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Innovate Your Business Model by Using the True Power of Big Data Analytics

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SYNOPSIS

The maritime industry is relatively advanced when it comes to technological progress. Automation is well-established, and vessels, platforms, ports and terminals are filled with sensors. However, the industry still lags behind in accepting new forms of digital technology. We have all the opportunities we need to truly analyse how to use Big Data intelligently, and apply it to tug, towage, salvage and OSV business models and supply chains. This paper presents case studies on how to use Big Data to optimise terminal towage operations.

INTRODUCTION

The current use of AI, machine learning, deep learning, edge analytics, and other expanding technologies is building momentum and establishing its indispensability in several industries. Innovative, disruptive business models are propelling the way forward as the Internet of Things is creating endless connections to enable the flow of information. This information is what we have come to identify as Big Data.

According to NewVantage Partners: "Organisations now have ready access to meaningful volumes and sources of data which are providing AI solutions with data to detect patterns and understand behaviours."[1] As much as this applies to non-maritime industries, however, the same cannot be said for the maritime industry. The OSV and towage sectors are more than familiar with Big Data, though, and operators are becoming increasingly aware of how it can benefit their business. Advanced analytics enabling energy efficiency, condition monitoring and optimisation of systems, machinery and operations are undeniably setting a course towards a more cost-effective supply chain.

Although an enormous amount of data is generated, and the industry is already using equipment that is becoming more connected, smarter and autonomous, the volume of data to be processed is an obstacle in itself. In addition, as the variety of data interfaces, protocols and formats increases, a multi-faceted hurdle emerges for collecting and accessing large volumes of data and making it meaningful. Limited bandwidth makes this worse. Ironically, the elusiveness of Big Data lies in our most important sources of data: offshore assets, the 'edge devices' of the maritime world (devices that process and store critical data at the edge of the network).

Giant online marketplaces such as Amazon and Alibaba understood early how to profit from technology by integrating a highly sophisticated delivery system. Imagine the implications on the maritime supply chain in, for example, the offshore supply industry and harbour operations. Soren Skou, chief executive of Maersk, has stated that his company must become more integrated to compete against Amazon. The Danish maritime leader aims to become the 'DHL of the sea', incorporating door-to-door delivery on a global scale.[2] His statement was made in relation to its container division but the same could be said about the world of offshore supply. Vessels are now being chartered for logistic support and transportation of goods, tools, equipment and personnel to and from offshore assets.

THE CURRENT STATE OF ADOPTION

The maritime industry is no stranger to technological progress. The Port of Rotterdam is a good example of early adoption. Its new Big Data platform uses advanced sensor technology to collect data from several sources, enabling the port authorities to receive analytics on the height of tide, the tidal stream, salinity, wind speed, wind direction and visibility data. Ronald Paul, the port authority's chief operating officer, says: "The cloud platform and the generated real-time information, which includes infrastructure, water and weather condition data, enable us to further improve mission-critical processes in the service to our clients."[3] This is an important point, as not only does this empower maritime operators in making better and informed decisions, but it makes the relationship between players in the supply chain more transparent.

The new platform sources its information from the port's assets. This is where the process becomes difficult. The most challenging connection in the maritime world is the one to its most critical resource: offshore assets. Automatic identification systems (AIS) have done a tremendous job in providing primary data on vessels, such as their unique identification, position and course. Data analysts have used this source of data in the maritime industry for their reporting, optimisation and planning purposes. Until now, though, more detailed datasets, working at scale, have not been available.

The lack of connectivity in the maritime world is partially rooted in the very nature of the maritime industry. For centuries, people at sea have been conditioned to be independent, and vessels have been conceived to operate autonomously. As a result, whereas onshore industries are currently riding what is referred to as the 'second wave' of Big Data, the maritime industry is still surfing the first: putting in place the right technologies to create and access volumes of data with speed and flexibility.

THE CHALLENGES OF BIG DATA IN THE MARITIME INDUSTRY

Expensive and often disparate connectivity, diverse infrastructures, systems and machines, both on land and on assets at sea, the physical hurdle of reaching a remote asset, the impracticability of an asset being non-operational, the shortage of trained personnel to maintain any of it – these are all issues that must be addressed before we can change course towards data-driven operations.

