Department of Primary Industries and Regional Development

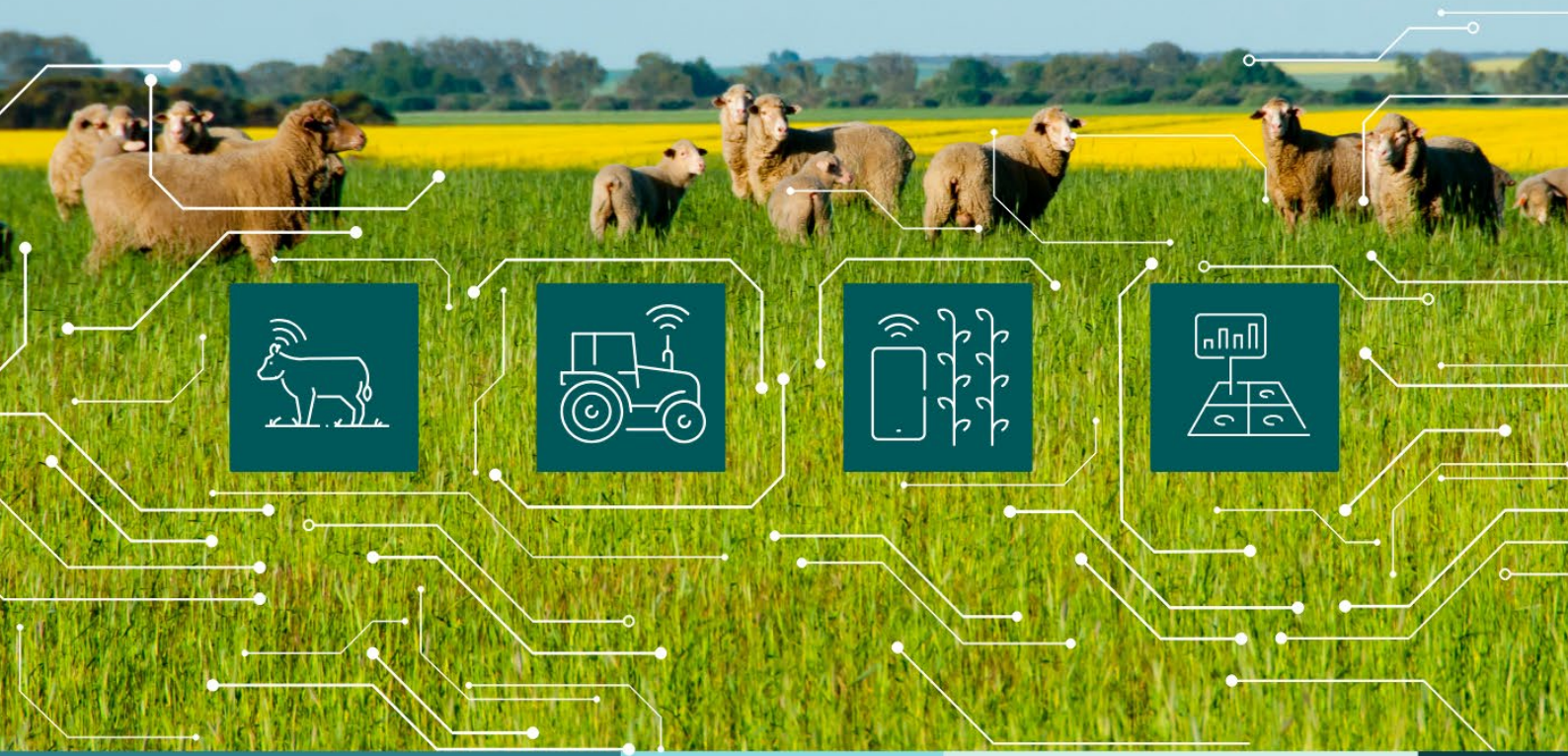
NSW GOVERNMENT

Agtech Fundamentals

Monitoring your farm with Agtech

Farms of the Future &
NSW PI Schools Program

Workbook



www.agtech.dpi.nsw.gov.au

Farms of the
FUTURE
Paddocks of Tomorrow,
Grounded in Technology

connect • grow • learn
DPI in SCHOOLS

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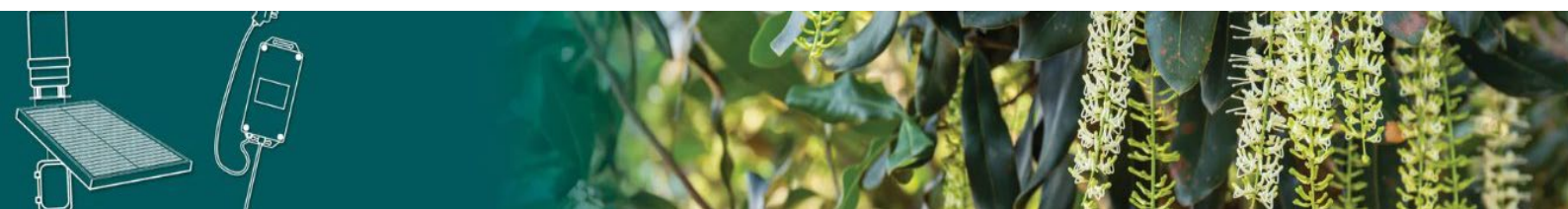
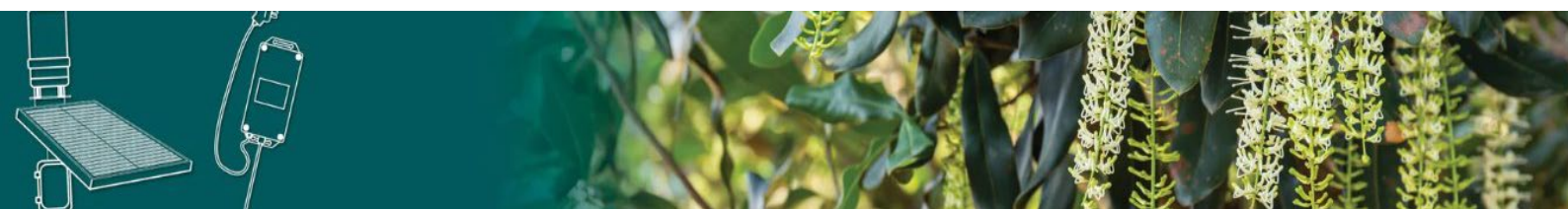


Contents



Farms of the Future – Monitoring your farm with Agtech

Overview

This resource aims to highlight the range of developing technologies which are transforming agricultural management and production. Students have the opportunity to study a range of concepts and technologies and analyse their impact on agricultural industry.

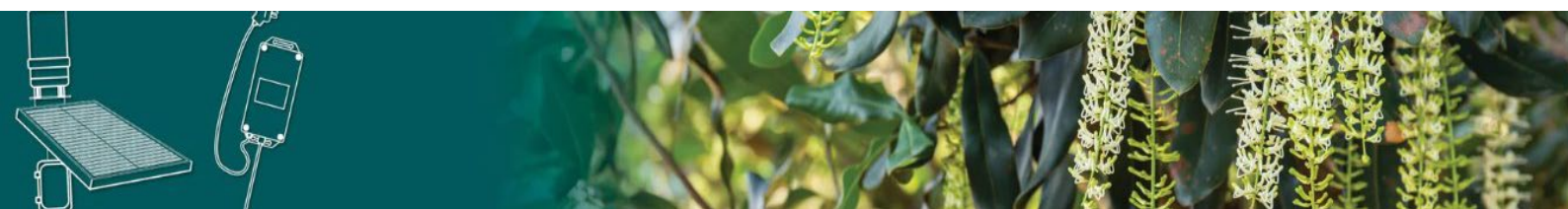
This document provides teachers and students with links to a number of resources and activities that align to the NSW Agricultural Technology Years 7-10 syllabus, 2019 outcomes and content to support their learning throughout this course. This supporting document has been developed as a digital resource to provide access to the large number of hyperlinks which it contains. It should be used in this format.

Access to the Farms of the Future (FoTF) Agtech Fundamentals free and online module is required to complete the activities throughout the workbook. Please register here to access FoTF Online Training Registration or follow the link on the NSW Primary Industries School Programs, Agtech Fundamentals page. Students can individually register, or teachers can register and 'host' the slide presentation. Registration and access is free.

Accompanying this document there is a suggested Answer guide available at the NSW Primary Industries School Programs, Agtech Fundamentals page.

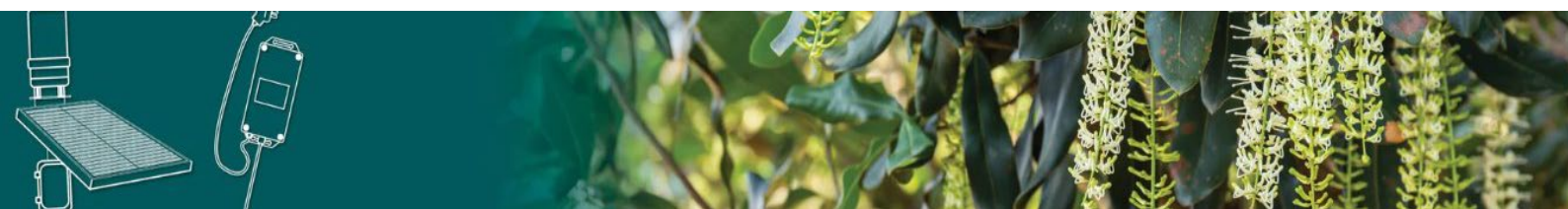
NESA Verbs and Key Words

It is integral students address the following key terms and verbs when answering questions. The following glossary developed by the NSW Education Standards Authority is provided to assist with the answering of activities throughout this booklet.



