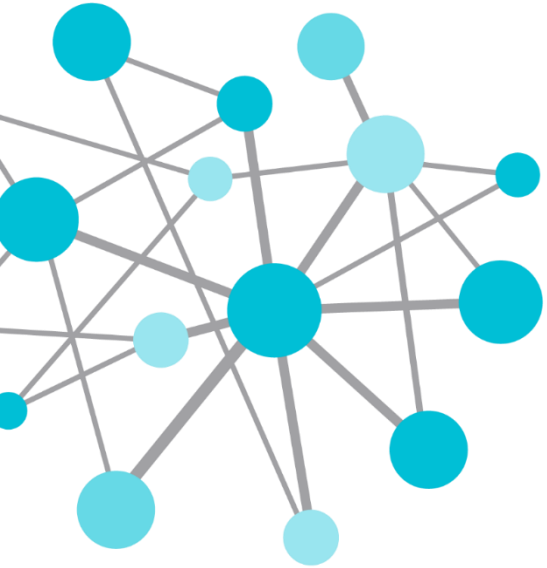


Unlock Data Insight with Machine Learning and Future Data

Presented by **Bertrand Lasternas,**
Center for Building Performance and Diagnostic

Carnegie Mellon University

Background: Carnegie Mellon University

Founded in 1900 by Andrew Carnegie

12,991 Students (6223 undergraduate)

CMU annual energy budget over $20M

That's over $1,600 per year per student!

Goal:

CMU to be a leading university in sustainability

About 6.500 000 sqft
65 + Buildings
80 000 data points

Challenges

- Monitor, diagnose and optimize building performance in real time
- Predict faults and system failures

Solutions

- Use advance machine learning solution for predictive analytics
- Predict / forecast / anticipate systems performance

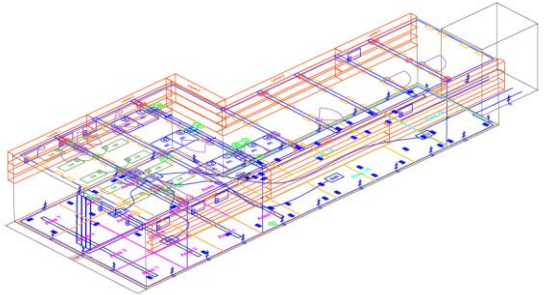
The Intelligent Workplace

The Robert L. Preger Intelligent Workplace, built in 1997, is a 7000 square foot living laboratory of office environments and innovations located on the campus of Carnegie Mellon University.

Test and Integration of several systems:

- Heating
- Cooling
- Ventilation (mechanical and natural)
- Lighting, and day-lighting
- Electrical
- Plug load

View of the sensors/actuators density 1500+



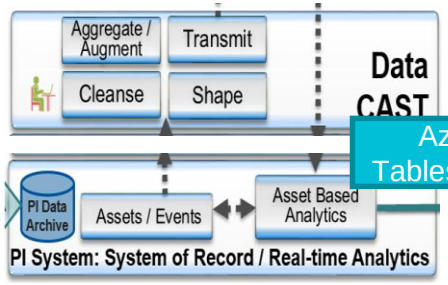
Why didn’t we save energy?

- We had no idea what we were using
- We had no idea how important it was
- There was no easy way to change outcomes
- We could not do numbers

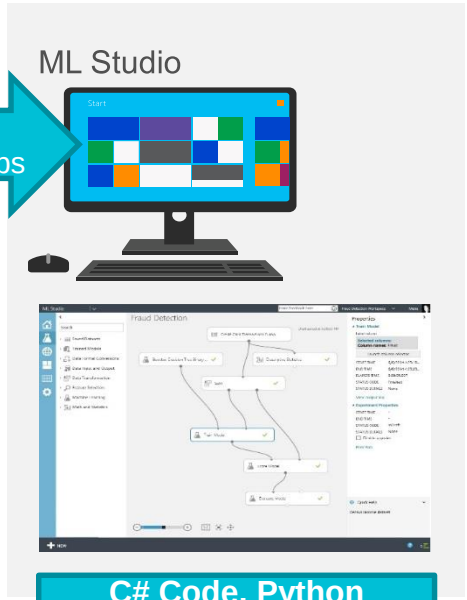
What are the steps?

