

Use of big data in the maritime industry



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Foreword

Big data has the potential to transform our industry. Through application and insights, big data is creating new opportunities to drive innovation and deliver tangible operational efficiencies across the shipping world. But information alone is not enough. It is the analysis of this data and the actionable insights it provides that will move our industry forward and determine our future.

This is a time of huge change for our industry. The advancement of automation, and the exponential rise in data it brings, mean disruption on a scale that 'shipping' has never seen before.

So much so, in fact, that Frank Coles, CEO of Transas, has talked about distinguishing between the 'shipping' and 'maritime' sectors. Maritime meaning ships and ship operations. Shipping meaning the end to end transfer of cargo, whether by sea, rail or air.

Shipping is doing brilliantly at taking advantage of new technology. Maritime, not so much. Retailers are already disrupting shipping by taking greater control over logistics: they are moving from last mile delivery to first mile – and the first mile is supposed to be the remit of maritime.

Trelleborg's marine systems operation has commissioned this independent study into the use of big data to help the maritime industry understand the opportunities it can offer, both now and in the longer term.

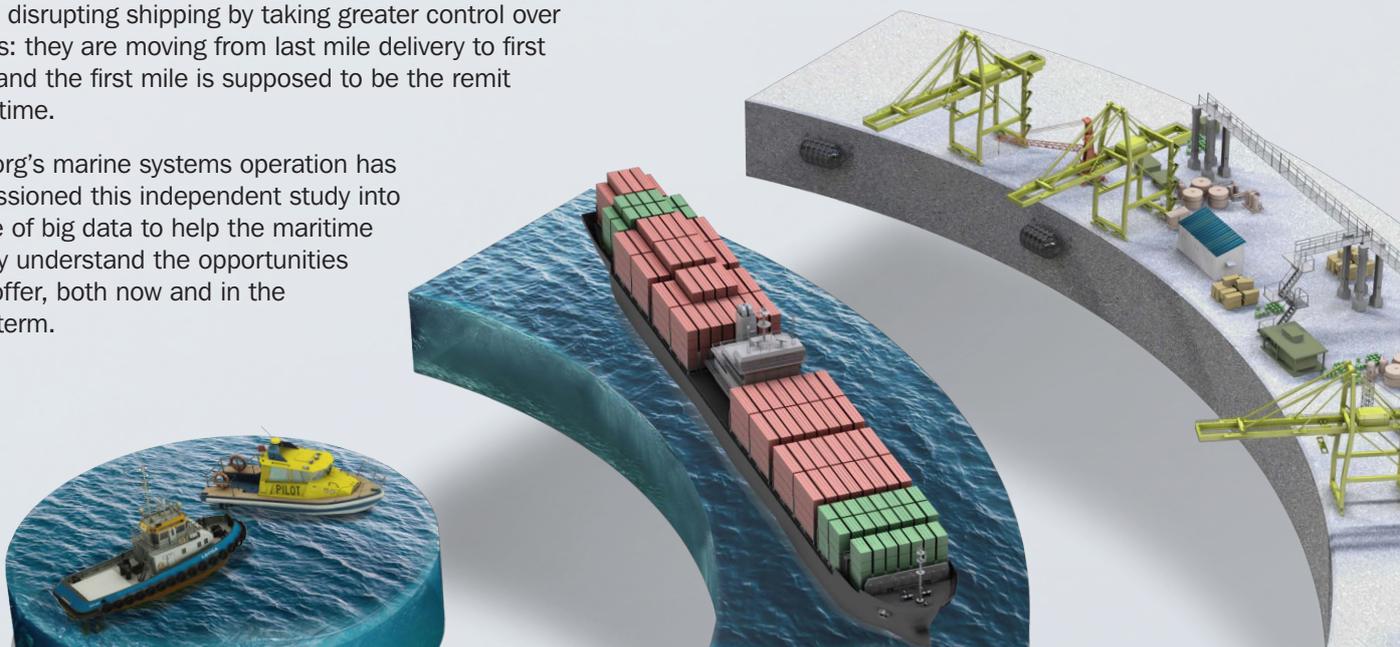
This objective research brings together all the latest news and thinking to provide a comprehensive overview of big data in the marine sector. It includes a look at how and where these technologies are being implemented and the key application areas that will deliver future operational efficiencies for ports and terminals. The study also explores some of the key barriers to change, such as investment and skills, and how to overcome these challenges.

