



Agri 4.0 - Connectivity at our fingertips

A deep dive into the most important enabler
for digital innovation on Australia's farms.

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Contributors and acknowledgments

KPMG has produced this report in partnership with MLA and AATLIS. We thank them for their input and contributions.



KPMG are leaders in the Australian IoT and AgriFood Tech markets, with specialists who understand the latest technologies and have the capability to determine how these can be used to create competitive advantage in the agri-food sector. KPMG is actively involved in AgriFood Tech and IoT through formal partnering, investing and advising organisations from start-ups through to multi-national agri-corporate and research institutions. Its dedicated IoT, AgriFood Tech and Agribusiness teams have a deep and practical understanding of the local and global marketplace and the key trends which are driving the industry.



Meat & Livestock Australia (MLA) is a service provider to the red meat and livestock industry whose role is to deliver world-class marketing, research, development and adoption initiatives that contribute to producer profitability, sustainability and global competitiveness. MLA has 50,000 cattle, sheep and goat producer members. As at 30 June 2018, MLA had a total portfolio of 604 current research contracts valued at \$460 million. This portfolio includes a range of Smart Farm projects, through which MLA is testing a wide range of IoT and AgriFood Tech solutions to foster greater adoption across the sector and foster the prosperity of the red meat and livestock industry.



AATLIS is an advanced agrifood production and innovation precinct being developed by FK Gardner Group in Toowoomba, Queensland, with a core focus on leading connectivity (including 5G) and data intelligence systems based around its Tier III regional Pulse Data Centre. AATLIS is committed to advancing early familiarisation with emerging connectivity and AgriFood technologies by its stakeholder community is crucial in understanding the opportunities, and will be working to advance opportunities for digital innovation through AATLIS with the support of its partners and members.

Foreword

For many primary producers, isolation is part and parcel with being in the business of agriculture. Living and working on remote properties, or even on the outskirts of regional towns, has meant operating in 'digital darkness' without mobile or internet coverage.

Producers have often complained that their businesses are operating at a competitive disadvantage to other industries or primary producers in countries where internet connectivity is more reliable and readily available. Australian producers have read about the \$20.3 billion uplift in Gross Value Produce (GVP), estimated by the Rural Research and Development for Profit initiative 'Precision to Decision', and they are eager to harvest the benefits. However, we often hear from primary producers that they cannot unlock the full benefit of digital agriculture because they are not able to achieve on-farm network connectivity or internet back-haul.

For the National Farmers' Federation (NFF)'s Talking 2030 \$100 billion of farm gate GVP target to be realised, connectivity and adoption of Internet of Things (IoT) and AgTech solutions as soon as possible is critical.

So it is time to bust the, 'I can't connect because of my lack of regional internet connectivity myth', and explore the options for creating connectivity across rural businesses .

In this collaborative paper, KPMG and MLAs IoT and AgTech advisors have laid out connectivity options and Australian AgTech solutions. We have unbundled the jargon of these technologies and included a series of case studies to help primary producers more confidently explore connection options to take advantage of the digital agriculture revolution – Agri 4.0.

Leveraging the experience of KPMG experts in advising numerous government and industry projects in the fields of AgTech and IoT, and MLAs practical experience in deploying connectivity and IoT solutions across five smart farms, our aim is to provide farmers with a practical guide to starting their digital journey and succeeding in the Agri 4.0 revolution.



Ben van Delden
Partner, Head of AgriFood Tech
KPMG



Introduction

Connectivity is an issue synonymous with the agricultural industry in rural Australia.

Whether it is mobile coverage, the NBN, or even a low power radio network — the topic has been an isolating factor for many in the agrifood value chain. A lack of connectivity has been a key contributor to why Australian agriculture has struggled to innovate and implement technologies as quickly and as effectively as other leading food producing nations such as the US and the Netherlands.

It is true that Australia, a continent, faces an array of geographical challenges not faced by other nations, and ubiquitous connectivity across rural enterprises is more difficult to achieve.

For example, unlike the Netherlands, which is 186-times smaller than Australia and with largely flat topography, Australia cannot simply cover its entire landscape with a Long Range Wide Area Network (LoRaWAN) in the space of a couple of months. Nor can we expect 4G or 5G coverage across all pockets of 7.3 million square kilometres.

However, disruptive digital technologies are emerging, providing new ways of operating in the sector.

Fundamental to this is the rapidly expanding reach of the Internet of Things (IoT).

IoT enables physical objects to be sensed and remotely monitored to create a direct integration between the physical and digital worlds. IoT gives farmers the information they need, when they need it, to better inform decisions and change the way they operate their businesses. Not only does this benefit the farmer, but the whole agri-food supply chain. Without efficient data collection and measurement at the farm level, it is very challenging to achieve transparency from paddock to plate. With IoT, the impact of on-farm connectivity can be extended through to the end consumer.

The rise in IoT and other digitally enabled AgTech means that on-farm connectivity is now a key requirement for technology uptake and innovation. For example, technologies such as water trough monitors which require connectivity out in a paddock; or, the ability to use a smart phone to access farm management apps where no mobile coverage exists.

To meet this need, new and exciting communication protocols and market players have emerged to provide connectivity solutions. These providers and technologies can service the connectivity needs of nearly any farmer today.

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The main barrier is not the technology available — it is understanding the business case and how to choose, implement and effectively use it. It is about cutting through the jargon and selecting a technology solution which is fit for purpose. On page 23 we have included a definitions page to help demystify some of the technology language of the IoT sector.

Technologies are constantly improving, with new protocols and upgrades emerging to respond to agricultural IoT and the challenges posed by Australia's unique landscape.

On-farm connectivity has been a barrier to digitisation in agriculture — but it is increasingly becoming less of a barrier. The key is equipping ourselves with the knowledge to discern the best method of connectivity for the individual agribusiness.

As we have seen in cities and urban spaces, once the connectivity is in place, innovation will follow. Without it, innovation stalls and location becomes a competitive disadvantage. Moving farms to find connectivity is not a viable solution, so farmers need to find ways to bring connectivity to them.

Connectivity enables better productivity outcomes, and can drive other benefits, such as increased worker safety, environmental and social benefits. It also plays a crucial role in attracting and retaining talent into rural industries.

The purpose of this paper is to cut through the confusion surrounding on-farm connectivity. KPMG IoT and AgTech specialists explore the technology landscape, and shine light on the stories of pioneering farmers who have already adopted digital technology to advance their enterprises.

Our aim is to help farmers who are looking to understand the connectivity options available and inspire them to embark on a technology journey of their own.

What is holding us back?

While the technology itself is exciting, there are a range of factors which are holding back the uptake of on-farm connectivity solutions. These include the complexity of navigating the technology marketplace, a lack of real life case studies to learn from, and the difficulty in proving the business case.

Navigating the market

Like any emerging market, the race to the top for communications vendors is competitive. New players and protocols are rapidly emerging with innovative solutions to various connectivity pain points. Farmers are having to learn the digital lingo that these pioneering AgTech and IoT companies speak.

