INDUSTRIAL ICT

IN THE TIME OF COVID-19: AGRICULTURE

CONTENTS

HOW MATURE IS IOT AT YOUR ORGANISATION?

Inmarsat's free IoT maturity tool helps you compare your organisation's IoT maturity with our respondents and your competitors. Your personalised report also explains what you need to do to improve your score.

www.inmarsat.com/ iotmaturitytool

ABOUT INMARSAT

Inmarsat is the leading provider of global mobile satellite communications services. Since 1979, Inmarsat has been providing reliable voice and high-speed data communications to governments, enterprises and other organisations, with a range of services that can be used on land, at sea or in the air. Inmarsat operates around the world, with a presence in the major ports and centres of commerce on every continent. For more information, please visit **www.inmarsat.com**

METHODOLOGY

The Inmarsat Research Programme is now in its fifth year, with this 2021 report providing an update on how the industrial Internet of Things (IoT) is being adopted by organisations across the agriculture, electrical utilities, mining, oil and gas and transport and logistics sectors.

Specifically, this report looks at the impact of Covid-19 on IoT adoption, as well as challenges related to connectivity, skills, security, data and investment.

To understand this Inmarsat commissioned Vanson Bourne, a specialist technology market research company, to interview 450 respondents in early 2021, a year after the start of the pandemic.

Respondents work for organisations with at least 250 employees and are drawn from various global regions including the Americas, EMEA and Asia-Pacific. All of those surveyed are responsible for delivering IoT initiatives at their respective organisations.
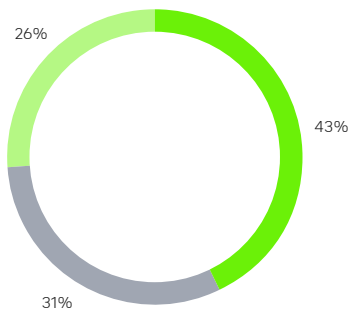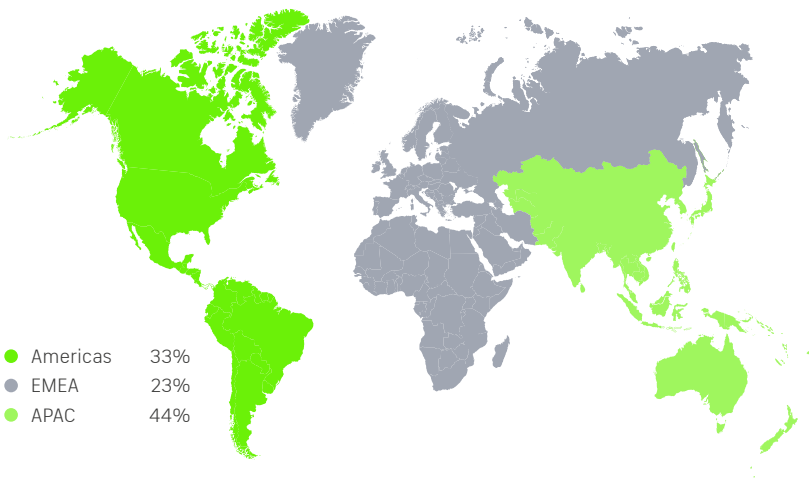

Respondents by sub-sector (%)

- Crop production
- Livestock
- Service providers
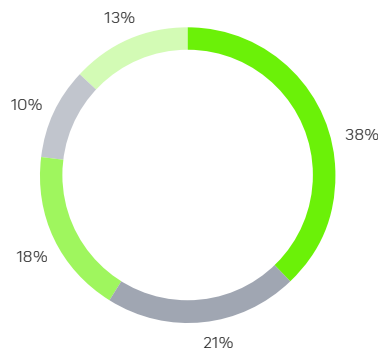
Respondents by size of organisation (%)

- 251-500 employees
- 501–1,000 employees
- 1,001–3,000 employees
- 3,001–5,000 employees
- More than 5,000 employees

Respondents by region (%)

- Americas   33%
- EMEA   23%
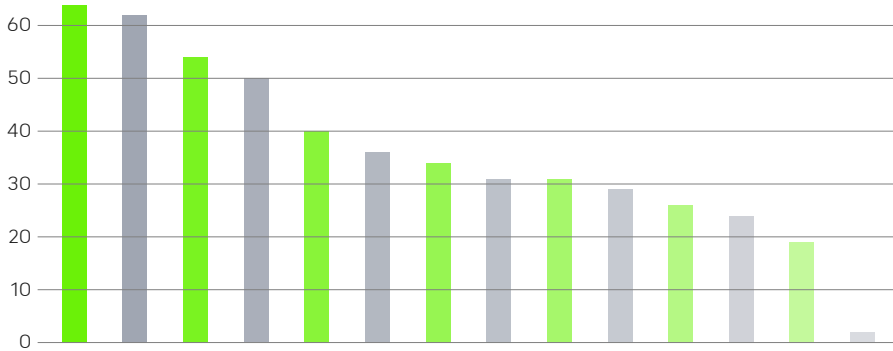- APAC   44%

EXECUTIVE SUMMARY

According to the UN, the world will need to double its food production by 2050 in order to feed its growing population.[1] This means agricultural producers will need to increase production efficiency with the finite land available. Concurrently access to water poses a huge challenge, with a demand deficit predicted in the next ten years. Agricultural producers are also facing the long-term effects of increased extreme weather events due to climate change, as well as declining soil health and biodiversity loss.

