

Industrial IOT on land and at sea: Transport



Inmarsat
Research
Programme
2018



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 Industrial Internet of Things (IIoT), 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.

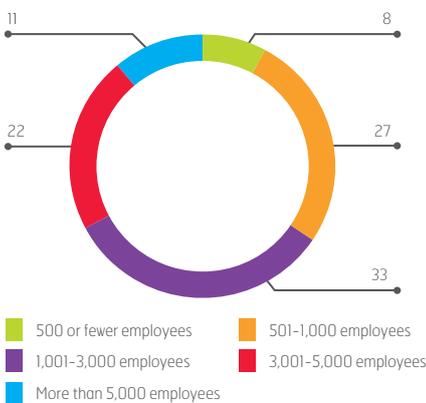
INMARSAT RESEARCH PROGRAMME

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 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 IIoT within their organisation and industry.

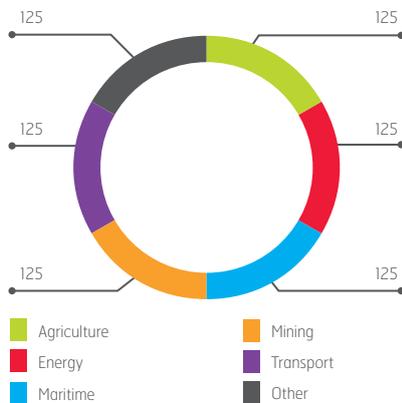
Respondents worked for organisations with at least 500 employees and have either decision-making or influencing responsibilities for IIoT initiatives. However, the profile of maritime respondents is different, in that 46 per cent worked for organisations employing fewer than 500 people.

RESEARCH DEMOGRAPHICS

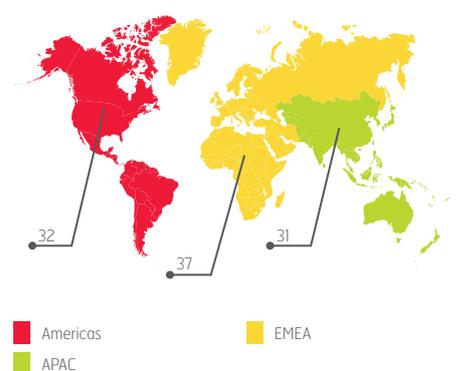
RESPONDENTS BY SIZE OF ORGANISATION (%)



RESPONDENTS BY SECTOR (750)

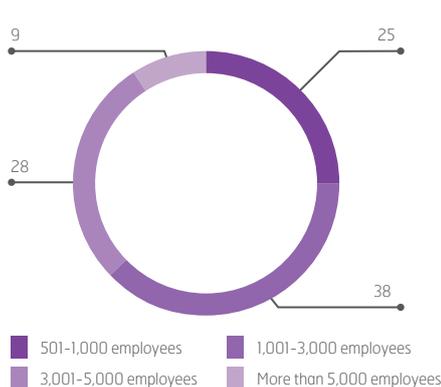


RESPONDENTS BY REGION (%)

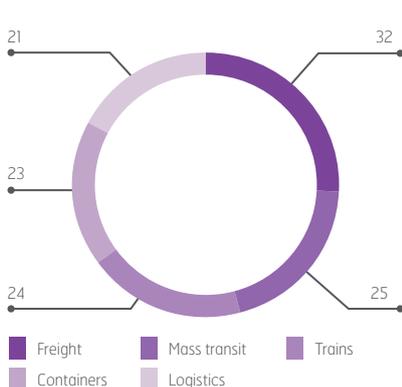


TRANSPORT DEMOGRAPHICS

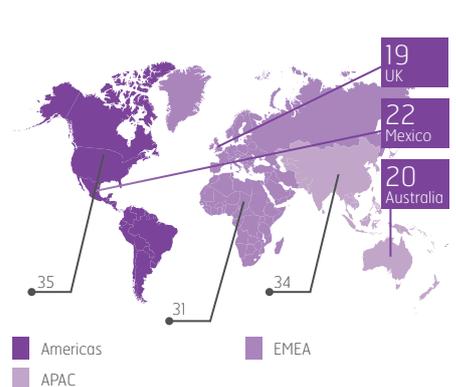
RESPONDENTS BY SIZE OF ORGANISATION (%)



