Global experience of automating irrigation systems

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Agenda

1. Irrigation
2. Automation benefits
3. Automation enablers
4. SCADA vs Autonomous Control
5. Case study - On farm productivity improvements
6. Future steps
Irrigation supply systems

Irrigation is the manifestation of human ability to reshape both the temporal and spatial distribution of land based fresh water.

First step in irrigation is to know where and when water is needed, and for what duration and quantity.

Second step is to transport water to the extractions points to meet the demand.

Irrigation consumes more than 70% of the world’s fresh water resources.

*http://www.irrigationmuseum.org/exhibit2.aspx
Water distribution - Challenges

Gravity powered distribution of water over a large network is a complex task.

In order to simplify the distribution process, the irrigation systems has been operated in a supply oriented approach since historic times.

Limitations of a supply oriented distribution

A supply oriented distribution process constrains farmers to grow certain types of crops and only supplying water in accordance with a rigid roster.

- Farmers do not have the flexibility to grow crops to maximise revenue earning potential while minimising risk.
- Roster systems mean crops may not get the required water at the optimal time, impacting productivity.
- Results in an inequitable level of service and lack of social harmony.
- Mismatched supply and demand results in huge operational losses.
Global irrigation scope and distribution efficiencies

Irrigated land by region

Average distribution losses in irrigation supply systems

* 90% efficiency: Coleambally Irrigation Area (2005/06) and Shepparton Irrigation Area (2010/11)

Sources: United Nations FAO and International Institute for Land Reclamation and Improvement (1990) as cited by Land & Water Australia

Automation components
Multi-tier representation of irrigation control solution

**Prediction**

- **METEOROLOGICAL DATA** (Temperature, precipitation etc.)
- **LAND USE DATA** (Crops, population, planting cycles etc.)
- **RAINFALL RUNOFF MODEL**
- **IRRIGATION DEMAND MODEL**
- **NETWORK MODEL**
- **OBJECTIVES AND CONSTRAINTS**
- **OPTIMIZATION**
- **SCADA REAL TIME WATER LEVEL AND FLOW MEASUREMENTS**
- **CONTROL**
- **RESERVOIR, BARRAGES & CANAL OPERATIONS**

**Actual requirement**

- **SOIL MOISTURE MEASUREMENT**
- **WATER ORDERS**

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Enabling factors for Autonomous Control

- **Field hardware and instrumentation**
- **Communication infrastructure**
- **IT infrastructure and SCADA software**
- **NeuroFlo software and Tuning**
- **Stakeholders**
SCADA Vs AUTONOMOUS CONTROL

Water level control

SCADA Vs AUTONOMOUS CONTROL

Operational spills

Cumulative operational spill volume at escape site SP-578 from 17-Sep-08 to 30-Apr-09

SCADA BASED OPERATIONS

AUTONOMOUS CONTROL

786L
Case study: On-farm improvements

Soil moisture graph for four months – total profile
Soil moisture graph for four months
Summary of benefits of Automation from across the world

- High level of service to the farmers – consistent flows at the rate, time and duration required for crops
- Equitable level of service to all farmers
- Improved water delivery efficiencies up to 90% - equivalent to close pipe systems
- Improved on-farm water application efficiency of up to 90% due to high flow application at optimal time
- Improved crop productivity for less water
- Huge water savings by closely matching water supply and demand spatially and temporally
- Improved Occupation Health and Safety for operators and farmers
- Transparency in operations
- Better communication interface between farmers and irrigation authorities
Future steps

- Bring flow metering standards for non-urban sector
- Bring legislations on metering water used for irrigation
- Bring water allocation entitlements to a farm or water user association level
- Set aside appropriate budget and procurement standards
- Trial a pilot. Autonomous control and its benefits has been proven consistently for many years in water starved regions of the world such as Australia, Central Valley in the USA and North Western China
- Commence training of irrigation authorities to prepare them for automated operations
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