Using low-cost, cloud based technology to assist with innovation and efficiencies in agriculture

A report for

By Linda Eldredge

2012 Nuffield Scholar

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Executive Summary

This report delivers information around the global emergence of low-cost technology and how knowledge gained from these tools can be applied in Australian agribusinesses to promote maximum efficiency, productivity and cashflow.

Australian agribusinesses are being pressured by declining terms of trade and there is a need for the modern agribusiness manager to implement further innovations into their businesses to increase production output to maintain and increase profitability.

Adoption of business analytics can deliver up to 10-20% increased profitability per annum, however, these business decision support tools are failing to gain momentum in the agribusiness world.

Lack of connectivity and bandwidth in regional Australia is a major impediment for rural agribusinesses in engaging in various cloud-based, analytical tools. There is a real risk of Australian agribusiness falling quickly behind global agribusiness benchmarks if access to connectivity cannot be addressed immediately.

Social media giants Facebook and Google are planning to compete on providing the two thirds of the world with no internet with free Wi-Fi connection. They propose launching large, unmanned drones 18200 to 27400 metres above the earth to deliver internet connections to all parts of the globe. It is unsure if this will address the lack of connectivity in regional Australia, but this innovation heralds a potential farming future around social media and technology driving a participatory approach with regard to agricultural production.

Australian businesses now have access to developing their own web-based management platform which can be styled to their own business operational, analytic and strategic needs. Investment in such a platform by the agribusiness and opening the data platform to complementary applications could be a significant step forward for adoption of cloud-based technology and analytics.

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Foreword

Tell me and I forget ... teach me and I remember ... involve me and I learn.

Benjamin Franklin

This report is designed to create some philosophical debate centred on the impending issue of global food security, the contentious public perception of foreign ownership and the next 'revolution' that needs to occur to ensure that Australian producers remain profitable and sustainable.

Business growth and sustained profitability is becoming more difficult for Australian producers because of the ever-increasing cost-price squeeze. The question needs to be asked, 'where will the next edge in creating business efficiencies come from?'

While maximising production has played a significant role in Australian farming systems – it has maintained farm profitability over the past two centuries – I am a strong advocate of agri-management. I am passionate about delivering practical management skills to rural and regional areas enabling all family members of a farm or agribusiness to participate in important conversations about operational matters, ongoing strategy and risk mitigation. These conversations are only relevant and worthwhile if business data is collected and managed. There are a range of management tools that support decision-making and strategy development by all members of the business. Sound decisions can be made with high-quality business data and analysis, regardless of the emotion that may be linked to that decision. With this information, families can be truly responsible to ensure the sustainable viability of their agribusiness.

With this in mind, and based on my passion to empower family agribusinesses in financial decision-making, I embarked on a Nuffield Scholarship to learn more about the next 'revolution' that I believe will ensure the continued profitability and sustainability of Australian producers– low-cost, cloud-based technologies.

Acknowledgements

I would first like to thank my family – Rhys, Bryce and Jessica – for all their support and encouragement throughout the Nuffield journey. Thank you to Rhys for handing me the application and encouraging me to apply, Jess for travelling with me around the world and enduring countless meetings and Bryce for being an enthusiastic and willing conversationalist. I cannot thank you enough.

To the amazing friendships that emerged from the Nuffield journey, from the Contemporary Scholar's Conference, the Global Focus tour, and special friends made in faraway lands, you will always have a special place in my heart.

To the many individuals, professional, colleagues and businesses who opened up their homes and workplaces, this made the intense learning and sharing so special. Your generosity in time and hospitality has been overwhelming and while naming you all and the many special things you did for me would fill a report in itself, please accept my genuine and heart-felt gratitude.

Finally, a huge thank you to Nuffield Australia, in particular Jim Geltch for all his support, my amazing sponsors GrainGrowers Limited, whose commitment has allowed me the freedom to search the world for low-cost cloud options for producers to consider and develop an ongoing network of innovators with a desire to change the agri-management world.

At home, with my trusty laptop, accessing and inputting real time management data with our Clare property pictured behind me

Objectives

The key objectives of this Nuffield Scholarship report are:

1. To gain an insight into the current demands on the agribusiness industry globally with a view towards low-cost, cloud-based technology and innovation to meet the impending food crisis.

2. To understand the value of the analytical tools that are being developed and measure their value and effectiveness through a model of innovation, technology and potential impact on profitability.

3. To investigate and challenge the paradigms that exist in the industry currently and explore how social media tools driven by large corporate, global business and their community platforms can collaborate with agriculture and assist in driving analytics into mainstream agribusiness.

4. To research bandwidth and connectivity of rural and regional Australia and to understand what communication infrastructure rural Australia requires to participate in these low-cost, cloud-based tools, along with other low-cost, data-seeking hardware currently being commercialised.

5. To reflect on what the future holds with regard to the next wave of low cost technology and connectivity globally driven by participatory opportunities.

Chapter 1: Global innovation in agriculture

"Every generation needs a new revolution."

Thomas Jefferson

1.1 Introduction

The initial aim of this Nuffield Scholarship was to gain an insight into the fast-emerging field of cloud-based innovations that are being developed and commercialised into the agri-industry. In particular, it details a search for the ultimate cloud-based tool, which could identify and assist in mitigating risk for agricultural businesses and help build innovation opportunities for increased production and profitability within the global farming sector.

While exploring India and China, it was clear that two-thirds of the world population was increasingly demanding more and varied types of food and 'consumer comforts'. This growing demand is placing pressure on a fragile production environment. For example, in the Punjab region in Northern India, meetings held with collaborative farming group Dhatti Agritech, confirmed their concerns around ongoing sustainability and the lowering of their underground water table, which has fallen by approximately 40 metres in 30 years. This has occurred due to overuse of irrigation in meeting consumer demands for rice and potatoes.

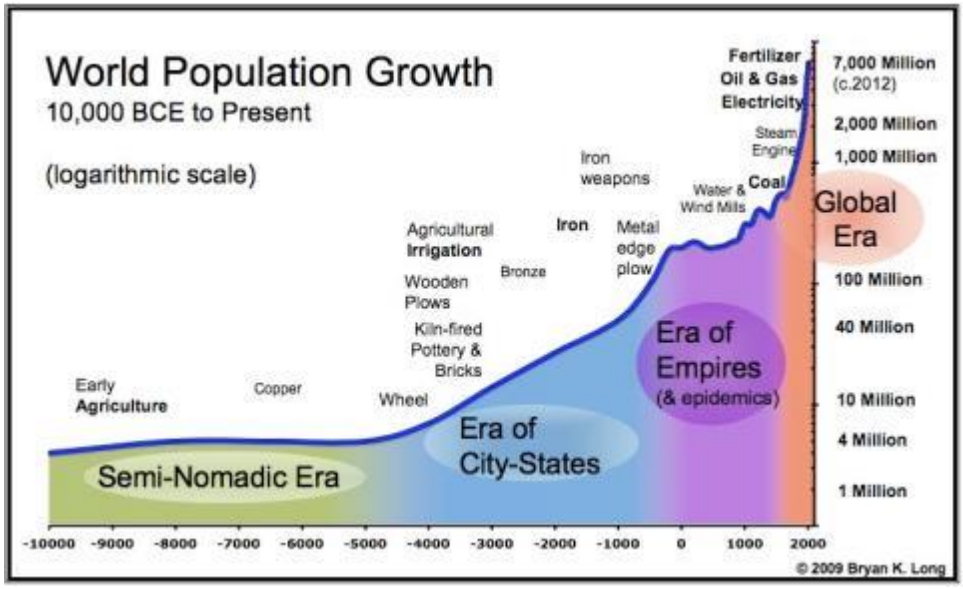
Figure 1: Visiting the fertile irrigated land of the Punjab region, September 2012

Source: Linda Eldredge (Sept 2012)

Humanity's desire to improve their standard of living, firstly on an individual basis and, at times, through the need for community sharing of resources has been a key driver of society reform. History reflects that change has been driven through disruption in people's environment and social conditions. At times, the greatest change has been delivered through innovation that has been necessitated by a crisis or revolution.

Improved living conditions, improved transport and increasing life expectancies have been brought about by using all the resources the world has on offer, as depicted in Figure 2, World Population Growth.

Figure 2: World Population Growth



Source: http://econosystemics.com/AphetaBlog/wp-content/uploads/2009/05/world-population-chart.jpg

This report explores the linking of the 'technology and knowledge revolution' with the challenges facing the Australian and global agri-industries with regards to sustainability, profitability, risk mitigation and resourcing the world without degrading our precious, fragile environment through using superior "real-time" management decision support tools.

1.2 Global Production and Innovation Pressures

"Agricultural productivity growth is only one to two percent a year; this is too low to meet population growth and increased demand."

Joachim von Braum
Director General of the International Food Policy Research Institute

The paper '*Monsanto-Helping Farmers feed the World'* (Bell, Knoop & Shelman, 2012) outlines a startling statistic:

> *The Food and Agriculture Organization (FAO) of the United Nations estimates that by 2050, agricultural production will need to double in order to sustain an anticipated population of 9.3 billion people – over 70% of whom would live in cities – under mounting environmental constraints.*

This leads to the debate about whether the world can support a population of nearly 10 billion by 2050. Renowned author Paul Ehrlich, who wrote the best-selling book *The Population Bomb* in 1968, was reported in the Guardian newspaper in April 2012, as saying that physical global numbers were as important as the amount of natural resources consumed. Ehrlich argued that "the optimum population of Earth – enough to guarantee the minimal physical ingredients of a decent life to everyone – was 1.5 to two billion people rather than the seven billion who are alive today or the nine billion expected in 2050".

In the same interview, Ehrlich contended that many of his predictions of the 1970s had come to fruition by the end of the century. He claimed to be one of the first to predict climate change, foreshadowed the risk of loss of biodiversity and an increase in epidemics.

Ehrlich (2012) stated: "*We have one billion people hungry now and we are going to add 2.5 billion. They are going to have to be fed on more marginal land, from water that is purified more or transported further, we're going to have disproportionate impacts on how we feed people from the population increase itself*."

