Operations Data Management & Reporting

Presented By:
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Operations Data Management and Reporting Agenda

- Overview of ODMS and Business Value
- Data Accessibility
- Data Quality
- ODMS Technologies
- Enterprise Integration
What is an Operations Data Management System

Enterprise Integration
- CMMS
- GIS
- LIMS
- FIS
- WQS
- Hydraulic Model

Data Mining, Visualization and Analysis
- Unified Operations Data Model
- Data Governance and Management
- PLCs:
  - Raw Water, Filtration, Disinfection
- Reads & Rounds: manual data entry
- Instrumentation
- Power Monitoring

Consequence + Value = Criticality

Value

Consequence

$
# The Business Value of Operations Data

<table>
<thead>
<tr>
<th>Business Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Quality</td>
<td>Regulatory reporting</td>
</tr>
<tr>
<td></td>
<td>Impact of operating events on water quality</td>
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<tr>
<td>Operations</td>
<td>Operations decision support</td>
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<tr>
<td></td>
<td>What-if analysis and optimization</td>
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<tr>
<td>Finance</td>
<td>Invoice of upstream and downstream clients</td>
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<tr>
<td></td>
<td>Power and chemical billing validation</td>
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<td>Unit cost of opr</td>
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<tr>
<td>Maintenance and Asset Management</td>
<td>Equipment performance data for condition-based predictive maintenance and asset renewal</td>
</tr>
<tr>
<td>Planning</td>
<td>Data for calibration of hydraulic models used for capital planning and emergency response</td>
</tr>
<tr>
<td>Customers</td>
<td>Analyzing the source of water complaints on aesthetics and pressure.</td>
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</table>
Understanding the Data Needs of Stakeholders
Ultimate Goal - the ODMS Holy Grail

“Achieve a Single Version of the Truth”

What does it mean?
• Consistency in data calculations and reporting

How is this achieved?
• Data normalization, centralization and synchronization, or
• Simply ensure that calculated results are reported from a single data source
Functional Objectives

- **Historical Data Capture and Management**
  - Reliable data capture of meaningful data
  - Provide secure, long-term, online storage of historical process data that is utilized to support business decisions.

- **Ad-Hoc and Scheduled Reporting**
  - Provide a user-friendly, reporting tool that meets the requirements of operational, planning and regulatory reporting.

- **Seamless Information Sharing**
  - Enable the timely, electronic exchange of data between process and business systems to support effective operations management and business process integration.
1. **Data Access**
   - Does every user that requires access to the data have access to the ODMS?
   - Are the Data Mining tools user-friendly?

2. **Data Quality**
   - Can we rely on our operations data?
     - Is the data accurate, is it complete, is it timely…
     - Is the data uniform or consistent across the enterprise?
Providing Data Access to all Stakeholders
Typical Architecture
Data Access – BI Tools for Data Mining

- Scheduled Reporting
  - Scripting, scheduling, and distribution
- Ad-Hoc Query
  - Graphical, menu-driven interface
- Dashboard
  - Summary data, red-flag with drill-down capability
**Data Access – Scheduled Reporting**

#### PENITENCIA WATER TREATMENT PLANT OPERATIONS REPORT

<table>
<thead>
<tr>
<th>Plant Production</th>
<th>Raw Inflow</th>
<th>Dutard</th>
<th>East Pipeline</th>
<th>Total Production</th>
<th>Utility Water</th>
<th>Recovered Water</th>
<th>Underflow Sludge</th>
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</thead>
<tbody>
<tr>
<td>Total MG</td>
<td>776</td>
<td>14.5</td>
<td>718</td>
<td>732</td>
<td>1010.1</td>
<td>30.0</td>
<td>1.3</td>
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<tr>
<td>Average MGD</td>
<td>25.0</td>
<td>0.5</td>
<td>23.2</td>
<td>23.6</td>
<td>32.58</td>
<td>0.97</td>
<td>0.04</td>
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<tr>
<td>Total Acre Feet</td>
<td>2381</td>
<td>44.4</td>
<td>2203</td>
<td>2247</td>
<td>3099.8</td>
<td>92.1</td>
<td>4.1</td>
</tr>
</tbody>
</table>

*NOTE: RAW INFLOW includes recovered water; TOTAL PRODUCTION is amount of treated water leaving the plant.*