Key Word	Definition
Account	Account for: state reasons for, report on. Give an account of; narrate a series of events or transactions
Analyse	Identify components and the relationship between them; draw out and relate implications
Apply	Use, utilise, employ in a particular situation
Appreciate	Make a judgement about the value of
Assess	Make a judgement of value, quality, outcomes, results or size
Calculate	Ascertain/determine from given facts, figures or information
Clarify	Make clear or plain
Classify	Arrange or include in classes/categories
Compare	Show how things are similar or different
Construct	Make; build; put together items or arguments
Contrast	Show how things are different or opposite
Critically (analyse/ evaluate)	Add a degree or level of accuracy depth, knowledge and understanding, logic, questioning, reflection and quality to (analyse/evaluate)
Deduce	Draw conclusions
Define	State meaning and identify essential qualities
Demonstrate	Show by example
Describe	Provide characteristics and features
Discuss	Identify issues and provide points for and/or against
Distinguish	Recognise or note/indicate as being distinct or different from; to note differences between
Evaluate	Make a judgement based on criteria; determine the value of
Examine	Inquire into
Explain	Relate cause and effect; make the relationships between things evident; provide why and/or how
Extract	Choose relevant and/or appropriate details
Extrapolate	Infer from what is known
Identify	Recognise and name
Interpret	Draw meaning from
Investigate	Plan, inquire into and draw conclusions about
Justify	Support an argument or conclusion
Outline	Sketch in general terms; indicate the main features of
Predict	Suggest what may happen based on available information
Propose	Put forward (for example a point of view, idea, argument, suggestion) for consideration or action
Recall	Present remembered ideas, facts or experiences
Recommend	Provide reasons in favour
Recount	Retell a series of events
Summarise	Express, concisely, the relevant details

Source: NSW Education Standards Authority, 2018



Technology in Agricultural Production

Technology and innovation play a critical role in the future of agricultural production to meet the world growing population and food, fibre and fuel requirements.

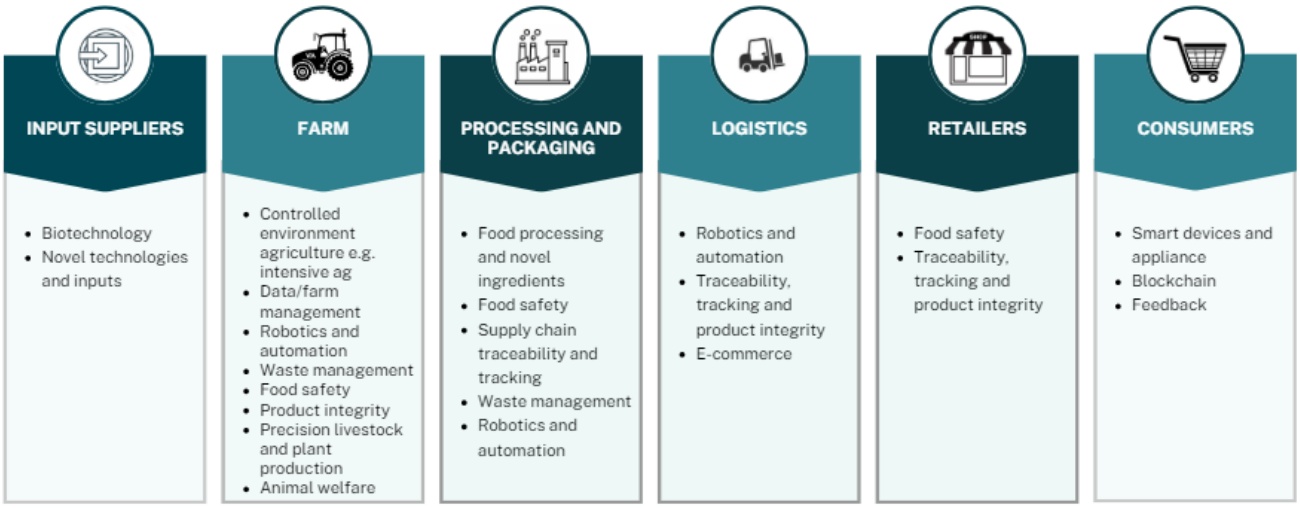
Watch "The future of farming and agriculture", TDC.

Technology in agricultural food, fibre and fuel production falls into main categories:

- Biotechnology: e.g., vaccines, biofuels, fibre, plant and animal breeding, pest and disease resistance, pesticide resistant crops, alternative proteins
- Digital technology: e.g., precision production devices including machinery, automation, artificial intelligence, sensors, soil and water monitoring, robotics, drones, autonomous vehicles, software, livestock tracking systems, waste management.
- Precision agriculture: Leverage Global Positioning System (GPS) and Global Navigation Satellite Systems (GNSS) technologies. Precision systems use satellites and software to determine positions on Earth, allowing for accurate and targeted management including navigation guidance, soil and water sampling by location, pest, disease and health monitoring, variable rate technologies, yield mapping and farm planning.
- Data collection: on farm data collection is used to inform management decisions and drive innovation on an individual farm level and broader basis. For example, predictive analytics, weather information, historical yield, soil, fertiliser, water and irrigation data
- Management technologies: e.g. integrated electronic real-time marketing, finance, infrastructure, climate forecasts, supply chain management and traceability technologies, pasture and herd management software and applications.

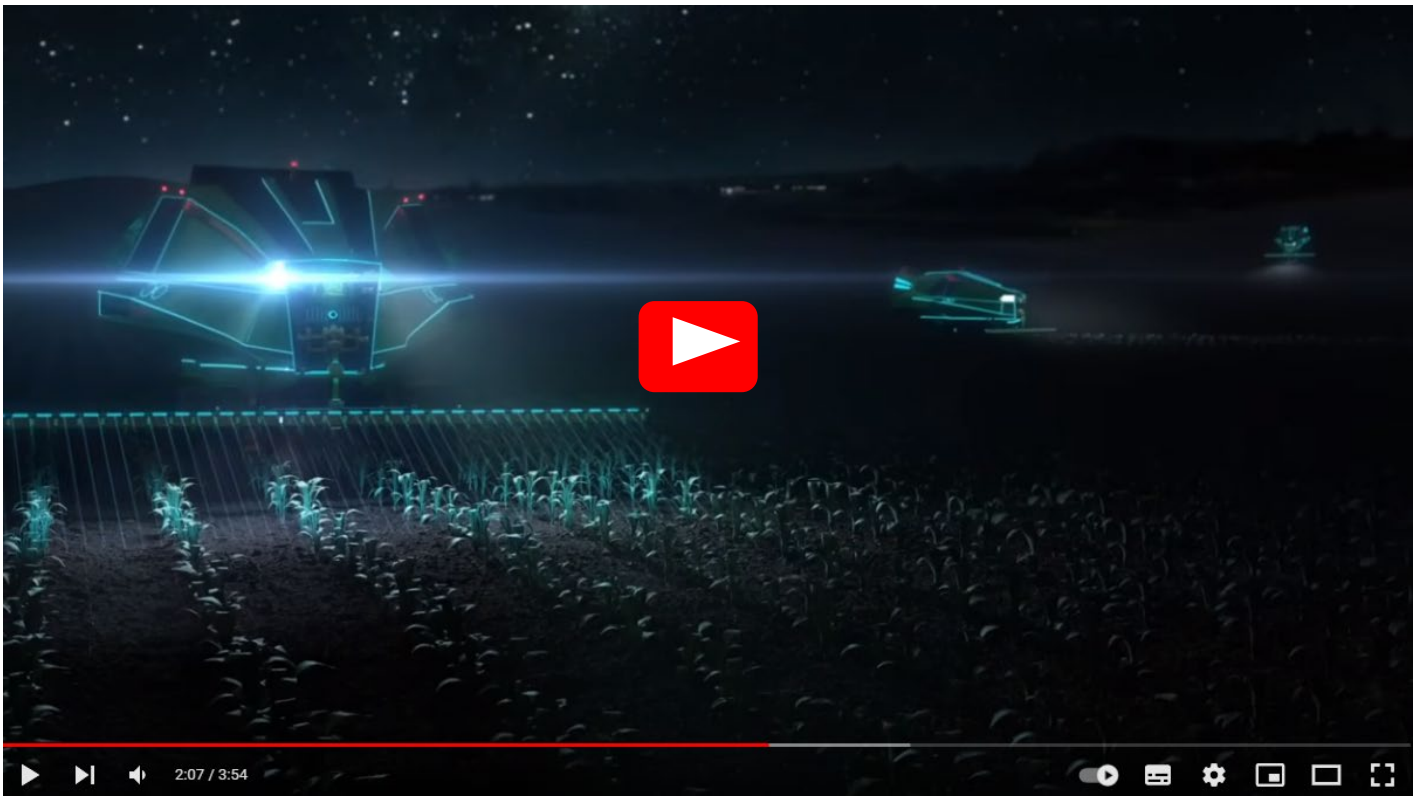
Technologies are used across the whole agricultural production and supply chain to maximise production and processing in an efficient and sustainable way (see Figure 1).

Figure 1 Examples of Agtech in an agricultural production and supply chain



This resource will focus on Agtech used in primary production on farm and the DPI Farms of the Future Program.

Watch Farm Forward, John Deere Innovation and Technology, to see a version of how farmers might control their operations in the future using innovation and technology.



What is the Farms of the Future Program?

The Farms of the Future program, is an initiative developed by the NSW Department of Primary Industries, dedicated to helping farmers embrace technology for increased productivity, market competitiveness, increased sustainability and better resource management.

Video links to the three Farms of the Future Pilot Farms.

Agtech Pilot Farm Narromine

Agtech Pilot Farm Blayney

Agtech Pilot Farm Coonamble

The programs aim involves enhancing digital skills in farming, promoting the use of IoT devices to boost productivity and sustainability, and collaborating with the Agtech industry to deliver innovative technologies.

The initiative facilitates collaboration across government programs, industries, and communities for a comprehensive approach to increasing the adoption of Agtech.

Find out more at: Farms of the Future.

What is Agtech?

