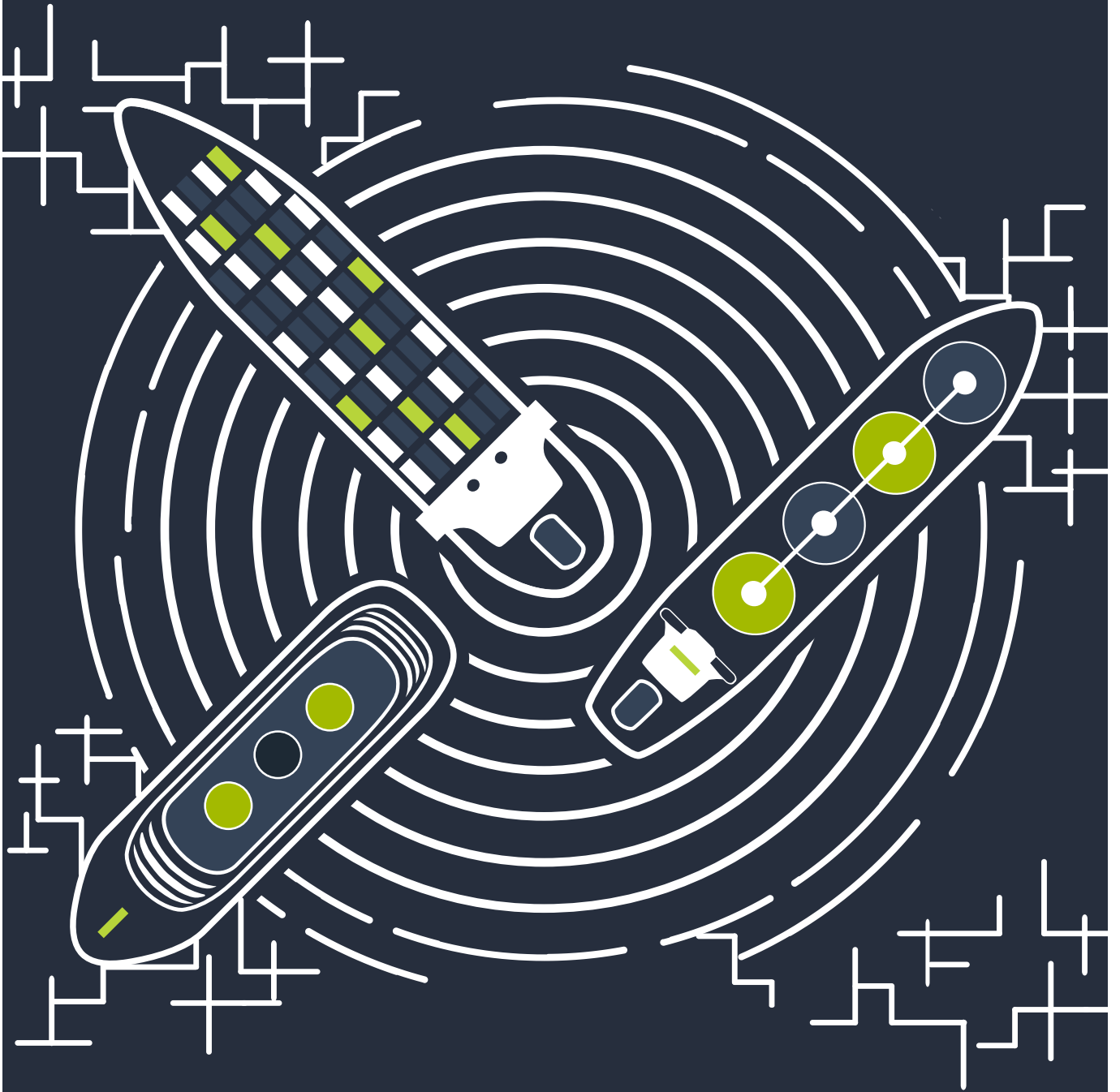# NEAR SHORE CONNECTIVITY WHITEPAPER

future nautics
the maritime future

vodafone

CONTENTS

CHAPTER

1

A CHANGING WORLD: SHIPPING IN TRANSITION

CHALLENGES FACING THE SHIPPING INDUSTRY
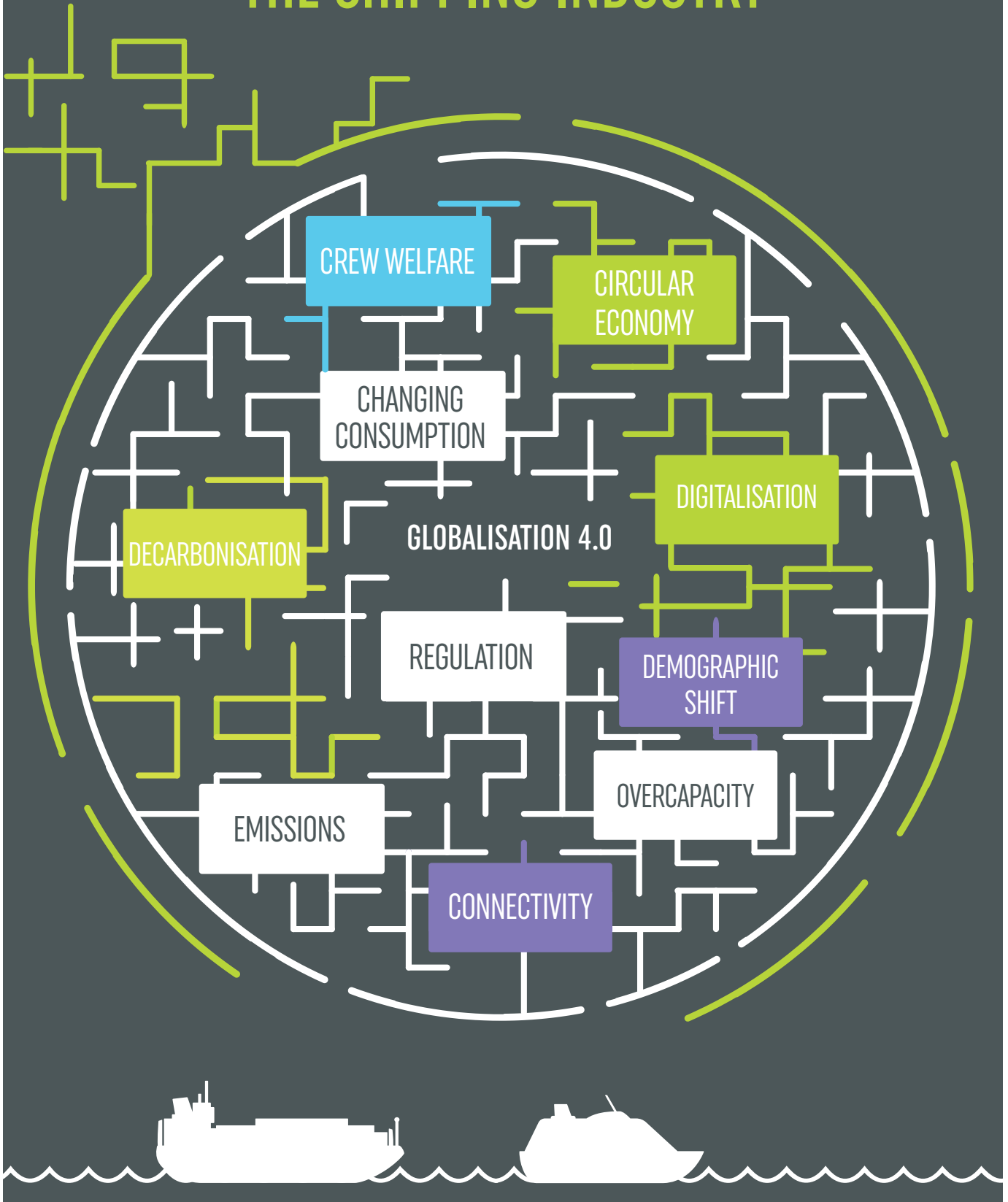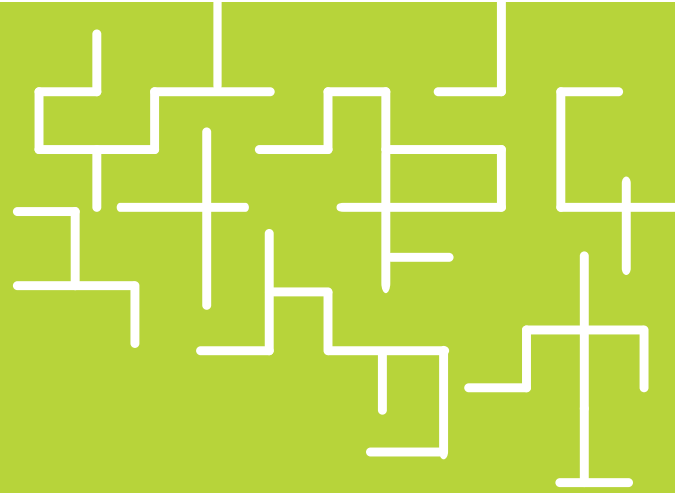
CREW WELFARE

CIRCULAR ECONOMY

CHANGING CONSUMPTION

DIGITALISATION

DECARBONISATION

GLOBALISATION 4.0

REGULATION

DEMOGRAPHIC SHIFT

OVERCAPACITY

EMISSIONS

CONNECTIVITY

Shipping is being uniquely impacted by digitalisation, decarbonisation, and the emerging circular economy drivers, together with changing consumption patterns brought about by Globalisation 4.0.

The commercial shipping industry has struggled for growth and profitability across most sectors for many years. Although many of its problems originate from the 2008 financial crash and overcapacity there are now a number of new trends that will profoundly challenge the industry in the years ahead. Shipping is being uniquely impacted by digitalisation, decarbonisation, and the emerging circular economy drivers, together with changing consumption patterns brought about by Globalisation 4.0. These forces are already starting to exert their influence on the volume and type of cargo being shipped today and that influence is set to grow.
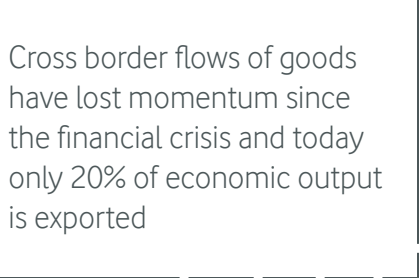
A CHANGING WORLD

The global population expanded quickly in the decades between 1970 and 1990 and with it the working-age population. China and Eastern Europe joined the world economy in the years leading up to the financial crash and drove significant expansion in world trade volumes. Today the world population and consumer demographic is ageing and countries such as Japan and Russia are already witnessing a decline in their populations. **As populations age they consume more services and less physical goods leading to a decline in seaborne trade.** A shrinking working age population reduces consumption levels and is compounded by reductions in disposable income witnessed in the millennial cohorts of many developed nations.

The consumers of the future — the vast young populations of Africa and India — are not set to drive growth in demand in the same way as in

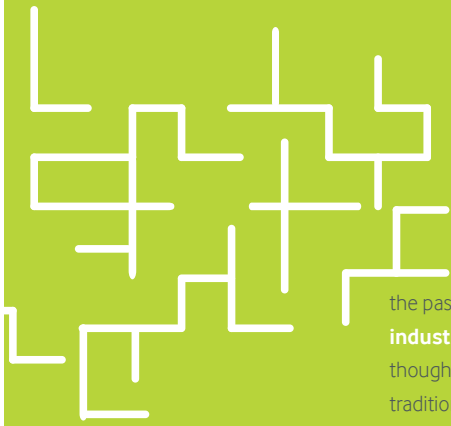Cross border flows of goods have lost momentum since the financial crisis and today only 20% of economic output is exported

the past. This is in large part due to the **digital industrial revolution of Industry4.0** which though efficient and productive, won't create the traditional manufacturing jobs that have helped other populations up the economic ladder.

Cross border flows of goods have lost momentum since the financial crisis and today only 20%[1] of economic output is exported. International trade flows remain highly focussed with the majority of flows taking place regionally, rather than between continents. Meanwhile cross border trade in services has outstripped physical goods by more than 60% in the last decade resulting in the world becoming more dependent upon flows of data than physical goods.

