*Smart waste-water networking for Small Works*

**The Jordan Valley Water Association (JVWA) Small Works upgrade – Case Story, Fall 2014**

The JVWA has been on the technological forefront of Israel's water, waste water, and irrigation for a long time.
JVWA is unique in Israel for supplying its owners and clients, the Jordan Valley inhabitants, with full water and waste-water (WW) services, including:



- Drinking water supply
- WW management
- Irrigation water supply

The JVWA accounted for availability and quality of all water products, from pumping stations on the lake shore and river banks to the most distant village in the valley, from water treatment to billing. Because of the growing needs and the continuous reduction of water availability in the Middle East, the JVWA is involved in innovative and important projects such as:

- Desalination of secondary and salt-water resources
- Water sharing with the neighboring kingdom of Jordan
- Water-management systems development

The JVWA manages the following assets:

- 30 water pumping stations with 115 pumps, 15–1200 HP
- 45 WW pumping stations (a waste-water collection system that uses gravitational flow to village hubs and then pumps waste-water to a regional treatment plant)
- 1 WW treatment plant
- Drinking water treatment plant
- 12 operational water reservoirs

An expansion and upgrade project is underway that includes a desalination plant.

Automation of the JVWA system began in 1980 with Remote I/O control using Motorola MOSCAD. Due to evolving needs and technologies, the JVWA, like many SCADA/DCS organizations, currently owns and operates diverse assets, including several vendor solutions. For example, one article describes the upgrade of the pumping-station network without replacing the old PLCs (WIPAC, April 2013, pp. 12–14, *Innovative optimization/upgrade of SCADA/DCS System in the Jordan Valley Water Association*)

**The need**


Waste water pumping station.

Israel is the leading country in the reuse of WW for agricultural irrigation (77%). The JVWA's aim is to maintain this target as a minimum, preventing the risks of WW mixing with water from lakes, rivers and the aquifer, easing the pressure of water-scarcity on farmers, and maintaining a high level of sustainability.

The JVWA decided to develop an innovative automation solution with an economical smart networking upgrade, optimizing its 45 existing WW Small Works assets.

**AGM**

AGM Communication & Control Ltd. ([www.agm.co.il](www.agm.co.il)) is working as JVWA's automation partner. It has been providing communication and control solutions for twenty years and has ample experience in **economical optimization, retrofitting, and upgrading** SCADA/DCS networks for **water, wastewater**, **oil, and gas** as well as other industrial applications, environmental telemetry, power sub-stations, and irrigation. AGM was asked to design a solution in collaboration with the JVWA automation team.

**Client's requirements:**
1. A sustainable approach utilizing existing infrastructure
2. Enhance existing system performance for defined parameters without new construction and minimal equipment replacement
3. Do not touch the SCADA Control Center!
4. Use commercially-available, standard, off-the-shelf, and locally licensed and supported equipment
5. Increase the level of security and resilience
6. The smart network should improve the automation and control operations
7. It should improve the quality of data streaming to the system's analysis and modeling applications to optimize the network, system management, and DSS applications
8. Keep it simple and in-line with existing operational practices, training, and regulations
9. Use compact equipment enclosed in an IP67 enclosure, with read/write capabilities suitable for typical Small Works needs (about 15 I/Os, including water/electricity/gas meter reading, input set up for real-time, online, and cumulative flow monitoring)
10. Real-time, resilient communication and control
11. An system adaptable to future technologies
12. Comply with present and anticipated security, and environmental regulations
13. Gradual upgrade according to budget

**Developing the solution**
AGM has developed a powerful networking tool, which acts as a point-to-point and/or point-to-multipoint IP WAN. It has been working successfully in several clients' SCADA/DCS installations for some years (see [Economical Asset Optimization](), 1-page PDF).