Encouragingly there are clear signs that producers are taking these challenges seriously, adopting new technologies (AgTech) that can help them increase their outputs in line with demand. While agriculture also produces building ma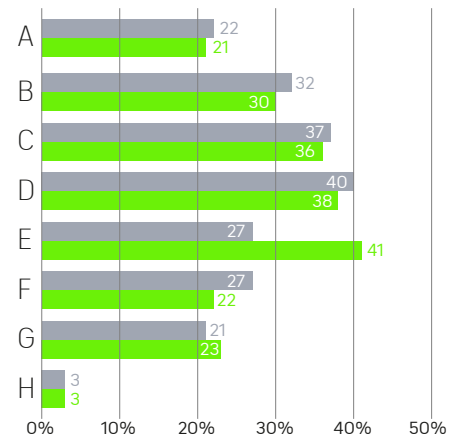terials, medicines and cosmetics, it is the area of food production where we can see the clearest example of technology being adopted to modernise production. Investment in technologies to bolster food production has increased by six times since 2012, up to $20 billion in 2019.[2] Technologies like genetic crop enhancement, precision agriculture and computational biology are germinating answers to one of humanity's greatest challenges: how to feed a growing population while limiting adverse effects on the environment.

The Internet of Things (IoT) is playing a key role for agricultural businesses across the entire production cycle. From helping growers understand water and nitrates in the soil, to providing cattle farmers with information regarding the health of their animals, to helping aquaculturists monitor the oxygen levels

"Agricultural producers will need to increase production and distribution efficiency and do more with the land available to them."

What are the most important drivers for the deployment of IoT projects for your organisation?

● Greater automation	64%
● Cost efficiencies	62%
● Greater supply chain insight	54%
● Improve environmental sustainability	50%
● Better decision-making	40%
● Improve health and safety	36%
● Increase staff productivity	34%
● Greater physical security	31%

● Improve compliance/regulatory	31%
● Reduced downtime	29%
● Lower insurance premiums	26%
● Improve customer experience	24%
● New revenue streams	19%
● Other	2%
Don't know	0%

"40 percent of agriculture respondents have a formal IoT strategy."

What barriers, if any, does your organisation face in the deployment of IoT projects?

A Lack of consistent and reliable connectivity
B Lack of available capital to invest in IoT projects
C A lack of in-house skills
D Lack of turnkey/off-the-shelf solutions
E IoT not being prioritised by the board
F Security implications
G Integrating IoT technology with existing platforms
H Not encountered any barriers at this stage
● Encountered in the deployment phase
● Encountered/expect to encounter this once deployed

[1] https://www.un.org/press/en/2009/gaef3242.doc.htm
[2] https://agfunder.com/

in their salmon pens, it is providing visibility and automation across production and supply chains, enabling businesses to operate in an informed manner, remotely. Key to organisations unlocking the potential of IoT is a formal IoT strategy, which 40 per cent of our agricultural respondents stated they have, although there is some difference between service providers (50 per cent), crop producers (41 per cent), and livestock producers (26 per cent).

The role of IoT has become all the more important during the Covid-19 pandemic where producers and supply chains have faced unprecedented challenges related to access, logistics and levels of changing demand. Our research suggests the operational impact of the pandemic has been more keenly felt by crop producers, than livestock producers or service providers. Additionally, 87 per cent of crop producers, 86 per cent of service providers and 83 per cent of livestock respondents have either accelerated deployment of IoT projects as a result of the pandemic or plan to in the next few years. It can be surmised that this will support automated operations in the face of local and national lockdowns.

Overall our research finds IoT in the sector at an inflection point: larger organisations of over 3,000 employees are clearly more progressed and are taking advantage of enterprise-level IoT solutions to optimise their more complex supply chains. Below this in the 250 – 3,000 employee bracket, organisations are starting to deploy IoT in greater numbers, driven by

technologies that are becoming available at affordable price points and are focused on addressing burning problems with attractive value propositions. For example, availability of new, lower cost IoT sensors such as weather stations and soil moisture probes. With these two vectors aligned, the decision to deploy IoT becomes a no brainer even where budgets are a challenge, because agricultural businesses are seeing clear benefits to adoption, often within a single production cycle or season. These benefits are predicted to ramp up in line with adoption levels in the years to come so agricultural businesses will need to keep an eye on the challenges holding them back.

Budgets are a challenge for the sector, particularly for smaller companies, with these representing some of the lowest budgets of any group within our research. There are also a range of other business challenges that are stopping the sector from getting the optimal benefits from the technology. A shortage in skills is a critical issue that needs to be solved, while the sector still has a lot of progress to make in terms of building the connectivity backbone needed to make IoT a true success. Linked to this is the need to have effective and efficient data management tools and strategies in place, as well as the security capabilities to ensure the growing threat of cyber-attacks is kept at bay. To achieve these goals, the sector needs to be prepared to invest in the right areas, both now and in the immediate future.

How would you score your organisation's achievement of expected benefits of IoT projects?