A contrasting opinion exists in the Peter Diamandis and Steven Kotlers' (2012) bestselling book *Abundance: The future is better than you think*. Diamandis explores the technological developments currently being engaged and in the pipeline that will support the increasing

demands of a global population. Diamandis' optimism on feeding the world is founded in his theory that technology's rapid innovation and growth keeps pace with population demands. This is combined with:

- Do-it-yourself innovation that creates commercial and production efficiencies.
- 'Open sourcing' to assist with design development and commercialisation.
- The influence of the 'technology philanthropist', described as a new wave of individuals who made their wealth in the computer boom of the 1990s and are spreading their wealth and technology innovations to developing countries.

As part of his forces of change, Diamandis names the concept of 'The Rising Billion' and explores an idea that the number of the worlds poorest is closer to four billion than one billion. He contends that China, India and Africa, which are home to majority of the rising population of developing countries, have started to progress in pulling themselves out of poverty (Diamandis & Kotler, 2012). According to Diamandis, the greatest tool helping individuals emerge from poverty are cell phones, and their use is rapidly spreading. Diamandis says "*adding 10 phones per 100 people adds 0.6 per cent to the gross domestic product (GDP) of a developing country*". Connectivity is becoming an important driver in the desire to eliminate poverty as it provides education, communication, and efficiencies in time and labour.

There are strong opponents to Diamandis' theory on abundance and, in particular, the lack of economic rationale in the development and operational costs to such food production methods. This includes energy costs involved in building and managing the food supply and environmental costs, such as greenhouse gas emissions and capital energy.

While travelling, there were numerous examples of agricultural development and food production in a non-commercially viable environment with large capital expenses. There was substantial evidence of how an environmental system can be manipulated to produce output, given unlimited access to money (Figure 3).

Diamandis' theory on abundance and society's need to create and innovate exponentially is a new viewpoint on what has driven society to this point of material need and satisfaction.

Figure 3: How money can manipulate production. Qatar sovereignty investments has taken an arid, limestone desert and, through massive capital investment, is producing fodder crops. A 180-degree view of the pivot irrigation and the land pre-irrigation.

Source: Linda Eldredge (September 2012)

Figure 4: Visiting Chernobyl and the haunting images of abandoned cities, standing in front of the reactor which has been described as "a crippled sarcophagus with around 97% of radioactive material remaining" (www.livescience.com). Technology pushed forward without appropriate due diligence in order to meet a community need.

Source: Linda Eldredge (September 2012)

Where the Diamandis abundance theory resonates most within the new communication environment is the social platforms that will allow individuals, rather than governments, to manage the socially changing development of the technological revolution. This can be financially and socially empowering for individuals with great ideas and the motivation to push beyond the normal government and corporate development and commercialisation models. A visit to Kickstarter in New York, April 2013, was an enlightening glimpse into the workings of a community funding platform for creative projects. Since its launch in 2009, 6.3 million people have pledged USD $1 billion and the creators of the ideas retain 100% ownership (www.kickstarter.com). This freedom to innovate and launch outside of the paradigms of established commercialisation and distribution through the established corporate channels has precipitated innovation and change at a more rapid pace.

Figure 5: The unassuming door of Kickstarter in the back alleys of New York and visiting Agchat CEO Emily Zweber, Iowa, with Tom McCue from GRDC. Agchat connects thousands of agribusinesses and individuals globally with its twitter feeds, conversations and information sessions.

Source: Linda Eldredge (April 2013)

The global demand for food and the emergence of a raft of new, low-cost innovation options has now intersected and is creating a world of imagination and innovation which has potential application in agriculture.

1.3 Emerging innovative global business technologies and analytics

"Never before in history has innovation promised so much, to so many, in so short a time."
Bill Gates

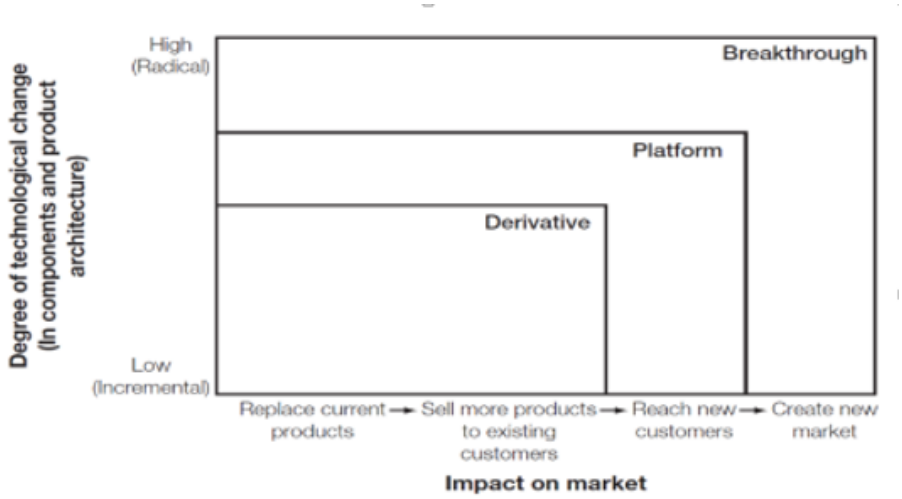
The purpose of this research is to find the 'ultimate' analytical diagnostic tool that can provide a one-stop shop for all agri-management decisions. Applications must be relevant in the paddock for busy production and business managers to be able to collect, review and make real-time and technically-correct management decisions on the go. Collectively this process is called business analytics.

In this fast-paced world, there are a number of different analytic tools that are available via real time, data response mechanisms. Therefore, it is important to define and explain what terminology exists in the new world of analytics. These various collection and data tools come in diverse forms and as stated at the outset, the aim of this Nuffield Scholarship was to find the ultimate, integrated, analytic tool.

However, there are an abundance of applications (apps), web-based tools and cloud-based tools that needed to be explored and reviewed to determine if a mixture of smaller tools would be a better outcome than committing to one fully integrated tool, with only one large company where data is stored in their cloud system and solely on their server.

More than 100 tools were purchased, analysed and reviewed through an academic model (Figure 6) to determine the tool's innovative edge and what production and profitability it could provide to a business. Many businesses, academics and producers were visited to determine the rise of emerging tools, the raft of tools available to industry, their ease of use and their application in a business. Tools were assessed by considering whether it was breakthrough technology or another way of record keeping and if it would make a difference to the bottom lines of Australian agribusinesses.

Figure 6: Model to measure project plan to focus product development



Steven C. Wheelright and Kim B. Clark, "Creating Project Plans to Focus Product Development," *Harvard Business Review*, March–April 1992, 10–82.

Figure 7: Outlines definitions and comments on new and emerging technology applications, software and hardware.

Terminology and Abbreviations	Definition and Comments[1]
Smart phone	Mobile phone that is built for the mobile operating system (ie 3G) with the capacity to access "data" similar to that of a standard computer via touchscreen and web browsers. High-speed access is delivered to the smart phone device via mobile broadband (3G), Wi-Fi and Bluetooth. *Business Insider Australia (Oct 19, 2013) research found that:* 1. *By the end of 2013, globally there will be 1.4 billion smartphones (22% of the population own a smart phone).* 2. *Tablets are showing a faster adoption rate than smartphones, it took smartphones nearly four years to reach 6% penetration globally, tablets have reached this figure in just two years.*
Apps	A self-contained program or piece of software designed to fulfil a particular process, an application, downloaded by a user to a mobile device 1. *By 2013 there was an estimated 200 billion downloads of apps globally* 2. *Between 56 and 82 billion apps are expected to be downloaded by the end of 2013* 3. *It is estimated that by 2017, there will be more than 200 billion downloads per year*

[1]Most current information obtained generally through Wikipedia (www.wikipedia.com retrieved September 2012 to September 2013)

Cloud	The “cloud” is essentially software, platforms and infrastructure owned by companies and operating through the internet that is sold “as a product/service”. The provider of the product/service has servers in remote locations so that a simple log on will store data as it is being input and will allow access from anywhere. This means data can be accessed from any computer when stored “on the cloud” and not just on one computer hard drive. 1. *Google Inc is one of the most well-known cloud vendors with products such as gmail and google calendar* 2. *Any updates to the program are done remotely without the user having to be aware or involved in an update. This is unlike a program loaded onto an individual’s personal computer, which is the responsibility of the individual to update software and save their data.*
ICloud	The storage and cloud computing services offered by Apple Inc. It can store data such as music, apps, photos, etc. and download them to multiple Apple IOS devices. It allows all of the data when downloaded to be automatically synced to other Apple devices, again allowing multiple access points, not just one personal computer. 1. *At July 2013, ICloud had 320 million users*
IOS (Apple devices)	Previously known as IPhone OS, IOS is the mobile operating system that has been developed and distributed by Apple Inc. 1. *Major versions of the IOS software are released annually* 2. *The current release IOS 7 was released in September 2013*
Android (Google)	Backed financially by Google and developed by Android Inc, this operating system is the user interface of Android-based smart phones and tablets and is based upon direct manipulation such as swiping, tapping, pinching and reverse pinching. 1. *This software has become a direct competitor to Apple’s IOS system and app developers now consider investment in an android version as their first priority*
Siri	A virtual voice response, intelligent personal assistant which works on the Apple Inc IOS system. This app uses a natural language user interface to answer questions, make recommendations and enable actions to happen by delegating requests to a set of web services that operate on the same platform
YouTube	A video sharing website in which users can watch uploaded videos or share their video with others over the web. YouTube TV has become popular and subscribers can register with a YouTube provider to access their videos as they come online.
Microsoft 365	The Microsoft cloud version of Office and allows users to have a complete office in the cloud where they can access their Microsoft tools virtually from any computer.

Dropbox	A file hosting service that offers cloud storage, file synchronisation, personal cloud and client software.
Facebook	An online social networking service
Twitter	An online social networking and microblogging service that enables users to send and read short 140 character text messages called “tweets”
Snapchat	A photo messaging application (app) where users can take photos, record videos, add text and drawings and send to a controlled list of recipients. Users set a time limit for how long recipients can view their “snaps” from 1 to 10 seconds. Snapchat story content is being viewed currently around 500 million times per day.
Tumblr	A microblogging platform and social networking website that allows users to post multimedia and other content to a short form blog
Linkedin	A business-oriented social networking service used mainly for professional networking.
Pinterest	A visual discovery tool that people use to collect ideas for their different projects and interests

In an article by Thomas H. Davenport (2006), Davenport stated, “*at a time when firms in many industries offer similar products and use comparable technologies, business processes are among the last remaining point of differentiation*”. The article also contests that many businesses which are engaging analytics are experiencing 20% growth and profits annually.

