Implementing a Workflow Solution
Leveraging SCADA and GIS/CMMS
at the Waterford Township DPW

Charter Township of Waterford
Oakland County, Michigan
DPW Assets

- 360 Miles of Water Main and Appurtenances
- 19 Production Wells
- 2 Elevated and 1 Ground Storage Tanks
- 13 Iron Filtration Plants
- 1 High Service Pumping Station
- 355 Miles of Sanitary Sewer
- 62 Sewer Lift Stations
- 15 Township Buildings
- 5 Township Cemeteries
- 230 Vehicle Fleet
Water Infrastructure Features

- 3,500 Gate Valves
- 3,400 Fire Hydrants
- 7,000 Water Main Segments
- 11 Water Treatment Plants
- 3 Elevated and Ground Storage Tanks
- 24,000 Customer Water Leads
Sewer Infrastructure Features

- 8,300 Sewer Manholes
- 8,500 Sewer Main Segments
- 62 Sewer Pumping Stations
- 25,000 Customer Sewer Leads

Totaling over 80,000 features that need attributes maintained and work history tracked
Major Technology Design Criteria

- Utilization of cost effective and open architecture based technologies
- Recognition of evolutionary change
- Focus on people and informational needs
- Recognition of different environments
  - Informational
  - Organizational
  - External/Public
- Ultimate goal of Enterprise Wide Application
Core DPW Technological Components

- GIS
- Asset Management System
- Utility Ticket Management
- Document Management System
- Wide Area Wireless Network
- Fixed Network Meter Reading/Automatic Meter Reading
- Utility Billing System
- Fuel Management System
- Supervisory Control And Data Acquisition (SCADA)
Computer Maintenance Management System (CMMS) Criteria

- GIS is viewed as the backbone application onto which specific applications would be developed to improve operations and data mining

- CMMS to provide the critical application that would be used to schedule, track and archive all activities and costs

- A properly selected CMMS would interface directly with the GIS application and would ensure that the GIS would be used daily as a part of the business process. It would also be used to interface with other core platforms for the generation of work orders and activity tracking
Selected DPW CMMS

- Azteca Cityworks used by Waterford DPW
  - Functions within the ESRI environment
  - Geodatabase-Centric
  - Currently over **240,000** work orders created
SCADA

- Facilitates efficient monitoring, control and optimization of water and sewer operations.
- Generates large amounts of operational information
- Alarms generated provide a major basis for CMMS work orders
Integrating SCADA and CMMS

• Originally developed a basic interface to speed SCADA related work order creation in CMMS, but it was cumbersome, had limited functionality and involved a lot of user interface

• Needed a “middleware” type of software to automatically trigger and populate SCADA related data into work orders in CMMS
Project Objectives

- Integration of SCADA alarms into Cityworks through GE Workflow via Work Order API
- Electronic Standard Operating Procedures (eSOP) - Provide method for documenting proper process and transferring institutional knowledge
- Provide a workflow component for SCADA – Auto task generation
The Solution

GE Workflow Software Integration “Middleware”

• Event Based, Process-Centric
  – Manual task automation
  – Digitized Standard Operating Procedures
  – Alarm Response Management
  – Direct Integration with SCADA and CMMS
  – Service Oriented Architecture – Key to Integration
Workflow: Middleware Solution

- Provides the ability to apply logic to SCADA tags for automatic work order generation in CMMS
- Create Electronic Standard Operating Procedures
- Forms for data collection
Project Overview

Cityworks

- **CMMS**
  - Primary System for Work Management
  - ESRI Geodatabase-Centric
  - Currently over **230,000** work orders created
Project Implementation

Phase I

- Automated workflows based on SCADA condition events
  - Pump number of starts
  - Pump runtimes

- Automated workflow based on time event
  - Sewer Station Site Inspections – 5-7 inspections per day as part of a 2 week cycle

- Incorporation of Cityworks Work Order API for automatic work order generation from SCADA into CMMS

Phase II

- Integration of Document Management System (OnBase)
- Development of additional workflows by internal staff
Workflow Overview

Workflow is made up of four main components

• Equipment Model – Models site/equipment and linkage of SCADA values

• Events – Conditional expressions or time based events that trigger workflows

• Workflow Templates – Configured Templates that contain automated process and manual steps

• Schedules – Combines events with workflow templates to initiate workflows

These components create a process driven workflow for managing by exception
Workflow Equipment Model

- Model of site and equipment
- Stores real-time SCADA values for evaluation

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Linked SCADA Tags
Workflow Equipment Model

- Model of site and equipment
- Stores real-time SCADA values for evaluation

External Data Link

This property is configured to link to external data. The source details are described below.

Data Source: SCADA.3.3_PUMP1_NOS.F_CV
Type: Single
Readable: True
Writable: True
Valid Event Variable: True
Test Result: Test successful - 6

Test external data link
Workflow Events – Conditional

- Conditional Expression – Uses values stored in Equipment to evaluate expressions

- Events can be triggered based on multiple criteria

- Events can be set so one or all criteria must be met

- Expressions can also evaluate criteria stored in the workflow process such as a process already running
Workflow Events – Conditional

- Conditional Expression – Uses values stored in Equipment to evaluate expressions

Example:

**NOS Difference Pump1/Pump2 > 3**

Expression:

```
ABS(Pump1NOS - Pump2NOS) > 3
```

**Expression Functions**

- **Math**
  - ABS: Returns the absolute value of a number.
  - ROUND: Rounds a value to the nearest integer or specified number of decimal places.
  - LN: Returns the natural logarithm of a number.
Workflow Events – Time Based

- Time Based Expression – Uses date/time expression to determine when event should be triggered
Workflow Template

- Configured steps and processes that are executed automatically and/or with user interaction
- Steps can be modified by workflow authors and services can be added by administrator
Workflow Schedule

- Combines workflow template with events, either conditional or time based to determine if a workflow should be generated.
Workflow In Action

When a workflow is triggered, either manually or automatically as part of a conditional or time-based event, a series of processes occur. An email is triggered, notifying appropriate personnel of the workflow and supplying a work order number if generated.
Workflow In Action

- Appropriate users can view details of the workflow and begin processing workflow.
Workflow In Action

- Information from SCADA is displayed in the workflow, along with specific eSOP information for troubleshooting.
Workflow In Action

- Steps guide users through resolution of the issue
- Steps have expiration timers, if steps are not processed in time escalation processes occur (notifications)
Workflow In Action

• Users can view list of completed workflows and can view details of workflows
Workflow In Action

• Managers can also view a complete list of pending workflows
Workflow In Action

- Managers can develop workflows based on functions of their group
Workflow In Action

- Workflows are based on actual processes that need to be documented and replicated as needed
Workflow In Action

- These Workflows can represent tasks that are routinely completed or tasks that are rarely executed, but must be done in a specific manner.
Future Steps

• Finish Document Management Integration

• Develop Additional Workflows Internally

• Integration with Cityworks Work Order Tasks

• Conversion of SCADA alarms from stand alone package into Workflow

• Integration of Neptune AMI events into Workflow
http://www.twp.waterford.mi.us

THANK YOU!

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