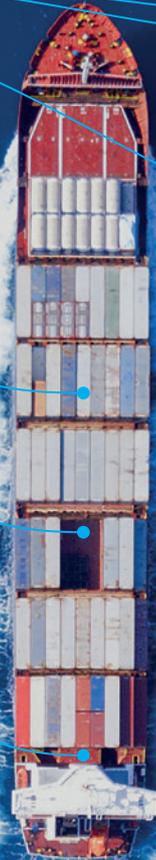


# Industrial IOT on land and at sea: Maritime



Inmarsat  
Research  
Programme  
2018

  
inmarsat

# INTRODUCTION

Humans are consuming more. There are more of us than ever, and we have become accustomed to new technologies and the greater access to information they bring to our lives. For businesses in our major industries – agriculture, energy, maritime, mining and transport – this is having a significant impact. Producers need to optimise their extraction processes, manufacturers need to trace goods from initial extraction to their final destination, and suppliers need to provide more information about the goods that they deliver.

Data, generated by smart technologies like the Internet of Things (IoT), is enabling these changes, and for businesses engaged in these industries, it has become the key differentiator. Every business needs to collect data effectively in order to create new efficiencies to pass onto customers, before their competitors beat them to it.

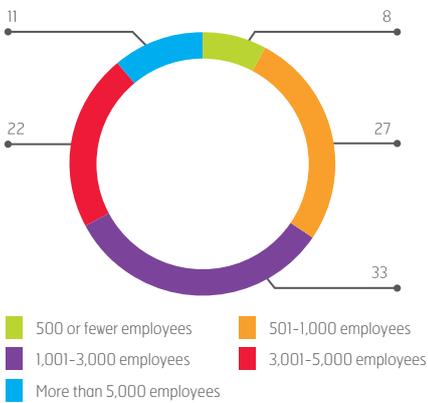
## INMARSAT RESEARCH PROGRAMME

The Inmarsat Research Programme is now in its second year. This 2018 research is focused on understanding the ways that the industrial Internet of Things (IoT) is affecting the global supply chain and the way in which organisations from the agriculture, energy, maritime, mining and transport sectors operate. In May 2018 Inmarsat commissioned Vanson Bourne, a specialist technology market research company, to interview 750 respondents about their use of, attitude to and predictions for IoT within their organisation and industry.

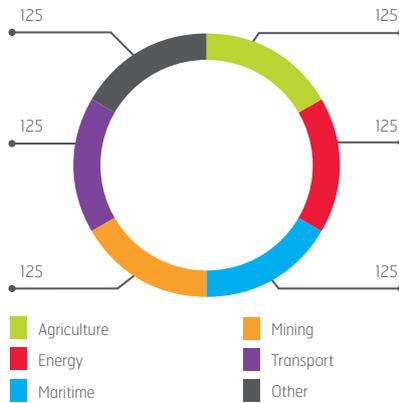
Respondents worked for organisations with at least 500 employees and have either decision-making or influencing responsibilities for IoT initiatives. However, the profile of maritime respondents is different, in that 46 per cent worked for organisations employing fewer than 500 people.

## RESEARCH DEMOGRAPHICS

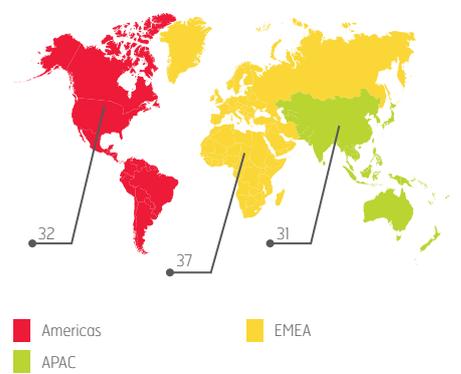
RESPONDENTS BY SIZE OF ORGANISATION (%)



RESPONDENTS BY SECTOR (750)



RESPONDENTS BY REGION (%)