1. **Integrate all information**
2. Continuously **monitor and diagnose** building performance
3. Make information accessible to **Facility Managers and Executives**
4. Display information for **Building Occupants**
5. Display information for **the Public (Disclosure)**
6. Enable Building Occupants to **control their environment**

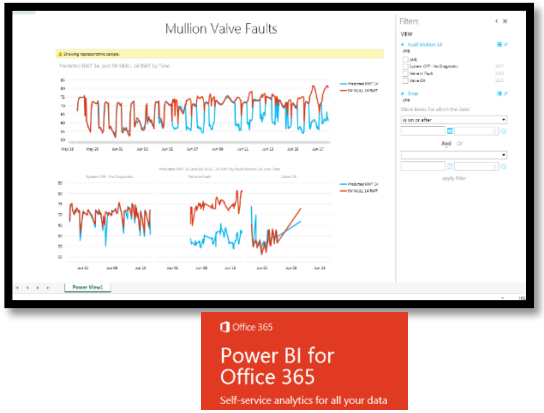
CMU Intelligent Workspace

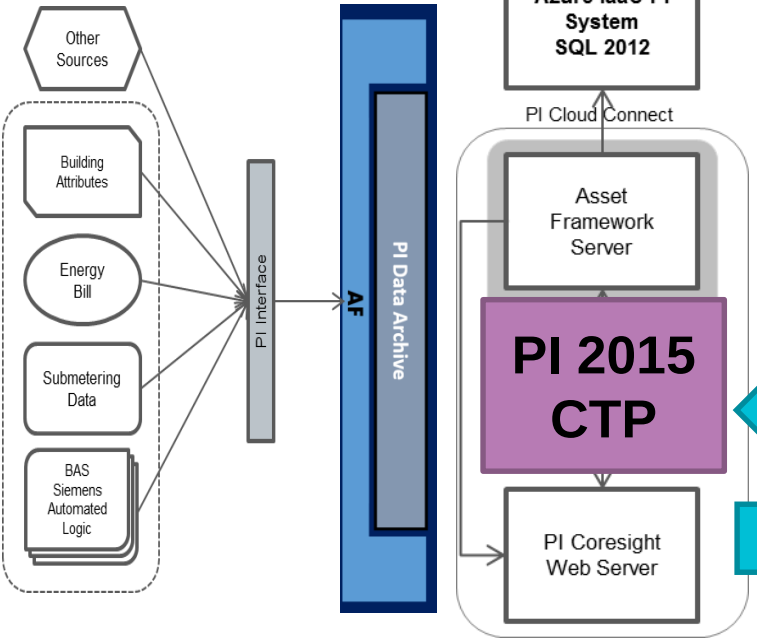


Azure Tables/Blobs



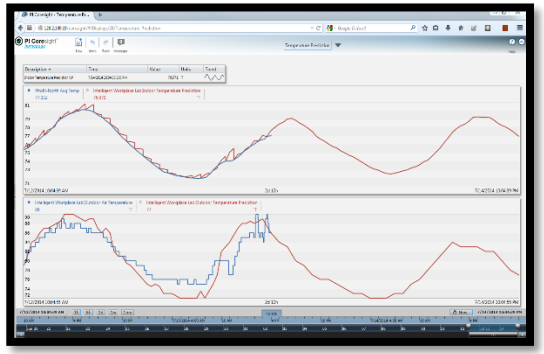
C# Code, Python Script, R, AzureML API





Future Data / Predictions

Plotting Real-time and Future Data



PI Coresight

Fault Detection and Diagnostic (Predictive Maintenance)

