight transportation assignment.

www.moffattnichol.com



Portchain

Portchain is the leading provider of berth alignment and planning software for container terminals and carriers. Working with leading container carriers and terminal operators, Portchain creates sustainable win-win solutions to improve operational efficiency and sustainability for container shipping. Operating at a global scale, Portchain serves container terminals and carriers across Europe, Asia, the Americas, Australia, and Africa.

www.portchain.com



PowerCon

PowerCon is an innovator in shore power. Born out of the world's leading Danish offshore wind industry, they are the world's leading manufacturer, providing shore power systems to ports all over the world. Their modular, flexible systems provide onshore power to all kinds of vessels; from smaller ferries to the largest cruise ships. They offer complete end-to-end solutions; from designing to installing, and commissioning systems as well as integrating with third-party manufacturers such as cable management systems.

www.powercon.dk



Ricardo

Ricardo is a global strategic, environmental and engineering consultancy at the intersection of transport, energy and global climate agendas. They work across the whole maritime value chain. They provide high-quality evidence-based research and advice for policy decisions. They analyse the techno-economic, social and environmental impacts of market drivers and disruptive technologies.

www.ricardo.com/en



Spire Global, Inc.

Spire Global, Inc. provides space-based data, analytics, and space services, offering unique datasets and powerful insights about Earth so that organisations can make decisions with confidence. They build and operate the largest multipurpose constellation of satellites that use radio occultation technology to collect over 20,000 profiles a day to observe, monitor and collect weather and Earth data. By providing reliable weather insights, they empower businesses and communities to prepare for extreme weather events and mitigate their effects. Spire Global, Inc. is committed to using its expertise to make the world a better place, one data point at a time.

www.spire.com/weather-climate

EXHIBITOR



Fjuel

Fjuel is a Norwegian startup jointly owned by three ports – Trondheim, Bodø and Tromsø – and two energy companies – Bodø Energi and Troms Kraft AS.

With their solution, manual processes are a thing of the past. Their system-agnostic software saves you time and eliminates errors. Fjuel is focused on these critical business issues:

- Automatic alarm management system
- Dynamic price model and streamlined invoice service.
- Insights and reports for different stakeholders
- Digitalising of maintenance process
- User-friendly user interface. Building an intuitive and clean system for ship operators.
- Authentication of customers using infrastructure.

www.fjuel.no



**SMART DIGITAL PORTS
OF THE FUTURE
EUROPE**



SMART, EFFICIENT & CONNECTED

SDP EUROPE IS BACK!

Join the **Smart Digital Ports of the Future 2024** conference and get an exclusive preview of the latest pioneering **smart technologies** that are shaping the port industry.

Gain access to leading experts in the industry, discover new insights, and network with like-minded professionals while we explore the challenges and opportunities that come with these advancing technologies.

**24 - 25
SEPTEMBER**

**ROTTERDAM,
THE NETHERLANDS**

**SAVE
€500
NOW!**

SUPER EARLY BIRD NOW €998!

SDP.PTIEVENTS.COM ←

250+

ATTENDEES

40+

SPEAKERS

85+

**PORTS &
TERMINALS**

12+

SESSIONS

FREE TO ATTEND FOR PORTS & TERMINALS!

**Platinum & Official
5G Sponsor**



Silver Sponsors



Bronze Sponsors



moffatt & nichol

Lunch Sponsor



**Three Group
Solutions**

Exhibitor



SPEAKERS



Abhijeet Kokate, Senior Manager – Decarbonisation Office, APM TERMINALS

Abhijeet has 14 years of experience at APM Terminals and is a founding member of APMT's Decarbonisation Office. He currently leads the Alternative Maritime Power/Shore Power programme at APMT, a key lever for reducing emissions and meeting the company's 2040 net zero goal.



Afshin Mansouri, Professor of Operations & Supply Chain Management, BRUNEL UNIVERSITY LONDON

Afshin is a Professor of Operations and Supply Chain Management at Brunel University London. Over the past decade, he has led a number of projects in the area of sustainable maritime shipping. In the EU project PortForward, Afshin has successfully led the development of The Green Yard Scheduler (GYS) to enhance the sustainability and productivity of container terminals for the first implementation at the Port of Vigo in Spain. He is actively seeking to promote the reach and impact of the GYS through its pilot testing and implementation in other ports.



Alberto Jaraiz, Head of Environmental Department, PORT OF VIGO

A graduate in Environmental Sciences, Alberto joined the Port Authority of Vigo in 2004, serving as Environmental Manager until 2023, when he assumed the position of Head of the Environmental Division in 2024. He is responsible for the integrated management system ISO 14001, EMAS, and PERS certification. As part of the Blue Growth team at the Port of Vigo, he actively participates in numerous projects funded by European calls, including Tefles, Samuel LNG, Core LnGas Hive, Digital Cologistics, Circazul, and ML Style, among others.



Aleix Pons, Principal Consultant – Transport Policy, RICARDO

Aleix is a Principal Consultant and leads the Economic Analysis service line in the Sustainable Transport team at Ricardo. He has over 11 years of experience in economic analysis of transport policies with a focus on decarbonisation policies across all transport modes. Aleix is highly skilled in assessing regulatory, pricing and governance reforms in transport, assessing costs and benefits, and the wider economic and environmental impacts of transport policies. As Project Manager/Director, he has been leading multiple international projects for a wide range of public and private clients.



Allyson Browne, Founder & Chief Executive Officer, HIGH AMBITION CLIMATE COLLECTIVE

Allyson Browne is Co-founder and Chief Executive Officer of the High Ambition Climate Collective (HACC), a nonprofit organisation bringing together climate champions, innovative solutions providers and progressive industry partners to build enduring power within policymaking institutions. Prior to HACC, Allyson served as Pacific Environment's Climate Campaign Director, leading their Ports for People campaign to end port and ship pollution.



Ambrish Bansal, Senior Vice President – Business Advisory & Consulting, LLOYD'S REGISTER

Ambrish has over 18 years of strong industry and consulting experience, primarily in Business Strategy & Transformation, Sustainability/ESG, Project management & Operation excellence across the Energy & Maritime sectors. Currently, he leads LR Management Consulting and ESG advisory services globally.



Ammar Sabbagh, Head of Industry & Partnership, ERICSSON

Ammar Sabbagh is a technology subject matter expert with over 20 years of experience crafting strategies for the innovation and entrepreneurial divisions within technology corporations. He derived technical expertise from operations and professional services roles in his early career then moved on to business development and strategy. He can uniquely advise on 5G private cellular networks, cloud, decentralised cloud, AI, and IoT solutions for business and industry and consult on the formation of use cases.

SPEAKERS Continued



Ana Arevalo, Head of the Shorepower Department, PORT OF BARCELONA

Ana Arévalo, with an M.Sc. in Naval Architecture and Marine Engineering from the Polytechnic University of Madrid (UPM) and a Master's in Management Development (PMD®) from ESADE Business & Law School, boasts over two decades of expertise in naval, logistics, and port management. Currently, as Head of the Shorepower department at the Port of Barcelona, Ana spearheads the Nexigen project, a pioneering endeavour aimed at accelerating dock electrification.



Ani Matcharashvili, Sales Engineer, PORTXCHANGE

Ani Matcharashvili is a green tech sales engineer with a profound commitment to aiding port communities in their journey towards sustainability. Armed with a dual MBA and a growing foundation in the maritime sector, Ani leverages her industry knowledge to drive significant improvements in operational efficiency and robust reductions in carbon emissions globally. Her portfolio, rich with high-profile maritime customers, underscores her effectiveness in speeding up major decarbonisation initiatives.



Antonio Goncalves, Business Development Leader & Member of the Maritime Advisory Executive Team, DNV MARITIME

Antonio Goncalves is a distinguished Business Development Leader and member of the Maritime Advisory Executive Team at DNV Maritime. With over 15 years of professional expertise traversing both Portugal and Norway, Antonio has left a mark across diverse industries, including Automotive, Military, Oil & Gas, and the Maritime sector. Antonio has been leading several initiatives towards maritime decarbonisation, circular economy implementation, and the establishment of green shipping corridors.



Bart Vermeer, Senior Director, MOFFATT & NICHOL

Mr. Vermeer has an extensive background in project management and business consulting in the marine terminal industry. With more than 20 years of experience in the field, his expertise involves strategic terminal planning, port and terminal development, specifications and performance for automated equipment, as well as operational analysis, terminal optimisation and equipment implementation. Mr. Vermeer has guided implementation teams through operational design, procurement, implementation, testing, and quality management.



Charles Wyng, Program Manager, WÄRTSILÄ VOYAGE

Charles has worked as a specialist in the deployment of vessel traffic management systems since 2006. As a trained marine chemist (University of Southampton, NOCS) and qualified VTS operator (Fleetwood Nautical College), Charles is passionate about the application of the latest technology to provide a sustainable, efficient and environmentally sound model for the future of VTS operations, marine security and port management.



Cristina Alburquerque Otero, Environmental Manager, BALEARIC PORT AUTHORITY

After a period onboard fishing trawlers, Cristina went shore-based where she has developed her career and experience for over 17 years in ports. Since July 2020 she has been enrolled in Balearic Port Authority as Environment Manager where, among other responsibilities, she is participating in innovation and research projects in the framework of Horizon 2020, with a strong focus on environmental sustainability and decarbonisation, as well as taking part in workgroups at Spanish PIANC.



Dafne Jose, Group Quality & Environmental Manager, EUROPORTS

Dafne José Fernández serves as the Group Quality and Environmental Manager at Euroports, leading initiatives to drive sustainable practices across the company's global operations. She focuses on Euroports' strategy to reduce its environmental footprint through minimising carbon emissions and promoting renewable energy, while creating value in the communities, prioritising safety in operations, and ensuring compliance with regulations and standards.


Daniel Ruiz, Responsible for Sustainable Fuels, PORT OF BARCELONA

Daniel is a biologist specialising in alternative fuels bunkering and energy transition with more than 20 years of experience in environmental sustainability in ports, environmental impact studies or environmental monitoring plans for port works and dredging. Since 2016, he has been in charge of projects for the introduction of natural gas as a fuel, the granting of authorisations for LNG bunkering or the introduction of sustainable fuels such as methanol, ammonia or hydrogen in the Port of Barcelona.


Elyse Lawson, Senior Program Manager, Green Ports & Shipping, C40 CITIES

Elyse Lawson is the Senior Programme Manager for Green Shipping and Ports at C40 Cities, where she is responsible for engaging and promoting the decarbonisation of the maritime sector. She has experience working with both public and private stakeholders at the intersection of international collaboration, climate risk, and green shipping corridors.


Emma Cobos, Director of Innovation and Business Strategy, PORT OF BARCELONA

Emma is always open to innovation and new challenges. Currently motivated to embrace changes in logistics and imagining the port of the future in order to make it happen. In January 2021 Emma was appointed Director of Innovation and Business Strategy at the Port of Barcelona. Previously she worked as Business Development Director (2010-2020) also at the Barcelona Port Authority, building up partnerships with their customers.


Emma Minken, Environmental Advisor, PORT OF OSLO

Emma is an Environmental Advisor specialising in marine ecology, strategic planning, and climate initiatives. With a Master's degree in Coastal Ecology, she brings a deep understanding of marine ecosystems and their delicate balance. Emma's expertise includes overseeing environmental systems within ports, ensuring compliance with regulations like ISO 14001, and developing strategies to reduce environmental impact, including working with GHG emission reduction and electrification initiatives.


Estefania Soler, Sustainability Leader, HUTCHISON PORTS BEST

Estefania started at Damm Group as Logistics Distribution Coordinator. In 2009 she joined Terminal Catalunya, which later became Hutchison Ports BEST. She is part of several working groups of the Port Community, a Member of the Impact and Sustainability Commission of the Círculo Ecuéstre and of a Business and Climate Foundation.


Gadi Benmoshe, Institutional Network Leader, AELER

Gadi Benmoshe is Institutional Network Lead at Aeler, the new-generation smart container company and Managing Director of Marinnovators, offering consulting services focusing on Digital Transformation, Innovation and Cybersecurity to Port Authorities/Operators and Maritime-Tech companies. Benmoshe is vice chair of the International Association of Ports and Harbors (IAPH) Data Collaboration Committee in which he led the development of the whitepaper "The mindset shift to innovation in ports".


Geert De Wilde, CEO, NXTPORT INTERNATIONAL

Geert is a pioneering force in integrating digital innovation with sustainable global logistics. With an unwavering commitment to environmental stewardship, he spearheaded initiatives that leverage new energy sources to revolutionise the logistics industry. Geert's expertise in digital strategies and sustainable practices drives operational efficiency and champions eco-friendly solutions, positioning him as a key influencer in building a greener future for logistics.

SPEAKERS Continued



George Wagner, Chief ESG Officer, YILDIRIM GROUP

George Wagner joined YILPORT in 2021 as Global HSSE Director and is now the Chief ESG Officer of YILDIRIM Group, which operates in 9 industries across 5 continents and 56 countries. George is leading the process of making ESG/Sustainability an integral part of this far-reaching organisation, whose portfolio ranges from terminal operations, shipping, mining/metallurgy and fertilisers to renewable energy. His responsibilities include ESG/Sustainability policy, compliance with relevant EU legislation including CSRD reporting, decarbonisation strategies for the group, and group-wide training and awareness at all levels.



Hanno Bromeis, Head of Port Energy Solutions, HAMBURG PORT AUTHORITY

Hanno joined the Hamburg Port Authority in 2020 to assume responsibility for HPA's shore power activities. He initially oversaw the go-to-market strategy and its execution ranging from the planning and construction to the launch and operation of the various shore power facilities. He then assumed the lead of HPA's newly founded Port Energy Division, to chaperone the other energy transition activities around the three main lines of activity around green electron delivery, green electron production and green molecule delivery, to meet EU requirements as well as the City/Port's own targets in this respect.



Hector Calls, Head of Environmental Sustainability, PORT OF BARCELONA

Hector holds a Bachelor of Marine Sciences and a Master's degree in Engineering and port management specialising in Port Dredging. He has more than 23 years of experience in environmental consulting and surveys, mainly in the marine (nearshore and offshore) and port fields. Throughout his career, in addition to specialising in the environmental aspects of port and marine projects, he has acquired extensive knowledge in hydrographic surveys, geophysics, oceanography and maritime engineering, as well as the application of cutting-edge technologies, in numerous national and international projects. From January 2022 he has been onboarded in Port of Barcelona as the Head of Environmental Sustainability.



Hugues Paris, Vice President Sustainability, PORT OF QUÉBEC

Mr. Hugues Paris holds a Bachelor's degree in civil engineering from the Royal Military College in Kingston and a Master's degree in project management. Whether as a strategic advisor or as a manager, he has been working for nearly 30 years in the fields of asset and infrastructure project management. His experiences have led him to work from a sustainable development perspective by trying to find relevant solutions that integrate the concerns of stakeholders. He has been working at the Port of Québec for several years and now holds the position of Vice-President Sustainability.