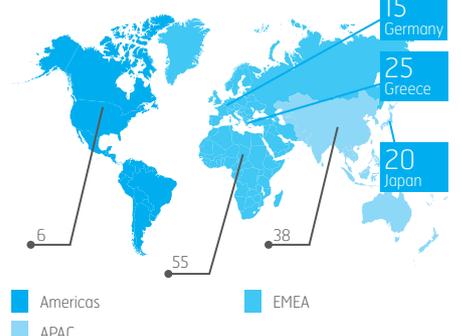


## MARITIME DEMOGRAPHICS

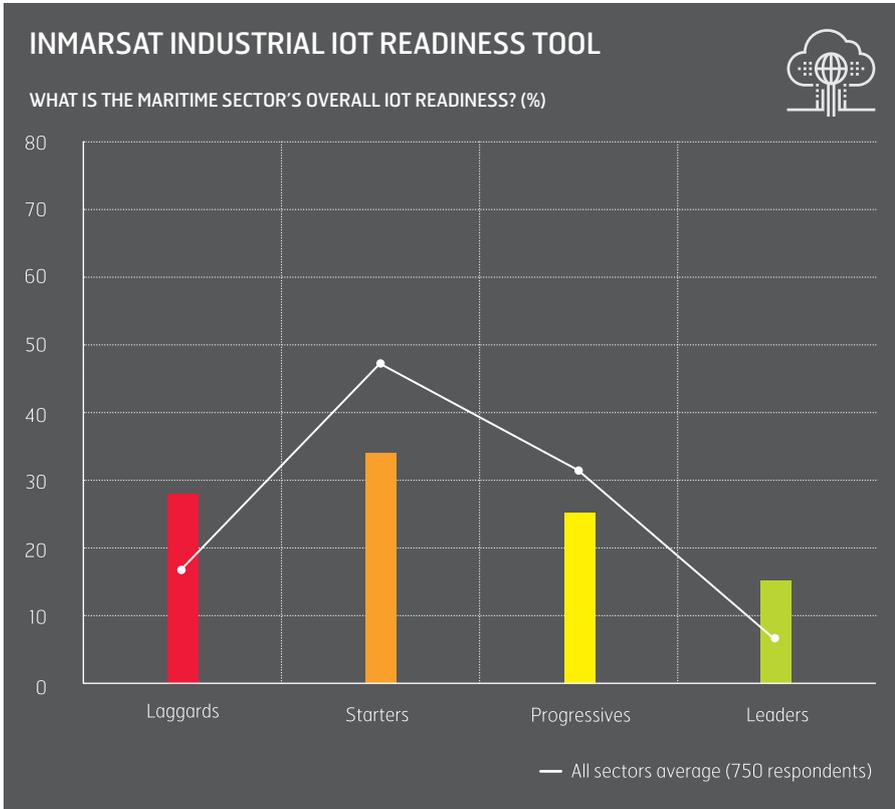
RESPONDENTS BY FLEET SIZE

Vessels	Total	Shipping	Fishing
1-10	40%	25%	79%
11-20	28%	33%	15%
21-30	16%	20%	6%
31-50	11%	15%	0%
51+	6%	8%	0%
<b>Average fleet size</b>	<b>19</b>	<b>23</b>	<b>8</b>
<b>Base</b>	<b>125</b>	<b>92</b>	<b>33</b>

RESPONDENTS BY REGION (%)



# MARITIME



maritime world where the class societies enforcing safety standards are trialling drones to support ship inspections, where shipboard CCTV monitoring brings clear benefits for the safety and security of crew and cargoes alike, and where the digital platforms used for weather forecasting and distress alerts are joining IIoT.

Nevertheless, full-blooded maritime commitment to IIoT-based solutions will also be driven by the competitive edge established by the 'IIoT leaders', identified here as representing a larger than anticipated segment of respondents. While shipping has more than its fair share of IIoT 'laggards', a significant portion of respondents overall can be seen as recognising the digital opportunities offered to cut costs. As the data in our research indicates, key areas for IIoT-based solution deployment have been identified for the coming months and years. It is also clear, not only that some maritime companies are not responding to the increasing digitalisation, but that industry strategists and managers have plenty of work to do to prepare procedures, skillsets and security to take best advantage of the opportunities on offer.

**With over 90 per cent of world trade carried by sea<sup>1</sup>, shipping sentiment is continuously influenced by other stakeholders in the global supply chain, including regulators. Today, over-capacity in the container market, slower growth in demand for raw materials, soft tanker rates and idle offshore tonnage co-exist with market positives that include new northerly sea routes, the rise of liquefied natural gas and demand for cruise tourism.**

Nevertheless, the consequences of the global financial crisis of 2008, the oil price slump from 2014 and tightening environmental regulations continue to frame the maritime narrative, with owners under pressure to cut costs and emissions but enhance safety.

In the following pages, we shall explore how IIoT-based solutions offer the maritime industry a straightforward way of 'getting its house in order' in response to rising environmental concerns, their use to enhance health and safety, and their potential to improve efficiency.

We will also address the challenges inhibiting adoption, including lack of in-house skills and industry knowledge, but also entrenched ambivalence towards new technologies.

Specific attention will be paid to 'gateway' IIoT-based solutions which simultaneously meet regulatory and cost efficiency requirements. For example, as further International Maritime Organization rules loom, limiting emissions from ships and ushering in an era of new more expensive fuels, IIoT-connected shipboard sensors provide a ready answer to monitor, report and verify fuel use. Today, 65 per cent of ship owners have or are trialling IIoT-based fuel consumption monitoring, with a further 9 per cent to do so within the next 12 months.

