Less Time as Data Collectors and
More Time as Data Users and Analyzers
Anvil Centre, New Westminster, BC
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Agenda

» Workflow, Tasks and being more Efficiency (Effective)
  • What are the things that suck time out of our day?

» Telecom Getting Data Will Not Be a Problem

» ISA 18.2 and ISA 101

» Visualization and what we do today
What are the things that suck time out of your day?

1. Windshield time
2. Paralysis by Analysis or too many tasks
3. Interruptions
Efficiency Vs. Effectiveness

This will go a hundred times faster!

Yeah in the wrong direction...
Efficiency - Understanding the Tasks and Organize to be the most effective

Task - a piece of work to be done or undertaken.

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Meter Reading 1</th>
<th>Meter Reading 2</th>
<th>General Appearance</th>
<th>Initials</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
</tbody>
</table>

Sample Lift Station Inspection Log

Pump Rating (gpm):

Date of most recent pump calibration:

Operator Notes:
A **workflow** is a sequence of tasks that processes a set of data. **Workflows** occur across every kind of business and industry. Anytime data is passed between humans and/or systems, a **workflow** is created. **Workflows** are the paths that describe how something goes from being undone to done, or raw to processed.
Valued Features

- Additional notifications at each step of the process – good option for compliance related monitored tags
- Add additional reports – useful to make troubleshooting flow charts readily available
Creating Rules

Build the Rule

Tag Sampling Mode, Interval
DEWATERING WORK FLOW INVESTIGATION

Please proceed through each step until the action resolves the problem.

Step 1
Contact instrumentation and inorganic to review last calibration of sludge cake density analyzer.
(No calibration necessary continue to step 2)

Step 2
Check operation of sludge cake pipeline lubrication system for correct operation.
(Normal operation verified continue to step 3)

Step 3
Review operational centrifuge cake production total solids for target values.
(If cake dryness below threshold then Centrifuge operation verified continue to step 4)

Step 4
Review laboratory data for sludge cake volatile content in range of 56% if less than 65%

Step 5
Sludge Cake feedstock heating value has changed. Initiate an external laboratory check of raw sludge, digested sludge and blended sludge for ultimate and proximate analysis.

Upon receipt of external analyses, if heating value has decreased discuss adjusting dewatering sludge cake target dryness benchmark to compensate for ensure autogenous operation.
Analysis

“Calculation Engine”

Workflow Process

Notification!
**Email Output**

---

### Autogenous Burn

**Dewatering (Trigger workflow for Incineration or Dewatering, 2019-Oct-04 04:05:00 to 2019-Oct-06 04:04:59)**

<table>
<thead>
<tr>
<th>Task:</th>
<th>Task 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workflow Status:</td>
<td>Incomplete</td>
</tr>
<tr>
<td>Workflow Started By:</td>
<td>e.RIS</td>
</tr>
<tr>
<td>Workflow Started At:</td>
<td>2019-10-07 13:14:10</td>
</tr>
<tr>
<td>Workflow Finished At:</td>
<td></td>
</tr>
<tr>
<td>Additional Information:</td>
<td>Reporting Workflow &quot;Autogenous Burn&quot; triggered by the tag PH.INCIN_DC_INC_T4_AUTO_DAY2_PRCNT_F_CV, with the value 49.79241 %, and the flag D: Dewatering (Autogenous Burn Prediction).</td>
</tr>
<tr>
<td>Notification Text:</td>
<td>Autogenous Operation Out of Desired Range</td>
</tr>
</tbody>
</table>
Telecom Technology Changes Workflow

» Getting data won’t be a problem; 5 G will put gigabit data to every square meter on the planet.

