DATA INTEGRATION FOR UTILITIES AND ENERGY

APPA INSTITUTE FOR FACILITIES MANAGEMENT
FT. WORTH, TX
JANUARY 11, 2023

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

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TODAY'S PRESENTATION

- Course Description:
- This course explores:
  - We will discuss our needs for data, and how we can share our data with our institution's vast data resources. Facilities Management energy, maintenance, financial, space management and other data is fast becoming another sought-after campus utility that should be available to the entire institution in an integrated, globally acceptable manner. To do our jobs, it's not enough to just know how to use data applications, we need to understand how an integrated, easily accessible "data warehouse" can optimize the performance of those applications.
- Learning Objectives:
  1. Become familiar with database structures
  2. Become familiar with integrating databases
  3. Learn how this can be useful to those who work in FM
  4. Think about how to convert data into information
  5. Begin to think about how the various sources of data in your institution can be integrated and used.

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PURPOSE OF TODAY'S PRESENTATION

- To provide a broad understanding of:
  - Data Warehouses/Data Marts
  - How to collect the data
  - How to convert data into information

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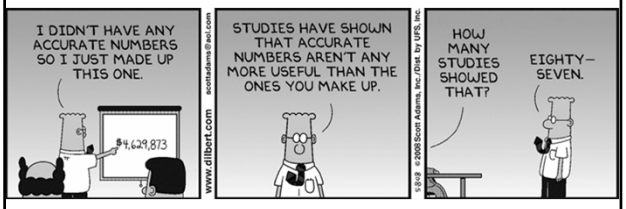
WORDS OF WISDOM



If you torture the data enough, it will confess to anything.

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DISCUSSION

- Create a report of energy consumption and cost for each building owned by your institution:
  - If served by a District Energy System or local system(s):
    - Chilled Water
    - Steam or Hot Water
    - Electricity
    - Water
    - Fuel-Gas/Oil/Coal
  - If served by the local utility
    - Electricity
    - Fuel-Gas/Oil/Coal
    - Water
  - This year versus last year information:
    - Consumption and cost
    - Hours used and weekly schedule
    - Average number of occupants, i.e. staff, students, faculty
    - Square footage of building including classification(s), i.e. instructional space, administrative, research, housing, etc.
    - Departmental ownership
    - Weather, e.g. average temperatures, % sun, etc.
    - HVAC system type

WHERE WOULD YOU GET THE INFORMATION TO PRODUCE THIS REPORT?

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THE DATA PROBLEM

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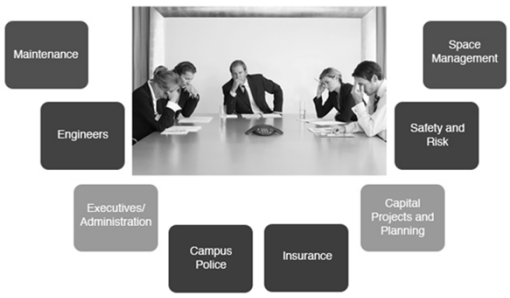
THE PEOPLE PROBLEM



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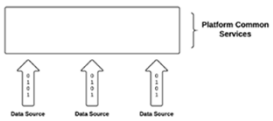
Platform Concept



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Platform Concept

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Platform Concept

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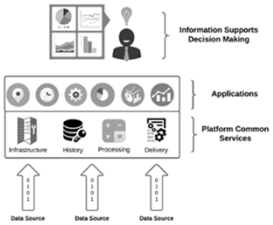
Platform Concept



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Benefits of Connected Systems

Generation Facility
- View key plant data outside the control room without affecting production
- Remote assistance for inexperienced operators with unique and challenging situations

Customer (building operator)
- Understand energy usage and invoicing
- Relate external data to usage (like weather data)
- Integrate building automation system (BAS) data into a single dashboard

Mobile Worker
- Save time and money by automating meter-reads
- Have access to customer operations data any-time, any-where.