● We achieved this (%)
● We have not achieved this (%)
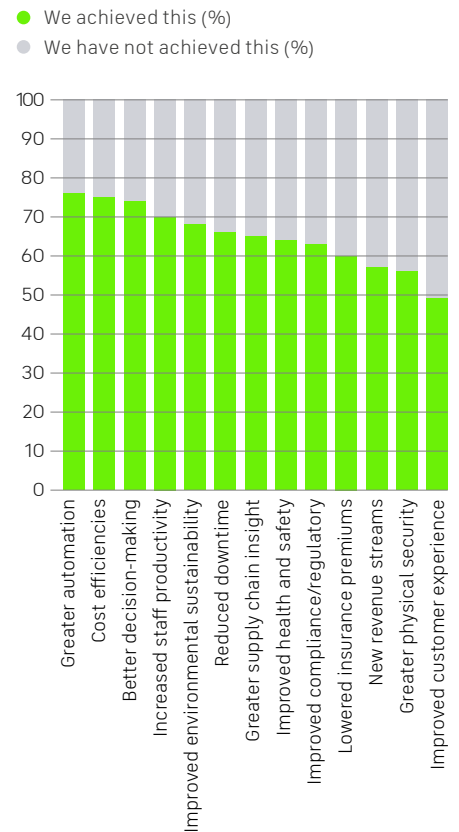
ADOPTION

Over three-quarters of organisations in the agriculture sector (80 per cent) have fully deployed at least one IoT project, up from 22 per cent in 2018. 53 per cent have deployed fully within the last 12 months showing rapid levels of adoption in 2020, which points to IoT adoption in the sector beginning to reach maturity. The remaining 20 per cent of respondents either plan to deploy IoT within the next two years or are currently trialling such projects.

As with most industries, agriculture has been challenged by Covid-19, and caused many to rethink their approaches to technology as a way to gain an operational edge. 60 per cent say that challenges related to the pandemic have demonstrated the importance of IoT and automation to the success of their business. As a result of experiences in the pandemic, 86 per cent of our respondents have either sped up deployment of IoT projects, or plan to do so in the next couple of years. This represents agricultural producers fortifying their ability to operate remotely and autonomously and demonstrates the faith our respondents have in the technology.

The drivers that are motivating the sector to deploy IoT projects are numerous with greater automation cited as the most popular reason by 64 per cent of respondents. Not far behind is cost efficiencies (62 per cent), followed by; improved greater supply chain insight (54 per cent), improved environmental sustainability (50 per cent) and better decision making (40 per cent). Environmental sustainability was viewed as the most important driver of IoT usage in North America (92 per cent), while in APAC it was greater supply chain insight and everywhere else it was greater automation. Interestingly, in North America respondents listed the highest number of different drivers for using IoT suggesting a sophisticated understanding of IoT's potential.

In terms of use cases the most common area IoT is being engaged is in remote water monitoring and control, where 27 per cent of respondents have already deployed IoT solutions, and an additional 22 per cent are in the trial phase. Crop storage monitoring was in second place with 26 per cent of respondents having actively deployed it.

In the next couple of years there is likely to be an increase in fully deployed IoT projects focused on weather and soil monitoring and process automation, with these two representing the most likely to be in trial currently (37 per cent and 33 per cent respectively). Of course this will be dependant on projects successfully moving through the trial phase, which isn't always the case. The most likely use cases to fail in the trial stage leading to them not being deployed was machinery and vehicle monitoring, as well as irrigation monitoring and control, both with 12 per cent. Some of the challenges contributing to these failed trials we will explore over the coming pages.

Beyond the farm, the sector is also recognising the need to gain better visibility of the supply chain. 24 per cent of respondents have already deployed IoT projects to improve supply chain traceability, while 29 per cent are in the trial phase. The larger organisations (over 3,000 employees) are ahead of the curve in this particular area, with 43 per cent having already leveraged IoT for supply chain management and an additional 33 per cent trialling it. These businesses are more likely to be supplying multi-nationals whose business models are dependent on complex digitalised supply chains.

Despite all of the progress barriers remain. During the deployment phase 40 per cent were challenged by a lack of skills, with 37 per cent feeling a lack of turnkey solutions hampered them and 32 per cent a lack of capital. The number of respondents indicating there was not enough capital

available to optimally deploy was high compared with the other sectors we interviewed, reflecting the tighter budgets agricultural businesses are often faced with. Once projects were deployed respondents indicated the biggest barrier was the lack of IoT support at board level (41 per cent) suggesting the need for greater C-suite education regarding the benefits achieved.

By and large, the majority of respondents have achieved the expected benefits of IoT projects across a range of areas, including increased automation, cost efficiencies and better decision making. This is encouraging given these represented some of the most important drivers. However, there remain areas where these benefits have not yet been achieved. For example, 51 per cent say their IoT projects have not yet led to an improved customer experience, while 44 per cent say they have not attained enhanced physical security, although these were not such strongly desired outcomes across the agricultural respondents.

1%
11%
8%
80%
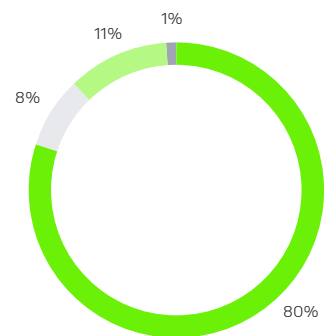
What is your current status in terms of deploying IoT projects?

- Fully deployed
- Currently trialling
- Planning to trial within 12 months
- Planning to trial in 18 months – 2 years