» IP Internet Protocol Changed everything – video voice...Technology Changes Workflow!!!
## Last Mile Connectivity

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Power Level</th>
<th>Data Rate</th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wi-Fi</strong></td>
<td>High power (&gt;500 mW)</td>
<td>High data rate (&gt;100 Mbit/s)</td>
<td>Low distance (10 m indoors)</td>
</tr>
<tr>
<td><strong>Bluetooth Low Energy</strong></td>
<td>Lower power (10 mW)</td>
<td>High data rate (1 Mbit/s)</td>
<td>Low distance (10 m indoors)</td>
</tr>
<tr>
<td><strong>Zigbee</strong></td>
<td>Low power (50 mW)</td>
<td>Medium data rate (250 kbit/s)</td>
<td>Medium distance (25 m indoors)</td>
</tr>
<tr>
<td><strong>Enocean</strong></td>
<td>Low power (50 mW)</td>
<td>Medium data rate (125 kbit/s)</td>
<td>Medium distance (50 m indoors)</td>
</tr>
<tr>
<td><strong>LoRa</strong></td>
<td>Medium power (100 mW)</td>
<td>Low data rate (1 kbit/s)</td>
<td>High distance (500 m indoors)</td>
</tr>
</tbody>
</table>
5G Technology is Driven by 8 Specification Requirements

- Up to 10Gbps Peak data rate uplink and 20Gbps downlink - > 10 to 100x improvement over 4G and 4.5G networks
- Spectral efficiency if 15 bit/s/Hz
- User experience target is 100Mbps downlink and 50Mbps uplink
- 1-millisecond latency Ultra Reliable (some specs are 0.5 msec) (4 msec enhanced mobile broadband)
- 1000x bandwidth per unit area
- 1,000,000 devices per km²
- 99.999% availability (Make before break) (currently 30 msec under 4G)
- 100% coverage
- 90% reduction in network energy usage
- Up to 10-year battery life for low power IoT devices
- 20msec wake time
Telecom 5G

- **Geostationary Orbit (GEO)** - 250-280 milliseconds
- **Medium Earth Orbit (MEO)** - 110-130 milliseconds
- **Low Earth Orbit (LEO)** - 20-25 milliseconds

**Note:** Not drawn to scale
Current Satellite Technologies

Leo

Geo

Iridium
210 Kbps
890 - 1750 Latency

Hughes Net
50.3 Mbps
750 Latency

BGAN
492 kbps
750 Latency
https://www.asc-csa.gc.ca/eng/satellites/cubesat/what-is-a-cubesat.asp
HOW HEAVY IS A SATELLITE?

LARGE SATELLITE
- RADARSAT-2: >1000 kg
- RHINO

MEDIUM SATELLITE
- CASSIOPE: 500-1000 kg
- BUFFALO

MINI SATELLITE
- SCISAT: 100-350 kg
- LION

MICRO SATELLITE
- M3MSat: 10-100 kg
- WOLF

NANO SATELLITE including CUBESAT
- Ex-Alta 1: 1-10 kg
- RACCOON
- DUCK

Note: These weights are approximations.
5G Over Satellite

- **5G Technology is Driven by Specification Requirements**
- Up to 10Gbps Peak data rate uplink and 20Gbps downlink -> 10 to 100x improvement over 4G and 4.5G networks
- Spectral efficiency if 15 bit/s/Hz
- User experience target is 100Mbps downlink and 50Mbps uplink
- 1-millisecond latency Ultra Reliable (some specs are 0.5 msec) (4-msec enhanced mobile broadband) 50 Milliseconds
- 1000x bandwidth per unit area
- 1,000,000 devices per km²
- 99.999% availability (Make before break)
- 100% coverage
- 90% reduction in network energy usage
ISA 18.2 Better Visualization 15 min

Alarm Counts

Alarm Priorities

Alarm Floods

Identify Bad Actors

271 minutes

Average Flood Length
2018-Feb

1.2

Average Floods per Day
2018-Feb

Alarm Counts

Alarm Priorities

BCWWA

www.bcwwa.org
Address the design, implementation, and maintenance of human machine interfaces (HMIs) for process automation systems, to:

- Provide guidance to design, build, and maintain HMIs which result in more effective and efficient control of the process, in both normal and abnormal situations
- Improve the user’s abilities to detect, diagnose, and properly respond to abnormal situations
- Look at the HMI holistically - not just the display

Standards are the “What”
Technical Reports and Recommended Practices are the “How”
Visualization – What do we do with all this data?

