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 fifth 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 five 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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Full report

How can you harness the technology of tomorrow for the benefit of agriculture today?

This research takes a look at five technology innovations with the potential to shape Australia’s rural industries:

- Human 2.0
- Enterprise Behavioural Analytics
- Drone Delivery
- Metal 3D Printing
- Cellular Agriculture

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HUMAN 2.0

HUMAN AUGMENTATION • BRAIN-COMPUTER INTERFACE

Human augmentation devices, such as exoskeletons and other assistive devices, are applied in physically demanding work environments. The devices can be either electrically powered or unpowered, and provide the wearer with significant enhancement to physical capabilities such as strength, endurance and resistance. A brain-computer interface (BCI) provides a direct link between a computing device and the brain and nervous system. This link allows a human to communicate and give commands to computing devices. The integration of BCIs with platforms such as virtual reality, augmented reality and the Internet of Things offers the potential for real-time control of objects within virtual and physical environments.

EXPERT OPINION

Experts were surveyed and asked to rate the impact of Human 2.0 technologies on a 5-point scale. On average, applications of brain-computer interfaces were perceived to have high potential impact for Australian rural industries. In comparison, technology used for augmenting human physical and sensory capabilities was evaluated to have only moderate potential impact for Australian rural industries.

Innovation of brain-computer interface technology has been more extensive than human augmentation technologies. Analysis of number of patents published by country identifies that the vast majority of patents have been published in the USA for both technologies. Analysis of number of patents published per year shows an increase in the innovation of brain-computer interface technology from 2014, and steady innovation since quarter 3 in 2015. Human augmentation technologies have had consistently few patents published over the past several years.
ENTERPRISE BEHAVIOURAL ANALYTICS

CUSTOMER JOURNEY ANALYTICS • EMOTIONAL ANALYTICS

Customer journey analytics is the use of data to track and understand customer interactions across business channels. Relevant data is used to map out customer journeys to better understand and even predict customer behaviour. This allows for products and services to be tailored to different groups of customers. Emotional analytics focuses on understanding human emotions by analysing human physiological and physical characteristics, such as speech, text, heart rate and activity. The ability to capture emotional data provides insights into the needs of customers and can be used to better target products and services at specific customer groups.

EXPERT OPINION

Experts were surveyed and asked to rate the impact of enterprise behavioural analytics technologies on a 5-point scale. On average, customer journey analytics was perceived to have very-high potential impact for Australian rural industries, while emotional analytics was perceived to have moderate potential impact. Unanimous favour was shown toward end-to-end understanding of customer interactions and its implementation to facilitate value and personalisation.

INNOVATION TRENDS

One implementation of enterprise behavioural analytics is identifying specific customer segments and understanding the interactions they have with a product through the various channels in the supply chain. For example, gaining detailed insights into the interactions that premium and convenience customer segments have with wine can identify new opportunities to better engage with those customers and provide valuable experiences. It could be possible to identify when and why customers move between segments, and develop product offerings to facilitate movement to preferred customer segments.
DRONE DELIVERY

Drone delivery is the use of drones (unmanned aerial vehicles) for the delivery of goods. Four- or eight-rotor copters are most common, however, other types (fixed-wing and hybrid) could be used. Drones have received considerable interest as a solution for 'last-mile' delivery. Last-mile delivery, which is the final stages of delivery, is highly problematic and costly. Several companies are experimenting with drone-based last mile delivery solutions in which small drones are launched from trucks and carry small packages the last-mile.

EXPERT OPINION

Experts were surveyed and asked to rate the impact of drone delivery technology on a 5-point scale. On average, responses show that drone delivery is perceived to have moderate to high potential impact for Australian rural industries. Collection and transportation of goods to and from remote areas and other locations was rated highly. Improving efficiency in the supply chain was rated to have slightly lower potential impact.

INNOVATION TRENDS

Continued development of drone technology, especially in the areas of battery technology, will lead to longer flight times and further distances travelled. This will increase the future viability and reliability of the technology for both short and long distance delivery.

As the technology does develop, it will be essential to provide good integration with existing supply chain infrastructure, such as ground transportation, while also building new infrastructure, such as warehousing and waypoint facilities. These integrations will be essential for last-mile drone delivery in remote areas.
Metal 3D printing enables the rapid and custom fabrication of fully functional metal parts. Metal 3D printing technologies are used commercially for the manufacture of low volume and complex parts. As metal 3D printing continues to improve, and becomes cheaper, the technology has the potential to facilitate a shift away from centralised manufacturing to smaller distributed manufacturing and repair of metal parts in a range of industries.

**EXPERT OPINION**

Experts were surveyed and asked to rate the impact of metal 3D printing technology on a 5-point scale. On average, responses show that metal 3D printing was perceived to have very-high potential impact for Australian rural industries. Highest rated was the capability to print fully-functional replacement parts, and to repair damaged equipment to minimise unplanned breakdowns and downtime. The design and printing of customised parts was rated slightly lower.

**INNOVATION TRENDS**

As metal 3D printing technology improves and becomes more accessible due to lower cost technology, it will become viable for part production in a range of industries. In particular, it can provide opportunities for large operations to vertically integrate maintenance services for large equipment fleets. As a service, 3D printing facilitates distributed manufacturing of parts. Manufacturing can be done on demand and closer to operations in remote areas. This provides the opportunity to increase rural infrastructure and employment, while significantly reducing part lead times and operation downtime.
CELLULAR AGRICULTURE

CELLULAR AGRICULTURE

Tissue engineering based • Fermentation based

Cellular agriculture is the use of cell-culturing techniques to artificially produce products that are typically obtained from livestock farming and processing. Some cellular agriculture methods require cells to be extracted from animals, while others use fermentation processes to grow specific organic molecules found in animals and animal products. Currently, cellular agriculture methods are being used to replicate beef, fish and poultry products. Other animal derived products such as egg whites, milk, and collagen are also being produced artificially using these methods.

EXPERT OPINION

Experts were surveyed and asked to rate the impact of cellular agriculture technologies on a 5-point scale. On average, cellular agriculture technologies were perceived to have high potential impact for Australian rural industries. Artificial production of meat products was perceived to have highest potential impact. Synthetically produced food items with enhanced health benefits were also perceived to have very high potential impact.

Food and drinks produced by combining organic molecules and flavours, rather than from naturally sourced ingredients

Using synthetic biology to personalise food items so that they provide novel health and nutrition benefits

Animal protein grown artificially in laboratories to produce processed meat items for human consumption

Whole foods grown artificially to enhance their nutrition profile, health benefits and environmental sustainability

FIGURE: ESTIMATED ENVIRONMENTAL IMPACT OF PRODUCING 1 KILOGRAM OF MEAT (USA). ADAPTED FROM [72]