Ilari Lehtinen, Sales Manager Horizontal Transportation, KALMAR

Ilari Lehtinen is a Sales Manager at Kalmar, specialising in Horizontal Transportation solutions, with four years of experience at Kalmar and a Master's degree in Industrial Engineering and Management from Tampere University. He is dedicated to understanding customer needs, building strong client relationships, and contributing to Kalmar's success in the global cargo handling industry.



Jasper Boessenkool, Senior Director Sales, PORTCHAIN

Jasper is Senior Sales Director at Portchain. He has extensive experience in Strategy Consulting and Technology & Innovation Management within technology-intensive industries. He has eight years of experience driving technology adaptation in the maritime sector: from Maersk, responsible for Future Technologies & Innovation, and Navis driving key client discussions on future requirements. Jasper has an MSc (with Merit) and a PhD in Physics from Utrecht University (the Netherlands).


Javier Garrido, Innovation Manager, PORT OF BARCELONA

Javier Garrido Salsas is an accomplished civil engineer with a robust academic and professional background that spans several countries and specialised fields. Since 2019, Javier has embarked on a visionary journey towards redefining the future of ports by pursuing a doctorate in collaboration with the Port of Barcelona. His research, Port Vision 2040, aims to chart a sustainable future for port activities, addressing the critical challenges of social, economic, and environmental sustainability. He currently works in the Department of Innovation at the Port of Barcelona and he plays a pivotal role in engaging the ecosystem of innovation of the port.


Jelle Burger, Program Lead Electrification Ports, APM TERMINALS

Jelle has worked most of his professional life at APM Terminals and joined the Decarbonisation team a bit more than a year ago. He heads the pilots and execution team that focuses on building the decarbonisation backbone in APMT, making the organisation ready to have a fully electrified fleet.


José Andrés Giménez Maldonado, Director of Port Logistics, FUNDACIÓN VALENCIAPORT

José Andrés Giménez is an Industrial Engineer (Polytechnic University of Valencia, 2005) and has 17 years of experience in the logistics-port sector, developing innovation and research projects focused on the fields of port logistics and maritime transport. His fields of expertise are related to increasing the efficiency of logistics and port operations through the development of Industry 4.0 models and technologies (IoT, Big Data, Artificial Intelligence, Process Automation, etc.). He has been Director of Energy and Security and currently developing his work as Director of Port Logistics at the Valenciaport Foundation (Port of Valencia).


Jurgi Areizaga Casares, Director, OFICINA VERDE - ALGECIRAS PORT AUTHORITY

Jurgi has over 18 years of experience as a Director of marine and coastal projects; he is an environmental and oceanographic consultant and a team leader. He has great experience in carrying out different environmental and sustainability studies. Notable projects include an environmental impact study of the electrical interconnection between Tenerife and La Gomera, strategic environmental studies of the Ports of Tarragona and Cartagena, marine environmental monitoring of the Nador West Med Port, and the management of technical assistance to monitor the environmental and sustainability strategy of the port authorities of the Balearic Islands and the Bay of Algeciras.


Karno Tenovuo, CEO, AWAKE.AI

Mr. Karno Tenovuo has been in the marine business since 2004 and launched several groundbreaking solutions to the market. Now he is the CEO of Awake.AI. He received his M.Sc. (Tech) from the Helsinki University of Technology and his M.Sc. (Econ) from Turku University. For the first seven years of his career, he worked at the Finnish shipyards leading R&D and business development. He then started his own company and Rolls-Royce became one of his customers and was soon offered a global role heading business development and strategy based in Norway.


Kevin Martin, Interim Transformation Manager, ONE DIGITAL NATION

Kristina Jumelet, Business Product Owner Operational Efficiency Standards, DCSA

Kristina is a Product Owner at the Digital Container Shipping Association and joined DCSA in 2020. She is responsible for setting the strategy and development of digital standards for operational container shipping processes, specifically addressing vessel-related information exchange between operational partners and their customers (i.e., Operational Schedules, Commercial Schedules, Just-in-Time Port Calls, Booking Forecasts, etc.). Her mission is to drive digital transformation in the industry and enable more efficient, transparent, and sustainable operations.

SPEAKERS Continued



Lorenzo Casullo, Technical Director for Sustainable Transport, RICARDO

Lorenzo Casullo heads up the Sustainable Transport team at Ricardo as Technical Director. He leads and oversees complex policy and strategy projects for public and private sector organisations, providing impartial advice to help them meet the challenge of decarbonising transport. As a former OECD official, Lorenzo's strengths also include building international alliances.



Lukas Leppert, Transport Policy Officer, NABU

Lukas Leppert is a Transport Policy Officer of NABU, the Nature and Biodiversity Conservation Union of Germany. It is Germany's oldest and largest environmental association with more than 900.000 members and 70.000 active volunteers. His work is focused on international shipping from an ecological viewpoint, mainly focusing on its impacts on nature and climate. He now uses his knowledge to take a critical stance on the status quo and highlights necessary steps for a shipping future that doesn't endanger our planet.



Manuel Martinez de Ubago Alvarez de Sotomayor, Business Manager & Product Manager, NEXTPORT.AI

Manuel Martinez de Ubago joined Moffatt & Nichol to lead the Business Development and Product Strategy of the Technology offering, with a significant focus on NextPort as a key investment. Previously he worked at the STC Group in the Netherlands. Before that, he held positions in different private organisations in the port and logistics fields, as well as in the United Nations. He holds an M.Sc. in Civil Engineering and another MSc in Transport & Logistics from the TU Delft, in the Netherlands.



Maria Manuel Cruz, Environmental Manager, PORT OF AVEIRO

Maria has been working for the Port of Aveiro Authority (APA S.A.) for about 29 years, responsible for the Sustainability and Environmental Management of the Port of Aveiro and Port of Figueira da Foz, concerning waste, water quality, wastewater, air quality and noise management, as well as environmental monitoring (aquatic and seawater quality, dredging sediments quality, benthos among others) of port infrastructure works.



María Ferrer Mena, Offshore Wind Port Planner / Assistant Engineer, MOFFATT & NICHOL

María Ferrer Mena, joining Moffatt & Nichol as an assistant engineer in 2022, holds a Masters in Civil Engineering from the Polytechnic University of Valencia. She specialises in the planning and development of offshore wind (OSW) ports, with a keen focus on optimising both fixed-bottom and floating OSW staging and integration ports. María coordinates Moffatt & Nichol's dynamic simulation modelling efforts for OSW ports, where concept plans are developed to build efficient port and vessel logistics models to optimise port operations.



Maurici Hervas, Energy Transition Researcher, PORT OF BARCELONA

Maurici Hervas is an Industrial Engineer (UPC), specialising in Energy. During his career, he gathered experience in several engineering fields such as a data consultancy for the Altran change management team for Naturgy as a production engineer in the automotive sector industrialising new parts. Later he was the engineering manager of the photovoltaic division, performing solar studies and redacting the technical projects. During the COVID-19 pandemic, he served as General Manager of an import/export company navigating all the uncertainty and challenges of the global supply chains. Finally, he started his research in the Port of Barcelona to help foster its energy transition.



Max Rouse, Infrastructure and Government Strategy, KPMG

Max works in KPMG's Future Mobility team in London where he supports clients in developing decarbonisation and digitalisation strategies across multi-modal transport. His experience includes supporting the UK's Maritime and Coastguard Agency (MCA) to develop green maritime technology pathways for the UK sector, supporting the UK's Department for Transport (DfT) to develop a maritime emissions model to inform policy decisions and is currently developing a maritime sustainability roadmap for a UK defence sector client.


Michaela O'Donohoe, Strategic Growth Leader, GE

Michaela O'Donohoe leads business development for the Microgrid Solutions business at GE Vernova, where she previously contributed to successful strategies for the Offshore Wind and Renewable Hydrogen businesses. Before joining GE, Michaela launched the offshore wind programme at Gamesa and then headed Marketing & Business Development at its offshore wind joint venture with Areva. Previously, Michaela was Chief of Staff at ArcelorMittal and she has worked in management consulting.


Nicholas Zylbergajt, CEO, UNMANNED LIFE

Nicholas Zylbergajt, CEO of Unmanned Life, brings over 15 years of international leadership experience in technology and entrepreneurship. With expertise in deep tech startup creation, fundraising, strategy, and innovation, he has worked across 20+ countries, partnering with major corporations like Telefonica, UPS, and Swisscom. A strong advocate for Transatlantic relations, he promotes diversity in the European Tech ecosystem and has supported over 1,000 women founders. Featured in Bloomberg and Politico, he's recognised as a top CEO in autonomous vehicles, with Unmanned Life lauded by Sifted as a leading company in the space.


Pablo Garcia, General Manager, HUTCHISON LOGISTICS SYNERGY SA

Pablo joined Hutchison Logistics Synergy as General Manager in June 2019 to grow this rail company that belongs to Hutchison Ports BEST. Pablo is responsible for the smooth running of the company, and he has to deal with every part of it: operations, commercial, finance, customer visits, suppliers negotiations and so on. Pablo has over 10 years of transport and logistics experience, always related to maritime and continental containers.


Patrik Benrick, Head of Strategic Development & Innovation, PORT OF GOTHENBURG

Patrik Benrick is the Head of Strategic Development & Innovation in the Port of Gothenburg, Scandinavia's largest port and one of the leading ports of the world in environmental matters. Mr. Benrick leads a team that runs a wide range of strategic development projects, in partnerships with shipping companies, truck manufacturers and terminal operators. First and foremost, the focus is finding green and smart logistic solutions and overall reducing CO2 emissions to reach Port of Gothenburg's goal of a 70 per cent CO2 reduction by 2030.


Peter Selway, Shore Power Specialist, POWERCON

With over 12 years of experience in shore power, Peter specialises in shore connection projects with a particular focus on helping to reduce the environmental impact of shipping. A regular speaker at conferences and events around the world, Peter has worked extensively with ports, the shipping industry and Governments to create a market for shore connections that works for everyone, especially the environment.


Pim van Leeuwen, Simulation Consultant, PORTWISE

Pim van Leeuwen is a simulation consultant at Portwise, a leading terminal design, simulation and automation company based in Rijswijk, the Netherlands. Holding an M.Sc. in Quantitative Logistics and Operations Research (Econometrics), he mainly works for container terminals of all shapes and sizes but also has experience with bulk terminals and warehouses. During projects, he determines terminal capacities using berth simulations and static calculations and finds design bottlenecks using detailed yard simulations.


Remmelt Thijs, Senior Project Manager, PORTWISE

Remmelt Thijs is a Senior Project Manager in the head office of TBA and provides specialised container terminal planning consultancy using extensive expertise supported by dynamic simulation. Remmelt Thijs (M.Sc. at Delft University of Technology) has been the principal consultant for multiple terminal design and optimisation studies for different terminals worldwide comprising all major terminal handling systems and both for small and large port operations.

SPEAKERS Continued



Sebastian Toft, Co-founder & CCO, STILLSTROM

Sebastian Toft is the Co-founder and CCO of the world's first offshore charging venture, Stillstrom by Maersk. With thousands of vessels idling outside ports any given day Stillstrom is set out with a vision to lead the way in offshore power and charging, for an emissions-free maritime future. Sebastian Toft brings 15 years of experience within the maritime and cleantech sector – focusing on building towards a decarbonised future for the ocean economy



Tim Scarbrough, Director of Maritime Strategic Growth & Development, RICARDO

Tim Scarbrough is the Director of Maritime at Ricardo. Tim leads high-profile techno-economic and policy studies for policymakers, such as the European Commission and the International Maritime Organization, and works with port and shipping industry organisations on their journeys to reduce their environmental impacts. His clients value that his evidence-driven expertise spans from policy through strategy development to implementation, and draws on cross-sectoral insights.



Tommaso Spanevello, Responsible for European Affairs, HAROPA PORT

Tommaso Spanevello is responsible for European Affairs at HAROPA PORT, the major river-sea Port of the Seine axis, France's largest port authority, merging the three French harbours of Le Havre, Rouen and Paris. He promotes the interests of HAROPA PORT vis-à-vis the European Union's Institutions and represents the port authority in various networks such as the European Sea Ports Organisation (ESPO) and the European Federation of Inland Ports (EFIP).



Victor Shieh, Strategy & Communications Director, IAPH



Yeşim Elhan-Kayalar, Advisor – Office of Chief Economist, ASIAN DEVELOPMENT BANK

Yesim Elhan-Kayalar has over 30 years of work experience in the development sector and academia in 27 countries. She has worked at national and regional levels to create long-term development solutions in public sector management, infrastructure and finance sectors. During her tenure at ADB, she has held senior positions, including as Country Director for Georgia, where she led ADB's country development strategy and portfolio from 2015 to 2019. At present, she focuses on policy and knowledge solutions for ADB's high-impact development assistance in Asia and the Pacific.



PORT TECHNOLOGY SUMMIT NORTH AMERICA



UNITING NORTH AMERICAN PORTS AND TERMINALS

JOIN US IN VIRGINIA!

After two successful launches in North America last year, the Container Terminal Automation Conference and Smart Digital Ports Conference will combine to create a brand new three day flagship **North American Summit** for ports and terminals.

We will return to **Norfolk, Virginia**, with an event that features the best of both conferences, uniting our North American audience!

The event will present CTAC mainstay topics such as **equipment, automation, and optimization**, alongside popular themes from the SDP conference including **digitalization, sustainability, and collaboration**.

We are excited to meet you this fall for the first of many Port Technology Summits, the new home of knowledge sharing, technology and networking in the North American port and terminal sector.

**19 - 21
NOVEMBER**

NORFOLK, VIRGINIA
USA

REGISTER NOW FOR 25% OFF ←

PTS-NORTH-AMERICA.PTIEVENTS.COM

Host Partner



Gold Sponsors



Silver Sponsors



Bronze Sponsors



moffatt & nichol

FREE TO ATTEND FOR PORTS & TERMINALS!

AUTONOMOUS VEHICLES: THE WAY FORWARD FOR AUTOMATION?





portwise

Dr. Zack Lu, Senior Project Manager, Portwise, and **Kaj de Groot**, Director of Automation Projects, Portwise

AUTONOMOUS VEHICLES - THE HOLY GRAIL?

In the container industry, automated transport has been successfully embraced by many terminals worldwide since 1993. Under virtually all circumstances, a fleet of Automated Guided Vehicles (AGVs) is carrying out the heavy duty of transporting containers to and from the vessels.

What this application does not resolve, is a mixture of manned and unmanned traffic. This may not be required for these types of terminals, but it is required for other common terminal operation environments including the bread-and-butter terminal equipped with Rubber-Tyred Gantry cranes (RTGs) and terminal trucks (TTs), maritime yard and rail yard container transfer, intermodal operation, etc.