It is important not to overplay the 'compliance' card, given that around half of the maritime respondents in the current study say either they do not aim at or do not expect greater compliance as an outcome of adopting IIoT solutions. However, owners today inhabit a

#### INMARSAT INDUSTRIAL IOT READINESS TOOL



Our tool allows us to benchmark sectors, organisations and industries against each other based on their IIoT readiness.

We asked our 750 respondents a series of questions, with points attached to their responses, scoring their IIoT development in six key areas:

- Adoption
- Security
- Connectivity and IIoT technologies
- Skills
- Data
- Investment and ROI

Using the scores, we divided our respondents into categories indicating their IIoT maturity: laggard, starter, progressive and leader.

<sup>1</sup> www.business.un.org/en/entities/13

# ADOPTION

HOW MATURE IS THE MARITIME SECTOR IN RELATION TO IIOT ADOPTION? (%)



Shipping’s notorious ambivalence towards new technology is today characterised by a willingness by some to engage with predictive remote diagnostics, automated processes and blockchain, while others take regulatory compliance as their investment cue.

Thus, shipping’s ‘conservatism’ is belied by the significant group of maritime respondents identified as IIoT ‘leaders’ in our research. Some 34 per cent see themselves as having ‘fully deployed’ IIoT-based solutions, a proportion that puts maritime ahead of other industries such as agriculture, energy and mining.

At the same time, maritime also finds a home for the group which represents the largest rump of IIoT ‘laggards’ compared with the other sectors we interviewed, despite the fact that IIoT technologies hold much promise for the sector.

Driving the ‘leaders’ is the need for ships to be more cost efficient, cleaner and safer than ever before, with 56 per cent of maritime respondents using or trialling smart asset monitoring. For the moment, fishing lags marginally behind commercial shipping, but the disparity may be short-lived: 57 per cent of the 33 fishing organisations polled envisage uptake over the next 24 months.

Regulation is playing its part. In shipping, restrictions on emissions are driving owners to monitor fuel consumption using electronic

reporting: 47 per cent of respondents already use IIoT-based solutions to monitor fuel use rising to 100 per cent by 2023. In fishing, the regulatory requirement comes from the need for fishers to demonstrate that catches are from sustainable sources.

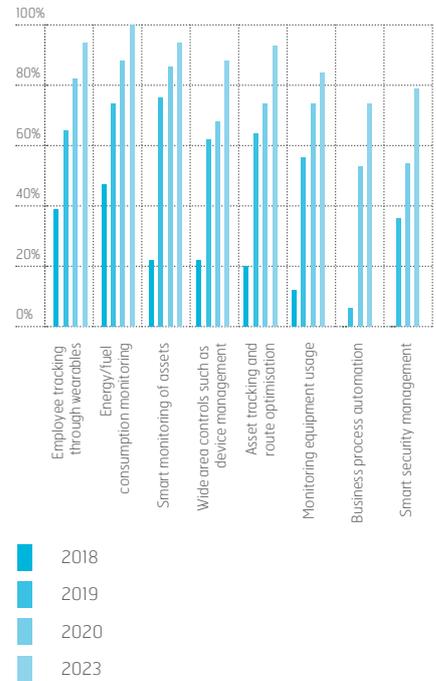
Safety is also a key factor in IIoT-based solution adoption. Cutting marine insurance premiums was cited by 70 per cent of respondents as one of the most important drivers for adoption, for example. Again, 45 per cent of shipping respondents (excluding fishing) use wearable technology for tracking, while 39 per cent intend to do so within two years.

Indeed, the 1.6 million seafarers working, resting and wanting to connect IIoT-based solutions from remote locations represent another variable peculiar to maritime: connectivity is a welfare issue within the Maritime Labour Convention and is also material to choosing an employer. Today, 25 per cent of the maritime industry obtains health and safety benefits through IoT solutions, while 56 per cent expect to do so in the future. Our research shows ‘health and safety’ as shipping’s second most commonly cited driver for adopting IIoT-based solutions.

However, the maritime sector’s decade-long fixation with cost is also of central importance. Some 51 per cent of respondents say the potential to generate new revenues does not figure in their thinking when considering IIoT solutions, while 75 per cent have or expect to realise cost savings. One technology identified is IIoT-based route optimisation, which 57 per cent of owners are operating or trialling, rising to 66 per cent excluding fishing. Respondents suggest that IIoT-based solutions will yield greater automation (40 per cent), achieve greater productivity (80 per cent) and improve decision-making (81 per cent).

Nevertheless, even in the case of costs, expectations appear divided: while 33 per cent of maritime respondents believe that IIoT solutions will bring 10-20 per cent savings within five years, 14 per cent believe that – even then – they will bring no savings at all.

