FUTURE PORTS AND PILOTING IN PANAMA

by

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INTRODUCTION

With so much talk about automation and data, and how they will impact ports, terminals and vessels in the future, this paper will be of particular interest to attendees as it takes a more practical, sober look at the technologies that are available now, how they can be used in practice and how they might evolve going forward. It calls on real life case studies and examples to highlight how the future is already arriving, and could offer huge efficiencies and savings for ports and vessels alike.

Shipping and ports are ripe for disruption, as big data, artificial intelligence and automation force a drastic change in the business models of today.

The shipping industry value chain will be driven toward 'hyper-collaboration'.

'The future won't be about doing one thing the best, it'll be about connecting to everybody else, who's doing adjacent things the best.'

The benefits of landside automation of port operations, must be extended to the shipside: with a need to improve safety, efficiency and sustainability of operations from vessel approach, to when it is moored.

This paper will discuss how ports and vessels will be shaped by data and smart technologies, through current case studies, while highlighting new technical innovations the company is evolving to support data-driven best practices.

Some of the pratical problems ports have handle every day are:

- that 45% of all container vessels are delayed by more than 8 hours

- High maintenance costs

- Larger vessels / deeper drafted

- Berth space

- Expansion problems

- Increasing environmental focus

In this paper we will highlight how we have a very pratical approach to solve these problems in a scalable and sustainable way.

VISION

The 'Port of the Future' or SmartPort vision sees vessels, ports and hinterland transport becoming part of a connected eco-system. This will require collaboration throughout the supply chain, which necessitates a common platform for communication and data sharing, with shared standards and processes.

As our industry faces globalization of operators, increasing scale and utilization of vessels, and expectation of ever-improving efficiencies, shipping and port operators must work smarter, together to address and deliver against these expectations.

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SmartPort realizes the now critical interface between ship and port, on land and at sea. Via engineering ingenuity, data capture and management, and technology-driven insight, SmartPort is accelerating performance through optimized operations, improved safety, reduced costs, greater sustainability and increased revenue return.

SmartPort is setting the true course for consistent commercial success, now and for the future.

FROM THE VIEWPOINT OF THE OPERATION

Taking a birds eye view of the complete vessel turn around process allows us to do a segmentation of the operations needed (Figure 1) to do vessel turn around. Allowing us to look in more details on each operation and how to improve, both on efficiency and safety. But even more importantly the bird's eye view allows us to see the interactions between processes and stakeholders in the various operations.

At sea: At sea, smart technology has a key role to play in ensuring shipping efficiency, optimizing fuel efficiency and improving sustainability.

Approach: As the vessel moves from the relatively unrestricted waters of the coastal phase into more restricted and busier waters near and within a bay, river, or harbor, the navigator is confronted with a requirement for more frequent position fixing and manoeuvring the vessel to avoid collision with other traffic and grounding dangers. Pre-berthing coordination is key to a smooth and efficient approach.

At berth: Once a vessel reaches berth, it's critical that personnel on-board the vessel, and on shore are able to communicate quickly, effectively and comprehensively informed by access to common data. A common approach to coordination and communication is required to avoid confusion and delays.

Transfer: When transferring hazardous materials such as oil and gas, safety is absolutely paramount. All parties require the correct data at the optimum time to stay informed and act quickly in an emergency.

Departure: From leaving berth to navigating the channel, it's essential that the vessel completes a controlled, safe and efficient procedure.

This allows us to look at models that will enhance collaboration across operations and systems.

The problem with today's systems is that they take a "systems" approach, not a data driven one. For example, if the need arises for controlling the entry to the port area, an access system will be purchased and put in place. This is a shielded off system that only does what it was made for - controll access. But looking at it from a data driven perspective, the same data (entry and exit of specific people) could be used for time billing / work hour registration and emergency coordination.

It is widely accepted that the way forward is to take a data driven approach to systems.