The sheer number of connectivity and AgTech options that are pitched to the agriculture community is enormous. Making sense of the solutions, sifting through the 'marketing speak', and indeed deciding on which is best for an individual operation, is no easy task. That is why KPMG is investing in collaboration with several organisations to develop an AgTech Finder Platform (www.agtechfinder.com) to help farmers find AgTech which matches their requirements.

Which protocol has the best coverage? Battery life? Service quality? Interoperability? Latency? Scalability? Device availability? Upgradability? Maintainability? Redundancy? Cost? What are Low Power Wide Area Networks (LPWAN)? Are they different to LoRaWAN? What does LoRaWAN even stand for? What does it do? How is this different from Narrowband IoT (NB-IoT)? What about Sigfox?

Even amongst experts, these factors are not straight-forward. For farmers, finding the time to undertake the necessary research to differentiate between the offerings is often impractical.

Few case studies to follow

The nascency of the market also means that there are few real-life case studies from which to learn from. Statistics show that most farmers are not early technology adopters, but are willing to follow the lead when the benefits have been demonstrated and the return on investment (ROI) clearly identified. This report includes four case studies discussing how farmers across Australia are using innovative connectivity solutions to drive digital uptake on farms.

Building the business case

Another barrier to adoption is developing the business case and justifying the investment in digital connectivity and technology solutions over, for example, an extra labour unit or an additional bore.

Getting the connectivity infrastructure in place, maintaining it, and paying network operation fees can be significant. For many, the benefits may not justify the investment.

An example of this is a small farm operation which may only need three sensors on its property to monitor weather and soil conditions. Paying for a fully-fledged connectivity solution will likely mean that the cost-per-sensor is not viable.

In another scenario, if a farmer requires 50-100 sensors on their farm to service multiple use cases, the connectivity cost-per-sensor is greatly reduced and the business case becomes more viable.

Luckily for the smaller operators, technologies are emerging which cater for network access on a sensor-by-sensor basis. Knowing your operations, and then developing the business case for your investment, is a critical step in the decision making process.

Which is the right connectivity solution for your farming business?

When it comes to selecting a communications network for a farming business, there is no one size fits all.

While one connectivity solution may be perfect on a 100 hectare dairy farm in Victoria, it might be inadequate for the needs of a large-scale grains operation in Western Australia.

What matters is the context of your deployment, including location, business requirements and technology use cases. These will dictate which communications network(s) is most fit for your purpose.

Know your business needs

Rather than focusing on the technology first, what is required first is a strong understanding of your farming business, your current and foreseeable key requirements, and the use cases which will be serviced by the chosen network. Understanding these elements will assist you in selecting a network which suits your context and is most fit for purpose.

When you know your requirements, and can clearly state your needs for connectivity, you are able to narrow down the options and focus on suitability.

Because connectivity does not stop at the farm gate, it is worth discussing with your neighbours to see if there is support for co-investing in connectivity across multiple properties.

Does the technology work?

When deciding on a connectivity solution, it is also critical to understand if the AgTech you are looking to attach to your farm network supports the given connection protocol. Many of the AgTech and IoT products may only support a single connectivity protocol, and alternating to another network can be impractical.

Work is being conducted in 2019 by MLA and others to review the interoperability of AgTech solutions and networks to help producers identify which technologies can piggyback data for other solutions.

Failing to pick the most appropriate technology can lead to failed use cases, inadequate coverage, inefficiencies, unnecessary costs, greater maintenance requirements, and a lower ROI.

Instead, by mapping your pain points or opportunities for digitisation first, and then looking to technology to address these, several of these deployment risks can be mitigated, and ROI can be stronger. KPMG have developed tools for farmers to assess pain points in their farming operations and identify opportunities for IoT solutions to overcome these.



What connectivity solutions are currently available?

A range of communications protocols have emerged in response to the growing need for on-farm connectivity in the IoT era. In the agriculture space, the most prominent include licensed and unlicensed LPWAN, Satellite IoT networks and on-farm WiFi systems.

A high level discussion on each communication protocol has been provided over the following pages.

LPWANs

LPWAN (Low Powered Wide Area Network) describes a variety of technologies used to connect IoT devices to a network beyond the reach of the traditional networks such as Bluetooth and WiFi.

LPWAN encompasses a range of technologies including LoRaWAN, Sigfox, Category M1 (Cat M1), NB-IoT and others. These have emerged to meet the need for long battery life (several years), low cost, and a long range reach of signal.

LPWANs are typically used for low data rate transfers, making them applicable to many agricultural uses where only small packets of data need to be sent.

Where technologies such as Bluetooth and WiFi are appropriate for many consumer-level connectivity use cases, the need for LPWAN technologies is much greater within industrial, commercial and agricultural settings, where the ability for sensors to generate, communicate and transmit over long distances is only feasible if infrastructure can be provided affordably, and maintained at low cost over time.

LPWAN benefits:



LPWANs enable the use of low power IoT sensors and devices that have very long battery life (up to 10-15 years), i.e. low power users.



LPWANs typically have a very long connectivity range and can provide coverage for a sizeable area. Range is largely dependent on topography and can be anywhere from 5-50km in regional areas, depending on what natural barriers are between the connection and broadcast points.



LPWANs can operate at low cost, with low cost sensors and devices and low cost base stations.

LPWAN constraints:



LPWANs can only transmit small packets of data at the edge, so are not suitable for applications requiring high bandwidth, such as imaging, voice or video. Farming businesses will need to look to other technologies such as on-farm WiFi to meet high bandwidth use cases.



Device availability for many LPWAN technologies in Australia is still in an immature stage and finding devices to match the connectivity type can be difficult.

Which LPWAN is best?

There are a number of LPWAN technologies which can be deployed to provide on-farm connectivity in Australia today. These include both licensed and unlicensed networks which both sit within the radio spectrum.

'Licensed' means that a telco will charge you for data usage on their radio spectrum, and 'unlicensed' means that the spectrum can be used by anyone without a license. There may or may not be fees associated with unlicensed access at the consumer level, and this depends on the network provider.

Although these technologies do exhibit some technical variations, these variations are not typically significant as it applies to agriculture. For farmers, the primary focus should be on the non-technical elements of the technologies relating to cost, ease of deployment and maintenance.

Unlicensed LPWAN technologies

Two unlicensed LPWAN technologies capable of providing on-farm connectivity for IoT use cases today are LoRaWAN and Sigfox



LoRaWAN (Long Range Wide Area Network) is a type of connectivity which uses unlicensed radio spectrum to enable wireless, wide area communication between minimal powered sensors and gateways connected to the network.

LoRaWAN networks can be set up quickly, nearly anywhere. A single LoRaWAN gateway installed on a farmhouse rooftop can service kilometers of farmland in each direction (depending on topography).

The business model for LoRaWAN allows farmers to 'build their own network' without relying on telco connectivity. This is one of its key value propositions, and has likely driven its early popularity.

It enables farmers to solve on-farm sensor and device connectivity by their own means if they are willing to be involved in the provision of on-farm IoT communications. This can remove some dependence upon third parties (i.e. telcos) and help insulate from price hikes for intra-farm IoT communications. However, setting up a LoRaWAN network is not necessarily straight-forward, and installation may involve a range of challenges related to topography, additional infrastructure requirements (i.e. towers) and configuration with existing networks/systems.