IN WHAT AREAS WILL YOUR ORGANISATION ADOPT IIOT-BASED SOLUTIONS? (%)



**70%**  
say cutting insurance premiums is one of the most important adoption drivers

Restrictions on emissions are driving owners to monitor fuel consumption using electronic reporting

# SKILLS

## DOES THE MARITIME SECTOR HAVE THE SKILLS IT NEEDS FOR IIOT? (%)



**A sector where individuals or small teams can have unusually strong decision-making power, which also acknowledges its own IIoT 'laggard' tendencies, is likely to benefit from not only enhancing, but importing and sharing new skills.**

From the 1970s onwards, elements of the maritime sector have bemoaned skills erosion at sea, identifying a widening gap between advancing technology and the skillsets available to handle it. Nor have the efforts of regulators to harmonise technology standards been universally welcomed: the phase in of mandatory electronic chart data information systems is only one example of how well-meaning regulation 'freezes' technical progression before the full consequences for safety at sea have been established.

IIoT-based solutions can be deployed to improve safety, environmental performance and efficiency at sea, whether through capturing seafarer activities in real time, fuel use monitoring, or the analysis of shipboard data for diagnostics purposes. However, the most frequently cited shortcoming identified when it comes to delivering IIoT-based solutions (in 56 per cent of cases) relates to decision-making skills. Maritime also identifies itself as behind the curve when it comes to planning skills, where 42 per cent of respondents believe their organisations would benefit from additional skills against 37 per cent across all respondents surveyed.

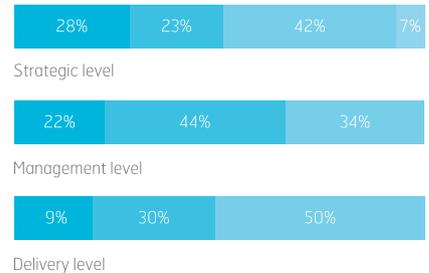
In all other areas, the maritime industry does not mark itself out as 'behind' comparable sectors in terms of the skills necessary to implement IIoT-based solutions. However, it should be noted that 53 per cent of respondents suggest additional security skills would be useful – a high number in absolute terms only diminished in relative terms by the extraordinary weight given to this indicator by mining respondents.

In maritime, individuals or small teams within an owner company can have unusually strong decision-making power when it comes to committing to IIoT-based solutions, but the maritime sector also self-selects itself for its IIoT 'laggard' tendencies: lack of in-house skills is its most frequently cited barrier to adoption. Respondents attribute a lack of skill in management (41 per cent), in strategy (42 per cent) and in implementation itself (50 per cent) as reasons why maritime organisations are not making the most of IIoT-based solutions.

The truth is that much of the technical expertise formerly held by owners has been outsourced to ship managers and equipment suppliers. A fuller picture when it comes to skills emerges after considering that marine equipment can contribute 70 per cent of the value of a new ship.

In reality, it has been suppliers – rather than owners – who have made much of the running on connectivity, big data analytics and application-triggered bandwidth to support remote equipment monitoring, diagnostics and preventive maintenance. In the current study, 68 per cent of maritime respondents said that they would use an external partner to facilitate 'some' or 'as much as possible' of their efforts to develop IIoT-based solutions.

## TO WHAT EXTENT DOES YOUR ORGANISATION HAVE THE SKILLS TO MAKE THE MOST FROM IIOT-BASED SOLUTIONS? (%)



- We have all the skills we need
- We would benefit from additional skills at this level to augment those we have
- We are lacking the skills we need at this level
- I don't know

# 42%

**believe their organisations would benefit from additional IIoT skills**

**Suppliers – rather than owners – are making the running on connectivity and big data analytics**

# THE CONNECTED SHIP:

## ENERGY EFFICIENT AND ENVIRONMENTALLY RESPONSIBLE

For over a decade, commercial and regulatory factors have kept shipping under unrelenting pressure. With fuel representing 50-60 per cent of ship operating costs and emissions more tightly controlled than ever before, fuel monitoring is proving a gateway for IoT-based solutions.



### DEEP SEA CONTAINER SHIPPING

A 14,000 TEU container ship makes the 12,000-mile transit between Shanghai and Rotterdam in 26 days.

6 | INDUSTRIAL IOT: MARITIME  
Container shipping efficiencies are based on scale economies.



### COUNTING THE 'COST' OF FUEL

For ships, fuel is the largest operating cost. A 14,000 TEU ship consumes 200-220 tonnes of Heavy Fuel Oil per day, using HFO of up to 3.5 per cent sulphur content.

On this basis, a 14,000 TEU ship would emit SO<sub>x</sub> of 18.5 tonnes a day and CO<sub>2</sub> equivalent to 80g/km/TEU.