Overall what does emerge from this benchmarking study is that while many shipping and logistics players recognize the importance of transformative technology, the maritime industry lags behind other sectors of the global economy when it comes to adopting it.

In the context of shipping, the economic outlook remains tough, so finding new ways to optimize performance and remain competitive is a priority. Big data needs to be part of the solution.

Richard Hepworth

President, Trelleborg's marine systems operation



About Port Technology International

Port Technology International (PTI), The Journal of Ports and Terminals and an online news hub covers the port and terminal industry in unrivalled detail.

The journal features exclusive technical papers from academics, port executives and industry specialists which seek to create discussion and disseminate solutions for the most pressing and pertinent problems in ports around the globe. The online news hub features a wide-range of content; breaking news, interviews, analysis and multimedia content.

THE PTI INSIGHT

What is big data? There's a tinge of the unfathomable about it in the present age. Perhaps it's because data these days is so vast in quantity, or the algorithms with which we use to analyze it are so seemingly complex. But this ostensible complexity is why I like the introductory sentence to the overview in this report:

“Big data is the name given to the large volume of data – both structured and unstructured – that is generated in our personal and professional lives.”



There is nothing complicated about that explanation. It articulates exactly what we're dealing with – data. It is in the analysis of such data where things get a little more complex, yet figuring out that complexity sits with the specialists, for the rest of us in the industry, we can benefit from the findings.

Big data offers great capabilities in optimizing operations to chime with ship calls, renewing port assets and ensuring optimum cyber-security. However, the buzzword of recent years has been collaboration, and big data provides a platform in which solution providers, ports and agents along the supply chain can sing from the same hymn sheet.

The application of big data offers huge potential in our industry, and it's great to see the case studies within these pages outlining the achieved benefits already.

The team at PTI are very proud to be supporting Trelleborg in this report.

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Section 1:

Big data in the
maritime industry today

Overview

Big data is the name given to the large volume of data – both structured and unstructured – that is generated in our personal and professional lives. It can be defined by its variety, and the velocity and volume with which it is generated. The analysis of this big data is extremely useful as it allows businesses to uncover hidden patterns, unknown correlations, ambiguities, market trends and other useful information.

SLOWER ADOPTION IN THE MARITIME INDUSTRY

Even though big data has significantly benefitted industries such as finance, media, telecom and healthcare, its uptake by the maritime industry has been slow. According to a report by Ericsson, the maritime industry lags behind other transport

industries in terms of its use of information and communications technology. Only a handful of marine companies currently leverage big data.

There are several benefits that the industry can derive through the use of big data. The industry generates roughly 100-120 million data points every day, from different sources such as ports and vessel movements.

Companies can analyze these data points to identify efficiencies such as quicker routes or preferred ports. Ultimately resulting in an extra 5 to 10% increase in performance.

For example, the implementation of Eniram's big data analytics systems in 12 Royal Caribbean Cruise ships resulted in 4% estimated annual savings: USD12m annually.

“Usually a big majority of the shipping industry adopts new technology after it's been tried and tested elsewhere. So it's not a matter of not wanting to change, but we are late to adjust in comparison to other markets, which has delayed the advancements in technology.”

Constantine Komodromos

CEO of VesselBot

“Big data remains untapped in the shipping industry, therefore there are huge opportunities for innovation, usage, driving optimal performance and leveraging assets better.”

