Welcome CAP Executive Board

September 27, 2012

CAP Chairman 2012 - 2013

Anton Monk, Ph.D. UCSD '94

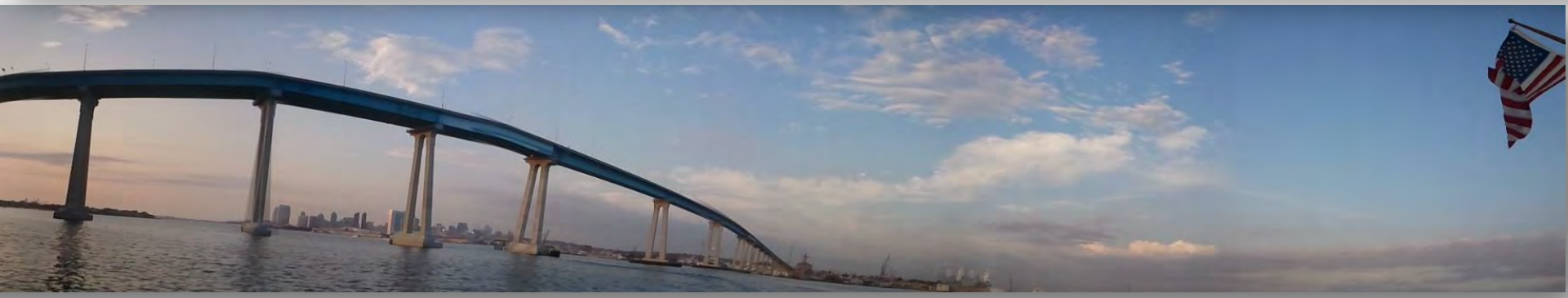
Co-founder & VP Technology

Entropic Communications

Solar Turbines

A Caterpillar Company

Thank you Carl Lippke and Solar Turbines for '*Spirit of Solar*' Cruise September 10th, 2012



Welcome New CAP Members!

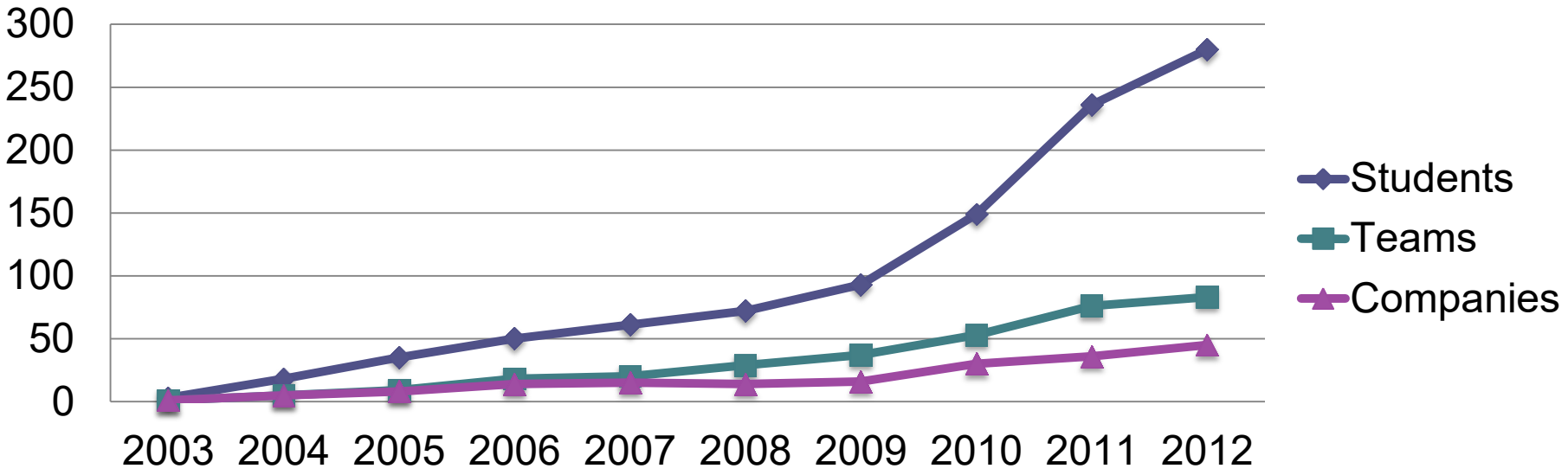
Welcome Distinguished Students

Triton Engineering Student Council

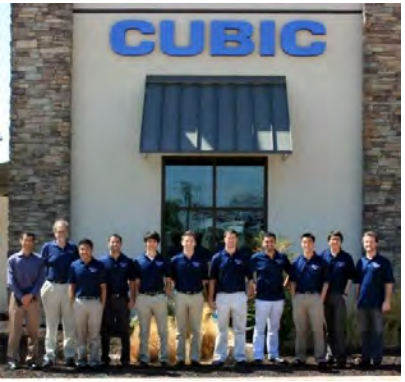
Pooja Makhijani, President

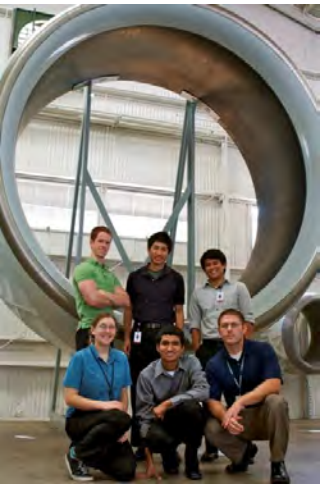
Team Internship Program

Team Internship Program Summer 2012



Team Internship Program	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Students	3	18	35	50	61	72	93	149	236	280
Teams	1	5	9	18	20	29	37	53	76	88
Companies	1	5	8	14	15	14	16	30	36	45
New sponsors	1	4	5	8	4	3	6	15	21	17
Returning sponsors	3	1	3	6	11	11	10	15	15	28
International teams				1	2	8	0	5	4	3





UCSD Jacobs School of Engineering
Team Internship Program

Team Internship Program – Featured Presentation

Smart Energy Dashboards and Controls – a UC San Diego Project

Amy Chiang EnvE ‘12, John Lee ME MS ‘13, Dung Nguyen EnvE ‘13, Peggy Ip ME ‘14

Smart Energy Dashboards and Controls

BUILDING ENERGY MANAGEMENT

presented by

Amy Chiang, Environmental Engineer '12
Peggy Ip, Mechanical Engineer '14
John Chung Sang Lee, Mechanical Engineer '13
Dung (Yung) Nguyen, Environmental Engineer '13

Dr. Chuck Wells, Supervisor

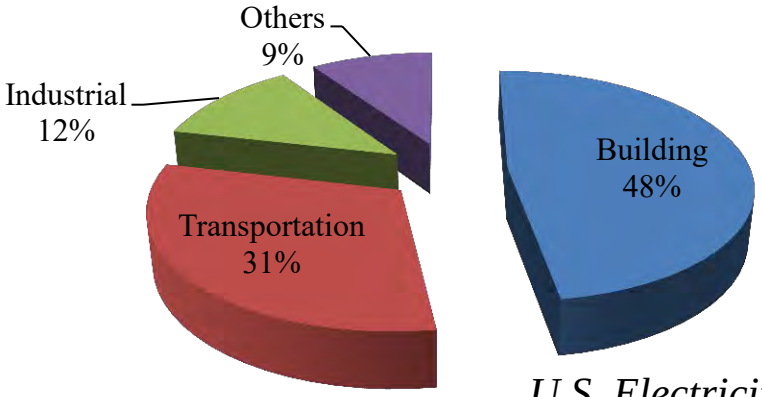
September 27, 2012

OSIsoft.