<table>
<thead>
<tr>
<th>Plant Performance</th>
<th>Raw</th>
<th>Settled</th>
<th>Ozonated</th>
<th>Comb Filter</th>
<th>Clearwell</th>
<th>Finished</th>
<th>Disinfection CT Ratio</th>
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</thead>
<tbody>
<tr>
<td>Average NTU</td>
<td>4.97</td>
<td>1.11</td>
<td></td>
<td>0.04</td>
<td></td>
<td>0.03</td>
<td>Minimum</td>
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<tr>
<td>Average pH</td>
<td>8.04</td>
<td>6.88</td>
<td>7.27</td>
<td>7.56</td>
<td>7.71</td>
<td>7.71</td>
<td>Maximum</td>
</tr>
<tr>
<td>Average Temp</td>
<td>22.9</td>
<td>23.0</td>
<td>23.6</td>
<td>23.3</td>
<td>23.0</td>
<td>4.4</td>
<td>Average</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Filter Performance</th>
<th>Filter 1</th>
<th>Filter 2</th>
<th>Filter 3</th>
<th>Filter 4</th>
<th>Filter 5</th>
<th>Filter 6</th>
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</thead>
<tbody>
<tr>
<td>Avg. gpm/ft²</td>
<td>3.7</td>
<td>3.7</td>
<td>3.7</td>
<td>4.0</td>
<td>3.6</td>
<td>3.7</td>
</tr>
<tr>
<td>Avg. Filter Run - Hrs</td>
<td>46</td>
<td>60</td>
<td>60</td>
<td>50</td>
<td>60</td>
<td>60</td>
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<tr>
<td>Avg. UFRV gal/ft²</td>
<td>10,328</td>
<td>13,232</td>
<td>13,470</td>
<td>11,865</td>
<td>13,013</td>
<td>13,336</td>
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</tbody>
</table>

| Total Filters Washed | 76       |
| Average Filter Run-Hrs | 56      |
| Backwash Total MG    | 14.4     |
| Backwash Avg. MG     | 0.192    |

<table>
<thead>
<tr>
<th>East Pipeline Flows</th>
<th>MG</th>
</tr>
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<tbody>
<tr>
<td>Mabury</td>
<td>70</td>
</tr>
<tr>
<td>Alum Rock</td>
<td>154</td>
</tr>
<tr>
<td>Hostetter</td>
<td>344</td>
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<tr>
<td>Milpitas</td>
<td>118</td>
</tr>
<tr>
<td>Intersta</td>
<td>0</td>
</tr>
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</table>

| Belt Press Operation | Operating Hours | 92 |

#### Chemicals

- **Aluminum Sulfate**: 21,866 Gallons Used, 239,038 Bulk lbs Used, 16.1 Avg. Dose mg/L
- **Anionic Polymer**: 35,560 Gallons Used, 587 Bulk lbs Used, 86.6 Avg. Dose mg/L
- **Aqueous Ammonia**: 2,625 Gallons Used, 20,263 Bulk lbs Used, 0.49 Avg. Dose mg/L
- **Ca Thiosulfate - Cl₂**: 0 Gallons Used, 0 Bulk lbs Used, 0.00 Avg. Dose mg/L
- **Ca Thiosulfate - O₃**: 0 Gallons Used, 0 Bulk lbs Used, 0.00 Avg. Dose mg/L
- **Cationic Polymer**: 1,814 Gallons Used, 15,739 Bulk lbs Used, 0.48 Avg. Dose mg/L
- **Ferric Chloride**: 0 Gallons Used, 0 Bulk lbs Used, 0.00 Avg. Dose mg/L
- **Hydrogen Peroxide**: 0 Gallons Used, 0 Bulk lbs Used, 0.00 Avg. Dose mg/L
- **Liquid Oxygen**: 4,814 Gallons Used, 47,870 Bulk lbs Used, 0.47 Avg. Dose mg/L
- **Nonionic Polymer**: 172 Gallons Used, 1,494 Bulk lbs Used, 0.23 Avg. Dose mg/L
- **PAC (Carbon)**: 0 Gallons Used, 0 Bulk lbs Used, 0.00 Avg. Dose mg/L
### Data Access – Ad-Hoc Queries

#### Proficy Historian Calculated Data Query

<table>
<thead>
<tr>
<th>Tag Name(s)</th>
<th>Start Time</th>
<th>End Time</th>
<th>Calculation</th>
<th>Calculation Interval</th>
<th>Output Display</th>
<th>Output Range</th>
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<tbody>
<tr>
<td>Sheet1!A3:B4</td>
<td>7/2/2009 00:00</td>
<td>7/2/2009 00:00</td>
<td>Average</td>
<td>By Interval</td>
<td>Tagname, Timestamp, Value</td>
<td>Sheet1!A2:D2</td>
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<tr>
<td>Tag: PWTP.A30004.F.CV</td>
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<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Tagname</th>
<th>Timestamp</th>
<th>Value</th>
<th>Quality</th>
<th>PercentGood</th>
<th>Comments</th>
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<tr>
<td>PWTP.A30004.F.CV</td>
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**Excel Formulas**