There is increasing consensus that the way in which physical goods are currently produced, transported, supplied, used, refurbished and recycled throughout the world is not sustainable economically, environmentally or socially. At the same time the growth of ecommerce is demanding faster and more efficient delivery, often at the expense of urban and suburban transport networks which are feeling the pressure of significantly expanded last-mile delivery vehicles. Initiatives around the Circular Economy and the Physical Internet are seeking to address this worldwide challenge, and intelligent transportation and autonomy will be a critical factor in enabling the global sustainability of physical object mobility.

These factors either in isolation or combination will affect production of goods globally. Sitting at the heart of so many global supply chains the importance of this change to the shipping industry should not be underestimated. Global demographics and the decline of the consumer economy will impact the volume of seaborne trade in consumer goods. The

growing importance of services with the introduction of new 'as-a-service' business models by manufacturers will blur the lines between physical goods and services, further compounding the impact.

Resource scarcity and circular economy principles will impact the dry bulk market. One estimate of the introduction of circular economy principles to just the automotive

> Intelligent transportation and autonomy will be a critical factor in enabling the global sustainability of physical object mobility.

and machining sectors projects a net global materials reduction of 170 million metric tons of iron ore per year. Similarly, the adoption of sustainability principles and **reduction of reliance on fossil fuels will inevitably impact the trade in refined bulk liquids and by extension the tanker sector**. The effect of the move to electric propulsion has an even wider impact than that on gasoline/petrol consumption. The internal combustion engine consists of around 2,000 moving parts whereas electric motors have around 20. Shipping is a key part of servicing supply chains for such parts.

The combinatorial effect for shipping is the removal of the shipping cycle and an end to the boom and bust that characterised shipping for the decades leading to the financial crash. A **'new normal'** has emerged where speculation in tonnage is no longer a tenable business model.

CROSS BORDER TRADE IN SERVICES OUTSTRIPPED PHYSICAL GOODS BY **60%**

ENVIRONMENTAL PRESSURE HAS INCREASED SHIP OPERATORS' EFFORTS TO OPTIMISE SHIPBOARD OPERATIONS

INCREASED SCRUTINY ON SHIPPING'S GREEN CREDENTIALS

ADDITIONAL COMPLEXITY TO SHIP OPERATIONS WITH THE SULPHUR CAP

A PRACTICE WHICH CUTS COSTS AND EMISSIONS FOR SHIPPING DOES THE REVERSE FOR ITS CUSTOMERS.

2020 2020 SULPHUR CAP WILL PROMPT EXAMINATION OF PORT DELAYS AND EMPTY BACK HAUL LEGS

$5.7BN COST OF SLOW STEAMING TO IMPORTERS

IN DIFFICULTY LIES OPPORTUNITY

Despite ship operating costs having fallen to levels last seen a decade ago[2] over capacity and market conditions continue to challenge companies in most sectors. The slowing of the global economy, emergence of the new trends already outlined, and increased scrutiny of **shipping's green credentials** has increased operators' efforts to **optimise their shipboard operations**. To date the response has been limited to **slow steaming**, on the basis that this reduces individual ship emissions. However, according to a McKinsey study[3] slow steaming adds **three days** to the supply chain between the United States and Asia, with additional annual inventory and obsolescence costs to importers of US$415m. Extrapolated worldwide that 3-day delay increases to around US$5.7bn. Hence a practice which cuts costs and emissions for shipping does the reverse for its customers. In addition to the financial costs the environmental impact of manufacturing, transporting and storing that additional inventory worldwide is enormous, yet shipping has yet to develop a sufficiently holistic view of the supply and value chains in which it plays to appreciate that impact.

The arrival of the **2020 sulphur cap** will introduce another layer of cost and complexity to ship operations, leading to an examination of practices that leave ships sitting idle and at anchor outside ports, or empty on backhaul voyages. **In a bid to improve margins ship operators are now investing in ship optimisation programmes designed to reduce costs both at sea and ashore using a variety of technical solutions.**

Whilst enterprise-grade connectivity, information availability and increasingly powerful software has permeated shipping's customers' operations ashore, shipping has failed to keep pace. With supply chains an increasingly critical element of competitive advantage, customer expectations are rising inexorably. With interruptions to the supply chain now exerting the largest downward pressure on share price, shipping's customers need a shipping industry fit for Industry 4.0.

> Shipping's customers need a shipping industry fit for Industry 4.0

In shipping the sharing of information and data between companies and their customers — and even within companies — has traditionally been rare. The situation has been exacerbated by the historical expense and complexity of deep-sea connectivity. However, with the advent of **new high throughput satellite systems, coastal connectivity including 4G and soon 5G, the gateway to the digital — or DX — economy is now opening for shipping.**

The challenges presented by the expectations of new generational cohorts and exponentially moving technologies are huge, but the opportunities are equally so. Shipping now has the tools at its disposal to reinvent itself and truly become an integrated, decarbonised, transparent and trusted partner within the worlds global supply chains.

2 BDO OPCOST 2019 Report
3 Container shipping: "The untapped value of customer engagement", McKinsey, March 2016

NEW TECHNOLOGY HAS SIGNIFICANTLY IMPROVED CONNECTIVITY ON-BOARD

VSAT

LEO (LOW EARTH ORBIT)

HTS (HIGH THROUGHPUT SATELITE)

FLEETBROADBAND

HTS (HIGH THROUGHPUT SATELITE)

5G

4G

FLEETBROADBAND

VSAT

LEO (LOW EARTH ORBIT)

75% VESSELS HAVE INTERNET CONNECTIVITY*

<1% OF TOTAL OPERATING COST IS CONNECTIVITY

61% SEAFARERS HAVE INTERNET ALL OR MOST OF THE TIME

CONNECTIVITY

Digitalisation and digital transformation are shaping companies across the world and ship operators are part of that movement. Many today are in the process of digitising existing practices in order to realise operational efficiencies. At the heart of the systems and solutions in which ship operators are investing is connectivity. Traditionally expensive satellite and with limited bandwidth ship-to-shore connectivity has often acted as a brake on wider technology adoption.

The introduction of **VSAT and more recently High Throughput Satellite (HTS) systems** has provided ship operators and crew with significant improvements in connectivity on-board. **Today 75% of vessels have internet connectivity compared to 43% in 2015**[4] Crew have also benefited from this surge in connectivity with an estimated **61% of seafarers having access to connectivity all or most of the time.**

On-board connectivity is likely to increase in speed and capacity as new **Low Earth Orbit (LEO)** constellations reach the market. Today constellations, from the likes of OneWeb and Amazon, will launch networks of hundreds of satellites into low earth orbits increasing capacity and reducing latency. When combined with existing satellite and cellular networks these LEO constellations will provide blended, layered connectivity across a number of different channels.

However, despite very significant advances in satellite network connectivity ship operators and their crew are unlikely, at least in the foreseeable future, to experience connectivity equivalent in price or performance to that experienced ashore. **63%**[5] **of ship operators still cite bandwidth as**

the main constraint associated with satellite connectivity and this will inevitably slow adoption of new technologies. Technologies that can surface operational efficiencies, reduction in insurance premiums and demonstrate regulatory compliance.

Connectivity spend by ship operators amounts to less than 1% of total vessel operating cost, and as compliance and transparency pressures mount there is a clear argument for spending more on this vital technology. However, understanding the ROI of that additional expenditure can be complex. Ship operators should examine their businesses to identify where that expenditure can be mitigated

> Digitalisation and digital transformation are shaping companies across the world and ship operators are part of that movement.

by, for example, the ability to exploit big data and analytics. This is not an opportunity unique to the shipping industry. The aeronautical industry has for many years used advanced analytics on large datasets collected from aircraft engines to extend service intervals, reduce maintenance costs and operational disruptions. Rolls Royce pioneered an approach to identify and process the most important engine data inflight and securely transmit it back to ground-based operations centres exploiting the limited available bandwidth. Other less urgent datasets were stored on board until the aircraft landed and were then transmitted using terrestrial networks.

4 Futurenautics – Crew connectivity Survey 2018
5 Near Shore Connectivity Survey 2019

USE 4G/5G TO OFF LOAD
NON TIME-CRITICAL DATA

A SHIP SPENDS 60% OF TIME IN PORT OR COASTAL WATERS
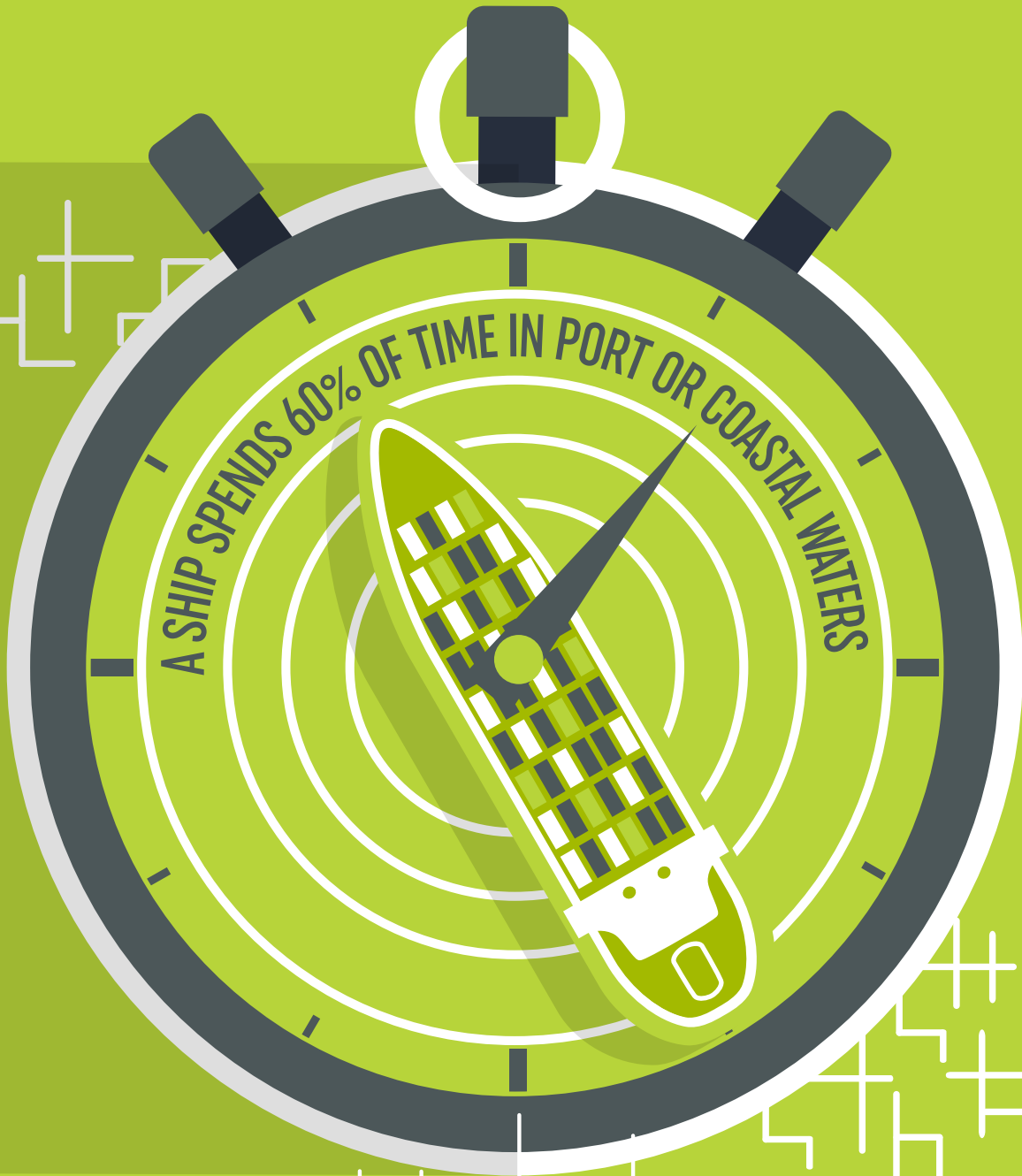
The Near Shore Connectivity survey, commissioned by Vodafone and covered in this whitepaper, seeks to determine whether this is a feasible model for commercial shipping. The ubiquity of cellular networks and near universal coverage of **4G/LTE networks** means that ship operators could potentially **utilise this technology to off load large non-time-critical datasets when in port or whilst transiting coastal waters.** Nearly 6,000 deep-sea commercial ships were represented in the survey and their operators told us that on average their ships spend **60% of their time in port or coastal waters** and potentially within 4G/LTE coverage.