UCSD Jacobs School of Engineering
Team Internship Program

PROBLEMS

- **40%+** of the U.S's building electricity usage comes from HVAC and lighting
- Imported energy is the **#2 UCSD money expenditure**
- It is difficult to extract information from building measurements without **organized data management**
- Building occupants are **unaware** of their energy usage
- There are no automated building controls infrastructure that includes **optimization** of key performance analysis to increase efficiency



U.S. Electricity Usage

HYPOTHESIS

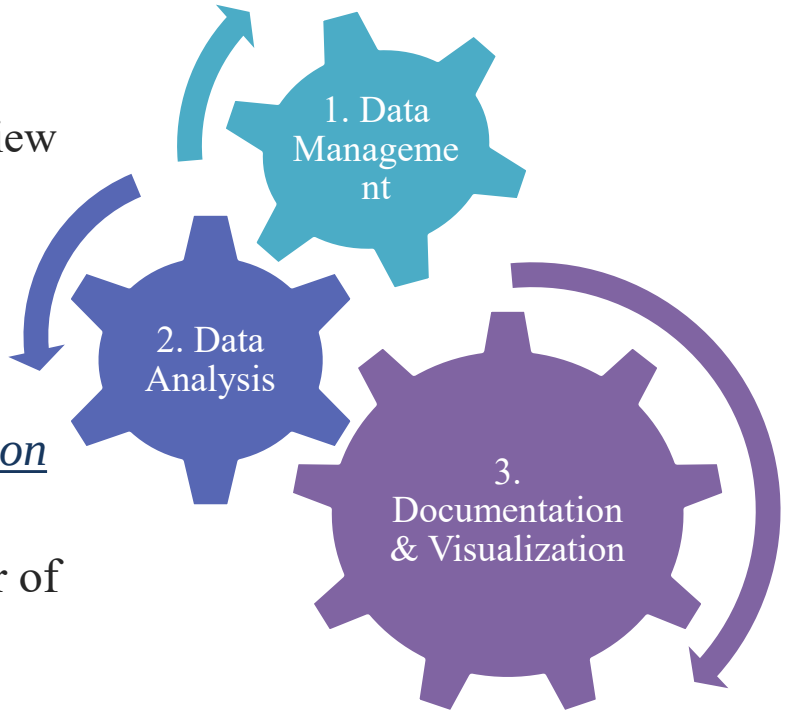
Smart Meter Project by CPUC forecasted reduced energy consumption by 15%. Therefore, if accurate real-time data analysis of building energy performance, utilizing PI system software, is available to local community, it would increase awareness to reduce waste.

APPROACH

OSIsoft. | UCSD Jacobs School of Engineering
Team Internship Program

STEP 1: *Organize & Research*

- PI Training
- KPI Literature Review
- Analyze PI system database (85,000 datasets!)



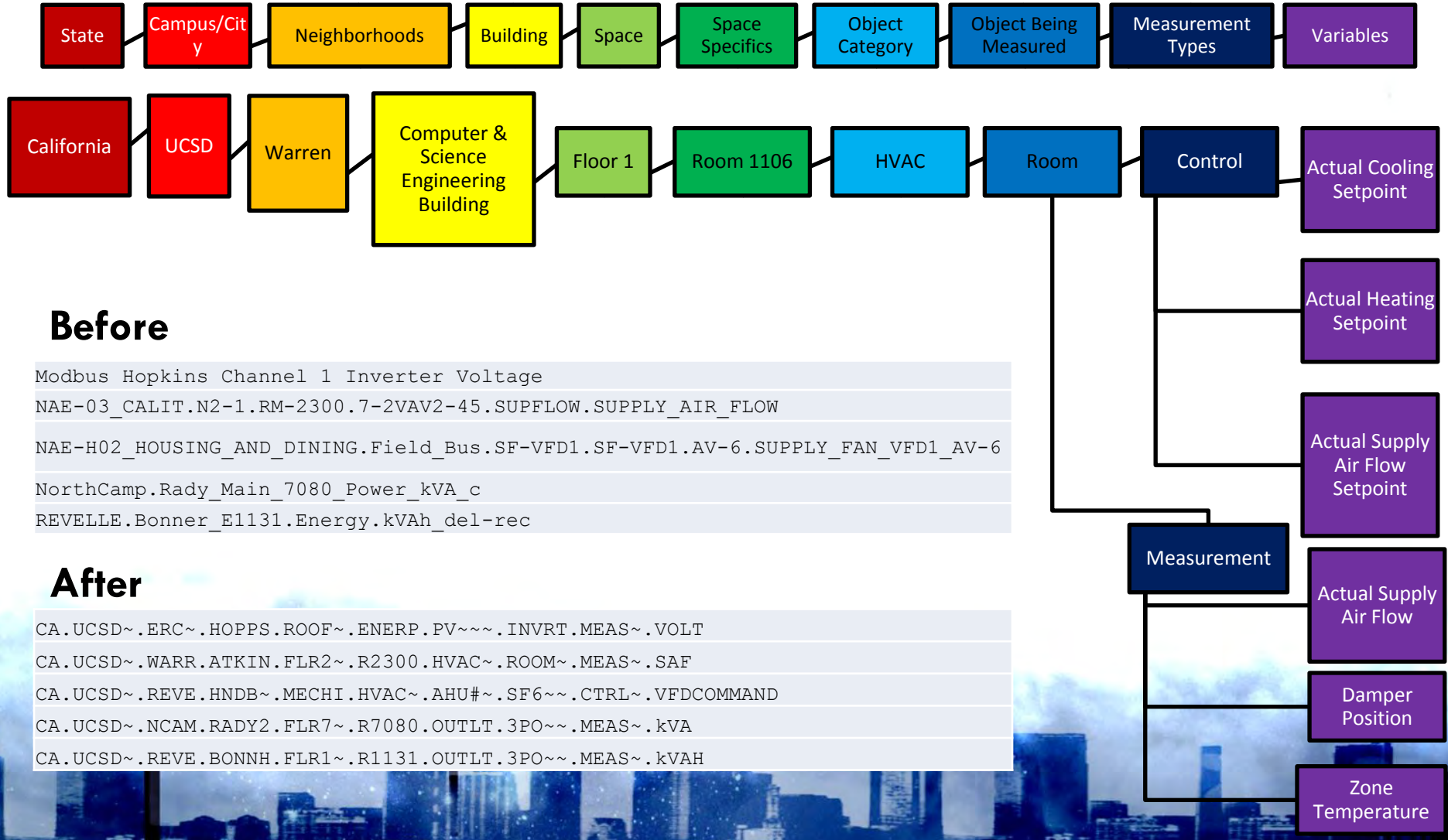
STEP 2: *Integrate & Analyze*

- Create a standard naming structure for building measurements
- Created a model 'Asset Framework' for EBU3B/CSE Building
- Determined energy consumption of HVAC versus other electrical loads
- Organized the data to be available on different means of data dashboards or visualizations
- Created web display for building KPIs

STEP 3: *Documentation & Visualization*

- Completed a paper of project findings
- Filed **patent** for 'Agent Control Theory'

Naming Structure



Before

```
Modbus Hopkins Channel 1 Inverter Voltage
NAE-03_CALIT.N2-1.RM-2300.7-2VAV2-45.SUPFLOW.SUPPLY_AIR_FLOW
NAE-H02_HOUSING_AND_DINING.Field_Bus.SF-VFD1.SF-VFD1.AV-6.SUPPLY_FAN_VFD1_AV-6
NorthCamp.Rady_Main_7080_Power_kVA_c
REVELLE.Bonner_E1131.Energy.kVAh_del-rec
```