What IoT projects has your organisation already deployed and what will your organisation deploy in the future?
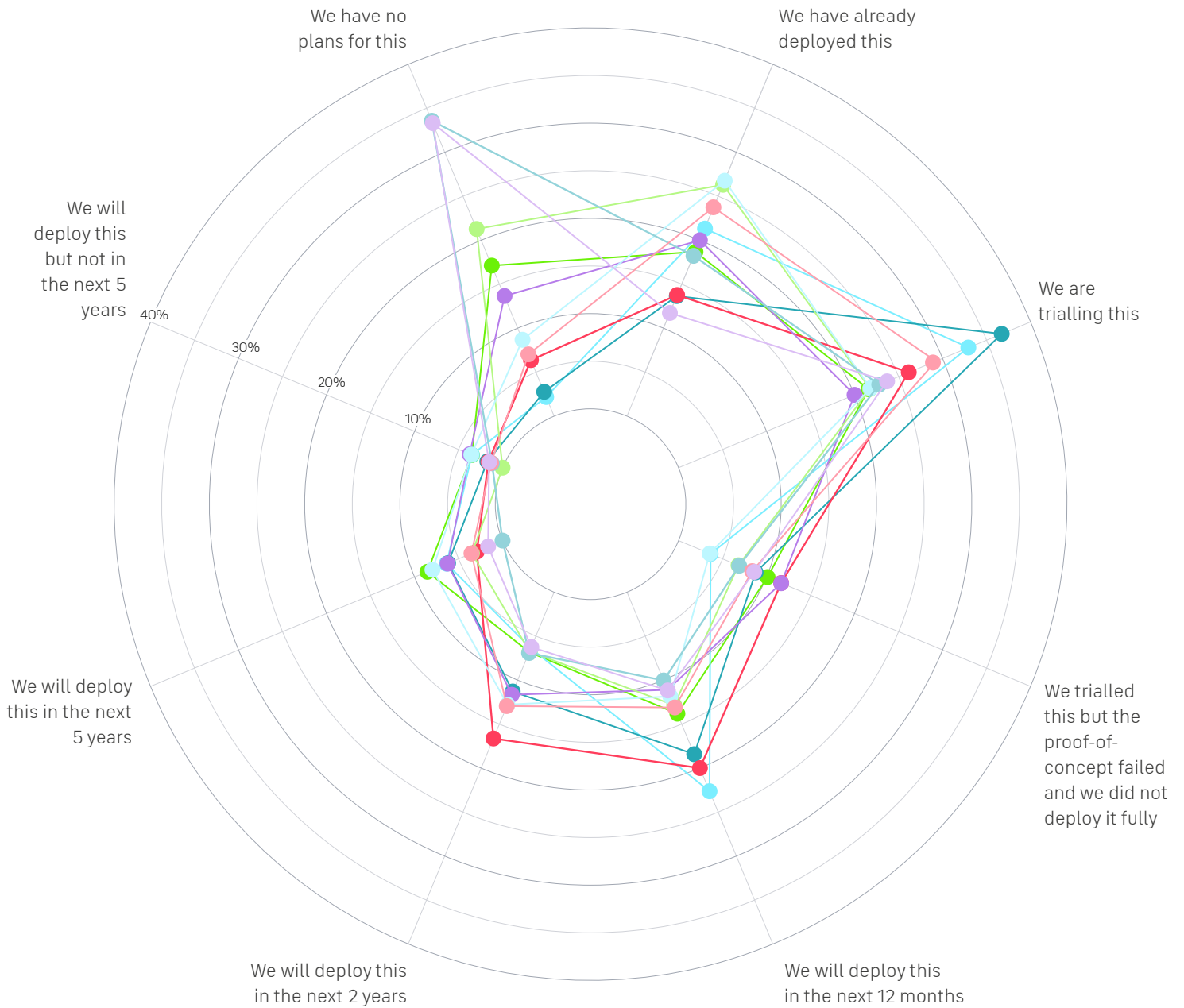
Legend:
- Vehicular and asset tracking and route optimisation
- Process automation
- Weather monitoring/soil monitoring
- Irrigation monitoring and control
- Machinery and vehicle monitoring
- Crop storage monitoring
- Remote water reservoir monitoring and control
- Livestock monitoring
- Supply chain traceability
- Cold chain monitoring

Axes (clockwise from top):
- We have no plans for this
- We have already deployed this
- We are trialling this
- We trialled this but the proof-of-concept failed and we did not deploy it fully
- We will deploy this in the next 12 months
- We will deploy this in the next 2 years
- We will deploy this in the next 5 years
- We will deploy this but not in the next 5 years

Radial scale: 10%, 20%, 30%, 40%

CONNECTIVITY

Connectivity, or the right kind of connectivity, is outlined as a key barrier to agricultural IoT adoption by McKinsey in recent analysis.[1] The good news is there are a range of connectivity technologies that can bring the benefits of IoT to the agriculture sector. These innovations help to overcome challenges related to the often remote situation of many farms and the associated lack of terrestrial connectivity infrastructure. These technologies are becoming available at a more accessible price-point and while our research focuses on large-scale agri-businesses, these technologies are also becoming more accessible to smaller businesses and increasingly to producers in developing economies.

Our respondents employ a wide range of connectivity types in their IoT projects, combining both short- and long-range technologies with three types used on average – common to our average across all sectors. Satellite figures most prominently in terms of long-range solutions (used by 49 per cent) while Wi-Fi is the most popular short-range connectivity type (57 per cent), despite its limitations in terms of range and power consumption. Since our 2018 report, adoption of Low Power Wide Area Networks (LPWAN) such as LoRaWAN have increased, likely because they are very suitable for connecting large numbers of devices over large areas.

Connectivity issues hampering the rollout of IoT projects are common. 59 per cent of respondents in the sector experienced difficulties deploying IoT because of connectivity issues in the areas they wanted to implement it, with 72 per cent encountering problems in the trial or proof of concept phase, and 64 per cent seeing issues after full deployment. There are, however, rewards to be reaped once these challenges are ironed out, as 78 per cent say that their IoT projects have been much more successful since mastering their connectivity woes.

Respondents displayed a range of preferences in what qualities they wanted from their IoT connectivity. Reliability was most commonly cited, along with cost (both with 42 per cent), while network coverage, bandwidth and security followed (all with 34 per cent). Across the industries we spoke with reliability was the most desired attribute for IoT connectivity, however; the agricultural focus on cost concerns, where operational budgets are tighter than other industries are more unique to this sector. Budgetary challenges might also go some way to explain the usage of terrestrial connectivity types even if they are not completely suitable for the task.