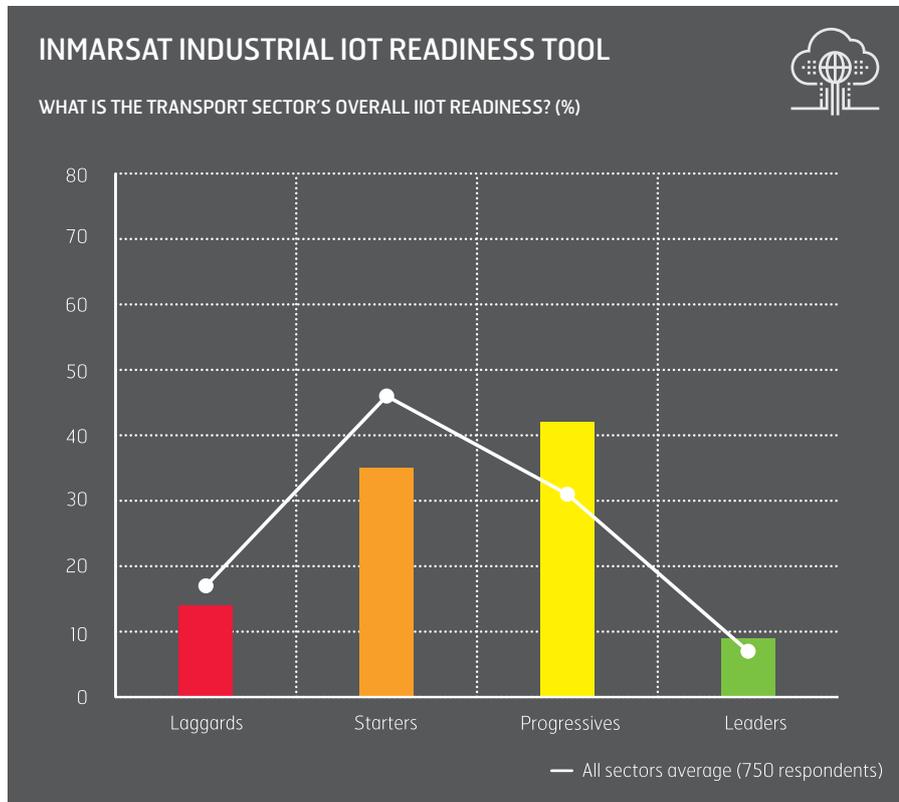
RESPONDENTS BY SUB-SECTOR (125)



RESPONDENTS BY REGION (%)



TRANSPORT



The transport sector clearly recognises the value that IIoT, in conjunction with other technologies such as big data, automation and robotics, can bring in helping to move people and goods across the planet more sustainably. Sensors that can monitor shock detection, heat and moisture, as well as location and security tags, can provide logistics managers with an all-encompassing, granular view of how their cargo moves across their supply chains, enabling them to identify friction points and optimise the flow of global trade.

We surveyed the freight, logistics, mass transit, rail and container sectors, and while there is still some progress to be made before global supply chains resemble connected networks, there is good headway being made in IIoT adoption across the sector. With over half of respondents categorised as leaders or progressives in their readiness for IIoT, the sector is well ahead of its counterparts in other industries, using data and technology to move towards more digitally-oriented operations.

While it is encouraging that the transport sector is well ahead of its peers in other industries, this may present challenges when managing global supply chains. If a shipment of iron ore can't be tracked from the moment it is extracted in Western Australia to when it arrives in the form of steel pilings at a construction site in Guangzhou, then friction points and inefficiencies will remain in the supply chain, costs will continue to be higher than necessary and global trade will suffer.

By 2050 the world's population is predicted to hit 9.8 billion¹. This increase in people will result in an explosion in the demand for goods and services. While the need for raw materials will put pressure on the producers in the agriculture and mining sectors, the movement of the components necessary for the manufacture and distribution of finished products will lead to unprecedented changes to global supply chains. Factor in the increased mobility of urbanising populations, with more people moving, and in greater distances than ever before, and it is clear that digitalisation will be the fundamental enabler to the transport industry.