The issue is, of course, more complex than just access to multiple connectivity solutions. It is about extracting data from a variety of onboard systems to a centralised point for transmission. Aggregating the large volumes of data generated by isolated, unconnected systems on board ready for transmission and analysis ashore is expensive and complex. However, solutions do exist to help ship operators and suppliers of onboard systems to overcome some of the barriers to getting valuable data ashore. **4G/LTE near-shore data connectivity solutions vary from simple USB dongles/modems, easily deployed by ship operators in multiple locations around the ship to dedicated 4G/LTE solutions bundled with shipboard and satellite communications systems.** These can significantly reduce the barriers for ship operators and equipment manufacturers alike to getting valuable data off the vessel to be processed ashore.

With the number of connected devices growing exponentially and expected to surpass 20 billion by 2020 the race for 5G has already begun, with major operators currently involved in deploying networks today. 5G offers significant increases in capacity, speeds measured in gigabits per second and low latency essential to connected devices and real-time applications. **With autonomous, unmanned vessels entering service in national waters in less than 12 months 5G networks can be expected to play a significant role in their navigation, tracking and regulation.**

Whilst satellite will remain at the heart of deep-sea vessel operations and safety, ship operators need to be aware of the ability of 4G/LTE solutions in providing cost-effective additional bandwidth and the more significant role 5G will likely play in future near-shore operations.

In this chapter, we will look closely at the maritime connectivity landscape today, ship operators' data usage now and in the coming 3-5 years, along with the applications that are

The ubiquity of cellular networks and near universal coverage of 4G/LTE networks means that ship operators could potentially utilise this technology to off load large non-time-critical datasets when in port or whilst transiting coastal waters.
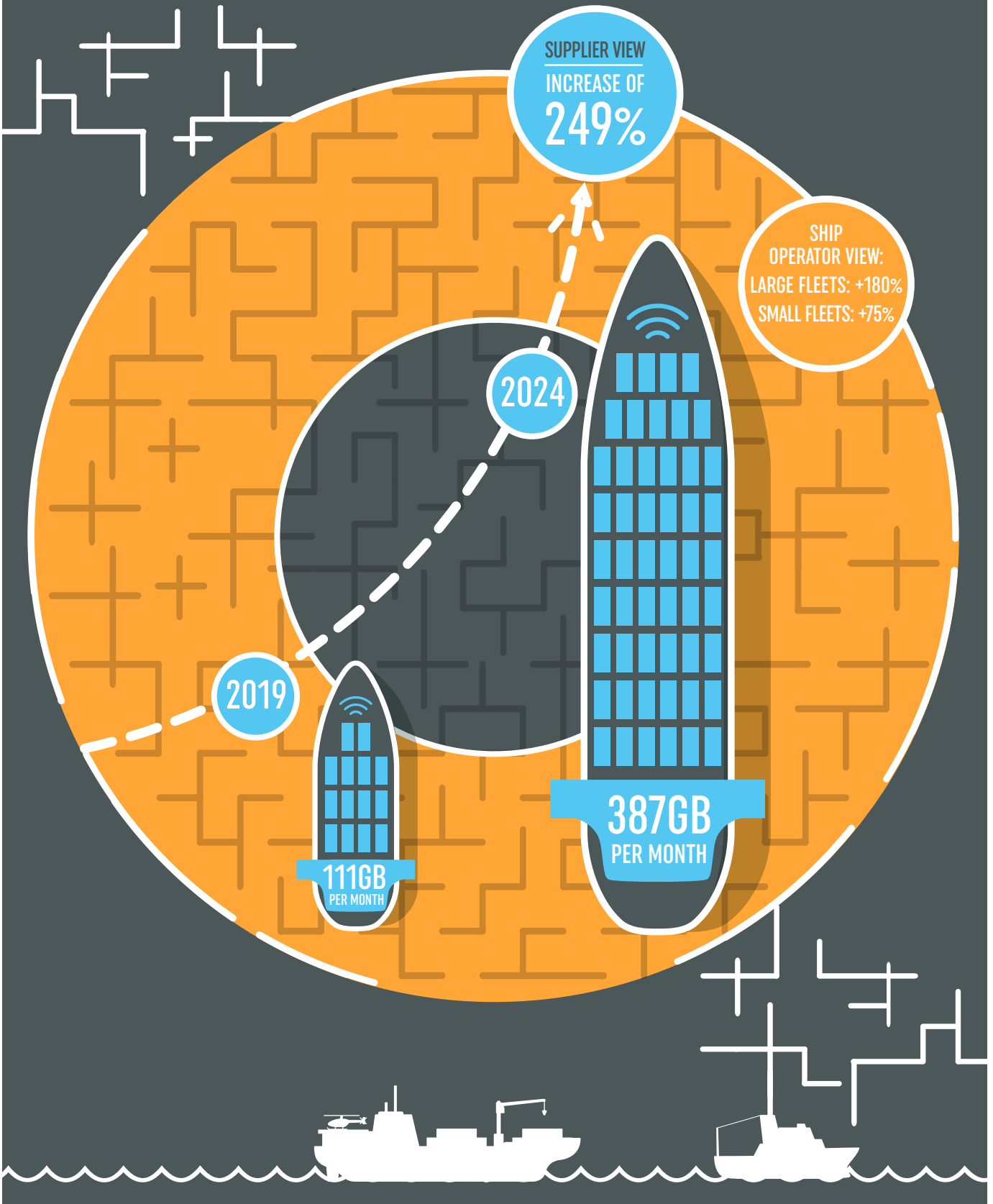
delivering ship operators most value. We spoke with software and hardware manufacturers to get their views on how their solutions are used today, how exponential technologies will drive data growth in future and determine whether 4G/LTE should take more of a strategic role in shipboard communications.
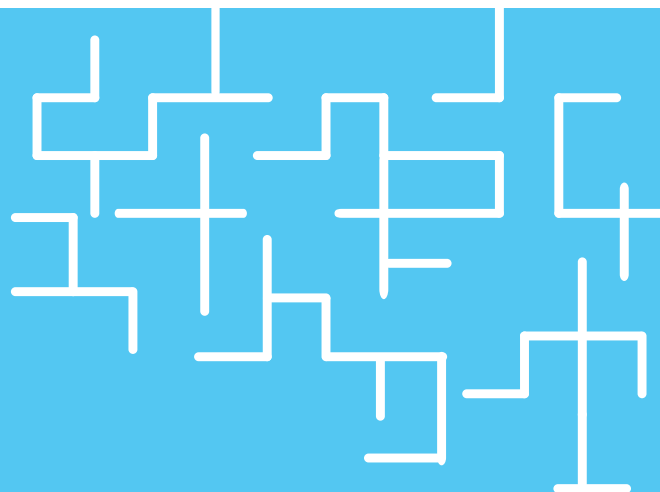
CHAPTER
2

OVERLOOKING THE VALUE

DATA GENERATION PER VESSEL

SUPPLIER VIEW

INCREASE OF
249%

SHIP OPERATOR VIEW:
LARGE FLEETS: +180%
SMALL FLEETS: +75%

2024

2019

387GB
PER MONTH

111GB
PER MONTH

In this chapter we explore the results of surveys undertaken with ship operators and maritime suppliers to determine the suitability of 4G/LTE near shore connectivity solutions to the maritime market.

We begin by examining how much data is generated on board ship today, its anticipated growth over the next five years and the applications that deliver most value to ship operators. We also highlight what ship operators spend on connectivity and IT both today and in future.

Not all data generated on board by Information and Operational technology is transmitted ashore, we quantify the volume of data that comes ashore and the amount that never leaves the ship. Suppliers share the time sensitive nature of the data generated by their applications allowing ship operators to plan what data should be sent by satellite and what could wait until the ship is in range of near shore connectivity solutions.

The results reveal high levels of anticipated data growth, an untapped analytics opportunity as well as the need for ship operators to assess how and when they transmit data to maximise their connectivity bandwidth.

Today, there are on average 30 data generating applications deployed on each commercial ship.
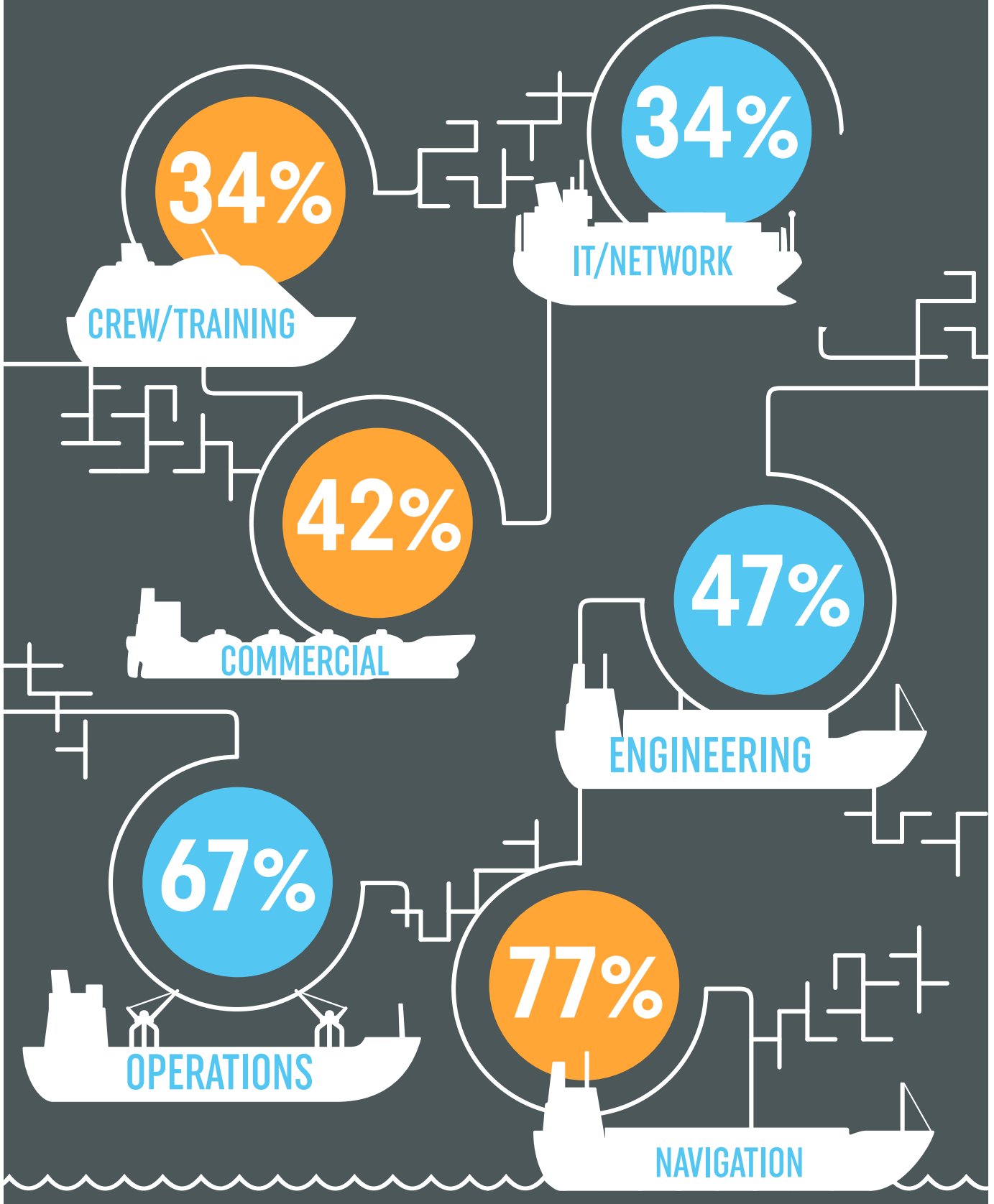
These applications generate on average 123Mb of data each per day, a figure which varies depending on the type of application from less than 1Mb per day to 1.5GB. **This equates to an average of 3.7GB of application data being generated on board each day or 111GB of data per month.**

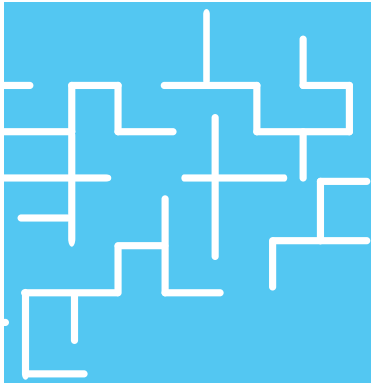**Supplier respondents forecast that growth in data generated by their applications would increase nearly 250% by 2024 to 387GB per month per vessel.** Approximately one third of this increase is forecast to be driven by new application features and enhancements whilst the majority of the increase, 53%, is anticipated to be driven by greater utilisation by ship operators of existing systems to extract data.