While organisations are seeking the most reliable connectivity possible there are inevitably instances where there are outages. These become increasingly problematic when connectivity is underpinning the production process and downtime results in a loss of production; it is therefore essential that a backup connectivity method is considered. However; only 33 per cent of respondents utilise a backup connectivity option, while a further 67 per cent indicated their operations would go offline, with 32 per cent continuing to collect data offline and 34 per cent pausing all data collection until the connection is restored. Without reliable backup connectivity the development of use cases like autonomous vehicles or drones will be impossible, as the result of a connectivity failure could result in dangerous scenarios.
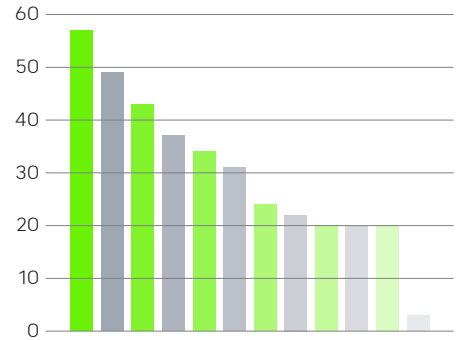
What connectivity types does your organisation use in its IoT projects?

● Wi-Fi	57%
● Satellite	49%
● Radio	43%
● Cellular (public)	37%
● LoraWAN	34%
● NB IoT	31%
● Fibre	24%
● Cellular (private)	22%
● Bluetooth Low Energy (BLE)	20%
● Sigfox	20%
● Zigbee	20%
● Other	3%
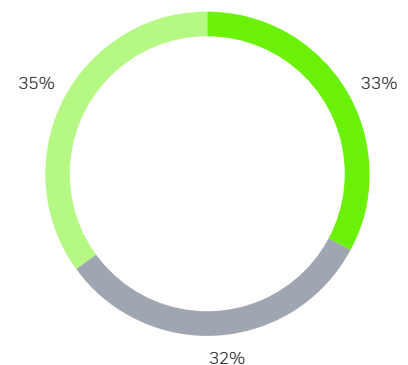
What do you do if unable to connect to your chosen connectivity type?

- ● Use a backup connection type to continue
- ● Continue collecting data offline until the connection is restored
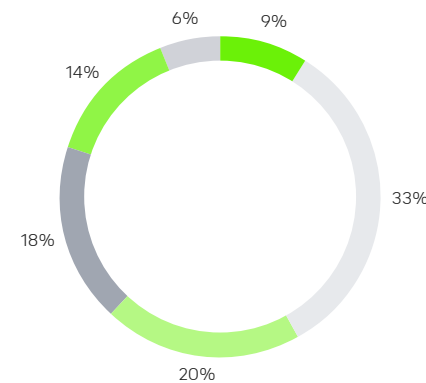- ● Pause all data collection until connection is restored

[1] https://www.mckinsey.com/industries/agriculture/our-insights/agricultures-connected-future-how-technology-can-yield-new-growth

DATA

The success of IoT projects can be measured in the actionable insights they create. To create optimal insights data needs to be with the right people, at the right time and in the right format. Like all of the sectors we surveyed, agricultural organisations still have some work to do in order to make full use of the IoT data they collect. The obstacles presenting effective data management are numerous, with security and privacy concerns the most prominent at 56 per cent. This is followed by a lag between data collection and availability at 44 per cent, echoing some of the connectivity challenges mentioned earlier. In third place the lack of an IoT data strategy was problematic for 36 per cent of respondents. More organisations should employ an IoT data strategy as part of their overall IoT strategy, as without this they are unlikely to get data to where it needs to go within the organisation let alone to other parts of the supply chain.
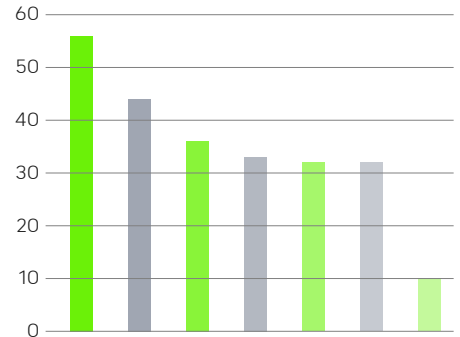
As far as data sharing is concerned, agricultural respondents are generally fairly open in approach, with 44 per cent making data available to anyone in the organisation, and an additional progressive 20 per cent sharing this with partners too. Just over a third, however, reserve access to this data to departments directly involved in IoT projects, which correlated with the group who did not possess a data strategy. In the future, agricultural organisations will increasingly share their data, to the point where just 18 per cent will limit data access to a select few departments. This is encouraging to see, as a culture of collaboration and joined-up thinking will help improve the efficiency of agricultural supply chains, though a data management strategy will be important to ensure the data only goes where it needs to.

In terms of the frequency that data is collected in agricultural projects, the sector has the lowest proportion gathering data in real-time (9 per cent), with only 4 per cent of the livestock respondents doing so. Businesses are most likely to collect data every half an hour (33 per cent), although hourly collection (20 per cent) and collection every two hours (18 per cent) are also common approaches. This is not that surprising as many IoT technologies today such as soil-moisture probes and weather stations require relatively infrequent data transfer. However, with greater automation being the largest driver for the deployment of IoT projects and new advances in technologies such as process automation and robotics coming on stream at a rapid rate the emphasis on real-time data is likely to increase.