To allow for mixing of manned and unmanned traffic, developments on autonomous transport (including live pilots) are ongoing for various types of operations. Different strategies are chosen by the key players with some focusing on teleoperation (as opposed to autonomy), varying autonomy levels between central fleet management system vs. vehicle itself, navigation reliance solely via sensors/cameras on vehicles or still with support via extra fixed infrastructure installed in surroundings or beacons.

THE STATUS QUO: TECHNOLOGY IS DEVELOPING QUICKLY - BUT THE USE CASE APPLICATIONS AND BUSINESS VIABILITY ARE STILL UNCLEAR.

Despite all these efforts and rapid progress, the current developments are far from level 5 automation (or even level 4). The path towards large-scale implementations in daily terminal operations is still faced with many challenges to solve. While technology readiness (driving and safety) is certainly one fundamental pillar, two other critical prerequisites for future large adoption of autonomous solutions exist:

- Capability for various daily operational container terminal use cases
- Business case viability of a fleet of vehicles

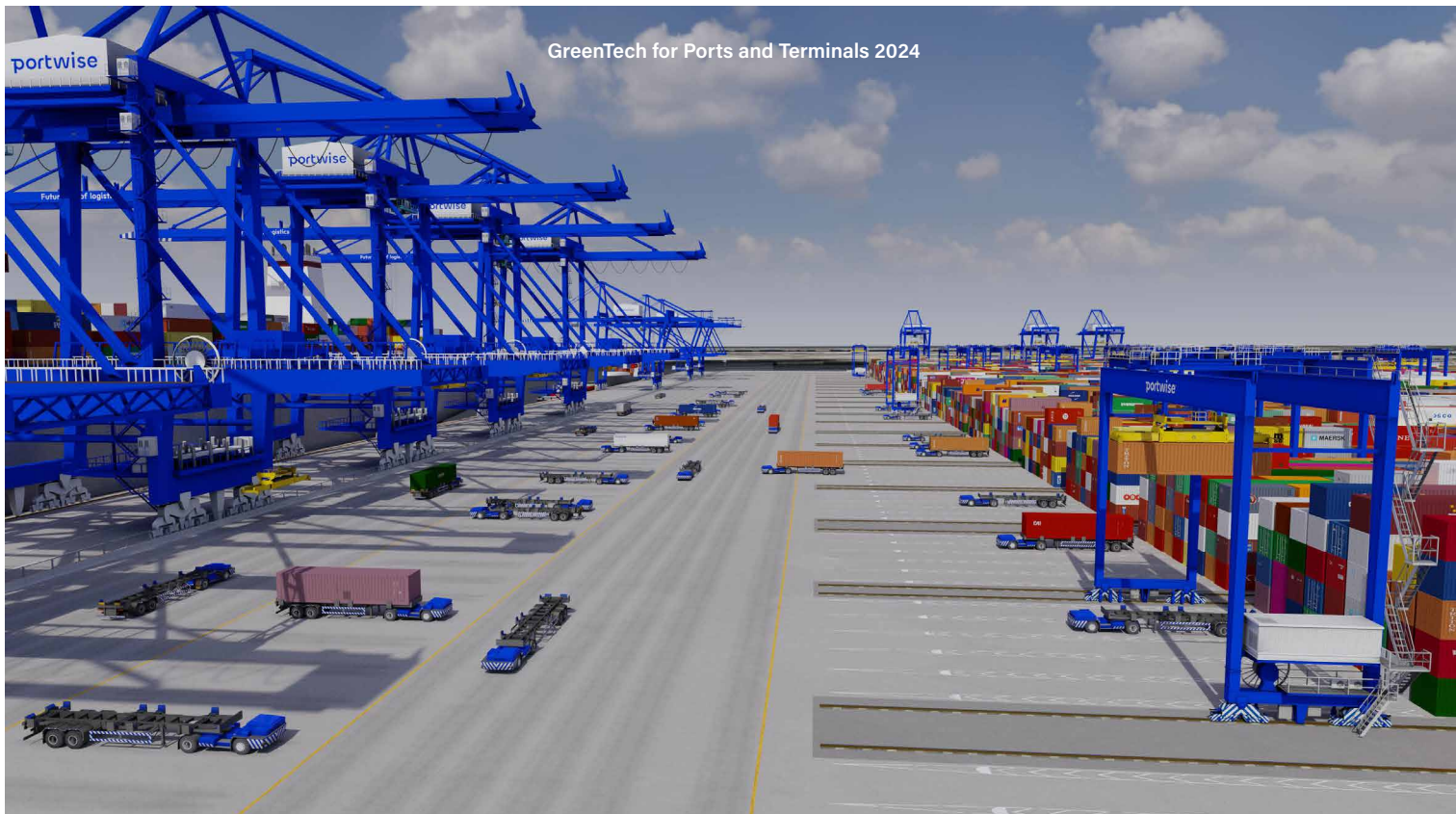
Most developments of autonomous vehicles are still in the general/early stage focusing on safety and vehicle driving – e.g. obstacles/moving objects detection and avoidances, vehicle routing and stopping/driving, safe container handover with other equipment. However important they are, these do not (yet) check off all the essential elements needed for efficient and reliable large-scale terminal operation – e.g. how sequences for loading should be managed, interactions in

a dynamic equipment environment including just-in-time delivery at quay cranes for loading, how the traffic rules/right of ways should be prioritised between manual and autonomous trucks.

Although there are some basic business case demonstrations available that argue the obvious benefits of reducing manpower by using automated trucks, there is a lack of in-depth quantification, especially regarding the performance impact. Therefore, a comprehensive business case is missing that takes into account a fleet of vehicles and a system perspective for the various types of terminals in our industry, as well as the different operational scenarios. Arguments applicable to an RTG – TT terminal can be different for TTs for container transfer between rail terminal and Automated Stacking Cranes (ASC) yard. Application for a transshipment site could require alternative strategies compared to a gateway site with heavy local traffic. Also, the question is not just whether to replace manual trucks with autonomous trucks but can well be why not to choose other more proven concepts over the still early-stage autonomous technologies.

While technology readiness is being addressed with tremendous efforts from various suppliers, in-depth attention to these two other pillars is still lacking. Wishful

“TECHNOLOGY IS DEVELOPING QUICKLY - BUT THE USE CASE APPLICATIONS AND BUSINESS VIABILITY ARE STILL UNCLEAR..”



thoughts and qualitative statements are just too general and not yet convincing enough. To bridge the gap from a terminal operation perspective, we also started looking into these two topics. Our approach is to first focus on short- to medium-term feasibility and viability for use cases that could be implemented with the current state of development from an operational perspective.

APPLYING AUTONOMY - FOUR USE CASES FORESEEN WITH MOST SHORT- TO MEDIUM-TERM FEASIBILITY AND BUSINESS VIABILITY

Below we will discuss four application use cases. We have selected them because we consider them possibly realisable in the short- to medium-term from a technology, regulation, and application

perspective, as well as viable from a business-case perspective. Each case still requires a more in-depth business case demonstration (for which case-by-case follow-up publications are planned).

This article intends to provide an introductory overview of these cases highlighting key underlying aspects for their application feasibility and business viability.

1. Non-mixed traffic operation

A possibility to run with autonomous TTs in the foreseeable future is by taking baby steps without changing too much on the existing status quo. An example is not to apply autonomy in mixed traffic operation yet, but to implement it as an alternative to AGV operation. For example, autonomous TTs with end-servicing ASCs.

In such a case, only one component of the current proven

FIG1. Autonomous terminal trucks in a non-mixed traffic operation environment (concept example illustration)

operations needs to be changed. It allows for gaining experience with autonomous TT operation and TT behaviour. This has a couple of advantages over an AGV system, such as lower pavement requirements and potentially lower CAPEX cost per equipment, which could benefit the business viability. Additionally, if autonomy fails to deliver, a fall-back strategy could be performed towards an AGV-like centralised equipment control system for vehicle routing and transfer point management, while operating the autonomous vehicles.

2. Limiting the capabilities of autonomous vehicles

One possibility to enable a mixed-traffic operation in the near future is to limit the capabilities of autonomous vehicles. An application example could be

“OUR APPROACH IS TO FIRST FOCUS ON SHORT- TO MEDIUM-TERM FEASIBILITY AND VIABILITY FOR USE CASES THAT COULD BE IMPLEMENTED WITH THE CURRENT STATE OF DEVELOPMENT FROM AN OPERATIONAL PERSPECTIVE.”

FIG 2.
Autonomous
terminal trucks
serving a rail
operation
(concept
example
illustration)



to use autonomous vehicles for rail container transfer for an ASC terminal with a rail terminal at the landside, while the ASC will also serve manned external trucks at landside. Instead of full mixed traffic, the capabilities of autonomous vehicles could be limited via a speed limit, dedicated interchange lanes at the landside ASC, dedicated traffic lanes to minimise traffic interaction points, strict/rigid vehicle routing and right-of-way management at intersections, to manage and achieve the safety requirements.

The downside of these limitations is certainly the performance loss – lower vehicle speed, more vehicle brakes/waiting, longer cycle time, lower vehicle productivity, and less just-in-time delivery. However, such performance loss can often and to a large extent be offset by adding extra vehicles or by preparation/buffering. In our studies, we see that similar or comparable overall operational performance can still be achieved to meet the required operational targets. Then, a comparison can be made between the extra CAPEX (from more expensive and more vehicles), and the OPEX savings in labours that are required for manned vehicles otherwise. Eventually, the OPEX

savings could still lead to a viable business case of autonomous application, especially foreseen at sites with high labour costs or scarce labour availability.

3. Human-assisted autonomy (1:1 / 1:N)

Another path with short- to medium-term feasibility and also economic viability is human-assisted autonomy. Autonomy handles parts of the operation, while human control/oversight remains from the central room via teleoperation. Depending on operational situations besides the technology capability and reliability, the man-machine ratio can vary from 1:1 to 1:N (1 teleoperator handles 1 to N vehicles).

The level of human involvement can also range from remote controlling of the entire or part of the process to only overseeing and intervening in case of exceptions or complex decision making. To do this effectively and efficiently, systems need to be in place for smart job selection, equipment assignment and smooth safe hand-over. Such a solution enables different possible N ratios to allow for manning reduction.

The extent of economic viability of such human-assisted autonomy and the varying levels of human involvement would also depend on local labour costs and resources. This solution could already reduce the idle time of vehicles even for the 1:1 case. Hence, a better and safer work environment is achieved, which is more than often considered by terminals as a strong business case driver. Combining human assistance and autonomy could result in a viable safe alternative balancing between performance and operational safety, with near-future applicability particularly to sites such as C-RMG/RTG with typically substantial mixed traffic from an operational perspective.

4. Occasions-based autonomy

Finally, occasion-based autonomy could be considered. Several automation projects have already taken this approach, for example by performing housekeeping moves throughout the night, when no external trucks are on site. This provides a more predictable environment to operate autonomous TTs. Despite not adding any productive moves, this operation can enhance operational efficiency



“THE MAIN CHALLENGE CERTAINLY STILL LIES IN HOW TECHNOLOGY FURTHER DEVELOPS.”

throughout the day due to the moves that have been prepared autonomously throughout the night.

Alternatively, one could also look at autonomous operation when the terminal is not busy and when there is less traffic on the terminal, therefore less interaction with external traffic. This can be used in the early stages to decrease OPEX, while the continuous roll-out of autonomous vehicles can be performed on demand. Manual labour could then be used to scale the horizontal transport demands.

FUTURE OUTLOOK: STILL MANY CHALLENGES TO FACE MOVING FORWARD

The cases (including possible combinations) could easily vary in their feasibility and business viability with different terminal characteristics and operational situations, but the potential of autonomy for selective applications in the near future is

certainly there. Yet, we shall still realistically acknowledge the many challenges on its road to large-scale application.

The main challenge certainly still lies in how technology further develops – which underlines all the essences for possible applications and business cases in terms of the needed functions, capabilities, performance, reliability, and safety. But via this article, we want to bring the essential use cases and business viability into the conversation also. We aim to contribute to the further development of autonomy and feedback to the autonomous technology development to gauge where to focus on (more) to move forward, especially in the short- to medium-term.

For each example provided, Portwise will publish separate follow-up white papers to provide more insights with case studies detailing the scenarios, CAPEX, OPEX and impact on performance.

FIG 3. Autonomous terminal trucks in an RTG operation (concept example illustration)

ABOUT THE AUTHORS:

Dr. Zack Lu works as a Senior Project Manager at Portwise. In the last 11 years, he has worked on various terminal projects related to design, simulations, operation optimisation, automation, etc.

Kaj de Groot works as Director of Automation Projects at Portwise. He has worked in the ports and terminals field for about nine years and has been involved in many different brownfield terminal design and automation transition projects.

ABOUT THE COMPANY:

Portwise, formerly part of TBA Group, is a world-leading consultancy and simulation firm that combines extensive automation and operational knowledge with proven simulation tools to create a future-proof plan for port, terminal or warehouse operations.

DIGITAL PORT CALL PLATFORM ENABLING FULL SITUATIONAL AWARENESS, JUST-IN-TIME PLANNING AND DATA-BASED DECISIONS

**"JUST-IN-TIME ARRIVALS REDUCE EMISSIONS,
REDUCE COSTS, IMPROVE SAFETY, REDUCE
CONGESTION AND OPTIMISE CAPACITY PLANNING."**



Karno Tenovuo, CEO, Awake.AI

BACKGROUND

Awake.AI and the Port of Gothenburg have been working together since 2021 when the AI-based berth planning was launched to the market. The berth planner was built on top of the Awake data platform enabling collaborative information exchange with cargo owners, ship operators and terminal operators to optimise the port-bound cargo flow. Now the parties have been working together since the summer of 2023 on a project called "Digital Port Call" where port call optimisation is taken to the next level and the entire port call is digitised.

This article describes the three main modules of the solution: (1) Situational Awareness, (2) Just-in-Time Planning and Communication and (3) Statistics and Analytics. Finally, a new way is presented how the port call-related waiting time, turnaround times and emissions can be significantly reduced.

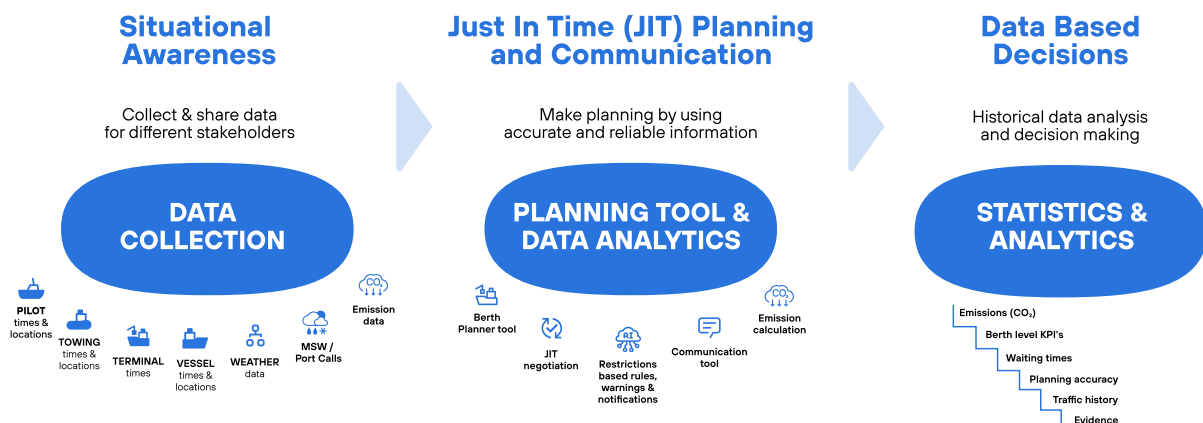
BELOW
Digital Port Call Platform and three main modules.