One major concern for the transport industry as it carries more goods across greater distances is its growing impact on climate change; our research found that monitoring environmental parameters was the highest rated driver for IIoT deployments in the transport sector. In addition, as demand grows in developing economies for more goods to be transported along multi-modal logistics networks, and these countries further develop their own mass transit networks, the impact of the

transport sector on the environment will increase. While innovations, such as electric vehicles, will offset this somewhat, transport organisations must make radical changes to their operations to ensure that they operate with optimum efficiency.

IIoT will play a central role in these efforts. Emissions in the transport sector are exacerbated by faulty equipment, engine damage and poor route planning, but IIoT can address this. Smart telematics devices and diagnostic sensors can automatically gather vehicle data, including engine management, emission monitoring and driver behaviour to instantly notify fleet managers with damage alerts, faults or inefficient driving alerts. By proactively improving driving efficiencies, limiting engine wear-and-tear and increasing average miles-per-gallon (MPG), wastage can be minimised, and overall emissions can be further reduced. IIoT will also provide the building blocks for intelligent traffic systems and real-time route planning, enabling drivers to adapt to poor weather, road closures and traffic density to ensure all vehicles take the quickest and most efficient routes to reach their destinations.

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:

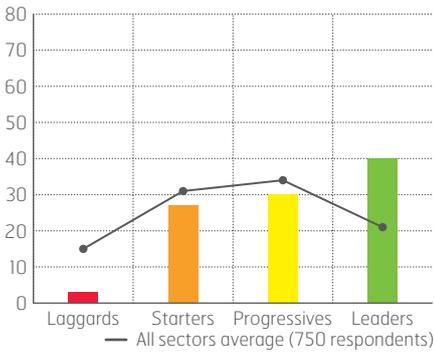
- Adoption
- Security
- Connectivity and IIoT technologies
- Skills
- Data
- Investment and ROI

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

¹www.un.org/development/desa/en/news/population/world-population-prospects-2017.html

ADOPTION

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



The transport sector is racing ahead of other industries in its efforts to deploy IIoT solutions, with 40 per cent of respondents ranking as IIoT leaders, and a further 30 per cent as IIoT progressives. This high level of deployment may be a result of relatively straightforward IIoT applications in the transport sector, such as asset tracking or emissions monitoring sensors, but it certainly shows an industry well on its way to creating a connected, data-rich global supply chain and wider transport network.

As it stands, 40 per cent of transport businesses have fully deployed IIoT solutions, and 18 per cent are at the trial stage. Every transport and logistics company surveyed reported that they plan to deploy IIoT solutions within the next two years.

Within the transport industry we can see stark contrasts between different sub-sectors. The mass transit sector shows the most progress in IIoT adoption, with 64 per cent reporting full IIoT deployment, and all companies from the sub-sector expecting IIoT deployment to be completed within the next 12 months. However, businesses within both the freight and containers sub-sectors present a very different picture, with just 19 and 22 per cent respectively reporting full IIoT

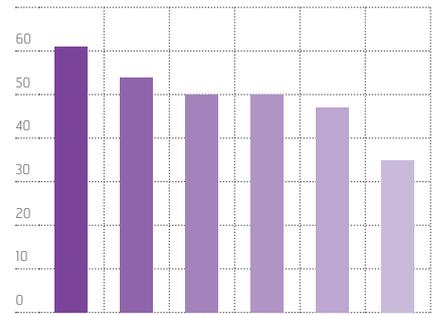
deployment, and a much slower rate of deployment predicted over the next two years.

Mass transit presents fertile ground for IIoT deployment, with controlled environments such as trackside infrastructure, as well as rolling stock, offering specific routing around which IIoT solutions can be built. Freight businesses, more susceptible to variable routes and conditions, appear to be struggling with IIoT deployment. The 'last mile' delivery sector in particular, where margins are relatively low, has thus far seen slow adoption of IIoT, however, when this takes off in volume it is expected to cause immense disruption to the sector.

However, despite these differences in adoption rates, there seem to be broadly similar objectives for deployment across the industry. Operating with greater efficiency is a key driver for the transport industry, with 61 per cent reporting that monitoring environmental changes - such as through the use of emissions sensors - was one of their primary motivations for IIoT adoption, and 54 per cent of businesses identifying a need to improve resource efficiency. Transport businesses are clearly having some success with this approach: 82 per cent of transport businesses reported that they are achieving, or expect to achieve, improved environmental sustainability, and 88 per cent reported reduced costs, surely due in large part to improving resource efficiency.