What barriers prevent your organisation from using data optimally?

●	Security/privacy concerns	56%
●	Lag between data collection and data being available	44%
●	Lack of IoT data strategy	36%
●	There is such a large volume of data we struggle to utilise it	33%
●	We don't have the skills to extract/ use data	32%
●	Data is stored in an unusable format	32%
●	We are able to use data as effectively as possible	10%

At what intervals do you typically gather IoT data points?

- ● In real-time
- ● Within half an hour
- ● Hourly
- ● Every two hours
- ● Every four hours
- ● Daily
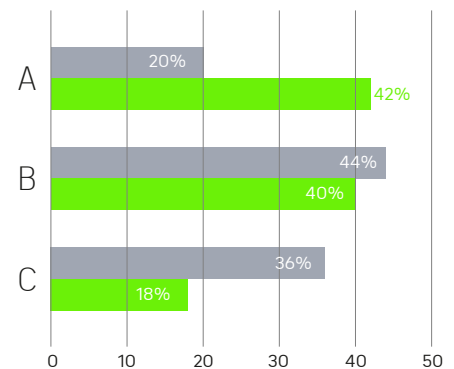
To what extent does/will your organisation share non-sensitive IoT data?

A It is available to anyone in the organisation, or our partners, to access and use

B It is available to anyone in our organisation to access and use

C It is only available to certain departments involved in the IoT project

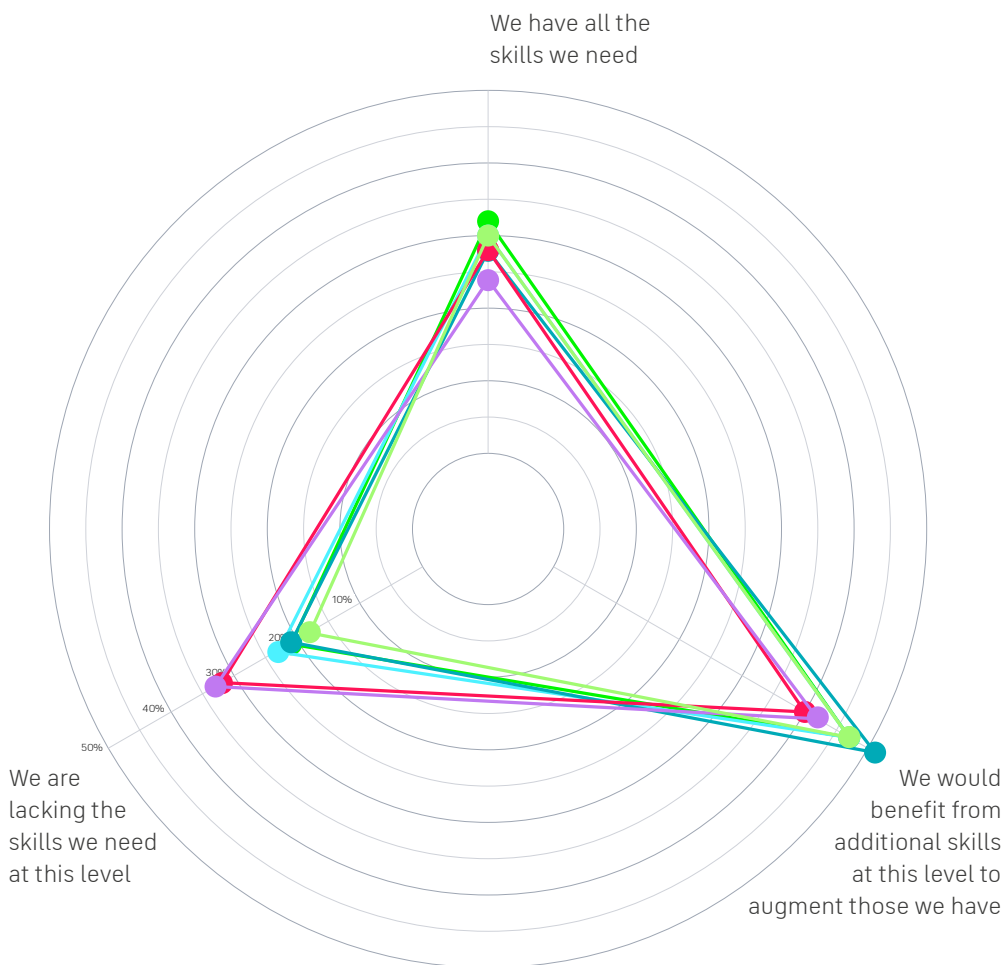● Currently ● In the future

SKILLS

For IoT to be a sustained success access to the relevant skillsets is needed at all levels. Considering the number one barrier to successful IoT adoption is a lack of the right skillsets, this needs to be fixed urgently either through hiring, upskilling or working with a service provider.

Under a third of all respondents thought that they had all the skills required in-house to successfully deploy IoT projects, with many believing that they would benefit from additional skills to augment what they already have.
The most skilled personnel were found at C-suite level (32 per cent), whilst the least number of sufficiently skilled workers were found at the integration level (24%). This is perhaps not surprising given the challenges around data and hardware interoperability that are experienced in the agriculture sector, with numerous technologies available, not all of which integrate with one another.

"The number one barrier to successful IoT adoption is a lack of the right skillsets."