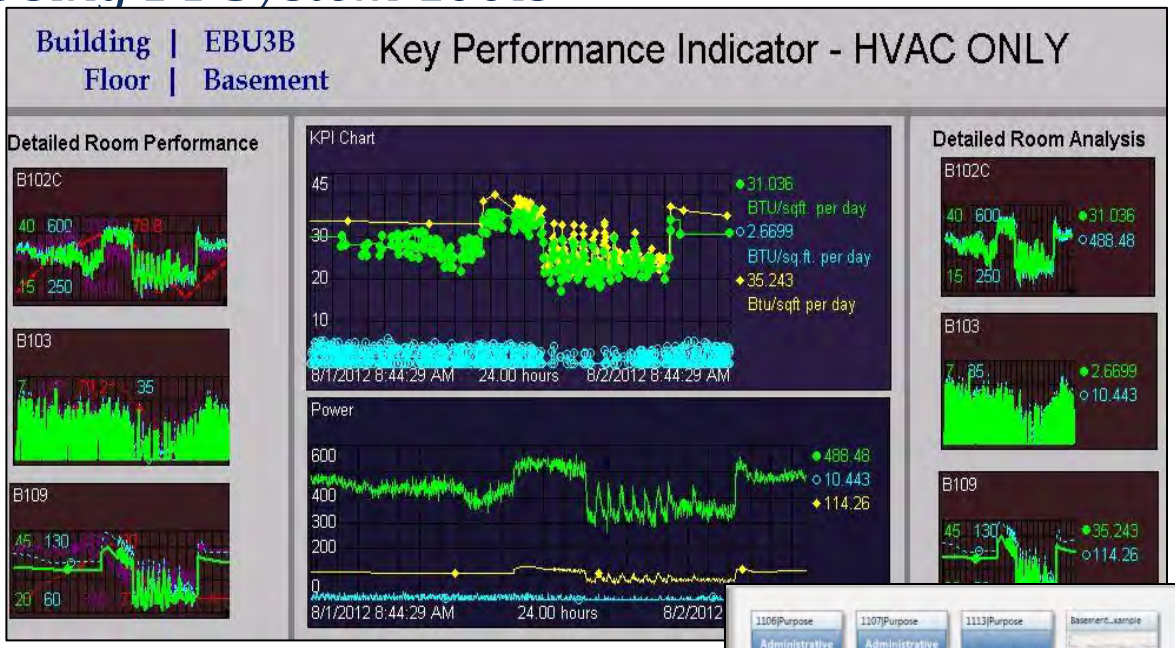
After

```
CA.UCSD~.ERC~.HOPPS.ROOF~.ENERP.PV~~~.INVRT.MEAS~.VOLT
CA.UCSD~.WARR.ATKIN.FLR2~.R2300.HVAC~.ROOM~.MEAS~.SAF
CA.UCSD~.REVE.HNDB~.MECHI.HVAC~.AHU#~.SF6~~.CTRL~.VFDCOMMAND
CA.UCSD~.NCAM.RADY2.FLR7~.R7080.OUTLT.3PO~~.MEAS~.kVA
CA.UCSD~.REVE.BONNH.FLR1~.R1131.OUTLT.3PO~~.MEAS~.kVAH
```

RESULTS | Data Management

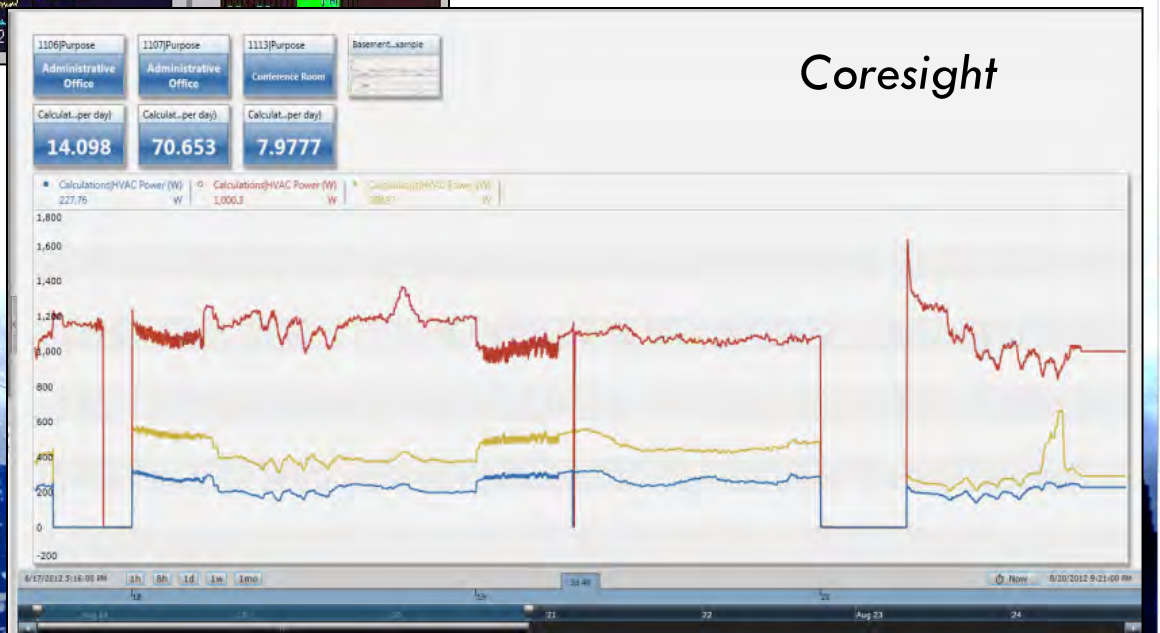
UCSD Jacobs School of Engineering
Team Internship Program

Using PI System Tools



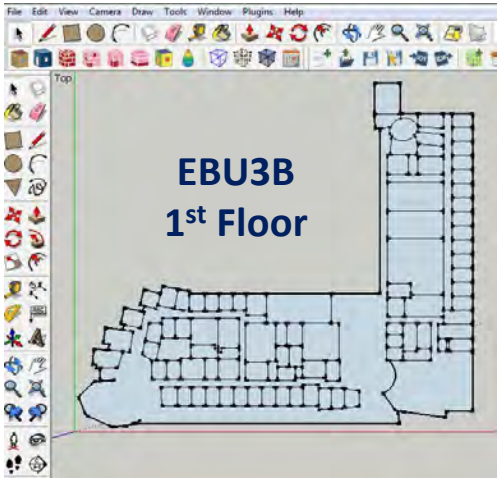
Processbook

Coresight



On KPI_{ea} (energy KPI : energy/area) using two methods

IDEAL: Baseline



Google Sketchup + EnergyPlus (from DOE)

ACTUAL: Calculation

Power $\dot{Q} = \rho v A D_p C (T_1 - T_0)$

- v: Supply Air Flow
- D_p: Damper Position
- T_1: Discharge Temperature
- T_0: Zone Temperature

KPI COMPARISION

	1106 Administrative	1107 Administrative	1113 Conference
Ideal	9.01 $\frac{kWh}{ft^2}$	14.55 $\frac{kWh}{ft^2}$	14.09 $\frac{kWh}{ft^2}$
Actual	10.95 $\frac{kWh}{ft^2}$	77.74 $\frac{kWh}{ft^2}$	9.20 $\frac{kWh}{ft^2}$
% Deviation	21.34%	432.30%	-34.72%