Another major benefit of LoRaWAN is its low cost. Although there are upfront costs associated with gateway installation, and typically annual maintenance costs, public LoRaWAN gateways do not require subscription fees. This makes it a cost effective solution for connecting sensors on a farm. In some scenarios, multiple farms can share a single public LoRaWAN gateway, which can help to drive down costs and increase the value proposition. Affordable infrastructure means a low cost per hectare end-to-end service can be obtained.

LoRaWAN is a very promising connectivity type which can be applied to many farming operations, and one which will likely play a key role in the digitisation of Australian agriculture moving forward.

The key question for farmers is, does the business case stack up to deploy your own network, or to share a network? In some instances such as in the Southern Grampians, councils are deploying gateways for the public to access and use. This model may have significant merit, and removes a large portion of cost to the farmer.



Sigfox is a connectivity technology which was rolled out in Australia/NZ in 2016 through exclusive provider and operator, Thinxtra. It is the largest unlicensed LPWAN in Australia in terms of population covered, with Thinxtra claiming to cover 81 percent of the population including all major capitals on the eastern seaboard (as at time of writing). This coverage should not be mistaken for geographical coverage.

The focus of Thinxtra's network deployment is currently urban regions with higher population density, so it may not necessarily extend to regional and remote areas. The Thinxtra business model is more akin to the telco 'build it and they will come' philosophy.

However, Thinxtra can still provide connectivity as-a-service for farmers in areas that are not part of its current network deployment map. Thinxtra can supply and install a gateway where required for a rental fee, including connectivity and back-end access.

Sigfox operates on a subscription model, meaning customers pay for network connection fees depending on the number of devices and the number of connections per day. This is the key difference to the LoRaWAN model and may be attractive for some users.

One constraint of Sigfox is its centralised model which relies on a singular company. This gives customers less freedom to switch between providers if required — compared to LoRaWAN, for example.

Sigfox is a key market player, but so far its level of uptake in agricultural settings is not nearly as high as LoRaWAN. The telco style operation of Thinxtra may suit farm operators who want to connect just a few IoT sensors, and where deploying a network of their own is not viable.

Licensed LPWAN technologies (operated by telecommunication companies)



NB-IoT (Narrow Band IoT) and Cat M1 are LPWAN technologies that run on licensed radio spectrum and are capable of providing on-farm connectivity for IoT. These enable IoT devices to be connected to networks through existing cellular infrastructure owned by large telco operators such as Telstra, Vodafone and Optus.

While Cat M1 has been available exclusively through the Telstra network since 2016, Telstra's NB-IoT network has only been switched on as of 2018. Meanwhile, Vodafone and Optus have run NB-IoT proof of concepts and have turned on NB-IoT networks in selected areas.

Where network coverage exists, NB-IoT and Cat M1 networks connect devices efficiently by leveraging already established mobile networks, removing the need for additional on farm network infrastructure deployment, such as the gateways required for LoRaWAN networks.

Compared to unlicensed LPWANs, NB-IoT and Cat M1 provide greater reliability and range, as well as greater security and freedom from interference by other users, because they use a licensed spectrum-based network that limits number of users on the bandwidth. However, in agricultural settings, the lower interference and greater security these benefits are less relevant given the small amount of users and low sensitivity of data.

Between the two technologies, NB-IoT is better suited to applications sending smaller amounts of data than Cat M1, and for operating with a longer battery life, such

as a moisture sensor or livestock tracking device. In this way, NB-IoT is typically more relevant for many AgTech/IoT use cases on-farm where smaller data packets are exchanged.

A constraint of NB-IoT and Cat M1 is that both rely on established cellular networks, and therefore may not be feasible for remote locations which have little access to existing mobile networks. Telstra NB-IoT coverage maps are available online, allowing farmers to see if their property falls within network range.

NB-IoT will likely play a huge role in the Australian IoT industry moving forward. The telcos will drive its uptake in the market, and this is already being seen in the cities and utilities spaces.

For farming enterprises, there are currently very few real life case studies of NB-IoT, although with the market picking up momentum, this may change.

Again, the decision to use NB-IoT at the individual farming level will depend on the unique farming requirements. It may be a solution for those who do not want to spend money upfront on infrastructure, but are happy to pay data usage fees on an ongoing basis. Or, for those who only want to connect a few devices, and deploying their own network is not viable.

Total operating cost per sensor will be a key consideration when deciding between NB-IoT and unlicensed networks such as LoRaWAN.

Satellite IoT



Satellite IoT technology has been developed to meet the demand for remote IoT connectivity where no other communication infrastructure is viable. It is particularly applicable in remote use cases, such as on large cattle stations and mining operations.

Australia is leading the way in this type of technology, with Adelaide-based companies Fleet Space and Myriota developing world-first solutions.

Satellite IoT uses low earth orbit nanosatellites to provide IoT connectivity from any location on earth

without the need for ground-based infrastructure (no gateways, no base stations and no repeaters).

Depending on the use case and number of sensors deployed, cost is typically higher than other technologies, but in areas where there is no other option for connectivity, it is a viable solution.

While Myriota's solution is direct to satellite, Fleet combines LoRaWAN on farm networks with satellite backhaul capability. Both solutions are promising for regional and remote use cases.

More bandwidth needed?

While the LPWAN and satellite technologies are ideal for IoT-enabled AgTech transmitting small packets of sensory data, they are not designed to handle the bandwidth requirements of use cases such as voice over WiFi, imaging and video transmission. These use cases can be enabled through on-farm WiFi networks.

On-farm WiFi networks can provide farmers with internet and mobile coverage across their properties, rather than being limited to the vicinity of the homestead or farm office where a regular WiFi signal exists.

These networks typically work by 'piggybacking' wireless or mobile signals across a network of repeaters to provide wireless internet where needed. These signals can be received from an internet connection on that property, or can be extended from a surrounding area with internet connectivity. This enables access even for farmers who are outside the reach of a cellular tower or in a blackspot area.

Use cases for on-farm WiFi include the ability to make phone calls over WiFi across your property, access to farm management apps on your smart phone or tablet device, CCTV surveillance, imaging solutions, and more.

Whilst it is possible to use on-farm WiFi for IoT use cases such as soil moisture monitoring, there is a reduction in range and an increase in power consumption, as compared to LPWANs.

In addition to on-farm WiFi solutions, solutions such as Digital Drift can be used as a bridge between the edge of the existing WiFi network and use cases on the farm. In these cases, coaxial cable can be used as an extension mechanism, however, it is generally not viable for distances of more than a couple of hundred metres and cables risk being cut or trampled in farm environments.

