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GREENTECH FOR PORTS AND TERMINALS 2024

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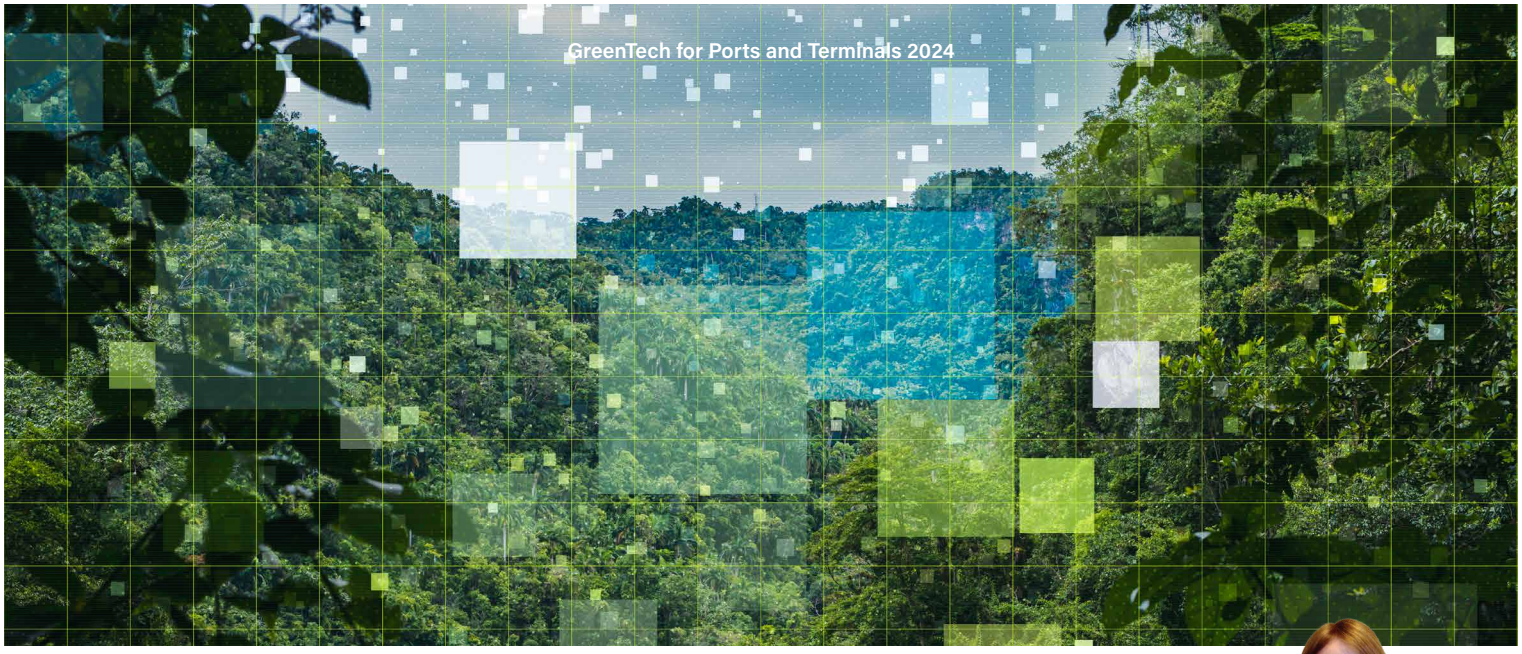

FROM THE EDITOR

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!

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AUTONOMOUS VEHICLES: THE WAY FORWARD FOR AUTOMATION?

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:

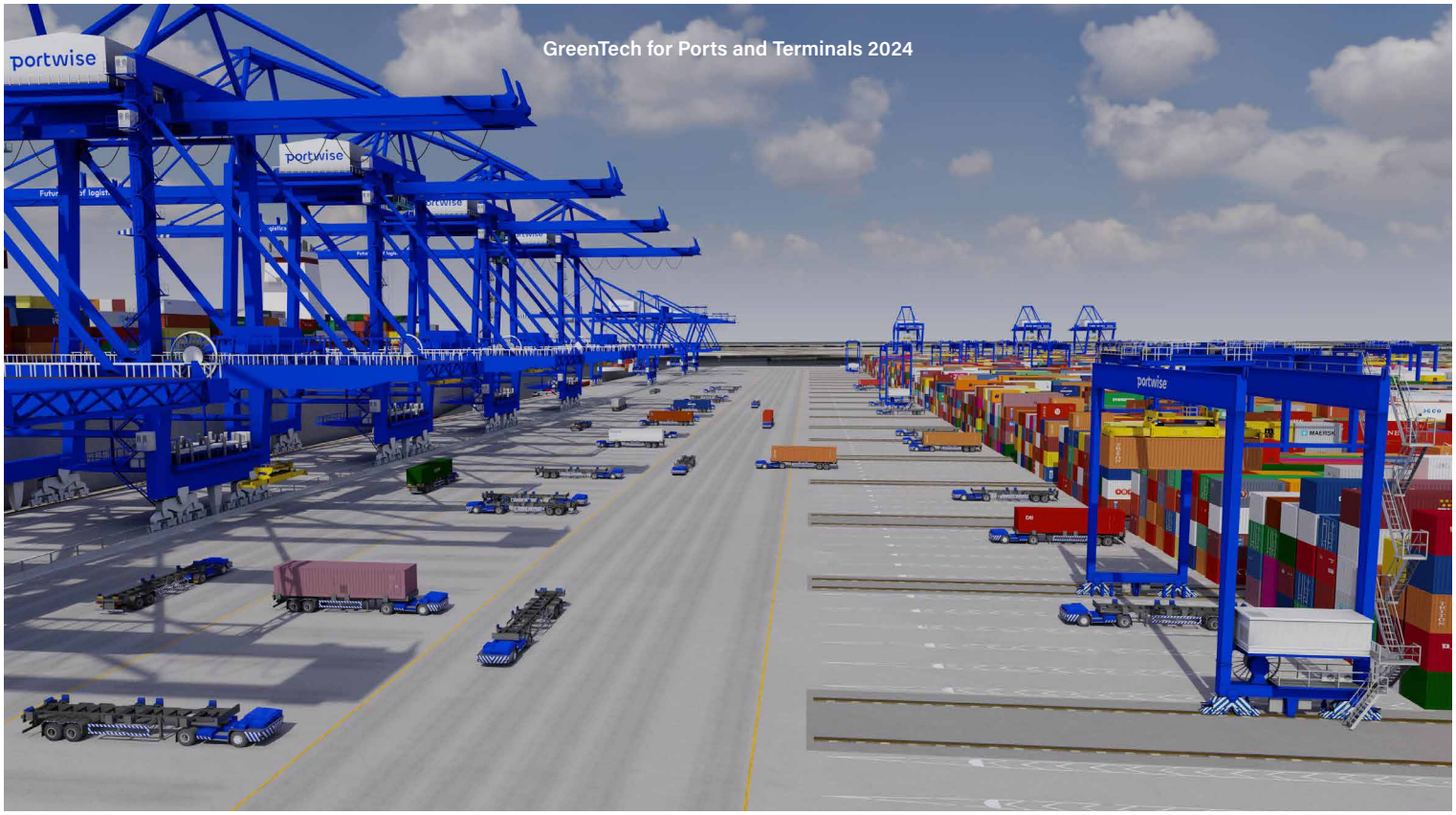
- Capability for various daily operational container terminal use cases
- Business case viability of a fleet of vehicles

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 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.

FIG 1.
Autonomous terminal trucks in a non-mixed traffic operation environment (concept example illustration)

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

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)

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

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.

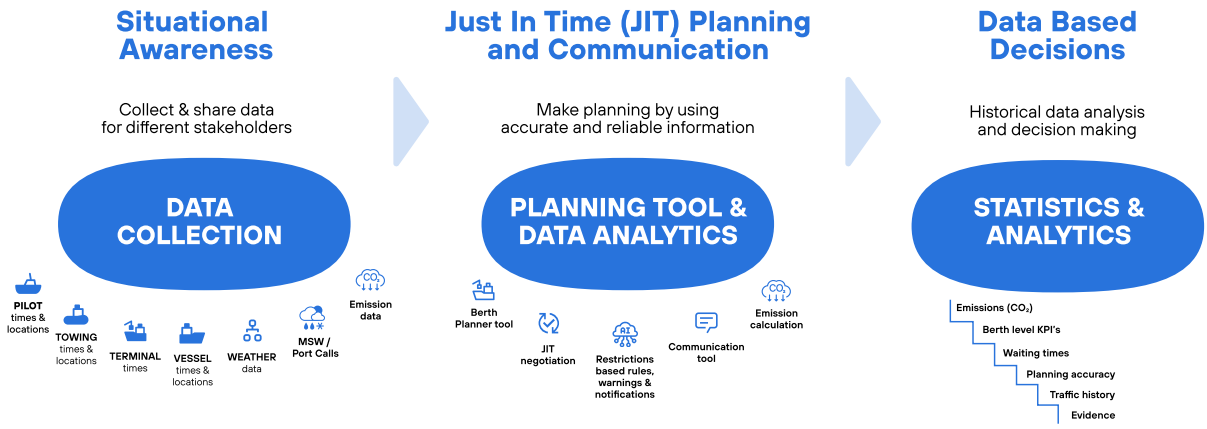
This article describes the three main modules of the solution: (1) Situational Awareness, (2) Just-in-Time Planning and Communication and (3) Statistics and Analytics. Finally, a new way is presented how the port call-related waiting time, turnaround times and emissions can be significantly reduced.