Anwar Siddiqui

Advisor to the CEO of Bahri

Source: arishipping.com / knect365.com / marinelink.com / knect365.com / worldmaritimeneews.com

Key statistics and leading opinions

INDUSTRY LEADERS ARE RECOGNIZING THE BENEFITS OFFERED BY BIG DATA

- In a Bain & Co. survey of more than 400 executives from companies with revenues of more than USD1bn, companies that leverage analytics are twice as likely to be in the top quartile of financial performance within their industries and five times more likely to make faster decisions
- According to Dr Argyris Stasinakis, a partner at MarineTraffic, big data was a recurring theme at several global maritime-related events in 2016, on the back of concerted efforts towards achieving efficiency by shipping industry players
- In another survey of maritime leaders, conducted by Sea Asia in 2016, 94% of leaders believe that it is time for the industry to move towards smart shipping. New technological developments are considered crucial in helping industry players transform the way their businesses operate sustainably.

81%

of respondents recognize the importance of big data in the future of the shipping and maritime industry*

“By embracing analytics and turning data into actionable insights, shipping and logistics players have an opportunity to drive improved efficiency and quality. In the long run, this will help transform their organizations into smarter, more dynamic entities that have a more informed picture of market trends and demands, and are better prepared to meet the challenges of tomorrow.”

Ibrahim Al Omar
CEO of Bahri

* According to a 2016 survey by Sea Asia

Source: arishipping.com / knect365.com / marinelink.com / knect365.com / worldmaritimeneews.com

Current and potential application areas

The following table provides a snapshot of application areas for big data in the maritime industry:

ROLE	FUNCTION	EXAMPLE OF BIG DATA APPLICATION
Ship Operator	Operator	<ul style="list-style-type: none"> ■ Energy saving operation ■ Safe operation ■ Schedule management
	Fleet planning	<ul style="list-style-type: none"> ■ Fleet allocation ■ Service planning ■ Chartering
Ship owner	Technical management	<ul style="list-style-type: none"> ■ Safe operation ■ Condition monitoring and maintenance ■ Environmental regulation compliance ■ Hull and propeller cleaning ■ Retrofit and modification
	New building	<ul style="list-style-type: none"> ■ Design optimization

Source: sapient.com / mlit.go.jp

Current applications in maritime

The following are some key application areas for big data in the maritime industry:

AREA	DESCRIPTION
Chartering	<p>A key function of charterers is to find the right ship for cargo at the most economical price. The task is highly dependent on information provided to them by known brokers and ship owners. However, as this information is limited, it may or may not be most efficient.</p> <p>Big data analytics can provide charters with readily available, accurate and actionable information to improve decision-making. Charters can integrate Automatic Identification System (AIS) information, position reports, estimated times of arrival, vessel particulars (such as size) and market information into an exchange portal to find all available alternatives as well as the freight forecast. This can give charterers and ship owners access to more options thus improving transparency and competitiveness.</p> <p>Bahri, the national shipping company of Saudi Arabia, has developed various data models in its new data platform, BahriData, to cover various key business areas such as chartering, voyage management, fleet operations, maintenance and customer services.</p>
Operations	<p>Speed: Ships, like automobiles, have optimum speeds, and various tests are conducted at the time of vessel delivery to determine the optimum speed for fuel consumption. However, operating a vessel at its optimum speed is difficult as it changes over time due to a variety of factors such as engine wear and maintenance. Big data analytics can help ship owners determine the optimum speed for fuel consumption, taking into consideration factors such as bunker cost, freight rates and schedules.</p> <p>Maintenance: Decisions regarding vessel maintenance, including hull cleaning and propeller polishing, are taken based on intuition or a schedule rather than on actual vessel performance. Fuel consumption data can also be used for cost-benefit analysis of vessel maintenance. Data analytics can make it easier for operators to decide the timing and the benefits of performing maintenance.</p>