APPLICATIONS REPRESENTING MOST VALUE TO SHIP OPERATORS

34%
CREW/TRAINING

34%
IT/NETWORK

42%
COMMERCIAL

47%
ENGINEERING

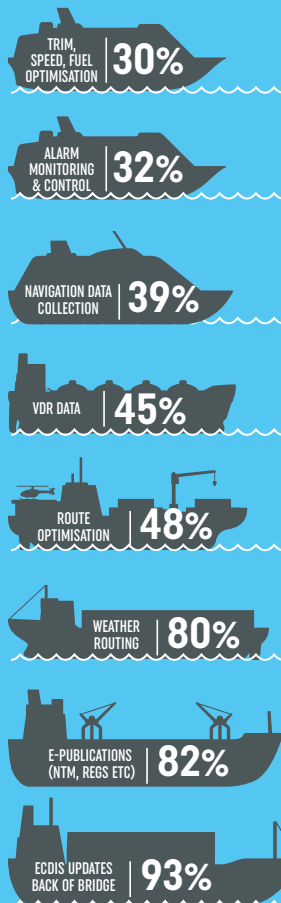**67%**
OPERATIONS

77%
NAVIGATION

Ship operator respondents forecast data growth varied significantly between smaller operators, those with less than 50 ships and the largest ship operators. **Smaller operators anticipated data growth over the same period to increase by just 75% whilst large operators forecast data growth at 180%.** This difference in data growth forecasts between operator groups demonstrates a greater level of digital maturity within the larger players and highlights the risks faced by smaller operators who, by delaying investment in their digital transformation, run the risk of becoming increasingly uncompetitive. The applications that generated the data on board were broadly categorised into six groups for the purposes of this research – Navigation, Operations, Commercial, Crew/Training, IT/Network and Engineering. Ship operators believe that Navigation, Operations and Engineering applications currently deliver the most value to their organisations. IT/Network and crew/training applications, although important, delivered least value to ship operators. It is clear that for many IT is still viewed as a cost centre rather than an enabler of value creation within the business. Crew applications, for many years the driver of connectivity installations, now no longer provide the same value due primarily to enhanced levels of connectivity now found on board a typical merchant vessel and the relative balance of seafarer supply and demand.
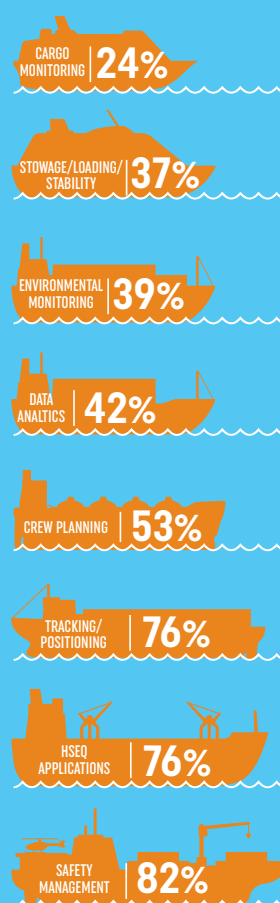
Ship operator respondents also foresaw little change in the current split between commercial business traffic and crew traffic over the next three years. **Currently, ship operators stated that the split between commercial and crew traffic was approximately 50:50. Anecdotal evidence from the industry would suggest that the split is closer to 25:75 commercial traffic to crew traffic.** The discrepancy could be down to the complexity of analysing data traffic sent to and from a ship or that operators are reclaiming some of their spare data capacity for commercial applications as market conditions remain challenging and the focus is on delivering further operational efficiencies.
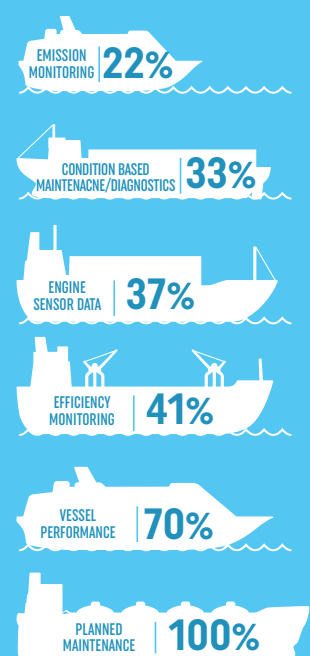
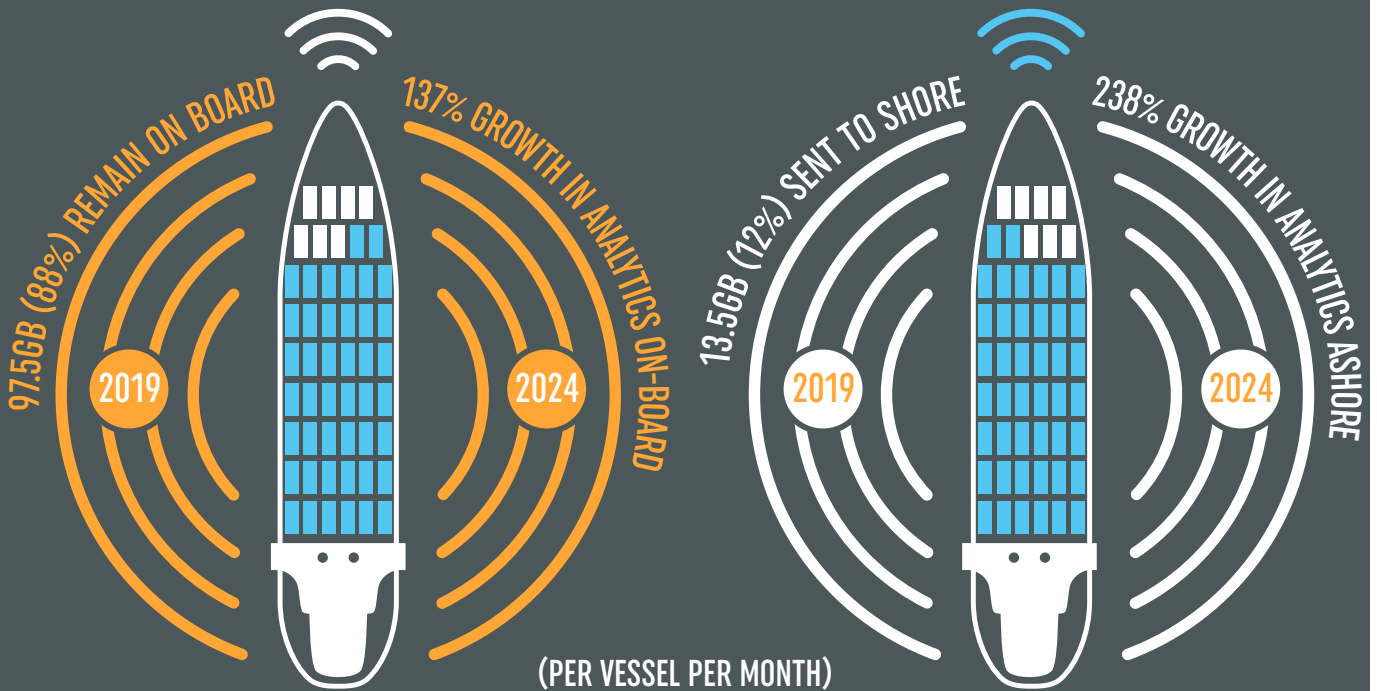# SHIPBOARD APPLICATIONS DELIVERING MOST VALUE

NAVIGATION APPLICATIONS

Application	%
TRIM, SPEED, FUEL OPTIMISATION	30%
ALARM MONITORING & CONTROL	32%
NAVIGATION DATA COLLECTION	39%
VDR DATA	45%
ROUTE OPTIMISATION	48%
WEATHER ROUTING	80%
E-PUBLICATIONS (NTM, REGS ETC)	82%
ECDIS UPDATES BACK OF BRIDGE	93%

OPERATIONS APPLICATIONS USED ONBOARD

Application	%
CARGO MONITORING	24%
STOWAGE/LOADING/ STABILITY	37%
ENVIRONMENTAL MONITORING	39%
DATA ANALTICS	42%
CREW PLANNING	53%
TRACKING/ POSITIONING	76%
HSEQ APPLICATIONS	76%
SAFETY MANAGEMENT	82%

ENGINEERING / MAINTENANCE APPLICATIONS USED ONBOARD

Application	%
EMISSION MONITORING	22%
CONDITION BASED MAINTENACNE/DIAGNOSTICS	33%
ENGINE SENSOR DATA	37%
EFFICIENCY MONITORING	41%
VESSEL PERFORMANCE	70%
PLANNED MAINTENANCE	100%

DATA ANALYTICS IS EXPECTED TO SOAR OVER THE NEXT 5 YEARS

97.5GB (88%) REMAIN ON BOARD

137% GROWTH IN ANALYTICS ON-BOARD

2019

2024

13.5GB (12%) SENT TO SHORE

238% GROWTH IN ANALYTICS ASHORE

2019

2024

(PER VESSEL PER MONTH)
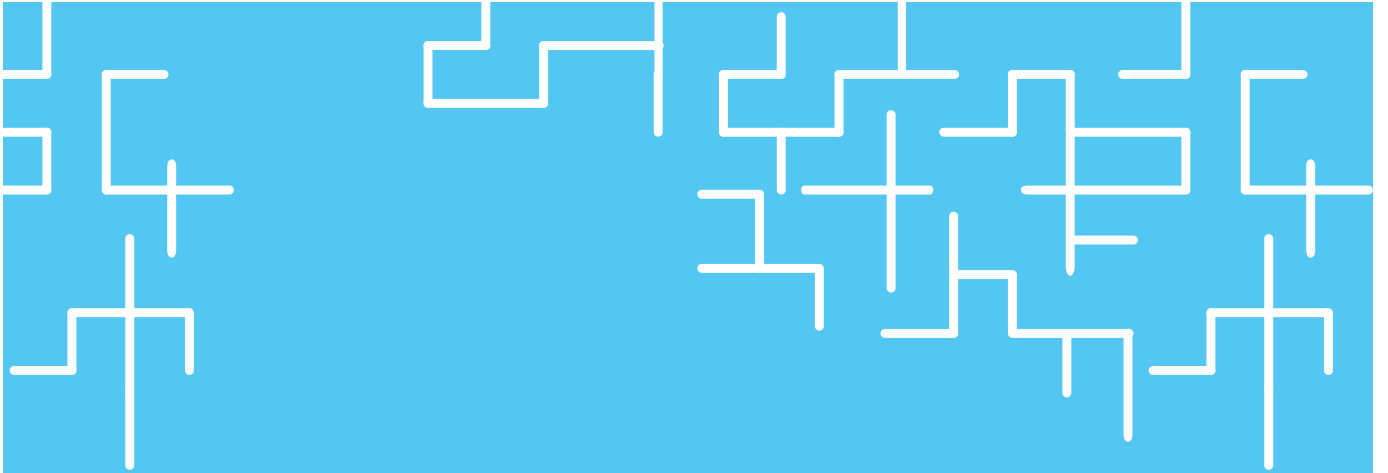
LARGELY UNTAPPED ANALYTICS OPPORTUNITY

The research strongly suggests that there is a large untapped data analytics opportunity within the maritime market. **Of the 111GB of data created on board the typical merchant ship each month only 12% or 13.5GB is currently transferred ashore. Nearly 90% remains on board** and likely never comes ashore. It appears a lot of value is potentially being overlooked as this data could be utilised to provide greater insights, cost efficiencies or be used to prove regulatory compliance and demonstrate operator risk profiles to insurers. All of this can help attract new finance, currently operators' primary concern in today's economic climate.