Digital technology in Agriculture, otherwise known as Agtech, is the collective term for the tools and technologies; devices, sensors, virtual reality, robotics, automation farm management software, imagery, and smart farm equipment and artificial intelligence – that enable best practice agriculture. Digital technologies (Agtech) allow for data-driven farming, which, when coupled with farmers knowledge, experience, intuition about their own farm and production system will help improve farm productivity, reduce costs and increase sustainability outcomes.

Agtech involves any innovation in the agriculture sector (farm to consumer) designed to improve efficiency, profitability and or sustainability.

Agtech can work by itself or be part of a network of devices such as the Internet of Things (IoT), where devices can connect to and interact with each other and the internet.

It also describes the connected systems that collect, collate, store and analyse large quantities of spatial and non-spatial data to support and action decisions. In the case of the NSW DPIRD Farms of the Future program, it is focused on connectivity and IoT based Agtech, which can support, and integrate, into a farm wide technology approach.

1.  Watch "What is AgTech? The technology that's disrupting the agricultural industry", INCYT
2.  View slide 6 in the FoTF Agtech Fundamentals online module to complete question 3 and slide 14 to complete activity 7.
3.  List five benefits of Agtech

   _____

   _____

   _____

   _____

   _____
4.  Discussion- Are there any disadvantages of Agtech
5.  List five disadvantages of Agtech

   _____

   _____

   _____

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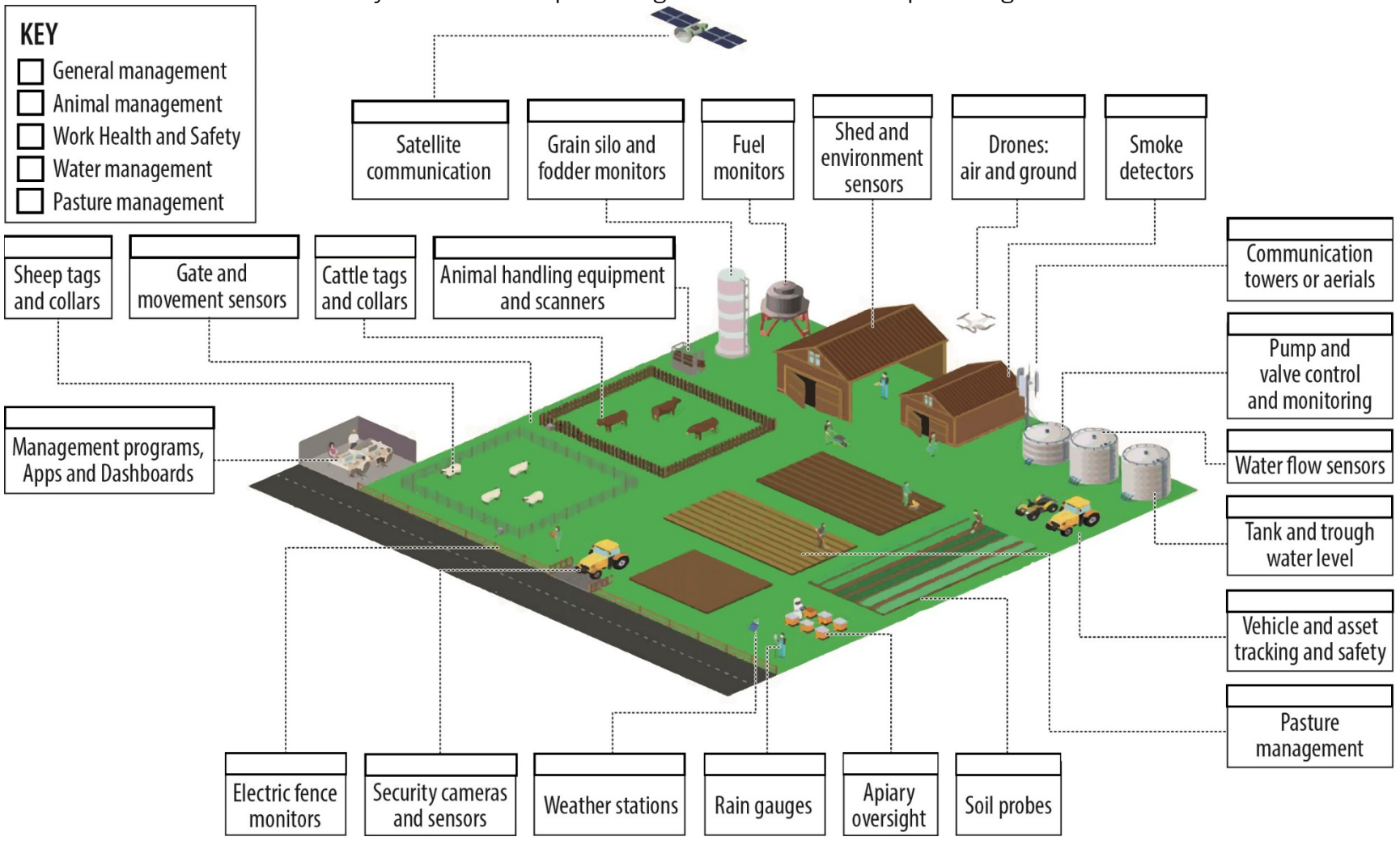
   _____
6.  Discussion– What type of technology have you seen on farms and what was its purpose?

7. Create a colour coded key to match examples of Agtech devices used in specific ag sectors.



Farm description and mapping

Maps in an agricultural business have many uses. From the most fundamental cases of simply marking infrastructure points, tracking livestock movement or even simply showing someone where to go on your property, a map is an extremely useful tool.

A farm map is a useful tool for management, planning and communication. It can assist with the day-to-day operations of the farm by providing a communication tool for staff and contractors and a useful planning tool for future developments helping to provide more accurate spatial data and hence budgets. Developing a farm map is an important component of developing a whole farm plan.

Historically, maps were physical documents, either hand drawn, photocopied or a photograph. They showcased a point in time, originals could be lost and updates were time consuming and challenging. More recently, there are many options for building a map. Many businesses develop specialised and customised digital maps.

A farm map should identify:

- Property records and paddock histories
- Boundaries
- Land capability and soils information
- Topography and aspect
- Natural resource constraints or opportunities
- Infrastructure
- Waterways and water sources

Digital mapping

Digital maps are key to planning a digital technology pathway. An early stage in applying digital technology into a farming business involves understanding and explaining the layout of the property, existing infrastructure and terrain (topography) for connectivity.

Benefits of digital mapping:

- Modern digital maps with overlays allow for planning changes to infrastructure, such as fencing or watering points, as well they can measure distance and altitude changes or add topographical and soil capability features.
- Information can be easily upgraded
- Maps and important information can be easily shared with staff, contractors etc.
- Minimise issues of losing master or physical copies of paddock data, maps, etc.

8. View slides 7-10
9. Complete Activities 1a and 1b from the Monitoring Plan.

Pain points

Pain points are persistent or recurring problems that continually disrupt operation and management efficiency. Farmer activities are labour intensive, time consuming, repetitive and often contain multiple pain points which are ongoingly endured as part of operations.

Common pain points surround:

- Time consuming repetitive tasks such as monitoring and measuring
- Difficulty to find and store information
- Difficulty to understand, stay up to date with and use information and technology
- Difficulty to access farm labour
- Lack of financial resources and irregular cash flow
- Lack of available labour
- Climate and weather risk
- Limited infrastructure and equipment
- Fluctuating demand and market volatility
- Limited resources
- Lack of connectivity

Not all these pain points can be easily overcome, however some can be solved or alleviated through the inclusion of digital technology (Agtech) and automated alternatives on farm.

Digital technology is a 'tool'. The pain point is the need which builds the use case for the need for a tool. Producers should always consider what needs to be measured or monitored and why, when considering the need for integrating Agtech. Technology should not be installed for 'technology's sake'.

Pain point scenario:

A producer is currently checking 5 tanks and 5 dams on their property, 7 days per week over summer and every 2 days for the remainder of the year. To do this, they must travel 22km. It takes 1.5hrs to complete a water check. Annually this adds up to a total of 180 water inspections per year.

- *Labour: 1.5 hours @ $30/hr = $45.00*
- *Vehicle maintenance and running: 22km @ $0.70/km = $15.40*
- *Fuel: 3L diesel @ $2.35/L = $7.05*
- *Cost per trip = $67.45*
- *Cost per year 180 x $67.45 = $12,141.00*

By installing water monitoring sensors on all watering points, physical water inspections could be reduced to 1 trip per week (70% reduction).

The economic savings created by the monitoring system exceed the cost of installation. Additional benefits include re-allocation of time/labour to other jobs. Water issues are alerted quickly saving time and reducing loss of water.

10.  View slides 11 - 13
11.  Complete Activity 2 from the Monitoring Plan.

Digital devices to alleviate pain points

12.  View slides 15-16
13. The following table lists the management categories and associated monitoring category. Go to the NSW DPIRD Farms of the Future Agtech Toolbox - investigate and list at least two specific examples of Agtech for each management category in the table. Include images where possible.

Management Category	Monitoring Category	Agtech Examples
Animal management	• Electric fence monitoring • Animal health monitoring • Tracking animal movement • Monitoring animal weight and growth	
Asset management	• Asset • Fuel tank • Gate and door • Other inputs • Silo • Site security	
Connectivity solutions	• Antennas • Coverage boosters • Relays, receivers & repeaters • Gateways • Wi-Fi • On-farm connectivity networks	

Dashboards	• Independent integrated dashboards • Supplier dashboards • Computer dashboards • Customised dashboards • Mobile phone apps	
Informed agronomy	• Microclimate • Soil moisture • Weather • Pest • Plant	
Water management	• Flow • Level • Pressure • Pump • Irrigation	

Understanding and connecting IoT devices

What is IoT and how do the devices connect?

The Internet of Things (IoT) refers to the network of connected devices and the technology that enables communication between devices and the cloud, as well as the devices themselves.