Things to ask yourself when picking an on-farm connectivity network:

1. Business/property considerations

- What are the key pain points or processes that you would like to see digitised to reduce effort, cost or risk?
- What is the topography of the land? (If flatter, signals will travel a lot further)
- What is the distance (range) your network needs to cover to connect devices on your farm?
- What is your internet capability like?
- What is your level of digital literacy?
- What is your appetite for cost, both upfront and on an ongoing basis?
- What will the cost per sensor be from a connectivity point of view?
- Who and how many users of connectivity will you have to support? What is the anticipated data requirements (social and business uses) and connectivity needs (speed/coverage/data/voice/video)?
- Does the business case stack up?
- Data requirements

2. Use case requirements

- Is there an adequate supply of configured sensors/devices for the chosen network? (Some Australian LPWANs such as LoRa use different frequencies than other markets such as the US and Europe, so imported sensor devices may not automatically run on your connectivity network frequency.)
- What is the type of information being transmitted? Does it have high or low bandwidth requirements?
- What is the frequency of data transmission required?
- Is data transmission time critical? E.g. real-time or periodic signal transfer.
- What is your expected battery life of the sensor device?
- Is single or two-way communication required?
- How does the network type cope with the farming operations? E.g. intensive orcharding with hundreds of individual plants and rows.



On-Farm Connectivity Solutions – Australia

Picking the right technology for your farm

There is no one size fits all. The context of deployment (including location, business requirements and use cases) will dictate which communication network(s) is most fit for purpose. *What does it all mean and who are some of the providers?*

Low Power Wide Area Networks (LPWAN)

Unlicensed

LoRaWAN: “Deploy your own network” model. Multiple providers in Australia. Low upfront costs for hardware installation and no subscription costs for public connection. Can transmit small packets of data 5-50km (depending on topography). Very long battery life (5-10 years+). Proven effectiveness in agriculture.

Sigfox: Can use existing infrastructure if in range, or can deploy your own gateway. Can transmit small packets of data 5-50km (depending on topography). Subscription model with monthly payment per device. Very long battery life (5-10 years+). Focus is cities and utilities but can service agricultural use cases as well.

Licensed

NB-IoT and Cat M1: Use existing Telco infrastructure, so no installation costs if inside network range. Can transmit small data packets 20km+. Subscription fees are modest, but relatively few case studies at this point in time due to recent deployment of networks. Cat M1 is better suited to sensors that are moving (wearables), NB-IoT is better suited to most agricultural use cases sending smaller packets of data, more infrequently.

Nanosatellites

Provide connectivity for IoT sensors from any location without the need for local infrastructure. Particularly viable solution in remote locations and for intermittent data transfer use cases. Additionally, the newly emerging LoRaWAN/Satellite hybrid solution combines the benefits of LoRaWAN with backhaul capability via satellite. Technology is new and with limited case studies – but lots of promise.

Nano satellites



FLEET

LoRaWAN / Satellite



Key:

IoT Specific

Voice and Video

Wireless Mesh / On-Farm WiFi

Provides farmers with internet coverage across their properties and helps eliminate black spots using repeaters to extend an existing connection (whether this exists on their property or somewhere nearby). The primary use cases for this connectivity type in this context is voice over WiFi and video (e.g. for surveillance or facial recognition). Whilst it is possible to use wireless mesh for IoT use cases, it is not generally practical due to its power consumption impacting sensor battery life and its lower range, as compared to LPWANs.



• **Licensed LPWAN:**

NB-IoT and CAT M1



NB-IoT



• **Unlicensed LPWAN:**

LoRaWAN



Sigfox



• **Wireless Mesh / On-Farm WiFi**



NB: Sample selection of Australian market players only.

Not intended to be comprehensive. Developed February 2019

Connectivity solved — What AgTech is available?

Once the connectivity baseline is in place, farmers can effectively implement IoT and other digital on-farm solutions to improve their productivity, reduce risk, improve safety for workers, and have better peace of mind. Farmers can tap into the power of data, and the insights which come from data.

As the world becomes increasingly connected through IoT, data becomes a more critical asset. Having access to insights resulting from real-time data allows farmers to respond at pace and make more informed decisions. Over time, the more data that is collected, means informed decisions and planning; ensuring precise resource use, less waste, quicker speed to market, traceability, improved biosecurity, and safer food.

Having integrated data sets creates a powerful basis from which to run predictive analytics. This helps with tracking finances, the state of business in general, as well as staff performance and equipment management.

As more farmers see the value in collecting data, they will be encouraged to implement more technologies to capture a wider range of data sets. Benchmarks across farms and best practice will be more easily implemented, tracked and rewarded.

The opportunity if we can get it right

Looking to other industries with mature digital enablement, there are strong signals that if the agricultural community could follow it would make a significant difference.

In the 2017 Rural R&D for Profit Report, *Accelerating Precision Agriculture to Decision Agriculture* ('P2D Report'), a **25 percent increase** in gross value of production from 2014-15 levels was predicted through unconstrained digital agriculture — equating to a potential **\$20.3 billion** GVP uplift to the industry.

Further, the KPMG and National Farmers' Federation of Australia's [Talking 2030: Growing agriculture into a \\$100 billion industry](#) discussion paper reported that Australia's agricultural productivity growth rate was averaging 1.1 percent, well below the 1.7 percent global average.

Despite this, the industry is optimistic, with the National Farmers' Federation setting a bold vision and roadmap for the industry; to create a \$100 billion industry by 2030. If we are to achieve this vision, digital enablement across the sector, starting on farm, will be critical.

Understanding some key areas of AgTech

There is a significant array of AgTech solutions in the market for farmers to choose from, such that the choice can be overwhelming. To help farmers sort the wheat from the chaff KPMG, in partnership with several organisations (Food Agility CRC, IAG, AgriFutures, MLA, NFF and others), is developing an AgTech Finder Platform (www.agtechfinder.com) to assist farmers to find the right AgTech solution for their requirements. Some of the AgTech use cases available to Australian farmers include:



Farm management platforms

Utilising production data collected off the farm through IoT sensors, farm management platforms offer a congregated dashboard of information for farmers. The dashboard allows farmers to manage and optimise the production activities and operations of their farms. As well as monitoring variables such as soil quality, weather variables and fertilisation, there is also an ability to track livestock.



Smart irrigation

The use and management of water on farms is in the spotlight. Approximately 70 percent of the total volume of water withdrawals in the world is used in agriculture irrigation. Around 60 percent of the water that is intended for irrigation is lost, either due to evapotranspiration, land runoff, or inefficient usage methods.

Smart irrigation solutions offer an IoT fueled management platform that can closely monitor and adjust a farm's water utilisation. A dashboard that integrates irrigation information means farmers have access to tools that enhance decision making around water. This means they can reduce water wastage and improve the quality of crop growth in their fields through precision agriculture practice. Factors such as timing, being able to minimise wastage and runoff, and analysing soil moisture levels give power to farmers to fine tune their irrigation requirements. Implementing smart irrigation also reduces the chance of human error, with automated systems such as smart valves alleviating this.



Weather & climate monitoring

Climate, rainfall and extreme weather conditions create further uncertainty for farmers in an already volatile environment. Technology to monitor external factors, such as weather predictions, puts the farmer back in the driver's seat to manage their farm with more certainty. For example, picking a crop a day early could offset the wipe-out of an entire crop if they know a storm is coming.

The ability to precisely manipulate inputs also enables the farmer to be in better control as to what they put into their farming systems as a management tool. As heat increases, for example, they can adjust their irrigation systems to input more water to offset dry conditions.



Pest management

Most farms currently monitor pests using visual cues. This is common practice but is performed periodically by qualified pest technicians. This is expensive, labor intensive, not monitored consistently, and lacks the ability to identify and react to an outbreak in real-time.

