Improving Irrigation Efficiency and Customer Service

Murrumbidgee Irrigation Operation and Planning System

Murrumbidgee Irrigation Ltd

Abstract

Faced with the challenge of future changes in water availability, Murrumbidgee Irrigation had to understand better the hydraulics of their distribution networks to improve distribution efficiency but without compromising the best possible service to irrigators.

To do this, Murrumbidgee Irrigation Ltd (MI) engaged Adasa to implement a Decision Support System to improve the day to day system operation efficiency, to address short to medium term water and asset planning and to assess requests for water trading.

Adasa designed and built the Murrumbidgee Irrigation Operation and Planning System (MIOPS) to respond to the needs of a complex delivery system driven by customer demand and which includes infrastructure that ranges from manually operated structures to remote manual operation and fully automated channels.

The key benefit of MIOPS has been to improve decision making by providing quick and easy access to information from various sources and gaining better knowledge of the scheme using virtual real-time and forecast information from simulation models.

At the same time, enhanced data quality and consistency has improved customer service by providing tools to assess water trading requests and assist equitable water order scheduling to meet customer expectations and compliance with company water policies.

Dave Gilbert
Executive Manager Planning
Murrumbidgee Irrigation
Australia

"The innovative approach of the MIOPS project has been a significant step forward for MI's Operational and Asset Planning teams. The improved data management and business intelligence will provide greater support to all business functions."

Benefits

- Maximised use of water diverted into the scheme, through better storage, capture and reuse, and by optimising the use of catchment runoff and of water resulting from miss-match of orders.
- Improved operational and planning knowledge associated with water delivery, water scheduling and ordering, and water delivery infrastructure and maintenance.
- Improved water demand forecast, which helps to optimise diversions and increase customer water availability and level of service supplied.
- Enhanced asset planning and long-term demand forecasting.
- Reduced business risk and water delivery risk during water shortages through better evaluation of impact of trading of delivery entitlements and flow rate share.

One of the largest private irrigation companies in Australia

Murrumbidgee Irrigation Ltd is one of the largest private irrigation companies in Australia serving over 3,200 landholdings owned by over 2,500 customers. The irrigation water and drainage services MI provides has helped create a diverse and highly productive agricultural region known as the Murrumbidgee Irrigation Area (MIA), which forms part of the Murray-Darling Basin and covers an area of 660,000 ha of which an annual average of 120,000 ha is irrigated.

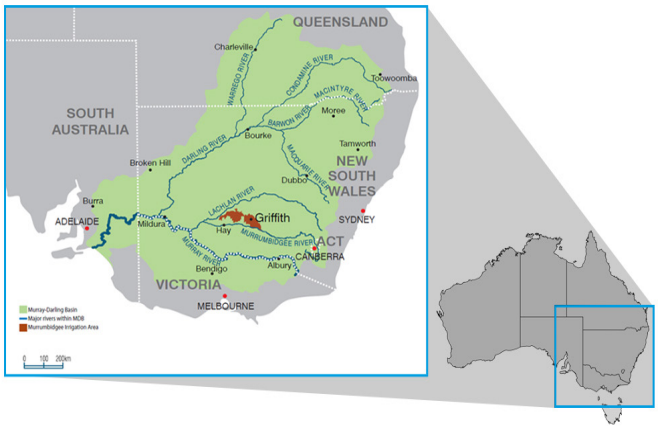

Figure 1 - MI irrigates 120,000 ha within the Murray Darling Basin. 70% of Australia's irrigated land area lies within the basin.

Water NSW, the NSW Government body responsible for managing rivers and dams in NSW, releases water into the Murrumbidgee River from the Burrinjuck and Blowering Dams in the Great Dividing Range. MI is licensed by the NSW Government to divert water from rivers and deliver it to MI's customers via a bulk water licensing arrangement. Water is diverted by two main offtakes within the system: the Main Canal diverts 6,600 ML/day and the Sturt Canal diverts 2,200 ML/day.