1/Collect Data Real-Time

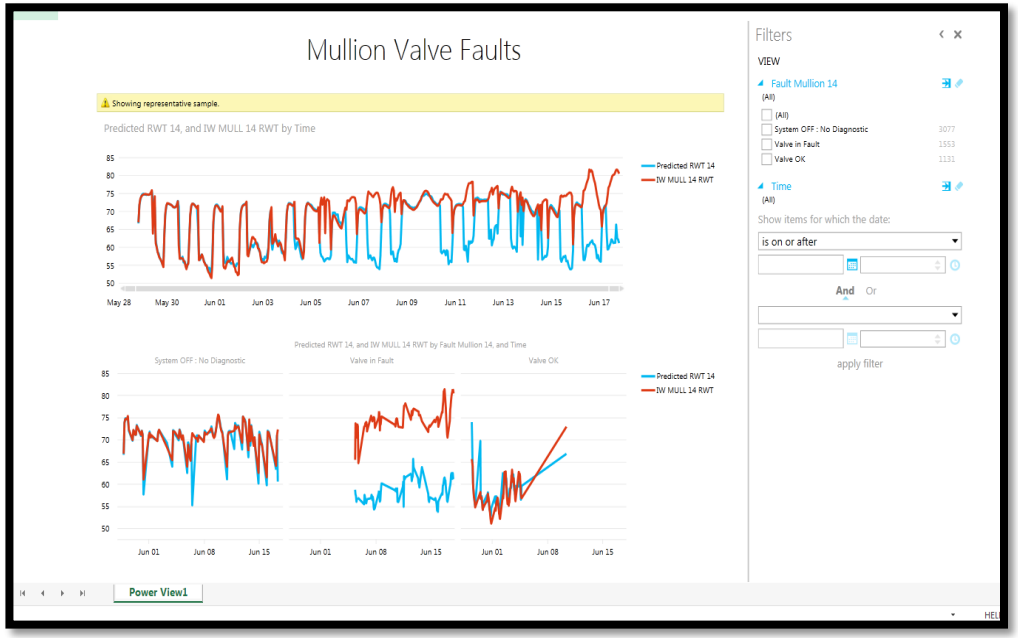
2/ Train Model against baseline

3/ Predict (project) baseline behavior

4/ Measure variation between prediction and measured behavior

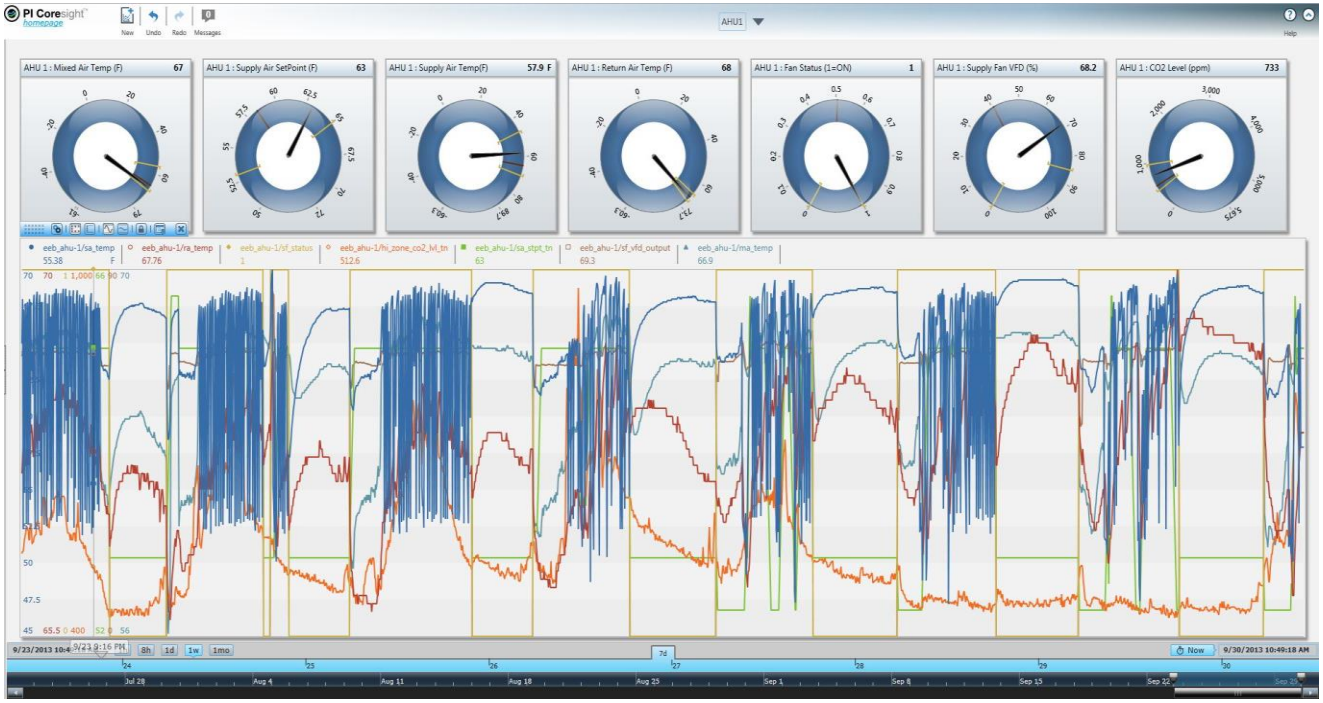
5/ Trigger notification, corrective actions