Application suppliers predicted a significant growth in data analytics both ashore and also on board the vessel. The opportunity for data analytics is seen by suppliers as the likely driver for much of the forecast data growth from ship operators.

60% of suppliers currently provide some form of analytics capability for ship operators and predict that data analytics ashore will grow by 238% over the next five years and, as significant, on board analytics is forecast to increase by 137% over the same period.

In line with other industries maritime data analytics is evolving towards centralised analytics at least in the short to medium term. Resilient connectivity will be essential in enabling this for ship operators.

90% of data remains on board and likely never comes ashore

The predicted growth in on board analytics points to the emergence of an edge computing model where, due to connectivity constraints, intelligence is pushed to the edge of the network and analysis and processing will take place at sea. It is a trend being witnessed in other industries driven by automation and the need to take real-time decisions.

The supplier channel is gearing up to meet the demand for analytics with nearly 90% of all application suppliers surveyed planning to provide their clients with analytics capabilities in future.
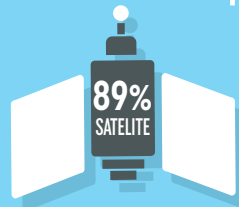
ANNUAL CONNECTIVITY AND IT EXPENDITURE

(IN USD $ '000 PER VESSEL)

39%
IT SPEND
$22.9

IT HARDWARE & APPLICATIONS

61%
CONNECTIVITY
SPEND $35.8

89%
SATELITE

11%
MOBILE

CONNECTIVITY BUDGETS EXCEED IT BUDGETS BUT WILL REMAIN FLAT

The survey asked ship operators how much they spent annually on connectivity (equipment and airtime) and also what they spent on annually on IT (hardware, applications etc.). **Ship operators spend on average $23k per year per ship on IT infrastructure on board with the largest operators spending the least.**

Ship operators regardless of size spent more on connectivity than IT. On average annual expenditure was $58.7k USD and the majority 61% was spent on connectivity. **As fleet size increased so did expenditure per vessel on connectivity with largest operators, those with fleets of more than 100 vessels, spending 15% more than smaller operators.**

The vast majority of the connectivity expenditure, 89%, is currently on satellite communications with ship operators spending **just 11% of their communications budget on 4G/LTE solutions.**

Despite the significant forecast increases in data volumes predicted by ship operators

60% expected their satellite connectivity expenditure to remain the same over the next 12 months. 75% of ship operators expected 4G/LTE expenditure to remain unchanged over the same period. This may simply be reflective of the fact that these operators are locked into long term connectivity agreements and therefore do not foresee any change in expenditure

Despite the significant forecast increases in data volumes predicted by ship operators 60% expected their satellite connectivity expenditure to remain the same.

levels. It may however reflect a view that **they expect connectivity prices to fall as greater capacity enters the market from existing and new satellite operators as well as the introduction of 5G services.**

42% OF DATA GENERATED ON-BOARD IS NON TIME-CRITICAL

REAL TIME 11%

LESS FREQUENT 42%

DAILY 47%
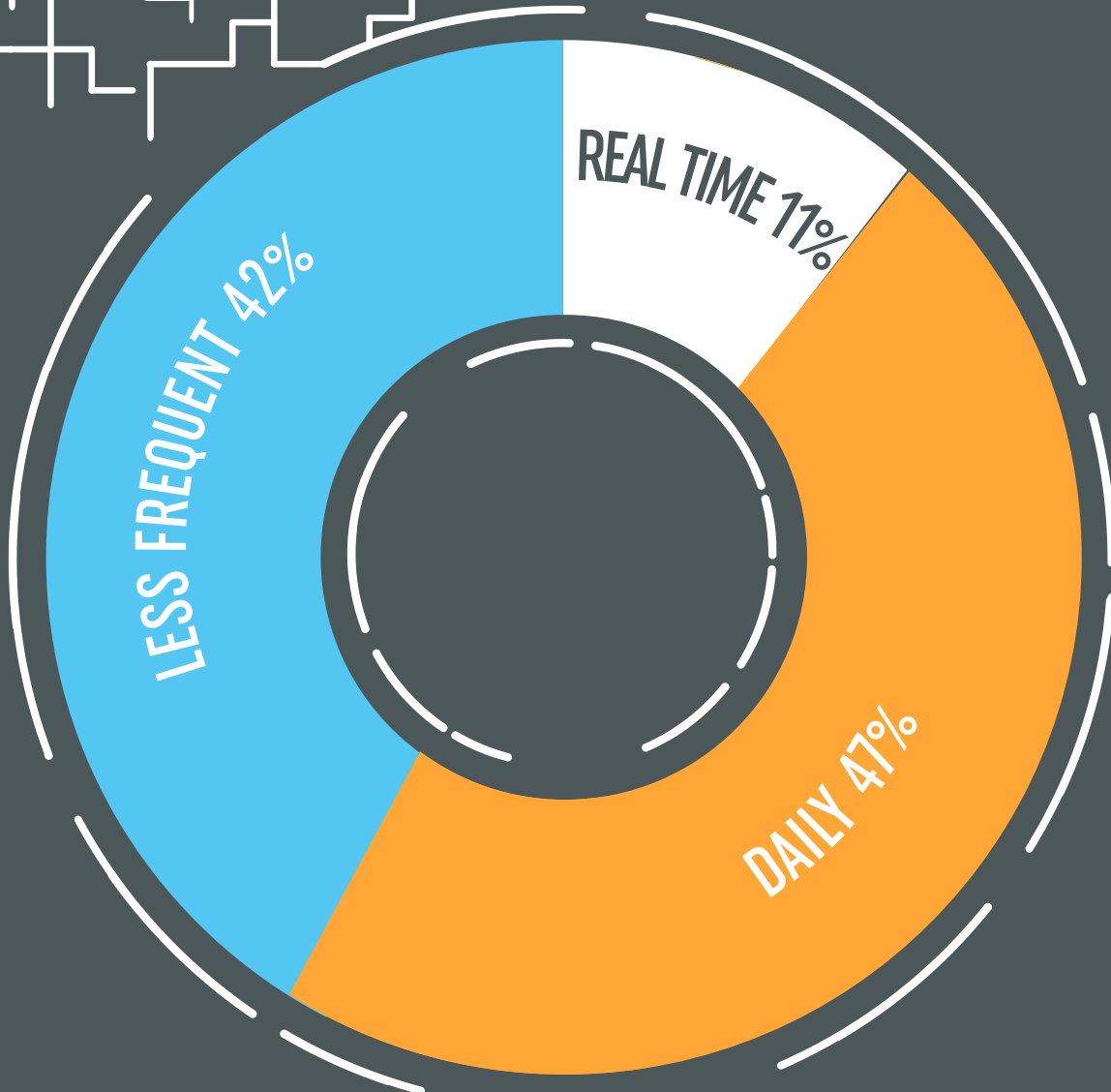
DATA TRANSMISSION VOLUME VARIES BY FLEET SIZE

(IN GIGABYTES PER VESSEL PER MONTH)

LESS THAN 50 SHIPS **43GB**

51-99 SHIPS **60GB**

MORE THAN 100 SHIPS **71GB**

57GB DATA TRANSMITTED PER MONTH, TO AND FROM THE VESSEL

Ship operators currently estimate that they are transferring, on average, 57Gb of data per month per vessel between ship and shore. This varies by operator size with the largest operators transferring 65% more data between ship and shore than smaller operators – indicating they are further ahead in their digital transformation journey. Of the data transferred just over half (53%) was data that originates ashore and is sent to the vessel and 47% was originated onboard the vessel and transferred ashore.

The volume of data transferred by ship operators is over four times that indicated by suppliers. The difference is primarily crew social traffic which is not management data associated with the applications provided for crew welfare i.e. Internet browsing.

A substantial proportion of data generated by applications on board is not time critical and does not need to be sent ashore immediately. **Supplier respondents indicated that 42% of data generated needed to be sent ashore weekly, or once per voyage.** This indicates clearly that not all data needs to be transmitted by satellite but could wait until the vessel reaches coastal waters or port to be offloaded via higher bandwidth, cheaper connectivity alternatives such as 4G/LTE.
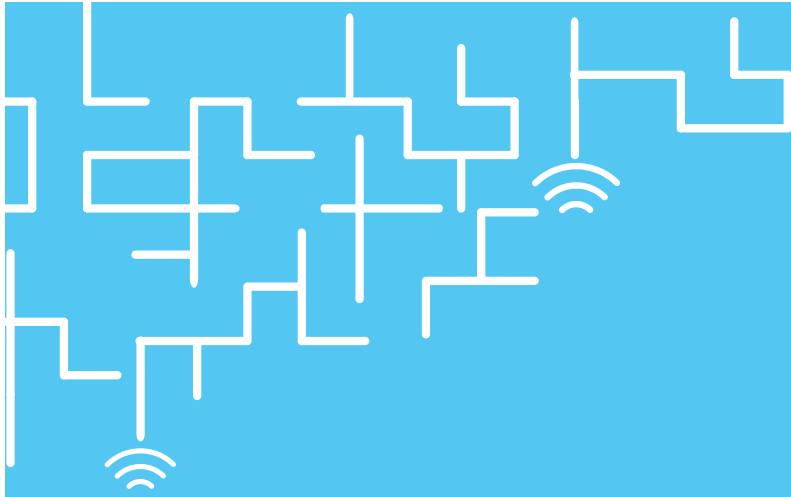
CHAPTER CONCLUSIONS

The survey has demonstrated that data volumes within the shipping industry will increase substantially over the next five years. However, today **much of the data that is gathered remains on board and the value held within these datasets is largely untapped – data that could be used in a variety of ways by ship operators to generate value in their businesses.** It is also clear that there is likely to be significant growth of centralised data analytics ashore in the short to medium term. This will require significant connectivity capacity and increase ship operator demand for resilient satellite and 4G/LTE solutions. The growth predicted in analytics onboard points to the emergence of edge computing techniques by suppliers which will lead to increased intelligence and automation on board.