The ability to remotely monitor pests will assist with the maintenance and health of a farm. Collecting and understanding data on a pest's activity, location and patterns allows for efficient and sustainable treatment of pests, integrated biosecurity tracking and more rapid responses across affected areas.

Opportunities to better manage pests on farms could be through connection of traps to report specific pest levels, thus automating monitoring and data collection to take more accurate and quicker countermeasures.

The ability to share data on biosecurity with the relevant agency and community enables faster risk mitigation and intervention.



Imaging, drones and UAVs

Satellite imaging, intelligent drones, and unmanned aerial vehicles (UAVs) can assist farmers to collect images.

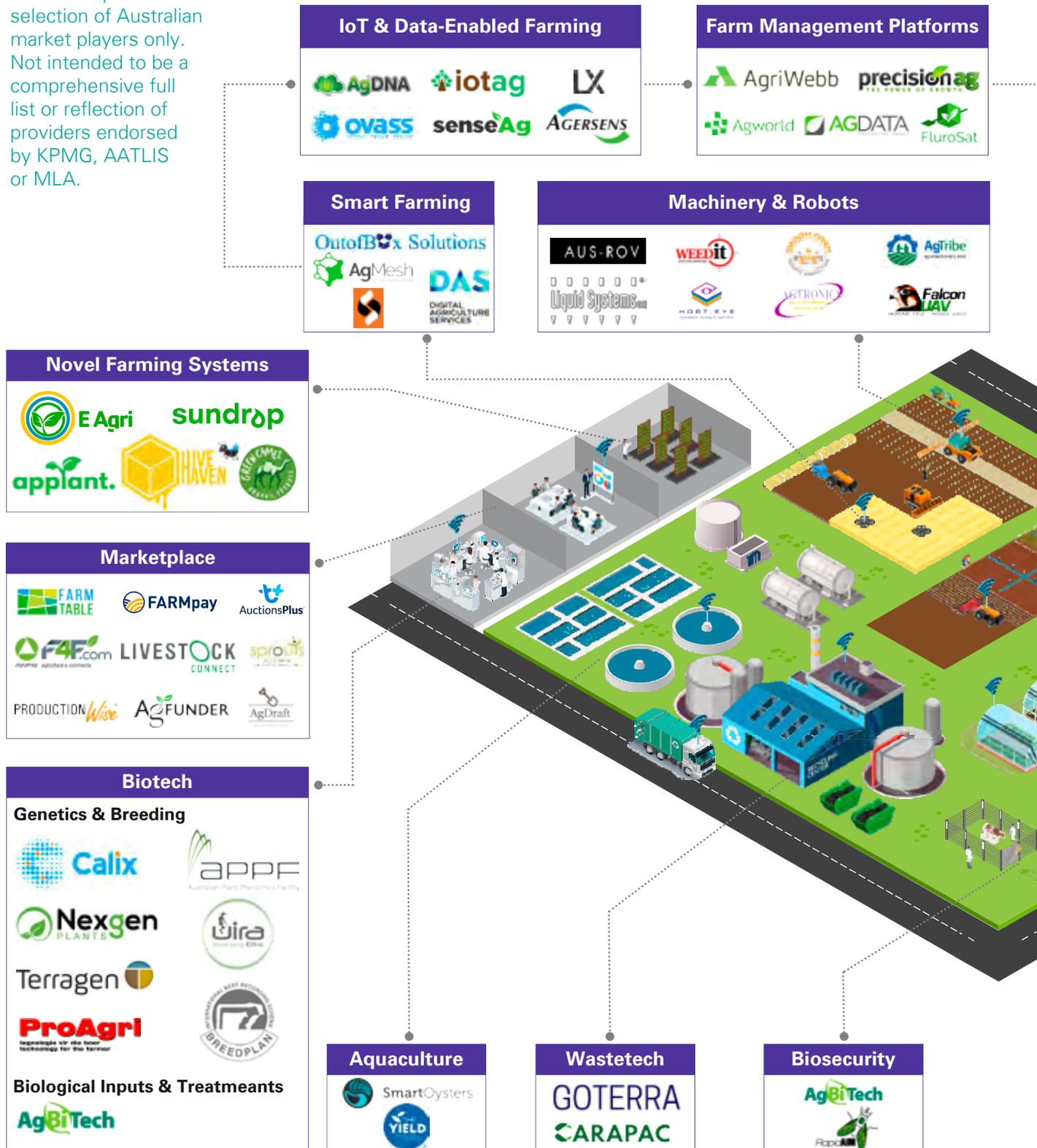
Imaging can identify changes to soil and vegetation, identify crop stress, and assess irrigation and assist crop spraying. Farmers can conduct crop forecasting and better manage their agricultural production and inputs.

Integrated mapping from various images can identify issues and therefore improve yields and efficiency of time for farmers. It can also be used as a tool to track livestock, and drones can be used to deliver inputs such as fertiliser.

Australian Origin AgTech Solutions

300+ Companies

Note: Sample selection of Australian market players only. Not intended to be a comprehensive full list or reflection of providers endorsed by KPMG, AATLIS or MLA.





Conclusion

While the Australian agriculture industry may be later adopters of digital compared to some other nations, it is by no means immune to its impacts.

The intersection between digital technologies and agriculture has a critical role to play in alleviating the pressure on the current food system, and is paving a new direction for the industry.

In order to capitalise on the huge potential promised through digital agriculture, we need to first get in place the baseline infrastructure.

This starts with connectivity — the single most important enabler for digital innovation in agriculture.

Connectivity is what enables farmers to access and effectively use farm management systems, IoT systems, AgTech, and decision farming techniques. It enables farmers to tap into the power of data, and the insights which come from data.

If we are to meet the 2030 vision of a \$100 billion industry, and even exceed this benchmark, we need to cut through the jargon, focus on what really matters, and make informed investment decisions in technology like those farmers profiled in the case studies included in this paper.

Australia can become leaders in the digital revolution sweeping agriculture and our farmers can benefit from the Agri 4.0 Agtech solutions coming to market.



CASE STUDY — DARREN PRICE

Name:

Darren Price, General Manager

Company Name:

Carwoola Pastoral Company

Location:

East of the ACT, near Bungendore

Farming type:

Mixed grazing with some winter fodder crop and irrigated lucerne

Property size:

Four properties totalling roughly 6,500 hectares

Number of employees:

5 + contractors



Key benefits of on-farm digital:

1. Remote management of business
2. Potential for new revenue streams
3. Peace of mind



Key advice:

1. Understand what infrastructure is required to deliver a solution
2. Make sure you have ongoing maintenance, support and advice from providers
3. Understand different pricing models
4. Find out what's out there and have a go!
Each deployment becomes easier and easier

Darren Price is the General Manager of the Carwoola Pastoral Company ('Carwoola'), whose properties are located near Bungendore just outside of the ACT. The company spans four properties in the Bungendore/ Queanbeyan/ Yass areas, with a total footprint of 6,500 hectares. The properties are used primarily for mixed grazing purposes, with some winter fodder crop and also irrigated lucerne.

Darren has been with the company for nearly 22 years and has seen the business move from a traditional farming business to one with some of the most extensive AgTech deployment in Australia.

