What are you doing with that data?

Is it useful? Is it VALUABLE?

Optimization  Efficiency  Reliability
Background

Data Requests
Kinds of Data

- Flow Rate (L/s, m³/min, gpm)
- Temperature (differential, absolute, Celsius, Fahrenheit)
- Power (kW, hp) or Energy (kWh, btu)
- Pressure (kPa, psi)
- Valve position
- Equipment information
- Flue gas
- Fuel or energy consumption
- Outdoor temperature, windspeed, humidity
- …more?
The VALUE of DATA depends on the QUALITY

Quality: “the standard of something as measured against other things of a similar kind”

The quality of data you need is driven by the purpose
- Billing
- Controls
- Decision making
The Wrong Type of Data

Thermodynamics – Specific Heat Capacity

\[ Q = mc \Delta T \]

Head/Pressure Loss Equations

\[ \frac{\Delta P}{L} = fD \frac{\rho v^2}{2D} \]

\[ v = C \sqrt{\frac{D \Delta P}{4L}} \]

Mass/Volume Flow

Temperature

Pressure
Data Quality

The Wrong Location
The Ideal Data

Flow: 160 L/s
Temperature: 90°C / 50°C
Pressure: 100 psi / 10 psi

Flow: 80 L/s
Temperature: 90°C / 40°C

Flow: 20 L/s
Temperature: 90°C / 54°C

Flow: 60 L/s
Temperature: 90°C / 62°C
Pressure: 90 psi / 20 psi
The Wrong Time

- Cumulative vs Instantaneous
- Peaks vs Average

<table>
<thead>
<tr>
<th>Month</th>
<th>Building A Energy Consumption (MWh)</th>
<th>Building B Energy Consumption (MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>November</td>
<td>71</td>
<td>198</td>
</tr>
<tr>
<td>December</td>
<td>86</td>
<td>257</td>
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<tr>
<td>January</td>
<td>79</td>
<td>234</td>
</tr>
<tr>
<td>February</td>
<td>73</td>
<td>211</td>
</tr>
<tr>
<td>March</td>
<td>68</td>
<td>182</td>
</tr>
</tbody>
</table>
The Wrong Time

- Sampling Rate
- Sampling Time

<table>
<thead>
<tr>
<th>Sample Time</th>
<th>Volumetric Flow Rate (L/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct-29 16:46</td>
<td>1.55</td>
</tr>
<tr>
<td>Oct-29 17:16</td>
<td>1.66</td>
</tr>
<tr>
<td>Oct-29 17:46</td>
<td>1.64</td>
</tr>
<tr>
<td>Oct 29 18:16</td>
<td>1.42</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample Time</th>
<th>Return Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018-09-28 16:01</td>
<td>40.56</td>
</tr>
<tr>
<td>2018-09-28 16:31</td>
<td>46.61</td>
</tr>
<tr>
<td>2018-09-28 17:01</td>
<td>45.59</td>
</tr>
<tr>
<td>2018-09-28 17:31</td>
<td>44.37</td>
</tr>
</tbody>
</table>
Data Quality

The Data is just WRONG
Data Quality

“Good” Data

- Supply Temperature
- Return Temperature
- Supply Pressure
- Return Pressure
- Outdoor Air Temperature
- Volumetric Flow
Data Quality

“Good” Data

Supply Temperature — Return Temperature — Supply Pressure — Return Pressure — Outdoor Air Temperature — Volumetric Flow
Data Quality

“Good” Data

- Supply Temperature
- Return Temperature
- Supply Pressure
- Return Pressure
- Outdoor Air Temperature
- Volumetric Flow
Data Quality

"Good" Data

- Temperature (°C) / Pressure (psi)
- Supply Temperature
- Return Temperature
- Supply Pressure
- Return Pressure
- Outdoor Air Temperature
- Volumetric Flow

- Oct 13 to Oct 20:
  - Mon, Tues, Wed, Thurs, Fri, Sat, Sun
Data Quality

“Good” Data

- Supply Temperature
- Return Temperature
- Supply Pressure
- Return Pressure
- Outdoor Air Temperature
- Volumetric Flow
Cycle of Data

- Gather
- Analyze
- Predict
- Implement
Gather

**Inventory & Calibrate**
- Improve current sensors
- Remove redundancy

**Install New Equipment**
- Balancing Cost / Accuracy / Maintenance

**Record & Archive**
- Centralized storage with back-up
- New cloud based storage with analytics & web based access
Analyze

- Build an understanding of the system
- Create a thermal-hydraulic model
Predict

- Identify losses / inefficiencies
  - Leaks & heat loss
  - Building performance
  - Locate & quantify
- Solve operational challenges
  - Low/insufficient pressure areas
  - Cycling equipment
Predict

• Plan for future expansion
  • Design pipes & pumps
• Real-time monitoring
• Predictive modelling
  • Plan preventative maintenance
  • Optimize equipment dispatch & staging
  • Reduce heat loss by up to 10%
  • CO₂ emissions by 2-5%
Implement

Gather

Analyze

Predict

Implement
Summary

Optimization
Efficiency
Reliability
Questions?

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