Advanced Design & Construction Management Techniques- Integrative Design Process- Occupancy, Operations, & Performance feedback

جلسه دوازدهم- خرداد ماه 1398- مدیریت پروژه

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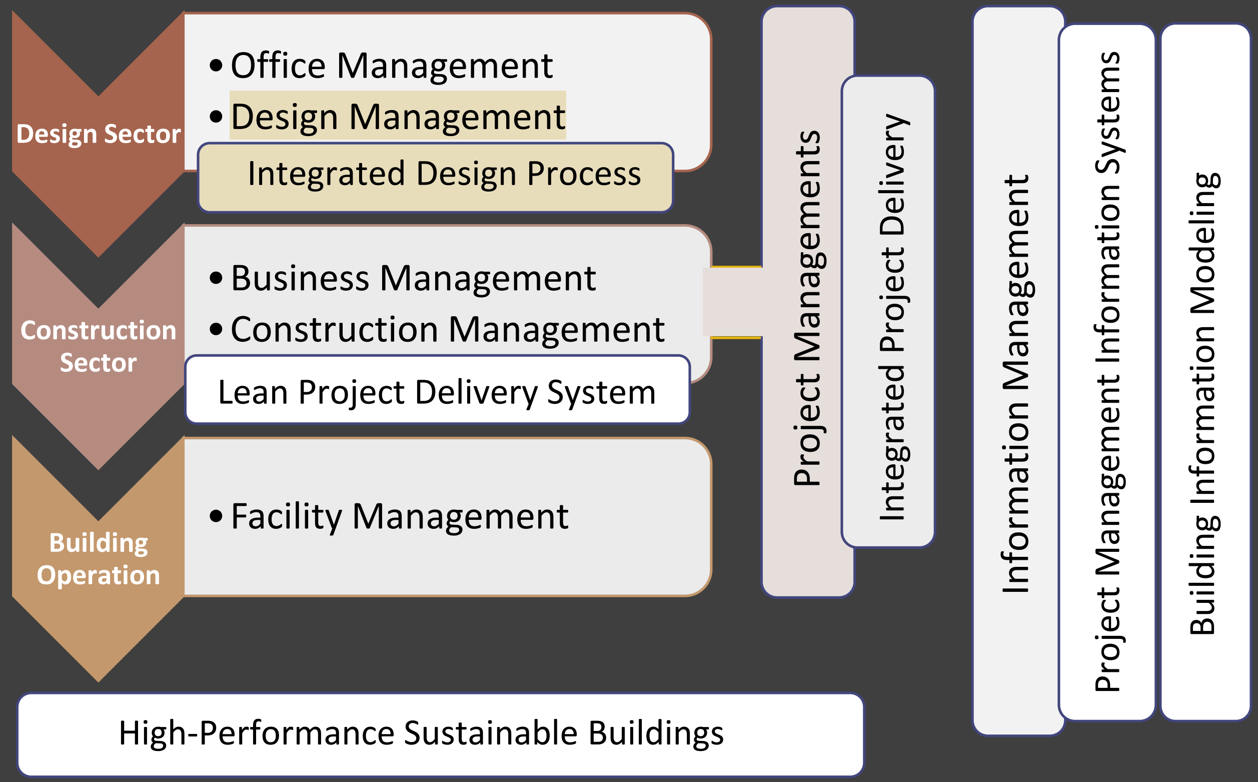
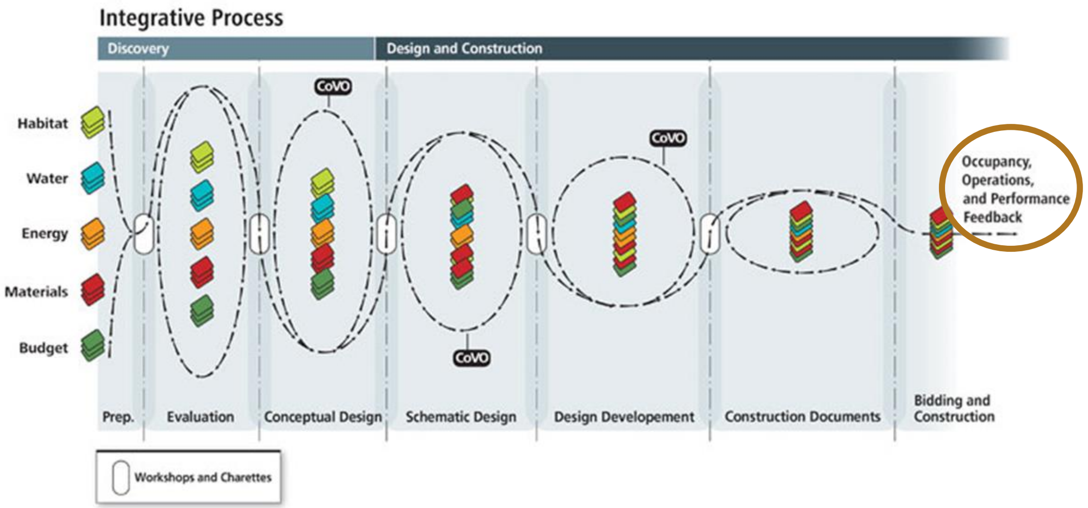
Introduction