RESULTS | Sharing Data

OSIsoft. | UCSD Jacobs School of Engineering Team Internship Program

NAVIGATOR

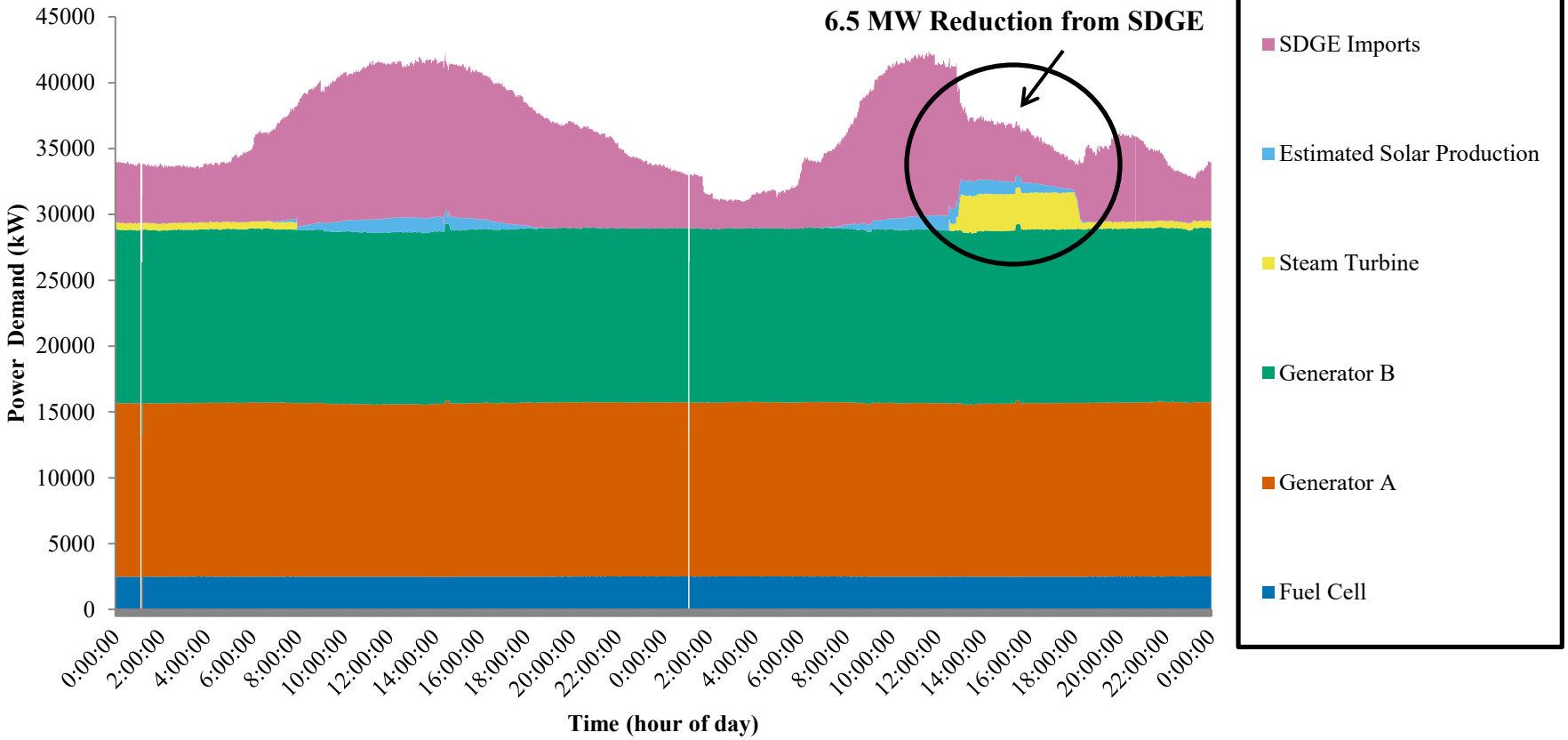
"click on EBU3B to view KPI value and ranking"

Installed Plugin Version: 6.2.2.6613

Final Product

OSIsoft. UCSD Jacobs School of Engineering Team Internship Program

Potential Energy Savings: Demand Response Example



RESULTS | Building Control

OSIsoft. UCSD Jacobs School of Engineering Team Internship Program

Object oriented agent based hierarchical control systems for buildings (patent pending)

It's a hot summer day but not too hot. Alright, I can adjust the thermostat from 68°F to 72°F in order to reduce 5% power demand. I can lower energy KPI while keeping comfort KPI constant. We are good.

Room

MICROGRID - UCSD

Oh no! We need to cut 30% of power demand! Building 1 of 2, cut 15%!

Building 1

Hmm, Microgrid tells me to cut 15%.

Hey room, you have "room" to cut 5% power demand. Do it!

Floor 1

Hey floor 1, according to my calculations, you can cut 10% of your power demand!

FUTURE GOALS

OSIsoft. | UCSD Jacobs School of Engineering Team Internship Program

- Build the AF naming structure for entire campus
- Implement hierarchical control system
- Use local microgrid frequency as building control signal
- Auto Discovery: Legacy tag-names can be automatically renamed to new PI tags that match the AF names
- Implement room agent Notifications and SQC
- Frequency decrease → load reduction

OSIsoft

UCSD Jacobs School of Engineering
Team Internship Program

THANK YOU!

ACKNOWLEDGEMENTS

- Chuck Wells
- Byron Washom
- Yuvraj Agarwal
- Bob Cadwell
- Jo Frabetti
- Dave Roberts
- Tanja Zseby
- OSIsoft Support Team
- UCSD TIP Program

Distinguished Faculty Presentation

Professor Yoav Freund

Computer Science & Engineering

Big Data Analytics:
What it is and why you should care

- Expertise: machine learning, computational statistics and their applications in biology, image processing and signal processing.
- Best known for his joint work with Dr. Robert Schapire on the Adaboost algorithm.
- In 2008 Dr. Freund was elected as a Association for the Advancement of Artificial Intelligence (AAAI) Fellow.
- Faculty Co-Director, along with Prof Yannis Papakanstantinou, for new MAS Program in Data Science and Analytics

Big Data

What is it and why should I care?

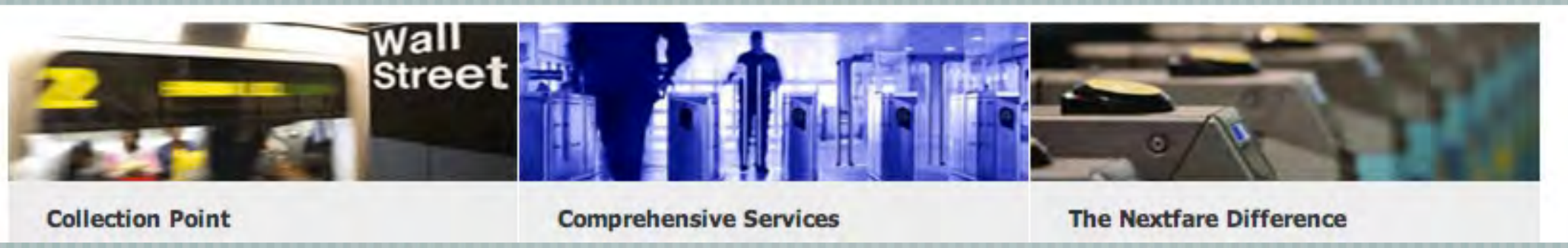
Yoav Freund
Computer Science and Engineering
UCSD

Big Data (For Business)

What is it and why should I care?

Yoav Freund
Computer Science and Engineering
UCSD

Example 1: Cubic Transportation



Example 1: Cubic Transportation

Fare collection systems in 40 public transportation markets around the world.

Example 1: Cubic Transportation

- Fare collection systems in 40 public transportation markets around the world.
- Side effect: systems store detailed data about movement of people.

Example 1: Cubic Transportation

- Fare collection systems in 40 public transportation markets around the world.
- Side effect: systems store detailed data about movement of people.
- The collected data is potentially valuable, how to monetize this value.

