BIG DATA IN THE DIGITAL AGE – THE IMPACT ON SHIPS AND PORTS

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Our digital universe contains some 2.8 trillion gigabytes (GB) of data. It is estimated that 90% of the data in the world today was created in the last two years alone and is expected to grow to some 40 trillion GB by 2020. This data comes from everywhere: sensors used to gather communication data, transport data, climate data, black box data, social media data, search engine data, stock exchange data, transport data, power grid data, digital pictures and videos, online shopping records, and cell phone GPS signals to name but a few. In 2012, the MIT Sloan Management Review reported that Google alone processes about 24 petabytes (or 24,000 terabytes) of data every day. By 2025, the Internet of Things (IoE) will exceed 100 billion connected devices, each with multiple sensors collecting data. This will lead to a trillion-sensor economy driving a data revolution beyond our imagination. Cisco's recent report estimates the IoE will generate USD 19 trillion of newly created value.

Big Data and advanced analytics have become a top-of-mind issue for business leaders around the world for one simple reason: It will likely determine who the market leaders are, and provide their businesses with a competitive advantage. The level of interest is very considerable in many industries - but the shipping industry is still grappling with the whole concept, and no wonder. Supporting big

data analytics is digitisation. Digitalisation allows decision makers far removed from one another, to make live decisions as to how to operate an asset. In the case of a ship owner, that could be a chief on board a vessel in the Atlantic interacting with a ship management team in Singapore, entirely free from the burden of downloading information, but instead having the same high quality dash board-sorted business decision tools available at the click of a mouse.

A few months ago I was at Singapore's newly opened PSA Pasir Panjang Terminal (PPT) Phases 3 and 4 to witness the terminal's operations from its automated crane operations centre (ACOC). I was amazed at how few people were involved in operating the terminal – a part of the world's busiest transhipment hub. They explained that vessel bay plans for the containers are loaded into its computer system prior to the ship's arrival. After the ship berths, mega quay cranes handle the discharge of containers onto prime movers which transport the containers to their system-assigned yard locations, where a fully-automated electric yard crane system handles the stacking of containers, leaving the staff to manage any exceptions from the control centre. At once, I thought to myself, this is great simplification using technology. But I can only appreciate the "behind the scenes" work, where massive amounts of data has been collected from various parties (the shippers, the agents, etc..). These data, sometimes bearing similar information and many times not, through the magic of modern algorithmic computer programming, are then massaged to provide a stream of useful information, bits that eventually find its way into the respective end terminals and shows up on the screens of different users, be it the ship planner, or the crane operator, or even the truck operations executive who assigns and

oversees prime-movers to pick up the cargo. I was seeing Big Data being exploited to optimise the work process for port efficiency.

I am confident that such technologies will help to raise port productivity, enhance PSA's ability to manage greater business complexity and create higher level, skill-based career opportunities. Singapore is not alone in this. In 2015, the EU set aside USD 10.5 million in funding a new project named 'EfficienSea2' aimed at using big data to increase safety and efficiency in shipping. The project is a collaboration by a consortium of 32 partners from 12 countries including the Danish Maritime Authority and several shipping and maritime companies, who will, over the next three years, map the scope of the potential related to the massive amounts of data found on ships, in offices and in the ports. The project also represents an important part in the development of a Maritime Cloud which will help strengthen the exchange of knowledge throughout the global shipping industry, such as e-navigation and monitoring of ships' emissions of greenhouse gases which will allow shipping companies and authorities' access to check for compliance with strict EU regulations.

Big Data is clearly much more than a buzz word. The business benefit of utilising Big Data is widely known - a study by MIT (Massachusetts Institute of Technology) found that data-driven organisations performs 5% to 6% better each year. The potential opportunities of this new technology will transform traditional business models. As President of the SSA which represents some 470 shipping companies and allied shipping businesses, I work closely with ship owners, operators, managers and agents and other ancillary parties such as brokers, classification societies, port operators, marine insurers, lawyers and bankers amongst others. I visualise an interconnectivity of such a management system that