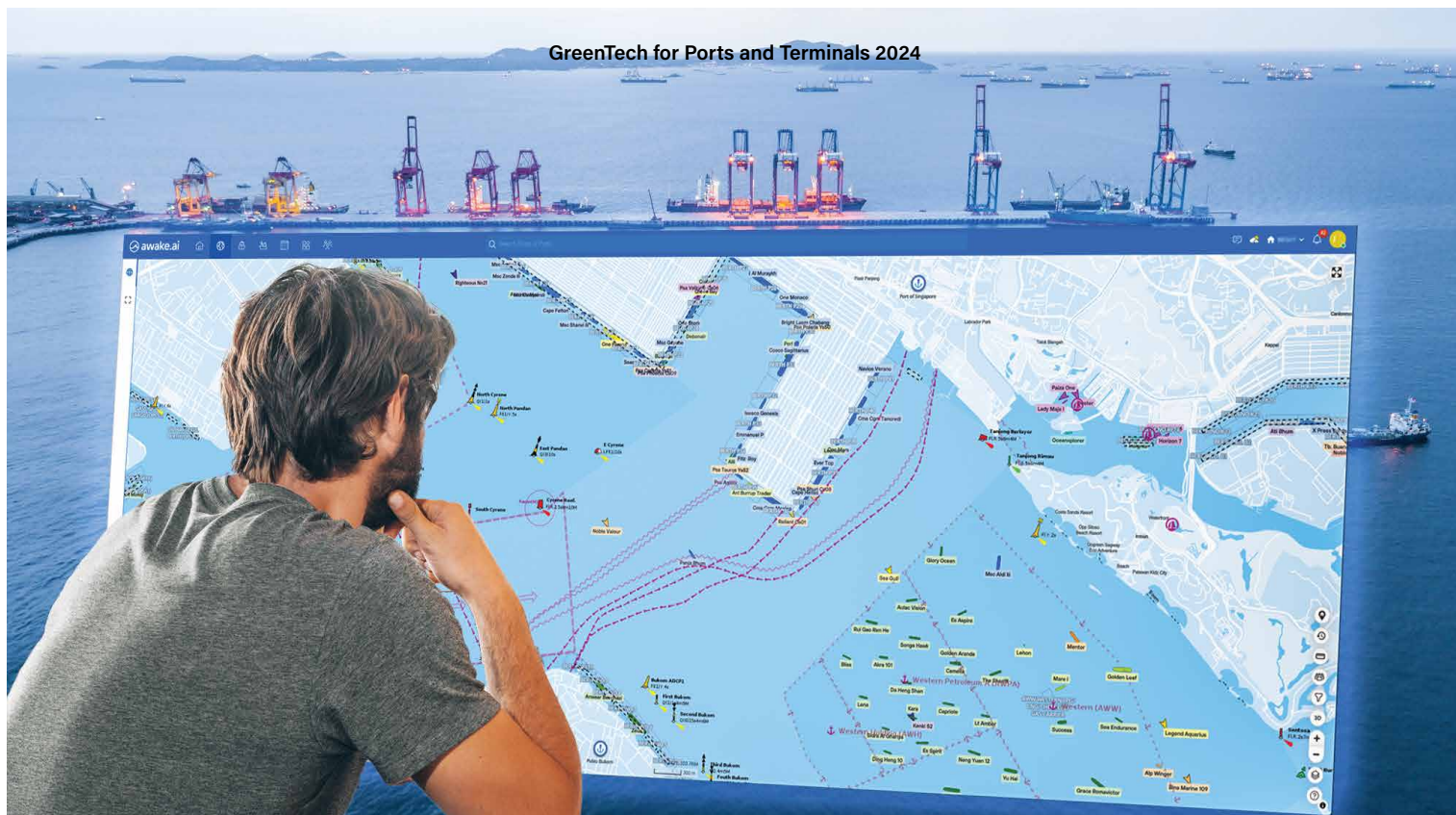
SITUATIONAL AWARENESS

Taking situational awareness to a new level requires the collection and sharing of data from all relevant stakeholders related to port calls. These include pilot times and locations, towing times and locations, terminal times, vessel times and locations, weather data, Maritime Single Window (MSW)/port call data, and emission data. This data is then collected to the Digital Port Call Platform enabling users to follow arriving and departing vessels, receive warnings and notifications, stay up-to-date on weather forecasts and get AI-based weather and schedule deviation warnings connected to the port calls and geofence areas of interest for specific work, restrictions or notices.

User management is carefully designed and developed to match different organisations,

roles and responsibilities to ensure GDPR and data security compliance as well as respect the commercial agreements between the stakeholders. Now they can efficiently chat with the right parties throughout the port call. All stakeholders get all the needed vessel and port visit information easily and fast while the AI system generates the vessel traffic lists dynamically by analysing globally all vessels heading to the selected port. Even if the AIS destination is not correct, the system still predicts where vessels are going and accurately predicts the arrival time. Machine learning-based predictions improve prediction accuracy by up to 80 per cent. Notifications are digital messages sent by the system to inform users about various events and activities. This helps all users to stay informed, organised and productive.





JUST-IN-TIME PLANNING AND COMMUNICATIONS

The maritime industry has been talking about Just-in-Time (JIT) arrivals for years and now we are launching a solution enabling port call stakeholders to plan and negotiate the optimal arrival times. This reduces emissions,

ABOVE

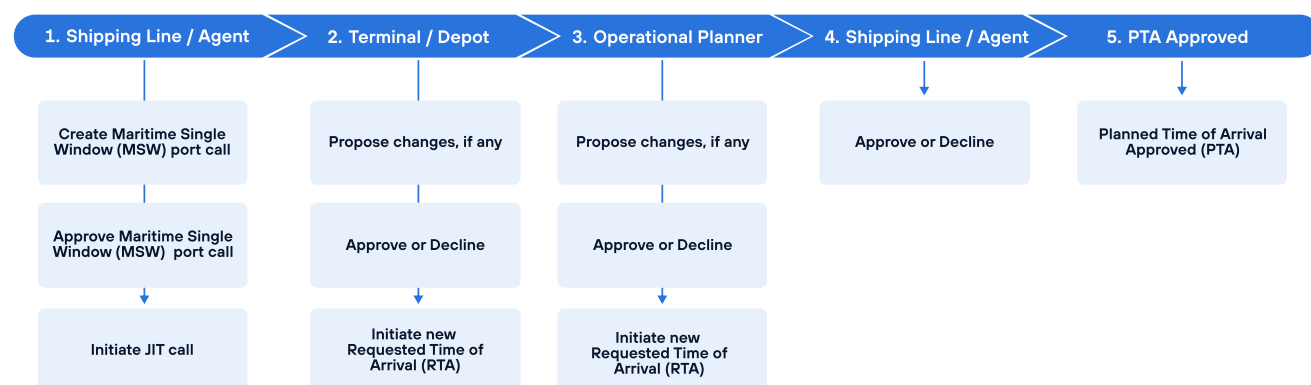
Situational Awareness with comprehensive real-time mapping of port traffic, areas and resources

BELOW

Just-in-Time process

reduces costs, improves safety, reduces congestion and optimises capacity planning. Key timestamps for JIT are Virtual Time of Arrival (VTA), Requested Time of Arrival (RTA) and Planned Time of Arrival (PTA). The key new functionalities introduced are user groups for JIT, JIT berth planning, JIT agreements, JIT time verification and JIT email

notifications. The system generates a history table automatically capturing who did what and when, as well as previous and new values and comments. It is easy for different users to go through the history if more information is needed than what was done earlier. The system shows the optimisation summary for potential sea voyage savings



“ONCE THE PORT CALL IS COMPLETED, THE AI-BASED SYSTEM REGENERATES THE REPORT AUTOMATICALLY UPON REQUEST REGARDING THE KPIS, TOTAL USAGE, ANCHORAGES, EMISSIONS AND PLANNING ACCURACY.”

based on the new proposed time and remaining vessel voyage. It also shows the potential anchorage savings based on the new proposed arrival time assuming that anchorage times are reduced

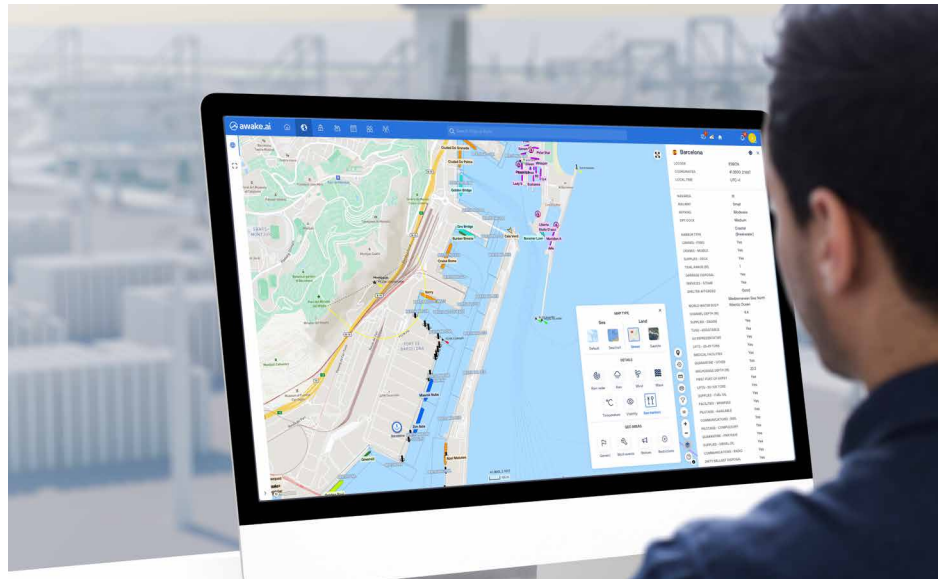
STATISTICS AND ANALYTICS SUPPORTING DATA-BASED DECISIONS

Once the port call is completed, the AI-based system regenerates the report automatically upon request regarding the KPIs (e.g. berth usage, vessels, ship types, CO₂), total usage, anchorages, emissions and planning accuracy. The system analyses port call and AIS-based data for different metrics which can be filtered for selected time ranges, terminals and berths, ship types and names. Emissions can be analysed and reported per vessel, location, and berth. Statistics service with comprehensive traffic activity analytics offers an interactive user interface and integrations to online data sources to automatically orchestrate updates to the data.

THE NEW WAY

To be more specific about how the Digital Port Call system works, the agent can make a JIT call when the vessel is heading to a port with the Digital Port Call Platform in use. The vessel must not already be in the port area.

First, the agent creates a port call for the MSW and the port needs to approve this before the JIT call request. Once the port call is approved, the agent opens the Digital Port Call Berth Planner and creates a JIT berth plan. Information such as date, contract speed, terminal and berth is needed. This



ABOVE

Continuous reporting on port KPIs, emissions and port calls

sends a notification to the terminal operators, operational planners and port control. Terminals and operational planners get an email link or they can go to the berth planner view to approve, decline or change the time of berth.

DISCOVER YOUR DIGITAL POTENTIAL

Awake.AI and the Port of Gothenburg introduce to the world a solution that digitalises the entire port call. To be a more competitive logistic actor, climate impact on logistic hubs must be reduced and the rate of digitalisation increased to optimise the cargo flows through the ports as Awake's AI-driven optimisation platform is doing. Discover your full digital potential by making the port calls more automated, optimised and safe.

When launched during spring 2024, the Digital Port Call Platform will be a very relevant and necessary tool for the industry to support proactivity, collaboration and sustainability. We invite all interested parties to get a more detailed demo by contacting sales@awake.ai.

ABOUT THE AUTHOR:

Karno Tenovuuo has been in the marine business since 2004 and launched several groundbreaking solutions to the market. He received his M.Sc. (Tech) from the Helsinki University of Technology and his M.Sc. (Econ) from Turku University. He has been leading the development for the Finnish shipyards and SVP of the Rolls-Royce Ship Intelligence business before co-founding Awake.AI.

ABOUT THE COMPANY:

Awake.AI is a Finnish optimisation platform company whose solutions are focused on developing customised AI-based solutions to optimise cargo flows through the ports and reduce waiting times and emissions. Awake's AI-driven Logistics Platform is developed to bring together all maritime actors at sea, ports and land, making port operations more efficient, safe and sustainable.

“THE DIGITAL PORT CALL PLATFORM WILL BE A VERY RELEVANT AND NECESSARY TOOL FOR THE INDUSTRY TO SUPPORT PROACTIVITY, COLLABORATION AND SUSTAINABILITY.”



Your Dynamic Operations Our Intelligent Solutions

Imagine achieving higher throughput with lower overheads and less hassle. At Avlino, we use advanced AI techniques combined with Operations Research to provide you with the level of control you need to tackle your specific challenges.

From optimal strategies to autonomous workflows, our AICON Solutions Suite ensures your operations run smoothly and profitably.