Water travel time from the dams to the river diversions is between 6 and 7 days meaning that irrigation demand has to be estimated and communicated to Water NSW 7 days in advance. This is a significant operational challenge. Overestimation can mean that water has to be discharged to the drains if it cannot be stored within the channel system and under-estimation can impact agricultural productivity.

In common with nearly all irrigation schemes in Australia, MI's delivery infrastructure is predominately a gravity based delivery system, which can present challenges in equitable water delivery during tenuous operating circumstances, such as water shortages or spiked increases in demand during a heatwave at the height of the irrigation season. The scheme is complex to manage with infrastructure that ranges from manually operated structures; to remote desktop operation; and fully automated channels.

Figure 2 - Murrumbidgee Irrigation's Main Canal.

Future changes in water availability

In 2007, in recognition of long-term over-exploitation of water resources in the Murray Darling Basin, the Australian Government established the Murray Darling Basin Authority to improve resource management. A management plan, called the Murray Darling Basin Plan (MDBP), was finalised in 2012 and will limit water use at an environmentally sustainable level, once fully implemented by 2020. The Plan is supported by Commonwealth investment in modernising irrigation infrastructure and irrigation districts like MI are encouraged to take advantage of this investment in return for a reduction in water diverted for irrigation.

As part of their response to the Plan with its projected changes in water availability, Murrumbidgee Irrigation decided that it needed to understand better the hydraulics of their distribution networks to protect the integrity of their water diversions, that is, to improve distribution efficiency but without compromising service to irrigators.

MI realised that hydraulic and water quality simulation models could provide effective means for predicting network behaviour of their water distribution system under an array of demand loading and operating conditions. By using real-time network modelling, MI wanted to create opportunities to optimise delivery and improve system efficiency when best water management was required. Modelling also held the promise of potentially enhancing the economic viability and environmental sustainability of irrigated agriculture without necessarily reducing water usage.

Figure 3 - The distribution network is gravity driven with a complex mix of automatic and manually operated infrastructure.

Decision Support System

Murrumbidgee Irrigation engaged Adasa to develop these models and incorporate them into a decision support system that would provide real-time insight into operations, assist staff to optimise performance, be easy to use for casual users, and be an open system that could be extended and improved over a long expected life time without dependence upon specific software vendors and integrators. The system was to be named the Murrumbidgee Irrigation Operation and Planning System or MIOPS.

In order to implement this system, a first challenge was to collect, integrate and quality assure a large amount of raw data from a wide variety of sources. These sources included two separate scada systems, gauging station data loggers from the NSW Government and internal stations, satellite images, meteorological (weather and evapotranspiration) observations and forecasts from the Bureau of Meteorology and CSIRO, and data from MIs own operational systems such as their water ordering and planning systems and customer data including allocations and geographical data on landholdings. Data came in a variety of formats including HTML, CSV, XLSX, JSON, DBF, NetCDF and GeoTIFF.

All data is received, qualitatively improved (automatic data validation and gap filling) and stored in a hydrological and hydrometric database as the source of truth for subsequent analysis and modelling. Data is distributed from this database to all components of MIOPS but the database contributes in its own right as an appropriate long term, permanent storage for later data mining.

A hydrological model was built for the whole MI area catchment to determine rainfall-runoff processes, including the calculation of soil moisture, drain flow releases through property drainage inlets and evapotranspiration processes.

Hydraulic models simulating water routing through all main channels in the MI scheme were developed to assess the real-time operation and to analyse flow behaviour through supply and drainage channels. Supply models were fed using data available from water demand databases whereas drainage models used outputs from the hydrological models. Real-time hydrometric data was used where available to adjust model simulations on a real-time basis.

An open data handling platform was integrated that provided an intuitive interface through which raw data (such as rainfall or channel water levels) and forecast data (such as demand) could be visualised and compared both graphically and geo-spatially.

Finally a business intelligence application was incorporated to analyse historical and importantly current performance (in real-time) as measured by MIs Key Performance Indicators (KPIs) and other key operational data such as storage levels and sales volumes. A dashboard was built in a web-based environment which is intuitive and accessible to all MI staff, executive management, board, and eventually, to some degree, customers and shareholders.