naturally integrates our port terminals and pilotage services that promotes increased efficiency, productivity and maximisation of resources that could benefit across our entire maritime industry! Vessels queuing at the anchorage for a pilot or waiting for a berth would be a thing of the past. Exchange of documents required to clear a vessel, its crew and cargo could be done with minimal manual intervention by the crew - and well in advance of arrival. I could imagine and see a time, where the noon reports from a ship, will offer insights for the shore-based office to plan for bunkering services, pre-order the right spare parts for equipment maintenance, preschedule a technician for service and so on.. And as the vessel is still 2 days away from port destination, ship systems will start to stream various information electronically to alert officials for cargo inspections, and at the same time, kickstart a whole series of event alerts for tugs/pilotage, truckers, port agents, custom clearance permits, bank drafts, etc… so that by the time the ship comes into port, all the jigsaw pieces have already been shaped to get the vessel in and out in as little time as possible.

There are, in fact, already commercial companies with global shipment management solutions that use big data for greater visibility and benchmarking for the vessels they manage. Taking the example of a large container vessel, it has some 2,000 sensors onboard and may daily download as much as 2 GB of information that it shares with its owner or manager ashore. Using data from its Automatic Identification System (AIS), these analytical tools monitor the vessel's speed, fuel consumption, location at port and at sea, routes and exceptional events to deliver performance reports on carrier reliability, carrier alliance performance,

and comparisons of the same routes across a variety of carriers. I will be citing this as a case study later in this presentation.

Further, I can visualise the live streaming of data between sea and shore as the norm in the future. Using algorithms, routine and predictable tasks would be handled by machines, whereby human intervention will be required only when there are exceptions. These "smart ships" will be able to "talk" through the use of nanotechnology in paints, coatings and materials while ultra-sensitive monitoring through the use of acoustic fibers will allow the detection of minute changes in vibrations. A day may come when "smart ships" will use voyage data and data from structures, components and machinery to enhance its own performance. Shipping must learn and adapt. Our task is to come together to implement practical solutions that both seafarers and COO/CEOs can unite around in their quest to make their companies smarter and hence more profitable, greener and compliant and thereby create a safer and more attractive industry in which the youth of tomorrow would want to be employed,

Big Data Zoomed Digital Picture of well-known Personality/Celebrity

A Case Study: Tapping the Potential of AIS Big Data

A case in point is the way DNV GL has utilised and integrated AIS Big Data to paint a macro picture. The big data approach links AIS data (for instance positions of vessels) with business models, port information and schedules of vessels. Combining various data sources with business intelligence software creates new data insight. This helps determine for example the cause of vessel delays, or ports with optimal anchorage times. The approach can be used for a

variety of applications supporting ship operators and ports alike. Data mining has become a powerful differentiator outside of shipping, where understanding customers and competitors better might be the difference between loss and profit. For the shipping sector, DNV GL believes that AIS (Automatic Identification System) data mining may become a fundamental game changer going forward.

The origins of AIS data go back about 10 years. For reasons of navigational safety, ships were equipped with transponders so that other ships and coastal traffic control could see them on their monitoring systems. Initially, only land-based antennas picked up the signals, but over time satellites have been installed with AIS receivers making global AIS monitoring possible today. AIS data include the MMSI (Maritime Mobile Service Identity) and IMO number, ship name, position, speed, draft and main dimensions. AIS data are commercially available by various providers, who offer also AIS-data derived information of different quality.

At present, some 100,000 ships with IMO (International Maritime Organization) numbers and more than 300,000 other ships are equipped with transponders. AIS signals are received with intervals between every few seconds to up to a few hours (in remote areas of the oceans). Storing and processing this big data requires significant hardware and software resources.

There are many potential applications for AIS data mining, e.g.:

- Ship owners can see the position of their fleets in real-time. Vessels can be tracked for route and speed over ground. Vessels can be monitored for next port of call with estimated arrival time.
- Navigational safety and security have been increased by monitoring unexpected and unwanted ship movements.
- Snapshot overviews of vessels in ports or in certain regional areas can be provided for cargo owners looking for available ships or status information on chartered ships.
- Cargo flows can be visualized by vessels calling in certain export ports and subsequent import ports.

