



Agricultural Competitiveness White Paper 2014

Digital Innovation for Farms

Executive Summary

This submission outlines opportunities to improve productivity, quality and income from Australian agriculture through the implementation of new technologies. Specifically, we respond to the questions identified in the Australian Competitiveness Issues Paper which relate to agricultural technology, innovation, export opportunities for technology, research and development and new tools.

The Warren Centre proposes the development of a national agriculture technology strategy ("*Digital Innovation for Farms*"), and we make recommendations for the major elements of such a strategy.

Digital Reinvention

Digital technologies offer great promise to the agri-foods sector. Big data, advanced algorithms, robotics, and genomics are some of the innovations which can usher in a different kind of agriculture.

This submission focuses on how Australian agriculture and its downstream customers need to be re-positioned to take advantage of new developments in digital technologies that will improve productivity and value-add across all agri-supply chain operations.

Digital Innovation for Farms is proposed.

Agriculture is entering an era of rapid technological change

Intelligent farm machines, ultra-cheap computing, more powerful algorithms, and Big Data have the potential to increase farm returns in the midst of tough global competition.

Australian agriculture must advance as an information economy, if it is to be globally competitive. Technologies that have developed dramatically in recent years in other fields and industries that could easily be applied in an integrated fashion in the next wave of agricultural productivity growth include:

- The Internet of Living Things: Networks of low-cost sensors, actuators and wireless networks for data collection and process monitoring of crops, livestock and agricultural eco-systems

- Advanced robotics: Robots with enhanced senses, dexterity, and intelligence used to automate tasks or augment humans, such as harvesting fruit and controlling weeds and pests
- Autonomous farm vehicles: Vehicles that can navigate and operate with reduced or no human control to herd livestock and harvest crops
- 'Farms in the Cloud': The simulation of real-time agricultural processes using data and algorithms
- Mobile broadband internet: Inexpensive and capable mobile computing devices with high-speed internet connectivity to the farmer in the field
- Decision support: Intelligent software that can perform farm planning tasks, and support decision-making and optimize large-scale production processes.

This digital agriculture will enable farmers to monitor each individual plant or animal on the farm, know its full life history, and manage production and harvesting using that knowledge. It will deliver a more flexible and ever-more precise agriculture.

What this means for farmers

Picture for a moment Australia's farmers in a decade from now. They are managing larger, leaner, more productive agri-food operations through more technologically advanced operations. Leading farmers will be making more money and using less inputs. For example:

- Growing premium-priced products using data-intensive production systems
- Adding traceability to the farm's menu of information services, and underpinning high food safety standards so that Australia can lead in global markets
- Producing organic food at near the costs of non-organic production methods
- Using less inputs on-farm, but producing more output using intelligent machines.

Many components of tomorrow's intelligent machines and IT data systems exist today but are currently either not integrated into coherent systems or are underutilised in Australia¹.

What this means for Australia

Australia risks being known only for commodity agriculture, in a world that is seeking premium products with defined quality standards, produced using sustainable methods. Moreover, there is mounting evidence² that productivity growth from existing agri-technology paradigms may have run its course.

Australia's economy can benefit from a growing agri-technology industry. The increasing complexity of digital agriculture offers a large number of entry points for Australian companies and start-ups to innovate in digital agriculture, both for local and export markets. There will be a new generation of agricultural service companies that design, build and maintain intelligent farm equipment.

¹ Contrast this for example, with Denmark and the specific example of IT systems supporting highly efficient compliance with regulations regarding the use of pesticides. Danish farmers achieve this "automatically" in their fields using smartphone apps, leveraging their national infrastructure of fully geo-coded fields. The farmer enters pesticide usage in real-time onto the smartphone app, and that's it – no paperwork, no delay, no added inconvenience or loss of productivity.

² ABARES Research Report 11.04

(http://www.daff.gov.au/ABARES/pages/publications/display.aspx?url=http://143.188.17.20/anrd/DAFService/display.php?fid=pe_abares99010542_11b.xml)

A huge technology implementation challenge lies ahead

Farm enterprises have the potential to produce terabytes of image and operational data each day. An increasingly valuable output of agri-enterprises will be the transformed raw data and meta-data arising from information rich agricultural practices that will add more value to the farm's products (data sold *with* the product) and drive significant operational efficiency gains (data used on the farm to produce those products).

Note however that these opportunities could be squandered through inappropriate proprietary system/technology lock-out.

The massive quantity of raw data generated across the entire agri-food supply chain presents a significant systems integration task. These opportunities for better farm produce and higher productivity will be adversely impacted if the devices and systems for digital farming are developed on closed protocols that prevent widespread communication between devices and systems. The sector needs a 'Decision Support Technology Platform' based on a set of open technical protocols or standards.

Companies overseas and in other industries are working on this problem. GE has a platform called Predix³ for industrial internet sensors in products like gas turbines. Boeing Co. has an avionics "sensor fusion" platform for its military fighters. But these are proprietary standards.

Monsanto is leading in the race to develop an integrated proprietary platform for crop farming, complete with its own monitoring satellite, together with soil, weather, crop seed data⁴. For the farmer, the outputs of Monsanto's platform are field scripts for 'recipe-based' farming, tailored for each plot of land⁵.

Moreover, overseas decision support platforms are geared to a farm environment specialising in either crops or livestock, but not a mixed farm environment which is typical of Australia.

The looming battle of the Platforms

Technology platforms are expensive to build: there are large fixed costs in R&D, software development and the construction of specialised supporting systems. This leads to economies of scale over a wide range of transaction volumes.

