final report

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Prepared by: Mark Gardner

Vanguard Business Services

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Meat & Livestock Australia Limited
Locked Bag 991
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On-farm demonstration of the installation and use of remote monitoring of stock water

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Table of contents

Abstract

The trial showed that telemetry is a viable cost saving technology, from both a practical "does it work" perspective, as well as having a short payback period (short time to break even on the investment).

It can also create significant time savings, allowing producers to spend time on more productive activities. There is also an enhanced "sleepability at night" factor as water can be checked on a smart phone wherever mobile coverage is.

Alarms can be set, so that if water levels fall below early warning monitoring point, a text message can be sent to a number of designated phones. The portable camera allowed stock to be monitored "real time" without driving out to see them.

The trial had significant producer involvement, and thanks to the Harvey family for hosting three field days to examine the technology being used in a large scale commercial setting.

Executive summary

A big challenge identified by the group of producers was on farm stock water supply over the last 10 years. Variable rainfall has meant that stock water has become a major limiting factor to sheep/beef production and stock numbers being able to be maintained.

This project sought to develop an on farm demonstration of the commercial installation and use of remote monitoring of stock water. It gathered information to be able to help assess the economic and other costs and benefits. Until now, there were no demonstration sites in the Central West of NSW for this technology.

The trial showed that while the technology was fairly robust, the landholders needed time to develop trust in the system. As confidence was gained in the system, less physical checks were made, and savings in time and vehicle costs became substantial. The usefulness of the telemetry was dependant on how much the technology could be trusted to provide the early warning monitoring required.

Allowing for wages, fuel costs and vehicle wear and tear, the payback period was less than one year. The intangible benefits include the ability to leave the farm and be *confident* that stock water is adequate, through the ability to check this on a smart phone; while at meetings, field days or time off. Like most technology, it is not problem free 100% of the time. However problems seem to be relatively easily solved via phone, or with a couriered spare part.

Background

A big challenge identified by the group of producers was on farm stock water supply over the last 10 years. Variable rainfall has meant that stock water has become a major limiting factor to sheep/beef production and stock numbers being able to maintained. Many group members have surface water, supplemented by bores. The checking of stock water is a time consuming and costly job (and running low on stock water is very stressful).

Phil Whitton from Observant Technologies spoke at the BESTPRAC Innovation Forum in Dubbo in 2009, where the concept of remote monitoring was introduced to the group, and was further consulted on this project through the application process for funding and implementation of the project.

This project sought to develop an on farm demonstration of the commercial installation and use of remote monitoring of stock water. It gathered information to be able to help assess the economic and other costs and benefits. Until now, there were no demonstration sites in the Central West of NSW for this technology.

This trial documented the costs of installation, identified potential issues and challenges, and sought to monitor the impact of the technology on the costs and time savings on *one group member's property.* It also assessed the practicality of the technology in hilly and timbered areas and where mobile services were not available.

Photo showing the undulating country on The Gilgais, with typically hilly timbered country in the background.

Telemetry – what is it?

Telemetry is the technology that allows the measurement and reporting of information from a remote location. Telemetry most commonly utilises the wireless transfer of data (eg radio or UHF systems) however, also includes data transferred via other media such as a telephone or computer network.

In agriculture, telemetry is most widely used in the transmission of weather data – air temperature, humidity, precipitation and leaf wetness, solar radiation, wind speed and sometimes soil moisture. These are all crucial factors related to the successful growing of dryland - especially irrigated crops.

Telemetry has also become an integral part of the monitoring and management of large water systems – eg Council water systems, Irrigation Schemes, sewerage treatment works, etc. This large scale management of water using telemetry has developed into a very practical application for the smaller end users - graziers.
The remote monitoring of water tanks, troughs and pipes in a grazing application is expanding – most commonly in the widely settled, pastoral regions where distances from home base to water points are enormous.

This project trialled the use of a range of telemetry technology in a difficult terrain.

Why consider it?

Remote monitoring technologies have saved Australian producers hundreds of thousands of dollars over the past few years. This technology helps reduce labour and fuel costs and protect livestock investment and their welfare. This technology allows producers to continually be up to date about the state of their livestock water, to learn about problems faster, and assure themselves that stock water levels are where they should be.

It helps a Producer to improve their "Sleepability at night" through early warning monitoring of a range of problems, before they become catastrophic.

How does Telemetry work?