### THE COMPLIANCE AND COST IMPERATIVES

From 2020, the IMO will limit fuel sulphur content to 0.5 per cent worldwide. From 2018, the EU introduces electronically-formatted reporting on fuel consumption; IMO also now agrees shipping will halve CO<sub>2</sub> by 2050.

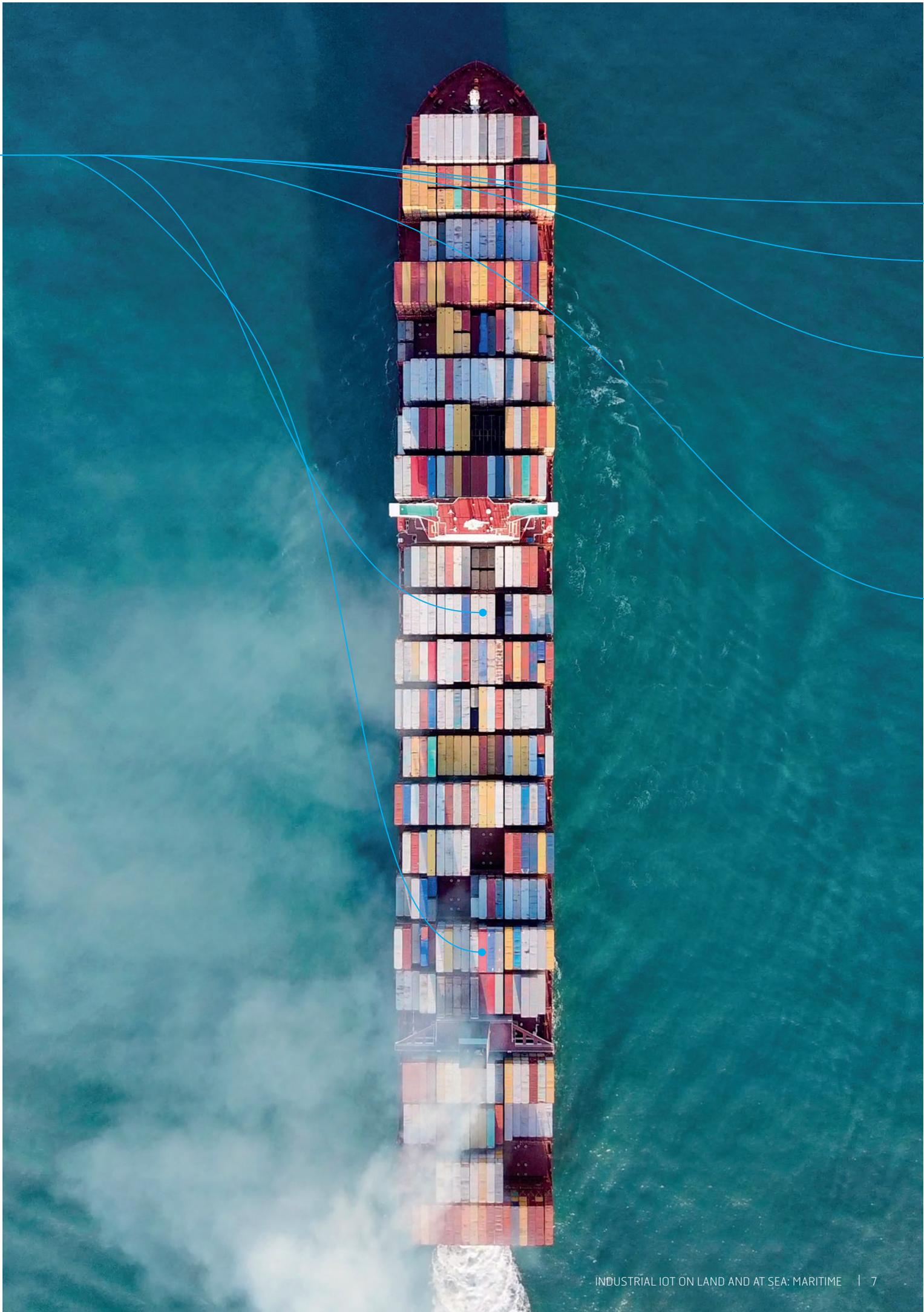
IMO 2020 restrictions alone expose owners to an HFO/low sulphur fuel differential of \$200 per tonne; \$40,000 or more a day for a 14,000 TEU ship.



### GATEWAY TECHNOLOGY FOR IOT

Satellite connectivity is creating the ecosystem for IoT-based tools that improve vessel efficiency, safety and security and crew welfare.

Fuel monitoring demonstrates that IoT-based solutions for shipping have both cost and compliance benefits.