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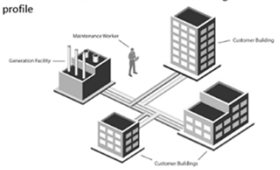
Benefits of Connected Systems

District Energy System Operator
- Improve accuracy and timeliness of billing
- Assist customers develop energy saving strategy
- Provide customers access to real-time and historical operations data without a security risk
- Incorporation of 'meta-data' allows customers to rank themselves against others of their same profile



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Utilities & Energy Management Information System (UEMIS):

Convert DATA into INFORMATION
Convert INFORMATION into KNOWLEDGE

- Gather dispersed and disparate utility related data from multiple sites, multiple suppliers and different types of equipment.
- Validate the data and manage missing or erroneous data.
- Convert the raw data into usable management information, particularly meaningful Key Performance Indicators (KPIs).
- Generate meaningful, added-value reports that include the analysis of trends and exceptions.
- Distribute the analyses and reports across multiple sites, internally and externally, in a timely fashion.

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INTEGRATE THE DATA

Data Warehouse operates on an enterprise level and contains all data used for reporting and analysis, while **Data Mart** is used by a specific business department and is focused on a specific subject (business area).

- Aggregate data into a single centralized repository available to all authorized stakeholders
- Integrate the data into consistent subject categories based on how users refer to them
- Apply consistent value representation, units, and descriptors to the data

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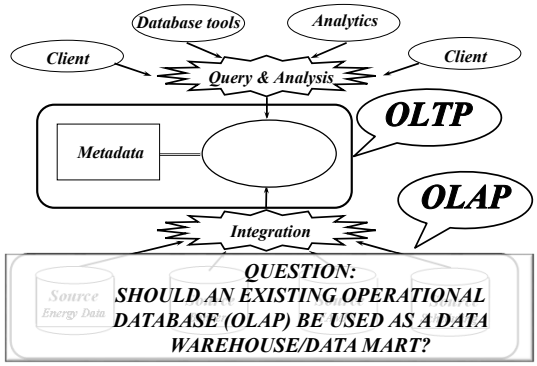
DATA WAREHOUSE/DATA MART ARCHITECTURE



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QUERY THE DATA

- Use IT database management tools to create "views" of data organized for use by reporting software (clients).
- Apply analytics, e.g. machine learning methods, artificial intelligence (AI), etc. to extract information from data subsets

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CONVERT DATA TO INFORMATION

- Microsoft Office
- Third party reporting tools and applications
- Analytics, AI
- Web applications

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GROUP DISCUSSION

- What data is collected by other functions in your organization that you can/want to use?
- What data is collected institutionally that can be used to meet your needs?
- What formats does the data require, i.e. spreadsheet, dashboard, formal reports, etc.?
- How can we convert the data into information in the required format(s)?

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EXAMPLE APPLICATIONS

- Convert INFORMATION into KNOWLEDGE
  - Operational and Decision Support
  - Analytics, AI, Fault Detection
  - Reporting

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AUTOMATED LOGIC
BUILDING UTILITY METERING PANEL
Centennial_Engineering
VALUES
SETPOINTS
ALARMS
Go To:
Chilled Water
Natural Gas & Dom. Water
Steam & Condensate
Elec. Bumps
All Alarms
Main BUMP Front
Utilities Map

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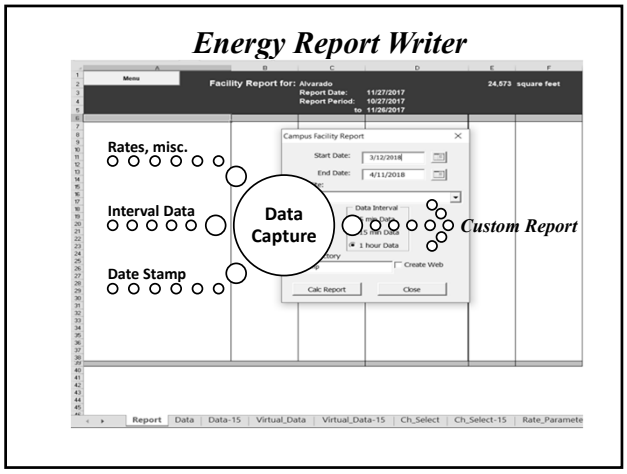
Energy Report Writer
Facility Report for: Alvarado
Report Date: 11/27/2017
Report Period: 10/27/2017
to: 11/26/2017
24,573 square feet
Campus Facility Report
Start Date: 3/12/2018
End Date: 4/11/2018
Data Interval
1 hour Data
Create Web
Calc Report
Close
Rates, misc.
Interval Data
Date Stamp
Data Capture
Custom Report
Report
Data
Data-15
Virtual_Data
Virtual_Data-15
Ch_Select
Ch_Select-15
Rate_Paramete