THE SMARTPORT PORT AND VESSEL INTERFACE OPERATING CYCLE

So, how do we manage that critical interface between vessel and port to best empower both? The SmartPort platform is designed to continuously capture, manage and present data to both quay side and vessel stakeholders, to ensure consistent communication between the two, improve operational decision making, and eliminate inefficiency in the port and vessel interface. But importantly, the platform is also engineered to build these data points into longitudinal strategic insights, to enable process refinement and business improvement.
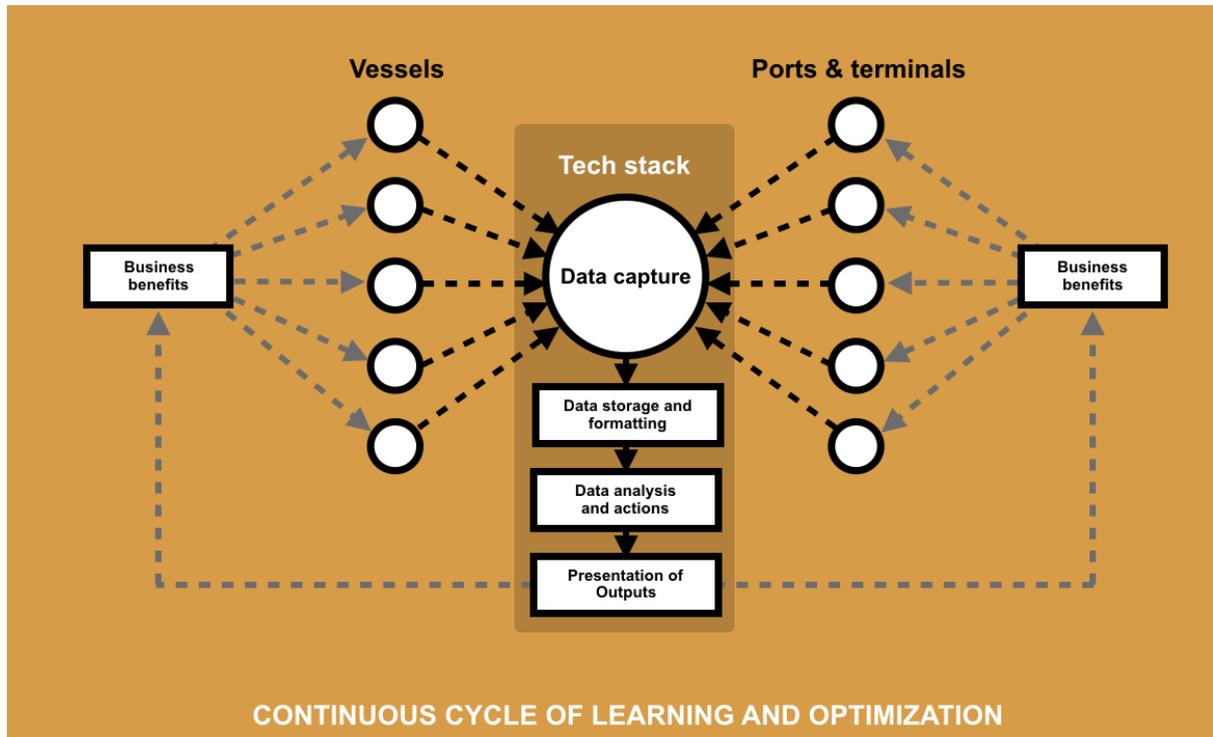
Figure 1: Port and Vessel Interface Operating Cycle

Data capture points, assigned to various assets across both vessels and within the port environment, feed the information they collect into a cloud solution. Data is standardized and analyzed, and useful insights are generated and presented back to the stakeholders that need them.

This presentation of data can be customized, so it is extremely relevant to the person viewing it. All viewed enjoy a clear picture of operations, to help them make quick and effective decisions, whether operational or strategic.

Ultimately, the outputs generated inform board level strategic decision making for the greater benefit of the business.

The ideas implemented, in turn, can be closely monitored and adapted where necessary, fueling this continuous cycle of learning and optimization, constantly improving the overall facility to help meet strategic drivers, and smoothing operations on an ongoing basis.

SmartPort connects port operations, allowing operators to analyze performance and use data to improve decision making (Figure 1). The system integrates Trelleborg, client and third party infrastructure by connecting a network of assets like fenders, mooring equipment, ship performance monitoring, and navigation systems through a network of sensors, across a common platform.

COLLABORATION AND THE TECH STACK

The majority of major ports in the world are looking at transforming the way they do business in order to adopt a 'smarter' approach. This paper looks at the importance of an open system to help the industry achieve a standardized way to collect, store and thereby benefit from data in its myriad forms. To achieve exactly that, the technology platform must be built around an API structure that enables collaboration with third party systems and third party assets, a step towards achieving a common platform for the industry. This openness allows customers to make more effective decisions through deeper, accurate insights across all operations, irrespective of supplier.

To be truly collaborative, technology solutions must have the ability to work across different aspects of the supply chain, whether that's within ports and terminals, on board vessels or as they get into the landside logistics.

By adopting smart technology built around open system architecture, any port or terminal asset can be brought under one cloud based system. This enables the development of custom apps to access asset data, interrogate it and present it across a wider range of users, enabling more effective decision-making through deeper, accurate insights. Multi collaboration is at the heart of these kinds of systems as they use data from many different suppliers of different equipment, to develop informative services that are as useful to the customer as possible. This requires all available data to be formatted, collected and stored in a common way, making it easier to analyze, identify and implement measures that enhance safety, efficiency and productivity.

Fundamental to the SmartPort architecture is the tech stack (Figure 2). The tech stack describes the architecture and operation of the SmartPort platform.

Performance data is captured through sensors and transmitters located on assets in the port and vessel environment. This data is standardized and stored, to enable seamless interrogation when it is accessed. Sector knowledge and engineering expertise inform the analysis of this data to present the most relevant and robust insights and recommendations.
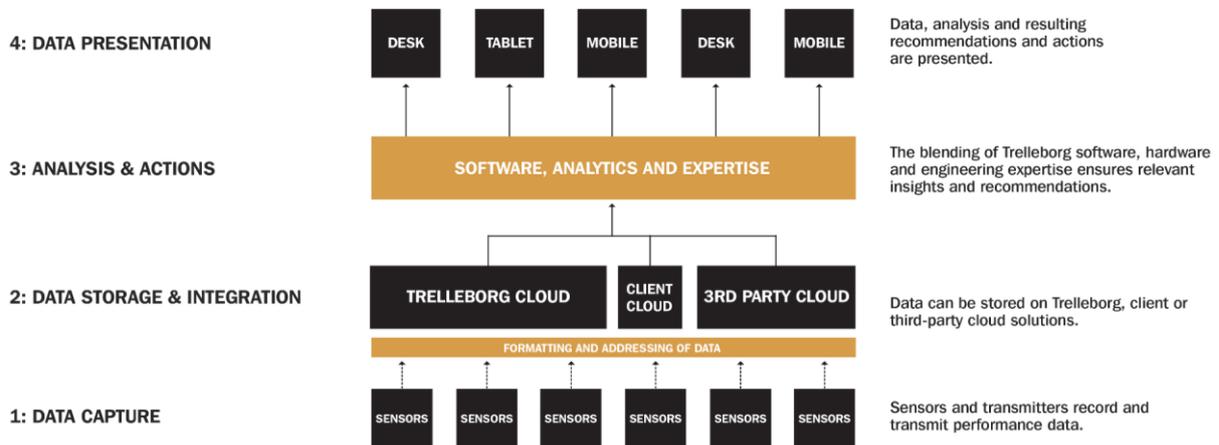