The report further contends that chaos lies within businesses where a “proliferation of under-developed spreadsheets and databases inevitably leads to multiple versions of key indicators within an organisation. Research has shown that 20-40% of spreadsheets contain errors ... therefore are a breeding ground for mistakes” Davenport, 2006).

So what is analytics? Davenport (2006) describes analytics as:

- *Placing all data-collection and analysis activities under a common leadership, with common technology and tools. This allows facilitated data-sharing and avoids the impediments of inconsistent reporting formats, data definitions and standards.*
- *Present data in standard formats, integrate it, store it and make it easily accessible to everyone. Expect to spend years gathering enough data to conduct meaningful analysis.*

Andrew McAfee (*2010)* reflected on the vast range of technology that has emerged over the past decade, such as smart phones, iPads, Google applications, and Microsoft tools. He named the cloud era as the significant technology sleeper of 2010 that was "*moving society and business into a new age of technology*". Social computing such as Facebook and Twitter were redefining the way society communicates, networks and "*gets its work done*". McAfee highlights the consumer demand for hardware and software to be appealing, intuitive and powerful and that the "*cloud era should be a central part of business strategy for companies that don't want to be left behind*".

Analytics using data collection is not a new concept, however analytics using intuitive, communicative, cloud-based hardware and software can be. As explored in section 1.1.2, Diamandis & Kotler (2012) stated that exponential growth in technology was creating new pathways for business. Cloud computing "*is transforming the face of IT with the potential to deliver real business value and business agility – the dexterity for business to quickly respond to changing business conditions with integrated research-enabled offerings*" (Golden, 2010). The example of the New York Times seeing a potential opportunity for a new service or product, and giving themselves 60 days to launch this product into the market. Instead of taking on the cost of expensive computer engineering, they engaged a cloud-based data service for the total cost of $240 and made the deadline launch within the 60 days to capture the market (Golden, 2010).

Significant capital investment has occurred over the past three decades in the agri-industry, including machinery investment in growing crops and maximising water use efficiencies. Furthermore, the uptake of production precision agriculture technology has been a significant capital cost to businesses, ranging from $1,000 to more than $500,000, depending upon the machinery and innovation. The next obvious step in gaining additional management efficiencies would be to gather all data presented in various formats and add it to an analytics platform of overall business management. The use of cloud-based shared platforms and tools has enabled business to participate in this business strategy through their smart phones, tablet and computer Wi-Fi at very low entry cost, ranging from no cost to about $1,000 per year for cloud-based software.

An analytic business looks beyond the basic statistics and uses predictive modelling to identify the most profitable enterprise, where different parts of the business can share data easily without the impediment of inconsistent formats, definitions and standards (Davenport, 2006). *These organisations don't gain advantage from one killer app, but rather from multiple applications supporting many parts of the business, and in some cases rolled out for use by customers and suppliers*". (Davenport, 2006).

If the theory of analytic analysis can be applied to Australian farming businesses, data already present in the farming system, such as harvest yield maps, soil tests and satellite imagery, could be fed into a single standard platform for strong analytic analysis. Davenport's claim of 10-20% increase per annum in profitability could become a sustainable reality.

The link that is missing in farming analytics in Australia is the measurement of data into a strong, integrated, and whole-of-business tool. Robust, 'real-time' decision making needs analysis that combines reflective business/management data with forward planning.

There are two issues for Australian producers:

- Collection, management and assessment of multiple datasets for individual enterprises along with the capacity of business resources in overall management and strategy formulation to tackle multiple business problems.
- Many producers cannot find the time to develop the essential analytical skills to deliver comprehensive and validated recommendations to the business they are operating within. As a result, having the skills to implement a system and time to establish it is vital to tackle these issues.

Davenport (2006) states that, "*analytic competitors are more than simple number-crunching factories. Certainly they apply technology – with a brutal force and finesse – to multiple business problems. But they also direct their energies toward finding the right focus, building the right culture and hiring the right people to make optimal use of the data they constantly churn. In the end, people and strategy, as much as information technology, give such organisations strength*".

In searching for this fully integrated analytic tool, meetings were conducted around the globe on every continent, with surprising results. Following is a small summary of highlights of each

major global region as to what technologies and tools are currently being explored, developed and launched.

1.3.1 United States of America (USA)

The USA was scheduled as the final destination on the Nuffield research trips based on its reputation for computing, innovation and the famous 'Silicon Valley', which accounts for one-third of all of the venture capital investment in the United States (Wikipedia, March 2014). Nicholas and Lee (2014) comment that experimentation, openness and collaboration mixed with competition has made the region synonymous with a culture of entrepreneurship. A visit to some of the major technology businesses occurred in April 2013. Following are some recollections of information about these computing and social media 'giants' from the visits to their organisations

Figure 8: Meeting with some of the most influential social media 'giants', Facebook (from top left), inside Facebook, my signature on the Facebook "wall" inside the Facebook compound. The world's most innovative workplace at Google, holding a Trimble hand-held GreenSeeker Crop Sensor, pre-commercialisation (middle bottom), and at Trimble Source Linda Eldredge (22 April 2013)

Facebook

The most amazing visit was to Facebook, which redefined the thinking of the author. One Facebook employee challenged agribusiness to "*think outside the square as to what is blocking data collection and analysis … if people are adverse to a pen and paper then they will not put their head over an iPad to input or analyse data*". Walking through the hallowed halls of Facebook, it presented a Disneyland-type of environment. The extreme innovation that was encouraged and inspired had a complete lack of hierarchy. Chief executive Mark Zuckerberg has no office and works with his colleagues in an open space, which was witnessed while being escorted through the complex. Work teams create their own inspiring workspaces, with bowling rinks, pin ball machines, cocktail lounges, a variety of free food, various restaurants and bicycle repair shops. It was truly a Disneyland, free thinking, no limits and an anything-is-possible environment.

Google

Most commonly known for its search engine and making the term "google" common vernacular, Google has been outstanding at collecting advertising revenue. With world-changing innovations and business acquisitions since the year 2000 (such as YouTube, Google maps, Gmail and Blogs), Google became the pioneers of cloud storage in 2003. In December 2012, Google reported $43 billion in gross revenue, 97% coming from advertising (Harvard Business School article, Amazon, Apple, Facebook and Google Dec 2013). Google are steaming ahead with other significant innovations that could be advantageous to the agri-industry, which will be discussed later in the report.

Apple

Leaders of intuitive hardware and innovative IOS software, Apple has grown from a market capitalisation of $8 billion in 2004 to $600 billion in early 2013. Of all apps downloaded since Apple and Google began distribution in the second half of 2008, Apple has been the source of 60% of all downloads (Harvard Business School article, Amazon, Apple, Facebook and Google Dec 2013).

Trimble

Trimble has offices globally and is establishing agricultural innovation through its many research arms. The biggest 'scoop' during the USA visit was holding the soon-to-be-commercialised, hand-held GreenSeeker crop sensor at the Oklahoma University. Research

teams at the university and Trimble had worked collaboratively on the scaled-down technology and, at the time of the visit, was expected to retail for about $US450.

John Deere

Meeting with John Deere executives at their global head office in Moline, Illinois, was an experience in agricultural history, innovation and global domination, with products that have stood the test of time. The meeting delivered an awareness of some of the company's innovations that have not made it to commercialisation. There was some discussion about data collection and analysis but it was evident this was one of their upcoming innovations that were yet to be announced. As a result, a certain level of confidentiality was agreed to by all parties. About nine months after the visit they announced their intuitive data collection system and comprehensive analysis product for use with other John Deere products. This will be reviewed later in the report. Impressively, all staff spoken to at the head office knew the shared vision of the company, "*to feed the world*". John Deere executives spoke at length about the need for innovations to be expedited to allow production growth to meet increasing population demands of food and energy.

SST Software

Based in Stillwater, Oklahoma, SST software is a privately-owned company with more than 80 million acres (32.3 million hectares) of land under their cloud-based management systems. Having been in the agricultural technology space for nearly 20 years, their products have now spread worldwide and SST has taken a leadership position in trying to unite precision agricultural efforts across the globe with a data sorting and sharing platform called *agX*. This platform will assist in sorting various different data platforms into one common platform, to allow simplified data collection and analysis, in a similar way to how the Microsoft platform allows willing participants to build their own individual tools using their meta-data platform and products such as Excel.

1.3.2 Australia

Pleasingly, Australia has some significant leaders in cloud-based agricultural products. For the purpose of this research, the author undertook many meetings and used the tools in an

applied manner, in conjunction with other farming participants. An outline of the most noteworthy Australian company's analytical tools is provided below.

Productionwise

ProductionWise was developed by GrainGrowers Ltd to provide an online crop management platform for farmers. It uses digital tools to record on-farm activities and operations to achieve greater traceability, improved accountability and achieve greater yields and profits through smarter farming. ProductionWise has some significant intellectual property with its nine month rainfall forecasting, soil moisture modelling and has increased its analytics with the Agricultural Production Systems sIMulator (APSIM) embedded into the model.

Agworld

As a forerunner of agricultural social platforms, the company's directors have a clear direction of what the product can achieve for modern agribusinesses. Its aim is to help with agronomic decision-making in the field as a one stop shop for communication between the agronomist and producer through ease of mapping, soil sampling and agronomist recommendations, based on collective data. It also provides some financial measurement tools such as gross margins. Agworld is keen to continue to add to the suite of tools available on the platform.

Plan 2 Profit

A significant whole of farm business, profit and cashflow predictive tool, this product has some substantial benefits for business in assessing ongoing financial viability and capital investment. At present, it is not on the cloud and is a stand-alone product. It would be an advantage for any of the other cloud products to link with the tool so data inputting is not constantly replicated. It would give both products a complete view of production and financial data linked intricately together.

1.3.3 Europe

Three visits to Europe failed to find any significant innovative, cloud-based, analytic tools or platforms. Meetings with market leaders in legislative compliance data recording, such as Farmgate and Muddy Boots, were enlightening. The data collection process and the rear-view intent of their products focused on protecting the consumer and producer in compliance and

accountability along the food chain. Leaders were impressed with the tools displayed but did not see it as their market space to move into. While meeting with researchers in Ireland and demonstrating the innovative tools that had been found worldwide, the comment was made that European Union subsidies had stifled the need for analytic tools. As a result, they felt their industry was now 15 years behind in data collection and management analysis tools (Kelly.T., July 2013 Personal communication). Discussions on tools emerging in other parts of the globe were held with Bart Ijtema, (July 2013 Personal communication), the Senior Vice President, Rabobank Food and Agri Development. His view at that point was that he had not experienced or viewed any cloud-based, real-time data collection and analysis tools for primary producers on the European continent.