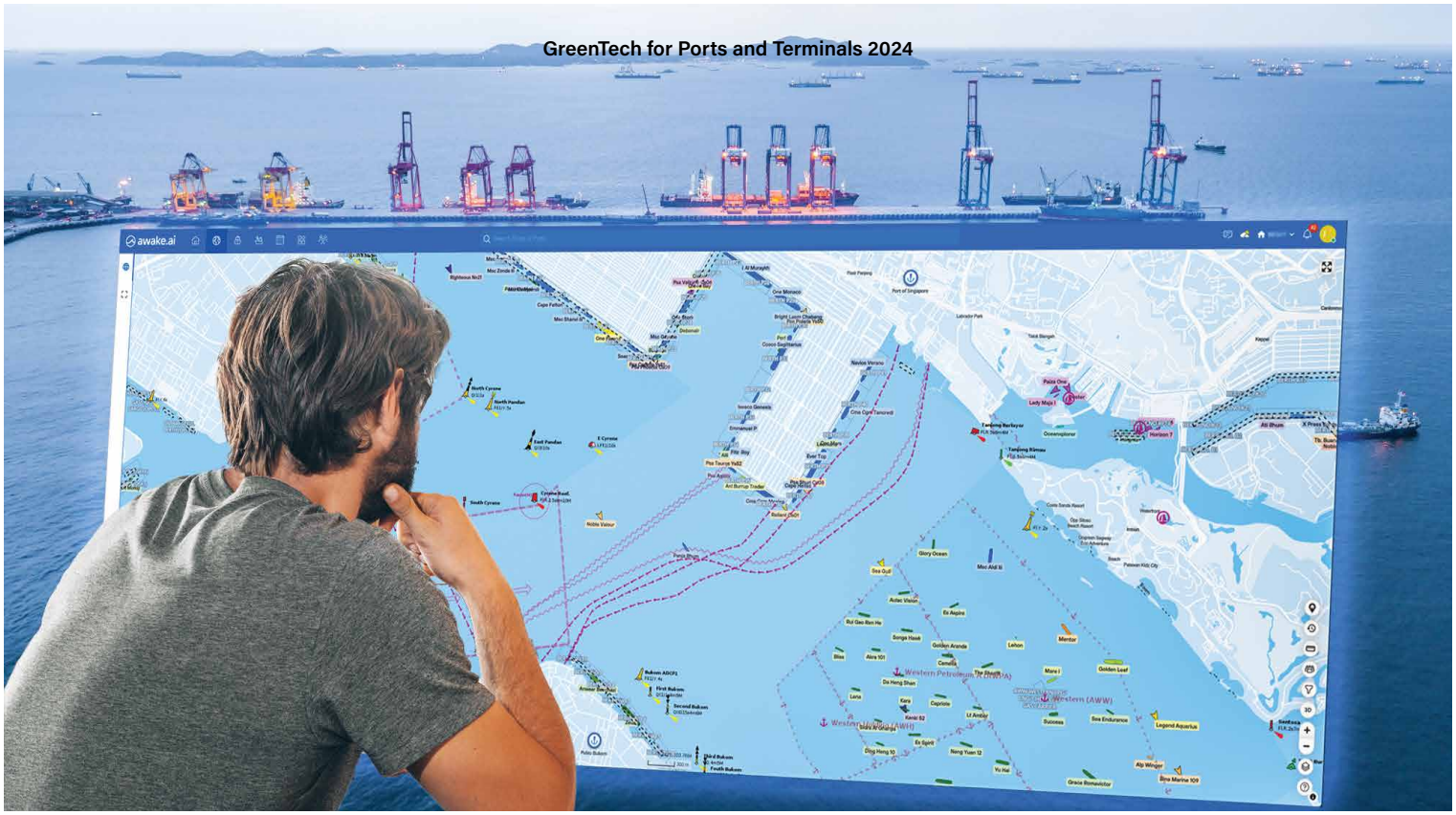
BELOW
Digital Port Call Platform and three main modules.