Source: sapient.com / mlit.go.jp

Current applications in maritime

AREA	DESCRIPTION
Voyage operations	<p>Terminal operators, voyage managers or port agents need estimated time of arrival (ETA) and cargo information. Vessels can be tracked using dashboards instead of relying on notes, emails or phone calls. This helps in making more effective decisions about terminal and berth allocation, cargo handling and route tracking.</p> <p>Dashboards can also provide information about any deviations from optimum performance. The ideal route, the weather service-provided route and the actual route can be tracked in real-time. Any changes to speed, ETA and other factors can be tracked and managed in real-time, thus ensuring that the voyage goes as planned and remains profitable.</p> <p>ClassNK-NAPA GREEN offers a real-time big data analysis performance monitoring and optimization solution. The solution passes data collected from both on-board and shore-side sources through advanced and predictive algorithms to deliver information on current operations and on potential operational changes to allow vessels to reduce fuel consumption.</p>
Vetting	<p>Vessel owners and operators try to ensure that their fleets are acceptable for use by charterers. Instead of improving the vessel quality, they focus on meeting or passing the acceptance criteria. The process of vetting includes getting feedback from various entities such as inspectors, terminals and port state authorities, as well as operator self-assessment.</p> <p>Data analytics can help charterers and vetting organizations analyze the different sources of information and select the right vessel with the least amount of risk involved in pollution preparedness, safety management and navigation.</p> <p>In 2013, RightShip, a Melbourne-based vetting agency redeveloped its online ship vetting information system (SVIS) with business analytics software from IBM. The system uses predictive analytics and reporting to give customers access to information such as ship ownership details and inspection records. It also allows customers to perform accurate risk forecasting on nominated vessels.</p>

Source: sapient.com / mlit.go.jp

Applications in ports and terminals

The following are examples of big data technology implementation in ports:

PORT NAME / PORT AUTHORITY	DESCRIPTION	PURPOSE / BENEFIT
Ports in Singapore and Malaysia	In Singapore and Malaysia, ports utilize big data techniques to create advanced inspection systems to assess the history and cargo type of importers.	The purpose is to segregate importers that most require inspection and allow other importers to operate quickly, without impacting the port's security objectives.
Maritime and Port Authority, Singapore	<p>In August 2015, Singapore's Maritime and Port Authority (MPA) signed a Memorandum of Understanding (MOU) with IBM to establish a two-year agreement for big data. The agreement involved developing a platform using IBM's Traffic Prediction tool to forecast vessel arrival times and estimate potential traffic congestion using fusion analytics. The platform also relies on data mining and anomaly detection by using IBM Incident Detection Module and IBM System G.</p> <p>According to Goh Kwong Heng, CIO of MPA, the port authority plans to invest in big data to improve port operations and activities. The MPA aims to use data analytics platforms to complement its port management systems in detecting anomalies and supporting both operations and planning processes.</p> <p>The authority also plans to invest in technologies such as drones and mobile apps to manage marine accidents and improve the efficiency of its port workers.</p>	<p>The port uses the platform to improve productivity and marine safety at the major trans-shipment hub.</p> <p>For example, by collecting information on ship positions and weather data, the platform helps avoid accidents by inferring the most likely path ships would take in a given situation. This also helps prevent illegal bunkering by detecting unusual movement patterns.</p> <p>According to Andrew Tan, the CEO of MPA, the port authority's collaboration with IBM enabled a mix of research expertise, software technologies and maritime domain knowledge to create new capabilities for the maritime industry in Singapore.</p>

Source: marinelink.com / shipmanagementinternational.com / informilo.com / imarest.org / splash247.com / marinemec.com

Applications in ports and terminals

PORT NAME / PORT AUTHORITY	DESCRIPTION	PURPOSE / BENEFIT
Hamburg Port, Germany	The Hamburg Port in Germany uses a cloud-based analytics tool called SmartPort Logistics. The tool pulls different types of data, such as vessel positions, height and width of bridges, and planned driving routes. This data can be viewed in real-time on mobile applications.	The tool aims to streamline the flow of goods. It allows port workers to know precisely when ships are expected to dock, and truck drivers to know when cargo is expected to be offloaded.
Port of Cartagena, Columbia	The port uses Cisco and IBM solutions for IoT analytics. The solutions help forecast equipment failures.	The solutions ensure proper and timely maintenance of port machinery.
Port of Rotterdam, The Netherlands	The Port of Rotterdam has recently implemented big data analytics.	Sustainable supply chain analysis for Reefer containers.