1.3.4 Asia

Three visits into the Asian region and a conference in Taiwan failed to bring to light any analytical tools or business development into such tools. The visits confirmed Asia's role in technology and computer support services, such as factories in Taiwan and China building computer hardware and call centre support in India. However, innovation into platforms and computer software was not as evident there as it was in the American and Australian continents.

1.3.5 Canada and New Zealand

There is some movement into cloud-based technology emerging in Canada in industries such as cattle feedlotting and, in a much less advanced manner, cropping. Desktop research has indicated some tools, generally based around livestock systems, exist in New Zealand and are specific to their grazing system. However, New Zealand was not visited as part of the research scholarship.

Chapter 2: Capitalising on applying low-cost, commercial cloud-based tools into a farming system

2.1 Introduction

Chapter 1 explored and reviewed the changing world of low-cost data tools and the promise of the tools being developed with commercialisation in mind. In this rapidly evolving and emerging portfolio of business tools for gathering data and accessing analysis, it is critically important to only engage in an analytic tool that will benefit the business significantly in terms of breakthrough technology, additional profit and sustainable capacity. In addition, in a world full of data and tools, business owners and staff tend to be time poor and focused on producing output. There must be a point when they let go of some of the information gathering and focus on tools they, as a businesses, want to maintain.

This is increasingly difficult because of the changing technological landscape in cloud-based portals. Generally, if the subscription lapses, the information is no longer available for the business to view. This was a question that was raised when discussing the new world of emerging data tools with GrainGrower's Professor Gordon MacAulay. He put it very simply that "*the degree of surprise is linked to the value of the information*" (MacAulay.G., Feb 2013, Personal communication). Once the information fails to surprise then the lesson has been learnt and it is time to continue on to finding the next surprise in business information and the lessons it teaches. This view is important when assessing and investing in the multitude of tools that daily flood the market.

2.1.1Cloud-based analytic tools

Using the academic review tool that was introduced earlier in this report, Figure 9 assesses the cloud-based tools currently available for farming businesses based around analytics.

The following tools were identified and reviewed by the author as having the most likely outcomes in achieving the result of business analytics for Australian producers, with the potential to increase production and profitability.

FIGURE 9	**Review of cloud-based analytic tools – January 2014**				
Web apps – use the internet browser to access your data, advantage ie you can access information on any device	**Networking platform 1-10**	**Agronomic platform 1-10**	**Breakthrough technology 1-10**	**Potential Australian agribusiness "game changer" 1-10**	**Comments**
ProductionWise	7	9	9	9	- Significant IP in the climate model predictions, outstanding results - APSIM model - Soil moisture modelling, stable results - Spray wise - Lacks whole of business financial analysis - Currently no livestock component
AgWorld	8	6	6	6	- Social platform (Facebook of the ag industry) - Simple dashboard - Easy to accept agronomist recommendation - Has formal distribution relationship with large chemical retailers - Lacks whole of business financial analysis - Currently no livestock component
SST software	6	7	8	7	- Leaders in soil science via computer models - Links with proven global models - USA-based and has link with collaborative resources and equity funding to grow - Multiple analytic tools but lacks whole of business financial analysis - Currently no livestock component
SST agX	9	N/A	8	7	- Outstanding concept to bring all the data into one common platform so replication of data is eliminated - Will struggle to recruit existing analytic tools to this platform due to competition and IP protection, but gives hope for future platform sharing innovations
Back Paddock Company	6	6	6	5	- 'Clunky' interface - Offers no real advantage to some of the other tools - Formal relationship with a chemical retailer
John Deere **"My John Deere"** **Dow Agrosciences**	6	7	6	5	- Still to be formally released - Two large multinational companies combining resources to collect and disseminate data and give in-field recommendations - Resistance to giving information to a multinational company and ongoing reliance on continually having to

					purchase their products to maintain the data flow
Monsanto **"Field script"**	5	7	6	5	As above, the same issues apply, with the added complication that any recommendation will require seed to be solely purchased from Monsanto
Ag data Phoenix production "Live"	6	Offers livestock and cropping data	6	8	- Australia's largest agricultural software company - Have had the production product for many years - Users join with good intention to commit to the data inputting but often fail with the complexity of the data collection and commitment to maintaining data - Phoenix financials are a very popular product

This list represents the more complex cloud-based data collection and analysis tools while the second list (Figure 10) outlines some of the apps that are available at a minimal one off cost.

For the producer who is hesitant about launching into using web-based, real-time tools, the other option may be to use some smaller, free "native apps" to gain confidence in how inputting and managing data occurs in this new world of electronic data collection.

FIGURE 10 Review of interesting native "App" tools – January 2014

Native app – written to run specifically on one operating system, not as accessible as a web app	**Cost**	**Agronomic or Livestock**	**Break-through technology 1-10**	**Potential Australian agribusiness "game changer" 1-10**	**Comments**
Tractorpal	Free to $4.99	N/A	4	4	- Keeps inventory and maintenance records for farm machines including cars
Crop Insurance calculator	$0.99	Cropping	5	4	- Crop insurance calculator was designed in the USA, but some parts of the tool may be useful for Australian producers
efarmer	Free (Lite version)	Mapping and other functions	5	4	- Mapping capacity - Rotations - Notes - Free entry into data entry apps for farming
Beyond Agronomy	Seed calculator $0.99 Tank Mix $1.91 Air cart maximiser $4.81	Agronomic	6	4	- Nuffield scholar Steve Laroque from Canada is a globally respected agronomist who thinks and operates "outside the square", well designed and delivered tools

Farm manager	Free to $17.99	Agronomic and Livestock	5	4	- Good record keeping functionality including crops, livestock, machinery maintenance
iCalve	$12.99	Cattle livestock	4	4	- Developed in USA - All cattle records, calving, treatment, herd data
Virtual Farm manager	$65 per month	Agronomic	4	4	- VFM was the first farmer-owned ag technology company - Keeps all paddock records - Developed in the USA
Spray	Free to $549 for full version	Agronomic	5	4	- Comprehensive app for recording chemical operations
JDLink	Free	Machinery	4	4	- Telematics systems to optimise productivity and efficiencies
Fertiliser removal by crop by Ag-PHD	Free	Agronomic	4	4	- Nutrient removal that includes some calculations for wider range of element/nutrients
EvoCrop	Free to full version $949.99	Agronomic	4	4	- Good interface and can be synchronised so information can be shared - Expensive when other tools like Productionwise, AgWorld are available with more functions, albeit with annual subscriptions
GRDC apps	Free (Ute guides)	Agronomic	4	4	- Winter cereal nutrition - Field Peas - Insect ID - Weed ID
Live to meat calculator	$6.49	Livestock	4	4	- Assists producers and consumers as to the amount of meat that will come from a meat animal, estimate the average as well as high-low range for the cold carcass weight
F-track	$250 per year	Agronomic and Livestock	4	4	- Acts as an electronic notebook for recording all that happens on the property, including livestock movement, crop manager, fuel inventory, silo manager, current market prices
AgVantage	Free	Livestock	6	6	- Determines the dose rate on sheep - Information quickly calculated - Withholding periods etc accessible
GPS test (Android)	Free	Agronomic	5	4	- Shows GPS signal and satellite positions in the sky
DTN - The Progressive Farmer	Free	News and market data	5	5	- News and market data
farmGRAZE	$9.15	Livestock	5	4	- Measure, record and manage the grazing platform
Victoria DPI crop disease app	Free	Agronomic	4	5	- Developed with GRDC funding
Farm Contractor	$10.49	Contracting schedules	5	5	- Records client and job details - 25 job types listed
Fertility improvement profit calculator	Free	Livestock	4	4	- Optimises the reproductive performance of dairy cows and captures extra value, developed by DSM nutritional products
Commodity Prices	Free	All	3	3	- Allows producers to keep up to date with all commodity futures
Seeding rate calculator	$1.29	Agronomy	3	4	- Calculates seed rate based on weight, germination and losses

Tank Mix by Du Pont	Free	Agronomy	3	3	- Easy calculator for tank mixes
Dragon Dictation	Free	Record keeping	4	4	- Easy to use voice recognition that allows the user to speak and instantly the text or email message is viewed
First Aid	$4.49	Health	8	8	- Comprehensive and easy to use which gives step-by-step instructions in a medical emergency
Nutrient removal app	Free	Agronomic	4	4	- Simple calculation tool that can assist with crop nutrition planning
Field notes	$25.99	Agronomic	4	4	- Paddock management for pesticides
Tape measure app	$0.99	-	3	3	- Assists in accurately measuring any object
Flashlight	Free	-	3	3	- Bright, fast, simple, essential for every farmer
Units – Free Unit Converter	Free	-	3	3	- Easy conversion tool over 43 different categories
Time Master	$9.99	-	4	4	- Simple, effective invoicing app
Evernote	Free	Organisation	6	5	- Effective note taking and note sharing within a business

2.1.2 The benefits of analytics in agriculture

It is difficult to quantify the economic benefits to agriculture as a result of these tools due to the random uptake and lack of milestones and measurement in the industry to this point. As previously outlined in section 1.3, the suggestion from academics and business analytic practitioners was that profitability could increase by 10-20% per annum.

The Australian Bureau of Statistics (ABS) conceded that it was difficult to determine the average weekly disposable income of Australian farmers due to climate and industry variability (ABS,2010). One statistic suggested that average profit over all Australian family farming partnership businesses was about $200,000 per annum (before capital and living costs). If analytics is applied to an average business and a result of 20% increase in profitability occurred, this would result in a potential upside of profit of about $240,000. If the cost of the hardware (say an iPad) is $1,000 and a cloud-based analytic management tool is $800-$1,000 per annum, a 20% increase in profitability is a stunning result given the low cost investment in the hardware and cloud-based technology. This is measured in the capital investment and analysis tool below.