The Internet of Things integrates 'everyday things' with the internet. There are a variety of options for connecting devices, depending on what you are trying to do (purpose) and where you are situated (location).

14. Watch 'What is IoT and what does it mean for farmers?', Agriculture Victoria

15. View slides 17-19 to define the following

16. Define the following and explain how they work. Hint- the Agtech Glossary of Terms may help.
    - IoT (Internet of Things)

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    - Sensor

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- Node

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- Radio frequencies

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- Gateway

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- Internet

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- Apps and dashboards

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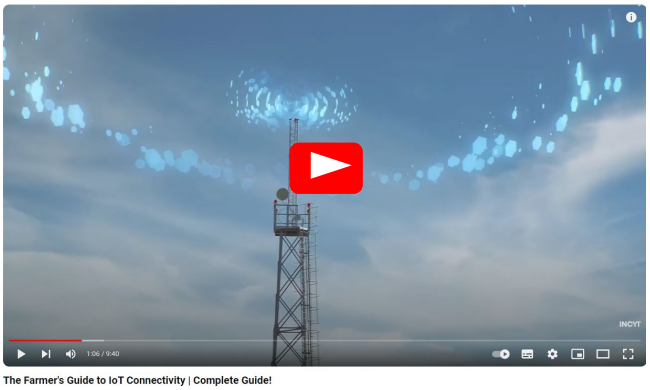
17.  Discuss with your class what societal impacts Agtech and IoT will have on Agriculture

Bandwidth range and coverage

Watch: 'The farmers guide to IoT Connectivity', INCYT Agriculture



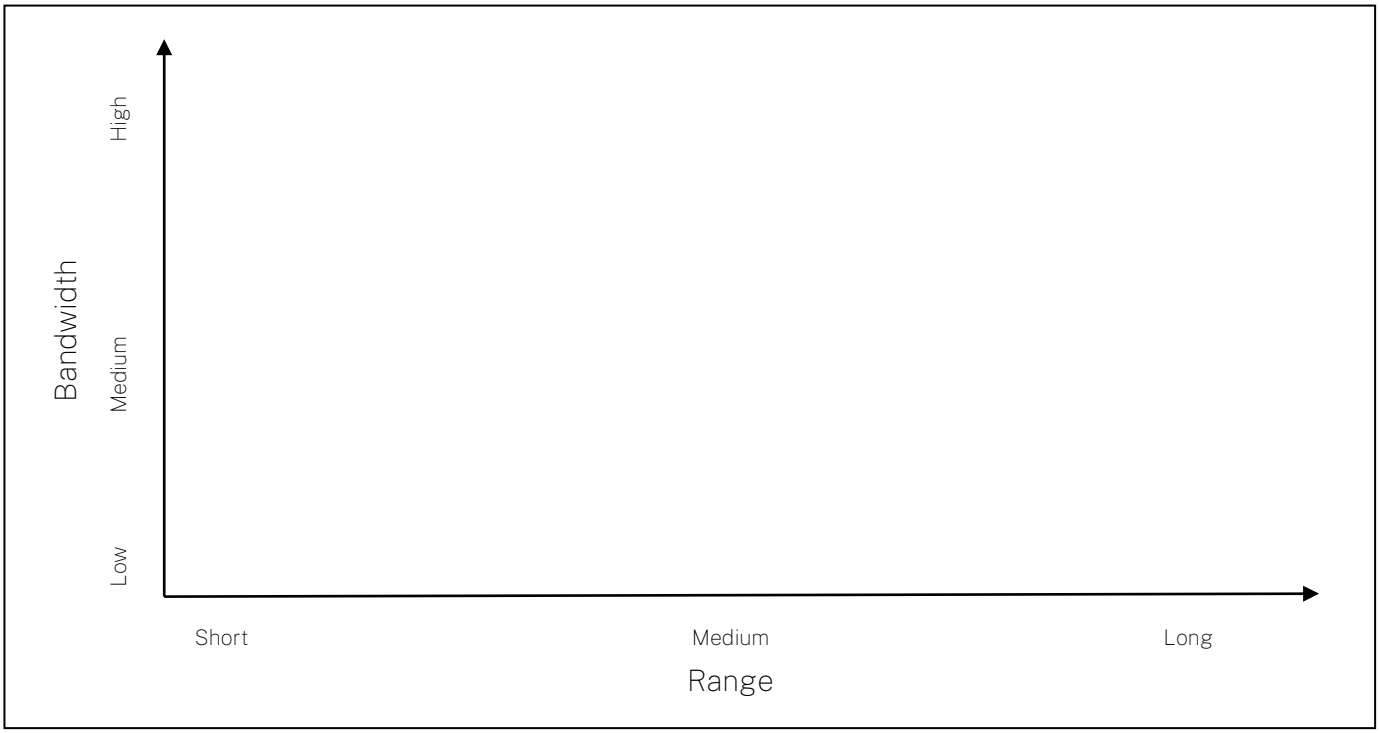
There are a number of connectivity options when it comes to IoT: cellular LTE (Long Term Evolution), Wi-Fi, Bluetooth, and ethernet, to name a few, not all are practical or available on all farms.

Mobile coverage and IoT coverage are different things, just because you don't have mobile cellular coverage, does not mean you won't be able to access an IoT network.

IoT networks are not designed for phone calls, video streaming or other high bandwidth applications. IoT networks are designed to carry small amounts of data.

18. View slides 20-25 to complete the following

19. Complete the graph showing the relationship between bandwidth, range and network coverage.



20. Give examples of Agtech which have:

a. High bandwidth and short range:

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b. Low bandwidth and short range:

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c. Medium bandwidth and medium range:

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d. High bandwidth and long range:

---

e. Low bandwidth and long range:

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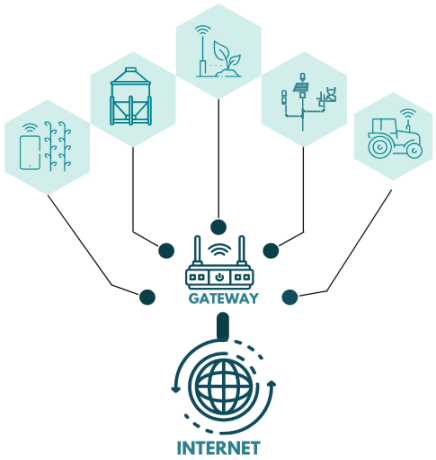
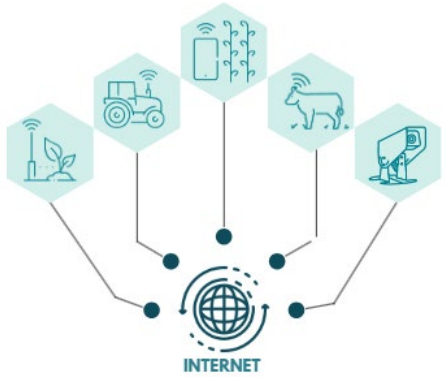
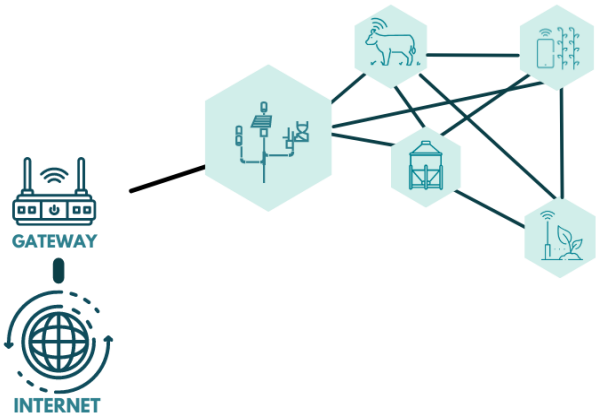
21. Explain in your own words the link between connectivity, bandwidth and Agtech device requirements. Use an analogy if it helps (Hint: think about the agricultural pumps)

22. Complete the table identifying features of either Mesh connect, gateway connect and direct connect networks.

Connection type (name)			
Diagram			
Describe how this connection type links devices to the internet			

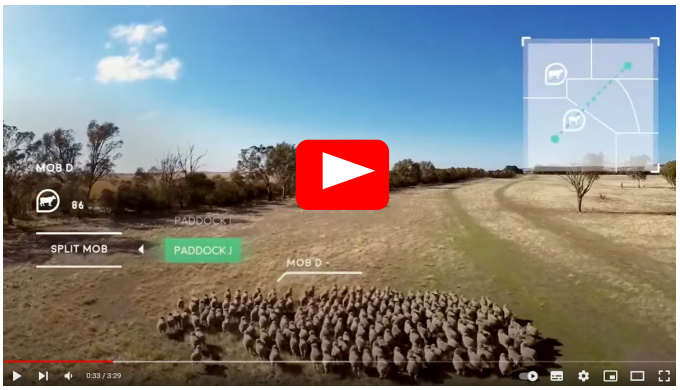
23. Complete [Activity 3- Monitoring plan]

Dashboards, apps and farm management

A dashboard or an app (applications) is used to interpret real time data from various devices and provide information to producers that is easy to understand. It can be remotely viewed on multiple devices including a computer, smart phone or tablet.

Watch What are Dashboards? Agriculture Victoria

Watch AgriWebb Introduction- Livestock management software



There are two types of dashboards:

- Supplier dashboards- provided by the same supplier as the Agtech device. These display and interpret data for that suppliers' devices only.
- Independent, integrated dashboards- display data from multiple third-party sources.