Save Time, Money, and Energy

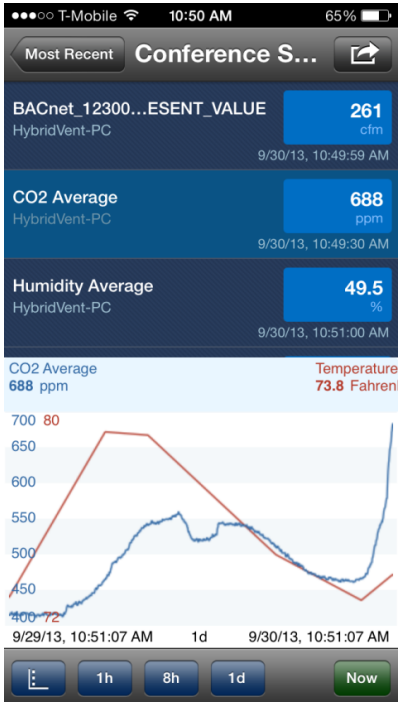


Power BI for Office365

Tablet-toting (mobile) field service



Online webpage and tablets interface



iPhone interface

Temperature and Energy Prediction

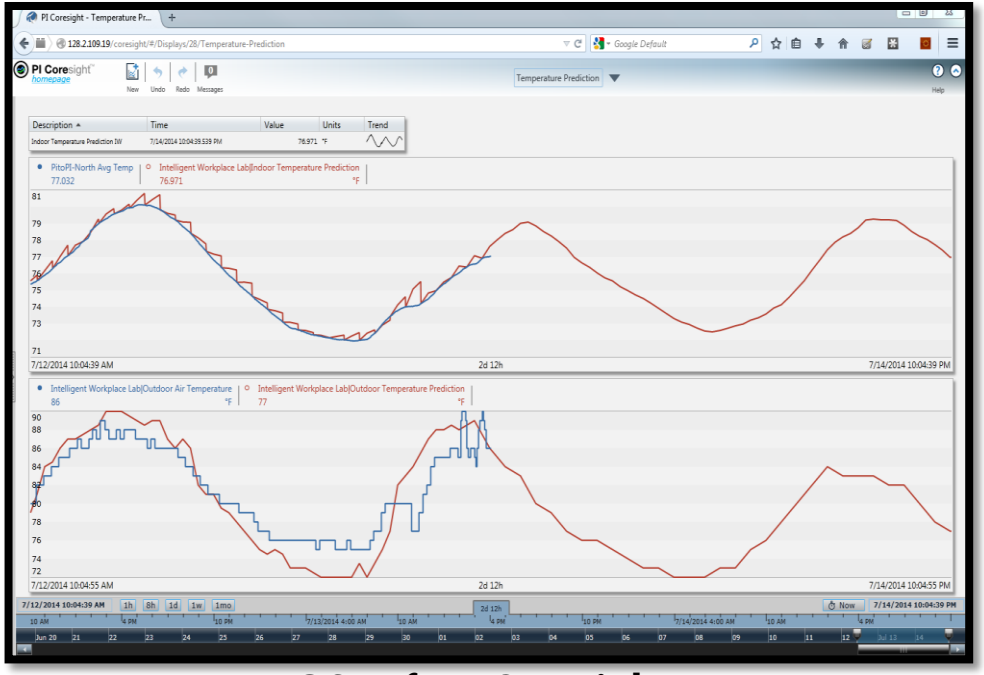
1/Collect Data Real-Time

2/ Train Model

3/ Predict temperature and energy at different horizons (up to 48h)

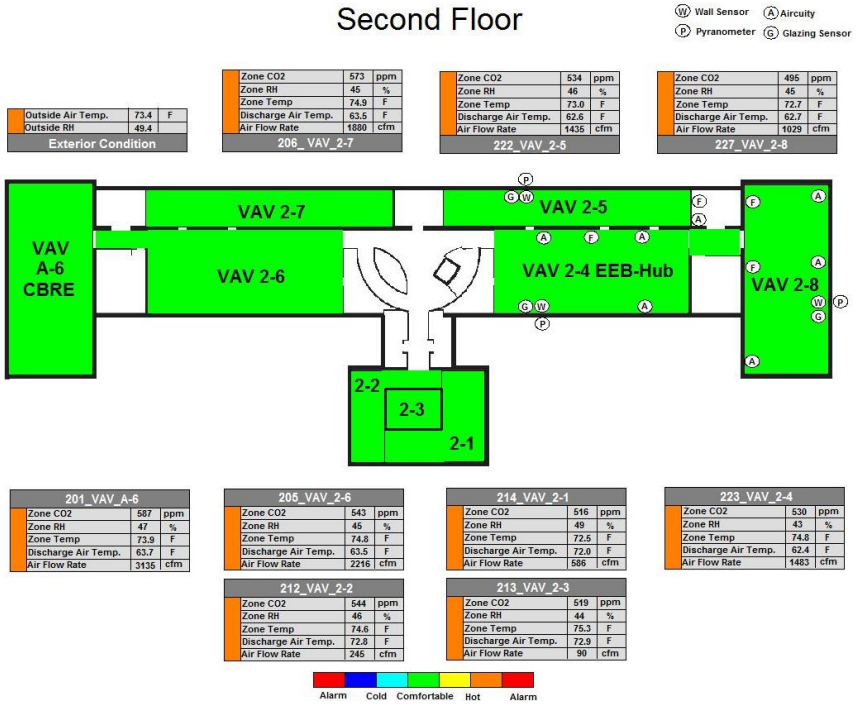
4/ Detect potential energy savings
* Over-Cooling/Heating
* Space conditioned without occupancy