Potentially the most striking of these findings is **the amount of data generated on board that is non time critical and needs only to be sent weekly or once per voyage.** With this knowledge **ship operators should potentially reassess what data is sent in real-time and what is left until the vessel is in port or coastal waters where higher bandwidth, lower cost solutions are available.**

Today, much of the data that is gathered remains on board and the value held within these datasets is largely untapped
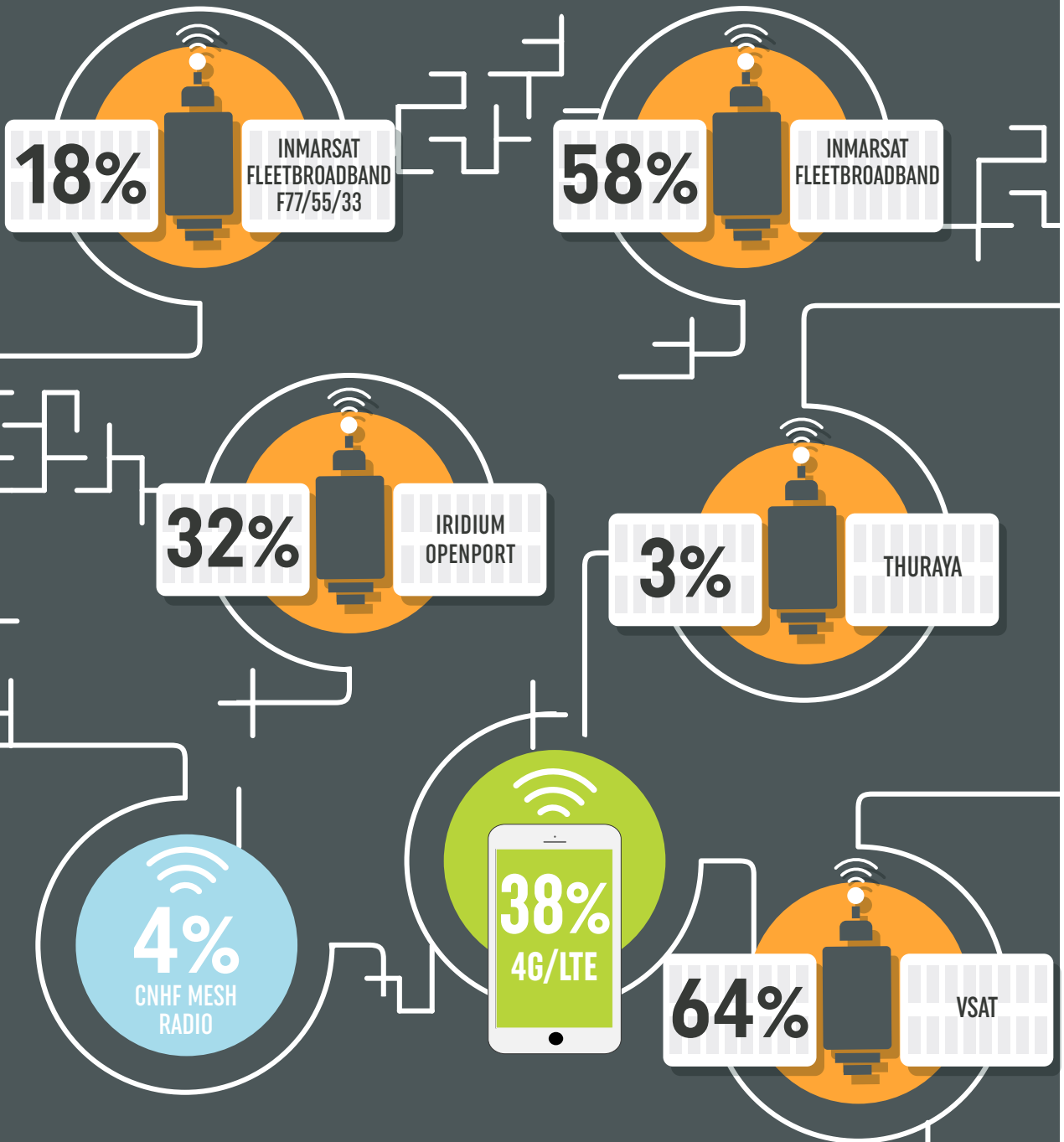
In the next chapter we provide insight into the type of connectivity solutions fitted on board, assess how and why ship operators use the connectivity solutions they do, and which are the primary means of communication deep-sea and near shore. Ship operators also reveal the primary constraints in using these solutions and how long their vessels spend in port and coastal waters.
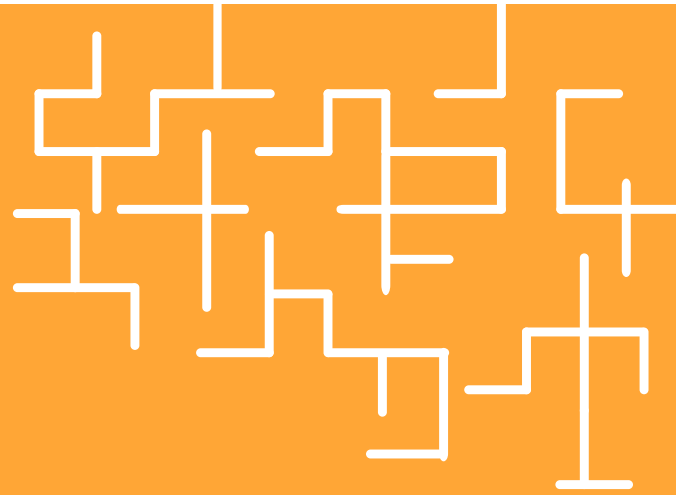
CHAPTER

3

REASSESSING YOUR ON BOARD CONNECTIVITY STRATEGY

DISTRIBUTION OF CONNECTIVITY SOLUTIONS

18% INMARSAT FLEETBROADBAND F77/55/33

58% INMARSAT FLEETBROADBAND

32% IRIDIUM OPENPORT

3% THURAYA

4% CNHF MESH RADIO

38% 4G/LTE

64% VSAT

In the previous chapter we concluded that there is likely to be significant growth in the amount of data generated but that much is likely to remain on board and its value unrealised.

Despite the forecast growth of centralised analytics, value was only likely to be created from a small subset of the total data available to ship operators. In addition, it became clear that a substantial percentage of data was non-time critical and could easily be delayed until near shore connectivity options were available.
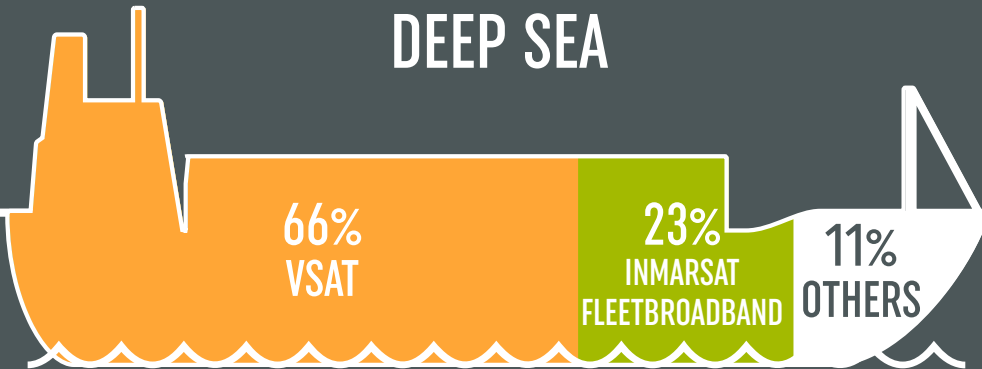
In this chapter we turn our attention to the type of connectivity solutions fitted on board, assess how and why ship operators use the connectivity solutions they do, and which are the primary means of communication deep-sea and near shore. **Ship operators also reveal the primary constraints using these solutions and how long their vessels spend in port and coastal waters.**

The results support the theory, suggested in the first chapter, that **shipping could easily adopt an aeronautical model to off-load non-time critical or underutilised datasets when higher bandwidth and lower cost connectivity solutions are available**. It concludes that ship operators need to assess their on board connectivity strategy to ensure that they are utilising near shore connectivity effectively to capitalise on the value lying within the data created on board.
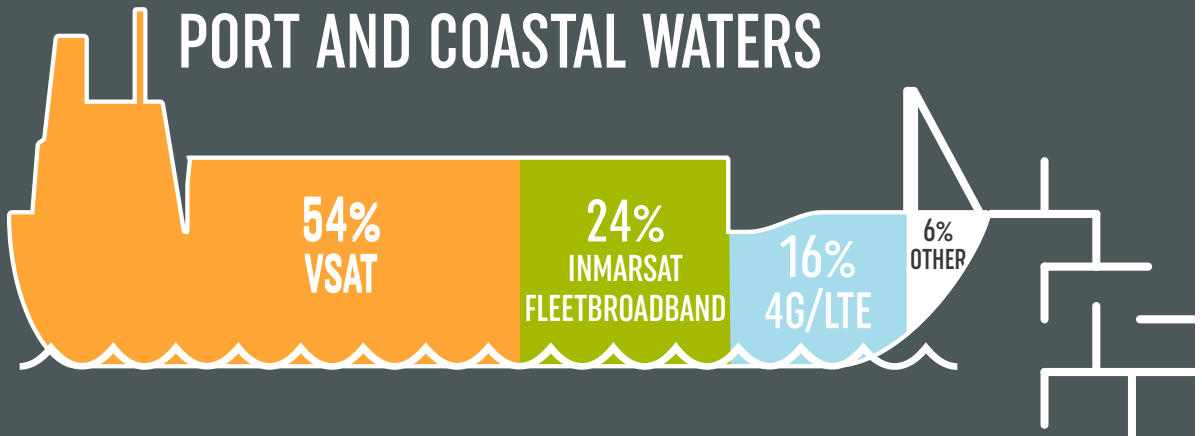
JUST 16% USE 4G AS PRIMARY CHANNEL IN PORT/COASTAL WATERS

DEEP SEA

66% VSAT

23% INMARSAT FLEETBROADBAND

11% OTHERS

PORT AND COASTAL WATERS

54% VSAT

24% INMARSAT FLEETBROADBAND

16% 4G/LTE

6% OTHER

BREAKDOWN OF TIME IN PORT AND AT SEA

(PER MONTH)

22% PORT

40% DEEP SEA

38% COASTAL WATERS
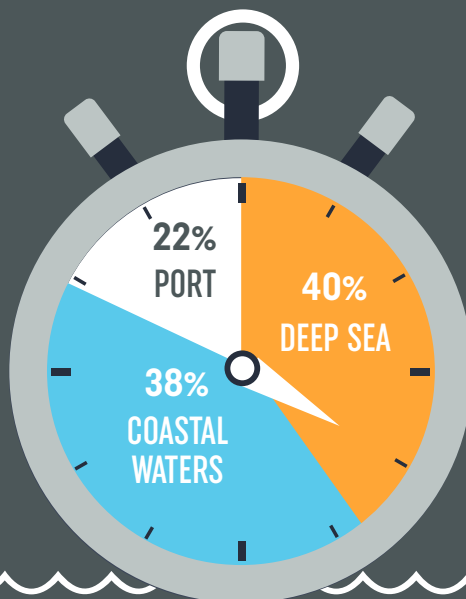
SATELLITE USE STILL DOMINATES

VSAT (Very Small Aperture Terminal) are now the dominant communications technology and were present in significant numbers in all shipping sectors. On average VSAT systems were present on 60% of all vessels in the survey. Once the principal connectivity solution for many sectors, **Inmarsat's FleetBroadband broadband service has shifted towards VSAT as ship operators have increased connectivity capacity on their ships.**

There are now significant levels of 4G/LTE installations (38%) which mean that this is the third most common real-time connectivity solution on board and is fitted in greater numbers than either Iridium or Thuraya satellite solutions. The majority of 4G/LTE systems deployed (48%) are handheld phone units provided to the ship's captain for in port or emergency use. **Simple data dongles attached to PCs deployed throughout the ship accounted for 38% of installations. 14% of ships were fitted with dedicated 4G/LTE solutions which comprise centralised Below Deck Equipment (BDE) plus a fixed external antenna.** Highest levels of 4G/LTE penetration were found in the tanker, offshore & general cargo sectors.

Also, for the first time we witnessed mesh Cognitive High Frequency Radio networks appear as a serious competitor to satellite or 4G/LTE services. Although providing comparatively slow connection speeds these solutions now provide global coverage through their mesh technology.

Not only is VSAT now the most prevalent satellite system at sea it is also the primary deep-sea and near shore communications system in terms of

> Ships spend 60% of their operating time in areas that are likely to have 4G/LTE coverage.

use. 66% of ship operators use VSAT as the primary system deep sea compared to only 23% using Inmarsat FleetBroadband. VSAT also dominates in port and coastal waters with 54% of ship operators using it as their primary communications channel.

Ship operators told us that as an average across all shipping sectors a ship will spend **8 days per month in port and another 10 days per month in coastal waters. Ships therefore spend 60% of their operating time in areas that are likely to have 4G/LTE coverage.**

Despite being widely deployed and available for the majority of a ship's voyage, 4G/LTE solutions are only used by 16% of vessels as their primary means of communication in port and coastal waters.