Tracking and monitoring assets as they move across the world will also enable transport businesses to streamline their operations, as well as ensuring that potentially valuable cargo arrives safely and in good condition at its end destination. Shock detection, heat and moisture sensors, and location and security tags can provide logistics managers with an all-encompassing, granular view of how their cargo moves across their supply chains, enabling them to identify friction points and optimise the flow of global trade.

WHAT ARE THE MOST IMPORTANT DRIVERS FOR THE DEPLOYMENT OF IIOT-BASED SOLUTIONS FOR YOUR ORGANISATION? (%)



- Monitoring environmental changes
- Improving resource efficiency of the organisation
- Improving health and safety across the organisation
- Improving the physical security of sites and assets
- Reducing costs in business operations
- Better access to data/insights

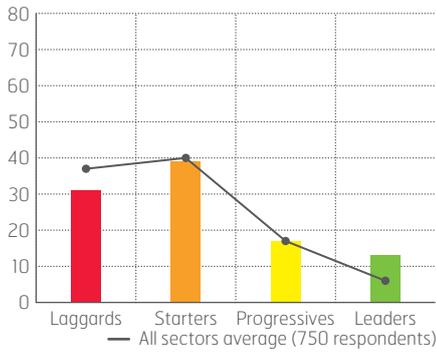
54%

reported that improving resource efficiency was a primary driver for IIoT adoption

Every transport and logistics company surveyed reported that they plan to deploy IIoT solutions within the next two years

SKILLS

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



A lack of relevant skills within the transport sector has emerged as one of the key barriers to adoption of IIoT solutions. While the industry is ahead of its counterparts in energy, agriculture and mining, 70 per cent of respondents rank as either laggards or starters when it comes to the state of their IIoT skills base. This is one area in particular that will need to be addressed if transport businesses are to capture the full value of IIoT.

Reflecting the skills shortage that is seen across many industries, 34 per cent of transport businesses reported that lack of in-house skills was a barrier to IIoT adoption, just behind security implications. This concern around security was further highlighted when respondents were asked to identify the skills they most required to accelerate their IIoT deployment; 59 per cent reported that they required additional staff with

security expertise, the highest rated skillset. 46 per cent of respondents cited a lack of staff with experience in data science and analytics, suggesting that without the right staff in place, transport businesses will struggle to make best use of the vast reams of data collected by their IIoT deployments.

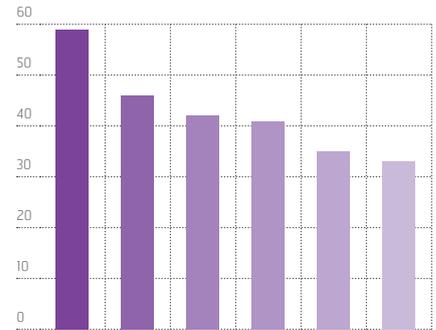
The skills shortages are particularly acute in certain sub-sectors of the transport industry. The mass transit sector faces a damaging lack of skills in data analytics, with nine in ten reporting a lack of staff skilled in this area, while 90 per cent of the containers industry requiring additional staff to provide technical support.

This skills shortage is also evident in the businesses' concerns around their IIoT deployments. Mass transit businesses cited a lack of skilled staff to extract and use the data as the top reason they weren't able to profit from their IIoT data. Similarly, with 90 per cent of the containers industry lacking sufficient technical support, it is no surprise to see that the sector shows the lowest rate of IIoT adoption.

59%

reported that they required additional staff with security expertise

WHAT ADDITIONAL SPECIFIC SKILLS DO YOU THINK YOUR ORGANISATION NEEDS TO DELIVER IIOT-BASED SOLUTIONS? (%)



- Security skills
- Analytical/data science skills
- Planning skills
- Technical support skills
- Decision-making skills
- Management skills

Mass transit organisations are suffering from a damaging lack of skills in data analytics, with nine in ten reporting a lack of staff skilled in this area

CONSTANT COVERAGE

ACROSS LAND, SEA AND AIR

A digitalised supply chain connects each vehicle, vessel or worker from any location across the globe through smart sensors and monitoring devices arrayed in IoT networks across land, sea and air. Following the journey of a vaccine from production to transportation to delivery illustrates the value of constant coverage and data gathering.