- **F26**: =AVERAGE(F2:F25)
- **F27**: =MIN(F2:F25)
- **F28**: =MAX(F2:F25)
Data Access – Ad-Hoc Queries

Operations Data Management System (ODMS) Sample Dashboard

Welcome, ops1

Plant Data Feed
- Total Wet Cake: 2356.7
- Primary Influent: 582.02
- Avg Sludge Depth: 5.4

Key Performance Indicators
- Mgmt
- Water
- WW
- Customer
- Org
- Maint

O&M Costs Per Connection
- Power: 25%
- Labor: 34%
- Chemical: 16%
- Other: 15%
- Contracts: 10%

Unbillable Water
- Sep-01: 1.4%
- Oct-01: 1.3%
- Nov-01: 1.2%
- Dec-01: 0.8%
- Jan-02: 0.5%
- Feb-02: 0.3%
- Mar-02: 0.1%

Cost to Treat Water ($ per MG)
- Sep-01: $60.00
- Oct-01: $65.00
- Nov-01: $70.00
- Dec-01: $55.00
- Jan-02: $50.00
- Feb-02: $45.00
- Mar-02: $40.00

Overflows: Events per Mile
- Sep-01: 9
- Oct-01: 9
- Nov-01: 7
- Dec-01: 3
- Jan-02: 2
- Feb-02: 2
- Mar-02: 2

Applications
- SCADA
- CMMS
- GIS Maintenance Activity Map
- GIS Distribution System

Email & Administration
- Calendar And Email

Regulatory & Industry Sites
- EPA
- AWWA
- Water Environment Federation
Confidence in the Data is Key to Business Success

- Perform the Metadata analysis (data about data) to ensure that meaningful data is collected.
- Automate data capture to the greatest extent possible.
- Consider potential impact of system component failures in the design to minimize data gaps.
- Map data flow
- Single version of the truth by consistently performing calculations and reporting against the same data.
ODMS Governance

• Who owns the ODMS and data?
• Disaster Recovery and Business Continuity
• Data Validation Policies and Procedures
  • Regulatory, Custody Transfer, Service Level, Production
  • Workflow, Ownership, Sign-off
  • Business rules for discovery and resolution
  • Data quality reports
  • Future – automated data validation
Data Management & Reporting
RDBMS Solutions

- **Oracle**
  - Largest installed base
- **Microsoft SQL Server**
  - 1/2 Municipal Market
- **Middleware**
  - Oracle Fusion
  - TIBCO, WebMethods
- **Reporting & BI**
  - Business Objects Vision
  - Oracle BI, Cognos BI
  - Vantage

- **Advantages**
  - RDBMS is an application enabler
    - Build to meet exact requirements of client
  - Client owns the data model and source code
    - Lower cost of ownership for large systems and long-term
  - Large installed base – significant 3rd party support
  - Optimized for management and access of large databases

- **Disadvantages**
  - Higher risk and cost for initial deployment.
  - The owner has responsibility for ongoing support and enhancements.
  - Specialised skill sets for support.
Data Management & Reporting

Time-Series COTS

- Wonderware Historian
  - Formerly Industrial SQL

- GE Historian
  - Formerly iHistorian

- OSISoft PI

- Advantages
  - Off-the-shelf canned products (low-risk deployment)
  - Tightly integrated with Vendor’s HMI (SCADA Master)
  - Flat-files database optimised for compression and high-speed capture
  - Vendor supplied data mining tool (usually an Excel Add-in)

- Disadvantages
  - Relatively small installed base
  - Limited or non-existent 3rd party support
  - “Canned” solution is restrictive
  - Pricing strategy can be costly long-term and for large systems
  - Database structure not optimised for data mining
Data Management & Reporting

P2P Case Study (Henrico)
Data Management & Reporting *Consolidated Data*

- **Internal Source Systems**
- **External Data Sources**
- **Extract, Transformation and Load**
- **Data Warehouse**
- **Data Mart**
- **Business Intelligence Systems**
Data Management & Reporting

**Middleware**

- **Financial System (ERP)**
- **Asset Management**
- **Performance (BI)**
- **LIMS**

**Drivers**

- EDI
- XML
- Native Drivers
- Others

**Historian Database**
Data Management & Reporting Middleware Case Study (DWSD)