Gartner describes Big Data as: "…high-volume, -velocity and -variety information assets that demand cost-effective, innovative forms of information processing for enhanced insight and decision making." [4] In this context, 'volume' applies to the amount of data being collected, 'velocity' refers to the speed of data processing, and 'variety' pertains to the number of sources and different data types. These so-called 'three Vs' relate to the maritime industry in specific ways.

Volume: Vessels generate an enormous amount of data, drawn from machines, systems, sensors and the crew. They produce this data continuously, and with high sample rates. Transferring these datasets is not a concern in itself, but due to limited bandwidth available and the high costs that come with vessel connectivity, optimal solutions must encompass technologies for pre-processing this data, such as compression or on-demand transfer.

Variety: the variety of sources and types of data infrastructures, even inadequate network infrastructures, make it very challenging to correctly handle the reading, translation, storage, transfer and processing of machine data offshore and onshore. Interfaces such as NMEA data, Modbus, CANbus, serial, TCP/IP, etc, all need to be dealt with.

Device data can be a combination of sensor values, with different sample rates and frequencies that require filtering and configurable retention and transmission. The organisational challenges this variety poses also need to be addressed. Systems integration on board is a laborious and notoriously cumbersome process. The best approach is one in which integration efforts are decoupled as much as is practical, and where the edge device itself incorporates software to make the connection to a wide variety of sources possible.

Velocity: The velocity at which data can be processed and analysed and turned into up-to-date and real-time metrics for measuring performance greatly depends on the technology used, but currently relies on outdated systems that cannot manage heterogenous data.

STARTING SMALL, WORKING FAST

The key to handling Big Data is, ironically, to start small. Big Data presents an environment that rewards rapid iteration, from small systems to more capable ones. Maritime businesses that start small can manoeuvre with more flexibility, experiment with more efficient operations, and learn faster.

The key is not just about starting small, but also about starting selectively. This addresses a major issue that current non-maritime industry leaders face: slow progress towards a data-driven culture. If the maritime industry can approach this change more intelligently, with short iteration rounds and with flexibility in connecting data sources, we have the opportunity to fast-forward this phase.

The solution lies in adopting a cost-effective platform that is data- and source-agnostic: an infrastructure integrating edge devices together with data processing and forms of AI for faster and better decision making. This platform should empower each enterprise and third-party organisation equally to develop applications that can perform advanced analytics and push forward business intelligence in the maritime environment.

One looming issue that repeatedly comes up in conversations regarding data is about the ownership of the data itself. Suppliers already providing connectivity to the industry commonly claim ownership of data automatically. The maritime industry's independent nature, however, perceives this as a very sensitive issue. It has therefore becomes a hindrance for maritime players engaging in new forms of connectivity. No business wants to give up its data. In our view, none should have to. As a result, the connectivity platform should be as open as possible.

To be clear, an agile and open platform is not necessarily an invitation to share data with competitors. It is, rather, an assurance that the data, and the choice to share it, remains in the hands of the original owners. The nature of the platform, the flexibility with which organisations can develop applications and use data from all kinds of edge devices, pushes innovation and collaboration forward without creating vulnerabilities in data ownership. The following two case studies illustrate these principles.

SHIP FUEL PROFILE OF TUGBOAT (DEMO-SHIP-1)

Activity name	Engine	Profile L/h	Profile L/NM
Transit (berth to job)	On	120	10
Towing	On	255	
Pinning	On	140	
Waiting time	On	100	
Transit (job to berth)	On	120	
Transit (job to job)	On	120	10
Standby (engine off)	On		
Rest	Off		
Barge transit	Off	130	
Barge standby	On		
Locks passage	Off	90	
Person transfer	On	100	
Maintenance	On		
Testing	Off	140	
Crew issue	On		
Transit (to other location)	Off	130	11

Figure 1: Using set-points to analyse activity

OPTIMISING TOWING OPERATIONS

Kotug Seabulk Maritime (KSM) was the first operator to work with Onboard's Big Data platform. Its fleet of four vessels in the Bahamas use an energy efficiency application, and connect to their own dedicated cloud solution running the Onboard platform's operating system. Managing fuel consumption is a challenge on tugs, as they are engaged in several activities of a variable nature. The goal was to use the data platform to generate a specific fuel consumption indicator for each different activity, and to find ways to manage and reduce it.