The technology works by gathering still-camera vision of water points, water level sensing of stock water tanks and the automated operation of pumps. This information is all relayed back to a remote base that makes the data available to both iphone and iPAD as well as PC via a web based server interface managed by Observant. Data being transferred can be measurements of tank water depth, a start/stop signal for a pump, a range of weather data or a real time photo.

"We've now got a roving camera that follows the mob, so we're saving a trip to those troughs as well – that's another 30 km round trip we're not making every day. I can see via remote that there are no leaks and everything is watering OK." Eric Harvey.

The managed system looks like:

The Paddock is in your pocket

The Observant iPhone application means the Observant system could be monitored from wherever there is phone coverage. At this stage the app required is compatible with apple only. It is a free download from the iTunes store. It has the following features:

- The simple to use interface gives property managers a complete view of their Observant remote monitoring system – view water levels, flow rates, pump data, weather data and camera images.
- Current or historical data is really easy to view via simple buttons to press
- It means that producers can stay mobile and remain flexible without losing touch with the farm situation via IPhone or IPad app.

The Observant iPhone app works as part of Observant Managed Services. Data is updated automatically, so you always have up-to-date information anywhere there is mobile phone coverage.

About the system being demonstrated

Stock water is supplied by 101 dams and three bores at Gilgai Farms. One of the three pumps is solar powered, the others run on diesel. Some 44 kilometres of pipeline feeds water to 94 watering points. The rolling land, with drops of up to 84 metres, had presented a challenge for the water engineer in designing the initial watering system.

This was a large operation with limited mobile coverage in some areas. Observant C2 units were retro-fitted to the existing pump system, as well as the tanks, camera and three rain gauges. Using Observant's technology, a UHF signal linked the units back to a mobile station located on a high point, and equipped with a Modem.

The trial was enhanced by the provision via sponsorship of an iPAD which allowed real time water data to be readily assessed from any location having mobile phone (and hence internet) coverage. While the iPhone worked fine, the larger screen size of the iPAD made a big difference. The combination of telemetry, web based solutions, iPhone/iPAD monitoring created a powerful early warning monitoring system.

"Luke monitors from his phone every morning. He might need to top up a pump with diesel fuel once a week or once a fortnight. So that's only about half an hour a week." Eric Harvey.

What does it cost to purchase?

Each Telemetry site has a custom built monitoring system taking into account terrain, number of tanks/outlets to be monitored, distance between installations and features required (such as cameras, weather stations and remote pump stop/start).

This trial utilised a full range of features in order to test the capacity of a range of telemetry devices to work in hilly country, it therefore cost more than a basic water monitoring only set up.

The cost of this trial set up was some **$21 000,** allowing the full range of monitoring on a number of water systems, cameras, weather stations and remote pump stop/start on a large property aggregation. Lower cost systems are definitely possible, and a basic water monitoring system could be established for far less than this trial.

In this trial the cost of the technology was spread over a three year period via a Business Lease negotiated through RIVWEST Finance, Dubbo. This is a commercially available option. From a practical perspective leasing the technology is a good way to reduce the upfront costs. Other producers may choose to purchase outright.

Costs to install will differ depending on the system which has been designed and installed. Some producers may want a top of the range system, some may choose a very basic system and this decision will obviously affect the cost and consequently the time it takes to pay for itself.

The actual component's that made up the system installed in the trial is given below:

Component	**Cost ($) (inc GST)**
Port adapter cable	343.2
Whip Antenna	448.8
observant Level Sensor	1801.8
Observant C2 power units	2805
Observant C2E power units	6435
Digital still image camera	918.5
3G data modem	918.5
3G modem field antenna	138.6
integrated power and data cable	33
Engine controller	1313.4
Solar Power kit	389.4
Annual subscription to 3G carrier network	511.5
Wiring harness	145.2
Installation	4400
Freight	473
	21074.9

Economic returns

A "payback" calculator was constructed in Excel, that allowed producers to calculate the breakeven payback period (defined as the time taken to accrue savings in order to cover capital costs) of an investment into Telemetry.

The payback (breakeven period), being a function of the total Capital Purchase cost, distance travelled to check water (km) and the number if times waters were checked over a year (hrs). The payback period was closely related to the number of times that waters were checked, as a backup to the real time Telemetry reports; the "trust factor".