Source: web.dpworld.com / joc.com / ibm.com / opengovasia.com / bigdata-alliance.org

Section 2:

The future of big data
in the maritime industry

Key trends and initiatives

The following are the key trends in the use of big data in the maritime industry:

TREND	DESCRIPTION	RELEVANT EXAMPLES AND INITIATIVES
Increase in partnerships to develop technology capabilities	To implement big data analytics, shipbuilders and shipping companies have been entering into partnerships with leading technology suppliers and universities.	<ul style="list-style-type: none"> ■ In July 2016, Hyundai Heavy Industries (HHI), the world's largest ship builder, signed a Memorandum of Understanding (MoU) with SK Shipping, Intel, Microsoft, the Ulsan Center for Creative Economy & Innovation and the Daejeon Center for Creative Economy & Innovation. Under the MoU, the parties will create software to improve the safety and well-being of crew members as well as to meet the needs of ship owners and safe ship operation standards. ■ In November 2016, Rolls-Royce formed a strategic alliance with VTT Technical Research Centre, Finland, to develop the first generation of remote and autonomous ships ■ In 2016, Japanese shipping company Nippon Tussen Kaisha, the Monohakobi Technology Institute and the Japan Marine United Corp agreed to jointly conduct big data research on 14,000 TEU boxships

Source: readwrite.com / osa-opn.org / zdnet.com / informilo.com / marinelink.com / oceanmanager.com / fujitsu.com / worldmaritimeneews.com

Key trends. and initiatives

TREND	DESCRIPTION	RELEVANT EXAMPLES AND INITIATIVES
Use of big data to reduce bunker costs	<p>Ship owners and operators are exploring the use of big data analytics to reduce their bunker costs. Low bunker costs can offset the record low freight rates in the market.</p> <p>Maritime software allows companies to achieve fuel savings through energy efficiency retrofits, using big data collection and analysis. For example, the ClassNK-NAPA GREEN software, collectively developed by ClassNK and NAPA, offers a real-time big data analysis performance monitoring and optimization solution for fuel efficiency purposes.</p>	<ul style="list-style-type: none"> ■ In November 2016, Netherlands-based We4Sea BV announced the launch of its big data fuel monitoring platform, with an aim to reduce bunker costs and ship emissions ■ In June 2016, Kawasaki Kisen Kaisha Ltd announced that it was working with Kawasaki Heavy Industries Ltd Group to develop K-IMS, which will allow the company to reduce its bunker bills ■ In April 2015, Maersk announced that it was looking at big data analytics to lower its bunker bills
Increasing number of companies offering maritime big data analytics software	<p>In recent years, there has been an increase in the number of companies offering high-level technologies for optimizing ship operations.</p> <p>Companies such as Eniram Oy and ABB are pioneers in this field. Further, sophisticated software by companies such as Laros and GreenStream have paved the way for the growing ship data market.</p>	<ul style="list-style-type: none"> ■ Ericsson has increased its focus on the shipping sector due to increasing implementation by carriers in the Middle East and Asia. Ericsson has collaborated with Cobham Satcom to enter the market. It has also signed a strategic agreement with Inmarsat to promote data sharing in the maritime industry. ■ Windward, an Israeli startup, maps maritime traffic and applies analytics on all historical and current data. This allows it to analyze even the slightest unexpected behaviors and patterns, which may indicate involvement in illicit activities.