Just over 12 months ago, Carwoola and Meat & Livestock Australia (MLA) teamed up with the purpose of deploying and testing a range of connectivity and AgTech technologies from a number of providers to gain deep, practical insight into what the market capability is at this point in time, and what benefits current technologies can bring to the farming enterprise. As a trial, the initial purpose is to test and learn followed by quantifying ROI if possible as well as building a "best practice" model for future adopters. The trial also includes assessing data usage requirements to understand what type of network and bandwidth is needed to support digital agriculture in its various forms. When confidence in the technology grows, the business will look to drive the program at a more commercial level.

From a connectivity point of view, the Carwoola deployment is unique in that MLA has deployed more than one IoT communications network. Across the four properties, there are now four LoRaWAN gateways, Sigfox gateways, Satellite IoT and on-farm WiFi. With mixed topography, ranging from flat to very hilly, this technology mix has been beneficial in providing greater coverage, but also servicing a more diverse range of use cases. MLA is trialling connectivity solutions from a range of vendors to compare solutions, pricing, and support models.

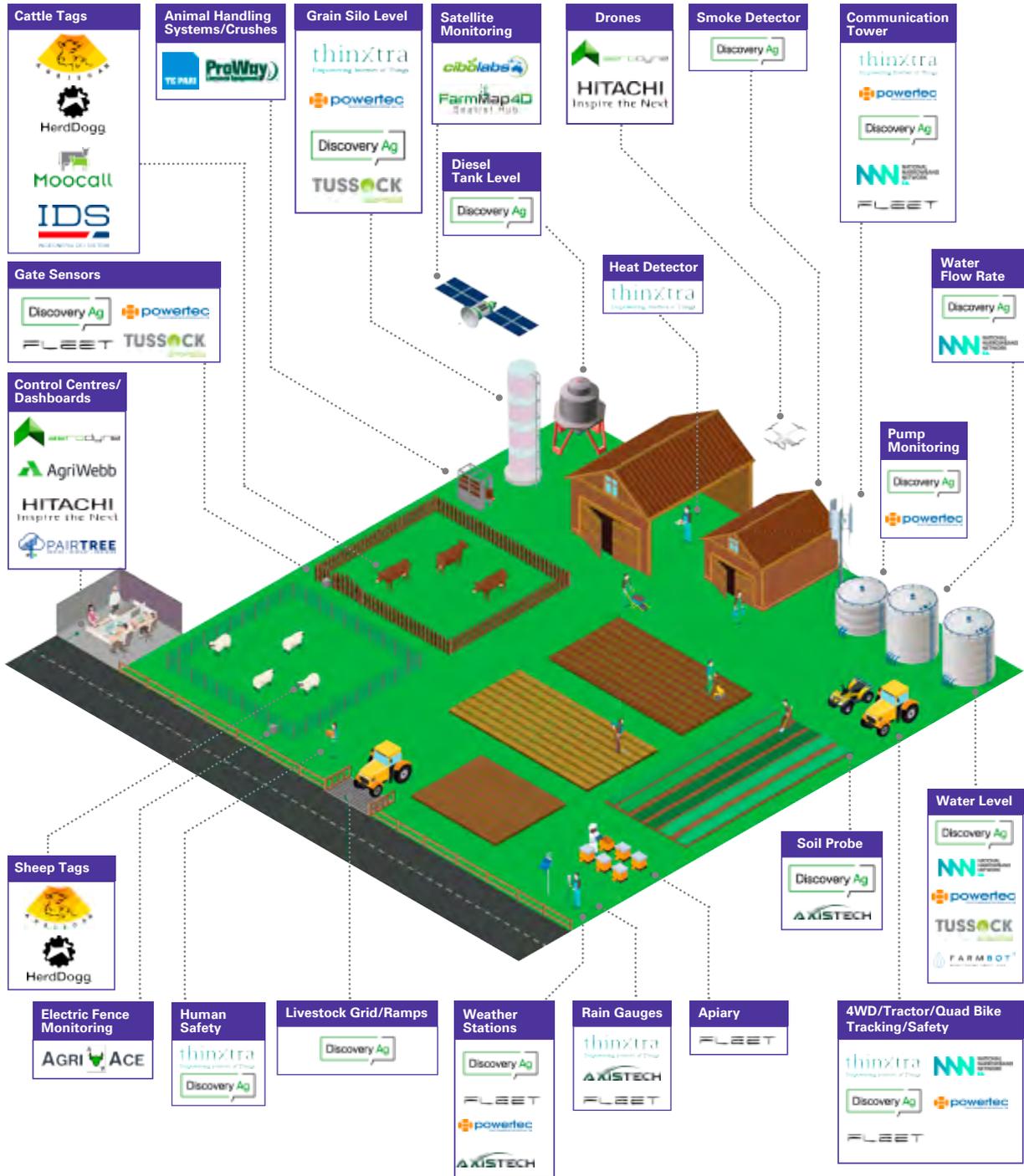
With regards to the selection of AgTech use cases for deployment, the process Darren went through was to create a "wish list" of areas in the business he either saw as pain points, or opportunities for digital transformation. MLA then went to the market to find what solutions were available to service Darren's wish list items as well as any other contributions toward digital advancement. As a result of this process, the Carwoola properties now have over 200 AgTech devices in operation, from 22 different service providers. As you can see in the image below, the trial incorporates use cases in a number of areas including cattle tags, rain gauges, soil probes, electric fence monitoring, pump monitoring, aviary monitoring, WHS and several others. There is also a keen interest to incorporate other suppliers and emerging tech as it presents itself into the future.

From Darren's perspectives as General Manager, one of the key benefits delivered through these use cases is the ability for him to remotely manage his business. With the ability to view, for example, the status of water tanks and pumps from his phone, he is able to travel from property to property, or elsewhere with peace of mind and with the ability to constantly manage what is going on within the business.

On the flipside, a key challenge of the deployment has been the lack of integration between solutions, a common problem to many in the sector. Deploying devices from 22 service providers means that Darren is effectively needing to access 22 different interfaces to access data and dashboards. In response to this, a current project Carwoola and MLA are tackling is to develop an integrated, holistic dashboard so that the business owners, Darren and his employees can see everything in the one place.

Going forward, the next 3-6 months for Carwoola and MLA is about gaining a full appreciation of the systems currently deployed and build in feedback loops to industry through MLA on what works, what is robust, and what is fit for purpose. This will inform the priority use cases for more scaled deployment going forward and provide key learnings and insights to the industry.

Install Base (200+ devices)





CASE STUDY — BEN WATTS

Name:

Ben Watts

Company Name:

Bralca

Location:

Molong, NSW

Farming type:

Sheep/contracting

Property size:

300 hectares

Number of employees:

6



Key benefits of on-farm digital:

1. Peace of mind
2. Greater efficiencies and overall productivity
3. Better decisions
4. Improved safety for workers
5. Improved animal welfare



Key advice:

1. Define your problems clearly
2. Start with the low hanging fruit
3. Be patient

In late 2016, Molong NSW farmer Ben Watts commenced an exciting partnership with NSW Department of Primary Industries and technology giant Cisco. The plan was to develop and implement a farm decision platform to provide ubiquitous connectivity, and enable the use of IoT and other decision making tools across the 300 hectares property.