Figure 11 – Cost/benefit analysis of capital investment

Development Name	20% increase in profitability based on $200,000 p.a. profit									
Year	0	1	2	3	4	5	6	7	8	9
Capital invested										
Income	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Increased profitability on say $200,000	$ -	$ 40,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000
profit at say 20%	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total	$ -	$ 40,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000
Capital expended										
Ipad	$ 1,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Operational expenses	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Subscription to cloud based tool	$ -	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Other expenses	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Time inputting data say 50 hours x $30/hou	$ -	$ 1,500	$ 1,500	$ 1,500	$ 1,500	$ 1,500	$ 1,500	$ 1,500	$ 1,500	$ 1,500
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total	$ 1,000	$ 2,500	$ 2,500	$ 2,500	$ 2,500	$ 2,500	$ 2,500	$ 2,500	$ 2,500	$ 2,500
Annual cash flow	-$ 1,000	$ 37,500	$ 37,500	$ 37,500	$ 37,500	$ 37,500	$ 37,500	$ 37,500	$ 37,500	$ 37,500
Cumultative cash flow	-$ 1,000	$ 36,500	$ 74,000	$ 111,500	$ 149,000	$ 186,500	$ 224,000	$ 261,500	$ 299,000	$ 336,500

D.R.	(DR= Discount rate)			IRR	Year 5				IRR
NPV 3%	$282,504				3750%				

There are other 'soft' benefits which farmers tend to not measure such as:

1. Ease of communication across the business with all partners and employees being able to participate, driving a shared vision of the business in an operational and visual manner.
2. Ease of real-time data inputting to create efficiencies within the business to limit inputting the same data multiple times.
3. The presentation of data to key stakeholders such as financiers, with the possibility of opening up negotiations on interest rates with data management and presenting strategies to mitigate risk and manage maximum production and minimum costs.
4. Knowledge management being formally shared and recorded within the business as part of a production and management succession planning strategy.

2.1.3 Barriers to adoption of analytics

Analytics is not a new business concept for Australian producers. There has been significant investment by governments and individual consultants in educating the Australian farmer about the importance of data collection and analytics, and yet there is still not a culture of analytics within the mixed farming business.

In order to understand the lack of uptake of these new cloud-based web tools, and native apps, two farmer surveys were reviewed for some answers to the lack of adoption.

Producers are reluctant to input data multiple times so the time taken to manage data is the major restriction in its adoption, use and analysis within the business. This is highlighted in a small survey of 113 agribusiness respondents, undertaken by the author in 2013 (Figure 12).

Figure 12 - Farmer survey of attitudes toward data inputting

Question	Strongly Agree	Agree	Disagree	Strongly Disagree
Having been given a definition of analytics, do you believe analytics will benefit your business?	82%	17%	1%	
Would you take on an analytic tool and input data yourself?	27%	39%	23%	11%
Would you take on an analytic tool if your agronomist entered the data?	69%	27%	4%	
Are you concerned about retail agronomists inputting their recommendations without your management input? ie, what is entered as a recommendation is adopted without management comparisons (price of inputs etc)?	93%	4%	2%	1%
Is increasing pressure on production work time the biggest factor in stopping you inputting data?	72%	19%	9%	

- Of the respondents 43% were male and 57% female
- 3% were less than 25 years of age
- 58% were aged between 25-50 years
- 39% were more than 50 years[2]

This survey highlights some interesting responses and it could be concluded that producers are willing to take on analytics to increase production, or reduce input costs and build a stronger profit margin and sustainability position. However, the inputting of data in a traditional manner would appear to be a major barrier to adoption of analytics via the various tools that are currently available.

[2]The survey was only a small data sample and it would be interesting to sample this survey further and wider as many of the respondents are connected to the author in either agribusiness training or consulting and there may have been some influence of previous conversations and training outcomes/exploration of various management tools that may have delivered the aforementioned results.

The second survey, compiled from information from GrainGrowers, clearly indicates the continued uptake of hardware, such as smartphones and tablet PCs, with exponential increases evident between the years 2012 to 2013. Interestingly, survey participants have identified a need for priority of a new app, their identification for app or cloud-based technology development rotates around data inputting/record keeping functions with a strong push for weather forecasting capabilities. A strong response towards mainstream management functionality has been identified as a priority in the survey.

Figure 13: GrainGrowers Ltd survey on uptake of hardware

A survey of the farming industry resulted in the following information:

Survey Questions	2012	2013
Farm Manager?	81.7%	78%
Apple IOS	32.5%	47.5%
Google Android	14.5%	18.1%
No smartphone	43.2%	23.9%
Tablet PC Apple IOS	24.3%	43.8%
Tablet PC Google Android	3.6%	5.8%
If intending to purchase would it be – Apple IOS	61.9%	58.8%
If intending to purchase would it be – Google Android	23.4%	19.9%
Access on a regular basis for:		
- Emails	98.3%	69%
- SMS text	N/A	87.7%
- PDF documents	72.2%	42.5%
- Weather services	88.5%	71.7%
- Social media	28.5%	34.4%
- Note taking	8.8%	21.3%
- Cloud storage (dropbox, skydrive)	15.9%	17.6%
- Farm keeping software	54.0%	16.0%
- PA (GeoSys, PA Source)	36.1%	6.3%
- Digital Camera	67.2%	62.2%
- GPS	66.9%	32%
- Messaging services (ie Skype)	25.2%	14.4%
- Calculators and converters	74.4%	67.5%

Priority for new App development?:		
- Grain price discovery	36.3%	37.8%
- Grain marketing/storage/contract management	N/A	29.9%
- Precision Ag tools	30.0%	24.9%
- Paddock record keeping	53.5%	48.0%
- Livestock record keeping	33.5%	27.8%
- Spray record keeping	55.1%	48.6%
- Farm Mapping	38.1%	24.1%
- Weather forecasting	54.8%	45.4%
- Yield forecasting	25.2%	18.1%
- Soil testing and interpretation	27.3%	21.0%
- Weed/pest/disease identification	38.7%	30.4%
- Agronomic information	39.4%	30.7%
- Agricultural news	25.5%	26.0%
- Climate analysis	18.6%	13.1%
- One app to combine the above	44.3%	32.3%

Source: GrainGrowers Ltd 2012, 2013

It would be interesting to take this survey to another level and measure who would undertake data implementation on a regular basis in their own business or alternatively, whether data collected is outsourced to third parties, such as agronomists and consultants.

The National Farmers Federation cited the average age of Australian farmer's as 52 (NFF, 2012). It highlighted the inactivity of these managers and owners of rural businesses in participating in the technological management 'boom' fast encroaching upon the business world.

Both surveys appeared to trend toward there being an understanding of the need for analytics but a sustained movement towards this becoming common business practice is still not evident.

A meeting with researchers in Ireland revealed that one young researcher was undertaking a PhD project measuring the "slippage" in uptake of new information/research and subsequent adoption by primary producers around the world. The study was not completed at the time of the visit, however preliminary survey results and anecdotal evidence indicated that only 10% of primary production managers are adopting analytical thinking and applying it to the business (Kelly.T. July 2013 Personal communication). These are alarmingly low adoption figures given the money invested globally into training in analytical thinking skills.

Questions to be asked include:

1. Is it the method of training delivery that is creating an environment of non-adoption from the education arena into the business?
2. Does there need to be another method of education and adoption explored to find the most immediate and responsive engagement and subsequent adoption?

2.1.4 Bandwidth and connectivity in regional Australia

The low rate of uptake of video, such as YouTube, conferencing, other data-heavy applications and web and cloud-based tools, has highlighted the poor infrastructure that is currently under pressure to service the increasing demand for data resources of Australian consumers and businesses.

There are numerous debates and speculation about the new government and public investment in the National Broadband Network (NBN). This has been highlighted in the political arena for the past four years since the former Federal Labor Government announced its infrastructure plan to lay cable and fibre to all households by 2024. The Abbott Liberal Government's plan of a mix of cable and fibre to premises and fibre to node by the year 2020 has been met with heavy criticism. Paul Budde (2014) called for a more constructive debate about Australia's future broadband needs, arguing that the current national conversation over the NBN is stuck in "yesterday's logic" because it failed to plan for the needs of a future only five to 10 years away (Figure 14).

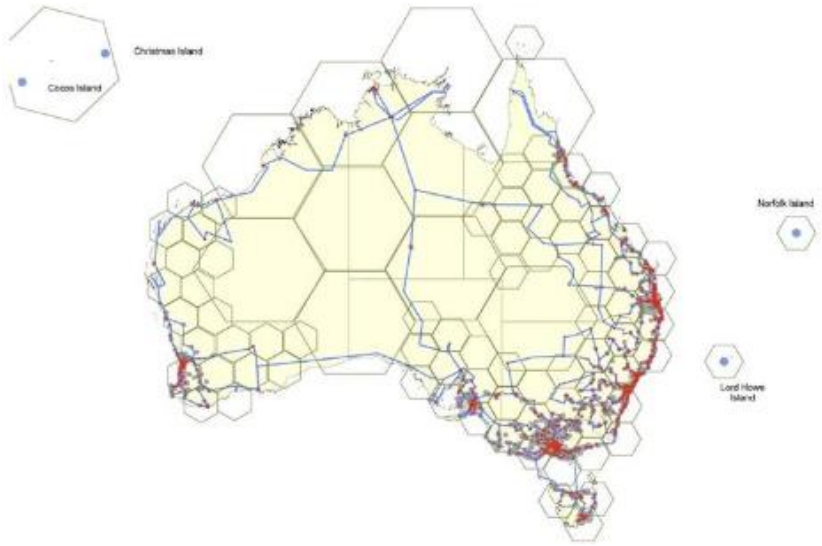
Figure 14: Connectivity and bandwidth plan for Australia

	REVISED OUTLOOK: LABOR NBN	MULTI-TECHNOLOGY MIX NBN
Year Completed	**2024**	**2020**
Fibre to Premise	100%	26%
Fibre to Node	0%	44%
HFC	0%	30%
25Mb/sec by 2016	22%	43%
50Mb/sec by 2019	57%	91%
100Mb/sec by 2019	57%	65-75%
Revenues 2011-2021	$10 billion	$18 billion
Capex to Complete	$56 billion	$30 billion
Funding Required	**$73 billion**	**$41 billion**

Source: www.delimiter.com.au

Regardless of the political arguments between parties as to the finer details of the fibre infrastructure for the majority of Australians, the reality for regional Australia is that seven percent of the Australian population will have no fibre connectivity, and will rely on inferior wireless or satellite. The following map depicts the coverage that Australia can expect with the modified NBN rollout. The red dots depict fibre to home deployments, blue lines are fibre backhaul, grey dots are wireless coverage and the hexagons highlight satellite coverage.