PRODUCTION

IIoT connected sensors monitor the process of production, packaging and preparation for storage with Quality Intelligence analysis software to maintain with compliance regulations.

STORAGE

IIoT-connected smart devices and tags in storage crates can enable quick location and retrieval of missing stock in storage facilities, avoiding lost or stolen items. Delivery receipts can be automatically processed with status updates instantly sent to the recipient.



AIR TRANSPORTATION

IIoT-connected refrigeration storage units can monitor data from the vaccine container, including temperature, humidity, pressure, vibration/shock. The vaccine's recipient can be notified of any potential breaches of regulated conditions and ensure it remains stable.



HAULAGE

Intelligent route planning across multiple continents allows deliveries and collections to be scheduled at exact times, using the shortest, fastest or most fuel-efficient route.



DELIVERY

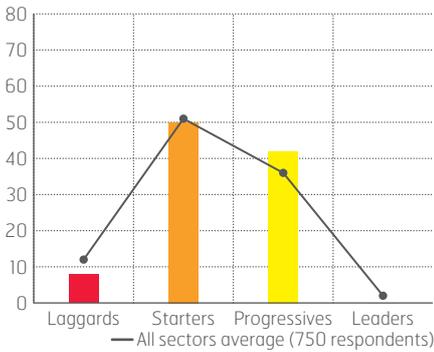
Electronic data receipts can automatically check with supplier data to ensure the correct vaccine and quantity has been received. This automated paper trail reduces mistakes and alerts all parties to the successful delivery.





SECURITY

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



With increased deployment of connected sensors across multi-modal supply chains, the level of vulnerability of international transport businesses to cyber-security threats will increase, so the industry must take action now to ensure that vital infrastructure is not exposed to cyber-criminals and hostile state actors. The IIoT Safety and Security Protocol Report, published by the World Economic Forum, recommends a number of measures that businesses deploying IIoT networks should implement, including risk assessment models, enhanced end-to-end encryption and a rigorous, standardised software development lifecycle process.

With 50 per cent of transport businesses identified in our maturity model as starters, and 8 per cent as laggards, there is an immediate necessity for transport businesses to ramp up their cyber-security defences. Transport networks, whether on rail, road, sea or air, are vital for a successful, thriving economy and society. A successful cyber-attack on, for example, an autonomous rail network would be a major coup for cyber-criminals and have potentially devastating effects on safety and a country's economic activity.

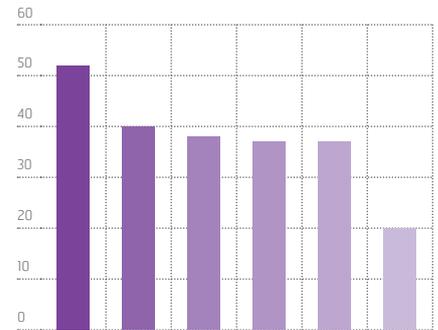
52 per cent of transport businesses identified external cyber-attacks as one of their biggest security challenges, reflecting the clear risk from malicious outside parties as we advance towards a more connected global supply chain. Other significant security challenges cited by transport businesses included poor network security (40 per cent) and insecure storage of data (37 per cent). Both of these fears align with the risk of external cyber-attacks, as poor network security and insecure data storage fundamentally weaken an IIoT solution and may allow those wishing to do harm access to sensitive data and infrastructure.

However, transport businesses demonstrate a strong understanding of their predicament. 64 per cent of transport businesses agreed that their processes to combat cyber-security threats could be stronger, and 66 per cent agreed that they could do more to protect against data mishandling.

Crucially the transport sector is not sitting idly by while its critical infrastructure comes under attack. While a lack of staff skilled in security, as identified above, may play a role in hampering the industry's efforts to bolster its defences, respondents to the Inmarsat survey identified a number of ways they are improving their security.