Features of a dashboard:

- Can be accessed on a computer or via internet browser or app on mobile device
- Requires internet connection
- Often provides analytics of historic data and export or download capability
- Supplier dashboards provided as part of an ongoing subscription
- Independent, integrated dashboards incur fees such as subscription and customisation

Features of apps:

- Developed to be used on mobile devices allowing access for all personnel without having to use a computer
- Provides a dashboard with real time and historical data, alerts and more
- Can be operated offline or when connected to the internet
- Useful for receiving notifications and alerts
- Not all suppliers have an app
- Can be limited by the amount and type of data displayed
- Update only when connected to the internet

24. Explain what a dashboard is.

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25. View slide 30 to complete the following

26. Describe the Farm Data Code? [Australian Farm Data Code - National Farmers' Federation (nff.org.au)]

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27. Some Agtech providers pass on data to a third party, which potentially could lead to data breaches and cybersecurity threats. Describe measures farmers should undertake to minimise these risks and safeguard data privacy.

Careers in Agtech

Envisioning a career in agriculture may bring to mind images of dirt-stained hands, sweat-soaked shirts, and challenging encounters with livestock. While these impressions are common, they barely scratch the surface of today's vibrant agriculture industry and diverse career opportunities.

In recent years, the industry has undergone a remarkable transformation, embracing innovation, technology, and sustainability. This evolution has paved the way for a diverse array of agricultural career opportunities that extend well beyond traditional farming roles. Whether you're a tradesperson or a seasoned professional, agriculture now offers exciting prospects for a fulfilling and dynamic career.

While manual and labour-intensive roles remain vital to farming operations across Australia, the scope of agriculture and primary industries production has expanded far beyond these stereotypical images.

Examples of careers using Agtech include:

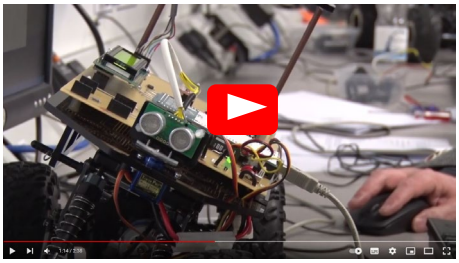
- Agricultural engineer
- Computer system analyst
- Data scientist
- Digital marketing specialist
- Drone technician
- Information technology App developer
- Information technology programmer
- Information technology software developer
- Information technology specialist
- Information technology web developer
- Information technology analyst
- Information Technology configurator
- Integrated solutions consultant
- Primary Producer
- Research scientist
- Robotics engineer
- Sensor technician
- Software engineer
- Systems administrator
- Technology strategist

28. Listen to the podcast: Agtech...so what? Breaking into Agtech when you're not from a farm and 'don't look the part'

29. Watch:

[Careers in Primary Industries NSW DPIRD Climate Smart Officer – Matt Pierce]

[Careers in Primary Industries Development Officer Farms of the Future – Clare Belfield]



[What's it like to be an agricultural engineer?]

30. Use the internet and other sources to investigate an Agtech related career of your choosing. For this career find out the following:
    - Title of the career/job
    - Role description
    - Personal qualities
    - Skills required (if formal courses or education is required, find out where you could train and the timeframe to complete the course, or what subjects to study at school)
    - Salary or wage range
    - Identify opportunities for job progression in the role

    Useful sites to help you with your research include:
    - Find yourself in Primary Industries
    - Career Harvest
    - Plant systems, Ag Careers.com
    - Agriculture robots: the future of job creation
    - How to become a robotics engineer
    - This is agriculture

Monitoring Plan

Hint: look at the Sample Monitoring Plan, to give you ideas on the level of detail for your own Monitoring Plan.

Property/School details

Property/school details	
Property name	
Address	
Size (Ha)	
Key enterprises and approximate area used for each (%)	

Activity 1a – Farm description

Farm Description	
List the infrastructure on your farm e.g., house, classrooms, sheds, yards and water points e.g., dams, troughs, tanks, bores	

List which infrastructure on your farm has power available	
Describe the topography of your farm	

<table>
<tr><td>List locations on your farm that have connectivity e.g., 3G/4G, LoRaWAN, Wi-Fi and those that are known black spots</td><td colspan="5"></td></tr>
<tr><td rowspan="2">Describe your current internet connection

(Answer where possible)</td><td>Provider</td><td>Service type</td><td>Data plan</td><td>Download speed</td><td>Reliability</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Activity 1b Farm mapping

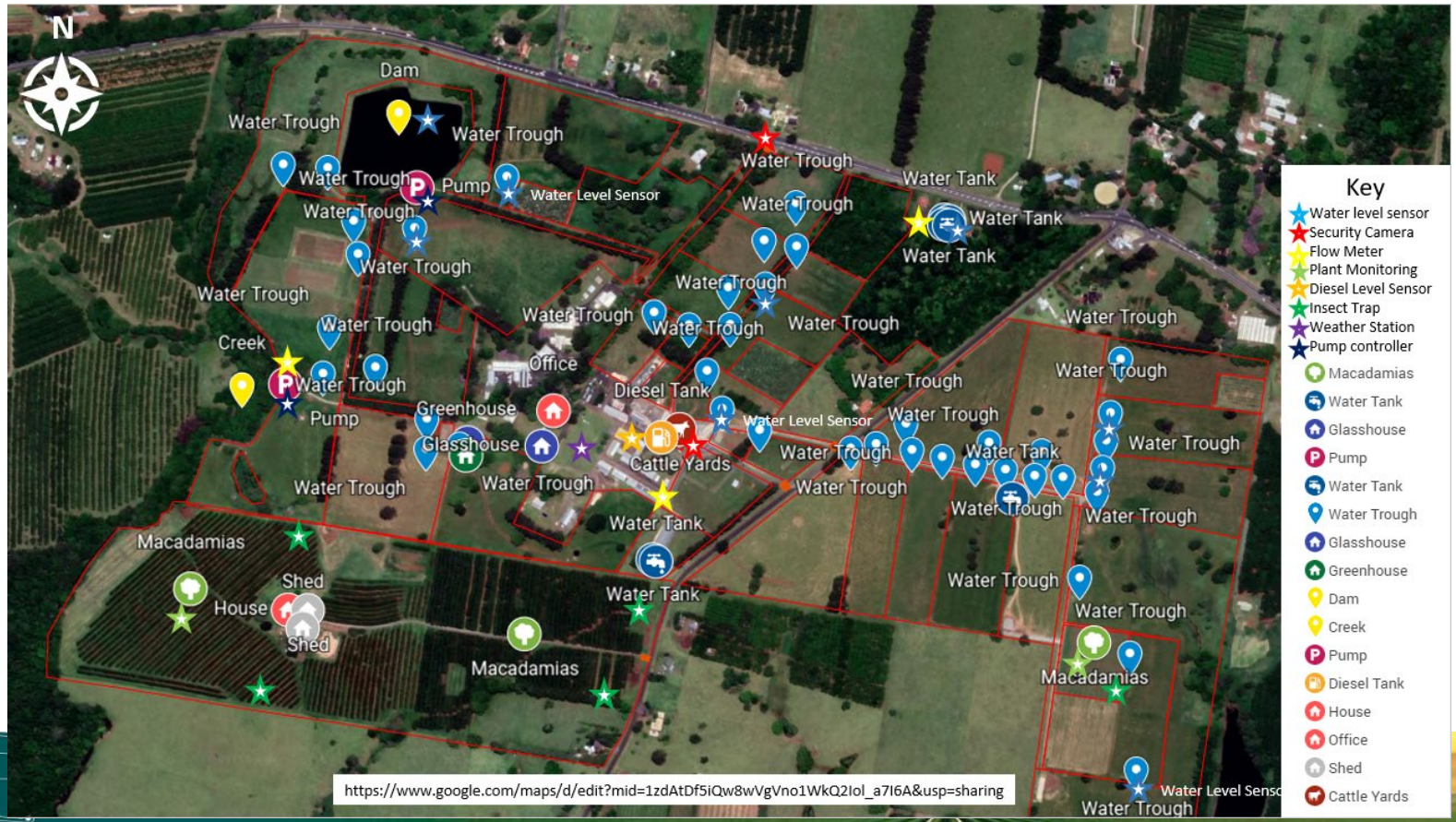
A farm map is an ideal place to start when designing a digital network for your property.

On your farm map, placemark your points of significance from the previous activity. E.g., houses, sheds, yards, dams, tanks, troughs.

Indicate on your map the topography of your property. Make sure you label your map with your name and property address.

Your map could be a physical printed map or digital map using programs and applications such as Google Earth, Google maps, SIX maps, ArcGIS Online, etc.

Example of site map- NSW DPIRD Wollongbar map



Activity 2 – Pain points

Pain points describe issues or problems that continually confront us.

In this activity, think about the key operational activity areas of connectivity, water monitoring, surveillance, crop or livestock management, environmental conditions and working in remote locations when you are recording your pain points.

Use the risk matrix below the table to help you assess your pain points.

Pain Points (On-farm challenges)	Benefits to addressing pain points (These may be financial or non-financial)	Pain point - Risk Level

Add extra rows as required		

Level of Risk for your Business						
	Consequences					
Likelihood		1 Insignificant	2 Minor	3 Moderate	4 Major	5 Extreme
	A Almost certain (occurs often)	Medium	High	High	Very High	Very High
	B Likely	Low	Medium	High	High	Very High
	C Possible (could occur)	Low	Low	Medium	High	High
	D Unlikely	Low	Low	Medium	Medium	High
	E Rare (very unlikely to occur)	Low	Low	Low	Low	Medium

Activity 3- What are your connectivity and IoT needs?

Using your knowledge of Agtech options available, refer to the pain points identified in Activity 2 and consider possible automated alternatives that could bring efficiency to your operation using the Farms of the Future Agtech Toolbox .

Think about the things you need to monitor and measure and consider where you can benefit from real time data and realise time and labour savings and increased peace of mind.

List connectivity options if you are aware of these – otherwise, after completing the course and your own research, fill in the table with the most suitable connectivity option for your situation.

Pain points (on farm challenges)	Possible Agtech device solutions	Distance data is required to travel (e.g. 1km or 10km)	Data packet size	No of units	Connectivity option for solution
Sample: Watering point monitor	*Water tank level sensor*	*5km*	*Small*	*6*	*4G or NB-IOT*

Insert extra rows as required

Now go back to your map and placemark the approximate location for the identified Agtech devices.