Figure 2: the Tech Stack

Data capture: Sensors and transmitters are attached to vessels and port assets to record and transmit a holistic range of performance data.

Data storage and integration: Data can be stored on any cloud solution, as the solution has been developed to enable standardized formatting and addressing to enable seamless interrogation of data.

Analysis and actions: The blending of software, hardware and engineering expertise ensures the data analysis focuses on the most relevant and robust insights and operational recommendations.

Data presentation: Data, analysis and resulting recommendations and actions are presented in an easy to access format, consistently across device-types: ensuring operational value is easily implemented.

Finally, consistent data is presented in an easy to access format to relevant stakeholders, across a range of device types.

A look at the layers

The core framework consists of three layers. The cloud layer manages intelligent data collection, transfer and storage. The application layer provides access to unique product functionality and data insights from within the cloud.

The cloud layer includes cloud connectors that enable data to be collected from remote devices, installed on specific SmartPort enabled products or assets such as fenders. In addition to data collected through

such devices, an API provides access to an open architecture that enables third party partner or client systems and data to be integrated with a data cloud.

The application layer delivers specific product functionality and business logic, to enable data to be easily accessed and visualized, and real-time decisions to be made. Dedicated Apps ensure easy deployment and provide remote access via connected devices. As the SmartPort enabled product portfolio expands, individual products and data clouds can be integrated to provide a connected view of all port operations: unlocking even greater efficiencies and empowering operational excellence.

The devices layer is the collected sum of all the devises / sensors / systems, i.e.: assets a port has. Each of these assets provides important realtime data to the cloud system. By nature these assets are all very different by different suppliers and providing access to their individual data points can be a challenge.

Therefore a critical point, upon purchase, is to be made about openness of sensors/systems to data interrogation. It is critical that the procurement process insures that new systems can indeed be integrated with third party system.
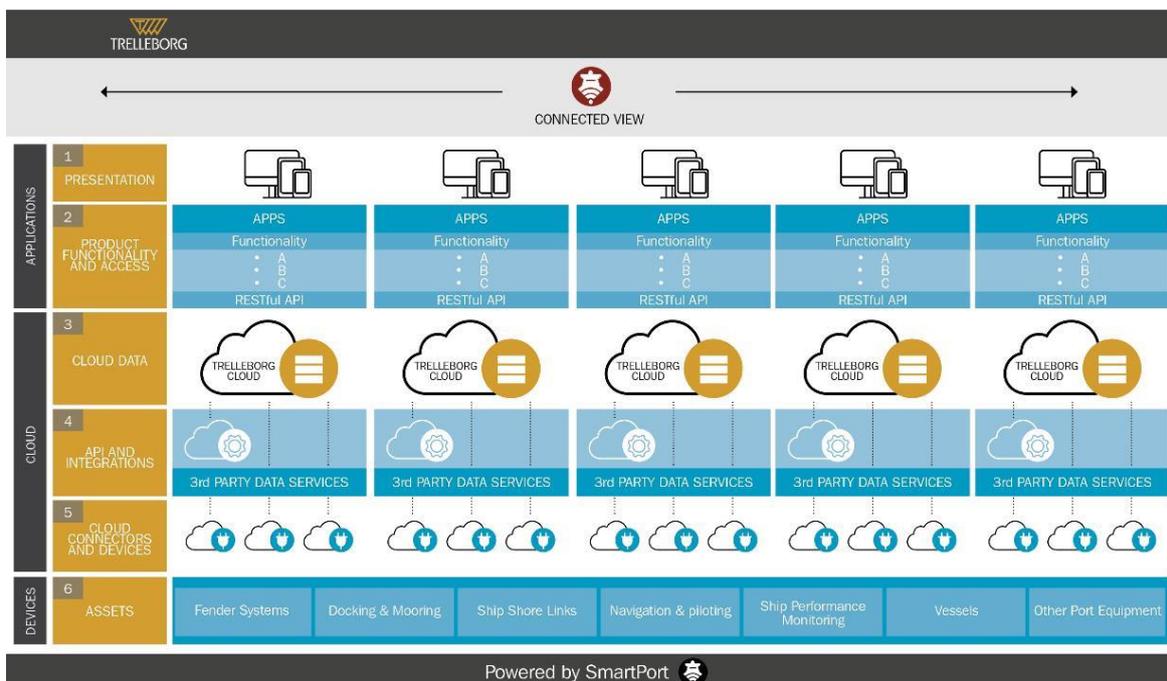

Figure 3: Tech Stack Details

CONCLUSION

So how do we help our customers to navigate their way through the vast sea of data (figure 4) in order to help their business grow?