The mass transit and rail sector is leading the way in training its employees on IIoT, with 63 per cent reporting doing so to improve their security, as well as showing higher levels of investment in new security technologies (45 per cent). Businesses within the freight and logistics sector are focusing their efforts primarily on upskilling existing staff and hiring additional skilled staff, while those operating in the container sector have directed their attention to upgrading their existing security technology and finding external partners to help them further tighten their security defences. For all sub-sectors, a combination of these approaches will be necessary to ensure security risks are minimised.

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



- Risk of external cyber attack
- Poor network security
- Internal data regulation and compliance requirements
- Potential mishandling/misuse of data by employees
- Insecure storage of data collected
- Supplier/partner data regulation compliance requirements

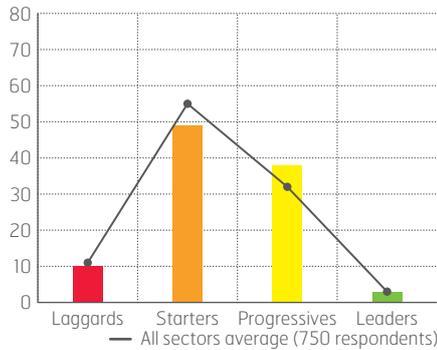
52%

identified external cyber-attacks as one of their biggest security challenges

A successful cyber-attack on an autonomous rail network would be a major coup for cyber-criminals and have devastating effects on a country's economic activity

DATA USAGE

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



With almost 60 per cent of transport businesses either identified as starters or laggards when it comes to using the data gathered by IIoT solutions, there are clearly many transport businesses still struggling to work out how to extract maximum value from their data. While data maturity in transport businesses is edging slightly ahead of their counterparts in other industries, the sector is tracking well ahead of others in deployment, suggesting a lack of strategy and insight into how best to use the data gathered by the IIoT solutions.

This may be about to change however as transport businesses clearly recognise the value that this data can bring and have identified a number of areas in which they aim to use this data, with efficiency and productivity at the forefront of their efforts. 56 per cent of mass transit and 63 per cent of rail companies identified that they would use their IIoT data to monitor productivity, the top-rated usage, while logistics businesses cited identifying cost saving and efficiency opportunities as their top priority. However, while transport businesses continue to have sub-optimal data-sharing processes and cyber-security hurdles to overcome, they will fail to create connected, multi-modal supply chains that ensure maximum productivity from their operations and staff.

61 per cent of respondents from the container industry reported focusing on managing stocks and assets as a key use for their data, understandable when IIoT offers so much potential for asset tracking and monitoring. This data is reflected in the rate at which the container sector is deploying IIoT to monitor its assets, with 66 per cent either already deploying or expecting to deploy within 12 months.

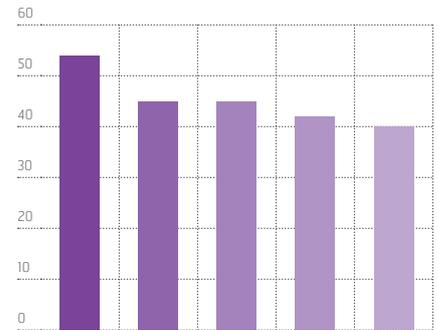
While it is clear that efficiency is the priority for many transport businesses, it is also encouraging to see that they recognise the positive benefits that IIoT could have for their staff, by improving health and safety, and reducing their impact on the environment. The mass transit and rail sectors are perhaps hoping to use IIoT to improve safety for passengers, with 64 and 54 per cent of respective respondents citing IIoT's potential for improving health and safety as key driver for deployment.

The transport industry needs to overcome a number of challenges before it can use its data to maximum effect. Security is still a major concern, with 41 per cent of respondents citing it as a reason why they are not able to use the data they collect as effectively as they should.

38 per cent reported that they face a lag between data collection and it being available, hindering an organisations' ability to make real-time decisions based on the data available to them. This lag is restricting the value that transport businesses can gain from their IIoT deployments, hindering them from making decisions in real-time from data gathered by connected sensors out in the field. In an industry which is so reliant on seeing where assets are this must be solved.

The issues caused by this lag are not helped by the restrictions that transport companies are placing on the visibility of data. Incredibly, in the mass transit sector just 2 per cent of businesses reported allowing anyone within their organisation to view it, hindering innovation and preventing colleagues from working together to establish creative applications for the vast swathes of IIoT data that they gather.