Visit us today to discover how!
WWW.AVLINO.COM

AICON Solutions Suite



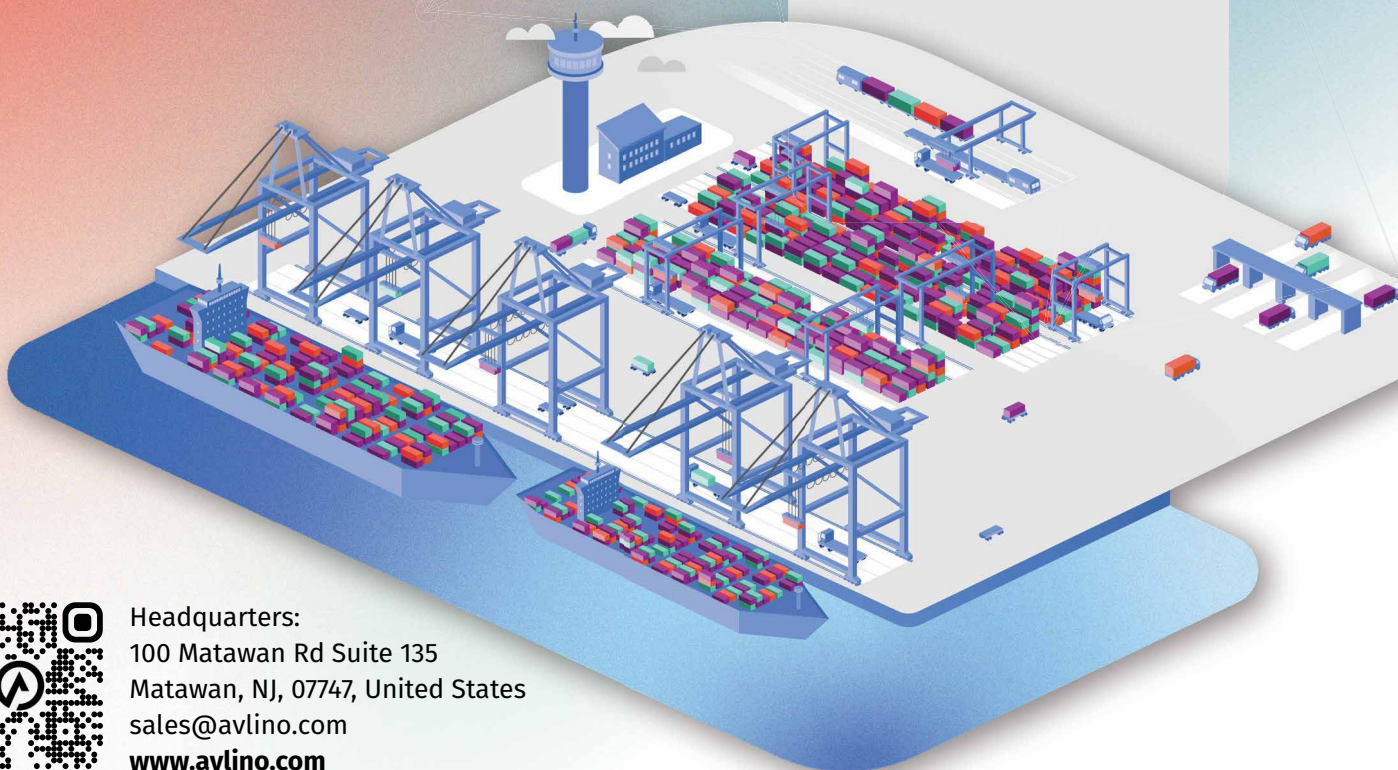
BerthSight



DispatchSight



YardSight



Headquarters:
100 Matawan Rd Suite 135
Matawan, NJ, 07747, United States
sales@avlino.com
www.avlino.com

NAVIGATING SUSTAINABLE MARITIME FRONTIERS: A DEEP DIVE INTO SPIRE'S SPACE-POWERED INNOVATIONS





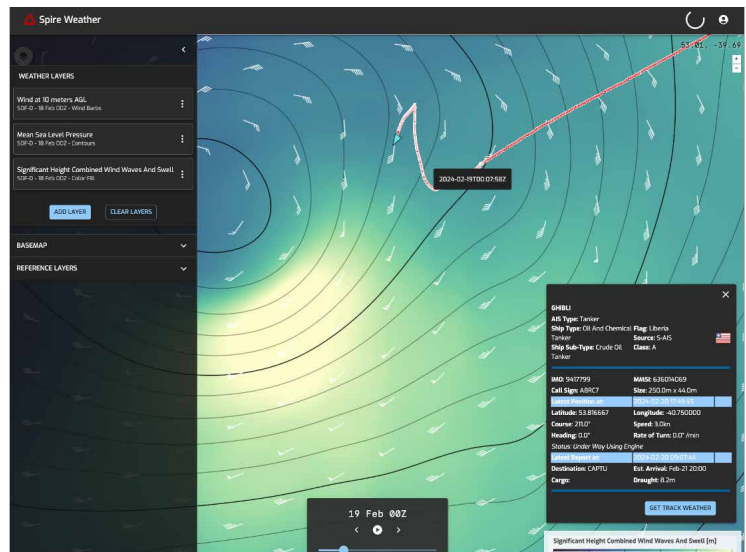
 spire | weather & climate

Carlos Losada, Global Senior Product Manager, Spire

In the vast expanse of maritime operations, where efficiency is king and sustainability reigns supreme, the convergence of cutting-edge technology and industry expertise is reshaping the seascape. Amidst the tumultuous tides of climate change, the maritime sector faces an urgent call to chart a course towards greener, more efficient practices. At the forefront of this transformation stands Spire Global, a pioneering force harnessing space-powered data to revolutionise maritime insights and operations.

In this exploration, we delve into Spire's groundbreaking solutions and unravel the intricate tapestry of technology and innovation woven into the fabric of modern maritime sustainability. From optimising vessel routes to safeguarding against risks and enhancing operational efficiency, Spire's suite of offerings promises to redefine the maritime landscape for port, shipping, and logistics professionals worldwide.

Join us on a voyage through the depths of maritime innovation as we uncover the transformative power of Spire's Deep Navigation Analytics (DNA) platform, Voyage Optimization solution, Risk Insight calculator, and beyond. Together, let us navigate the seas of change, forging a path toward a more sustainable, resilient maritime future.



How does Spire Deep Navigation Analytics contribute to sustainable maritime practices, particularly in reducing carbon emissions and optimising fuel consumption?

In the maritime industry, efficiency hinges on weather and shipping traffic. This becomes increasingly crucial amidst weather extremes fuelled by climate change. Yet, grappling with vast datasets poses a challenge for many maritime stakeholders. Spire's Maritime Deep Navigation Analytics (DNA)

platform offers pre-processed data and integrated technologies, enabling users to prioritise decision making over redundant tech rebuilding.

Could you provide further insight into Spire's Voyage Optimization solution and its capacity to optimise routes for multiple parameters simultaneously? How does Spire's Voyage Optimization, powered by Theyr, distinguish itself from traditional optimisation algorithms?

"AMIDST THE TUMULTUOUS TIDES OF CLIMATE CHANGE, THE MARITIME SECTOR FACES AN URGENT CALL TO CHART A COURSE TOWARDS GREENER, MORE EFFICIENT PRACTICES."

This represents a prime demonstration of Maritime DNA's value. Rather than requiring users to integrate the optimisation solution with weather and ship models, it seamlessly integrates with our comprehensive data suite. Weather accuracy is pivotal to voyage optimisation, and Spire leverages data from its constellation of over 100 satellites to provide unparalleled insights into weather conditions across under-observed regions, including remote land areas, oceans, and higher altitudes of the atmosphere.

Traditional voyage optimisation algorithms typically focus on avoiding adverse weather conditions or minimising consumption or costs. However, such approaches often fall short in an industry where balancing complex and sometimes conflicting

factors is essential, such as maintaining emissions ratings while adhering to specific arrival time windows.

Spire's Voyage Optimization technology operates on the principle that every possible route must be calculated for a given voyage. By thoroughly exploring the solution space, the system identifies the most suitable route that aligns with the user's combined voyage objectives. This approach empowers users to select routes that effectively address both their commercial and environmental objectives.

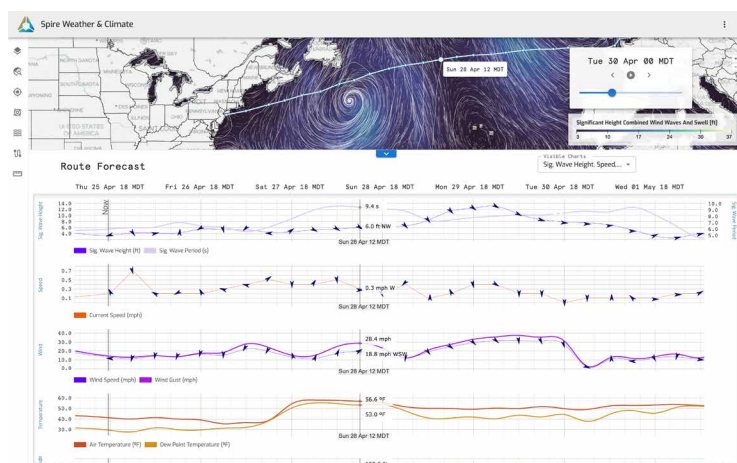
How does Deep Navigation Analytics leverage innovative technologies to bolster the sustainability of maritime operations, and what role does AI play in this process?

Addressing every possible route and schedule between two ports manually would prove time-prohibitive for our users. Spire Voyage Optimization harnesses genetic algorithms, employing evolutionary AI techniques. Essentially, variations of a designated route are systematically explored to navigate each route objective's solution space. Successful variations are iteratively refined, ensuring a highly efficient exploration of all objectives.

Could you discuss the Route Insights product and its role in delivering actionable insights to safeguard vessels, cargo, and crews along customer shipping routes? Additionally, could you elaborate on Spire's proprietary weather data and how it empowers unparalleled insights?

"SPIRE'S ROUTE INSIGHTS ALLOWS USERS TO EFFORTLESSLY ASSESS ROUTE SAFETY AND EFFICIENCY, SHOWCASING HOW OUR MARITIME DNA PLATFORM ENHANCES ACCESSIBILITY TO OUR CUTTING-EDGE WEATHER DATA."





Spire's Route Insights allows users to effortlessly assess route safety and efficiency, showcasing how our Maritime DNA platform enhances accessibility to our cutting-edge weather data.

Typically, evaluating routes requires significant development effort in processing weather data and developing the relevant algorithms. However, with Spire Route Insights, users simply submit their route alongside vessel type and cargo parameters, receiving an immediate evaluation in return.

Spire's weather data stands out as the sole source built upon our comprehensive dataset of space-based climate insights. Our satellite constellation gathers data on atmospheric properties, precipitation, soil moisture, and ocean winds, facilitating a nuanced understanding of current weather conditions. This detailed dataset minimises forecasting errors by providing precise initial conditions. The weather predictions are then optimised further through satellite-validated comparisons.

What role does digitalisation play in advancing sustainability within maritime operations, and how does Spire contribute to this aspect?

Digitalisation, in our context, signifies the enhancements following the digitisation of information. Spire's contribution lies in providing vessel tracking and weather data to numerous voyage optimisation service providers, enabling real-time decision making amid weather fluctuations. While similar outcomes could be achieved through sensor installation or public weather data utilisation, Spire's datasets and technology enable vessel tracking sans sensors and voyage optimisation with the added benefit of space-based weather forecasts.

This offering stands unparalleled for ports, terminals, and agents, offering real-time visibility and operational forecasting to enhance decision making.

How does Spire's space-powered data revolutionise insights into vessel traffic and weather?

With a comprehensive database covering every vessel and port worldwide, Spire's data presents significant opportunities for the industry's pursuit of just-in-time arrivals and multi-vessel optimisation along trade routes.

This comparison highlights the contrast in coverage between Radio Occultation and Weather Balloons, two methods crucial for assessing atmospheric changes at various altitudes – an essential component for weather prediction models. Radio Occultation, a pioneering technique, offers a holistic view of the atmosphere at every level globally. Leveraging a constellation of over 100 satellites, Spire achieves this breakthrough by analysing signal bending from GPS/GNSS satellites influenced by weather elements.

While Weather Balloons, equipped with meteorological instruments, are confined to launch areas over land, Radio Occultation-derived atmospheric profiles obtained via satellites offer expansive coverage, transcending geographical constraints. Spire's unrivalled weather data coverage extends from the poles to remote oceans, providing indispensable data insights.

ABOUT THE AUTHOR:

Carlos Losada, Spire Global Senior Product Manager responsible for maritime weather solutions, is a Naval Architect and maritime digital solution expert. He graduated from The University of Southampton in the UK, with experience in the field of voyage optimisation, including building, implementing, and selling solutions with companies such as Wartsila.

ABOUT THE COMPANY:

Spire Global, Inc. is a leader in space-based data and analytics offering access to powerful datasets and insights about Earth so organisations can make confident decisions with accuracy and speed. Spire uses one of the world's largest multi-purpose satellite constellations to capture data, enriching the maritime, aviation, and weather industries.

“SPIRE'S UNRIVALLED WEATHER DATA COVERAGE EXTENDS FROM THE POLES TO REMOTE OCEANS, PROVIDING INDISPENSABLE DATA INSIGHTS.”

KALMAR ENABLES MULTIPLE BATTERY TECHNOLOGIES FOR ELECTRIC STRADDLE CARRIERS

"WITH THE INTRODUCTION OF THE KALMAR ELECTRIC STRADDLE CARRIER CHARGE FAMILY, WE NOW HAVE A FULL RANGE OF PRODUCTS THAT PROVIDE MAXIMUM FLEXIBILITY FOR TERMINAL OPERATORS."





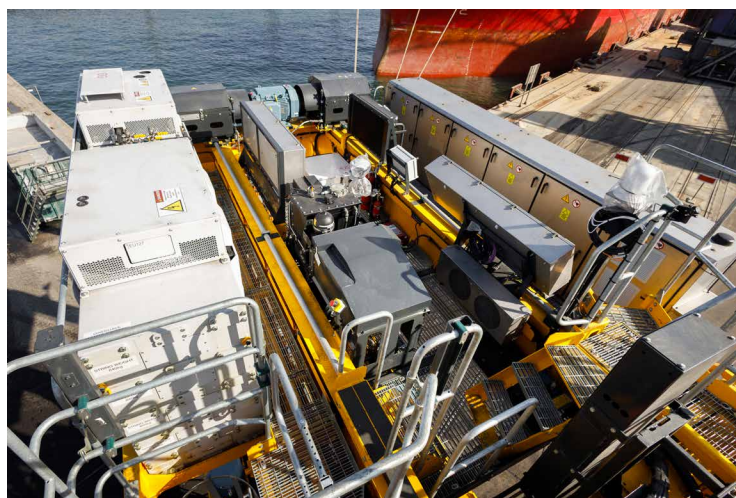
Kalmar has recently announced the launch of the Electric Straddle Carrier Charge Family as the latest addition to its rapidly growing portfolio of fully electric equipment. The Charge Family comprises battery technologies, charging solutions and software for Kalmar straddle carriers, supporting operators of both manual and automated terminals in transitioning towards decarbonised operations.

With the introduction of the Charge Family, Kalmar electric straddle carriers are now available with two different battery technologies. The Kalmar electric straddle carrier with a high-energy battery is capable of up to four hours of continuous operation with a charging time of around 45 minutes. As an alternative, the Kalmar electric straddle carrier with a high-power battery (previously known as the Kalmar FastCharge™ straddle carrier), is capable of up to 50 minutes of continuous operation with a charging time of 5 to 6 minutes.

The battery technologies are supported by two different charging options that can be combined flexibly depending on the needs of the terminal. A standard CCS charging interface is compatible with any commercial charging station, while the optional high-power technology charges the onboard battery via a pantograph at a FastCharge station.

SMART CHARGING

The equipment solutions are complemented by supporting Kalmar software that allows terminals to make efficient use of



their electrified equipment and identify areas for improvement through monitoring and data analysis. Kalmar Charge Optimiser automatically assigns charging tasks to the operator to avoid queues at charging stations and ensure the efficient utilisation of charging points. Kalmar One Fleet Optimiser software for Kalmar AutoStrad™ handles job scheduling and dispatching, while the Kalmar Insight Energy Module provides visibility over battery charging status, energy utilisation and key performance indicators related to charging.