# SECURITY

HOW MATURE IS THE MARITIME SECTOR'S APPROACH TO IIOT SECURITY? (%)



**Cyber-security has become a central concern for the maritime industry due to digitalisation and greater exploitation of IIoT increases the risk.**

Shipping's vulnerability to cyber-crime was highlighted by the NotPetya virus in June 2017, whose impact is estimated to have cost one of the largest shipping groups in the world \$50 million. Its spread may explain why cyber-security fears in the current research focus on inward-facing matters such as data storage methods (55 per cent), poor network security (50 per cent) and potential mishandling/misuse of data (44 per cent), rather than targeted attacks (39 per cent).

In fact, some 87 per cent of maritime respondents either strongly agree or agree that their organisation's processes to protect against data mishandling could be improved. Whether justified or not, maritime also counts itself as one of the least exposed to external security challenges that might emanate from supplier or partner data regulation and compliance requirements (16 per cent of respondents) when measured against other sectors.

Cyber-security fears focus on inward-facing matters such as data storage

While the threat to cyber-security may not principally derive from targeted attacks, 72 per cent of maritime respondents nonetheless either agree or strongly agree that their organisation's processes to combat theft or malicious damage to hardware, software or the information on them could be stronger. Meanwhile, 53 per cent believe that more security skills would help deliver IIoT-based solutions.

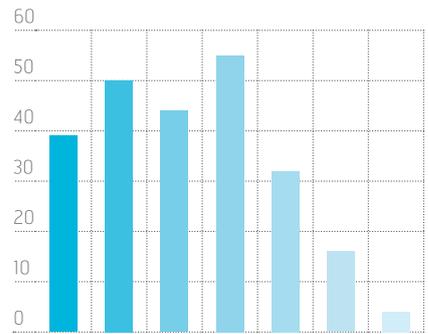
However, maritime is significantly behind the curve when it comes to addressing its own security skillsets: only 37 per cent of respondents report initiatives to improve security training, with only 25 per cent working on new IIoT security policies and just 18 per cent using skilled security staff.

One reason for relatively low activity to address security vulnerabilities in the maritime sector may be that 56 per cent of respondents say that the Chief Information Security Officer (CISO) is simply not involved with the organisation's IIoT initiatives. While 32 per cent of respondents answering in this way think that individual should be, a remarkable 24 per cent think that the CISO does not need to be involved in IIoT-based solution development at all!

Further analysis of data indicates that 77 per cent of maritime respondents are identifiable as 'laggards' or 'starters' when it comes to changes made or intended to address IIoT security concerns.

Meanwhile, the better informed maritime respondents appear to be putting their faith in IIoT-based smart security management: while no respondent reports having IIoT-based smart security management and only 2 per cent are trialling such an approach, 34 per cent say they will deploy within the next 12 months.

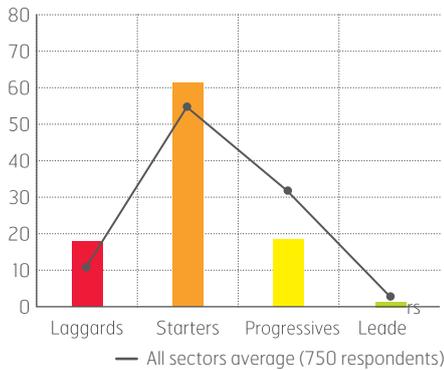
WHAT ARE THE BIGGEST SECURITY CHALLENGES ASSOCIATED WITH THE USE OF IIOT-BASED SOLUTIONS IN YOUR ORGANISATION? (%)



- Risk of external cyber-attack
- Poor network security
- Potential mishandling/misuse of data by employees
- Insecure storage of data collected
- Internal data regulation and compliance requirements
- Supplier/partner data regulation compliance requirements
- We have/will not face any security challenges

# DATA USAGE

HOW ADVANCED IS THE MARITIME SECTOR'S APPROACH TO IIOT DATA? (%)



**Befitting an industry where seafarers rely on safe ships and operations for their survival, maritime respondents most frequently cite the monitoring and improving of health and safety as their reason for collecting the data usable in IIoT-based solution.**

However, the pressures being exerted by costs and environmental considerations are also fully apparent: where 43 per cent of respondents use or will use data for health and safety, cost saving opportunities and environmental monitoring (both 40 per cent) are close behind.