AGM's original product is called R-Win. It upgrades DCS network performance and optimizes assets through "brain implants" in each remote station, using wireless MESH for real-time networking. The difference compared to previous systems is similar to the PC revolution a generation ago, when "dumb terminals" were replaced by "intelligent desktop units." R-Win is installed between the PLC and the transceiver (RF and/or cellular router), acting as an intelligent field unit (R-Win Technical Review, 12-page PDF).

Simply put, we see most small utilities' pumping stations (water, waste water, oil, gas, etc.) as "dumb terminals" with no automation or PLC. However, SCADA/DCS and utilities managers are looking for network and stations performance upgrades. Installing "intelligent agents" in distributed remote assets seem to us as the preferred approach and solution. So our goal was to develop a compact unit with reliable processing, I/O control, two-way real-time on-board communication, high performance, modern security and low cost.
The product we developed has been working successfully in commercial SCADA/DCS installations in Israel. We call it **R-Win I/O**.

**R-Win I/O** and R-Win units are network peers. R-Win is installed where a PLC is needed or installed already and **R-Win I/O** would be installed where automation needs are limited but crucial.
If PLC is needed on the asset few years after R-Win I/O installation, **R-Win I/O**'s modular design is natively programmed to interface with most standard PLCs and RF/Cellular devices for additional asset performance upgrade without replacing any components.

**Smart waste-water Small Works networking scenario**
*Part of the JVWA WW stations map*
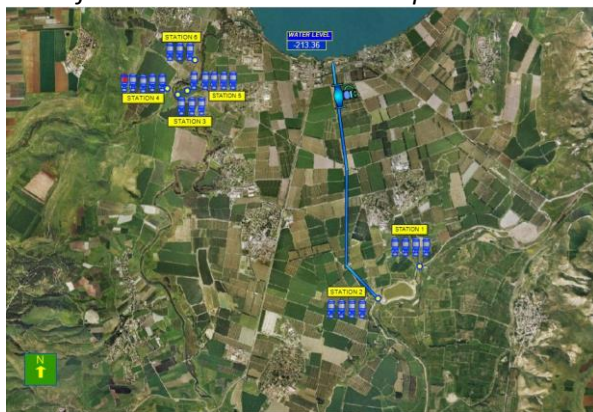


The **scenario components** are: four Small Works waste-water pumping stations and one regional Waste-water treatment plant (WWTP). Together they are a *functional-cell* due to their unique characteristics. The regional WWTP is fed by additional functional-cells that comprise several Small Works and/or WW pipelines.
The system is set to normal operation mode (done by a local operator, simpler than PLC programming). When irregularity in flow, content, or asset status is detected, the system switches to another mode and automatically optimizes local flow. It reports changes in real-time to downstream stations, other involved functional-cells, the regional WWTP, and the main SCADA control center.
Since every R-Win and R-Win I/O unit can function as ad-hoc control centers for local processes with several other Small Works, irregularities such as flooding and contamination risks can be treated early at upstream locations before local risks go downstream and become regional problems.

**Some key industry trends addressed during the R-Win I/O development, with some subjective interpretation.**

1. Regulations

The EU and the US have set 2020 as a target date for achieving the new "sufficient" or "good status" classifications for all water and waste-water services. By 2020, UK utilities must incorporate all Small Works.

- *All Small Works must be monitored and controlled by 2020.*

2. Old utilities upgrades

"Doing more for less" is the goal of most utilities companies currently doing upgrades.

- *Given the present shortage of investment in the industry, a "smart economical upgrade" is not less effective than "smart network."*

3. Security and infrastructure resilience

Between SCADA-Cybersecurity and "if it works – don't touch it," there is a big gap and a lot of room for security measures, which are simple to operate and cost effective.

- *Any SCADA/DCS upgrade project should include higher level of security. There are additional dangers to address in order to enhance infrastructure resilience.*

4. Big Data

Big organizations invest big money in Big Data applications. Small organizations are looking for not-so-big or expensive solutions for DSS, network optimization, etc.