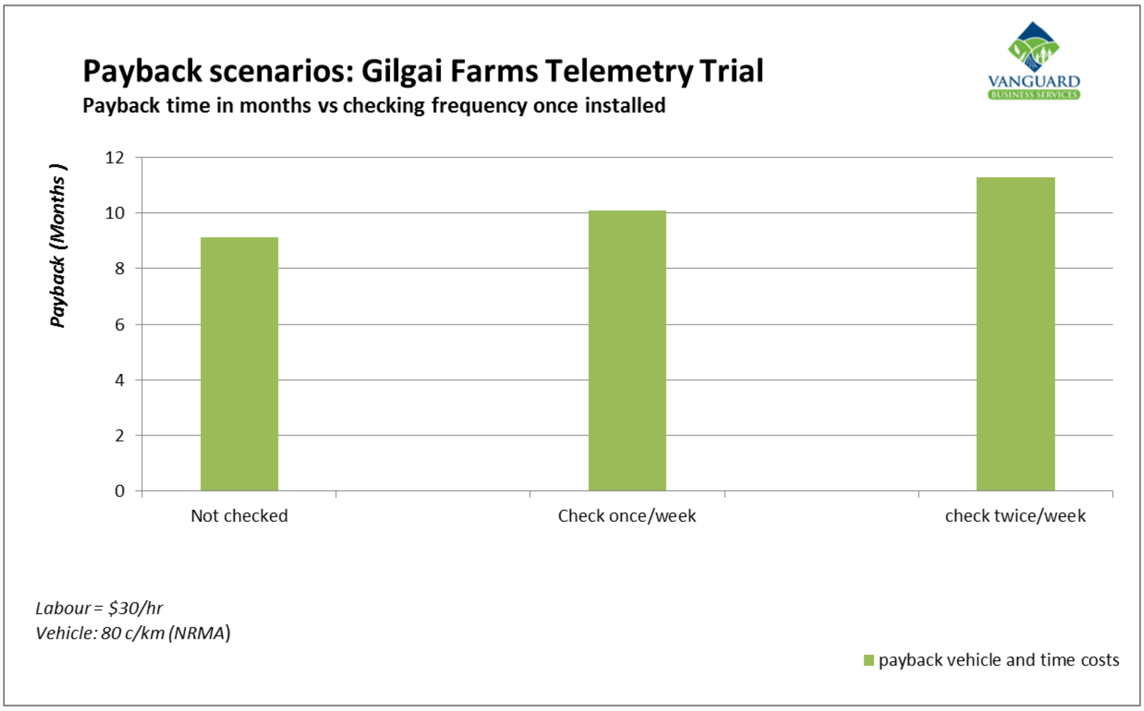
The trial showed that while the technology was fairly robust, the landholders needed time to develop trust in the system. As confidence was gained in the system, less physical checks were made, and savings in time and vehicle costs became substantial. The usefulness of the telemetry was dependant on how much the technology could be trusted to provide the early warning monitoring required.

The "payback" calculator is an easy way to calculate the payback period for each producer's unique situation, and to do some budgeting prior to purchase.

The graph below shows the payback period for the trial, modelled across a number of checking frequencies. As can be seen the shorter payback period (higher financial returns) was achieved when less checking was undertaken.

The cost of labour ($30/hr) and vehicle (NRMA km rates) was included.

The overall result was that for the demonstation, a payback period of less than one year (12 months) was measured (including labour and vehicle costs). This shows the technology is very cost effective.



Adding up the cost savings

Gilgai Farms captured data to calculate the payback period for the technology. Allowing for wages, fuel costs and vehicle wear and tear, the payback period was less than one year. This has also saved around 12 hours per week (assuming 26 physical checks per year).

Gilgai Farms can now:

- Save up to 12 hours a week on water runs, or almost two working days
- Visually check on livestock and troughs with four camera images a day – saving an additional 30 km trip every day
- Capture data on rainfall and water usage
- Identify and fix leaks immediately,

"This remote monitoring will pay for itself within the first year besides providing an early warning system regarding our livestock watering system and our 'peace of mind'. Eric Harvey

Social Benefits: Increasing peace of mind

Apart from the economic gains, there have been significant "peace of mind" benefits that are difficult to quantify, however they are important to identify.