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



- Monitoring productivity
- Monitoring and improving health and safety
- Managing stocks/assets
- Identifying efficiency/cost saving opportunities
- Monitoring environmental changes

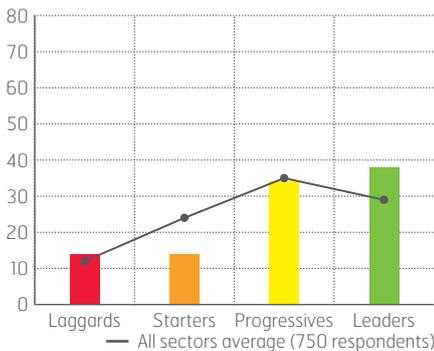
38%

reported that they face a lag between data collection and it being available

Effective data-sharing processes will be critical to the creation of connected, multi-modal supply chains, but cyber-security hurdles must be overcome before this is a reality

CONNECTIVITY AND IIOT TECHNOLOGIES

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



Transport businesses are largely achieving the connectivity levels that they require, edging ahead of their counterparts in other industries with more IIoT leaders than any other sector. Much transport infrastructure is focused on urban areas, so this will be a contributory factor in why businesses in the sector are largely able to access the connectivity they require.

However, by their very nature, transport networks pass through remote regions and areas without consistent communications coverage at regular intervals. It is in these connectivity blackspots that a full view of critical data is most important, to ensure the safe passage of staff, passengers and cargo through potentially risky environments. Clearly a combination of connective technologies will be key to supporting the type of 'connectivity bubble' that will keep an asset continuously connected.

Transport businesses appear to recognise the challenges they face keeping their IIoT solutions in constant communication and are opting for a range of connectivity types to ensure reliable data transmission. Perhaps surprisingly, satellite communication networks emerged as the most common choice to support IIoT solutions amongst transport businesses, with 76 per cent using it. This was closely followed by cellular networks (75 per cent), fibre (64 per cent) and radio networks (36 per cent).

The rate of adoption of satellite networks among transport businesses was significantly higher than other sectors, reflecting the need within the transport industry to have truly global coverage to service global supply chains. Underlining this, 78 per cent of transport businesses agreed that satellite connectivity is crucial to supporting their IIoT communications networks, again slightly higher than other sectors, which came in at 69 per cent.

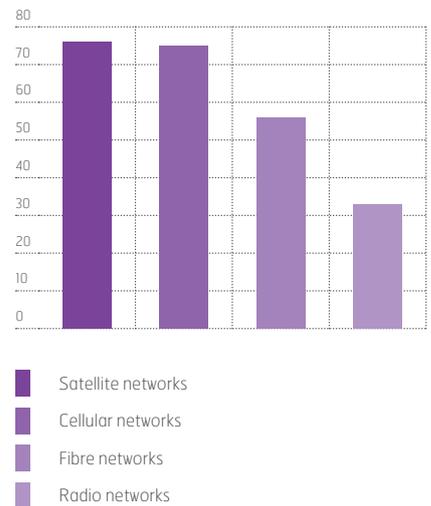
This is particularly pronounced within the logistics sub-sector, where 95 per cent of businesses agreed that satellite is crucial to their IIoT solutions. This perhaps should not come as a surprise, when supply chains are becoming increasingly global, delivering goods across vast distances where the need for constant, reliable connectivity is just as great.

To enhance their IIoT deployments, transport businesses are investing in a number of wireless data collection technologies. Radio frequency identification (RFID) emerged as the favourite, with 41 per cent utilising it in IIoT deployments.

The logistics industry is leading the way here: 62 per cent of respondents are using RFID to track vehicles and shipments of goods across global supply chains, much higher than any other technology. This is no surprise, given the capability of RFID tags to carry vital data, such as the contents of a container or identification of a vehicle. Integrating warehousing and vehicle RFID data into one process delivers further value. For example, the system will notify the driver if he has delivered too much or too little to the wrong location as he shuts the door getting into the truck. This value is reflected in the sector's adoption of IIoT solutions for asset and vehicle tracking, with 86 per cent of logistics businesses reporting that they have either already deployed these solutions or will deploy them within the next 12 months.