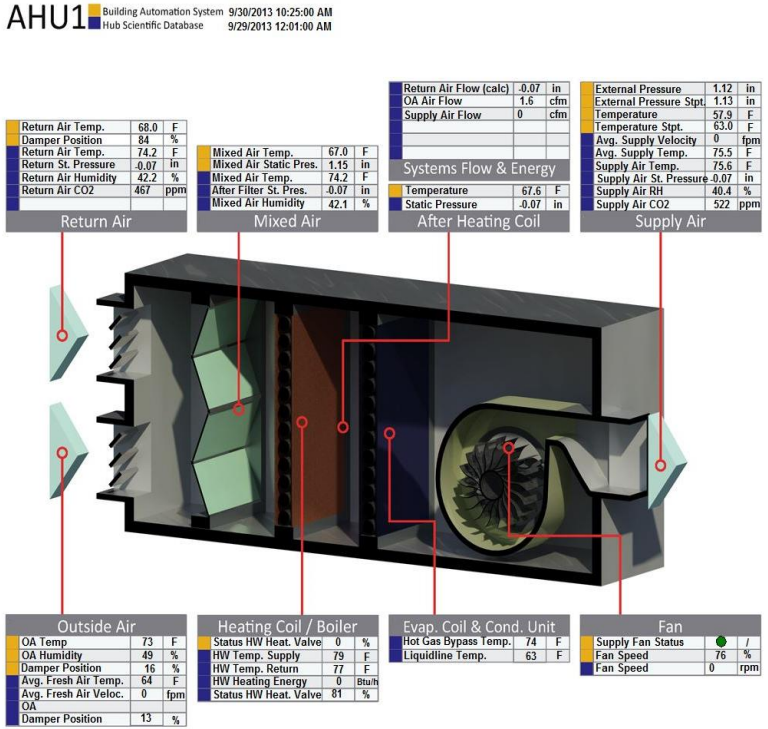
5/ Corrective Actions:
* Adjust Control Logics
* Turn Off systems