Monitoring Plan- Sample

Farms of the FUTURE

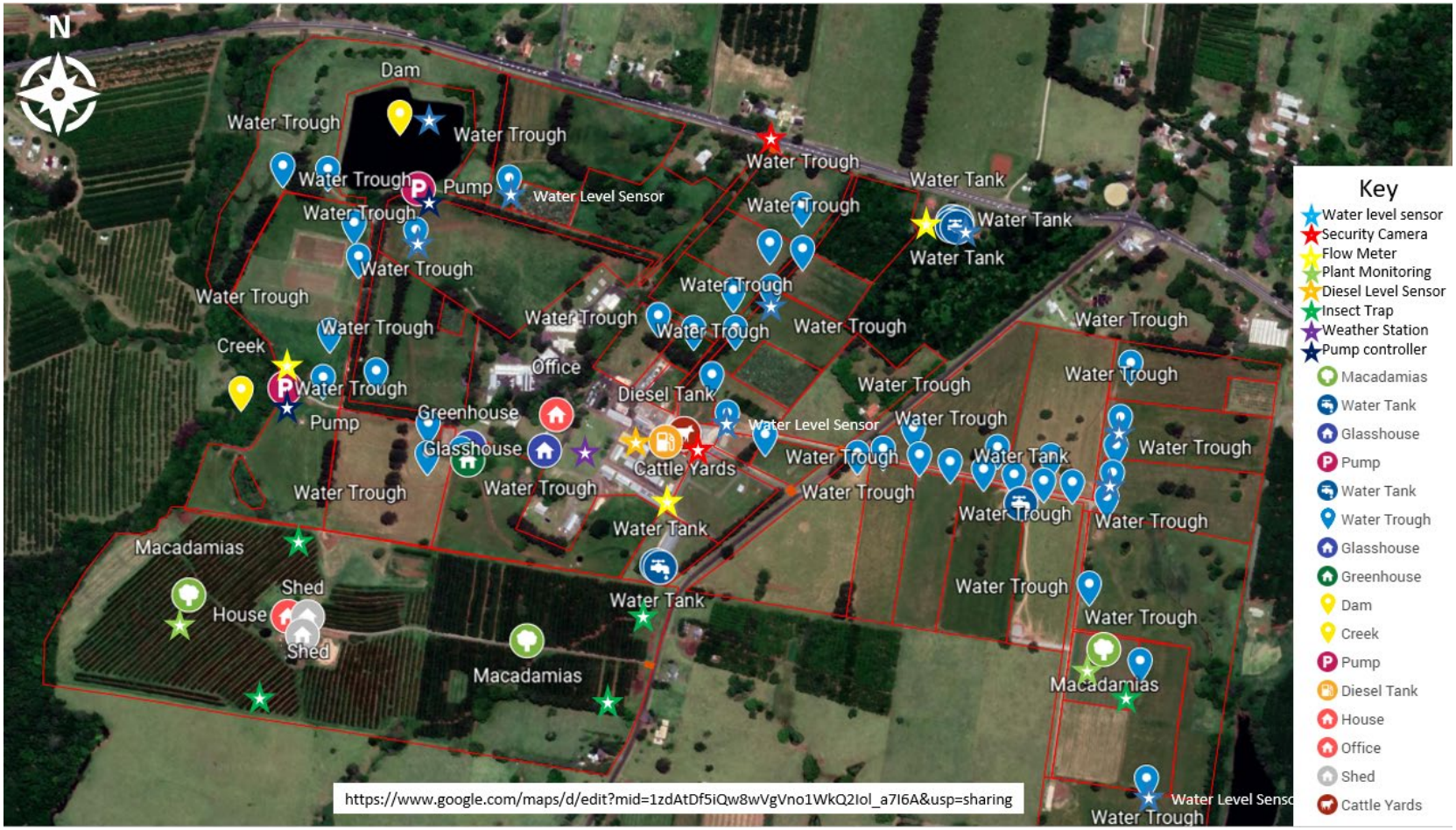
Paddocks of Tomorrow,
Grounded in Technology

Activity 1a - Farm Description Company Information					
Company Name and Address:	Four Creeks Pastoral Company PTY LTD Four Creeks Road, Manilla, NSW, 2346				
Property Name/s and Address/Addresses:	"Spring Creek" Four Creeks Road, Manilla, NSW, 2346				
Contact:	Don Johnson				
Telephone:	61 427 888 xxx				
Size of property/properties:	1500 hectares				
Key enterprises & approximate % of area used for each:	Beef 50% Sheep 30% Winter fodder crops 20%				
List which infrastructure on your farm has power available	All infrastructure at main farm area has 240-volt power. 2 x homes, 1 x Shearing shed, 1 x Cattle yards, 1 x Sheep yards, 1 x Machinery shed.				
Describe the topography of your farm	Undulating topography. Ranging from flat to high timber covered ridges. Timber ridge runs through centre of property.				
List locations on your farm that have connectivity e.g., 3G/4G, LoRaWAN, Wi-Fi and those that are known black spots	Good 4G across farm. Wi-Fi access at main farm infrastructure from main house. Will be hard to link from one side of the farm to the other, due to a high timber ridge in the centre of the property. Some areas with thicker timber may have low connectivity.				
Describe your current internet connection	Provider	Service type	Data plan	Download speed	Reliability
	SkyMesh NBN	Fixed wireless	Unlimited	65.6 Mbps Download 5.41 Mbps Upload	Very good

Activity 1b Farm mapping

A farm map is an ideal place to start when designing a digital network for your property.

On your farm map, placemark your points of significance from the previous activity. E.g., houses, sheds, yards, dams, tanks, troughs. Indicate on your map the topography of your property.



NSW DPIRD Wollongbar Site Map

Activity 2 – Pain points

Pain points describe issues or problems that continually confront us.

In this activity, think about the key operational activity areas of connectivity, water monitoring, surveillance, crop or livestock management, environmental conditions and working in remote locations when you are recording your pain points.

Pain points (On farm challenges)	Benefits to addressing pain points (These may be financial or non-financial)	Pain point risk level
We have had thefts of fuel and tools occur and need a way to monitor people accessing the property when we are not there. The potential of thefts causes us stress and the loss of assets have an impact on us financially and can delay work.	Understanding movements in and out of the property. This would include theft activities but also movements of contractors to ensure they are onsite when they say they are. Both benefits would provide peace of mind.	5
Monitoring water levels of tanks and troughs is time consuming. I do not have confidence leaving the property for long periods of time due to the risk to livestock if troughs were to run low.	Monitoring of water storage takes up a lot of time and labour so Agtech would reduce running costs. There is also a risk to livestock enterprise if water levels run too low or there is a leak so seeing water status remotely would reduce risk. Being able to monitor water when off property is attractive and would reduce stress when away from the property.	5
Monitoring cattle across the property can be labour intensive and there have been times when cattle have left the property through a hole in the fence. During joining it is hard to say which bulls are performing as required.	Being able to see position of stock in paddocks will reduce time needed to send staff member and so reduce running costs. If cattle leave the property, we would be able to identify this more quickly. Also, tracking sires would be helpful during joining.	4

I must monitor the bore and keep records manually. If this is not done, then irrigation may not happen as expected and dry-running of pump may damage or break them which has happened previously.	Watching the level in the water bore associated with the centre pivot irrigator is important to protect aquifer levels and ensure pivot is delivering correct level of flow. Agtech would allow us to do this remotely, quickly and accurately and maintain records. We can also have confidence that irrigation is occurring, and pump is working correctly.	4
We only have a rain gauge and record rainfall manually with pen and paper. Better weather data would allow better farming decisions. Spraying decisions are currently based on a distant BOM weather station which often doesn't reflect our microclimate.	Monitoring weather and rainfall would be helpful in overall management of enterprises. This would allow us to make data-based farm decisions rather than going by instinct. Accurate and frequently updated weather info would help with maintaining compliance around spraying activities and provide records of spraying conditions.	5
Monitoring the electric fence takes time and labour. When there has been an undetected issue, cattle have caused damage to irrigation infrastructure and grazed irrigated fodder crops.	Being able to see position of stock in paddocks will reduce time needed to send staff member and so reduce running costs. If cattle leave the property, we would be able to identify this more quickly. Also, tracking sires would be helpful during joining.	4

Activity 3- What are your connectivity and IoT needs?

Using your knowledge of Agtech options available, refer to the pain points identified in Activity 2 and consider possible automated alternatives that could bring efficiency to your operation using the Farms of the Future Agtech Toolbox .

Think about the things you need to monitor and measure and consider where you can benefit from real time data and realise time and labour savings and increased peace of mind.

List connectivity options if you are aware of these – otherwise, after completing the course and your own research, fill in the table with the most suitable connectivity option for your situation.