This is only the tip of the iceberg of what can be done with AIS data. These examples basically only require AIS data, an electronic map and a set of GPS (Global Positioning System) coordinates to identify key areas (ports, quays, emission control areas, etc.). An even more interesting insight can be gained from combining AIS data with other data, e.g. data on fuel consumption, emissions, weather and sea state, granular geospatial objects, or ship schedules. AIS based insight can support maritime business at operational, tactical or strategic level. AIS positions and corresponding speed can be combined with knowhow on fuel consumption to create accurate proxies on (daily) fuel consumption for a whole range of vessels. When further combined with its ECO Insight tool, this allows verification of noon report data with data obtained through AIS monitoring. Further, benchmarking of average fuel consumption against similar vessels of other owners on similar routes can be extracted.

These are examples of business intelligence being put to use as market information, which is accessible and helps companies to make faster and smarter decisions. This applies to different stakeholders in the maritime industry, ship operators and owners, port operators and authorities, insurance companies, commodity traders, maritime service providers, etc. In order to generate the business intelligence, a merger of data sources to extract new and relevant insights is required. With billions of data records per year and terabytes of data, this demands powerful data warehousing and processing capabilities, and this is where the maritime industry needs to make decisions to facilitate as broad use of the data extracted as possible. While cross industry participation no doubt is preferable, we must acknowledge that this is complex, and therefore that individual commercial solutions are far more likely to set the tone for successful ventures into digitalisation in its early years. Examples of AIS data intelligence include:

Port selection. An oil major has congestion problems in certain ports. The supply chain manager of the oil major believes that the vessel turnaround time is the problem and that in other ports in the same region faster turnaround is available. In order to reduce charter hire and avoid supply chain bottlenecks he is keen to identify how to reduce the berth turnaround time of the vessels. The AIS analysis could give average turnaround times for crude and product tankers in neighbouring ports for vessels of similar size as benchmark values.

Berth selection. A container carrier contemplates a schedule change and needs berthing availability of various terminals in ports within a region. Acquiring berthing availability can be a lengthy process mainly caused by delays in

communications between container carrier and terminal operator. A snapshot overview of which terminals are underutilized on which day of the week can be made available. Being able to see arrival and departure times of vessels by terminal for recent weeks/months allow a relatively accurate picture of the utilisation of each terminal. Such observations are only the starting point for more detailed discussions with a terminal operator, but are a good example of the insight digitalisation, and in this case use of AIS data can provide.

Japanese Adopts Big Data

It was reported on 2 March 2016 that a collaboration between two big names in shipping. MOL is working in partnership with ClassNK (Nippon Kaiji Kyokai) to pioneer a ship data centre. The aim is to create an environment which uses marine broadband services to enable both the collection of big data from its fleet and the sharing of information between vessels and shore in real time.

By using the centre's integrated data, the user will be able to maximise the benefits of big data at minimum cost. A wide variety of information, including data from ships' voyage data recorders and data loggers, will be obtained from the company's fleet of vessels. The data centre is scheduled to begin full operations next month. The ambition is to create and develop a comprehensive vessel operation support network based on big data analysis to improve operational safety, reduce the impact of its ships on the environment, increase cost-efficiencies in vessel operations, enhance ship management and promote high quality training and education for seafarers. Going forward, the system will also help to optimise ship operations and improve condition-based monitoring of machinery. The digital data technology could play a useful role in helping the

industry overcome current and emerging challenges and the system was cited to be able to assist in monitoring the European Union's Monitoring, Reporting and Verification (MRV) regulations which requires ship owners and operators to annually monitor, report and verify fuel consumption for vessels of 5,000-plus gross tonnage that call at any port within the European Union.

It appears to me that we have only just begun to scratch the surface in harnessing the capabilities of data analytics. The future brings untold opportunities of what more we can do for our maritime industry and is only limited by our imagination. I am sure this audience will have many ideas and suggestions but I hope you will agree with me that technology is not the limiting factor. A key element to success is to not get carried away with what technology can do for us in shipping, but work in a determined manner towards an adoption of digitalized decision making tools that human operators take satisfaction in working with. After all, the unmanned ship, while perhaps technically possible, will only sail in a distant future.

Importantly, that vision of an unmanned vessel can only be realized on a backbone of a highly digitized and massive data managed system that is reliable, and widely adopted by all stakeholders. An unmanned ship does not sail alone. It can only sail because, the owners have invested in the technology that drives it, the agents, ancillary services, and port terminals and operators have adopted systems that support it, and the port regulators embraced it.

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