SCADA - real-time operations, includes:
• Alarming
• Visualization
• Trending
• Historization
• Operator interface
• Calculations
• Reporting
• Connectivity via industrial protocols

Aggregate System - consolidation of multiple system, includes:
• Alarming
• Visualization
• Trending
• Operator interface
• Calculations
• Data Transforms
• Historization i.e. OSI PI
Let’s Talk SCADA

Principles

» HMIs of the past
  • Primarily schematic / pictorial
  • Inconsistent / Distracting use of color
  • Number sprinkling
  • No/limited use of trends
  • Encouraged operating “by alarm”

» Poor HMIs are a contributing factor to major accidents
Principles

» High Performance HMIs
  • Use of color to attract attention
  • Redundant Coding of state information (Text Description + Graphics)
  • Glance Widgets – Identify abnormal values at a Glance
  • Trends to provide Context
  • Alarm information is clearly displayed
Operate by exception
Display Organization

Quad / Single Monitor Views
Glance Widgets – Identify importance of data quickly

<table>
<thead>
<tr>
<th>Blood Tests for Fluffy -1</th>
<th>Blood Tests for Fluffy -3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Test</strong></td>
<td><strong>Results</strong></td>
</tr>
<tr>
<td>HCT</td>
<td>31.7%</td>
</tr>
<tr>
<td>HGB</td>
<td>10.2 g/dl</td>
</tr>
<tr>
<td>MCHC</td>
<td>32.2 6/dl</td>
</tr>
<tr>
<td>WBC</td>
<td>9.2 x10^9/L</td>
</tr>
<tr>
<td>GRANS</td>
<td>6.5 x10^9/L</td>
</tr>
<tr>
<td>U/M</td>
<td>2.7 x10^9/L</td>
</tr>
<tr>
<td>PLT</td>
<td>310 x10^9/L</td>
</tr>
</tbody>
</table>

Answer: Unless you are vet, how can you know?
High Performance Graphics
Alarming

Priority 1 (Highest)

Priority 2

Priority 3 (Lowest)

Priority 4 (Diagnostic Level)
Trends provide context to make decisions
Navigation – Operating Procedures or Workflow

(L4 Example – Specialized task-based display) Pump Start-up

**Water Injection System - REDA Injection Pump Start-up Procedure**

- **Set South Boot 70-PIC-287 into Manual at 5% Open**
- **Set North Boot 70-PIC-290 into Manual at 5% Open**
- **Set deviations to max set point**
- **Downstream Pressure MUST be above 10,000 paa with 5 minutes or REDAS shut down**

**Startup 2 Charge pumps**

Wait for pressure to stabilize

**Start 1st REDA**

Adjust 287-290 PIC outputs (CV %) so upstream pressures (286, 289) are 10,500kPa or lower

**Start 2nd REDA**

Adjust 287-290 PIC outputs (CV %) so upstream pressures (286, 289) are 11,000kPa or lower

**Start 3rd REDA**

Adjust 287-290 PIC outputs (CV %) so upstream pressures (286, 289) are 11,000kPa or lower

**Start 4th REDA**

Adjust 287-290 PIC outputs (CV %) so downstream pressures are 12,400kPa or lower

**Start 5th REDA**

If starting 5th REDA proceed to next step

If NOT starting 6th REDA:

Once pressures (287, 290) have stabilized, slowly Adjust 287-290 PIC outputs until the pipeline pressures (287, 290) are within 100kPa of the set points (set both to 15500kpa) then put control loops (287, 290) into auto

**Start 6th REDA**

Ensure PICs 287-290 are in manual and adjust the PIC outputs (CV %) so downstream pressures (226-289) pressure is 14,700kPa lower. If (286-289) pressures are above 14,700kPa you cannot start the 6th REDA
Navigation Maps

[Diagram of a computer interface with a map and various legends and controls]
Navigation – Grids Instead of Maps