4G/LTE SOLUTIONS USED ON-BOARD

48% HANDHELD PHONES

38% DATA DONGLES

14% DEDICATED SOLUTIONS WITH BDE
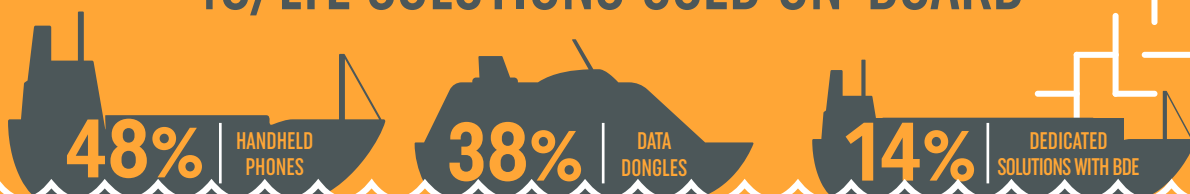
MAXIMIZE VALUE BY TIMELY OFF LOADING OF DATA

4G
IN PORTS AND COASTAL WATERS

44%
4G USERS WHO IDENTIFY COST SAVINGS

18
DAYS ACCESS TO 4G EVERY MONTH

42%
OF DATA ON-BOARD IS NON-TIME CRITICAL

88%
OF DATA ON-BOARD IS NEVER SENT ASHORE

LARGE POTENTIAL TO OFFLOAD DATA VIA MOBILE NETWORKS

4G/LTE solutions were fitted primarily to reduce overall communication costs, provide a backup to existing satellite solutions and to provide crew with a cheaper alternative to satellite for their personal communications.

Three key results have emerged from this research that should give ship operators pause for thought regarding their current connectivity strategy. **The growth in data predicted over the next five years, the untapped requirement for analytics, and the time ships have access to near shore connectivity,** inevitably lead us to question whether operators' focus should remain so firmly on satellite connectivity?

In the first chapter we looked at how the aeronautical industry has adopted new methods to derive maximum value and insight from its assets. The data from these surveys clearly suggests that this type of model could work for shipping given:

- Resilient alternative connectivity channels for non-urgent data exist in the form of 4G/LTE solutions present in ports and coastal waters

- Ships have access to these channels on a regular basis — on average 18 days out of every month

- 42% of data generated on board ship is non-time critical and could wait until the vessel is in coastal waters or alongside.

- 88% of the data generated on the ship is never sent ashore for analysis and significant value is unrealised

By reassessing how data transmission is prioritised operators have the ability to free up satellite capacity whilst deep-sea, a strategy that would allow capacity to be utilised elsewhere or help manage overall connectivity costs.
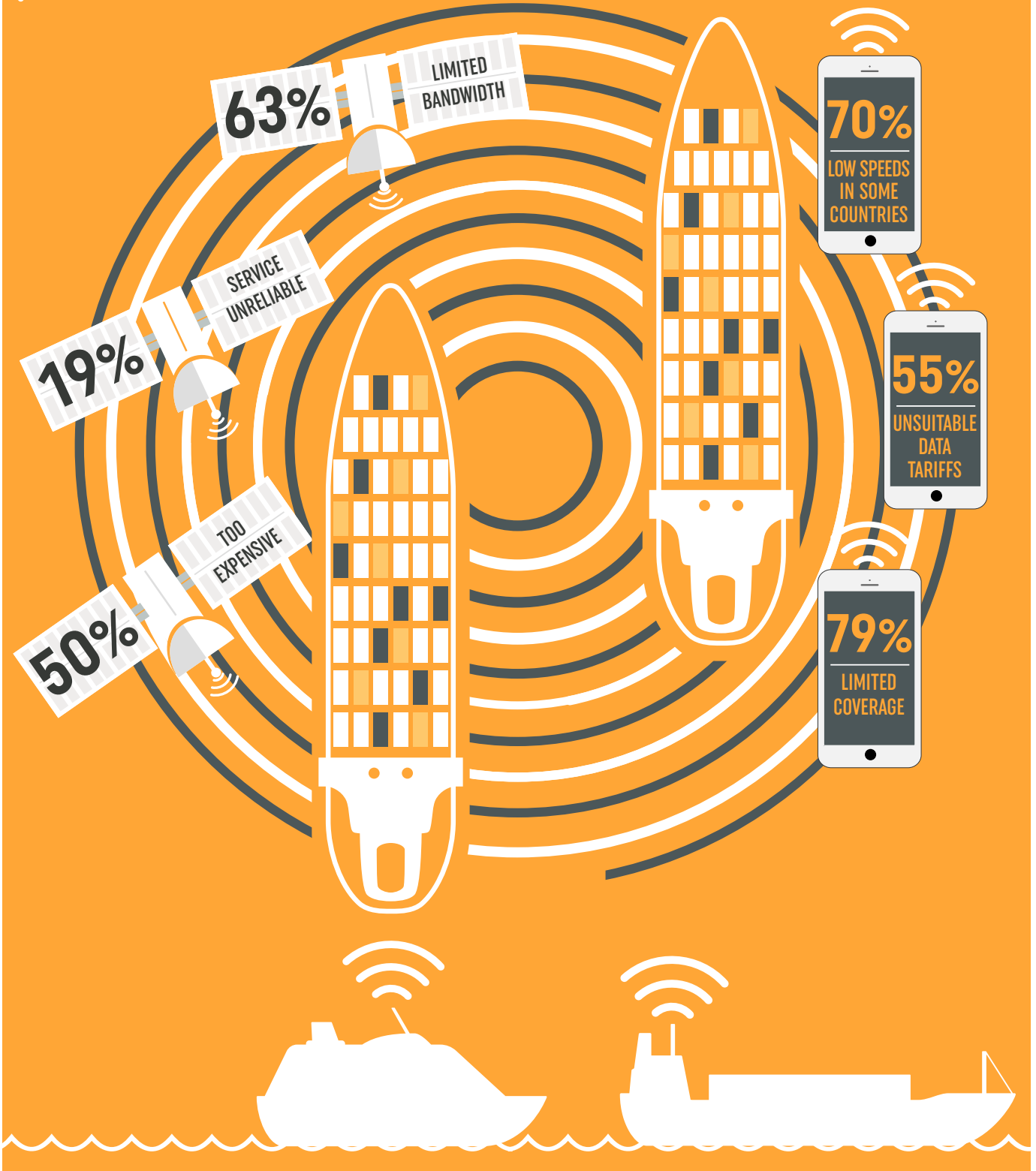
By reassessing how data transmission is prioritised operators have the ability to free up satellite capacity whilst deep-sea, a strategy that would allow capacity to be utilised elsewhere or help manage overall connectivity costs. The large volumes of data that are currently so under-utilised could be offloaded whilst the vessel is in port or coastal water by near shore connectivity solutions. The efficiency gains, value generated, and cost saved will help improve margins in an extremely volatile and competitive market.

TOP 3 SATELLITE AND MOBILE CONSTRAINTS

63% LIMITED BANDWIDTH

19% SERVICE UNRELIABLE

50% TOO EXPENSIVE

70% LOW SPEEDS IN SOME COUNTRIES

55% UNSUITABLE DATA TARIFFS

79% LIMITED COVERAGE

THE FUTURE IS HYBRID

Ship operator respondents believe that **lack of bandwidth is the biggest constraint when using satellite** communications. Regardless of whether this belief is well founded it does explain why such large volumes of data remain on board. **Cost is still quoted as a major constraint.** Despite the increase in bandwidth available and the fall in its cost in recent years it is still viewed by operators as a constrained resource. Almost one in five ship operators stated that the current satellite solutions installed on board their ships were unreliable.

Whilst suppliers recommend VSAT over any other communications solution over a third of suppliers suggest that current connectivity solutions onboard limits their ability to sell solutions to ship operators. This, they suggest, is most often down to a lack of understanding within ship operators of the connectivity onboard. They also quote airtime costs as a constraint as well as the complexity of interfacing their solution with the connectivity platforms onboard. Although VSAT is recommended by suppliers 4G/LTE has been proven to work with over 60% of application suppliers' solutions, the same number as for secondary satellite solutions such as Iridium.

Ship operators highlighted the limited coverage of 4G/LTE services and the low speeds experienced in some countries as the two biggest constraints that they faced using GSM today. Many ship operators also pointed to the fact that, because they were buying off-the-shelf 4G/LTE data products the data tariffs were ill-suited to the shipping industry.

> Ship operators believe lack of bandwidth and cost are the main constraints to using satellite connectivity.

Most ship operators have adopted a hybrid approach to connectivity and have a number of solutions available on board but the extent to which there is a clear strategy around how to use these systems most efficiently is unclear. There is also an underlying sense, however, that all the systems at their disposal are constrained in some way and this limits their ability to fully exploit data being collected on board.

CHAPTER CONCLUSIONS

Satellite connectivity is and will remain the primary connectivity solution on board for safety, compliance and commercial purposes and near shore solutions won't change this. **4G/LTE technology can never be a replacement for satellite but it has been overlooked as a complementary service that can in certain circumstances deliver real benefits to ship operators and their crews.** Therefore, we have sought within this chapter to highlight why ship operators should perhaps pause and reconsider their connectivity strategy on board to lean more heavily on 4G/LTE services.

Ship operators feel that satellite solutions constrain the volume of data that they can cost effectively transfer and the quality of connectivity services they can provide to their crew. Today this appears to be preventing ship operators from transferring the vast majority of data that is generated on board. Given the non-time critical nature of the data generated much could be left on board until higher bandwidth, lower cost alternatives are available. With ships

spending 60% of each month in port or coastal waters 4G/LTE could provide the mechanism needed to adopt an aeronautical model, outlined in the first chapter, offloading large volumes of data for little additional cost. With nearly 40% of the market equipped with 4G/LTE solutions its utilisation and value should be reviewed.

The predicted growth in data requirements at sea is not matched by an expectation within ship operators to pay more to support this growth. It is unclear how ship operators anticipate supporting their business objectives unless they re-assess their connectivity strategy on board in favour of lower cost, higher bandwidth near shore alternatives.

Satellite and 4G/LTE services can complement each other to assist ship operators to maintain their competitiveness and resilience in tough market conditions. As GSM systems become more prevalent on board and more integrated within the communications infrastructure, we can expect to see greater reliance on these services by ship operators, particularly as we enter the 5G era.
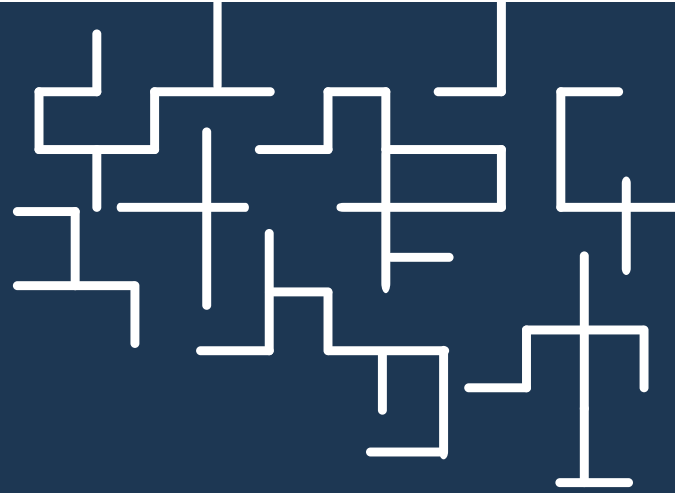
CHAPTER

4

CONCLUSION: CONNECTIVITY & SHIPPING'S AUTONOMOUS FUTURE

SHIPPING IS TRANSITIONING TO A NEW TECHNOLOGY ECOSYSTEM

EDGE AND ANALYTICS | SENSORS | ROBOTICS | AUTONOMOUS SYSTEMS

4G
4G
4G
4G

SHIPPING ANALYTICS

%

Mon
Tue
Wed
Thu
Fri
Sat

Contrary to what many believe, shipping has been a steady, if slow adopter of technologies over the past thirty years.

But the cost and complexity of vessel connectivity has inevitably meant a divergence between the ability of shoreside companies to roll out highly functional applications, and that of shipping companies operating their main assets at sea.