Some of these intangible benefits include:

- Ability to leave the farm and be *confident* that stock water is adequate, through the ability to check this on a smart phone; while at meetings, field days or time off.
- Ability to remotely *"see"* stock and troughs through the camera system which can post photos at given time intervals.
- Checking of tank storage levels; either manually, at given time intervals or through an alert system that sends a message to designated phones if a problem arises.
- Ability to take time away from the farm and have confidence that stock water will be adequate, allowing owners to relax.

"I got a call from my son Luke when he was at the coast in February because he could see on his iPhone that one of the tanks was down to 2% of capacity," Eric Harvey said. "I was able to tell him that we'd had a blow out in one of the pipes and that we had fixed it. It really hit home to us that no matter where we are, we can check the waters with confidence."

Payback period vs Capital Setup costs

Using the Payback Calculator, we entered in a range of capital costs for the Telemetry, illustrating that even though we were trialling a very "Rolls Royce" system, we were interested in the paybacks of more basic systems. The easiest way to do this was to simply discount the capital costs of the system. This may be reflected in savings in the scope of the monitoring (for example not having a portable camera and power unit, or reducing the scope of the pump automation).

As can be seen below, the base system had a payback period (time to get to breakeven period through savings made in vehicle and labour costs) of 9.6 months, less capital outlay costs reduced the time required to cover the capital costs (shorter payback period).

The take home message is that all scenarios tested had a payback period less than one year. This is very short, showing the value of the technology.

Payback sensitivity
Capital costs vs time to payback

system capital cost	***$***	***payback (no. of months)***
base (as demonstrated)	21 000	9.6
less 20%	17 000	9
less 40%	14 000	8.2

Is the technology physically robust and reliable?

During the life of the trial some software and hardware issues were experienced, however the back up from Observant was generally good. The technology is generally physically robust. There is quality phone technical support from Observant and the technology has an increasing capacity to be examined by Observant "on line" through an on line diagnostic system to identify problems. This is a new development and assists with the remote technical management of the system.

Like most technology, it is not problem free 100% of the time. However problems seem to be relatively easily solved via phone, or with a couriered spare part. Difficulties retro fitting the technology to a diesel pump was encountered, and this required a wiring harness to be made up and fitted. This took some time and effort to get right.

The base units supplied were generally robust and made of heavy duty UV resistant polymer.

We believe some brands of pumps may be easier to retro fit than others and this needs to be individually investigated by producers who may have existing pumps and are looking to install automatic pump monitoring/controls. Some brands of new pumps come prewired now to accept a standard wiring harness.

A combination of UHF and mobile phone modem provided a robust signal in hills, valleys and trees. A system can be individualised with a combination of UHF and mobile phone. This is a real innovation.

Acknowledgements

This project was successfully completed mainly due to the openness, willingness to share and time spent "tweaking" the system by the Harvey Family, Gilgai Farms, Geurie. They have a passion for solutions. **www.gilgaifarms.com.au.**

Thanks also to MLA for the main project funds (Richard Apps and Gerald Martin). **www.mla.com.au.**

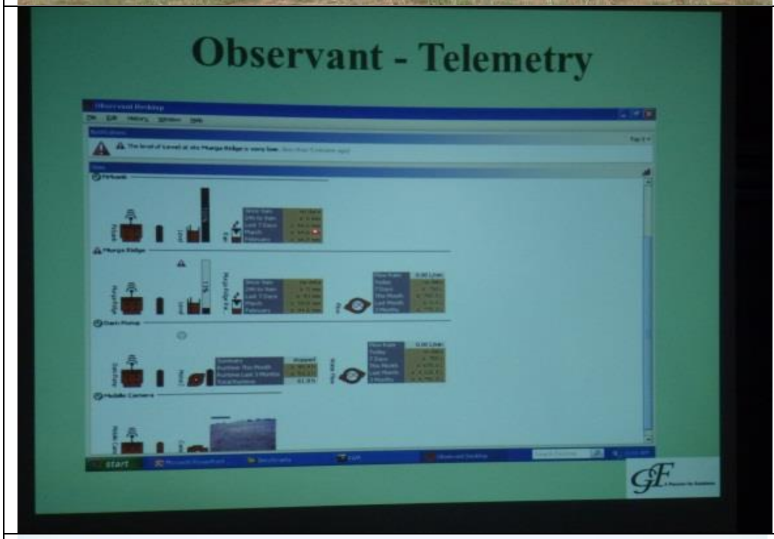
Thanks to the Central West CMA, RIVWEST Finance for leasing the Telemetry and Rabobank for their sponsorship and Phil Whitton from Observant for his expertise. **www.observant.com.au.**

Thanks also to the nearly 60 landholders that participated in the project over 3 years and came to the many field days we held.

