High impact innovations transforming Australian agriculture

Agriculture is being transformed by technologies that have the capacity to make the entire agricultural supply chain more precise, more profitable and more sustainable.

With a strong track record of technology integration, the speed of technology innovation means that industries need to proactively seek out alternative sources of technology and sift out those with the potential to be game changers.

This is the sixth report in a series of scans looking for high impact technologies overseas and in other sectors of the Australian economy that will likely disrupt the agricultural supply chain.

The six technologies identified through the research will support industries to be better positioned to maintain a strong competitive advantage and ensure the sector is well placed into the future.

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Final report


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**Edge Computing**

Edge computing is a computing topology in which data storage and analysis is kept close to where it is collected, without needing to be sent to the cloud. Computing is done locally on edge devices, such as sensors and equipment that collect data, or on other locally connected devices, such as smartphones and other dedicated hardware. Perhaps one of the most relevant applications of edge computing is that it provides a solution for operating Internet of Things (IoT) in remote areas with limited or no internet connectivity.

**Expert Opinion**

Experts were surveyed and asked to rate the impact of edge computing technology on a 5-point scale. On average, responses show that edge computing technology is perceived to have very-high potential impact for Australian rural industries. Equipment capable of on-board data analysis without requiring an internet connection was highest rated. This was followed by local processing of data, rather than relying on cloud services.

**Innovation Trends**

As edge computing devices advance and on-board compute power increases, it is increasingly possible for data to be analysed in real-time by the devices that collect the data, without the need for internet connectivity [9], [13]. This real-time data processing allows for context-aware applications. Edge devices in proximity to other edge devices can communicate real-time data such as location and behaviours. This can allow the devices in the system to act in relevant ways, such as by delivering useful information based on context [14].
EXTENDED REALITY

Extended reality technologies create experiences that blur the boundaries of real and digital environments. Augmented reality, virtual reality, 360° video and wearables all fall under the umbrella of extended reality. With extended reality, real life situations can be mirrored in virtual reality simulations allowing people to experience hazardous or rare situations without fear of making mistakes. People in remote areas can access the same digital experiences as people in cities. Learning experiences can be more engaging to improve retention of information and be more relevant to the next generation of workers.

EXPERT OPINION

Experts were surveyed and asked to rate the impact of extended reality technology on a 5-point scale. On average, responses show that extended reality technology is perceived to have very-high potential impact for Australian rural industries. Rich communication between people without the need to be located in the same place were the capabilities of extended reality perceived to be of highest impact, followed by immersive training in the field.

INNOVATION TRENDS

Removal of distance is highlighted as one of the most significant capabilities of extended reality technology. The technology can create a platform for immersive and engaging communication between people in any number of environments [15], [19].

As new technologies enter the agriculture sector, such as robotics and wireless sensor and actuator networks, extended reality could provide farmers access to essential expertise - remotely. Collaborations could form irrespective of proximity to improve decision making and productivity.
**INNOVATION TRENDS**

A critical capability of high altitude wireless internet delivery is to provide continuous internet service over a large area. Airbus’ Zephyr has achieved over 14 days of continuous flight powered only by solar [33]. While still in development, Alphalink’s model 3 is initially targeting 100 days of flight, with the hope to extend that to over a year or more with improved solar and battery technology [34]. Advances in drone technology allows these systems to be sent where needed, for example specific rural areas [29]. Loon’s balloon navigation system has been developed to such an extent that winds can be predicted and thus groups of balloons can be sent to specific areas. This is an essential development to ensure that there is a consistent delivery of balloons and connectivity to the areas that need it [31].
QUANTUM COMPUTING

Quantum computers operate on completely different principles to general-purpose computers. Where the information units used by general-purpose computers are processed sequentially to solve problems, the information units used by quantum computers can be in many states and relationships. This means that computation can occur simultaneously to converge on solutions to problems rapidly. In short, quantum computers are best suited to solving complex modelling problems that would not be possible using general-purpose computers. Quantum computers could have significant impact for agriculture by improving the methods for producing ammonia-based fertiliser.

EXPERT OPINION

Experts were surveyed and asked to rate the impact of quantum computing technology on a 5-point scale. On average, responses show that quantum computing technology is perceived to have high potential impact for Australian rural industries. Both applications, reducing the energy required to produce fertiliser and producing more efficient chemical pesticides and fertilisers, were perceived to be of equal potential impact.

Technology to significantly reduce the energy required to create nitrogen-rich ammonia-based fertilisers

Modelling complex molecular reactions to help produce more efficient chemical pesticides and fertilisers

INNOVATION TRENDS

Analysis of number of patents published by country shows that innovation of quantum computing technology has been considerable. The USA has been the primary focus of quantum computing technology innovation. The reasonable number of patents filed with the World IP Organisation suggests that the number of multi-country patents for quantum computing technology is likely to increase.

Analysis of number of patents published per year shows that innovation of quantum computing technology has been steadily increasing since 2013.
**ARTIFICIAL PHOTOSYNTHESIS**

Artificial photosynthesis is the process of producing energy using only water and sunlight as inputs. The energy produced by artificial photosynthesis is in the form of hydrogen. When separated from water, this hydrogen can be stored and converted into electrical energy without producing any harmful by-products. Artificial photosynthesis technology has also been used to directly produce liquid fuels. The generation of electricity and liquid fuels using artificial photosynthesis has considerable application potential and could potentially have an impact wherever industrial energy is required.

**EXPERT OPINION**

Experts were surveyed and asked to rate the impact of artificial photosynthesis technology on a 5-point scale. On average, responses show that artificial photosynthesis technology was perceived to have very-high potential impact for Australian rural industries. Applications of artificial photosynthesis to produce renewable electricity and liquid fuels were perceived to be of higher impact than the application of producing ammonia for fertiliser.

**INNOVATION TRENDS**

Analysis of number of patents published by country shows that innovation of artificial photosynthesis technology has predominantly been focused in the USA. However, the number of patents published for the technology is relatively low, overall. This is likely due to the highly specific nature of the technology.

Analysis of number of patents published per year shows that innovation of artificial photosynthesis has varied over the last six years. While it has increased overall, a consistent pattern is difficult to ascertain from the data.
SMART CITY

Smart cities aim to advance the liveability, sustainability and economic benefit of an urban area through the use of technologies such as Internet of Things, artificial intelligence and cloud computing. The expectation is that the convergence of these technologies in urban systems will create environments that profoundly improve living experience, while taking care of all the necessary aspects of supporting a city and its residents. There are considerable smart city initiatives occurring around the World, including Australia where a total of $50 million in funding was recently awarded to a variety of projects.

EXPERT OPINION

Experts were surveyed and asked to rate the impact of smart city technology on a 5-point scale. On average, responses show that smart city technology was perceived to have high potential impact for Australian rural industries. The provision of autonomous services to distribute and add value to food, as well as smart environments to facilitate a greater emphasis on health and lifestyle, were all perceived to be of similarly high impact.

INNOVATION TRENDS

Analysis of number of patents published by country shows the USA as the primary focus of smart city technology innovation. There have also been a substantial number of patents filed with the World IP Organisation, which suggests that the number of multi-country patents for smart city technology is likely to increase.

Analysis of number of patents published per year shows that smart city technology innovation has increased considerably since 2015. Prior to this, the number of patents published per year was consistently low.

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