It began as an 'early adopter' trial, and now digital technology and IoT are embedded in Bralca, and have transformed several aspects of the business. Ben's innovative, yet pragmatic use of technology has been a shining light for many other farmers in the industry.

Before this began, the only digital on-farm tool that Ben was using was a 3G enabled water sensor on his water troughs. Not only were these expensive, but they were unreliable sources of data. For example, troughs would require manual inspection to calibrate findings. Connectivity was a constant challenge, and installing digital technology in any meaningful capacity was not feasible.

The partnership provided Ben with the opportunity to explore new ways of solving for connectivity, and in turn, providing the foundations for greater digital uptake.

The solution chosen was LoRaWAN, given the rolling hill topography and size of the land, as well as the use cases to be serviced.

A single LoRaWAN gateway provides Ben with a 7km radius of IoT connectivity, servicing more than

1133.12 hectares. The LoRaWAN gateway has been installed on top of an 8m tower to provide greater range. Ben has since had LoRaWAN gateways installed on three more of his properties.

Ben has installed entry point monitoring, soil moisture probes, pasture growth monitors, EID tags for sheep, water trough monitors, wind monitors, drones and walk over weighing.

The benefits have been game changing. Ben has increased overall productivity by 20 percent through greater efficiencies. For example, the water trough monitor has reduced as much as 0.2FTE and significant diesel costs by removing the need to spend a whole day each week driving around the property checking on troughs.

The 'multiplier effect', as Ben describes it, provides him with the ability to leverage timely and meaningful data to make better decisions. For example, he can conduct better sheep and paddock management by overlaying the data coming from soil moisture probes and pasture growth monitors. Through early identification of issues affecting feed, Ben is equipped with the knowledge to proactively manage risks before sustaining impact to his business. This also leads to better animal welfare.

Ben says using sensor technology in replace of staff on quad bikes and utes checking on troughs and other key equipment has improved staff safety.

For Ben, the overall impact is peace of mind. If you need to know what your technology needs are, Ben says to think about what keeps you awake at night. Then look for what will take those worries away.

Secondly, he says to make sure you start with the low hanging fruit. These will bring about the greatest impact with the least amount of effort.

Ben's final piece of advice is to understand that it will take longer to embed a system and get it working than you initially thought. Fitting in new technology with existing systems can be difficult. Where possible, use 'open source' software so you can feed data back into whatever database you may need to use.





CASE STUDY — WALLY NEWMAN

Name:

Wally Newman

Company Name:

Woodstock Trading, and Chairman, CBH

Location:

Newdegate, WA (400km southwest of Perth)

Farming type:

Sheep, grain

Property size:

11,000 hectares across three locations.

Number of employees:

3 in partnership, 3-6 contingent workforce



Key benefits of on-farm digital:

1. Greater efficiencies and overall productivity
2. Reduced risk through real-time data
3. Better decisions



Key advice:

1. Consider battery life of sensors
2. Carefully weigh up pricing models

The first on-farm connectivity solution that Wally invested in was 2-way radio back in 1972. He was the first farmer to do so in WA. The private channel extended 30 miles' line of sight and enabled voice communication for Wally and his team on another side of the property. Wally used the system up until 2014 when mobile coverage became a better option.

In regional WA, Telstra mobile coverage is typically good if you have an aerial on your phone, or you invest in some boosters. Wally invested in boosters and a 13,000 hectares farm-wide WiFi network providing internet/voice connectivity, video surveillance and backhaul for a LoRaWAN network. This means that the team now has access to WiFi signal across the property, rather than just at the office. It means harvesters can send yield data direct to the cloud from the field.

With an extended WiFi network in place, Wally began to investigate the use of an LPWAN technology for low power transmission of data. Wally invested in a single LoRaWAN gateway for the Newdegate property. The gateway was sourced from and installed by WA-based supplier, SimplyCity (www.simplycity.net.au) which was born out of Perth IoT Community who are working collaboratively to design and pilot smart farm solutions to drive positive change for WA farmers. The idea was to run a number of proof-of-concepts and test the feasibility for wider AgTech investment utilising the LoRaWAN communication network.

From a single LoRaWAN gateway, Wally was able to get 20km coverage. The Woodstock team has since installed sensors on flow meters on water pumps, sensors on feeder bins, water troughs, battery monitors for solar powered systems, equipment tracking, and gate open or closed detection.

So what are the benefits? There are two prime use cases which demonstrate a clear return on investment.

Firstly, is a water level monitoring solution. Sheep can die within 3 days without water, so it is a key priority of the team to ensure that water troughs are full. The water level monitoring solution has helped do this without the need to drive around for hours on a quad bike — using up precious staff resources and fuel. It has also led to a reduction in water wastage by detecting leaking water.

Secondly, is a feeder bin system. The system informs the team of the level of each bin in real-time, and alerts the team to re-fill only when below a certain level. Removing the need to go out and check every feeder bin has saved nearly a whole day of time per week. In both cases, the ROI is evident through saved time and a re-allocation of resources through live information.

The team is now looking into weather stations to inform spraying decisions, and gate sensors. They are also looking to separate sheep on weight using a walk-over weighing system.

One challenge has been the battery life of IoT devices. Driving around the farm to change batteries every 3 or 4 months on dozens of devices is not sustainable. Finding devices which are low power enough to last at least 12-18 months is a challenge, and even more so to find devices which report battery level.

Avoiding devices, to the extent possible, that sit on standby is a start. Secondly, carefully weighing up various vendor pricing models before outlaying money is important, as some have low upfront hardware costs, but can have high ongoing costs. Paying for a service is important, but only when it is delivering clear value.



 CASE STUDY – TOM RIGGS

Name:
Tom Riggs

Company Name:
RBJJ Riggs Pty Ltd

Location:
Burra, South Australia

Farming type:
Family owned cereal cropping and sheep grazing operation

Property size:
32,300 hectares

Number of employees:
3



Key benefits of on-farm digital:

1. Reduced labour
2. Reduced operational costs
3. Reduced risk
4. Peace of mind



Key advice:

1. You don't need to be tech savvy to invest in and benefit from AgTech

In early 2018, the Riggs family business participated in a 6-month water tank monitoring trial with Myriota. Myriota is an Australian start-up with a goal to provide connectivity to remote IoT use cases which lie outside the reach of other communication networks. Myriota's technology allows transmitters to talk to a constellation of low-earth-orbit nanosatellites providing global coverage for IoT use cases. The Riggs' involvement in the trial makes them one of the first businesses in the world to be enabled by this technology.

For the family owned business, a challenge is understanding water levels in tanks and troughs across their properties. The task of

checking water levels across over 32,300 hectares takes at least a day per week for one of their staff members, and demands significant amounts of diesel. Over a year, these factors can add up to be in the tens of thousands of dollars.

The ability to remotely monitor key water points, some as distant as 50km from the homestead, was not something the Riggs family had been able to do before being involved in the Myriota trial. The solution made a significant economic and operational impact on the business. Not only were operational costs reduced, but the Riggs were given greater peace of mind and operational risk was reduced.