Even for shoreside companies the pace of change is accelerating as exponential technology growth drives falling costs and increases in functionality, but for the shipping and maritime industry the scale of the change is highly disruptive.
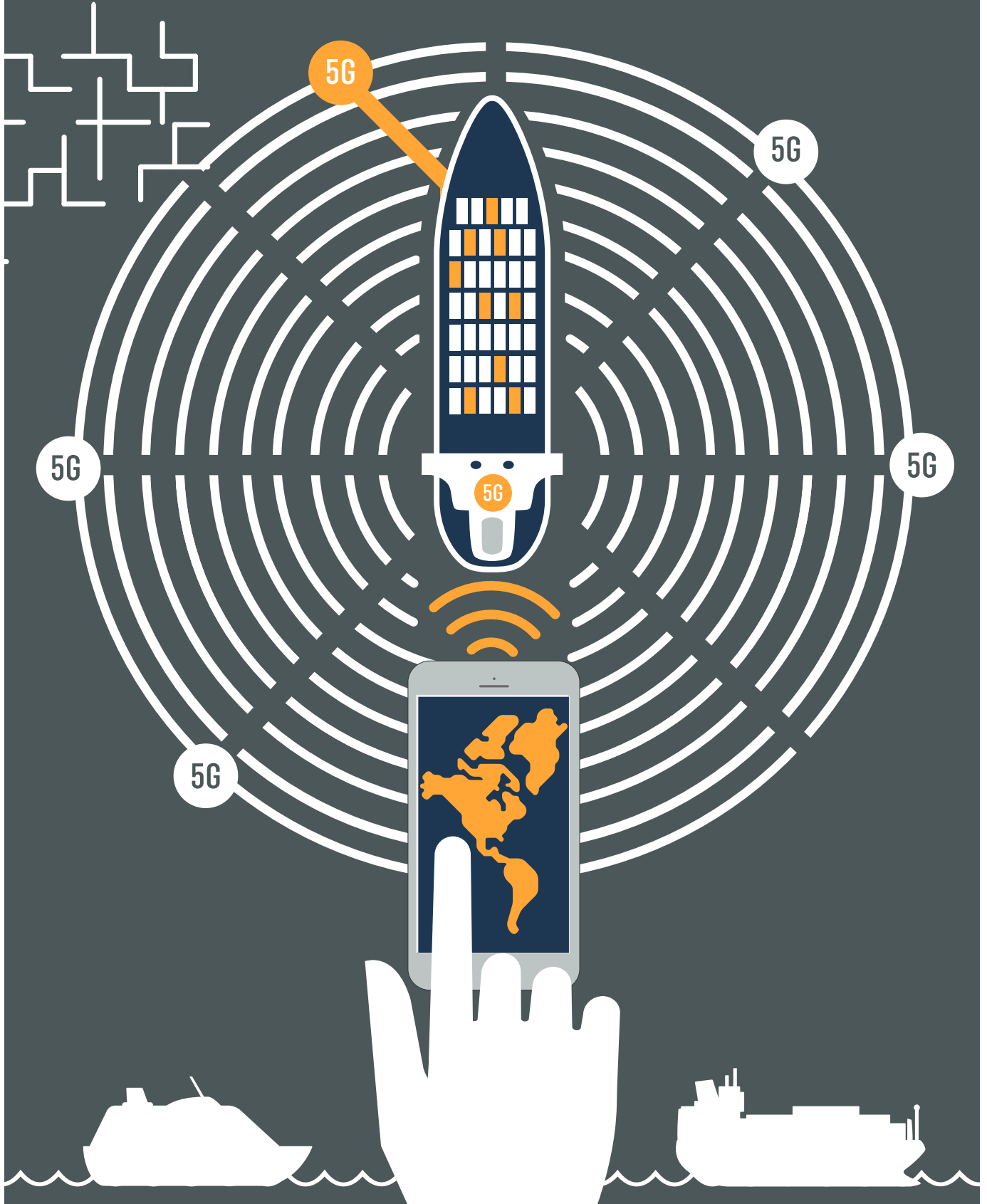
As the research clearly demonstrates, the opportunities to add value via digitalisation of assets and processes is recognised, and being adopted by Tier One ship operators, but even here significant amounts of value are being left on the table. **The current narrative around digitalisation has been very much focussed on efficiencies and cost reductions – both of which shipping requires – however, the**

rigid focus on costs has so far squeezed out an important conversation about value.

Designing and investing in systems which capture that value requires a clear understanding of where and how it will be created in the future. Shipping is transitioning from being a siloed industry to a constituent part of multiple ecosystems which will require secure, highly functional and interoperable technology platforms. At the same time these ecosystems will need to be decarbonised and likely able to adopt or support circular business operations.

5G WILL BRING ABOUT A STEP-CHANGE IN CONNECTIVITY SOLUTIONS

So much of the onboard technology to date has been optimised to cope with high-latency satellite links, and is therefore more expensive and lacks the functionality of the systems used ashore. But opportunities today to utilise better connectivity, such as 4G enable shipping to begin playing a part in ecosystems which span sea and shore.

The use of analytics is set to rise sharply, and with the advent of edge computing we are likely to see more of this taking place at sea. Edge and analytics coupled with sensors, actuators and robotics will underpin the autonomous systems, and eventually the autonomous vessels, already being designed and built.

Autonomy is developing hand-in-hand with decarbonisation, which is why we are likely to see the first autonomous vessels operating in territorial/coastal waters where use of zero-emission technology is not determined by deep sea security of operation concerns. There are a range of interdependencies and reinforcing effects around the Industry 4.0 technology basket which are all contributing to the speed of this change, but one of the most critical is the advent of 5G networks. **Many in shipping do not fully appreciate the step-change that 5G will bring** — it is argued that a fully functional 5G network when deployed will allow the owner to create its own version of the Internet — and the implications for connectivity solution design and investment today are significant.

> Far from a cost-centre, connectivity and IT has transitioned into a driver of strategic competitive advantage for the business,

As the shipping ecosystems take shape, they will include operators, cargo owners, regulators, insurers, lenders, ports, sea-traffic management and a new range of Blue domain stakeholders, all of which will be looking for radical transparency into the operations of the vessel. Perhaps the most striking feature of the research findings is the lack of an evidence base, or unified view about the state of data use, exchange and value in current shipping operations. For shipping ecosystems, the ability to create this unified view, and make that transparent to a range of stakeholders will be critical in the future. It will allow value to be created in multiple new ways — from regulation to safety and compliance.

Far from a cost-centre, connectivity and IT has transitioned into a driver of strategic competitive advantage for the business, and recognising this is now pivotal for ship operators. What is required is a next-generation approach to shipping connectivity and IT which leverages the maritime domain knowledge alongside a broader understanding of the potential of new technologies like 5G to underpin radical new business propositions, and capture new value.
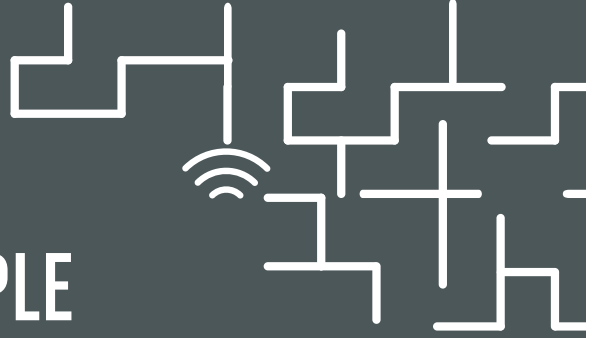
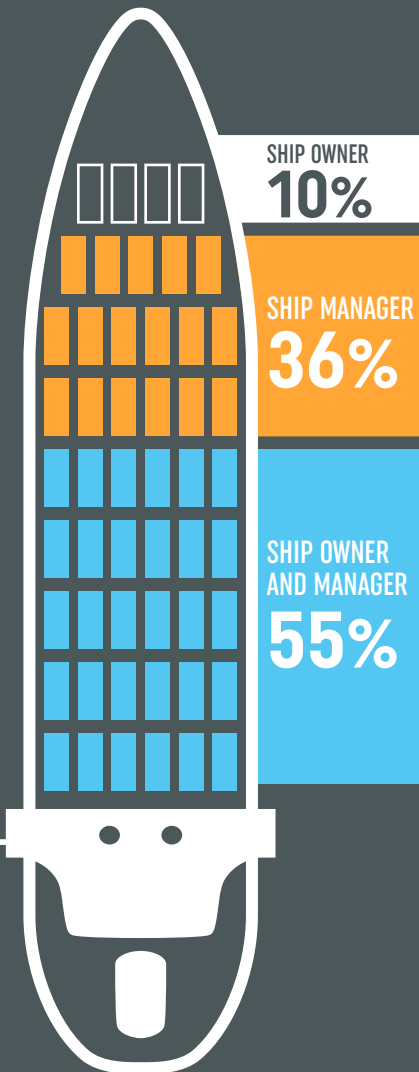# CHAPTER
5

SURVEY SAMPLE

SURVEY SAMPLE

The Futurenautics / Vodafone Roaming Services Nearshore Connectivity Survey was conducted between May & July 2019. It surveyed both ship operating companies, owners and managers, and also companies involved in the supply of data generating applications to ship operators.

73 ship operating companies consisting of owners, managers and owner managers participated in the research with the majority located in Europe and Asia (84%).
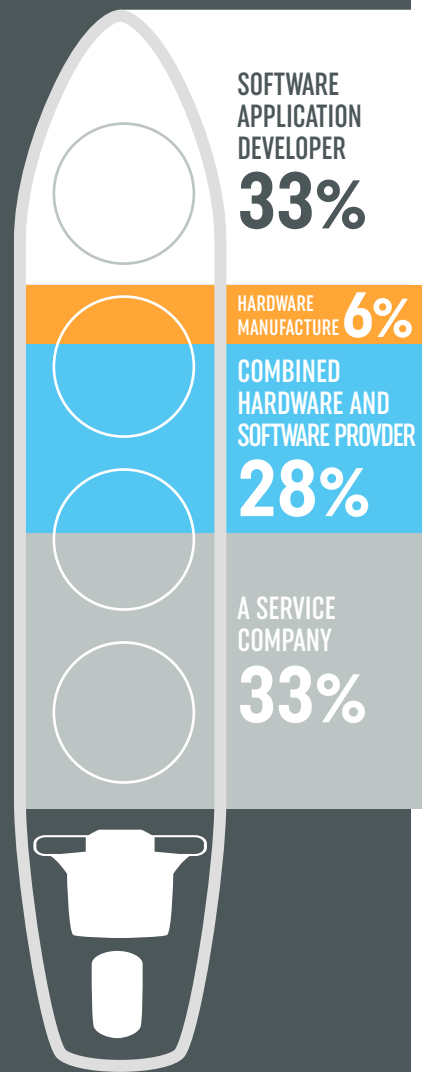
These operators controlled a total 5,779 ships with an average fleet size of 79.

37 supplier companies providing solutions primarily to the commercial shipping sector participated in the research. 33% were pure software application developers, 33% service companies, 28% were combined hardware and software suppliers. **Suppliers had applications deployed on just under 70,000 ships worldwide.**

SHIP OPERATING COMPANY RESPONDANTS

SHIP OWNER
10%

SHIP MANAGER
36%

SHIP OWNER AND MANAGER
55%

SUPPLIER COMPANY RESPONDANTS

SOFTWARE APPLICATION DEVELOPER
33%

HARDWARE MANUFACTURE **6%**

COMBINED HARDWARE AND SOFTWARE PROVDER
28%

A SERVICE COMPANY
33%

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Futurenautics Maritime offers world-leading expertise, foresight, research, corporate advisory services and consulting. The combination of deep domain knowledge, relationships and expertise alongside a truly global perspective on technology and other megatrends makes Futurenautics Maritime a unique partner, with an intimate understanding of the immediate challenges for those leading, financing and transforming shipping and maritime companies as we enter the next phase of globalisation.

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NEAR SHORE CONNECTIVITY WHITEPAPER 2019

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