Figure 4: the Vast Sea of Data

Answer:

- Evolve from product bundling to integrated solutions provider

- Develop consultancy style sales skills

- Support the most progressive customers with their "Port of the Future" challenge

- Act as an integrator when the customer wants it

- The smarter the equipment/product is, the more attractive it gets to the customer

- A wide spectrum of services is a competitive advantage

We are doing this already with help from the core components of the SmartPort sytem, the Tech Stack.

Following are two case stories and a technology systems description that will highlight the value of a data driven approach.

CASE STUDY - SMART NAVIGATION WITH AMP

The technology platform is designed to empower decision making and communication during port approach, docking and deberthing. A key part of this process is the piloting and navigation operation.

The Association of Maryland Pilots (AMP) are utilizing their Portable Pilot Units (PPUs) and a Port System server solution to facilitate consistent, real-time information sharing between almost 70 pilots.

The AMP serves the Chesapeake Bay, the longest pilotage route on the East Coast of the United States, with its nearly 200 miles of waters. The scale of the waters put demands on the operational battery time the piloting equipment requires. Vessels of almost 48 feet draft transit the narrow channels of the bay, which themselves are only 50 feet deep.

The PPU combines a Rate of Turn sensor with a GNSS high-accuracy positioning sensor. It is used in paired units, with one connected to the ship's AIS pilot plug and power adaptor for continuous charging. The other is located on the bridge wing, running on a built-in battery. When the battery is flat, the pilot simply swaps the two units, allowing a continuous operation.

All data is visualized on an iPad overlaying a sea chart. The iPad is continuously in connection with the cloud to exchange vital data.

The technology platform system server solution synchronizes data between pilots. Updates to information are made on shore, and distributed in real time to ensure accurate decision making during the piloting operation. Recordings of all operations are stored for future review and pilot devices backed up in the data cloud, enabling the data storage and sharing that will offer real insight for future operations, a key element required within the Smart Port model.
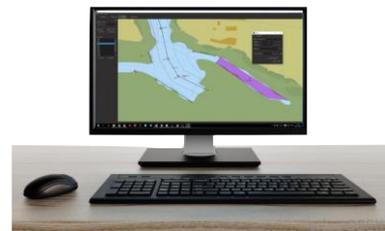
One of the main drivers for the AMP is the real time data exchange. From shore all valuable information is geographical added to the system, automatically uploaded to the cloud and distributed to all clients. That could be essential information like notes to mariners about missing sea marks or weather warnings. Furthermore, the precise navigation of the piloted ships is shared, allowing everyone to see the precise movement of each vessel.

Collaboration with NOAA on the integration of the NOAA ports system, means that realtime weather information is present at anytime on all screens.

The combination of sensors, integration of 3rd party systems, cloud data and intelligent apps for data display gives AMP a unique advantage and added safety when navigating the Chesapeake Bay waterways.

The add on possibilities are endless. By adopting a data driven SmartPort solution, AMP is ready for future demands.
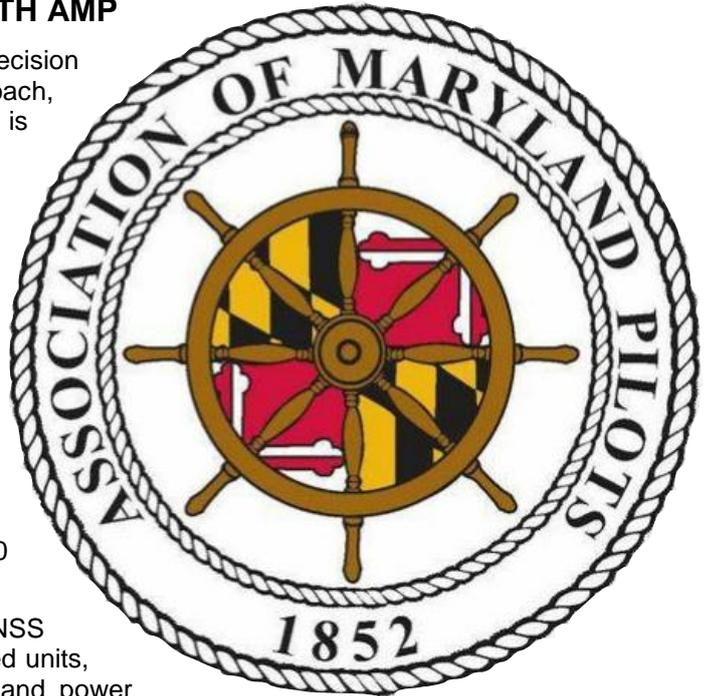
TECHNOLOGY SYSTEM - ADAPTIVE UNDER KEEL CLEARANCE (AUKC)

As ship sizes grow and many waterways become more constrained, the need for precision tools increases. Under Keel Clearance (UKC) systems is one such tool used for describing the amount of water from the ship's keel to the seabed. This is mostly used in the planning phase, to be able to determine the optimum time for passing the constrained waterway, sometimes called the tidal window. The output from the planning phase is a passage plan that describes the voyage waypoint, speed, time, etc.

There is a number of challenges associated with determining UKC.