Pain points (on farm challenges)	Possible Agtech device solutions	Distance data is required to travel (e.g. 1km or 10km)	Data packet size	No of units	Connectivity option for solution
Watering point monitor	Water tank level sensor	5km	Small	6	4G or NB-IOT
Security	Security Cameras	4 km	Large	2	4G or Wi-Fi
Livestock tracking	Tracking tags	4 km	Small	200	Satellite
Water Bore monitoring	Water level sensor	1 km	Small	1	4G or NB-IOT
Weather and Rainfall monitoring	Weather station	4 km	Small	2	4G or NB-IOT
Electric Fence monitoring	Electric fence sensor	1.5 km	Small	2	NB-IOT

Syllabus Outcomes:

Agricultural Technology Years 7-10 Syllabus, 2019

Outcomes	Content
AG5-6 explains and evaluates the impact of management decisions on plant production enterprises AG5-7 explains and evaluates the impact of management decisions on animal production enterprises AG5-8 evaluates the impact of past and current agricultural practices on agricultural sustainability AG5-9 evaluates management practices in terms of profitability, technology, sustainability, social issues and ethics AG5-11 designs, undertakes, analyses and evaluates experiments and investigates problems in agricultural contexts AG5-12 collects and analyses agricultural data and communicates results using a range of technologies	Core A: Introduction to Agriculture • research the required assets, infrastructure and management techniques required for plant and animal production (ACTDEK047) • research an agricultural problem and develop possible solutions, for example: (ACTDEP048) • identify and apply ethical and WHS practices, for example: (ACTDEP050) • research a range of current and future employment opportunities in agriculture, Plant Production 1 • evaluate the social and ethical issues that would be confronted in the chosen plant enterprise, for example: (ACTDEK040) • research an agricultural issue relevant to the plant enterprise chosen and propose possible solutions (ACTDEK044) • investigate technologies that assist in record-keeping and monitoring of the plant enterprise and its performance (ACTDEK047) Animal Production 1 • investigate technologies that assist in record-keeping and monitoring an animal enterprise and its performance (ACTDEK047) • evaluate current sustainable and unsustainable agricultural animal management practices, for example: (ACTDEK044) Core B: Plant Production 2 • identify and select technologies to assess the effectiveness of plant production practices, for example: (ACTDEK047) • evaluate the impact of current technologies on sustainability (ACTDEK041, ACTDEK044, ACTDEP051) • formulate a solution to an agricultural issue (ACTDEP048) Animal Production 2 • select and use technologies to assist effective animal management practices (ACTDEK047) • identify emerging technologies that affect sustainability (ACTDEK041

Technology 7-8 Syllabus 2023

Outcomes	Content
TE4-SDP-01 explains relationships between sustainability, design and production TE4-SAF-01 selects and safely uses tools, materials, technologies and processes TE4-DIG-02 uses data and digital systems to code, design and produce projects	Food and agricultural practices • Describe how food and agricultural products are grown, harvested, manufactured, packaged and distributed • Investigate current and emerging technologies used to improve quality in production and distribution • Investigate current and emerging technologies used to improve quality in production and distribution • Explain social, ethical and legal considerations associated with food and agricultural • Describe how food and agricultural products are grown, harvested, manufactured, packaged and distributed • Use equipment, tools, techniques, technologies and processes to develop practical skills • Justify the selection of equipment, tools, technologies and processes when developing food and/or agricultural solutions • Explore agricultural practices to assess the impact of changing conditions, improve the quality of production and reduce waste

Agtech Glossary of terms

General Farms of the Future Terminology	
Monitoring Plan	A plan that outlines what is going to be monitored across the business farming enterprise. A product of the FoTF training, it will encompass operational pain points, farm mapping, a landscape assessment and connectivity availability. It will act as a tool to assist in the selection of on-farm Agtech devices and the creation of an Agtech Plan which can be used as part of a whole farm plan.
Tech List	A list of Agtech devices, connectivity solutions and integration products from the Agtech Catalogue that will fulfill the monitoring needs outlined in the monitoring plan.
Agtech Plan	The Agtech Plan is the combination of the Monitoring Plan and the Tech List.
Agtech Catalogue	A product catalogue that includes Agtech devices, connectivity solutions and integration products, created by the DPI, to aid producers in the development of an Agtech Plan.
Artificial Intelligence	
AI	Artificial Intelligence (AI) is the theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition and decision making. AI also enables machines to learn from experience.
Computer vision	Computer vision is a part of computer science working to enable computers to see, identify and process images in a manner similar to human vision.
Deep learning	Deep learning is a machine learning technique that teaches computers to learn by example.
Haptics	Haptics is the science of applying tactile sensation and control to interaction with computer applications.
Machine learning	Machine learning is a method of data analysis that automates construction of analytical models, based on the idea that systems can learn from data, identify patterns and make decisions with minimal human intervention.
Neural networks	A neural network is a computer system modelled on the human brain and nervous system. It is designed to help machines reason more like humans.
Computing and the Cloud	
API	Application Programming Interface (API) is a set of routine definitions, protocols, and tools for building software and applications. An API allows one software system to easily and automatically share data to another software system with a set of permissions allowed by the user. An API connects your business processes, services, content, and data to channel partners, internal teams, and independent developers in an easy and secure way.
APN	Access Point Name (APN) is a gateway that translates communications between telecommunications and computer networks, most commonly the internet.
Cloud Computing	Cloud computing is internet-based computing that allows for data access from distinct computers or devices. It is typically referred to as though the cloud itself is storing the data, but data is stored on physical computers that allow access to the data system any time via the internet.

Edge Computing	Edge computing is a model in which computation is largely or completely performed on device nodes known as smart devices or edge devices. These are often distributed around an area and saves the need of it taking place in a centralised cloud environment.
Firmware/FOTA	Firmware is a specific class of computer software that provides the low-level control for a device's specific hardware. FOTA refers to the capability of upgrading Firmware Over-The-Air.
Flow-based programming	Flow-based programming is a type of dataflow programming in which programme steps communicate with each other by transmitting data through some kind of channel. The channels are managed by the larger system, leaving the connected components free to focus on processing input and producing output.
Fog Computing	Fog computing is also known as edge computing or fogging. Fog computing is a term created by Cisco that refers to extending cloud computing to the edge of an enterprise's network.
Hybrid Cloud	A hybrid cloud computing environment can use a variety of on-premises, private cloud and third-party, public cloud services linked between the two platforms.
JAVA/JSON	JAVA OR JSON (pronounced JASON) is a general-purpose computer programming language designed to produce programs that will run on any computer system.
Open source	Open software describes software for which the original source code is freely available and can be redistributed or modified.
Peer to Peer	Peer-to-peer computing or networking is used to separates tasks or workloads between peers.
SOAP API	Simple Object Access Protocol (SOAP) is a communication protocol for the exchange of information between various operating systems using Extensible Markup Language (XML).
Communications Protocols	
CAN Bus	CAN bus is a protocol used in vehicles, cars, tractors and trucks for sensors and on-board computer control modules to communicate.
Lightweight M2M	Lightweight M2M is a device management protocol designed for sensor networks and the demands of a machine-to-machine (M2M) environment.
Modbus	Modbus is a serial communications protocol for use with programmable logic controllers (PLCs) that is used to connect industrial electronic devices.
MQTT	Message Queuing Telemetry Transport (MQTT) is a protocol designed to connect the physical devices and networks with applications and middleware, making it an ideal connectivity protocol for IoT and M2M.
MTC	Machine Type Communications (MTC) is a descriptive term for fully automatic data generation, exchange, processing and actuation among intelligent machines, with low or no intervention by humans.

Data Terminology	
Big Data	Big Data are amounts of data that are so large that traditional technologies cannot handle their transfer or analysis. Certain IoT technologies are able to handle and transfer big data.
Blockchain	A blockchain is a growing list of records, called blocks, which are linked using cryptography. For use as a distributed ledger, a blockchain is typically managed by a peer-to-peer network collectively adhering to a protocol.
Data Filtering	Data filtering describes a wide range of strategies for refining data sets so they provide what a user, of set of users, needs without including other data that can be repetitive, irrelevant, or even sensitive.
Data Packet	A data packet is a unit of data made into a single package to travel along a given network path.
DDDM	Data Driven Decision Making (DDDM) is an approach to business governance that requires decisions that can be backed up with verifiable data.
HADOOP	HADOOP is an open-source distributed processing framework. It manages data processing and storage for big-data applications running in group-systems pervasive-computing, also called ubiquitous computing. Th-e embedding of computational capability into everyday objects to make them effectively communicate and perform useful tasks in a way that minimises the end user's need to interact with computers.
SCADA	Supervisory Control and Data Acquisition (SCADA) is a computer system for gathering, analysing and controlling real-time data.
TCP or IP	Internet Protocol (IP) suite is the computer networking model and set of communications protocols used on the Internet and similar computer networks.
General Terminology	
Access point	An access point is a wireless network device that acts as a portal for devices to connect to a local area network.
Actuator	An actuator is a component that is responsible for moving and controlling a mechanism or system, such as opening a valve.
Augmented Reality (AR)	Augmented reality (AR) is an enhanced version of the real physical world that is achieved through the use of digital visual elements, sound or sight. This can be delivered via goggles or a digital device like a phone or tablet.
Backhaul	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 locations. All IoT devices need backhaul, whether directly built into the device or through a network.
Bandwidth	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.
Beacons	Beacons are small transmitters that connect to Bluetooth and Bluetooth Low Energy (BLE)-enabled devices such as smartphones or tracked packages.