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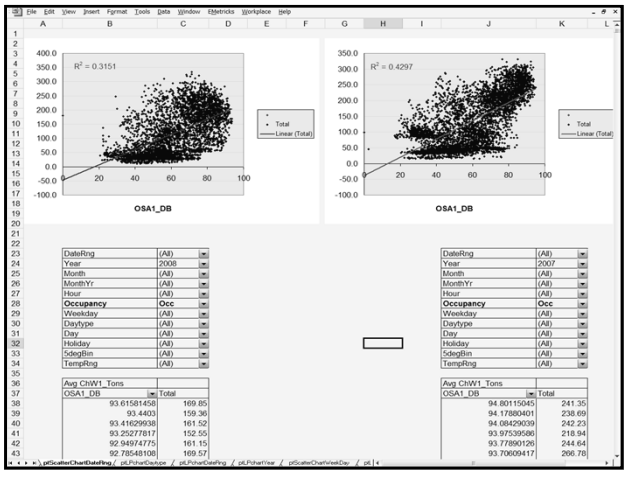
R² = 0.3151
R² = 0.4297
OSA1_DB
OSA1_DB
DateRng (All)
Year 2008
Month (All)
MonthYr (All)
Hour (All)
Occupancy Occ
Weekday (All)
Daytype (All)
Day (All)
Holiday (All)
5degBin (All)
TempRng (All)
Avg ChW1_Tons
OSA1_DB Total
93.61581458 169.85
93.4403 159.36
93.41629938 161.52
93.25277817 152.55
92.94974775 161.15
92.78548108 169.57
DateRng (All)
Year 2007
Month (All)
MonthYr (All)
Hour (All)
Occupancy Occ
Weekday (All)
Daytype (All)
Day (All)
Holiday (All)
5degBin (All)
TempRng (All)
Avg ChW1_Tons
OSA1_DB Total
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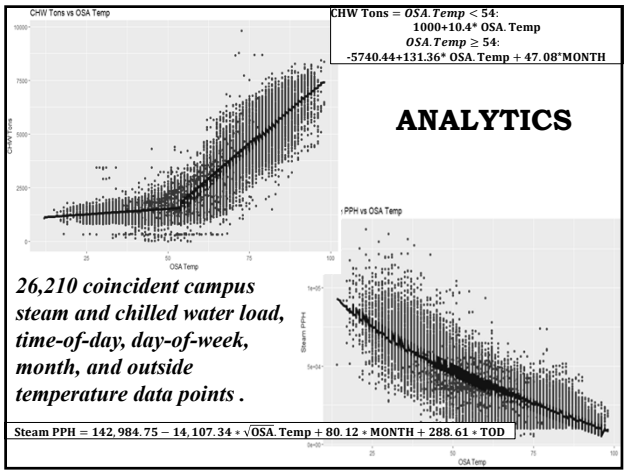

$$\text{CHW Tons} = \begin{cases} OSA.Temp < 54: & 1000 + 10.4 * \text{OSA. Temp} \\ OSA.Temp \geq 54: & -5740.44 + 131.36 * \text{OSA. Temp} + 47.08 * \text{MONTH} \end{cases}$$

ANALYTICS

26,210 coincident campus steam and chilled water load, time-of-day, day-of-week, month, and outside temperature data points .