- *R-Win and R-Win I/O contribute to the quality, credibility, and security of the data stream coming from the field to processing centers. Having star-wars class algorithms with "dumb-terminals" as data originators will take us back to our old "garbage in – garbage out" situation. Intelligent agents in the field is a must in order to have anything "smart" in the system.*

5. Advanced maintenance and asset management/integrity tools

Effective maintenance is a big money saver for any automation system. It streamlines utility operations and management.

- *The R-Win and R-Win I/O product family support preventive maintenance and conditions based maintenance tools through real-time responsiveness, network resilience, and standard interfaces.*

6. Internet or not

Some countries in the Western world consider the world wide web to be an unsecure platform for utilities infrastructure.

- *The R-Win product family applies wireless MESH topology using both RF and cellular routers for extra resilience (if needed, as parallel communication channels).*

**R-Win I/O** installed at a waste-water pumping station on the lake shore

*R-Win I/O* installed in an IP67 control cabinet



Pump's Station

Table: **Features and Benefits of R-Win I/O**

| *Features* | *Benefits* |
|---|---|
| Real-time monitoring and control for SCADA / DCS networks | a. Responds to changing asset and environmental conditions, preventing risks to assets (equipment) and media (water, WW, power, oil, and gas)<br>b. Conforms to EU and US regulations |
| Smart communication management by R-Win I/O | a. Change-of-state communications interrupts, no "polling" by control center needed<br>b. Data filtering, which reduces wireless traffic and improves response time<br>c. Each unit can serve as an ad-hoc mini control center for a remote group of stations, sharing a control sub-process |
| Lateral communication between assets, wireless MESH networking | a. System redundancy and resilience<br>b. Asset operational upgrade<br>c. Network optimization |
| Up to 16 I/Os | a. Saves equipment cost (no need for PLC)<br>b. Dynamic configuration, meeting Small Works application requirements<br>*8 digital inputs/outputs for connecting all kinds of switches (floats, limit switches, etc.) and activating relays, alarms, etc.*<br>*8 analog voltage/current (software selectable) inputs for connecting flow meters, pressure meters, vibration transmitters, etc.* |
| Auto reconnection after communication failure | No need to "run to the field" to reset the unit in case of communication failure (built-in WatchDog) |
| Direct communication with client's server using static IP address | a. Saves third-party communication fees<br>b. Improves data security and system resilience<br>c. Improves system response time |
| Advanced on-board and protocol security tools | Upgrades system data and communication security |
| Standard interfaces using Modbus, TCP, Modbus Serial, TI, DF1, Siemens and more<br>*Additional protocols are available* | a. Easy to install and maintain in new and existing installations, lengthening existing asset life cycle<br>b. Smooth and low-cost integration with standard, off-the-shelf equipment<br>c. Smooth integration with asset management and maintenance applications |
| Integrated with R-Win network<br>*(R-Win is installed between a standard PLC and a wireless device, RF or cellular, or both in parallel).* | a. A system-wide solution for optimization<br>b. An economical upgrade<br>c. Could function as a stand-alone system with its own compact HMI, and/or integrated with full scale existing SCADA system, using standard methods, protocols, and tools |
| Gradual installation | Low investment and risk (could start with as few as four stations and a temporary HMI) |
| Low cost of R-Win I/O | Asset optimization, performance upgrade, data security, and regulations conformity with minimal investment |
| Proven solution | The R-Win solution has been commercially installed and effectively functioning for three years |

An R-Win I/O network drawing is available (see Small Works Networking drawing, 1-page PDF)

**Impact**

- The solution is coherent with the expected features and benefits.
- Several Israeli companies are currently installing more R-Win I/O in waste-water, water, oil, gas, and power applications.
- Negotiations are underway for R-Win solutions implementation abroad.

**Tags**

SCADA, DCS, wireless MESH, utilities, water, waste-water, oil & gas, Asset Optimization, pumping stations, system integrators, Distributed Control Networking, Utilities upgrade

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