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.



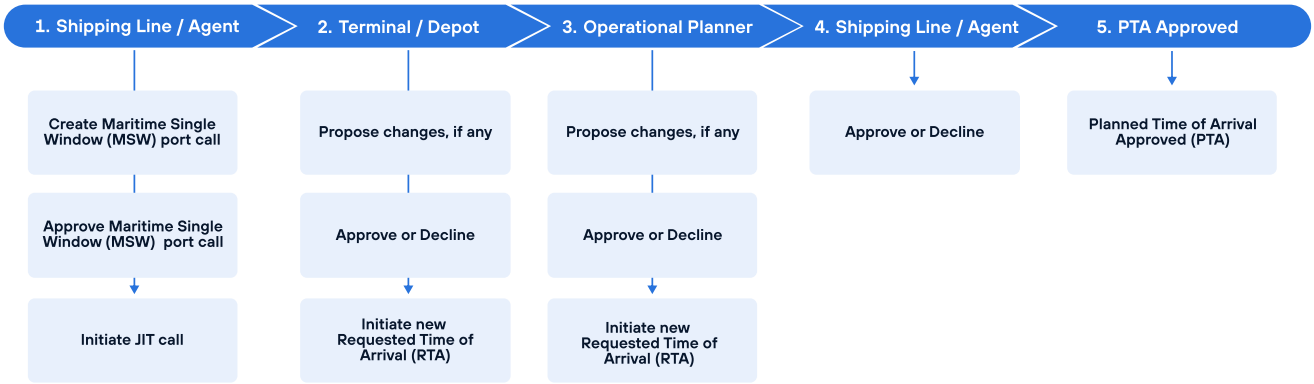


JUST-IN-TIME PLANNING AND COMMUNICATIONS

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, 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

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

BELOW
Just-in-Time process



"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

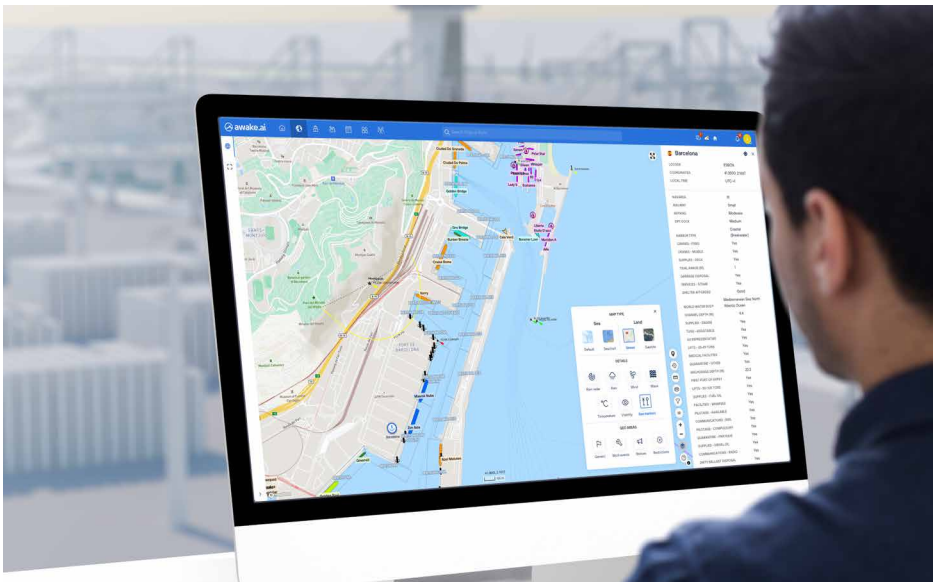
STATISTICS AND ANALYTICS SUPPORTING DATA-BASED DECISIONS

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 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.



ABOVE
Continuous reporting on port KPIs, emissions and port calls

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 Tenovuo 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."