Code	Code, sometimes known as source code, is a term used to describe text that is written using the protocol of a particular language by a computer programmer.
Contactless	Describes technologies that allow a smart card, mobile phone or other device to connect wirelessly – without contact – to an electronic reader.
Cyber-physical systems	Cyber physical systems are integrations of computation, networking and physical processes with feedback loops where physical processes affect computations and vice versa.
Data	Data is a collection of statistics or facts for future analysis or reference use.
Device	A device is a unit of physical hardware or equipment that provides one or more computing functions within a system.
Gateway	A gateway is a "hub that translates" communication between two digital sources or devices that allows these to share each other ́s data transfer and communication.
GSM	The global system for mobile communications (GSM).
Hub	A hub is a hardware device that connects other data-transmitting devices to a central station.
Integrator	Data management and translation service to incorporate multiple datasets into one format for a single display.
IoT	Internet of Things (IoT) is the concept of connecting any device to the internet and to other connected devices.
Node	A node is any active, physical, electronic device attached to a network.
Precision Agriculture	Precision Agriculture is the management of production at a highly granular level such as individual trees in an orchard, or zones with a paddock. It can be enhanced by the use of Internet of Things (IoT) technologies to improve operations via use of smart devices to monitor crops, livestock, and weather.
Pressure Transducer	A pressure transducer measures the quantity and percentage of fluid in a vessel based on applied pressure of the material being measured.
Ultrasonic Sensor	An ultrasonic sensor emits sound waves which reflect back off the material being measured. Level is determined based on time taken for sound waves to return to the sensor.
Variable Rate Technology (VRT)	Variable Rate Technology (VRT) allows variable application rates of inputs across a farming system to better match requirements across an area in a Precision Agriculture system.
Virtual Reality (VR)	Virtual Reality (VR) is a computer-generated simulation in which a person can interact within an artificial three-dimensional environment using electronic devices. These can include special goggles or gloves fitted with sensors.
Hardware and Software Terminology	
Digital Twins	Digital twins are digital replicas of physical assets, processes, people, places, systems and devices that can be used for various purposes such as modelling systems and integrating historical machine data into a digital model.

eSIM	The embedded SIM (eSIM or eUICC) is a secure element designed to remotely manage multiple mobile network operator subscriptions and be compliant with GSMA specifications.
GIS	Geographic Information System (GIS) is a system designed to capture, manipulate, analyse, manage and present spatial or geographic data.
GPS	Global Positioning System (GPS) is a technology created by the US Government that allows for location services. It is now commonly used worldwide.
HAV	Hardware-Assisted Virtualisation (HAV) is the use of a computer's physical components to support the software that creates and manages virtual machines (VM's).
ICCID	Integrated Circuit Card Identifier (ICCID) is the unique serial number embedded on a SIM card.
IoT Module	An Internet of Things (IoT) module is a small electronic device embedded in objects, machines and things that connect to wireless networks which send and receive data.
IMSI	International Mobile Subscriber Identity (IMSI) is a unique number, usually fifteen digits, associated with identifying a GSM-connected device.
IMU	Inertia Measurement Unit (IMU) is a device that measures and reports a body – such as a drone's – specific force, angular rate, and sometimes the magnetic field surrounding the body.
IP Address	An Internet Protocol Address (IP Address) is a unique designating number assigned to a computer o another device that is connected to a network, most notably the internet.
Latency	Latency is the delay in transfer of data or signal.
LIDAR	Light Detection and Ranging (LIDAR) is a remote sensing technology which uses the pulse from a laser to collect measurements which can then be used to create 3D models and maps o objects and environments.
Mechatronics	Mechatronics is engineering of both electrical and mechanical systems which includes a combination of robotics, electronics, computing, communication systems, control and product engineering.
Modem	A modem is a hardware device that allows a computer to send and receive data over a telephone line or a cable or satellite connection.
NDVI	Normalised Difference Vegetation Index (NDVI) is used as an indicator of plant health by highlighting changes in plant growth using a comparison between infrared and visible light transfer.
OBC	An on-board computer (OBC) is a small computer that is installed inside the cab of a truck. Key features of the on-board computer include: trip and hour registration, trip planning, track and trace, truck navigation, messaging traffic, fuel consumption, registration and the possibility to measure the driver's driving style.
Radar	Radio Detection and Ranging (RADAR) is a detection system that uses radio waves to determine the range, angle, or velocity of objects.
Router	A router is a hardware device designed to receive, analyse and move incoming IP packets to another network.

SIM	Subscriber Identity Module (SIM) is a smart card that stores data including identity, location, phone number, network authorisation data and security keys. It is installed into a wireless device.
SOC	System on chip (SOC) or a single-board computer, is a microchip with all the necessary electronic circuits and parts for a given system. Good examples include a smartphone or wearable computer, on a single integrated circuit.
Telematics	Telematics is a method of monitoring an asset by using GPS and onboard diagnostics to record movements on a computerised map.
Wireless modem	A wireless modem bypasses the telephone system and connects directly to a wireless network. Via this it can directly access the internet connectivity.
IoT and Security	
Botnet	Botnet is a network of private computers infected with malicious software and controlled as a group without the owners' knowledge.
GDPR	General Data Protection Regulation (GDPR) came into force in May 2018 and imposes rules on controlling and processing personally identifiable information.
IAM	Identity and Access Management (IAM) is a framework for business processes that facilitates the management of electronic or digital identities.
ICS	Industrial Control Systems (ICS) is a collective term used to describe different types of control systems and associated instrumentation. This can include the devices, systems, networks, and controls used to operate or automate industrial processes.
IPSec	IPSec is a secure network protocol suite that authenticates and encrypts the packets of data sent over an internet protocol network. IPSec uses cryptographic security services to protect communications over IP networks.
PKI	Public Key Infrastructure (PKI) is a set of policies and procedures needed to create, manage, distribute, use, store and revoke digital certificates and manage public-key encryption.
TLS	Transport Layer Security (TLS) is an encryption protocol used to protect data in transit between computers enabling two computers to agree to encrypt the information in a way they both understand.
LPWA Technologies	
EC-GSM	Extended coverage (EC) GSM IoT is a Low Power Wide Area technology. It is designed as a high capacity, long range, low energy and low complexity cellular system for IoT communications.
LoRa	The Long Range (LoRa) low power wireless standard is intended for providing a cellular-style low data rate communications network. Aimed at the Machine to Machine (M2M) and IoT market, LoRa is suitable for intermittent low data rate connectivity over significant distances.
LPWAN	Low-Power Wide Area Network (LPWAN) is a WAN that caters to smart devices using low power.

LTE-M (Cat-M1)	Long term evolution for machines (LTE-M) also known as CatM1, refer to the LTE-MTC (LTE-Machine Type Communication) standard defined by the GSMA (Global System for Mobile communications). It is Low Power Wide Area technology which allows extended coverage over 4G/5G.
NB-IoT	A narrowband radio technology (NB) specially designed for the Internet of Things (IoT), hence its name. Special use is on indoor coverage, low cost, long battery life, and large number of devices. This technology can be deployed in GSM and LTE spectrum on 4G/5G.
Sigfox	Sigfox is a cellular style system that enables remote devices to connect using ultra-narrow band, to provide low power, low data rate, and low-cost communications for remote connected devices.
UHF	Ultra-high frequency (UHF) is a commonly used radio frequency range between 300 MHz and 3 GHz (3000 MHz).
Mobile Network Technologies	
3G	The third generation of cellular technology (3G) which delivered faster data-transmission speeds, enabling video calling and mobile internet.
4G	The fourth generation (4G) of cellular technology, released in 2008, which brought further increases in speed so HD mobile TV, video conferencing and other apps were enabled.
5G	The current generation of cellular technology is 5G (fifth generation) with deployment commencing in 2019 offers even greater speeds of up to 100 Gbps, lower latency and greater device density per cell.
LTE	Long term evolution (LTE) is a standard for 4G wireless broadband technology that offers increased network capacity and speed to mobile device users.
Mobile or Cellular	A mobile or cellular network is a radio network distributed over land through cells where each includes a fixed location transceiver known as base station.
Roaming	Roaming enables a travelling wireless device
3G	The third generation of cellular technology (3G) which delivered faster data-transmission speeds, enabling video calling and mobile internet.
Radio Communication Technologies	
Bluetooth	Bluetooth is one of the world's most common communications technologies. It allows for data transmission by radio waves over a short distance.
LAN	Local Area Network (LAN) is a network that interconnects devices within a limited area with locally managed network equipment. Most commonly seen as a connection between two devices by way of an ethernet cable.
Mesh Network	A Mesh network is a local network in which infrastructure connects directly to as many other nodes as possible and cooperates with one another to direct data to and from clients.
WAN	Wider Area Network (WAN) is a network that extends over a large geographical area.
Wi-Fi	Wi-Fi is a technology that allows for wireless device communication over specific radio bands and is the most common technology used for wireless internet connection.

WLAN	Wireless Local Area Network (WLAN) functions the same way as a LAN does, except that a device can connect to the network wirelessly.
WSN	Wireless Sensor Network (WSN) is made up of autonomous devices using sensors to monitor physical or environmental conditions.
Z-Wave	Z-Wave is a communications technology typically used in security automation and smart homes because of its low energy radio waves which enable it to communicate from appliance to appliance.
Satellite Technology	
CubeSat	A CubeSat is a miniature satellite that is generally cheap to build and launch.
GEO Stationary Orbit	Satellites that sit above the equator and orbit at the same rate of movement as the earth are in a geostationary (GEO) orbit. Because they are positioned a great distance from the earth they allow for wide areas of view.
GNSS	Global Navigation Satellite System (GNSS) is a constellation of satellites providing signals from space that transmit positioning and timing data to GNSS receivers.
Low Earth Orbit	Some satellites have a low earth orbit which means that they orbit the earth at very low altitudes, enabling them to circle the earth quickly. They have limited view of the earth surface due to low altitude positioning.
Nano Satellite	Nano satellites are small satellites weighing up to 10 kg.
Polar Orbit	The polar orbit refers to the orbit in which satellites orbit the earth from pole to pole rather than along traditional east-west direction.
Tracking and Identification	
IMEI	International Mobile Equipment Identity (IMEI) is a unique identification or serial number that all mobile phones and smartphones have.
International Article Number	International Article Number is a barcode identification symbology and numbering system used in global trade to identify a specific retail product type. This may be from a specific manufacturer in a specific packaging configuration.
MEID	Mobile Equipment IDentifier (MEID) is a globally unique number identifying a physical piece of CDMA2000 mobile equipment.
QR Code	The quick response, or QR Code is a two-dimensional version of a barcode able to convey a wide variety of information almost instantly by scanning with a mobile device.
RFID	Radio Frequency Identification Devices (RFID) are used for data transmission and capture by way of radio waves. Usually applicable to short distance transmission.
Smart Label	Smart label is an enhanced version of a bar code. Smart labels take the shape of RFID tags, Electronic Article Surveillance (EAS) tags, or the most commonly seen, QR codes.
UID	Unique Identifier (UID) is a number given to any device within any system to allow the ability to interact with it.
URI	Uniform Resource Identifier (URI) is a string of characters that unambiguously identifies a particular resource.