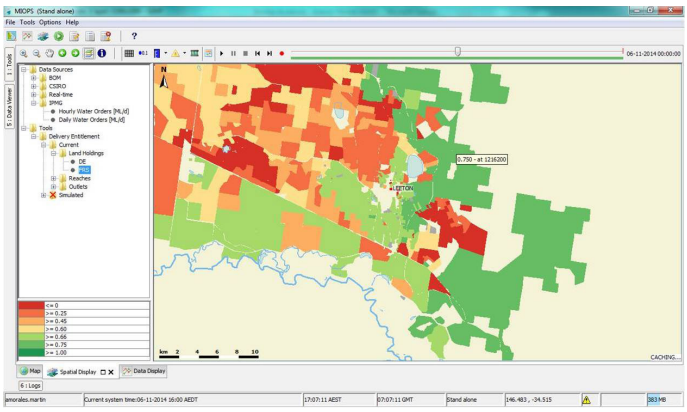

Figure 4 - MIOPS reduces business risk by visualizing the impact of water trading on MIs delivery obligations.

Results

Murrumbidgee Irrigation is now making smarter decisions because they have the right information of the right quality at the right time. They now make fact-based decisions because the data is of a higher quality, is no longer disputed, is available to all staff that need it, and accessible at the time decisions are needed.

> ***"I was able to perform tasks in 4 seconds that we used to take up to 3 months."***
>
> Noel Heath, Operations Manager,
> Murrumbidgee Irrigation.

MI is now improving their 6-7 day water ordering forecast reported to Water NSW by anticipating crop water needs based on previous patterns, current and predicted rainfall-runoff, evapotranspiration and water orders. MIOPS is able to forecast crop water demand requirements at a landholding, channel, division, district and global level in moments, rather than through the laborious traditional approach. The tool has captured some of the expertise built up over many years by the most experienced operators and helps share and retain that knowledge within the organisation.

The increased transparency and access to data in near real time across the organisation has improved operational and planning knowledge associated with water delivery, water scheduling and ordering, and water delivery infrastructure and maintenance. Operational and Planning staff are now using MIOPS for asset utilisation measurement, metering investigations, maintenance planning, schedule optimisation, automation and capital works business planning and review. The ability to analyse historical trends in-line with comparative operational years is improving current decision making.

> ***"Murrumbidgee Irrigation is now making smarter decisions because they have the right information of the right quality at the right time."***

MIOPS is also impacting asset planning and capital investment. For example a Scheme Modification module takes a "snapshot" of the MI delivery system and tests options for the viability of asset replacement, automation or removal and their impacts on the scheme.

The dashboard is providing real-time water balances to division, supply and system levels, and the ability to target areas for investigating water loss categories such as seepage, non-compliance and operational.

MIOPS is assisting with the development of operational goals to maximise water distribution and order scheduling at a property, channel, division and global level. Retrieving past scenarios and assessing the impacts of different distribution approaches using simulation with the same models is enabling assessment of improved water delivery methodologies.

And MIOPS is now supporting business growth because it enables visualising and analysing the success of automation and modernisation projects which will improve the success of future projects. These systems are pivotal in providing critical data and knowledge for capital planning and investment, as well as assisting with target business improvement and growth.

ADASA

Figure 5 - MIOPS dashboard provides a real-time overview of key operational indices like delivery efficiency and storage utilisation.

> ***"MI has improved operational and planning knowledge associated with water delivery, water scheduling and ordering, and water delivery infrastructure and maintenance."***

Figure 6 - MIOPS can be used in an operations control room.

About Adasa

Adasa is a global firm dedicated to improving the management of water businesses by leveraging advanced ICT technologies, hydrological modelling, real-time water quality instruments, and the water-related sciences to build systems that improve decision making, enhance efficiency and effectiveness and reduce risk.

Founded in 1988, Adasa is a leader and reference company in Environmental Information Systems operating in 7 countries. Our team of experts understands the increasing need of managing efficiently the rapidly growing amount of water and environmental data in order to realise its full potential value for our clients.