- Ships motion affects displacement

- Accuracy of seabed survey

- Prediction of weather / tide / sea state

- Realtime conditions might changed from the prediction
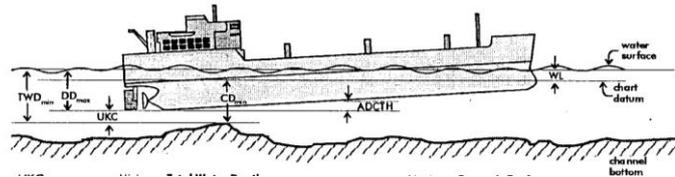
**Adaptive Under Keel Clearance (AUKC)**

The AUKC system uses third party integrated data to overcome these challenges, by providing a planning tool to develop a Passage Plan that is specific to the vessel and its journey. It will then provide real-time measurement to ensure that the plan is still valid throughout the approach, updates when conditions change and alert if there is a risk that the AUKC will be too small further down the route.

The AUKC system will potentially enable ships to carry more cargo, save on dredging cost and increase safety.

There are three phases of AUKC: Plan, Monitor and Analyze. Each has an important role to play in supporting real-time collaboration and decision making, and optimization.

The Adaptive Under Keel Clearance system will:

- Provide a planning tool to develop a Passage Plan for the specific vessels visit/journey

- Provide realtime measurements to asses if the plan holds.

- Provide realtime updates on No go areas when conditions changes.

- Alert if there is a risk that UKC will be too small further down the route.

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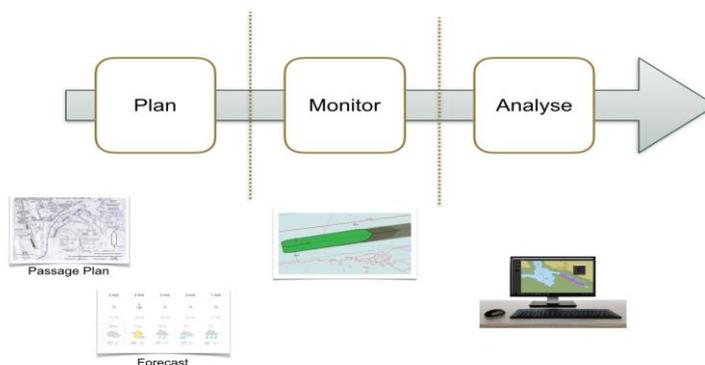
Planning

There are many different planning / prediction tools available, some ports use these today. But most don't. There is great value in doing passage planning and prediction of tidal windows. But of cause the benefit varies from location to location. But going from a paper plan to a digital one is a big step forward, and allows for integration of weather forecast and ship model calculation to better predict the tidal

Paper plan   Digital plan
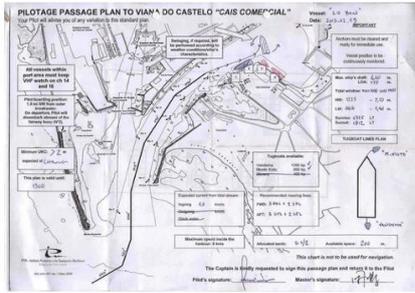
Passage plan done on paper by the pilot
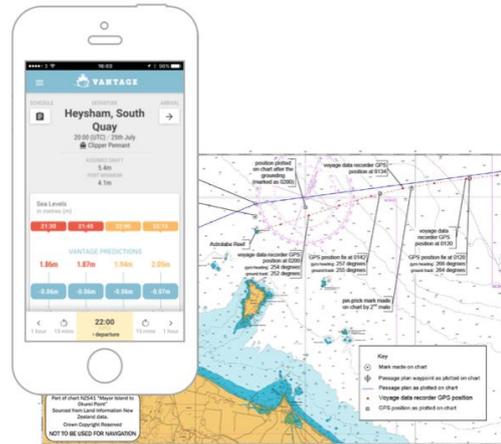
window.

Monitoring

On the vessel the pilot uses his precise navigation tool. To accurately monitor his exact location, and equally important, measure the ship's motion. By utilizing precise survey of the seabed synchronized from the cloud whenever there is new data, a very accurate under keel clearance can be calculated along the route.

As the ship moves through the water, a number of hydrodynamic effect occur. These are captured using realtime accelerometers, gyros and RTK GPS. All embedded in a carry along package (PPU) the size of a loaf of bread.
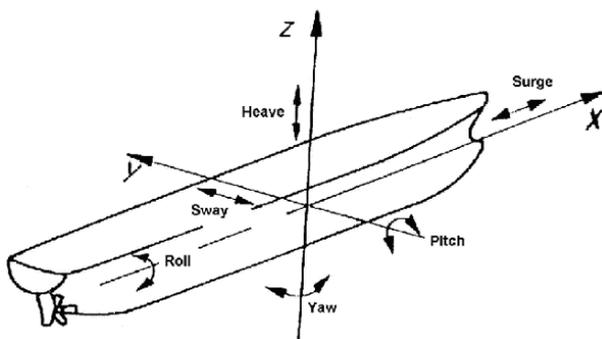
Ship Motion and PPU System