"With the introduction of the Kalmar Electric Straddle Carrier Charge Family, we now have a full range of products that provide maximum flexibility for terminal operators," said Marko Hopeaharju, Head of Horizontal Transportation Solutions, Kalmar. "The battery and charging technologies can be chosen depending on the specific operational needs of the terminal, and

the performance of the system can be optimised very effectively with the aid of our software products."

FLEXIBLE CHOICES

The optimum choice of battery and charging solution will depend on the fleet type and operational concept of the terminal. The high-energy battery will provide a continuous operational time of approximately half a workshift, and the straddle carrier can be recharged for example during a lunch break for a further four hours of operation. By contrast, the high-power system uses a smaller battery that provides 45 to 50 minutes of operational time with fast opportunity charging that takes only a few minutes between work cycles.

"The battery systems depend on two different energy storage concepts," said Sami Yli-Äyhö, Senior Manager, Product Management, Kalmar. "The high-



“ONE OF THE GREAT ADVANTAGES OF THE KALMAR ELECTRIC STRADDLE CARRIER CHARGE FAMILY IS THAT THE TWO CHARGING AND BATTERY SOLUTIONS CAN BE COMBINED FLEXIBLY.”

energy solution is slower to charge, but has a larger capacity, while the high-power system can take in a large amount of energy in a very short time. Typically, the high-power solution with automated FastCharge™ charging would be the first choice for automated straddle carrier terminals, but the system is also suited to manual terminals."

LONDON GATEWAY GOES ELECTRIC

In the second quarter of 2024, Kalmar will be delivering eight fully electric Kalmar straddle carriers with high-energy batteries to DP World's London Gateway logistics hub. London Gateway is a state-of-the-art deep-sea port, rail terminal and logistics park situated on the River Thames. Terminal operator DP World is committed to minimising the terminal's environmental impact, and fully electric equipment is seen as a key part of the drive to improve eco-efficiency.

DP World's Kalmar electric straddle carriers with high-energy batteries will be capable of operating for up to 4 hours. No major changes are required to the yard infrastructure as the charging stations will be located in parking areas outside operational hotspots. The straddle carriers will be fitted with a CCS2 charging interface that is compatible with any commercial charging station. DP World will also install two Kalmar FastCharge™ charging stations in the yard area that can be used to top up the machines' batteries during shifts.

"One of the great advantages of the Kalmar Electric Straddle Carrier Charge Family is that the two charging and battery solutions can be combined flexibly," said Jeroka Alanko, Senior Manager, Product Management, Kalmar Automation Solutions. "The pantograph-based FastCharge™ system can complement traditional CCS charging and act as a supplemental charger for the high-energy solution. Both machine types are also fitted with the standard CCS charging interface."

ZERO EMISSIONS ON SITE

In terms of performance, the electric straddle carrier compares favourably to its diesel counterparts. "Electric machines always need to be charged at some point, so we typically estimate a 90 per cent availability rate for our high-power systems to account for charging," noted Hopeaharju. "However, with optimisation, opportunity charging between container moves can be utilised very effectively without impacting productivity."

All-electric container equipment also has the potential for lower lifetime maintenance costs as the diesel engine and traditional powertrain are eliminated. In addition to the standard warranty, Kalmar offers an extended battery warranty of up to five years when combined with remote diagnostics through the Kalmar Insight service, which allows operators to track the

performance of their equipment as well as battery performance and status in real time.

"Fully electric container handling equipment is the logical next step for terminals on their decarbonisation journey," said Hopeaharju. "Kalmar electric straddle carriers are fully zero-emission on site, but the environmental impact of the terminal as a whole naturally depends on how the electricity for the site is produced. We are seeing a clear drive towards more eco-efficient operations in our global customer base, and are happy to support their goals with the Kalmar Electric Straddle Carrier Charge Family alongside our other solutions."

ABOUT THE COMPANY:

Kalmar is the global leader in sustainable cargo handling for ports, terminals, distribution centres and heavy industry. With our extensive electric portfolio and global service network, we help our customers move towards safer, more eco-efficient and productive operations. Together, we develop innovative solutions that shape the future of our industry, improving our customers' every move.

www.kalmarglobal.com

Kalmar is part of Cargotec. Cargotec's (Nasdaq Helsinki: CGCBV) sales in 2023 totalled approximately €4.6 billion (\$5 billion) and it employs around 11,400 people.

www.cargotec.com

FUEL EMPOWERS THE MARITIME SECTOR THROUGH TECHNOLOGY AND EXPERTISE



Svetlana Hansen, CCO, Fjuel

INTRODUCTION

As the maritime industry seeks innovative solutions to reduce environmental impacts, we at Fjuel emerge as leaders in providing sustainable energy systems. Leveraging advanced digital technologies, our platform enhances efficiency and profitability in both the design and operational phases of energy transformation at ports. We focus on implementing and managing energy infrastructures such as shore power, charging stations, and batteries, while also planning to integrate sustainable energy production facilities and sustainable energy carriers in the future. This article explores how our solutions are setting new standards in the industry.

EVOLUTION OF SHORE POWER TECHNOLOGIES

Our platform stands as a leading IoT IT system in the maritime energy sector, specifically engineered to integrate energy infrastructure such as shore power and charging units from various suppliers into a unified digital interface. This advanced integration not only optimises operations but also substantially enhances the decision-making capabilities

of port operators by providing in-depth visibility into the finance and operational efficiency of the infrastructure.

• **ENHANCED DATA INSIGHT AND CUSTOMISATION FOR PORT OPERATIONS**

Our platform harnesses advanced data analytics to process and display both real-time and historical data, empowering ports to efficiently manage their energy infrastructure. This functionality allows for deep dives into session-specific data or broader aggregated views, enabling ports to monitor metrics across all units or analyse them individually. Detailed reports generated by our system provide critical insights into profitability, usage patterns, and emissions reductions, facilitating strategic decision-making and operational improvements.

• **TAILORED USER INTERFACE**

The user interface of our platform is tailored to meet the diverse needs of our users, featuring distinct access points for ports, shipping companies, and vessels. This segmentation ensures that each user type accesses only the data relevant to their operational

requirements, streamlining the decision making process. By granting specific user permissions, we ensure that critical metrics are easily and quickly accessible, thereby enhancing data security across the maritime industry.

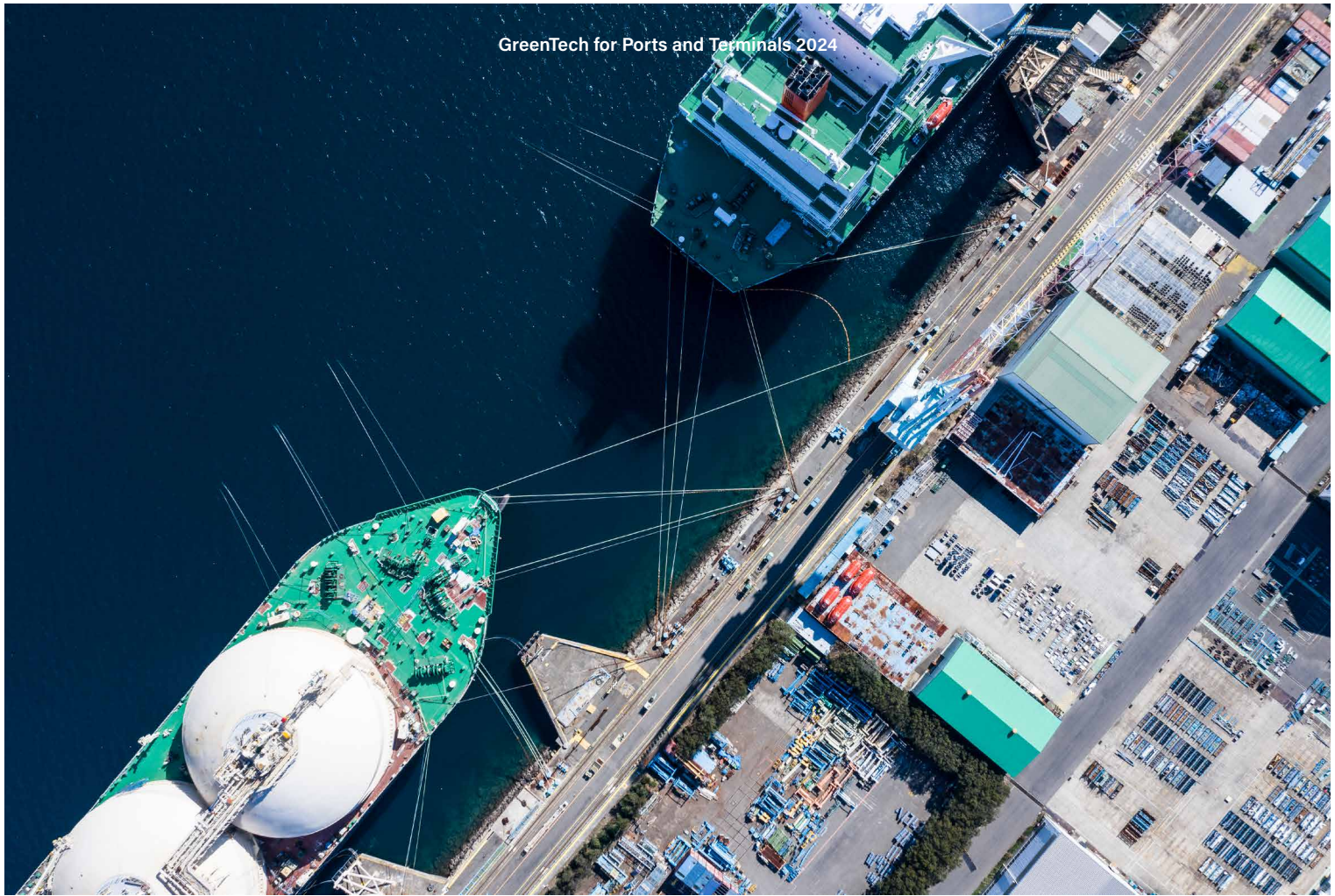
• **COLLABORATIVE DATA SHARING**

Our platform includes a constantly growing database of vessels that connect to shore power and charging stations. This data is shared across ports, empowering all our customers with information that is currently locked in each vessel. This data will help ports plan upcoming calls, operate infrastructure more intelligently, and generate revenue from the sale of energy while reducing emissions. This system not only enhances the operational efficiency of ports but also contributes to environmental sustainability by ensuring that the energy solutions provided are utilised to their maximum potential and efficacy.

• **SCALABILITY AND INTEGRATION WITH RENEWABLE ENERGY:**

Our technology is designed for scalability to meet the evolving demands of modern ports,

“WE EMPOWER PORTS TO OPTIMISE THEIR DEVELOPMENT OF ENERGY INFRASTRUCTURE, REDUCE ENVIRONMENTAL IMPACTS, AND ENHANCE OVERALL OPERATIONAL EFFICIENCY.”



from small marinas to large commercial hubs. This scalability extends beyond simply adding diverse onshore power facilities; it encompasses the ability to seamlessly integrate with a wide variety of vessels, ensuring digital data sharing between ports and vessels. This integration provides each with enhanced insights and eliminates the need for phone communications as a primary communication asset. The solution also facilitates easy onboarding onto our platform.

- **COMPREHENSIVE DATA INTEGRATION:**

Designed for extensive data collection and sharing, our technology incorporates robust API integrations that connect with external databases and IT systems. We have successfully established multiple integrations, including with port IT systems, ERP systems, Nord Pool, the Norwegian Coastal Authority, and the Norwegian Maritime Directorate, among

others. As we continue to expand into new countries and markets, we will develop additional integrations tailored to meet the needs of new customers. These integrations offer significant advantages in collecting and systematising data, thus delivering new customer values by enabling ports to leverage comprehensive insights into their operations and energy usage.

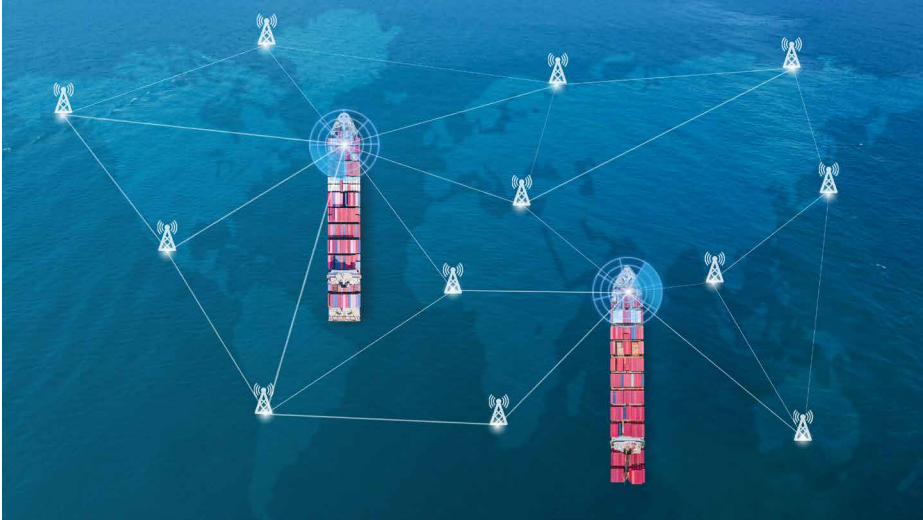
By continuously advancing our technology with these innovative features, we empower ports to optimise their development of energy infrastructure, reduce environmental impacts, and enhance overall operational efficiency.

We are committed to facilitating a unified platform that integrates all existing infrastructure, whether it involves traditional shore power systems, charging stations for vessels or EVs, batteries or renewable energy production facilities. By centralising data and operations, we enable ports to optimise their management

processes and enhance operational efficiency across their networks. This integration empowers ports to not only meet their current operational demands but also to plan and adapt to future growth and technological advancements effectively.

TECHNICAL INNOVATIONS AND EXPERTISE

Our strength lies in our comprehensive expertise in designing and managing energy infrastructure, which includes a system-agnostic platform capable of interfacing with various types of energy infrastructures. We leverage this experience to enhance technical specifications and functionalities, thereby simplifying system operations and enhancing usability. Our focus on high uptime and problem-free usage, combined with our commitment to modular design, ease of integration, and adaptability to different port environments, underscores our dedication to providing flexible and efficient solutions tailored to the unique needs of each port.



“OUR FOCUS REMAINS FIRMLY ON INNOVATION IN THE FIELDS OF ENERGY AND GRID CAPACITY AVAILABILITY AND ENERGY MANAGEMENT FOR BETTER UTILISATION OF EXISTING ENERGY INFRASTRUCTURE.”