**Does your organisation have the skills needed to fulfil IoT projects at different levels?**

We have all the skills we need

We are lacking the skills we need at this level

We would benefit from additional skills at this level to augment those we have

10%
20%
30%
40%
50%

- ● C-suite/senior leadership team
- ● Strategic IoT decision-making
- ● Operations
- ● Procurement of IoT projects
- ● Integrating IoT projects
- ● Ongoing support and maintenance of IoT projects

Service providers tended to possess more IoT related skills, and this is not surprising since they are often developing the technology and can sometimes be responsible for installing and managing it on farm. Latin American respondents were more likely to indicate they were lacking skills at all levels, while smaller organizations were more likely to be lacking the procurement skills to ensure they brought on onboard the right IoT solutions.

To address deficiencies, analytical and data science skills are most sought after (cited by 48 per cent), followed by connectivity technology skills (46 per cent) and technical support skills (43 per cent). Many businesses are focused on improving their data analytics capacity as it represents a critical step in taking data and turning it into actionable insight. Organisations of over 3,000 employees were much more likely to seek skills in this area, no doubt driven by deployed projects producing large quantities of data that needs to be turned into business enhancing insights.

When it comes to purchasing decisions for IoT projects, the most common decision maker is middle management. However; smaller businesses are much more likely to have C-suite and senior management involvement, while for the largest businesses it is typically a middle management decision. To some extent this difference in methodology reflects the number of employees at an organisation, although it is important that larger organisations still incorporate an IoT focus at board level, even if decision making for specific projects is delegated.

Roughly half of those polled (53 per cent) are aware of off-the-shelf IoT solutions that can help them meet their organisation's needs, with this figure rising with the size of the organisation (41 per cent for companies under 3,000 employees versus 78 per cent for those with more than 3,000). This underlines the maturity and spending power of larger organisations as well as established strategic partners serving their part of the market. At the other end of the spectrum, service providers focused on smaller scale companies clearly have some work to do to create propositions addressing the challenges of smaller producers where the value proposition for the major drivers such as automation is less compelling.
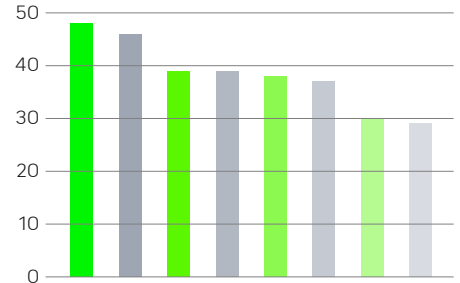
What additional skills do you need to deliver IoT projects?

🟢	Analytical/ data science skills	48%
⚫	Connectivity technology skills	46%
🟢	Project management skills	39%
⚫	Technical support skills	39%
🟢	Strategic skills	38%
⚫	Security skills	37%
🟢	Database management skills	30%
⚫	Procurement skills	29%
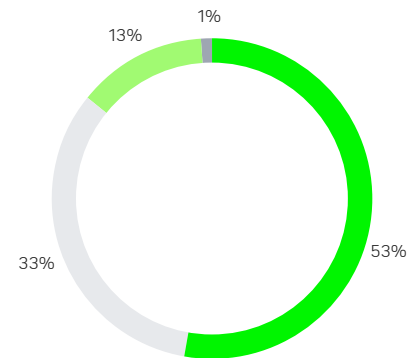
Are you aware of off-the-shelf IoT solutions that meet your needs?

- 🟢 Yes, we are aware
- ⚪ No, providers only meet some of our needs
- 🟢 No, providers don't meet our needs at all
- ⚫ Don't know

SECURITY

While agricultural businesses may not immediately seem like a target for bad actors, the risk is increasing as businesses are putting more onus on their digital operations as a way of boosting their output. Anything which hampers production or leads to delays in supply could have dire repercussions for a company, its valuation and place in a supply chain, or if carried out on large enough scale, for consumers. It is not just cyber-attacks agriculturalists need to be wary of either. Misused or misplaced data could easily give competitors a huge advantage, stressing the importance of effective IoT security and data management strategies.

Agricultural respondents listed poor network security as the clear leader in terms of their security challenges, with half of those surveyed stating it as an issue. Businesses will need to harden their networks to avoid these perceived risks being exploited. Internal data regulation (46 per cent) is also seen as a key challenge to overcome, as is the misuse of

data by employees (42 per cent), while the risk of cyber-attack was stated as a risk by 41 per cent. These worries are reflected in respondents' opinions of the security of their IoT projects. A total of 76 per cent believe that IoT security needs to be strengthened in some way, with 33 per cent of these wanting to see major improvements. Encouragingly, a relatively small amount of respondents have not prioritised cyber-security threats at all with all of these responses found in businesses under 3,000 employees and predominantly between 251-500 personnel.

In response to the perceived threats it faces the sector is carrying out a range of activities to tackle security problems, with external IoT security policies (49 per cent), partnering with a third party (41 per cent) and specific IoT training for staff the most common (38 per cent). Larger organisations are more likely to be addressing security issues in-house while smaller organisations are more reliant on third-parties to help sure up their defences.
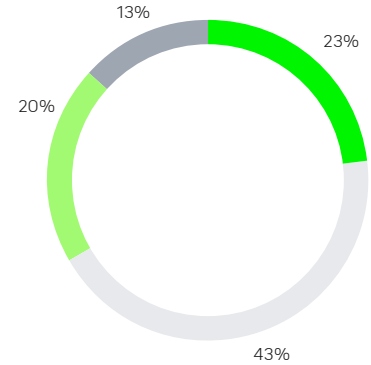

Which of the following statements are accurate regarding the security of your IoT projects?