Figure 15: Coverage for Australians under the National Broadband Network



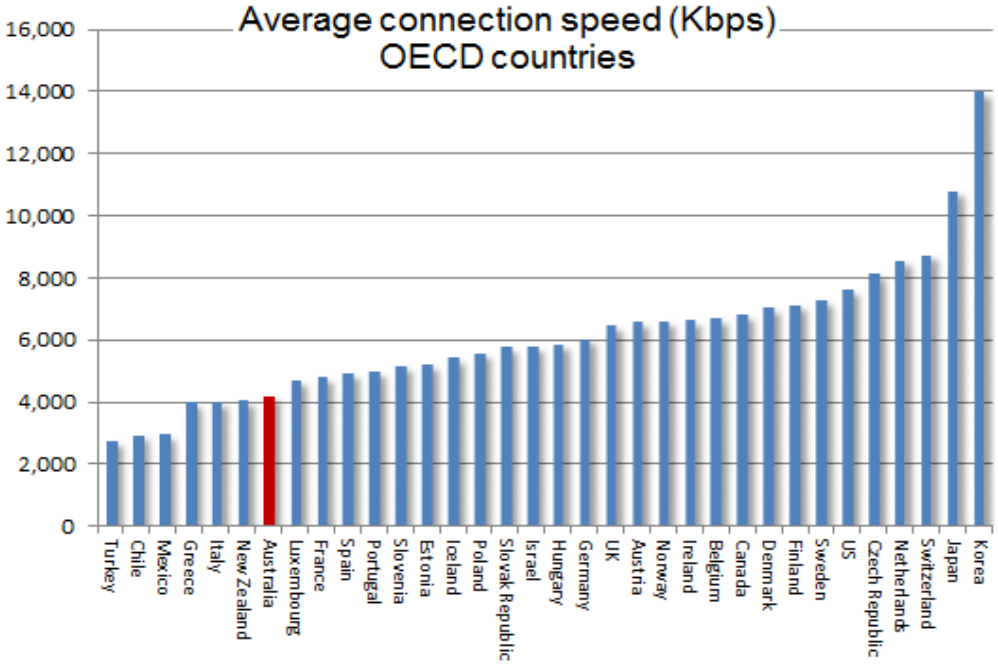
Source: www.nbnexplained.org/wordpress/what-will-it-deliver

One NBN rollout milestone is to achieve a minimum of 12 megabytes per second for every Australian family and business, with the aim of 65-75% of Australia having 100 Mbps by 2019. However, the uncertainty of broadband coverage in a small Australian rural agribusiness market is a major impediment to investment in development and commercialisation of tools that could assist in the critical art of analytics. The risk of a lack of commercial investment in new technology and analytic tools could lead to a situation where Australian farmers become uncompetitive and unresponsive to risk management on the world stage.

The renowned '*Akamai State of the Internet Quarterly Report*' has identified where Australia is placed with regard to internet speed and connectivity within the OECD countries (Figure 16). The report highlights the need for Australia to maintain investment in bandwidth connectivity in order to participate in the technological revolution that is occurring (Dobbie, 2014). A lapse in critical infrastructure investment will result in Australia, and more critically

rural Australia, not having the luxury of fibre. Instead, they will be relying on wireless and satellite, becoming uncompetitive in adopting and managing cloud-based tools for analytical purposes and be at risk of not being able to manage business risks and opportunities effectively.

Figure 16: Ranking of internet connectivity of OECD countries, Quarter 4, 2012



Source: www.zdnet.com/australian-broadband-speeds-slow-akamai-report

A connectivity solution may be driven by global competition and the need for social media giants to procure new markets. Facebook and Google plan to place unmanned drones, powered by the sun and the size of a Boeing 747 at between 18200 to 27400 metres above the earth to service two-thirds of the world which cannot access the internet. Facebook hopes to have commercial drones, providing free internet to the world, operational by the end of 2015 (Wired, 2014).

Information on how the drone will provide internet globally was not revealed, however if rural Australia is in a position to receive this internet connectivity in 2015, it will assist the agri-industry in remaining competitive with access to the range of cloud-based tools and applications available.

Figure 17 Facebook internet connection concept using drones

Source:www.dailymail.co.uk/sciencetech/article-2773578/Facebook-s-internet-providing-drones

2.2 Facilitating strategic relationships and sharing information platforms

- Adoption and extension – now that's the challenge ...
- Disruptive innovation in the agri-industry… it needs to happen
- Social communities in sharing the problem

"Here's to the crazy ones. The misfits. The rebels. The troublemakers. The round pegs in the square holes. The ones who see things differently. They're not fond of rules. And they have no respect for the status quo. You can quote them, disagree with them, glorify or vilify them. About the only thing you can't do is ignore them. Because they change things. They push the human race forward. And while some may see them as the crazy ones, we see genius. Because the people who are crazy enough to think they can change the world are the ones who do." Steve Jobs

Real-time management tools exist in various forms, and at various costs to the producer, but there appear to be business concerns around:

1. Proprietary intellectual property
2. Apprehension over the ownership of data platforms/standards.

When searching for the answer to promotion and adoption of analytics leading on to increasing business profitability, and contributing to the looming potential crisis of feeding and resourcing a growing population, this report now has a second premise: 'How to get commercially-focused industries working together for a solution to all of the questions raised?'

Perhaps the answer to these questions and a possible solution is delivered by Hilary Cottam (2012). Global issues, such as climate change, prevention and management of chronic illnesses, and the ever-important food security issue "*requires the pooling of diverse types of knowledge and resources and harnessing the motivation of billions of individuals and their communities. Participatory systems harness the new technology at our fingertips to tackle 21st century challenges, encouraging us to ask, not 'what is wrong with our current institutions and how can we reform them?' But rather, 'what collective capabilities and knowledge do we have and how can we harness them?'.*" (Cottam, 2012).

A participatory system will engage the agri-industry and the global community as a whole with a sense of urgency to address the potential impending food and resource crisis. It will bring together the brightest minds, the most innovative creators of computer technology and people who understand how to "push" data to the agribusiness/manager. This would enable the agri-manager, who now exists in the fast-paced world in which society operates with an ever-increasing demand for efficiencies of productive time, to be the beneficiary of technology that will ease the burden of data inputting and allow the manager to participate in analysis to increase production and profitability.

In keeping with Steve Jobs' quote, and taking on-board the theory behind a participatory system, maybe it is time for someone outside the industry with no preconceptions to cast their skills over current tools and analytical systems to create a reference framework. Development of a new framework must consider that:

- Instead of collecting data and inputting it into an established software tool, it engages the capacity of critical business analytics and thinks laterally, and uses the innovative, emerging tools that are becoming affordable in our society.
- It could be time to think differently about how data and knowledge is delivered to the producer by taking the data processing from an output situation to an input

management system. This would mean information and prompts come to the agri-manager, releasing them of the need to seek information which makes them more time efficient.

- Existing systems need to factor in analytics that improve agri-management, new agri tools and other agri-research in this field. New systems must include lessons learned from tools already developed, global participation, and global data standards of established powerhouse cloud-based companies such as Google, Facebook or Apple. Knowledge gained through this process must be shared in the interests of corporate social responsibility and the collective need to feed the world.

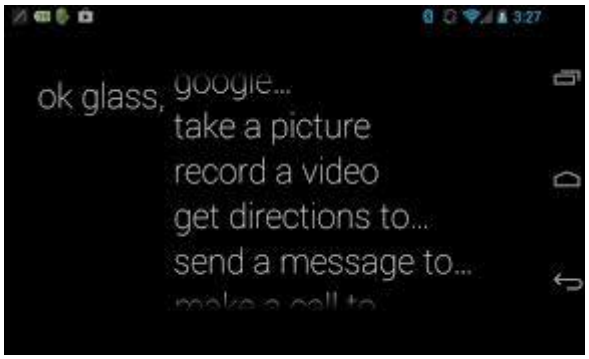
Indicative research and supporting anecdotal evidence gives rise to the need for a new streamlined data delivery method to the agri-manager. As previously discussed, given the new era of innovative technology tools and hardware, driving a collaborative and participatory system would fast-track an extension and adoption revolution. However, this depends on technology that will bring together all the best parts of analytics.

One of the innovative tools that would help drive an integrated system is *'Siri'*. This is a voice recognition tool that allows users to search, access basic information such as addresses and maps, and direct the phone or computer to search and connect with an address or telephone number without the need of traditional scroll and search with vision and hands. *Siri* is the technology that started to push the boundaries of information reach beyond the traditional model of view and touch/feel access inherent in many smart phones and tablets..

Another product that is pre-commercialisation which may forever change our traditional search and record paradigms is '*Google Glasses'* (Figure 18). It uses all senses in physically inputting data into a software program, to allowing the user to "push" or "retrieve" data hands-free.

This revolutionary new product was expected to be launched by Google in 2014 and was thought to retail for about $A1700. Recently Google announced a halt in producing the Google Glass prototype, however they have confirmed their commitment to the continual development of the product.

Figure 18: Google Glasses



Source: www.techradar.com/au/news/video/google-glass-what-you-need-to-know

The glasses respond to voice commands and gives visual information via the prism located over the right eye, relieving the user of the need to find information in traditional ways of punching data and/or requests into a static tablet phone or computer. This requires the operator to stop tasks to focus solely on the screen, head down opening a program or a window and inputting data in the traditional written manner.

Imagine if the brightest minds that have developed Google Glasses can combine with real-time agriculture tools and a voice command to a task list as follows:

"OK glass, google and input ….

- Scan and estimate crop nutrition

- Scan chemical barcode and add into real-time management tool information - '1 litre per hectare for all paddocks going into wheat'

- An estimation of soil moisture

- Tell me what the wheat swap prices are currently and input price into the marketing strategy tool".

Or ... "*OK glass, google and report:*

- *What are the crop conditions currently in Ukraine?*
- *Locate these map coordinates and advise the wind speed and other spraying conditions*
- *Report on sheep numbers in last month's sales and average prices."*

Some of these information requests, or pushing data to an analytic tool, can already be accessed and inputted from a laptop, tablet or smart phone with data connectivity. However the fact remains that for the busy producer, the time spent looking at a tool and not being physically productive leads to some excellent analytic data tools not being used to their full capacity.