CASE STUDIES: SUCCESS STORIES OF IMPLEMENTING TECHNOLOGIES IN TROMSØ AND TRONDHEIM

Our successful implementations in Norwegian ports such as Tromsø and Trondheim showcase the tangible benefits of our shore power solutions. These ports have witnessed significant reductions in CO2 emissions and enhanced operational workflows, demonstrating our ability to deliver effective and sustainable results. We provide ports with the capability to monitor and manage energy usage in real time, contributing to a more sustainable maritime environment and supporting ports in meeting their climate goals.

HARNESSING EXPERTISE FOR SUSTAINABLE MARITIME INFRASTRUCTURE

At Fjuel, we bring a unique blend of competencies to the design and operation of shore power systems for ports. Our commercial acumen ensures that ports

can design their infrastructure correctly from the start, avoiding overinvestments and fostering profitable operations. We excel technically in creating solutions that optimise port operations, enhancing both efficiency and sustainability. Furthermore, our deep familiarity with the supplier market allows us to discern which hardware and solutions are effective and which are not, ensuring that only the best practices are implemented. We also offer expertise in the technical implementation and day-to-day operations of shore power and charging units.

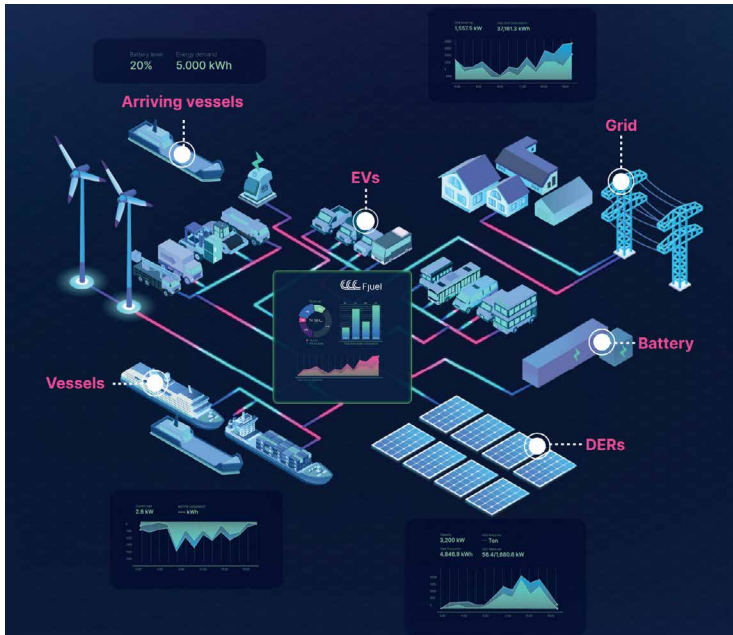
THE FUTURE OF PORTS POWERED BY FJUEL

Looking forward, we are poised to significantly expand our impact within the maritime sector as we continue to scale our technologies and explore new markets. Our focus remains firmly on innovation in the fields of energy and grid capacity availability and energy management for better utilisation

of existing energy infrastructure. Importantly, our platform is set to evolve beyond traditional electrical energy infrastructure to include digital communication with ports' systems delivering hydrogen, ammonia, biofuel, and other low-emission or emission-free energy carriers. This expansion aims to provide a comprehensive overview for ports as they transition to sustainable operations.

Our integrated approach will allow ports to combine insights from all types of energy infrastructure, creating a holistic view of their energy sales, availability, and sustainability metrics. By doing so, we will enable ports not only to meet their immediate energy needs but also to strategically plan for their future development in alignment with global sustainability goals.

Additionally, our technology will enable total tracking of emissions across green corridors and door-to-door transportation routes, offering a seamless and transparent view of environmental impacts and



regulatory compliance. This capability is crucial for ports aiming to reduce their carbon footprint and for companies committed to enhancing their sustainability practices throughout the supply chain.

As the industry moves towards a greener future, our innovations will help facilitate this transition by offering a range of solutions that support the decarbonisation of maritime operations. The integration of diverse energy sources into a unified management platform will be crucial in achieving a truly sustainable maritime infrastructure, ensuring that ports remain competitive and environmentally responsible in the decades to come. This strategic expansion reflects our commitment to leading the change in transforming ports into eco-friendly hubs, leveraging

cutting-edge technology to foster cleaner, more efficient operations worldwide.

CONCLUSION

We are not merely a service provider but a partner in the maritime industry's transition to sustainability. With our advanced technologies and committed expert team, we will help ports around the world reduce their environmental footprint while enhancing operational efficiency.

This narrative aims to showcase our pivotal role in transforming maritime operations through innovative energy solutions, highlighting how our technology and expertise are essential to the future of eco-friendly port management.

ABOUT THE AUTHOR:

Svetlana Hansen is the Chief Commercial Officer at Ffuel. Passionate about driving digitalisation and innovation in the transport and maritime sectors, she specialises in emissions-free solutions. At Ffuel AS, Svetlana excels in integrating energy solutions and fostering business growth. Her focus is on customising and managing shore power installations to reduce carbon footprint, contributing to a sustainable future.

ABOUT THE COMPANY:

Ffuel is a Norwegian startup jointly owned by three ports – Trondheim, Bodø and Tromsø – and two energy companies – Bodø Energi and Troms Kraft AS.

Ffuel offers comprehensive commercial and technical expertise that assists ports in designing and building optimally designed energy infrastructure for future-proof operations. Once the infrastructure is in place, Ffuel enhances its offerings with a digital IoT solution that integrates seamlessly with various systems from suppliers of shore power, charging stations, batteries, solar panels, etc. This solution is meticulously developed to digitise and streamline operations, significantly boosting efficiency and providing deeper insights. The main focus is on maximising infrastructure uptime and ensuring user-friendliness for end-users, which contributes to profitable operations while reducing emissions.

“OUR COMMITMENT TO INNOVATION ENSURES THAT OUR SOLUTIONS REMAIN AT THE CUTTING EDGE OF TECHNOLOGY, PROVIDING OUR CUSTOMERS WITH THE ESSENTIAL TOOLS TO SECURE A COMPETITIVE ADVANTAGE IN THE ENERGY TRANSFORMATION OF THE MARITIME INDUSTRY.”

NAVIGATING THE FUTURE: AI AND CO-SIMULATION FOR GREEN SHIPPING





Bogdan Iancu, University Lecturer, Åbo Akademi University, **Sébastien Lafond**, Professor in Software Engineering, Åbo Akademi University, and **Hergys Rexha**, Researcher, Åbo Akademi University

Over 90 per cent of international trade depends on maritime transportation, which is crucial to the global economy since it provides a reliable and affordable alternative to other modes of transportation. However, shipping alone contributes to nearly 3 per cent of the world's greenhouse gas (GHG) emissions. This prompted the International Maritime Organization (IMO) and private enterprises to launch campaigns to promote green shipping and make environmental sustainability a priority.

Growing concerns regarding the environmental impact of shipping in recent decades led also to the inclusion of green shipping into global transportation policies. The intricate nature of every maritime ecosystem though makes it challenging to implement these regulations in local maritime contexts. IMO revealed its aspirations to reduce carbon emissions from international shipping by at least 70 per cent by 2050 and by 40 per cent by 2030. Also, more demanding requirements were set on sulphur and nitrogen oxides (SOx, NOx) for commercial vessels, giving rise to Emission Control Areas (ECAs) such as in the Baltic and North Seas.

In this context, sustainable practices come at the forefront of development to create cutting-



edge solutions for maritime operations that benefit the economy and environment alike. Embracing such practices not only benefits the environment as such but reinforces the cost reduction and promotes the profitability of the industry in the long run. Several measures can contribute to fostering innovation while minimising environmental impact: improving energy efficiency, cutting down on waste products and ballast water pollution, more advanced engines less harmful to the environment, complying

with governmental regulations to avoid penalties, anticipating, and reducing environmental risks, etc.

LEVERAGING THE POWER OF AI - A JOURNEY TOWARDS DECARBONISATION

In an effort to mitigate environmental impact and reach the ambitious targets set by the IMO with the support of the maritime community, companies initiated different strategies: vessel retrofitting, investigating alternative fuels, and even reevaluating vessel design.

“SUSTAINABLE PRACTICES COME AT THE FOREFRONT OF DEVELOPMENT TO CREATE CUTTING-EDGE SOLUTIONS FOR MARITIME OPERATIONS THAT BENEFIT THE ECONOMY AND ENVIRONMENT ALIKE.”



Complementing all these, is artificial intelligence (AI) ultimately the holy grail of green shipping? To promote the sustainable development of the maritime sector, the strategies mentioned above evoke three key areas which proved to be notably relevant: ship design, operational efficiency, and voyage planning, which we will briefly discuss below.

OPERATIONAL PERFORMANCE: BETWEEN AI AND CO-SIMULATION

The operational efficiency of a vessel can be characterised through computational models involving relevant variables like operational velocity, weather conditions, vessel maintenance status, etc. These models rely on extensive empirical data from real-life, but also simulated scenarios. AI can help generate these simulated scenarios and complete automatic performance testing on them, revealing potential shortcomings in operational efficiency.

Contemporary maritime vessels integrate highly interconnected subsystems that function autonomously at different levels of resolution. These subsystems may

execute specialised tasks or oversee essential day-to-day ship operations. Together, they play a crucial role in maritime decision making by exchanging information. Creating efficient maritime systems that facilitate interdependent modules and ensure their seamless operation is a complex undertaking. It involves modelling the interactions among software modules across diverse timeframes and scales, considering a variety of accuracy requirements.

Simulation environments thus play a crucial role in deploying and expanding maritime software systems, being integral to both the architectural setup and the software development lifecycle. However, maritime systems are notably diverse, requiring the integration of modules from various domains often developed within specialised software frameworks.

Typically, such modules are built by multiple suppliers that deliver components, sensors, and software that shall work coordinated, where simulation models are considered an important part of the continuously updated virtual documentation which follows a vessel from the design phase

and into sea trials and finally into operation (digital twin).

To address this challenge, co-simulation emerges as a solution, enabling the system-level simulation of different subsystems together in a distributed manner. These subsystems, functioning as software artefacts, act as black boxes, receiving inputs (e.g., from other software artefacts), progressing forward in time using built-in routines and providing outputs that can become inputs for other similar subsystems.

Time synchronisation among subsystems occurs through discrete communication points, serving as the sole interaction between them. Aside from these communication points, these subsystems operate independently.

Co-simulation enables, thus, dynamic modelling of various systems for cooperative use in software, hardware, and human-in-the-loop simulations. Its benefits range from versatile use and performance enhancement through shared computational resources to the flexibility of changing the full-system architecture dynamically, facilitating continuous integration of different modules. Moreover, each subsystem can be implemented as a black box, allowing companies to cooperate and share models without revealing proprietary information.

SHIP DESIGN: DAWN OF A NEW ERA

Beyond its role in reducing emissions in maritime operations, one aspect has taken shipbuilding by storm: the electrification of ships.

Electrification possesses significant potential to revolutionise ship design, construction, and vessel operation itself. It essentially streamlines design

“ELECTRIFICATION POSSESSES SIGNIFICANT POTENTIAL TO REVOLUTIONISE SHIP DESIGN, CONSTRUCTION, AND VESSEL OPERATION ITSELF.”

and enables more adaptable use of space, fundamentally altering the process of equipment installation on ships. Substantial opportunities exist for establishing dominant designs in this context, akin to those made for electric vehicles in the automotive industry through car platforms. Additionally, integrating a similar type of platform in shipping could confer a competitive edge by enabling revenue generation throughout the vessel's lifespan.

Essentially, we are witnessing a technological transition that offers considerable potential for gaining a competitive advantage by reimagining how ships are conceived, constructed, operated, and maintained, thus capitalising on productivity enhancements and the new business prospects that it presents. Consequently, we

are witnessing the replacement of one technological paradigm with another within the realm of shipbuilding and shipping itself, involving stakeholders who directly influence and are impacted by this transformation.

Electrification and digitalisation are intertwined in facilitating this transition, prompting to draw upon interdisciplinary expertise to comprehend the business and policy implications of this evolution.

VOYAGE, VOYAGE: VOYAGE PLANNING FOR A BETTER TOMORROW

By streamlining routes and enabling vessels to select the most fuel-efficient ways, AI-driven optimisation techniques help cut down on emissions and fuel

usage. Also, an important aspect is emissions at the port side associated with port calls, involving different resources and maritime actors. Port calls need to be optimised to reduce port waiting time. Furthermore, real-time data analysis helps with proactive maintenance to increase fuel economy by supporting ongoing vessel performance monitoring. Predictive maintenance driven by AI is becoming increasingly popular to ensure that engines and other equipment operate at their best, reducing emissions and downtime.

The power of AI-based systems can help increase the operational efficiency of vessels by making use of IoT sensor data from the ship, weather reports, and historical travel data. By utilising AI technologies,

**“BY STREAMLINING ROUTES AND ENABLING VESSELS
TO SELECT THE MOST FUEL-EFFICIENT WAYS,
AI-DRIVEN OPTIMISATION TECHNIQUES HELP CUT
DOWN ON EMISSIONS AND FUEL USAGE.”**





there is a full potential for the integration of renewable sources where there is the requirement, and the usage of fuel cells alternative to Internal Combustion Engine (ICE) to significantly drop the emissions of GHG.

The adoption of automated route planning is witnessing a steady growth facilitated by the deployment of expert weather routing and radar systems. Its effects are a decrease in the number of maritime accidents and enhanced energy efficiency of vessels. This technique considers various environmental variables such as wave movement, wind and current direction, air and water temperature and density. For safety assurance, radar systems are also used to detect other vessels and maritime objects.

Moreover, cutting-edge AI-powered surveillance solutions improve vessel tracking in real-time, guaranteeing legal compliance and reducing hazards. By identifying possible risks and operational bottlenecks, predictive analytics enables prompt interventions and accident avoidance.

SHIPPING INTO THE FUTURE... SUSTAINABLY

AI is the driving force behind the shipping and maritime industry revolution. The journey towards sustainability, efficiency,

and resilience is paved by the integration of AI, from decarbonisation projects to workforce empowerment and improved safety. These sectors are navigating the waters of growth and leading the way towards a more technologically advanced, environmentally conscious, and optimistic future as they capitalise on AI.

Long-term sustainability is a critical consideration, especially when it comes to the maritime industry. As we explore alternative fuels, renewable energy sources, and AI, we must ensure that these advancements align with broader sustainability objectives.

Moving from traditional fossil fuels to cleaner alternatives (such as biofuels, hydrogen, or electricity) can drastically reduce GHG emissions. However, we must assess their impact on maritime ecosystems and ensure they do not harm biodiversity.

Using wind, solar, and wave energy can power vessels more sustainably. Yet, we should carefully evaluate the environmental effects of installing and maintaining renewable energy infrastructure in marine environments.

AI technology, as mentioned before, can highly impact the maritime environment, but in the end, we must strike a balance between technological advancement and ecological preservation.