The data is then compared in realtime, by sending measurement data back to the cloud to see if the prediction from the passage plan still is within the safe tidal window. If not the pilot will be warned.
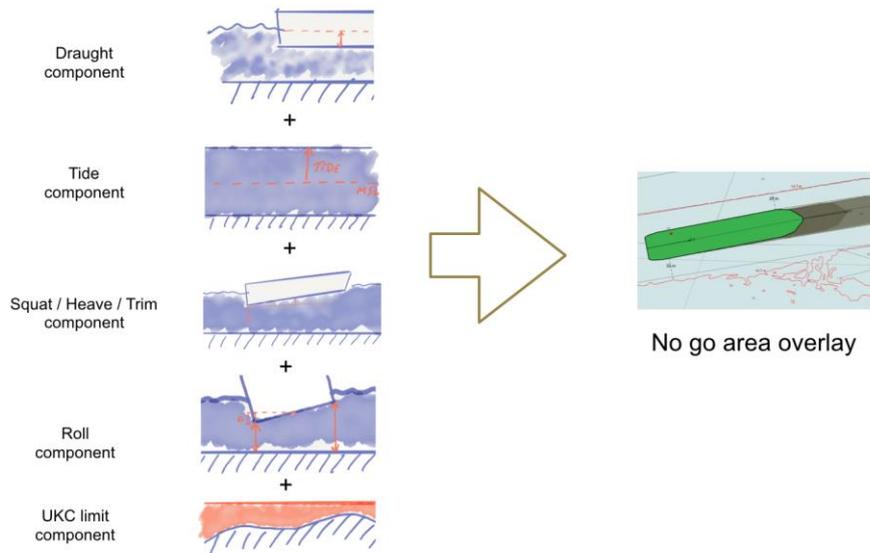
The cloud system then reassesses and provides an updated prediction. Consisting of no-go areas marked on the sea chart.
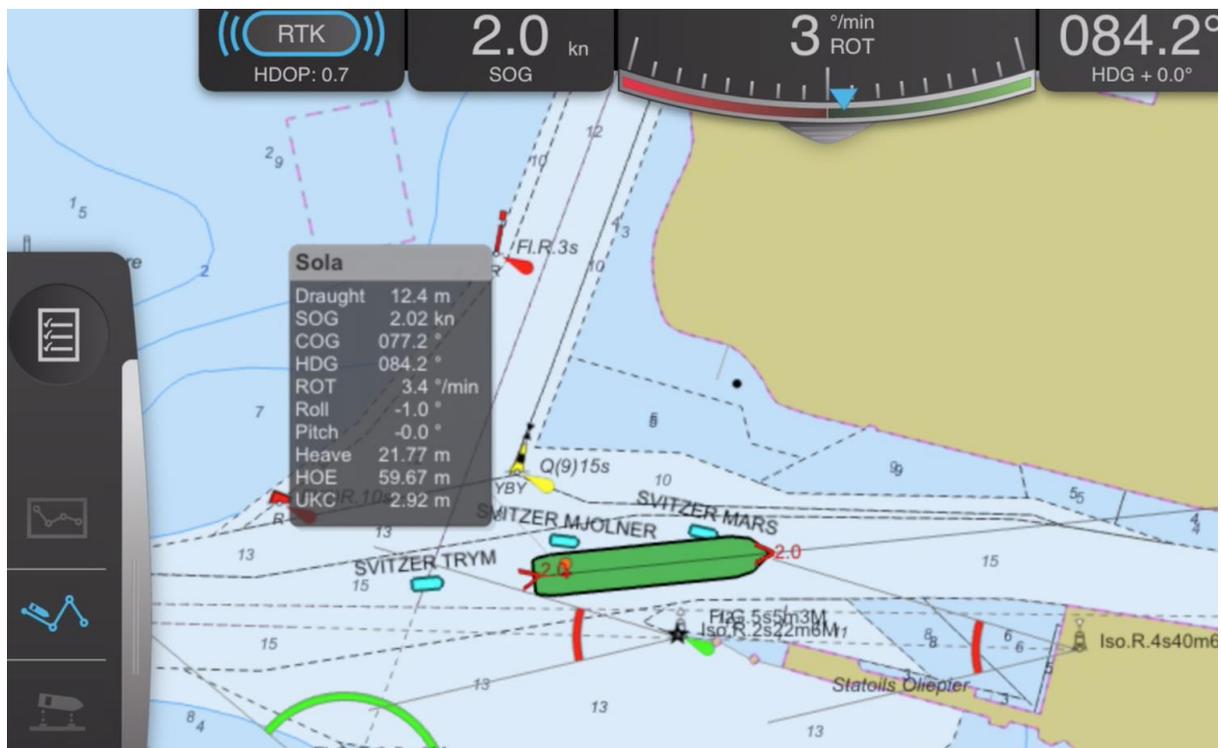
Analysis

All the data measured by the sensors are sent back to the cloud and can be used for analysis. Several different usages are possible, among others:

- Identifying areas of need for dredging

- Feedback into passage plan for future voyages

- Increasing allowed draft

- Increasing port throughput

The Adaptive Under Keel Clearance (AUKC) will allow for a predicted and realtime adaptive under keel clearance, and indication of NO-GO areas.
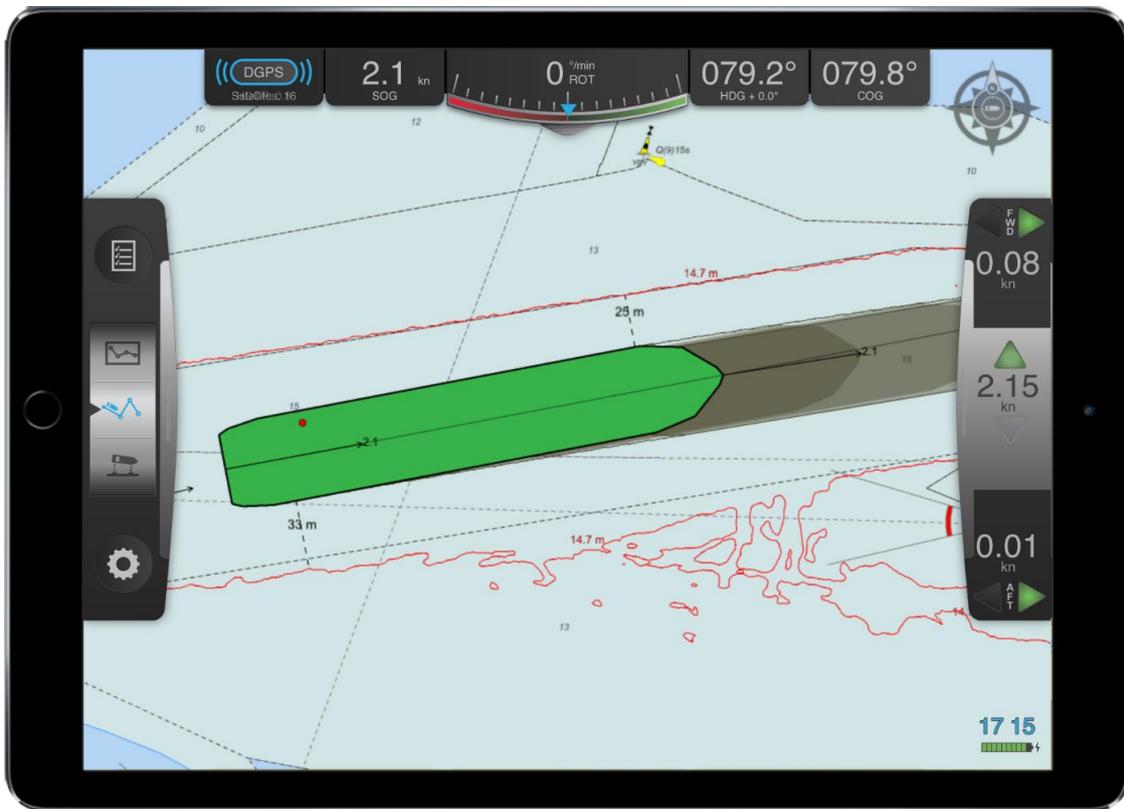
CASE STUDY - PANAMA CANAL

Trelleborg has supplied the ACP - The Panama Canal Authority and the Panama Canal Pilots with state of the art navigational and piloting systems for the new canal expansion.
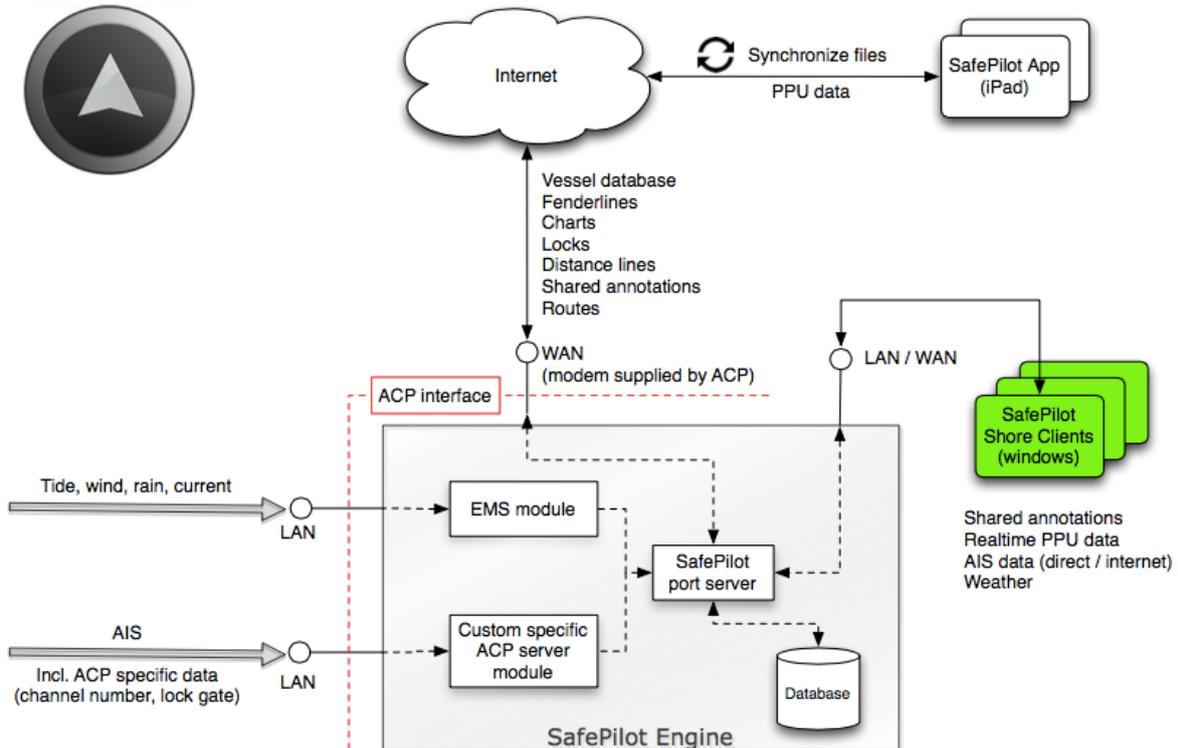
A specific ACP module was developed. This module replaces the name of ships with schedule numbers, and color coding for different types of ships.