Example 2: Electronic Medical Records

Example 2: Electronic Medical Records

- Hospitals and clinics are required to switch to electronic records.

Example 2: Electronic Medical Records

- Hospitals and clinics are required to switch to electronic records.
- EMR companies provide services to meet requirement.

Example 2: Electronic Medical Records

- Hospitals and clinics are required to switch to electronic records.
- EMR companies provide services to meet requirement.
- Collect variety of data:

Example 2: Electronic Medical Records

- Hospitals and clinics are required to switch to electronic records.
- EMR companies provide services to meet requirement.
- Collect variety of data:
  - Doctor Notes.

Example 2: Electronic Medical Records

- Hospitals and clinics are required to switch to electronic records.
- EMR companies provide services to meet requirement.
- Collect variety of data:
  - Doctor Notes.
  - bedside signals (heart rate, EKG ...)

Example 2: Electronic Medical Records

- Hospitals and clinics are required to switch to electronic records.
- EMR companies provide services to meet requirement.
- Collect variety of data:
  - Doctor Notes.
  - bedside signals (heart rate, EKG ...)
  - Images (X-ray, CT, MRI, Pathology, ...)

Example 2: Electronic Medical Records

- Hospitals and clinics are required to switch to electronic records.
- EMR companies provide services to meet requirement.
- Collect variety of data:
  - Doctor Notes.
  - bedside signals (heart rate, EKG ...)
  - Images (X-ray, CT, MRI, Pathology, ...)
- Great potential for medical studies

Example 2: Electronic Medical Records

- Hospitals and clinics are required to switch to electronic records.
- EMR companies provide services to meet requirement.
- Collect variety of data:
  - Doctor Notes.
  - bedside signals (heart rate, EKG ...)
  - Images (X-ray, CT, MRI, Pathology, ...)
- Great potential for medical studies
- Great potential for abuse by health insurance companies.

Other examples

- Car insurance.
- eCommerce
- Web advertisement.
- .....