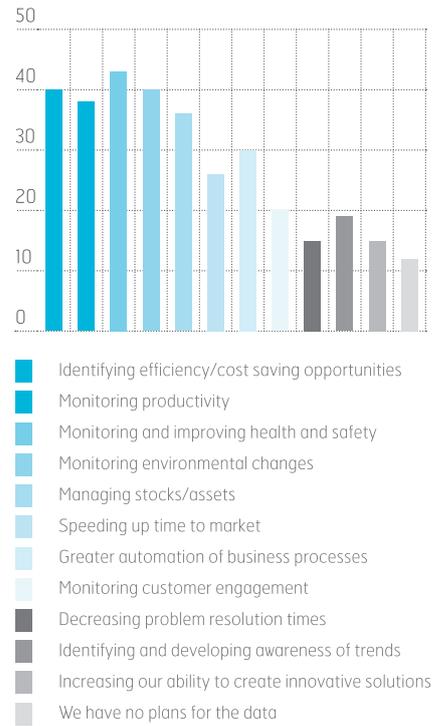
What research makes clear, and of particular significance for the current report, is that the maritime audience sees lack of timeliness in data availability as the most important single obstacle to successfully optimising IIoT-based solutions. Asked why their organisation was not able to make best use of data collected from IIoT-based solutions, 51 per cent of maritime respondents blamed the time lag between collection and availability for use. This was 11 per cent ahead of any other explanation.

The finding suggests that a greater maritime appetite for IIoT-based solutions will emerge if more data is delivered in real time, given that the maritime sector says it is also collecting data with the aim of boosting productivity (38 per cent) and better managing stocks/assets (36 per cent). It should certainly allow the startling 12 per cent of maritime respondents who say they are collecting data without any plans for it to consider better information use.

The fact that an above average 34 per cent of maritime respondents (29 per cent on average) identify themselves as lacking the skills to extract/use data and 10 per cent profess not to know who has access to data collected surely offers further impediments to widespread IIoT-based solution adoption. However, this lack of awareness does not appear to be related to a conscious lack of sharing. While 31 per cent of maritime respondents say IIoT-based data is only available to departments involved in IIoT deployment, a lower 21 per cent say that such data is restricted to senior management and IT departments.

**Lack of timely data availability is frustrating success for IIoT-based solutions**

HOW ARE YOU INTENDING TO USE THE DATA COLLECTED THROUGH YOUR ORGANISATION'S IIOT-BASED SOLUTIONS? (%)



**43%**

**use or will use data to improve health and safety standards**

# CONNECTIVITY AND IIOT TECHNOLOGIES

## HOW WELL IS THE MARITIME SECTOR ADAPTING TO THE CONNECTIVITY REQUIREMENTS OF IIOT? (%)



Given its global presence and the fact that ships are increasingly using satellite connectivity for operational efficiency, crew welfare and safety it is perhaps no surprise that the maritime sector does not strongly identify connectivity issues as impediments to IIoT-based solution uptake.

Only 20 per cent of maritime respondents cite connectivity as a barrier to adoption of IIoT-based solutions within their organisation – lower than any other sector. The finding is of significance because maritime is the sector most reliant on satellite connectivity for its IIoT-based solution adoption. No respondent at all disagreed with the proposition that satellite connectivity is ‘providing crucial support’ for their IIoT communications networks.

Some 69 per cent of maritime respondents say they rely on satellite connectivity to support their IIoT-based solutions, against 66 per cent using radio networks. Perhaps most remarkable – although not to the industry itself – is the maritime sector’s high usage of VSAT. 41 per cent of respondents use VSAT to support their IIoT-based solutions, against an average VSAT use across a range of industries of just 9 per cent. One caveat is the distinction between shipping and fishing, where VSAT is cited by 50 per cent of shipping respondents but only 15 per cent of fishers.

The pre-eminence of maritime satellite services overall is further demonstrated as respondents rank the networks supporting IIoT connectivity. Here, satellite networks are ‘number 1’ by some distance, claiming 51 per cent first ranking by respondents, with VSAT achieving 22 per cent and radio networks 21 per cent.

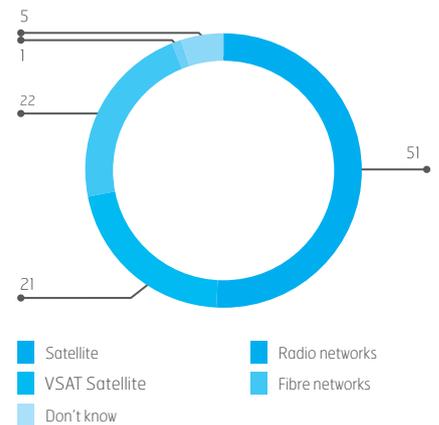
Network coverage, security and cost were the most frequently cited considerations determining connectivity choice for their IIoT-based solutions.

The dominance of established satellite networks in the maritime space, and the collection of vessel performance data also accounts for the low uptake of maturing technologies that support IIoT-based solutions. Some 50 per cent of maritime respondents (45 per cent in shipping and 64 per cent in fishing) do not use any other technology, while a further 16 per cent had no knowledge of any alternative technology used.