The first challenge was to be able to handle the variety of fuel consumption measurement solutions found onboard vessels – whether the data comes directly from the engines, motor panels, flow meters, or other automation systems, independent of make and model. Fuel consumption data alone does not have much meaning. In order to give it meaning, we needed to add a context, for which we developed a plugin to collect navigational data, and an application for the crew on the bridge to easily record the tug's activities, together with other feedback.

To realise the above requirements, the traditional solution is a Purdue five-layer industrial automation architecture, used with software running and configuration on all five levels, and multiple databases, buffering and communication interfaces. This multilevel architecture, standard in the maritime industry, is inflexible, complex and costly. By contrast, the Onboard platform integrates all five levels to create a much more responsive system architecture. The result is a radical increase in flexibility and decrease in costs for development, hardware and maintenance. The system is installed on board, enabling agile software development, and consequently being able to remotely and continuously deploy, configure and update the complete system. Instead of two or three hardware components, the system requires only one (or not even that, when running on a virtual machine). The platform directly interfaces with the sensors, provides analysis, and runs the application for the crew who can access the application with every existing bridge display.

The energy efficiency application developed provides full insight into the operation of the fleet. Based on different profiles, 'set points' can be configured for each vessel. For every activity the application pinpoints as being an activity with high fuel consumption, an easy filter is created for the fleet manager to work with *(see Figure 1)*. These set points are also automatically shared with the crew, so they know what their performance targets are. They also receive real-time feedback on their own fuel efficiency, and that of their entire shift.

The first use of the energy efficiency application showed big differences in performance between different captains, and different tugs. Our analysis of the data returned pointed in the direction of a specific type of activity called 'pinning'. Pinning is the action of pushing the vessel to the jetty until the vessel's mooring lines are attached. Koos Smoor, manager fleet performance and innovation at Kotug International, said that before using the energy efficiency application, they did not have any detailed insight into this activity.