$$\text{Steam PPH} = 142,984.75 - 14,107.34 * \sqrt{\text{OSA. Temp}} + 80.12 * \text{MONTH} + 288.61 * \text{TOD}$$

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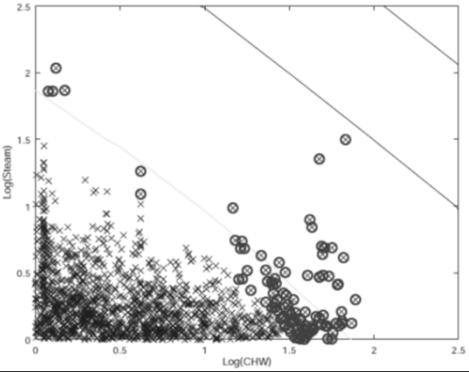
ANALYTICS
FAULT DETECTION AND DIAGNOSTICS



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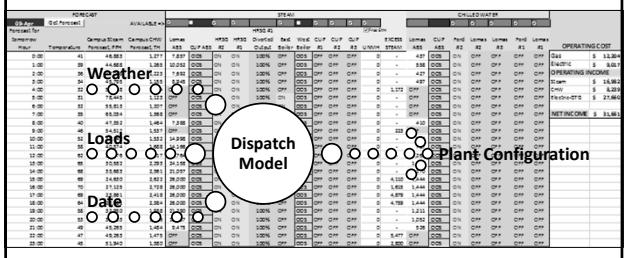
Operational and Decision Support



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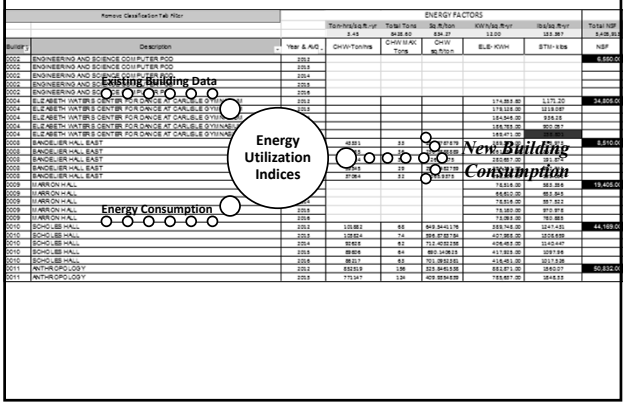
Operational and Decision Support



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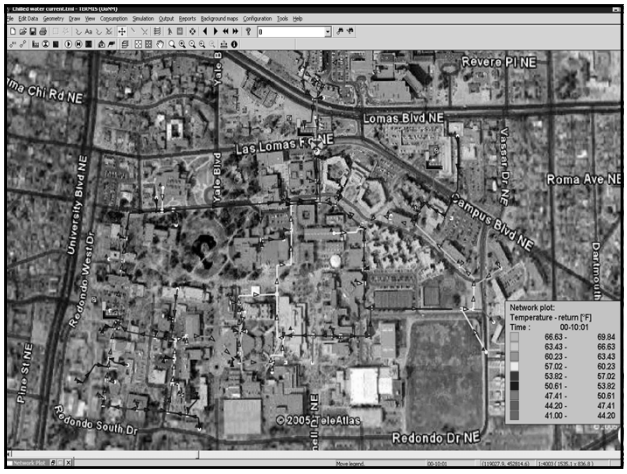

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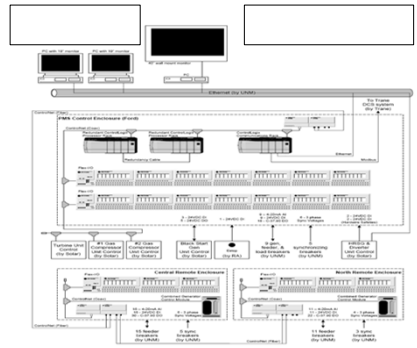
QUESTIONS & ANSWERS

Thank You!



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THIS CONCLUDES THE AMERICAN INSTITUTE OF ARCHITECTS CONTINUING EDUCATION SYSTEMS COURSE

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