Source: shipping-2030.com / shipandbunker.com / shippingwatch.com

Key trends and initiatives

TREND	DESCRIPTION	RELEVANT EXAMPLES AND INITIATIVES
Maritime companies setting up internal infrastructure for big data implementation	<p>As big data implementation is still at a nascent stage in the maritime industry, the approach to data capturing is fragmented. Similar data has to be sent to different vendors and processes are time consuming and inefficient. To counter this, maritime companies are developing internal platforms and entities to ensure efficiency and data security.</p>	<ul style="list-style-type: none"> ClassNK established its Ship Data Center as a separate entity with a secure shipping operations database that serves as an independent information hub Bahri created BahriData, a data platform, to improve operating performance and unlock growth opportunities. The company has developed various data models in its BahriData platform to cover various key business areas such as chartering, voyage management, fleet operations, maintenance and customer services.
Funding to encourage big data application in shipping	<p>According to observers and industry stakeholders, big data is the next major revolution in the shipping industry. There have been recent cases of funding to promote the use of big data in different applications of shipping.</p>	<ul style="list-style-type: none"> In 2015, the European Union (EU) funded USD10.5m for a project, aiming to increase the use of big data in safety. The project, named EfficienSea2, involved the Danish Maritime Authority and several shipping and maritime companies. Over three years, these companies will map the scope of the potential related to the massive amounts of data found on ships, in offices and in ports. In 2013, Singapore's Maritime and Port Authority (MPA) initiated a fund, called the Maritime Innovation & Technology (MINT) fund, to support the R&D efforts of the shipping industry. Under the scheme, 50% of the qualifying costs for a project will be supported by the fund in the development of technology products or solutions for the shipping industry.

Source: shippingwatch.com

Key challenges

The following are the key challenges faced in the adoption of big data by the maritime industry:

CHALLENGES/ISSUES	DESCRIPTION
Cyber threats	<p>Marine IT and telecommunication infrastructures are at high risk of penetration from cyber criminals, terrorists or other malevolent interests. According to CyberKeel, a Danish cyber security firm, more than 90% of the largest container lines are vulnerable to hackers. ESC Global Security's head of cyber security division, Joseph Carson, also mentioned that big data will increase the vulnerability to cyber-crime in the maritime industry. There is the potential for a major cyber-attack on the maritime industry, which may lead to disruption in food and energy supplies, as shipping transports 90% of the world's total trade.</p> <p>ClassNK has been taking a leading role in the implementation of cyber security standards for maritime data analysis. It has collaborated with the United States Maritime Resource Center to improve its understanding of existing and emerging cyber security challenges due to big data across the marine transportation system.</p>
Misreporting of data	<p>The following are highlights of a report by Windward, published in 2014:</p> <ul style="list-style-type: none"> ■ 1% of all ships broadcast fake IDs, i.e. a ship claiming to be a completely different vessel ■ Less than half of all vessels report their next port of call accurately ■ 55% of ships misreport their actual port of call throughout their journey <p>Misreporting of data can cause concerns, as it may lead to incorrect analysis and inappropriate decision-making.</p> <p>“Although the marine sector recognizes the advantages of big data in terms of value to business, human element, environmental protection, offshore activities and so on, it hasn't yet found ways to overcome the challenges of data ownership and sharing.”</p> <p>Maria Kouboura Senior Technical Advisor, IMarEST</p>

Source: marinelink.com / shipmanagementinternational.com / informilo.com / imarest.org / splash247.com / marinemec.com

Key challenges

The following are the key challenges faced in the adoption of big data by the marine industry:

CHALLENGES/ISSUES	DESCRIPTION
Slowdown in investment in big data analytics due to existing challenges	The shipping industry has been facing numerous disturbances and challenges such as market fluctuations, over supply, margin pressures and labor shortages. These challenges are expected to impact the industry's profitability. According to a report published by IHS in November 2015, in the coming 5–10 years, the industry will experience slow growth. In such an unstable environment, players are uncertain about implementing big data as it is a relatively new technology in the industry. As a result, investments by these companies in big data analytics technologies is decreasing.
Lack of cross-enterprise technology implementation	Currently, ship builders, ship owners and ports are solely focusing on running reasonably efficient operations and not on running a highly flexible, responsive trading business of 'container-as-a-community'. This means that there is a lack of cross-enterprise processes. Companies are concentrating on automating processes within functional silos instead of taking a holistic view of the enterprise. This prevents the true potential of big data from being realized.
Lack of big data-skilled workforce / Skills shortage	Ensuring enough quantity and quality of human resources is essential for developing the use of big data solutions for maritime. There is a shortage of highly trained data scientists. This shortage is expected to further increase in the future. According to McKinsey, by 2018, there will be more than 490,000 data science jobs in the US alone. However, there will only be 200,000 available data scientists to fill those positions. Demand for data scientists is expected to exceed supply by more than 50% by 2018.

Source: oceanmanager.com / ihs.com / splash247.com

The outlook

Big data is considered one of the top initiatives that will transform the shipping industry. As more companies realize the importance of connected technology in increasing efficiency, the use of big data analytics in day-to-day operations is expected to increase.

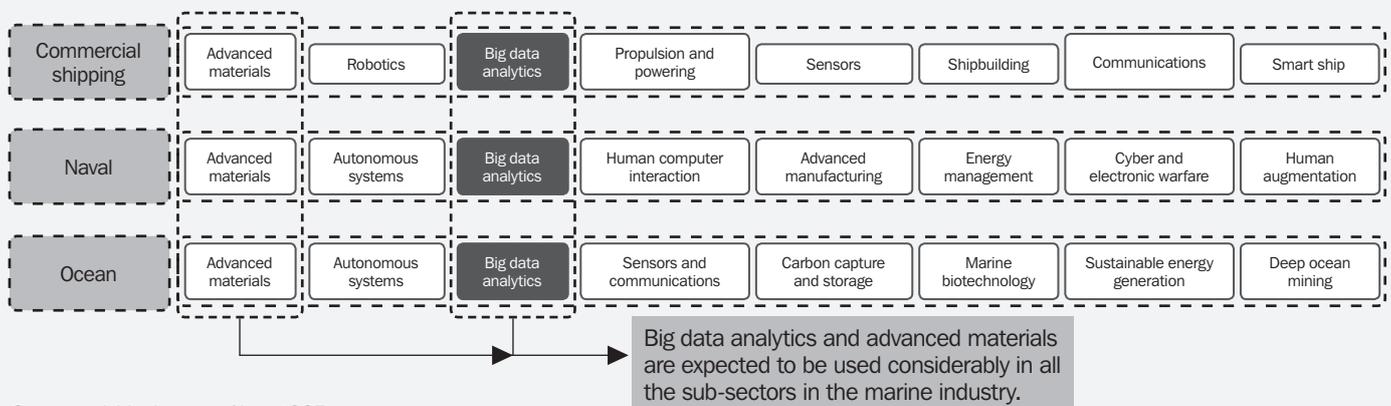
According to the Global Marine Technology Trends 2030 report published in November 2015, big data analytics will be one of the top 18 transformational technologies being used by the sub-sectors (commercial shipping, naval and ocean) in the marine industry. The figure below highlights all of these technologies:

“In the future, ship managers will use big data to a far greater extent and will develop a pathway towards achieving the promised operational benefits.”

Takashi Nagatome
President and CEO of Ship Data Center

“Technology, and in particular, the smart use of big data is going to drive the next generation of ships. Over the next 10 to 20 years we believe ship intelligence is going to be the driving force that will determine the future of our industry, the type of ships at sea, and the competence levels required from tomorrow’s seafarers.”

Mikael Makinen
President of Rolls-Royce Marine



Source: arishipping.com / knect365.com

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