- ● We have robust cyber-defences
- ● Our defences are good but could be stronger
- ● We need much better cyber-defences
- ● Our cyber-defences need to be vastly improved
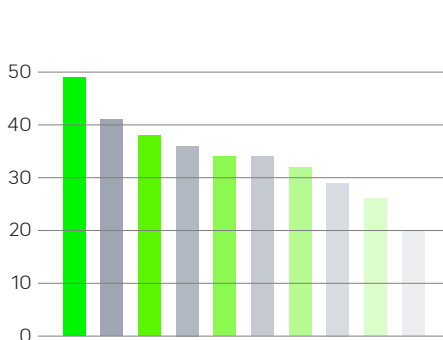
What changes have you made to address IoT security concerns?

- ● Creation of an external IoT security policy for suppliers and partners — 49%
- ● Partnering with a third party — 41%
- ● Training employees on IoT — 38%
- ● Investing in new security technologies — 36%
- ● Securing physical assets such as sensor nodes — 34%
- ● Creation of an internal IoT security policy — 34%
- ● Upgrading existing security technologies — 32%
- ● Communicating to customers on the use of IoT — 29%
- ● Hiring skilled staff — 26%
- ● Implementing a backup connectivity network — 20%
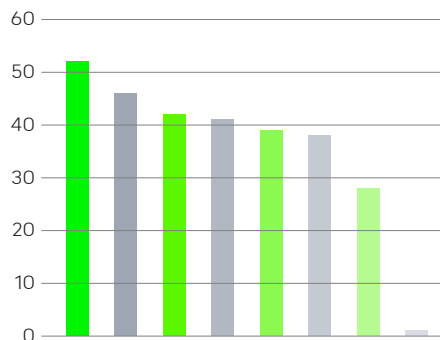
What are your biggest IoT security challenges?

- ● Poor network security — 52%
- ● Internal data regulation and compliance requirements — 46%
- ● Potential mishandling/misuse of data by employees — 42%
- ● Risk of external cyber-attack — 41%
- ● Insecure/unencrypted edge networks — 39%
- ● Supplier/partner data regulation compliance requirements — 38%
- ● Insecure storage of data collected — 28%
- ● We have/ will not face any security challenges — 1%
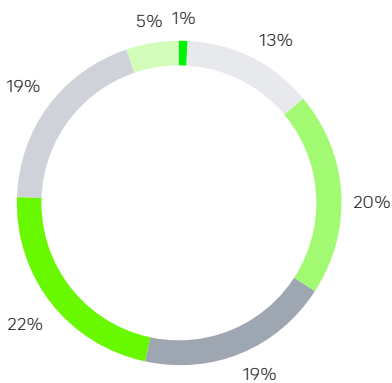
INVESTMENT

IoT budgets for the agriculture sector were significantly smaller than the other sectors we surveyed. On average the planned spend on IoT projects in the next three years is $1,974,167, with service providers understandably spending more ($2,178,571), followed by crop producers ($1,931,410) and livestock producers ($1,797,826). While this is similar to the other sectors we survey as a percentage it is considerably lower in real terms versus the average of $2,804,899. However, spend on IoT amongst agriculturalists grew depending on the size of the organisation, ranging from an average of $1,440,206 in companies below 500 employees to $4,796,250 for those with more than 5,000. Despite these differences in terms of size, it is clear to see that IoT ranks comfortably ahead of other digital technologies across the board.

Another encouraging sign is that respondents in the sector have a strong awareness of the potential for IoT to save the business money both in the short and long term. Currently, the average estimated saving for the business is 7 per cent, with this expected to rise to 12 per cent in 12 months, before eventually reaching 28 per cent in five years. This final figure is only slightly behind the wider sample average and given the fine margins in agriculture, points toward an optimistic future. Larger organisations with over 3,000 employees that can exploit greater yields and therefore gains, expect to see an even larger saving in the long term, expecting an average of 38 per cent in five years.
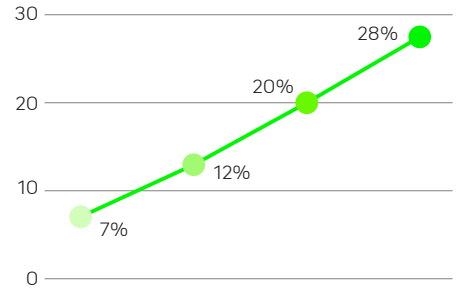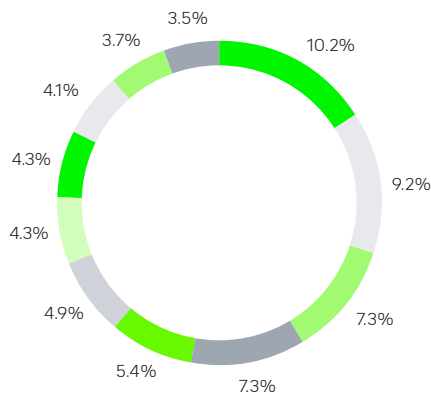

What proportion of your organisation's costs are saved/going to be saved from IoT projects?

● Currently	7%
● In 12 months	12%
● In 3 years	20%
● In 5 years	28%

What is your planned investment in IoT projects in the next three years?

- ● $0 to $100,000
- ● $100,000 to $500,000
- ● $500,000 to $1,000,000
- ● $1,000,000 to $2,000,000
- ● $2,000,000 to $3,000,000
- ● $3,000,000 to $4,000,000
- ● $4,000,000 and above

What proportion of your IT budget will you spend on IoT projects in the next three years?

- ● IoT projects
- ● Cloud computing
- ● Big data analytics
- ● Next generation security
- ● Robotics
- ● Augmented Reality
- ● Virtual Reality
- ● Machine Learning
- ● Cognitive AI
- ● Blockchain
- ● 3D Printing