ABOUT THE AUTHORS:

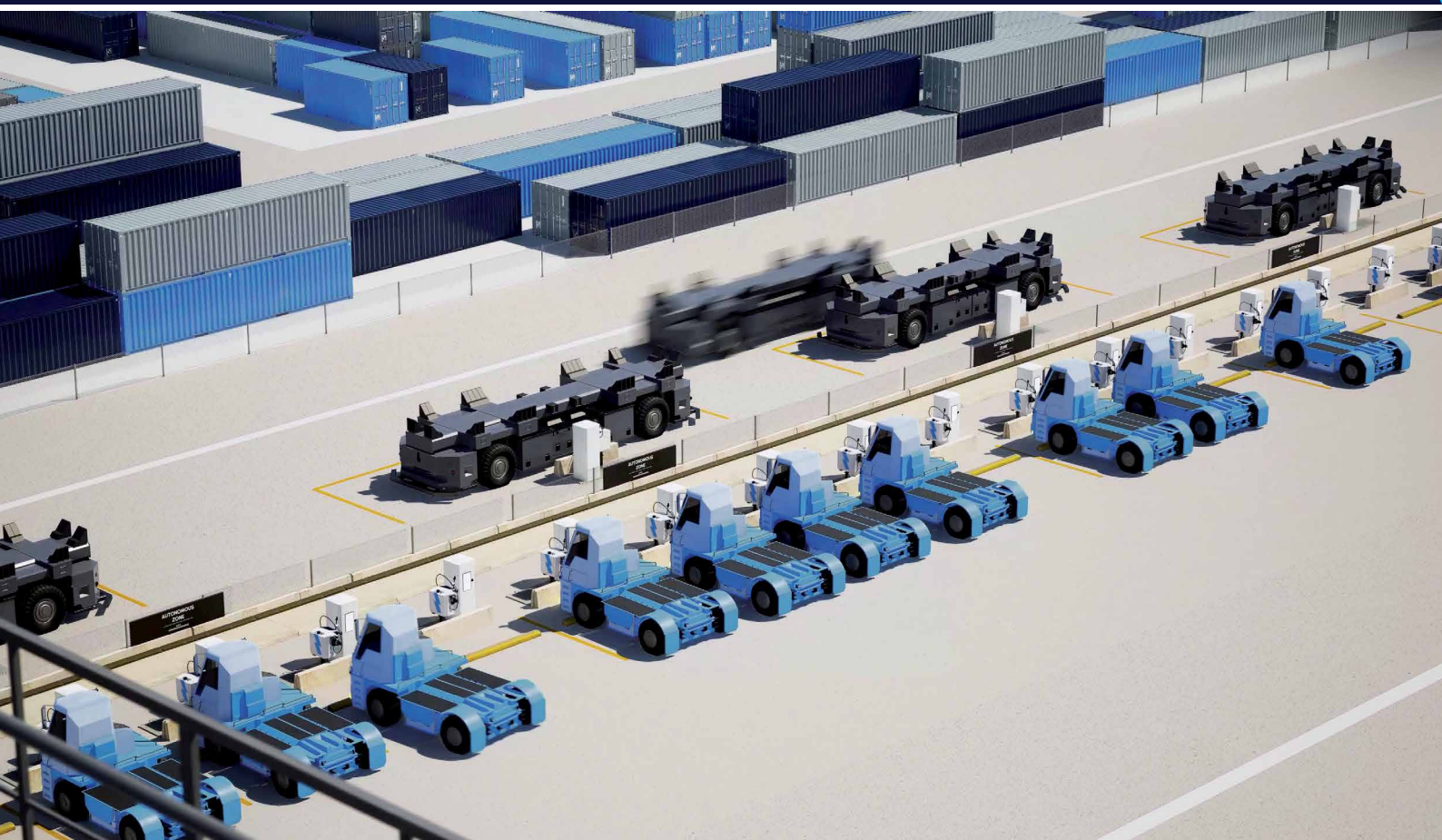
Bogdan Iancu is a computer scientist who completed his undergraduate studies in Bucharest and his PhD in Turku. He worked both in the academic and industrial sectors and is currently a university lecturer at Åbo Akademi University. His research focuses on data ecosystems, data-centric AI, and maritime informatics.

Sébastien Lafond is a full professor in Software Engineering at Åbo Akademi University. He was a principal investigator in the Business Finland projects Future Shipping Electrified (FUSE) and Decarbonizing Transport Corridors (DECATRIP), working on software life cycle simulations and innovative digital twin solutions for maritime software systems.

Hergys Rexha is a computer engineer who completed his Bachelor's and Master's studies at the Polytechnic University of Tirana and his PhD studies at Åbo Akademi University. He is currently working as a researcher in the IT department of the Faculty of Natural Sciences and Technology. His research interests are embedded systems, energy efficiency in multicore platforms, reconfigurable hardware, and ML applications in the maritime domain.

ABOUT THE UNIVERSITY:

Åbo Akademi University is a Swedish-language multidisciplinary academic university in Finland. The institution aims to contribute to society through general learning, education and new scientific knowledge. The Faculty of Science and Engineering at Åbo Akademi University develops solutions and processes that slow down climate change and promote a cleaner environment. The faculty's ultimate goal is for people to prosper in a sustainable society.



ROCSYS AUTONOMOUS CHARGING

- Improved safety
- Increased vehicle productivity
- Optimized workforce

PIECING TOGETHER THE FUTURE OF SAFE, EFFICIENT, AND SUSTAINABLE PORT OPERATIONS

"AS PORT OPERATORS FOCUS ON DECARBONISATION, IT SHOULDN'T BE AT THE EXPENSE OF IMPROVING SAFETY STANDARDS. IDEALLY, THERE ARE TIMES WHEN INVESTMENTS CAN ACHIEVE BOTH."





Richard Hepworth, Business Unit President,
Trelleborg Marine & Infrastructure

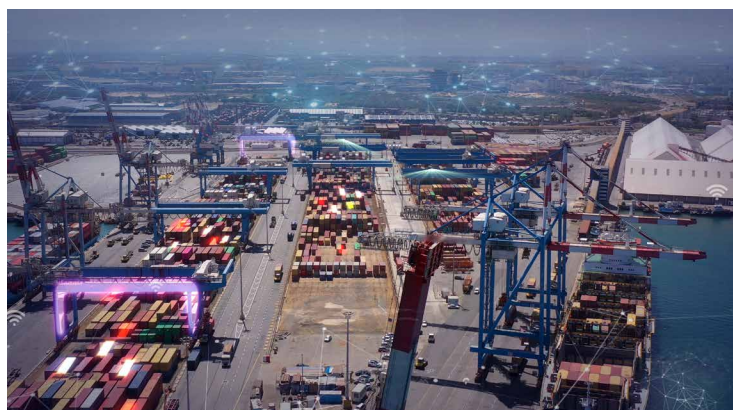
Today's ports face a variety of significant challenges, with larger vessels, increased cargo volumes, improved safety awareness, and tightening environmental regulations complicating operations and plans for development. Nonetheless, safety and environmental protection are issues that continue to evolve, and it's important for ports to keep pace.

To overcome these challenges, a dynamic patchwork of solutions and initiatives is required that ensure safety standards are met, sustainability requirements are achieved, and operations are optimised. The approach must take into account the rise of smart ports which, contrary to popular belief, will be a slow transition – evolutionary rather than revolutionary. In other words, the journey towards integrated, technology-driven port management will involve the blending of physical and digital innovations. These require a strategy that considers the inherent interconnectedness and complexity of the challenges faced.

SAFETY IN THE SPOTLIGHT

As port operators focus on decarbonisation, it shouldn't be at the expense of improving safety standards. Ideally, there are times when investments can achieve both.

According to data published by maritime ESG company, Rightship, around 50 per cent of maritime incidents occurred within port or terminal boundaries during 2022. This includes while at berth or using facilities, waiting at anchorage or during transit. Furthermore, nearly



34 per cent of these took place at docks. Looking at this from a different perspective, the UK Protection and Insurance Club have previously reported that over the last 20 years, 6 per cent of all accidents that occurred during mooring operations were due to equipment failure.

These incidents highlight the vulnerability of ship owners, cargo owners and ports to experiencing unplanned downtime, reduced service levels and both human and reputational costs caused by incidents. Ports therefore need to take an integrated approach to ensuring their berthing structures are safe when they are initially installed and that they remain so throughout their lifetime.

VALUE OF PHYSICAL INNOVATION

Fenders are a good example of traditional assets that can easily be ignored amid the tide of digital transition, yet their value should not be underestimated. Fender systems are critical for safe, efficient, and sustainable port operations.

Despite their unassuming appearance, the failure of a single fender can have wide-reaching implications. Designing and implementing reliable fender systems is crucial to preventing damage to the vessel's structural components, ensuring port operations run smoothly and supporting a sustainable profile by limiting frequent fender replacements. That is why taking the time and attention to develop an effective fender system is so important, especially if it is to perform for its entire lifespan which should be around 15 to 20 years.

There's no off-the-shelf solution for all, and fender systems are an example of how the design, engineering, quality control and maintenance of each component of berthing solutions play a part in enabling safe and optimised operations. The reality, however, is that cheap, poorly designed, and low-quality fenders are currently on the market, with manufacturers of these products promising performance at low-cost prices.

Without expert guidance, it is inevitable that port operators and their consultants will be unable to distinguish the merits of competing solutions, and could unwittingly jeopardise operations if basing decisions on cost alone.

A lack of rigorous, independent testing and standardised certification is exacerbating the issue of distorted and significantly differentiated quality and value in the marketplace. It is still acceptable for manufacturers to conduct their performance tests and self-certify products. This distinct conflict of interest and lack of standardisation means that customers have no benchmark or third-party quality assurance regarding the design and components of fenders.

The World Association for Waterborne Transport Infrastructure (PIANC) set guidelines for the design of marine fender systems, but they have become outdated over time. Trelleborg has been working closely with PIANC to develop a new set of guidelines which were published in March 2024. These provide guidance on the design, manufacture, and testing of fender systems to ensure sufficiently safe installation and operation on both vessel and berth, with optimal total cost of ownership.

From a maintenance perspective, proactively scheduled inspections of fenders are crucial to addressing deterioration early on and identifying dangers and repair

opportunities, before further damage occurs. Standardising the documentation of inspections increases user awareness of fender conditions, enabling managers to review inspection results in real time for greater insight.

Looking ahead, smarter fenders are being developed with next-generation solutions being able to collect berthing data to provide deeper insights into berthing operations to improve safety and efficiency. Even QR codes will shortly be introduced to provide easy access to information about manufacturers, design, sustainability and maintenance. It's a great example of how even physical infrastructure is being enhanced through the digital transition.

“THE PATH FORWARD WILL INVOLVE A STEADY INTEGRATION OF SUB-SYSTEMS, RESEMBLING A CAREFUL ASSEMBLY OF PIECES, RATHER THAN A SUDDEN, DRASTIC OVERHAUL.”



"AUTOMATED MOORING SYSTEMS ARE NOW AVAILABLE THAT USE DATA TO MAKE MORE INFORMED DECISIONS ON ASPECTS SUCH AS HOW LINE TENSION AND VESSEL POSITION HAVE HAD ON IMPROVING SAFE, EFFICIENT BERTHING."

AMALGAMATING ANALOG AND DIGITAL SOLUTIONS

However, contrary to the popular notion of sweeping change from initiatives like 'Ports 4.0', for most ports, this will be a gradual transformation. Indeed, advanced ports like Rotterdam and Singapore serve as inspirations that many less developed ports can model themselves upon, however, a vast majority of ports still rely heavily on manual labour and physical operations. The path forward will involve a steady integration of sub-systems, resembling a careful assembly of pieces, rather than a sudden, drastic overhaul.

To start, the critical interface between ship and port, on land and at sea, must be strengthened by utilising technologies that connect port operations, allowing operators to analyse performance and use data to improve decision making. These systems integrate assets like fenders, mooring equipment, ship performance monitoring, and navigation systems, and are underpinned by cloud and Internet of Things (IoT) technologies.

To achieve seamless integration of IoT and other technologies within port systems, emphasis must be placed on vendor collaboration – something that has been a barrier to scaling modernisation initiatives in the past.

AUTOMATING LEGACY OPERATIONS

Access to real-time data is becoming especially important in the realm of maritime and shipping. Automated mooring systems are now available that use data to make more informed decisions on aspects such as how line tension and vessel position have had on improving safe, efficient berthing. For example, Trelleborg's rope-free automated mooring system

uses vacuum technology to rapidly attach and secure a vessel at berth.

The system reduces vessel motions and continuously monitors all mooring loads acting on the vessel at berth. This provides live data to the operator to optimise day-to-day port and terminal operations. Traditionally, the process can take between 5 minutes for a RoRo ferry berth to as much as 2 hours for a bulk cargo terminal at an exposed location, but the system reduces the mooring operation to around 30 seconds. This offers both commercial and environmental advantages as vessels spend less time idling, resulting in reduced fuel consumption and emissions.

From a safety perspective, these solutions also minimise personnel involvement, reducing human error and improving safety, while helping ports and terminals become more environmentally efficient by reducing mooring time.

Transitioning from mooring systems that transfer lines onto bollards to vacuum technology is a significant shift for port operators. Progression is currently being held back through a lack of product specifications and standards. That is why Trelleborg is championing the development of standards for these more intelligent solutions so that more ports can feel confident about making the change. By doing so, they will be empowered to reduce incidents, lower in-port emissions and offer customers a faster service to stay competitive.

LOOKING AHEAD

The evolution of port operations towards safer, more efficient, and sustainable practices requires a holistic approach that incorporates a complementary patchwork of 'analogue' and digital systems. As we navigate the complexities of integrating smart solutions, such as

automated mooring systems, with established infrastructure like fender systems, it becomes evident that collaboration and rigorous standards are essential drivers of progress.

The journey towards smart ports is not about abrupt change but rather a deliberate integration of analogue and digital tools, ensuring that safety, efficiency, and environmental considerations remain at the forefront of port management strategies. By embracing this blend of technologies and standards, ports can pave the way for a future where operations are not only optimised but also resilient to the challenges of tomorrow.

ABOUT THE AUTHOR:

Richard Hepworth is a Chartered Mechanical Engineer. He graduated from the University of Manchester Institute of Science and Technology in the UK and now holds the position of Business Unit President for Trelleborg's marine and infrastructure operation, based in Dubai. Richard has over 30 years of experience working in the offshore and marine construction industry and has held a number of roles both within Trelleborg and other large engineering companies in this sector, covering engineering, project management, sales, business development and general management.

ABOUT THE COMPANY:

Trelleborg Marine & Infrastructure is a leading provider of premium, smarter, engineered polymer and technology solutions; advancing operational efficiency, safety and sustainability in critical marine, port and built infrastructure applications.

They manufacture and install bespoke fender systems, docking and mooring equipment, navigation and piloting solutions, oil and gas transfer technology and vessel efficiency technology for marine environments all over the world.