- **Occupancy, Operations, & Performance feedback**



Occupancy, Operations, & Performance Feedback



PART C—OCCUPANCY, OPERATIONS, AND PERFORMANCE FEEDBACK

Stage C.1

Occupancy: Feedback from All Systems

C.1.1 Operations Activities

- Establish operations team consisting of key stakeholders responsible for continuously monitoring, maintaining, and improving environmental performance
- Establish and implement standard operating procedures (SOPs) that provide continuous feedback regarding performance of the four key subsystems:
  - Habitat
  - Water
  - Energy
  - Materials
- Commissioning: Conduct periodic Recommissioning in accordance with Recommissioning Manual

C.1.2 Principles and Measurement

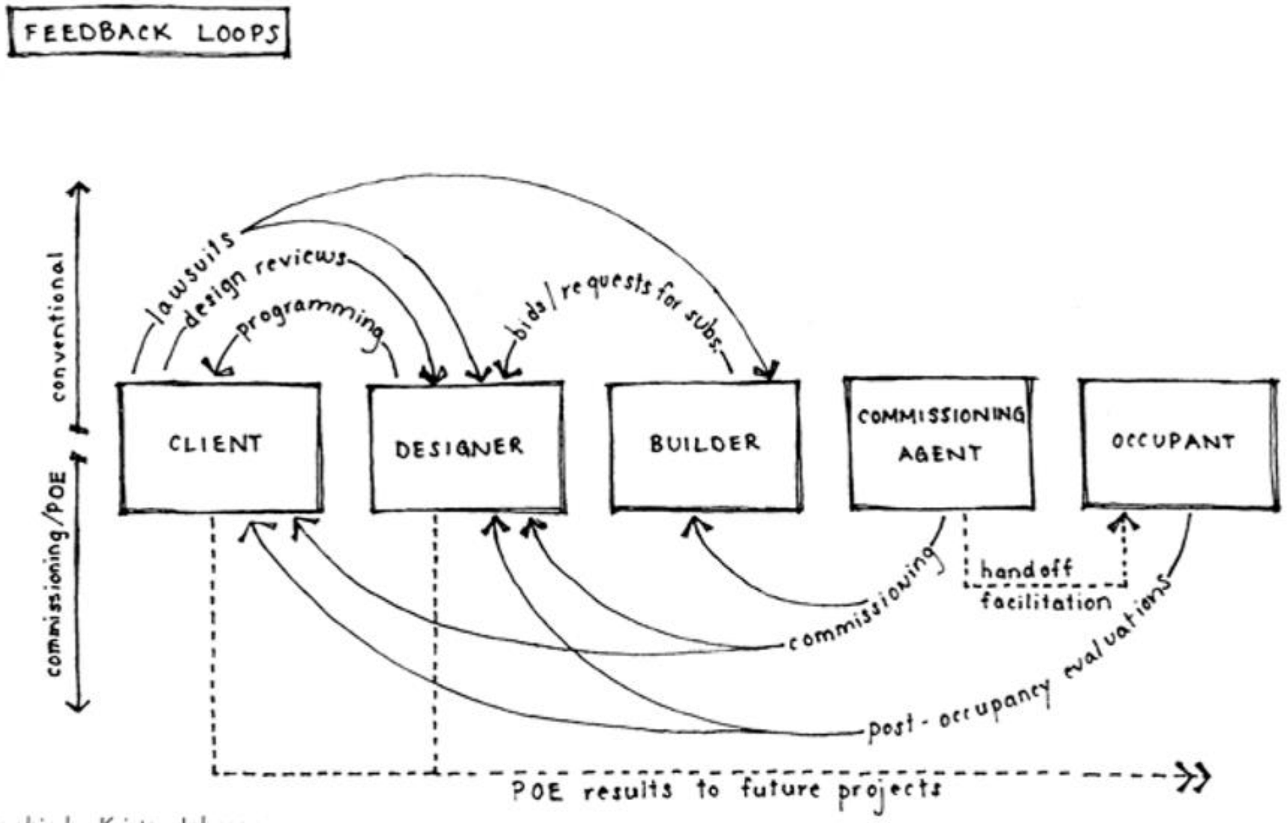
- Document key indicators that serve as proxies for the health of the larger ecosystem
- Document occupant surveys and reconcile results with building systems performance
- Implement Measurement and Verification (M&V) plan continuously over the life of the building
- Insert results of periodic Recommissioning into Recommissioning Manual