A global, stable and secure communications network, supported by satellite connectivity, will be fundamental for any transport business hoping to capitalise on the myriad opportunities of IIoT. Those that integrate satellite networks as part of their connectivity framework will be able to make significant operational improvements and offer a superior level of service, resulting in a better customer experience and increased profit margins.

WHAT TYPES OF COMMUNICATION NETWORKS DO YOU USE TO SUPPORT YOUR IIOT-BASED SOLUTIONS? (%)



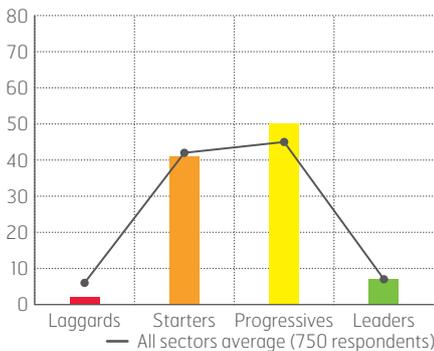
With increasingly global supply chains, 95% of logistics businesses agree that satellite is critical to maintain connectivity with their IIoT deployments

76%

of transport businesses are using satellite to support their IIoT initiatives

INVESTMENT AND ROI

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



The transport industry tracks slightly ahead of other sectors when it comes to investing in IIoT. With 57 per cent of the industry identified as progressives or leaders, the transport sector is clearly stepping up its investment in IIoT, at a seemingly commensurate rate with the level seen across the other sectors examined in this report.

Transport businesses expect to invest an average of \$3.5 million in their IIoT development over the next three years, accounting for approximately 8 per cent of their total IT budget. Leading the field is the rail sector, expecting to spend 11 per cent of its total IT budget on IIoT development and deployment, with the logistics sector not far behind with an expected 9 per cent spend, above the industry average of 8 per cent.

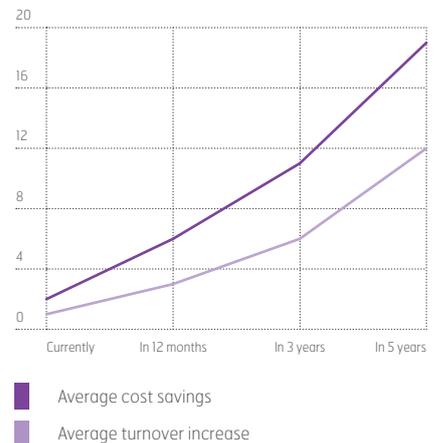
The complexity of operations in the rail and logistics sectors perhaps goes some way to explaining why businesses are investing heavily in IIoT monitoring to optimise their operations. In contrast to the container industry, which is prioritising asset tracking, the rail and logistics

sectors present a wider range of applications for IIoT deployment. With more staff put into potentially dangerous situations such as railway lines and ports, rail and logistics businesses can use IIoT to monitor and track staff health and safety. Monitoring vehicular energy consumption and environmental impact is also a key priority for rail and logistics firms' IIoT deployments, and we should expect to see high deployment rates (79 and 76 per cent have already deployed this to some extent) grow even further.

The wide range of use cases for IIoT in rail and logistics is further underlined in these sectors' expectations for how IIoT will help them to reduce their costs over the same three-year period. Businesses within the rail sector reported that they expected to save approximately 12 per cent of their costs, and logistics business 10 per cent. While these are relatively impressive figures, these sectors should step up its level of investment if it is to reap the full benefits of IIoT solutions.

The expected growth in turnover from the use of IIoT also shows the mass transit and rail sector to be leading the way in the transport industry. The sector expects to grow its turnover by 8 per cent by using IIoT, well above the industry average of 6 per cent, leaving sectors like freight and logistics (5 per cent) and containers (6 per cent) with much ground to make up.

WHAT OPERATIONAL COST SAVINGS AND TURN-OVER INCREASES IS YOUR ORGANISATION LIKELY TO ACHIEVE THROUGH ITS USE OF IIOT (%)



8%

of IT budgets will be invested in IIoT over the next 3 years

Transport businesses expect to invest an average of \$3.5 million in their IIoT development over the next three years



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