<table>
<thead>
<tr>
<th>Production Wells</th>
<th>Site Display</th>
<th>Flowline Pressure</th>
<th>Pumpjack Min Load</th>
<th>Pumpjack Peak Load</th>
<th>Pumpjack Runtime</th>
<th>Pumpjack Speed</th>
<th>Tubing</th>
</tr>
</thead>
<tbody>
<tr>
<td>2B2-25-5-11#3B12-25-5-11</td>
<td>Open</td>
<td>7320.0</td>
<td>19520.0</td>
<td>100.0</td>
<td>5.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2B3-21-6-10#2D3-20-6-10</td>
<td>Open</td>
<td>4180.0</td>
<td>16570.0</td>
<td>100.0</td>
<td>6.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2B6-31-5-10#1C6-32-5-10</td>
<td>Open</td>
<td>4870.0</td>
<td>19360.0</td>
<td>0.0</td>
<td>6.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2C9-31-5-10#4D14-31-5-10</td>
<td>Open</td>
<td>0.0</td>
<td>40000.0</td>
<td>0.0</td>
<td>6.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2D3-5-6-10#3C9-32-5-10</td>
<td>Open</td>
<td>4710.0</td>
<td>16910.0</td>
<td>100.0</td>
<td>6.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2D3-8-6-10#2D15-5-6-10</td>
<td>Open</td>
<td>2302.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2D6-36-5-1#3B13-310-5-10</td>
<td>Open</td>
<td>5540.0</td>
<td>14620.0</td>
<td>100.0</td>
<td>4.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2D6-5-6-10#4B4-8-6-10</td>
<td>Open</td>
<td>4790.0</td>
<td>9810.0</td>
<td>51.1</td>
<td>6.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3A3-17-6-10#2B6-16-6-10</td>
<td>Open</td>
<td>772.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3A9-8-6-10#1C3-5-6-10</td>
<td>Open</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3A3-7-6-10#4C4-8-6-10</td>
<td>Open</td>
<td>3690.0</td>
<td>10190.0</td>
<td>42.0</td>
<td>6.0</td>
<td></td>
<td></td>
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<tr>
<td>3B10-20-6-10#4B12-22-6-10</td>
<td>Open</td>
<td>9140.0</td>
<td>13220.0</td>
<td>67.2</td>
<td>6.1</td>
<td></td>
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<tr>
<td>3B13-31-5-10#2D14-36-5-11</td>
<td>Open</td>
<td>6270.0</td>
<td>13350.0</td>
<td>56.6</td>
<td>5.8</td>
<td></td>
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<tr>
<td>3B13-32-5-10#2D11-32-5-10</td>
<td>Open</td>
<td>7130.0</td>
<td>13820.0</td>
<td>100.0</td>
<td>6.8</td>
<td></td>
<td></td>
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<tr>
<td>3C11-32-5-10#4D1-6-16-10</td>
<td>Open</td>
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<td>18220.0</td>
<td>60.4</td>
<td>6.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3C15-5-6-10#4A15-9-6-10</td>
<td>Open</td>
<td>5100.0</td>
<td>18770.0</td>
<td>98.0</td>
<td>5.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3C7-9-5-10#3A12-9-6-10</td>
<td>Open</td>
<td>5340.0</td>
<td>10260.0</td>
<td>100.0</td>
<td>4.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3D14-7-10#3D16-10-6-10</td>
<td>Open</td>
<td>4510.0</td>
<td>15420.0</td>
<td>91.4</td>
<td>5.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3D3-21-6-10#B10-20-6-10</td>
<td>Open</td>
<td>1035.5</td>
<td>4640.0</td>
<td>18940.0</td>
<td>64.9</td>
<td>7.1</td>
<td></td>
</tr>
<tr>
<td>4A1-8-6-10#4A7-8-6-10</td>
<td>Open</td>
<td>942.9</td>
<td>4030.0</td>
<td>12230.0</td>
<td>69.6</td>
<td>6.6</td>
<td></td>
</tr>
</tbody>
</table>
Trends

- Analog graph
- Digital graph
- Time scale and slider
- Toolbar

Inflow Rates
- Tag Selection
- Export
- Time Span
- Pan & Zoom
- View
- Note

Table:

<table>
<thead>
<tr>
<th>Pen</th>
<th>Name</th>
<th>Description</th>
<th>Value</th>
<th>Maximum</th>
<th>Minimum</th>
<th>Average</th>
<th>Starts</th>
<th>On Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tank Level</td>
<td>Monitor tank level</td>
<td>9.5</td>
<td>91.3</td>
<td>48.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Running State Pump running status</td>
<td></td>
<td>0</td>
<td>1</td>
<td>0.449</td>
<td>12</td>
<td>809</td>
<td></td>
</tr>
</tbody>
</table>

Plot:
- Grid
- Notes

Choose what to display
Access pen properties

Hide pen
Remove pen

Tag list with statistics for the visible time frame.
**Trends**

**Grid View – Data Retrieval Mode**

<table>
<thead>
<tr>
<th>Time</th>
<th>Midale\Plant\Treaters\HT-8003\10T1092 HT-8003 Temperature</th>
<th>System Notes System Notebook</th>
<th>Midale\Plant\Treaters\HT-8004\10T1110 HT-8004 Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug 25 15:30:06.618</td>
<td>39.401</td>
<td></td>
<td>38.681</td>
</tr>
<tr>
<td>Aug 25 15:34:33.900</td>
<td>39.401</td>
<td></td>
<td>41.557</td>
</tr>
</tbody>
</table>
Alarms

Alarm Page

» Always open in the top right window or in the Alarms tab of single headed workstation

- Acknowledge All displayed Alarms
- Acknowledge selected Alarm
- Shelve selected Alarm
- If History is selected control date range.
- Define a filter
- Show Shelved Alarms
- Silence Alarms until the next occurs
- Simple Text Filter Clear using the X
- Silence Alarms for a defined period of time

Priority

Ack Button

Current State

Alarm Reports and Statistics (Useful to identify bad actors)

Add a note to this alarm

Press to Open this L2
Augmented Reality – Hololens
The Aggregator

Manual Data Entry

SCADA

LIMS

Other Data Sets

~ ONE DAY

GIS

CMMS

AI

Visualize Information

Analyze Information

Manage Information

Sources

Connectors

Virtual Appliance

Cloud

Public / IIoT

www.bcwwa.org
Things an Agregator May Do

Dashboards

Ad Hoc Data Queries & Trends

Reports

Manual Data Entry

Data Validation

Alarm Management
Logging Voice and Pictures for Offline Data

Mobile Entry
Analytics for Line Break

Zone X Pressure and Flow on April 28

Main break called in

Lead Times
Plant
Public

Hydrant 1

Hydrant 2

www.bcwwa.org
Leak Detection (using Acoustic Analysis)

Pre-Leak... or Leak... April 8, 2019
Leak Detection (using Acoustic Analysis)

Leak!
April 9, 2019
Alarm Management and Event will be centralized across the cloud and all systems.

Alarms and events need to be dispatched at a minimum with one protocol so that when someone goes on vacation alarms can be rerouted.
Future Concept: Alarm Management and Event will be centralized across the cloud and all systems

Alarms and events need to be dispatched at a minimum with one protocol so that when someone goes on vacation alarms can be rerouted.
Analytics in the field
Summary

» 1. Data is data it’s all IP (voice, video, email, texting)...it’s how we use it...connectivity will not be an issue

» 2. Augmented Reality – lets us virtualize anywhere and we can operate by exception...process more data with less effort

» 3. Speech to text and voice interaction is here

» 4. Video conferencing allowing the parties to see and hear what we see – Real time assist

» 5. Video analytics, picture analytics is still developing

» 6. Drones and autonomous vehicles are still developing

» We are missing common standards and best practices to categorize our data, do we do it in the cloud or on the edge?
References


» TED. (2013, June 11). The astounding athletic power of quadcopters | Raffaello D'Andrea [Video file]. Retrieved from https://www.youtube.com/watch?v=w2ItwFJCgFQ

» RT. (2018, October 8). SpaceX Falcon 9 launches satellite, brings rocket back in historic landing [Video file]. Retrieved from https://www.youtube.com/watch?v=dj1hV5hZqQU


» BettsM Controls Inc. (2017, May 3) VTScada Video Analytic Drone [Video file]. Retrieved from https://www.youtube.com/watch?v=H8yzeff2UhkA