This intangible benefit is more valuable than often given credit for. Knowing when there is a small issue and being able to deal with it before it becomes a bigger issue is very valuable. For instance, if a bore is checked on Saturday, and then breaks down on Sunday, the sheep may be without water for 4 or 5 days without anyone knowing. A remote sensing solution can remove this risk.

The family are keen to investigate the use of Myriota's satellite connectivity to enable electronic ear tags for sheep monitoring and flow meters on troughs.





CASE STUDY — ROWAN DOLLAR

Name:

Rowan Dollar

Role:

Chief Information Officer, Department of Primary Industries and Resources, Northern Territory (NT)

Location:

Douglas Daly, 2 hours south east of Darwin, Northern Territory

Farming type:

Cattle, crop and pasture research

Property size:

3,100 hectares



Key benefits of on-farm digital:

1. Worker safety and wellbeing
2. Improved productivity
3. Better decisions



Key advice:

1. Solve the big ticket items first

The Douglas Daly Research Farm (DDRF) is a NT Government research facility that was set up in the 1960s to research the development and extension of agriculture in the Top End of the NT.

DDRF is located 230km from Darwin, North West of Katherine in the Douglas Daly region. The region has been recognised as being valuable for agriculture, given its rainfall levels and soil types.

However, like most parts of the NT, a key challenge on the facility has been the lack of connectivity. In this case, meaning no coverage, 3G or otherwise.

This is typical for most of the NT agriculture industry, and highlights the difficulty of farming operations in these parts.

Rowan Dollar, CIO, Department of Primary Industries and Resources, NT, says the lack of connectivity on the property is problematic for several reasons.

To begin, it is a clear safety concern and an issue for worker wellbeing.

Secondly, it denies the region of the ability to take advantage of the benefits offered through digital agriculture. While productivity and better farm management is a clear benefit of technology, Rowan points out that animal welfare is equally important.

Rowan came across Agrinet, a NSW-based business which installs farm-wide wireless networks to give farmers reliable internet and mobile coverage across their property. Rowan worked with Agrinet to install a farm-wide Sleepy WiFi network across 3100 ha of the DDRF, providing connectivity, video surveillance and infrastructure for IoT devices, and for future projects including soil moisture probes, walk over weigh bridges, and pump monitoring/control. It was the first time that Agrinet had used satellite backhaul for its WiFi network.

Now the team can use smart phones and iPads across the research facility, giving them access to information when and where they need it.

While Rowan has looked into other connectivity types such as LoRaWAN, he believes that in the NT WiFi networks are usually more fit for purpose given they can solve a range of pain points, including voice and video, within the one solution.

Of course, range and expense comes into play when talking IoT, but making sense of IoT data through analytics is not feasible without internet coverage as a foundation.

Demystifying the language of IoT - definitions glossary

Backhaul: In both the technical and commercial definitions, backhaul generally refers to the side of the network that communicates with the global internet, paid for at wholesale commercial access rates to or at an Ethernet Exchange or other core network access location.

Bandwidth: Describes the maximum data transfer rate of a network or Internet connection. It measures how much data can be sent over a specific connection in a given amount of time. For digital devices, the bandwidth is usually expressed in bits per second (bps) or bytes per second. For example, a gigabit Ethernet connection has a bandwidth of 1,000 Mega-bps.

Base stations: A base station is a wireless communications station installed at a fixed location and used to communicate as part of a telco's network.

Cat M1: Category M1 LTE is a Low Power Wide Area (LPWA) air interface that lets you connect IoT and M2M devices with medium data rate requirements (375 kb/s upload and download speeds in half duplex mode). It enables longer battery lifecycles and greater in-building range, compared to standard cellular technologies such as 2G, 3G, or LTE Cat 1.

Gateways: Antennas that send and receive broadcasts between devices and the network. Devices use low power networks like LoRaWAN to connect to the Gateway, while the Gateway uses high bandwidth networks like WiFi, Ethernet or Cellular to connect to the internet.

Edge Computing: The practice of processing data near the edge of your network, where the data is being generated, instead of in a centralised data-processing warehouse.

Half duplex mode: Where a device is able to choose between sending and receiving, rather than full duplex where the device sends and receives at same time.

IoT: The Internet of Things. IoT can be defined as any 'thing' that has a sensor attached to or embedded within it, to enable the measurement and transmission of data relating to that 'thing' over a communications network. (A 'thing' is any object, animal, or person. Data - data points with a unique voice or identity).

IoT communications network: A wireless network specifically designed to transmit small packets of data from 'IoT devices / sensors' (Examples include LPWANs and Satellite IoT).

IoT device / sensor: Objects (such as a soil moisture probe), often with minimal power requirements, capable of recording, collecting and sending data via wireless communication.

Latency: Network latency is the term used to indicate any kind of delay that happens in data communication over a network. Network connections in which small delays occur are called low-latency networks, whereas network connections which suffer from long delays are called high-latency networks.

LoRaWAN: Long Range Wide Area Network. An unlicensed LPWAN which enables low power, wide area communication between remote sensors and gateways connected to the network. Uses lower radio frequencies with longer range between gateway and devices.

LPWAN: Low Power Wide Area Network. A broad term that describes a variety of technologies used to connect IoT devices to a network beyond the reach of the traditional networks such as WiFi. LPWAN encompasses a range of approaches including LoRaWAN, Sigfox, Cat M1, NB-IoT and others.

LTE: Long Term Evolution is the name given to 4G network (which the main mobile telco companies use), ie a progression from 3G / GSM.

M2M: Machine to Machine, refers to objects that can communicate to each other, for example two or more autonomous tractors may communicate their location to each other.

NB-IoT: Narrowband IoT is a Low Power Wide Area Network (LPWAN) radio technology standard developed by 3GPP to enable a wide range of cellular devices and services.

Protocols: A communications protocol or network protocol is the specification of a set of rules for a particular type of communication.

Range: The distance that a signal can travel to connect to and service an end device.

Repeaters: A wireless repeater takes an existing signal from a wireless router or wireless access point and rebroadcasts it to create a second network.

Spectrum: The radio frequency bandwidth on which a gateway and device communicate. LoRaWAN frequencies are determined by national / regional regulators. Allocated LoRaWAN frequencies differ between countries devices (Australia 915-928 MHz, US 902-928 MHz, EU 863-870 MHz, China 470-510 MHz and 779-787 MHz) which means farmers need to consider when procuring imported sensors and applications that they will run on Australia's allocated LoRaWAN range 915-928 MHz.

Key contacts

KPMG



Ben van Delden
Partner,
Head of AgriFood Tech
+61 424 150 463
bvandelden@kpmg.com.au

MLA



Sean Starling
General Manager,
Research, Development and Innovation
+61 (2) 9463 9307
sstarling@mla.com.au



Piers Hogarth-Scott
National Practice Leader,
Internet of Things (IoT)
+61 405 151 971
piershs@kpmg.com.au

AATLIS



Grant Statton
CEO, FKG,
Digital Innovation and Energy
+61 439 200 523
grant.statton@fkg.com.au



Tom Lyons
Senior Consultant,
Internet of Things (IoT)
+61 (2) 9335 8606
tlyons2@kpmg.com.au

[KPMG.com.au](https://www.kpmg.com.au)

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