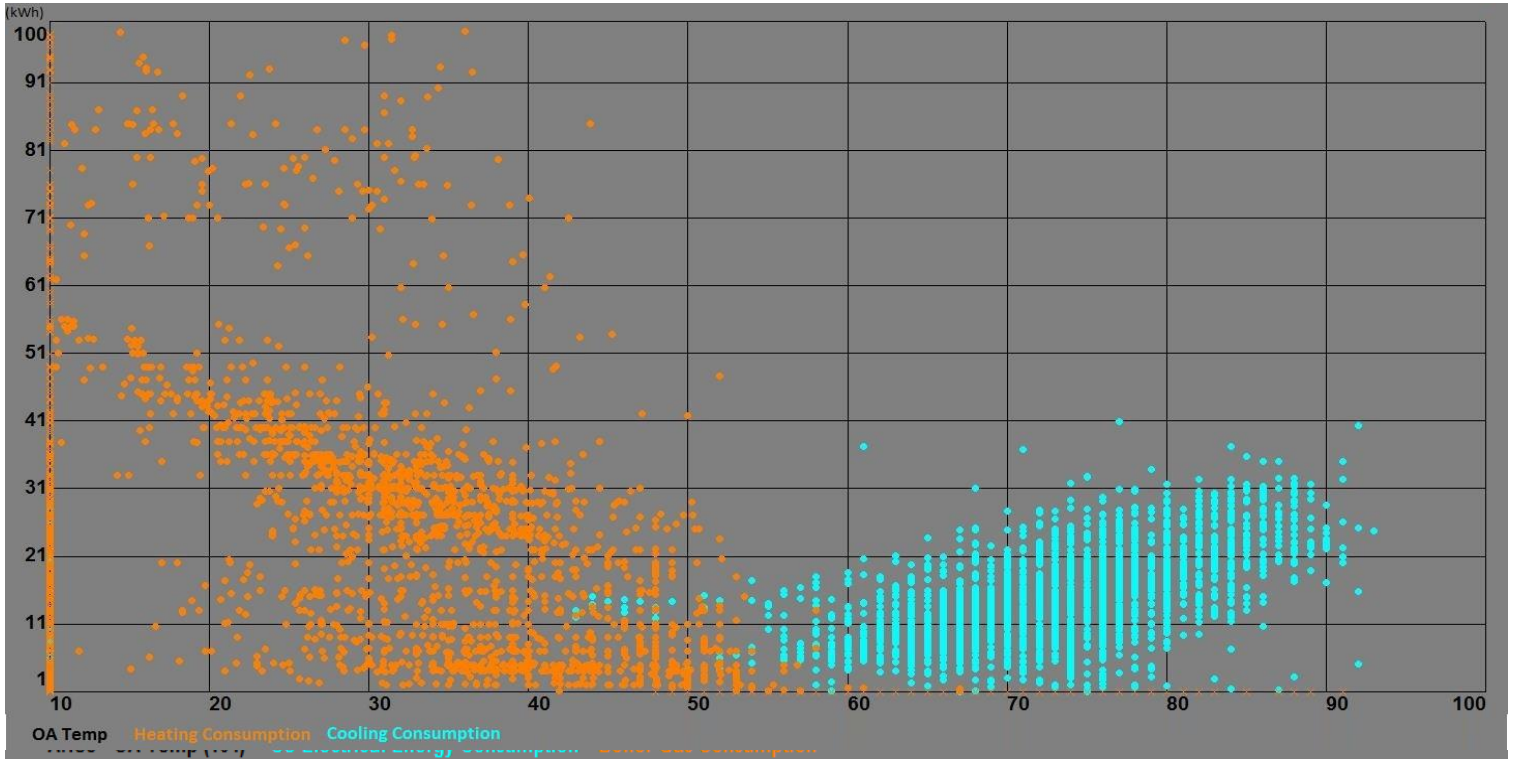
OSIsoft PI Coresight

Facility Manager Dashboard





(ID-F) Data Analytics



Real-time measured data for meaningful diagnostics

Demo

Benefits

- Expected energy savings of about 20% for predictive building control and Automation (currently tested in the Intelligent Workplace)
- Substantial Potential Energy Savings at a Campus scale
- **Tablet-toting field service technicians will use the predictive analytics using PI Coresight to check and update remote equipment before it fails**

Smart Buildings/ Smart Campus

Demonstrate real-time, analytic and visualization capabilities to integrate, monitor and diagnose building performance indices.

Generate knowledge and distribute it through the chain of decision

CBEI CONSORTIUM for BUILDING ENERGY INNOVATION