Integration with ACP systems are managed by the Cloud system, specifically the SafePilot Engine. The Engine binds together pilots and port administration during operation with all information and data needed for efficient piloting and port management. It allows personnel, data, schedules and subsystems to be linked together.

The SmartPort Engine is the brain of the SafePilot system, synchronizing data between pilot, port and subsystems. It is a complex server set-up that gathers, structures, stores and communicates data in real-time.

Recordings of all operations can be stored and pilot devices backed up in the Engine.

The system consist cm accuracy RTK GPS portable Pilots Units (SafePilot Cat III) for the new locks and sub-meter accuracy SafePilot Cat ROT/1 system for the old locks.

For both the new and the old locks, the pilots are using SafePilot app for data monitoring and precise navigation.

Further weather sensors, AIS repeater stations and admin data are all updated to the cloud on a realtime basis. Even sensors on the lock gates allow the pilots to monitor the open/closed state on the gates directly on the Safepilot app.

A built-in alarm system allows a pilot to set his ship in an alert state to notify his colleagues on the water that his ship is in trouble. This alert will show up on all screens both on the water and on shore, quickly identifying and marking the troubled ship.

The pilots also utilize the advance built-in meeting point calculations function. This allows the the pilots to quickly access when and where they will meet an oncoming ship in the canal, allowing them to adjust speed accordingly. They can get a recommend speed for meeting the oncoming ship in a select location, allowing for safe passage.

Future of pilotage in the Panama Canal

There are a lot of potential benefits of building on top of the existing system. Fortunately, ACP have chosen a data driven approach that gives them the advantage of easily adapting new innovations. These innovations could be third party systems, but Trelleborg also has a range of Smart products that could enable an even smarter system in Panama. To mention a few:

SafePilot: already being used as a navigational tool, it also offers an overview of planned as well as ongoing port and piloting operations by intelligently integrating relevant schedules.

AutoMoor: a rope-free, automated mooring system. Created for efficiency and safety, it uses vacuum technology to rapidly attach to and secure a vessel at berth. The need for mooring lines is eliminated, and safety is greatly improved.
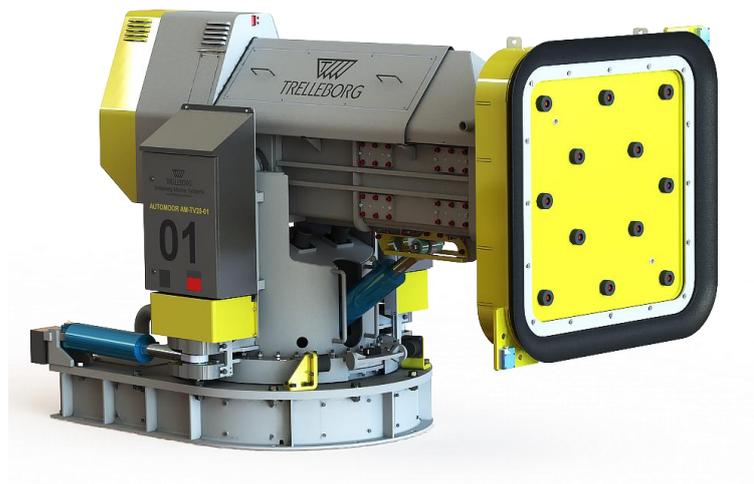
Pneumatic fender monitoring: sensors fitted to fenders to monitor pressure, temperature and position. Data is shared through the cloud


SafeTug: tugs carry a SafePilot system. This allows both Pilot and Master to see the position of each tug as they are working with on the Pilot's system, increasing situational awareness and safety. The Pilot will also be able to see the tug's realtime power reserves.

Ship-Shore Link Service App: collates all service history data for SSL shore and terminal systems, including spares purchasing, to allow proactive interaction for service contracts. Tracking of equipment and purchasing behavior will also allow product and training issues to be identified.

Smart bollards: Bollards don't provide line monitoring, berths are exposed to overload conditions or slack lines which can result in;

- Mooring line failure.
- Injury from line recoil in the event of a mooring failure.
- Successive mooring line failure from transfer of forces to adjoining lines.
- Vessel damage
- Significant down time and demurrage fees.
- Slack lines lead to uncontrolled vessel drift off.
- The ability to provide real time monitoring and alarm conditions is fundamental to safe mooring.
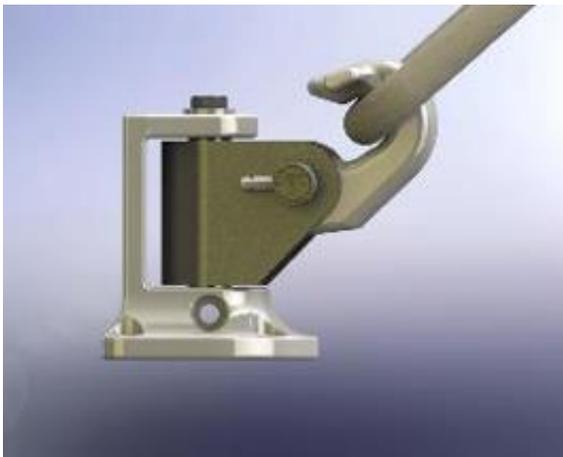
With the Smart Bollard system all this information is shared and available to the reliever personnel.