Photos

	Inside getting a quick Introduction to one of the three field days before we went out into the Paddock. Approx. 32 people came to the day, as far south as Braidwood (7 hr drive). A few locals were finishing shearing/crutching so our numbers were impacted a bit by weather but still a good turn out.
	Out at site 1, discussing the movable camera focussed on a trough which waters some 2600 ewes and 800 head of cattle at peak period.
	Camera is moved to follow the mob, reducing capital costs.

Large dam and remote engine and pump telemetry fitted to a diesel pump. Pump stops and starts according to tank levels on the hill. All automated.



An example of the real life data Eric Harvey produced and discussed.

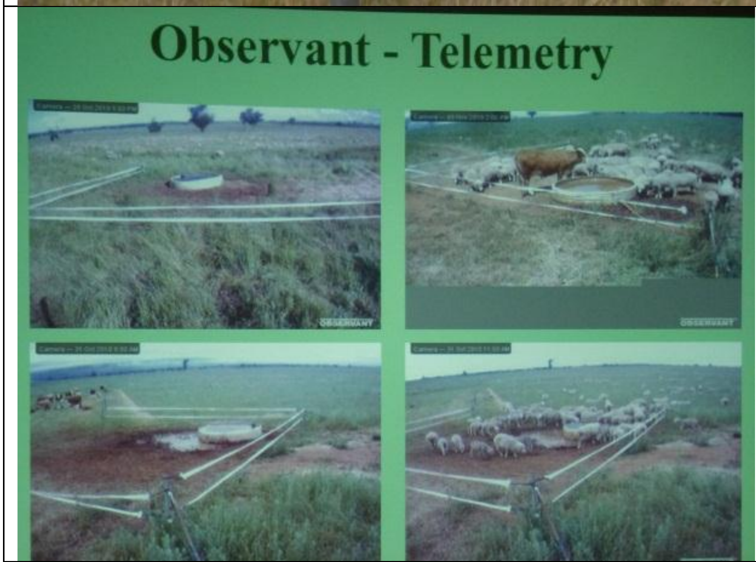
Graphs show the Tank water levels being monitored, along with important pumping data.

Alarms can be set for Tank Levels too low (and too high).

Showing the remote tank monitoring unit with probe on the right. The small black “flower pot” on the LHS is the remote weather station, able to send back information by the same UHF monitoring unit.

The Tank level monitor can be seen entering the tank and is connected to the solar panel power and communications unit. Note, UHF aerial which sends data to central 3G Modem.

	Remote monitoring pump equipment. This enables the Yammer diesel pump to be remote started, stopped, flow rates to be monitored and alarmed and pump protection to be enabled. This equipment has been set up on a trailer, which means the monitoring can follow the pump to additional sites, providing additional value for the capital outlay and creating flexibility.
	Ease of information access has been enhanced by adding an Apple iPhone app. It enables Luke Harvey to monitor water and pump performance for any place he has mobile phone coverage, at any time. Alarms have been created to send warnings to both mobile phones and desktops. This example shows the tank level at Comobella (96.9% full) and, Murga Ridge (99.7% full). The graph shows the change in tank level over time. The button "Mobile camera" can be touched on the phone to show the most recent remote paddock and stock photos.

	Portable camera with solar panel positioned at watering point. Camera is presently in unstocked paddock. When stock are moved into this paddock the pole will be moved to a new position. Data is sent via UHF to a central 3G Modem.
	Example of remote camera paddock shots, programmed to send pictures back on specified time intervals. In this example the camera is set up on the watering point and stock can be seen entering the Cell centre to water.
	Example of an in line flow rate meter which can monitor flow into and out of storage tanks. Changes in the normal patterns of in and outflow can be an indicator of problems (blow outs).

	Example of the inside of the power unit. The Solar Panel hinges backwards, exposing a small motor bike sized battery (power unit) that is constantly recharged and provides power to the system. The electronics capture and send data. In this instance, the camera data is being sent by UHF (note aerial) to a central 3G modem, where it will be sent via internet to the Managed System run by Observant. Data then is avialable to the producer via mobile device from this server, in any location mobile phone coverage is evident.