Carnegie Mellon

Business Challenge

- Monitor, diagnose and optimize building performance in real time.
- Predict Fault and system Failures.

Solution

- PI CAST (Prototype), PI Data Archive 2015, PI AF 2014
- PI ProcessBook, PI Coresight 2014, PI WebServices,
- Power BI for Office 365, Azure Storage, Azure IaaS and Azure Machine Learning

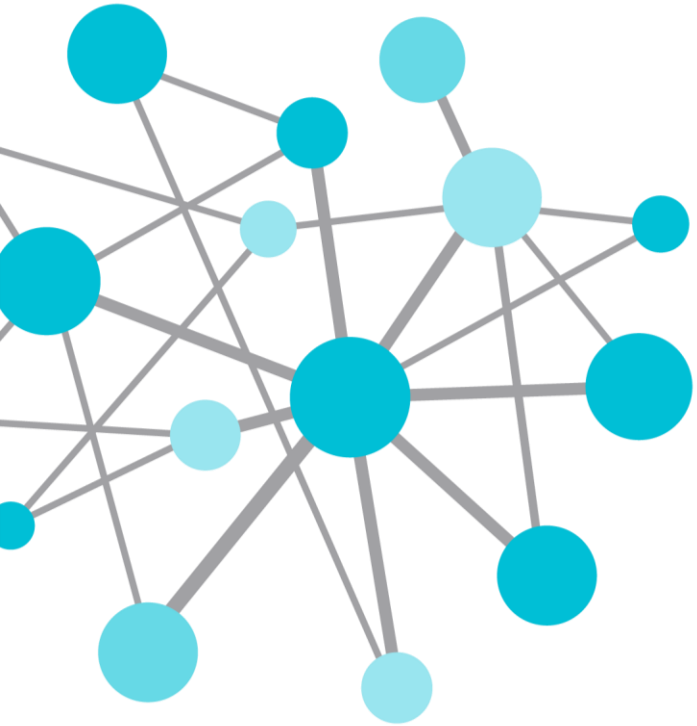
Results and Benefits

- Ensure Energy Savings and Carbon footprint reduction.
- Prioritize investments and retrofit actions.
- Increase Occupants Comfort, Satisfaction and Productivity.

Questions

Please wait for the microphone before asking your question

Please state your name and your company



THANK YOU

Brought to you by OSIsoft.

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Carnegie Mellon University