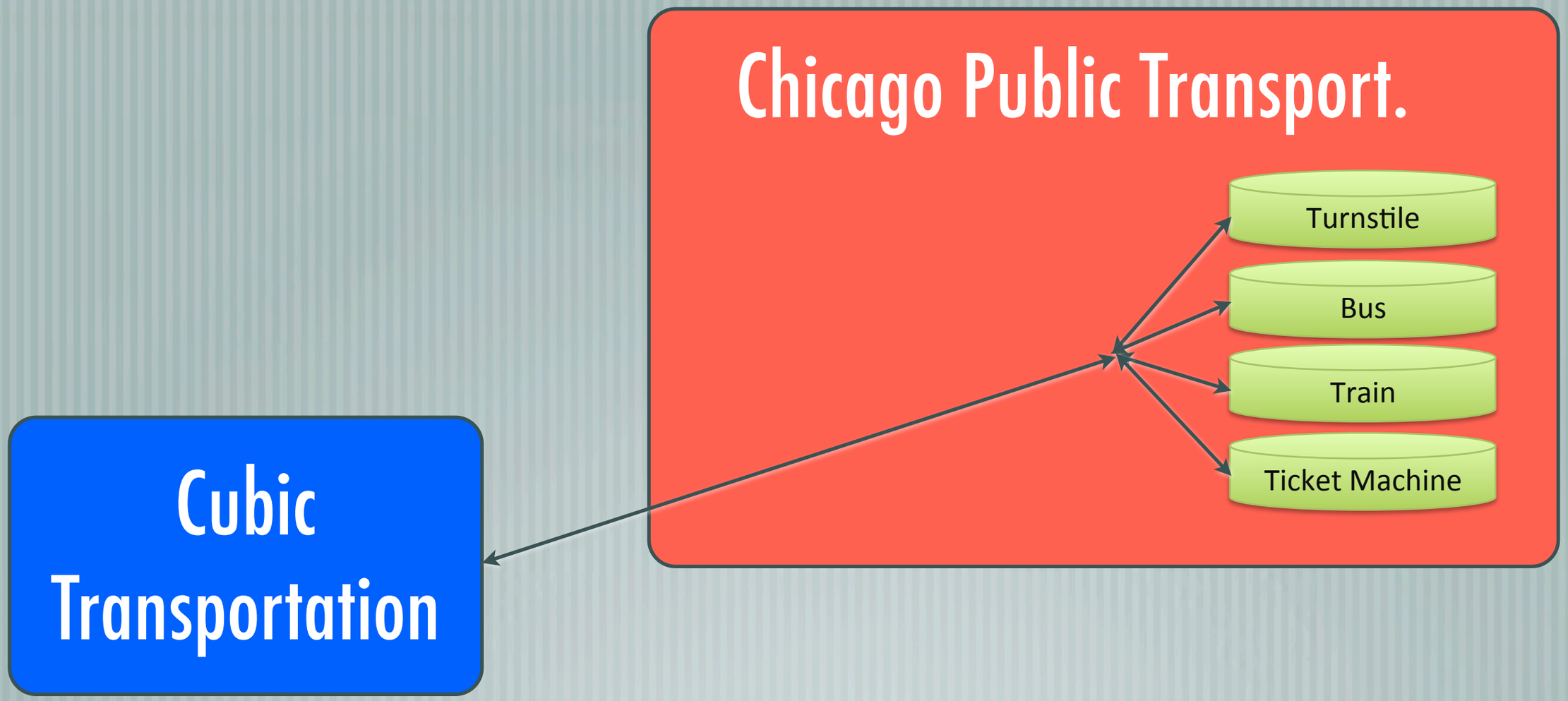
Emerging pattern

Cubic Transportation

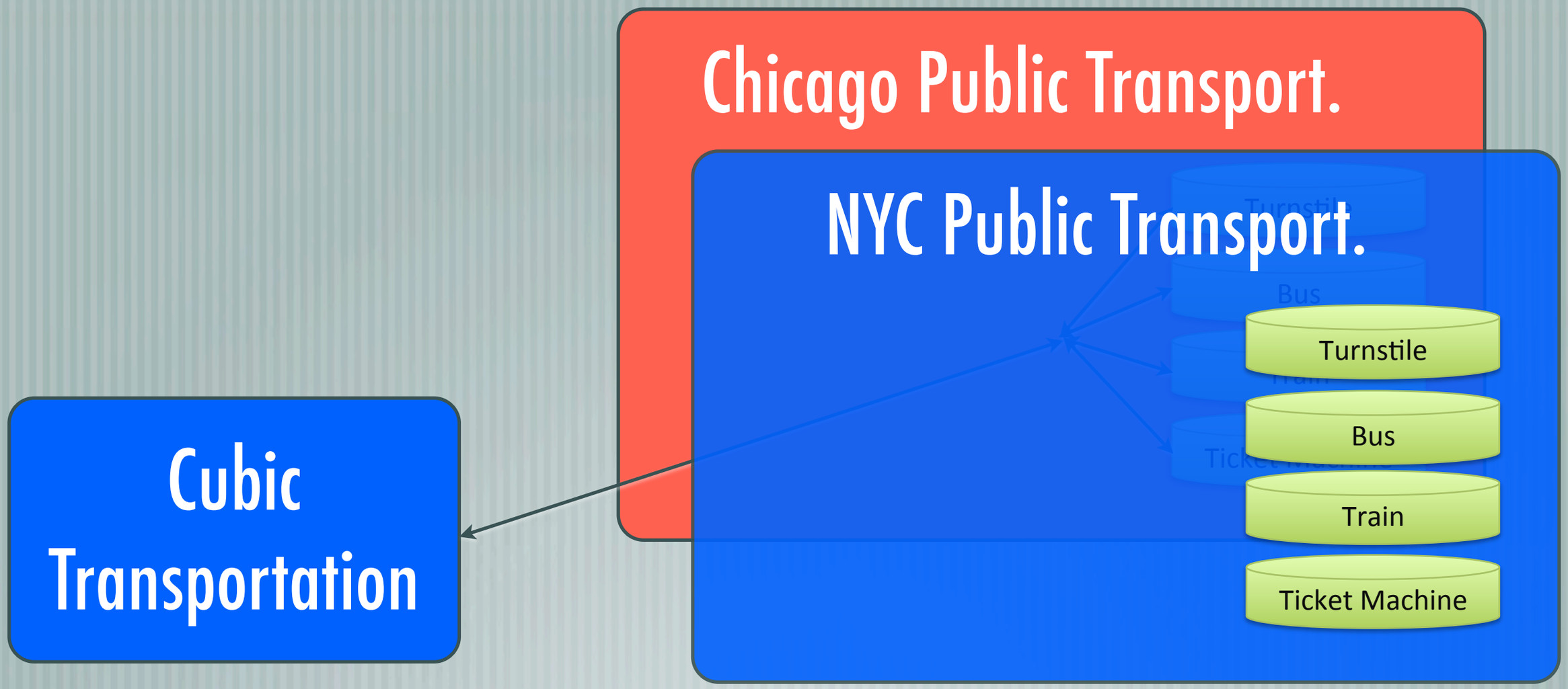
Emerging pattern

Cubic Transportation

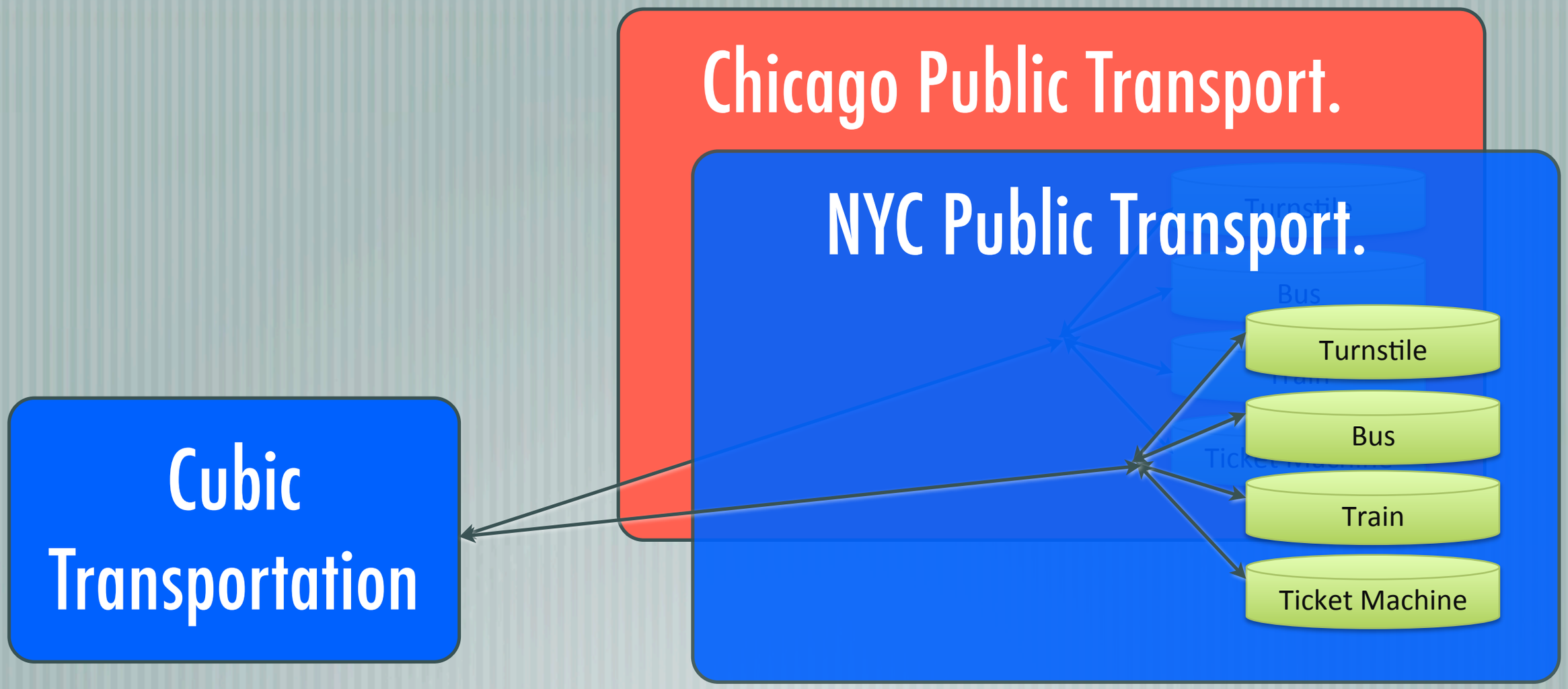
Emerging pattern



Emerging pattern



Emerging pattern



Emerging pattern

Chicago Public Transport.

NYC Public Transport.

Milano Public Transport.