Given the heterogeneity of Australian agriculture The Warren Centre is of the view that an open technology standard needs to be promoted for Australian agriculture. Australian agriculture faces unique challenges that will not be solved in North America or Europe.

Recommendations

A national strategy for Australian Agriculture to benefit through rapid technological progress: *Digital Innovation for Farms*

The ultimate objective for Digital Innovation is to change the way food and fibre is produced. This is of enormous importance to productivity growth in agriculture. It also opens up a new way of organising farming enterprises to help deal with the ageing workforce in agriculture.

The Warren Centre recommends that a set of complementary initiatives – collectively termed *Digital Innovation for Farms* – needs to be implemented if Australia is to properly exploit the benefits of digital agriculture. These initiatives include:

³ GE Predix. <http://www.gesoftware.com/predix>

⁴ Monsanto IFS. <http://www.monsanto.com/products/pages/integrated-farming-systems.aspx>

⁵ Monsanto FieldScripts. <http://www.monsanto.com/products/pages/fieldscripts.aspx>

1. Agricultural Technology Services Business Development

Australia needs to expand and promote the cluster of Australian industry and enterprises involved in agricultural technology. With the emergence of new technologies of relevance in the agricultural space, there will be (and could be additional) new industry participants and expanded opportunities for revenue growth from innovative Ag-Tech products and services, configured as smart farming solutions.

An effective, coherent and well-functioning Australian Ag-Tech industry will not only underpin productivity growth in Australian agriculture but is capable of generating growing export income from technology products and services. Those opportunities mirror Australia's highly successful mining equipment technology and services industry cluster, whose members generate \$50bn revenue including \$15bn exports annually. A similar vision should exist for agricultural technology.

This must be a national priority, involving participants from R&D, finance and investment sources, commercialisation specialists, as well as farming groups and State and Federal Governments. The Warren Centre believes that an Australian Ag-Tech products and services sector has the potential to deliver a multi-billion dollar addition to the Australian economy and export income.

2. Facilitate uptake of the Digital Farm. Specific implementations mechanisms to encourage Australia's farming sector to roll-out digital farming technologies and drive the associated productivity growth include:

- a. **Build awareness** of the opportunities both inside and outside of the agricultural sector: Entrepreneurial farmers will intuitively grasp the significance of these new technologies. But in many cases, they will lack the technical resources to transform their farming enterprises to take full advantage of digital agriculture.

Awareness building is also needed to harness the financial resources of venture capital and private equity firms.

- b. **Design an Ag-Tech Policy** around data ownership, open systems: Standards constitute a fundamental, though often invisible, framework for the technologically mediated world. There is a role for regulators and users to oversee the development of technical standards, those often-obscure protocols, rules, and codes that specify how a given group of technologies should operate (or interoperate). We need to prevent the lock-up of the future digital farm in the proprietary systems of a small number of powerful vendors.

Data ownership rights may also need to be defined, or at least clarified.

- c. **Invest in skills and training** in data acquisition, integration, analytics and decision support for on-farm applications: Australia has well-established education programs for agronomists, but not for data scientists or robotics engineers in agriculture.

The explosion of analytics in agriculture and agri-supply chain and logistics, requires people who can analyze data effectively and support analytical decisions. The rollout of new technology will demand specialised resources for training, maintenance, software upgrades and support.

Degree programs and majors in Agricultural data analytics and Agricultural Engineering are needed, and extension officers need to be trained to help farmers prepare for the different agriculture of tomorrow.

- d. **Fund demonstration projects:** The widespread adoption of digital agriculture in cropping and livestock industries requires coordinated action across sensor

developers, product manufacturers, telecom providers, farm advisers, and most importantly, farmers. This difficult objective will take time to achieve. However well-executed demonstration projects can greatly enhance adoption.

Horticulture – for example tree crops of nuts and fruit – are good early candidates to benefit from advanced technology such as autonomous systems and would be a sensible choice for early demonstration projects that can leverage Australia's natural advantages.

- e. **Facilitate further investment in R&D** to fill the knowledge gaps and lower the risk of commercial players implementing new technologies: Further investment is needed in intelligent farm machines, data processing algorithms and decision support systems such as for anomaly detection, prediction, comparison, optimisation for resource planning. Systems for integration of existing technology are an early priority. Appropriate government policy settings could encourage wide industry investment in these essential developments, benefiting both our domestic agricultural productivity and our agricultural technology & services export sector.

Conclusion

By following the approach outlined in this Submission, The Warren Centre believes that Australia will be well prepared to capture the benefits in the coming decade of technological opportunity that can benefit farmers greatly.

The Warren Centre offers to discuss or amplify any aspect of this submission.

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This submission has been prepared with the assistance of our partner organisation *The Australian Centre for Innovation*, also located at The University of Sydney. www.aciic.org.au

About The Warren Centre for Advanced Engineering

The Warren Centre is an academically independent not-for-profit social enterprise located at the University of Sydney that uses robust, collaborative processes with its extensive networks in industry, government and academia to find solutions in an increasingly complex economic, technical and social environment. It is expert at leveraging its connections for optimum results, such as:

- Fostering excellence and innovation in advanced engineering throughout Australia;
- Stimulating the application and further development of new engineering technology;
- Encouraging the integration of innovation and engineering technology into Australia's public policy and wealth creation;
- Providing independent comment and advice to government and industry on relevant issues;
- Helping create competitive advantage for specific industries in Australia and overseas and viable opportunities for wealth creation.

The Warren Centre owns the process – and everyone owns the benefits.

www.TheWarrenCentre.org.au