A second review of survey answers from the 113 local agribusiness respondents, reveal the final question regarding Google Glasses (Figure 19).

Figure 19: Survey with additional question on Google Glasses

Question	Strongly Agree	Agree	Disagree	Strongly Disagree
Having been given a definition of analytics do you believe analytics will benefit your business?	82%	17%	1%	
Would you take on an analytic tool and input data yourself?	27%	39%	23%	11%
Would you take on an analytic tool if your agronomist input the data?	69%	27%	4%	

Are you concerned about retail agronomists inputting their recommendations without your management input, ie what is input as a recommendation is adopted without management comparisons (price of inputs etc)?	93%	4%	2%	1%
Is increasing pressure on production work time the biggest factor in stopping you inputting data?	72%	19%	9%	
Having been shown "Google Glasses" and the functionality explained would you be more likely to operate and manage an analytical tool if you could push data and receive data hands-free and view it visually?	77%	21%	2%	

When shown the emerging technology, such as Google Glasses, the respondents were extremely interested in where this technology could be positioned within the management practices of the business.

Foreseeably, current analytical tools could use the Google Glasses technology and create their own glasses to "push" data to their tools and for the user to receive data hands free, enabling them to continue physically working.

Hence, to allow this brilliant technology to be active and used to best effect worldwide, and linking it to the impending food and resource crisis that is emerging, the only real solution is for "disruptive innovation". This is described as: *"An innovation that helps create a new market and value network, and eventually goes on to disrupt an existing market and value network (over a few years or decades), displacing an earlier technology. The term is used in business and technology literature to describe innovations that improve a product or service in ways that the market does not expect, typically first by designing for a different set of consumers in a new market and later by lowering prices in the existing market." (*Wikepedia April 2013*).*

Disruptive innovation solutions need to be linked with a sense of urgency to the new, innovative, agribusiness analytical tools on the market.

Is it possible that all major providers of the technology could link together and work collaboratively in a participatory manner? Possibly not, as the ethos of mainstream global

businesses is generally about the “triple bottom line” and is a powerful mantra in our society. However, the power of the people, their social responsibility and ethical consciousness that is emerging with every click through social media could influence the power-brokers of the business world to come together to address a global crisis of how to feed the world using the collective might of social technology feeding into agricultural analytics.

If analytics can be the next ‘revolution’ for increased profitability and production sustainability, and to bring together innovative tools to the agri-management system in a socially responsible manner, then it will need to be driven by the social force of people to ensure links between all parties start to occur for the long-term benefit of the world population. As referred to earlier in this report, the natural forces of exponentiation will drive the forces of collaboration together (Diamandis & Kotler, 2012). However, 200 billion apps and numerous cloud systems are currently on the technology market yet there are less than 50 worthwhile agri-management tools available. Therefore, at this point in time, it is fair to assume that the theory of technology exponentiation will not be the driver linking cloud-based technology and agricultural analytics. Rather it is more likely to be the force of social responsibility and a crisis of feeding people that will bring together the mighty force of technology giants and ‘disrupt’ innovation and technology for the greater good of increasing food production.

Currently, a number of the analytical tools that are on the market have established distribution channels, generally through their retail suppliers and staff agronomists. This allows the producer to work with their agronomists and take on board their recommendations.

However there is scepticism by some:

- Queries on where their data is being distributed and who may be viewing the individual and industry collective data.

- A lack of connection with some of the recommendations when it is delivered to them via the analytic tools and lack of management thinking and input.

- Terms and conditions on the use of the tools; for example if the user wishes to exit the analytic tool subscription, can the collective paddock and other data be taken in a raw form

and available for viewing in Excel? As there are no common datasets being shared and used in the agricultural industry currently then Excel is possibly the only method of taking raw data if an annual subscription is not renewed.

The response from the providers of the tools has been to be transparent about the terms and conditions of use, data storage, and access to the data if required. It really has to be the responsibility of the purchaser of the tools to ensure that data and information is not being on-forwarded and that the data will be able to be retrieved if the subscription is terminated. The landscape of business information ownership and access has suddenly changed with these cloud-based information and analytical tools capturing business information on their servers, and it is not being solely captured and stored on an individual business computer hard drive.

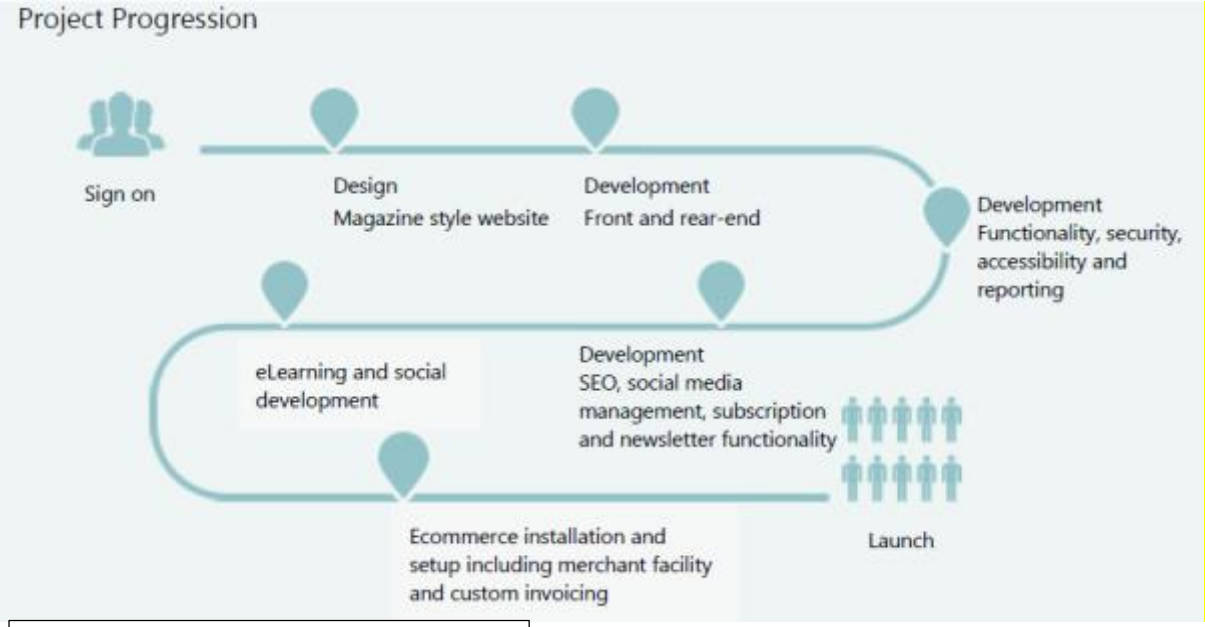
While these analytical tools have delivered a bright new vision of the world of farming and real-time decision-making, there are some management, ownership and access questions that a business needs to review and confirm when choosing an analytical tool for the business.

Another emerging possibility for business management is purpose-designed website platforms. Many forward-thinking businesses are creating their own website platforms to deliver cutting edge data collection and decision-making. The cost of websites and other cloud management platforms has been driven down to a price point where it is feasible that individual agribusinesses develop their own sophisticated management systems targeted to their needs. This could become a viable option in managing the data and analytics of the business, and easy information sharing between the management team.

For example, an investment of less than $4,000 enables a business to design a secure, interactive, cloud-based web page that can incorporate operational procedures, ordering procedures, staff management and analytics. This platform can incorporate videos, links to other cloud-based applications and information such as marketing, pricing and sales analysis.

The potential of the platform is only limited by the imagination of the designer, which is why it is important that developing an interactive web-based business platform must be driven from the agri-management team to deliver the specific outcomes required. Figure 20 depicts the process in designing a web platform.

Figure 20: Designing a business management platform using current technologies available such as social media, e-learning and other complementary analysis tools.



Source: Eldredge and Associates design quote received

A carefully designed web platform that can link into complementary systems will negate some of the issues previously discussed around large global companies managing and accessing agribusiness data, enabling the retailer to dictate to the producer.

While not directly attributed to agribusiness analytics, there are other emerging technologies involving low-cost technology hardware that could assist in managing production decision-making in the future. The hardware is:

1. GoPro camera
2. Small robotic helicopters (commonly known as drones)
3. Hand-held GreenSeeker
4. 3D printers

This hardware costs less than $A1,000 each to buy and gives some further perspective of what is happening in our production environment. For example, a drone with a GoPro camera can hover above established crops and give a perspective of growing conditions and a crop's strengths and weaknesses. If the GreenSeeker could be attached to the drone and data fed back on crop health and nutrition in an efficient and expedient manner, then real-time decisions, such as fertilising and spraying, could be made with this low-cost hardware. In the

near future, it is possible a drone with a camera could be piloted from hundreds of kilometres away, via a computer that would enable remote checking of livestock, water and crops, creating efficiencies in time and production management.

Figure 21: From top left, a hand-held Trimble GreenSeeker, GoPro camera and helicopter drone, a user wearing 'fat shark" goggles to navigate the drone in real-time vision, anunmanned drone spraying a crop and a 3D printer

Unmanned spraying drones have been used for 20 years in Japan and there were about 2,300 unmanned drones in Japan in 2010 for spraying herbicides over rice crops (Wired Technology, 2014). This limited human pilot vulnerability and allowed for increased efficacy of the chemical onto the crop.

The emergence of 3D printing has excited the business world with the possibility of printing spare parts and specifically designed implements. This technology will revolutionise agribusiness in future through its ability to easily engage with computer-assisted design. It has potential to change the face of manufacturing globally and cause a revolution of its own as the low-cost technology is rapidly adopted.

This will deliver real-time, innovative, competitive advantages for Australian agribusiness in driving down the cost of repairs and maintenance, along with ease of in house manufacturing alleviating somewhat the tyranny of distance in a global world of spare part distribution channels.