Turnstile

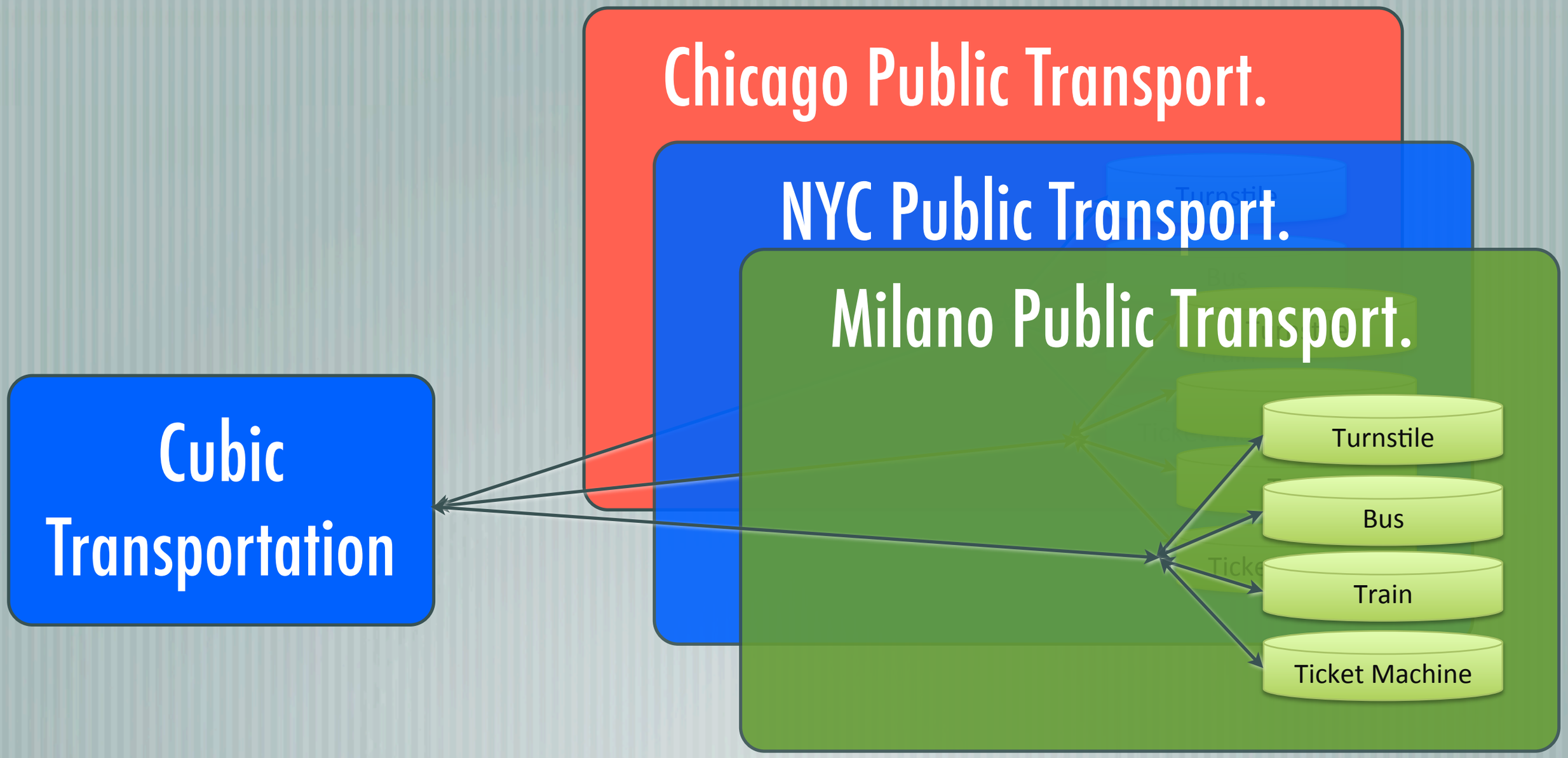
Bus

Train

Ticket Machine

Cubic Transportation

Emerging pattern



Who owns the data?

Who owns the data?

The transportation organization owns the data, but has no means of analyzing it.

Who owns the data?

The transportation organization owns the data, but has no means of analyzing it.

Cubic has access to all of the data, and can analyze it, but does not own it.

Who owns the data?

- The transportation organization owns the data, but has no means of analyzing it.
- Cubic has access to all of the data, and can analyze it, but does not own it.
- The commuter has a right for privacy.

Communication through APIs

Communication through APIs

- Price-tag for complete dataset prohibitively high.

Communication through APIs

- Price-tag for complete dataset prohibitively high.
- Transmission of large datasets is very expensive.

Communication through APIs

- Price-tag for complete dataset prohibitively high.
- Transmission of large datasets is very expensive.
- API's allow doling out of information one record at a time.

Example: Google Maps API

Service	Usage limit (per day)	1,000 excess map loads (in U.S. dollars)
JS Maps API v2	25,000	$1.00
JS Maps API v3	25,000	$0.50
Static Maps API	25,000	$0.50
Street View Image API	25,000	$0.50

Privacy

Privacy

- Allowing access to data compromises privacy.

Privacy

- Allowing access to data compromises privacy.
- Queries that present a smaller threat:

Privacy

- Allowing access to data compromises privacy.
- Queries that present a smaller threat:
  - What is the median time to travel from A to B ?

Privacy

- Allowing access to data compromises privacy.
- Queries that present a smaller threat:
  - What is the median time to travel from A to B ?
  - What blood pressure alarm minimizes the number of false alarms? (while keeping misses below 1/10,000)

Privacy leakage

Privacy Firewall

Privacy leakage

Privacy Firewall

What is the average personal wealth?

Privacy leakage

Privacy Firewall

What is the average personal wealth?

$30,000 - $31,000

Is there a billionaire in the house?

Is there a billionaire in the house?

- Suppose we really wanted to know if Bill Gates is in the database.

Is there a billionaire in the house?

- Suppose we really wanted to know if Bill Gates is in the database.
- Bill gates personal wealth is so high that he can move the average significantly.

Is there a billionaire in the house?

- Suppose we really wanted to know if Bill Gates is in the database.
- Bill gates personal wealth is so high that he can move the average significantly.
- Similar situation: patients with very high medical expenses.

Is there a billionaire in the house?

- Suppose we really wanted to know if Bill Gates is in the database.
- Bill gates personal wealth is so high that he can move the average significantly.
- Similar situation: patients with very high medical expenses.
- Turns out that asking for the median does not leak personal information.

Is there a billionaire in the house?

- Suppose we really wanted to know if Bill Gates is in the database.
- Bill gates personal wealth is so high that he can move the average significantly.
- Similar situation: patients with very high medical expenses.
- Turns out that asking for the median does not leak personal information.
- How can we prove that a given API preserves privacy?

Differential Privacy

Privacy Firewall

What is the
median personal wealth?

$30,000 - $31,000

Differential Privacy

Privacy Firewall

What is the
median personal wealth?

$30,000 - $31,000

Differential Privacy

Privacy Firewall

What is the
median personal wealth?

$30,000 - $31,000

Differential Privacy

Privacy Firewall

What is the
median personal wealth?

$30,000 - $31,000

Differential Privacy

Privacy Firewall

What is the
median personal wealth?

$30,000 - $31,000

Differential Privacy

Privacy Firewall

What is the
median personal wealth?

$30,000 - $31,000

Differential Privacy

Privacy Firewall

What is the
median personal wealth?

$30,000 - $31,000

$31,000 - $32,000

Summary

Summary

- Big data - Highly distributed data with complex ownerships.

Summary

- Big data - Highly distributed data with complex ownerships.
- API = A way of doling out small pieces of information.

Summary

- Big data - Highly distributed data with complex ownerships.
- API = A way of doling out small pieces of information.
- Differential Privacy: a formalism for proving that private information is not leaking through the API.

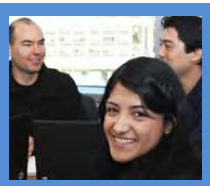
Summary

- Big data - Highly distributed data with complex ownerships.
- API = A way of doling out small pieces of information.
- Differential Privacy: a formalism for proving that private information is not leaking through the API.
- Masters of Advanced Studies in Big data analytics.

Dean's Report

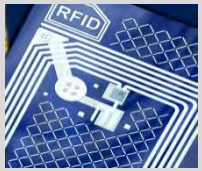
Dean Frieder Seible
Jacobs School of Engineering

Multidisciplinary Master of Advanced Study Program

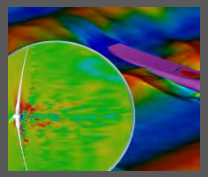


MAS Architecture-Based Enterprise System Leadership Program
Bridge the gap between engineers and managers; gain a better understanding of management essentials coupled with a broad view of engineering disciplines.

MAS Medical Device Engineering (BioEng + MAE)
Broad education in biology, mechanical design, and materials focused on medical device engineering.



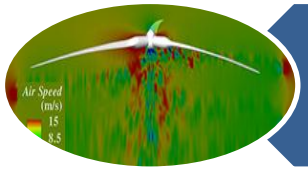
MAS Wireless Embedded Systems (ECE + CSE)
Deep and broad education in the multidisciplinary fundamentals of wireless communications and embedded system design.



MAS Simulation-Based Engineering (SE+ MAE)
Solve multi-physics engineering problems using the techniques of modern computational analysis.

MAS Structural Health Monitoring (SE + ECE)
Apply interdisciplinary toolsets for intelligent structural/ system monitoring and life-cycle management.