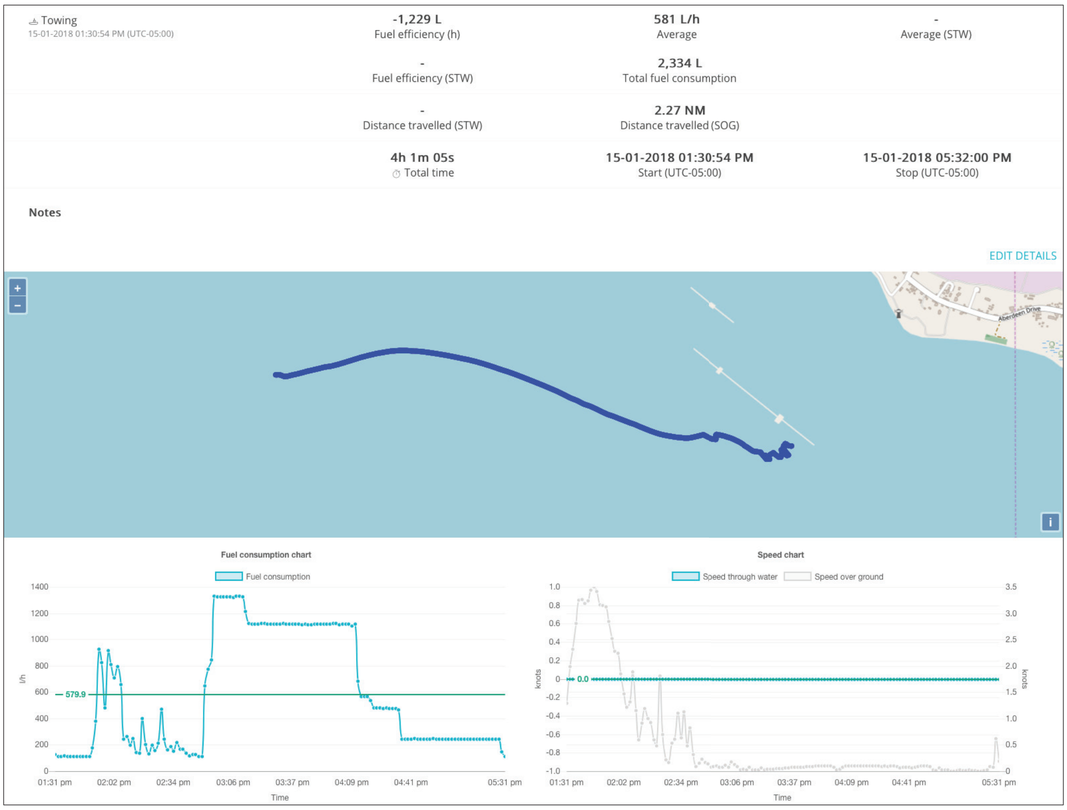

Figure 2: Plotting vessel approaches

Once the activity was added to the system, though, the measured results showed that in the month of December alone, the fleet of four vessels executed 50 pinning activities with a total duration of 48 hours and a total fuel consumption of 13,700ltrs. Based on these results, captains received targeted training, and KSM also decided to add a lines boat to the fleet.

Efficient terminal operation is a joint effort. Besides the crew and the lines man, the pilot plays an important role, planning the manoeuvring and stop of the vessel. The application also provides insight into the performance of the pilots, detailing the approach at berth: the angle, the speed of the vessel, and the use of the tugs. *Figure 2* illustrates how the combination of position data and vessel activities provides the tools to improve this activity. In this case illustrated, the approach of the vessel to the jetty was not at the correct angle and the manoeuvre in the end took four hours. Using automatically generated data makes spotting such practices much easier and more routine.

Tugs not reaching their profiles on this system also provide a clear indicator of technical problems, such as faulty autopilot settings or degrading performance of the engines, hull or propeller. The crew also benefits from this automatic reporting, as there's no additional administration for them. Smoor reports that the KSM vessels now employ paperless bridges. Overall fuel savings over the 18 months of use for the system are 147,842ltrs for four vessels, a fuel saving of more than 12 per cent of a total fuel consumption of 1,053,610ltrs.

ITERATION

In another case study of the use of Big Data, Netherlands-based Multraship equipped four of their vessels – two of which are Carrousel RAVE Tugs (CRTs), ***Multratug 32*** and ***Multratug 33*** – with the data platform and energy efficiency application. The two CRTs are new and unique. Novatug, a partner belonging to the Muller Maritime Group, of which Multraship is part, developed and launched the revolutionary design, in which efficiency optimisation was one of the main drivers. These new tugs have more control over the ships they assist and provide more safety for the crew. CRTs can use their own hull to create lift for braking and steering, as a result using less energy and fuel. The Carrousel mechanism uses part of the assisted ship's energy to manoeuvre, as a result using less energy and fuel.

In addition to these existing optimisation characteristics, Onboard was invited to support Novatug in benchmarking the new tugs' towing performance. Flexibility in deploying software updates, and flexibility in handling the variety of data sources, enabled us to collect extra data and deploy the new towing performance feature without going onboard to install. Additional data regarding the winch pull force and power produced by the engines used to generate the pulling force was therefore easy to add.

Towing performance shows the actual performance of the new design. This key performance indicator is shared real-time with the captain, and sent to shore for benchmarking and training purposes. This makes it a valuable tool to validate the new design and to share with the industry how it can improve overall shipping and logistics industry performance. *Figure 3* illustrates the vessel's unique capability to generate a substantial pulling force without much engine power. In this specific operation, the vessel's average towing performance was 40.3kW/ton, and during the high peak from 1813hrs until 1826hrs, the engine was just idling.

Figure 3: Data from CRTs used for training purposes

CONCLUSION

The Kotug and Multraship case studies illustrate the principle discussed in the previous sections: Start small with Big Data, analyse, iterate and grow fast. Looking ahead, in the very near future, the harbour and terminal towage industry will also be riding the second wave of Big Data, having ready access to meaningful volumes and sources of data which are providing AI solutions with data to optimise integrated terminal towage operation and tug design. With its history having been written in the planet's toughest and most tempestuous environments, the maritime industry is nothing if not adaptable. Big Data is a surging riptide to embrace, and doing so with agility, by starting small and acting fast, is certainly the course towards blue skies.

REFERENCES

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