Conclusion

Chapter 1 highlighted the need for the global population to undertake a stocktake on the world's finite resources and review current production systems, along with participating in creating a new 'revolution' in the agri-sector to increase future profitability and production sustainability. This report also briefly touched on the declining terms of trade for Australian farmers and plateauing of production globally in wheat and other staple grains. This Nuffield project was explained in detail and the effort in exploring the world to determine the main suppliers of apps and cloud-based tools that have the potential to become an important part of the management cycle. Details of the countries visited and the lack of interest in creating agribusiness analytic tools on a global basis was evident, except for USA, Australia and, to a lesser extent, New Zealand and Canada. The view of business academics globally is that analytics can give up to a 20% increase in profitability per annum in any well-managed business. However research into analytics in agribusinesses in Australia was lacking. The chapter concluded with reviewing some of the common terminology embedded around this new technology and introducing the academic tool through which a range of new, low-cost, cloud-based tools were measured.

Chapter 2 reviewed the tools that had been found while travelling and some that have emerged since the last study trip, and these tools were scored to compare different platforms and knowledge innovation. The tool that came through as having the potential for being a 'game changer' for Australian agribusiness was ProductionWise, as it assisted in mitigating business risk with nine month rainfall prediction, APSIM yield predictions and soil moisture measurement. Software from AgWorld and SST scored well, however, while being considered worthy data collection tools, they lacked ProductionWise's innovative edge in agri-management modelling. An explanation of global domination of multi-national companies and their interest in these analytical platforms, with offerings of consumer purchases into their platforms could potentially create a locked-in system where the large multi-nationals can create a wealth of data information. This is collected from the data the producer is inputting and potentially creates a dependence upon their systems and products going forward, as well as data information on the production issues and opportunities arising could benefit the multinational company in their selling and positioning of products.

The report questioned the lack of analytics in the Australian agri-management system. Various surveys showed a strong interest in the analytic process, but still a lack of adoption is evident. The complicated link between apps and cloud-based tools being pushed from just social community use into management application was explored, and it emerged that a participatory approach between social media giants and agriculture would bring forward the best collaborative chance of change in adoption. The largest impediment to adoption is managers taking the time to record the data for analysing at a later date.

Peter Diamandis' theory of exponentiation is not producing the rapid expansion of agribusiness cloud-based tools or subsequent innovation to solve the impending food security crisis (Diamandis & Kotler, 2012). Therefore, the study has clearly identified that a participatory approach with social communities sharing the problem of feeding the world is the pathway forward at this point. The industry appears to need a common data-sharing platform that could integrate emerging and new technologies, such as Google Glasses, into the management system, where physical work could continue while data is being pushed via voice response to and from the cloud-based programs and platforms. This appears to be an obvious solution, however, it would require a substantial amount of goodwill from the social media 'giants' in developing across platforms and technology to service, what is currently, a small agri-industry. The report contends that this is unlikely to occur until such a time as there is a food crisis and the threat of developed countries being short of food creates a 'new revolution' of agribusiness analytics.

There is some hope that the natural forces of product competition may give rise to producers of cloud-based platforms being able to take the technology that will emerge with Google Glasses and replicate it into their product. For example, cloud-based technology will come with its own set of glasses that will link specifically with the individual product and allow data inputting to commence and information to be received in real time, while continuing to work hands-free.

This report has, however, highlighted the need for bandwidth connectivity to be a priority in that the infrastructure must be substantial enough to drive current and future real-time, cloud-based tools. In travelling around Australia and examining and assessing the apps and cloud-based tools available out in the paddock, there was evidence of frustration concerning

the connectivity ‘black holes’, which has led to many producers not even considering cloud-based tools as part of their management decision-making. For Australian agriculture to remain competitive and profitable in the future, both political parties must acknowledge the importance of bandwidth and connectivity in rural and regional areas and invest in infrastructure to support agribusinesses and families in adopting and adapting with technological change.

Recommendations

The key findings from the report are:

1. The responsibility of data collection and analytics must remain with the agribusiness to allow all the parties within the business to develop an understanding of the importance of risk mitigation and opportunity gathering through analytics.
2. Urgent collaboration is needed to bring a common data platform to the agri-industry for the benefit of agribusinesses and to negate replication of data inputting.
3. An agribusiness “needs analysis” process needs to be undertaken to determine where risk lies and what analytical tools will assist in mitigating risk.
4. Review the terms and conditions of the tools and determine if the business and industry data is being collated and “on sold” as market research to multinationals and/or other agri-providers.
5. Large multinational companies are using the benefit of innovative technology and analytics collected in real-time by their machinery and associated software to create a sales culture of dependence upon their products and ongoing access to previously collected business data and analytics, effectively locking producers into their products and services. The lockdown of data and analytics within large multinational companies products and services needs to be managed and risk mitigated.
6. Agribusinesses need to consider investing in their own web-based business platform. As the capital cost of these platforms significantly reduces, this whole-of-business approach to management will drive increased efficiencies and manage future risk in a very relevant, real time manner.
7. Education of the agri-manager in analytics needs to continue, however clearly the traditional method of training and workshops is not bringing results with the lack of adoption of analytic tools and management methodology.
8. Given the statistics on the growth of apps (50-70 billion were downloaded in 2013) and other innovation tools in the market, there is becoming a need for independent consultancy advice to tailor apps and cloud systems to the business requirements.

9. Agri-managers need to be aware of the raft of new, low cost technology products such as drones and 3D printing that will bring a new wave of management decision making and production cost efficiencies for Australian agribusiness.
10. Understanding the impending global food and resource crisis and the enormous benefit tools can deliver in increasing production and reducing input costs, social and philanthropic leadership needs to bring together the best analytic tools and computer hardware in a participatory manner to assist with maintaining and increasing agricultural production.
11. A whole-of-industry promotional campaign is needed to outline what these tools can bring to a business and the benefit and added profitability that is achievable.
12. There is an urgent need to build more bandwidth and connectivity into rural and regional Australia to remove 'black holes' experienced when tools were accessed in the field. It is unsure at this point in time if the Facebook and Google participatory approach of providing commercial drones 18200 to 27400 metres about the earth with Wi-Fi will reach rural Australia and provide a much needed connectivity solution.
13. There is an outstanding opportunity to bring together the whole community on creating an analytic solution. With the new age of apps and cloud technology often the domain of the young, who have the time to explore what technology can offer, there may be an opportunity to bring country, city and generations closer to develop a mentoring and participatory culture.

Appendices

1. Useful agricultural websites

www.ag.ndsu.edu

www.agdata.com.au

www.agchat.org

www.agrecord.co.nz

www.agresource.com

www.agriapps.com

www.agridata.co.uk

www.agrimarketing.com

www.agrolife.net

www.agstudio.com

www.agjunction.com

www.agworld.com.au

www.angel.co/fall-line-capital.com

www.backpaddock.com.au

www.beyondagronomy.com

www.bluerivert.com

www.dynagra.com

www.canadianbusinessexecutive.com

www.cffm.umn.edu.com

www.croplife.com

www.cropnation.com

www.DTN/the progressivefarmer.com

www.economywatch.com

www.farmdoc.illinois.edu

www.farmindustrynews.com

www.farmz.com.au

www.farm-mgmt.wsu.edu

www.farmwizard.com

www.fmc-gac.com

www.gatesfoundation.org

www.grdc.com.au

www.ipipotash.org

www.johndeere/mobilefarmmanager.com

www.kickstarter.com

www.monsanto.com

www.mitchellfarm.com

www.muddyboots.com

www.plan2profitagri.com.au

www.precisiondecisions.co.uk

www.productionwise.com.au

www.popherald.com

www.realagriculture.com

www.nowlin.css.msu.edu

www.sstsoftware.com

www.trimble.com

www.theuavguy.wordpress.com

www.web.cals.uidaho.edu.com

www.willyweather.com

www.wirelessfarmer.com

www.zedxinc.com

YouTube:

www.ted.com (The Earth is full – Paul Gilding)

www.ted.com (How cognitive surplus will change the world – Clay Shirky)

www.ted.com (How to fight desertification and reverse climate change – Allan Savory)

www.ted.com (Let the environment guide our development – Johan Rockstrom)

www.ted.com (The thrilling potential of Sixth Sense technology – Pranaz Mistry)

www.ted.com (The other inconvenient truth – Johnathon Foley)

www.ted.com (Photos that changed the world – Jonathon Klein)

www.ted.com (Welcome to the age of the industrial internet – Marco Annunziata)

www.ted.com (Let's prepare for our new climate – Vicki Arroyo)

www.ted.com (The global food waste scandal – Tristam Stuart)

www.ted.com (The generation that's remaking China – Yang Lan)

www.ted.com (The new power of collaboration – Howard Rheingold)

www.ted.com (Bring on the learning revolution – Ken Robinson)

www.ted.com (Teaching design for change – Emily Pilloton)

www.ted.com (Technology's epic story – Kevin Kelly)

www.ted.com (Innovating to zero! – Bill Gates)

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Plain English Compendium Summary

Project Title:	**Using low-cost, cloud based technology to assist with innovation and efficiencies in agriculture**
Nuffield Australia Project No.:	1216
Scholar:	Linda Eldredge
Organisation	Eldredge and Associates Pty Ltd
Phone Number	0428 832167
Email	linda@eldredgeandassociates.com.au
Objectives	To gain insight into commercially available cloud based analytical tools and to evaluate their value to Australian agri-businesses with regard to increased production, cost efficiencies and growing whole of business profitability. These tools are reviewed and the apparent lack of adoption of decision support analytics is explored with regard to barriers to adoption and implementation of analytics.
Background	Australian farmers are renowned for their innovation drive in their quest for increased production output. However the art of analytics has not been prioritised in the agri-business, with attempts to collect data not being sustained or consistent and therefore not being of value to the business decision making processes. With Australian farmers facing a decline in their terms of trade and a world demanding more food and energy, there does appear to be a place for analytics in agriculture with evidence of a 10-20% increase in profitability in businesses that undertake the collection and analysis of data as part of their management culture.
Research	Research involved multiple trips around the world and looking within at what was currently available specifically for agri-businesses and what was becoming available in a cloud based form, but also what could be complimentary technology in the social media world and other industry that could assist with adoption of analytics.
Outcomes	Increased efficiencies in knowledge management and real time decision making “in the paddock”. Resulting in maximising per unit returns whilst managing the variable and capital costs of the business. Cloud based analytics will be revolutionary for the manager who is seeking immediate, real time knowledge and making decisions on the go.
Implications	Australian agri-businesses are struggling to maintain profitability and they risk losing the art of innovation due to the lack of cash and capital investment. This could quickly place Australian agri-business in a high risk category if sufficient capital is not available in the business to invest in production innovation and output.
Publications	Findings have been presented at various conferences and in the rural press.