Master of Advanced Study Degree

	Fall 2011 Enrolled	Fall 2012 Enrolled
 Architecture-Based Enterprise Systems Engineering	30 new / 27 returning	30
 Wireless Embedded Systems	20	31
 Medical Devices Engineering	6	14
 Simulation-Based Engineering	--	27 *submitted**
 Structural Health Monitoring	--	16 *submitted**

Chancellor, Pradeep K. Khosla

Sabbatical - Bauhaus


INNOVATE
HB

Acting Dean

Juan Lasheras

Distinguished Professor
Mechanical and Aerospace Engineering
Bioengineering

Penner Chair in
Engineering and Applied Science

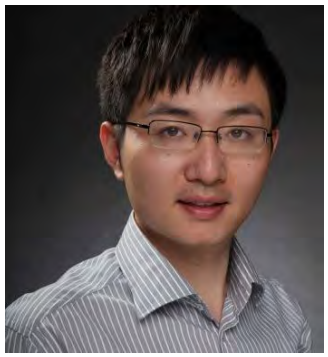
National Academy of Engineering

Director,
Center for Medical Device and Instrumentation,

Faculty Director,
MAS Medical Device Engineering

Faculty Hires

Chiara Bisagni, SE
Composite Aerospace Structures



Shengqiang Cai, MAE
Energy/Mechanics & Materials

Shadi Dayeh, ECE
Solid State Devices & Nanotechnology

Olivia Graeve, MAE
Nanopowder for Fuel Cells

Drew Hall, ECE
Biomedical Electronics

Pradeep Khosla
Chancellor
ECE/CSE

Darren Lipomi, NE
Renewable Energy Solutions

Shachar Lovett, CSE
Computational Complexity

Jason Mars, CSE
Warehouse Scale Computer Optimization

Patrick Mercier, ECE
Ultra Low Powered Integrated Circuits

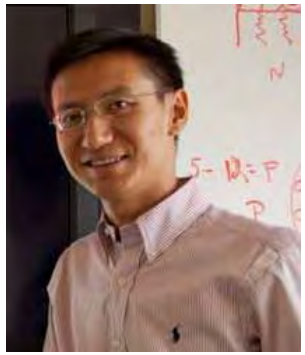
Faculty Hires, continued

Mark Mercola, BENG
Regenerative Therapies
for Heart Tissue

Jian Luo, NE
Nanomaterials for
Energy Efficiency

Justin Opatkiewicz,
NE
Nanotube Devices

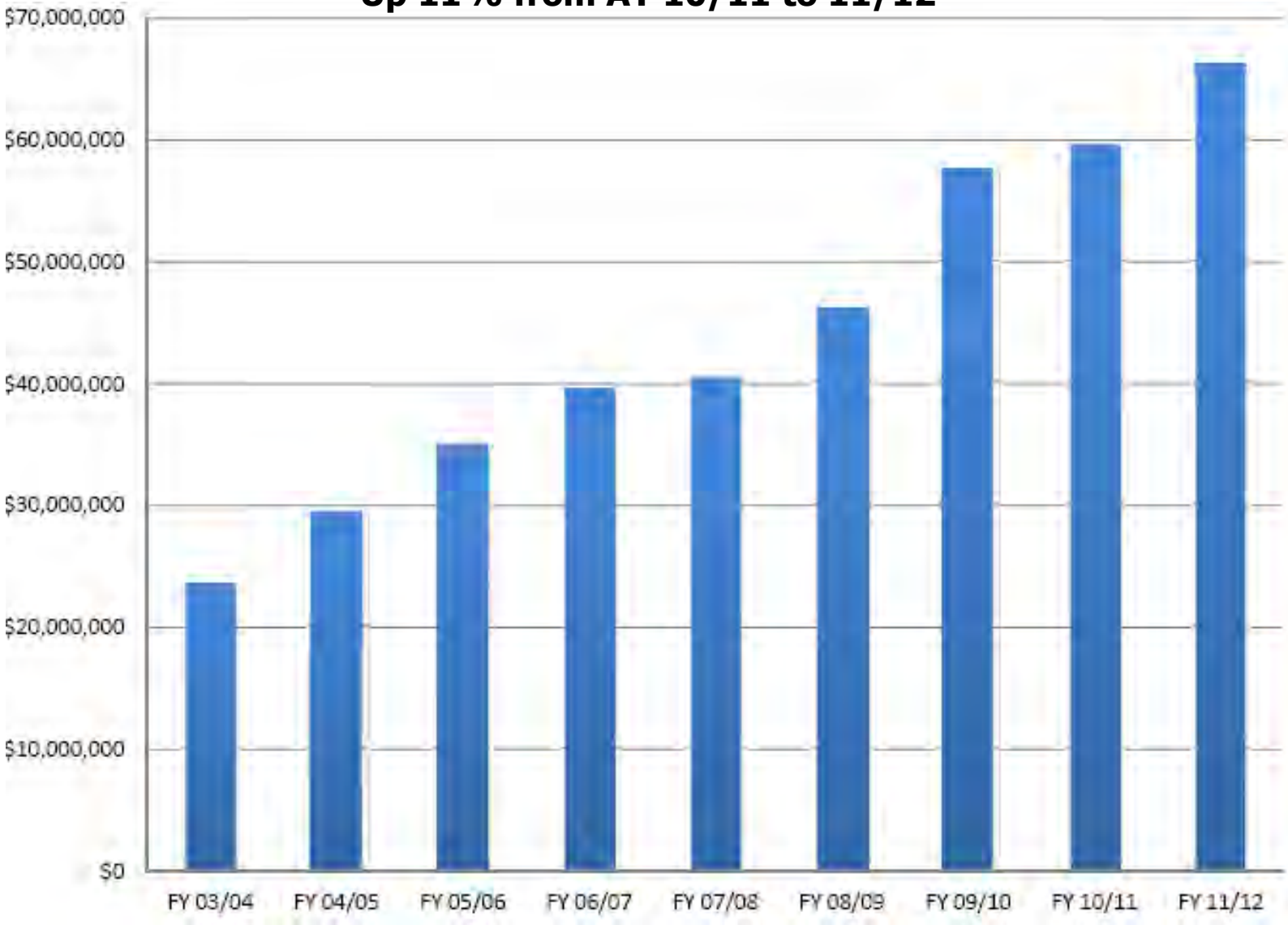
Peter Wang, BENG
Live Cell Imaging and
BioNanotechnology



Sheng Zhong,
BENG
Bioinformatics

Industry & Private Research Expenditures

Up 11% from AY'10/11 to 11/12



UC San Diego #1

Strength in:

- Social Mobility
- Research
- Service

sort	Institution (sort a-z / sort by state)	Overall Score
1	University of California-San Diego (CA)*	100
2	Texas A&M University (TX)*	91
3	Stanford University (CA)	90
4	Univ. of North Carolina-Chapel Hill (NC)*	89
5	University of California-Berkeley (CA)*	87
6	University of California-Los Angeles (CA)*	85
7	Case Western Reserve University (OH)	84
8	University of Washington-Seattle (WA)*	84
9	University of California-Riverside (CA)*	82
10	Georgia Institute of Technology-Main (GA)*	81

UC San Diego #1

'Call it a three-peat'

College Rankings BEST National Universities Washington Monthly 2012

sort	Institution (sort a-z / sort by state)	Overall Score
1	University of California-San Diego (CA)*	100

Washington Monthly 2011 College Rankings TOP 10

sort	Institution (sort a-z / sort by state)	Overall Score
1	University of California—San Diego (CA)*	100

Washington Monthly 2010 College Rankings TOP 10

sort	Institution (sort a-z / sort by state)	Overall Score
1	Univ. of California, San Diego*	100

Structural and Materials Building – Long-term Vision


MATTHEWS LANE
COASTAL ZONE BOUNDARY
VOIGT DRIVE
LYMAN LANE

Tour NanoEngineering and High Bay Aerospace Labs

CAP Business:

Dates to Remember:

Nov 1, 2012	Professional Evening with Industry-NSBE, SWE, & SHPE
Feb 7, 2013	CAP Executive Board Meeting
Feb 21, 2013	Disciplines of Engineering Career Fair (DECaF)
Apr 18, 2013	Research Expo
Jun 6, 2013	CAP Executive Board Meeting

Thank you CAP Executive Board

September 27, 2012