Technologies such as LoRaWAN, BlueTooth, Sigfox, SigB and ZigBee are currently making little impression, although RFID is playing a role, predominantly in asset tracking and port-side, with 16 per cent of maritime respondents using the solution, rising to 30 per cent among Japanese respondents.

**51%**  
rank satellite connectivity as ‘number 1’ by usage

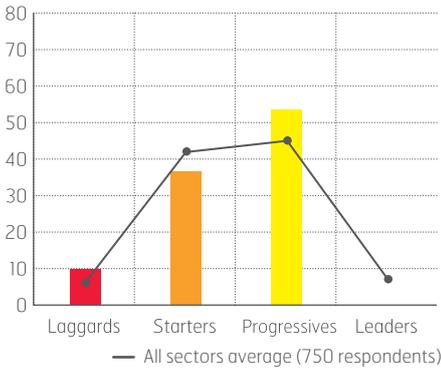
## WHICH CONNECTIVITY TYPE IS MOST IMPORTANT TO YOUR IIOT DEPLOYMENTS? (%)



Maritime does not identify connectivity issues as impediments to IIoT uptake

# INVESTMENT AND ROI

HOW WILL THE MARITIME SECTOR INVEST IN IIOT? (%)



**Maritime businesses expect to invest considerable sums into IIoT over the next three years – generating an average figure per respondent organisation of \$2.5 million.**

It is worth considering that budgets for IIoT-based solutions in the maritime sector go beyond pure IT spending, given that the IIoT and ship connectivity costs cut across the operations, safety and training budgets that often sustain adoption of new technologies.

If this is so, the maritime industry offers several or dispersed points of entry for IIoT-based solutions, over and above strategic decisions from senior managers.

Closer analysis of findings from the maritime sector nonetheless characterise the sector as featuring a larger proportion of IIoT 'laggards' (18 per cent) and 'starters' (61 per cent) than other industries, and a correspondingly smaller proportion of 'progressives' (19 per cent against 32 per cent overall).

# 14%

average cost savings predicted through IIoT-based solution use within five years

The planned spend on IIoT places it as the number one next generation technology that maritime companies expect to invest in over the coming period.

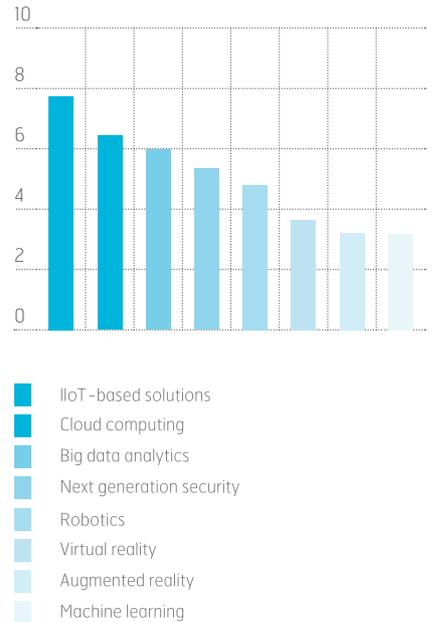
Respondents expect to spend more on IIoT than they will on cloud computing and big data analytics (each at 6 per cent) over the next three years, further indication of the sector's faith in IIoT.

However, there is some significant variation within the average spend on IIoT, with around a quarter of respondents (24 per cent) expecting to invest over \$3 million over the next three years, while 15 per cent say they will spend less than \$100,000 over the same period. Although size of operation will naturally dictate how much companies are able to – or need to – spend on the technology, this disparity once more demonstrates the variation in adoption attitudes within maritime businesses.

Plainly, not all maritime businesses have the same R&D budgets, and a high proportion of maritime respondents envisage making use of turnkey solutions in their forward-looking adoption projects. Some 64 per cent of respondents say that they are using or plan to use external parties to support some or as much as possible of their IIoT deployment strategies, while 48 per cent seek external help with management on an ongoing basis.

Maritime businesses see IIoT solutions as able to help them save money, but are less convinced of their ability to generate new revenues. While the cost savings are negligible today (2 per cent), this is expected to rise to 3 per cent within 12 months, to 7 per cent within three years, and then sharply to 14 per cent by the end of five years. Revenues generated by IIoT-based solutions are expected to increase less rapidly, reaching 7 per cent in five years, compared to 1 per cent today.

WHAT PROPORTION OF YOUR ORGANISATION'S IT BUDGET DO YOU EXPECT TO SPEND ON THE FOLLOWING DIGITAL TRANSFORMATION TECHNOLOGIES OVER THE NEXT THREE YEARS? (%)



Respondents expect to spend more on IIoT than they will on cloud computing and big data analytics (each at 6 per cent) over the next three years, further indication of the sector's faith in IIoT

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