C.1.3 Cost Analysis

- Track economic performance of the four key subsystems

C.1.4 Schedule and Next Steps

- Implement all of the above forever



Graphic by Kristen Johnson

- “Feedback is a process whereby some proportion of the output signal of the system is passed “fed back” to the input. This is often used to control the dynamic behavior of the system”.
- Lack of feedback in design and construction industry.
- Designers & contractors keep doing the same thing not because it works well, but because they haven’t received negative feedbacks in the form of complaints or lawsuits.

Learning from Feedback

Operations Activities

Establish Operations team consisting of key stakeholders responsible for continuously monitoring, maintaining, and improving environmental performance.

Led by the building owner.

The specific key team members responsible for performing the required monitoring tasks vary, usually lead by the owner’s facilities managers + the company responsible for providing and/or installing the building’s control systems.

Other key stakeholders: Architect, engineers, builder, energy modeler, commissioning authority, POE researchers, …..

Conducting continuous systems training for new staff and refresher courses for all staff

Video taping all the trainings

Establish & implement standard operating procedures (SOPs) that provide continuous feedback regarding performance of the four key subsystems

Identify & document the mechanism by which feedback will be received:

- The data that needs to be collected
- The means for gathering data
- How the data will be analyzed (metrics & benchmarks)
- How the resultant information will be communicated.

Incorporating the procedure into the project’s standard operational practices.

Habitat (human)

Post- Occupancy Evaluation (POE) performance measures:

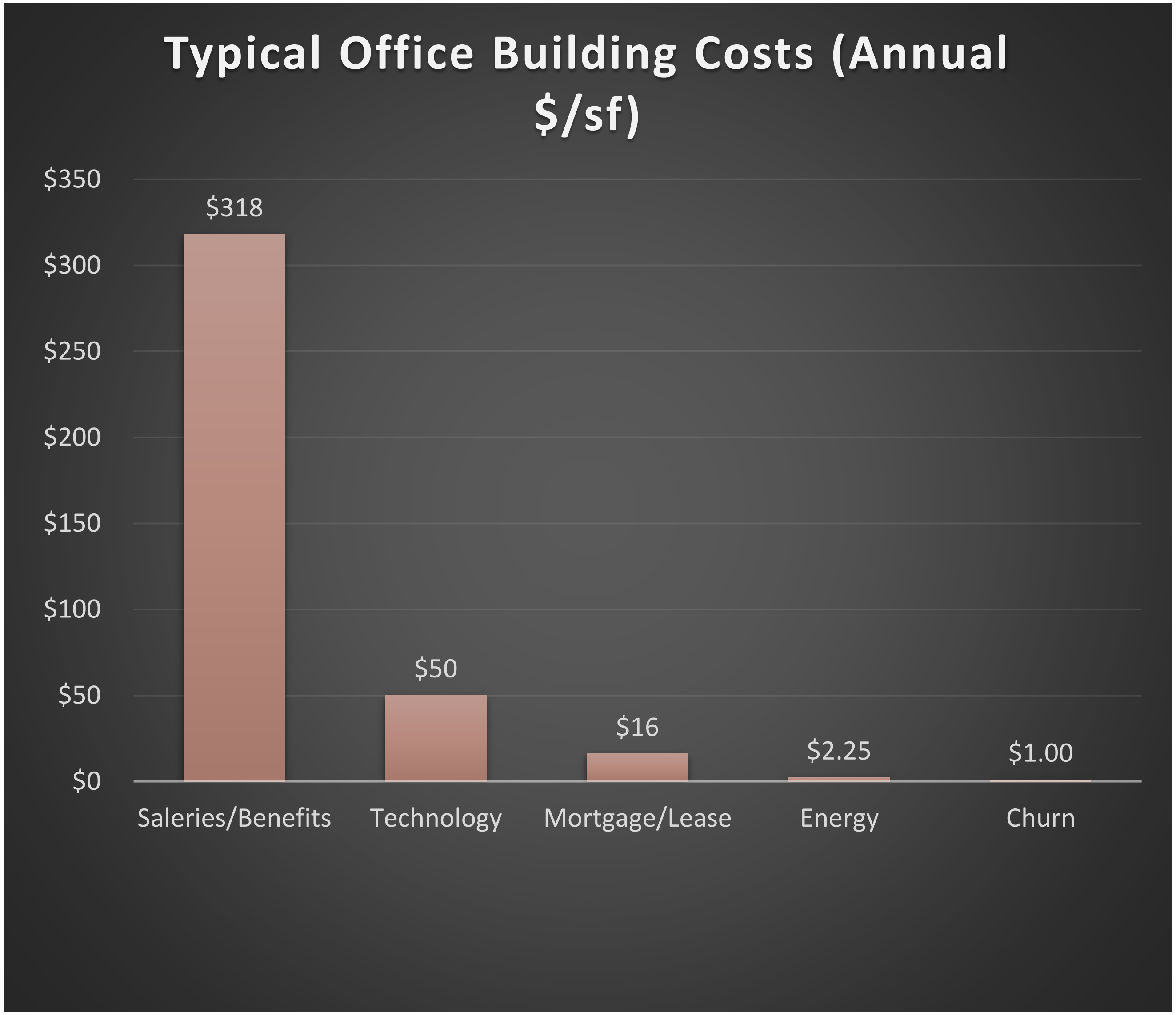
- Utility billing data
- Factors that influence human performance
  - indoor air quality
  - Daylighting
  - Acoustics
  - Thermal comfort level,…
- Human performance itself
  - Productivity
  - Absenteeism
  - Turnover rates
  - Reduced error rates

Greening the Building and the Bottom Line: Increasing Productivity through Energy-Efficient Design (Romm et. al)

How can we encourage M&V plans and POE studies?

Knowing the benefits of extending the relationship between design teams and owners into occupancy

- Owners can alter operations and/or future design pursuits for the benefit of their employees and their bottom lines.
- Designers can apply the implications of these results to their future work.
- The sustained relationship between owners and designers can inform their future work.



How can we incentivize M&V plans and POE studies?

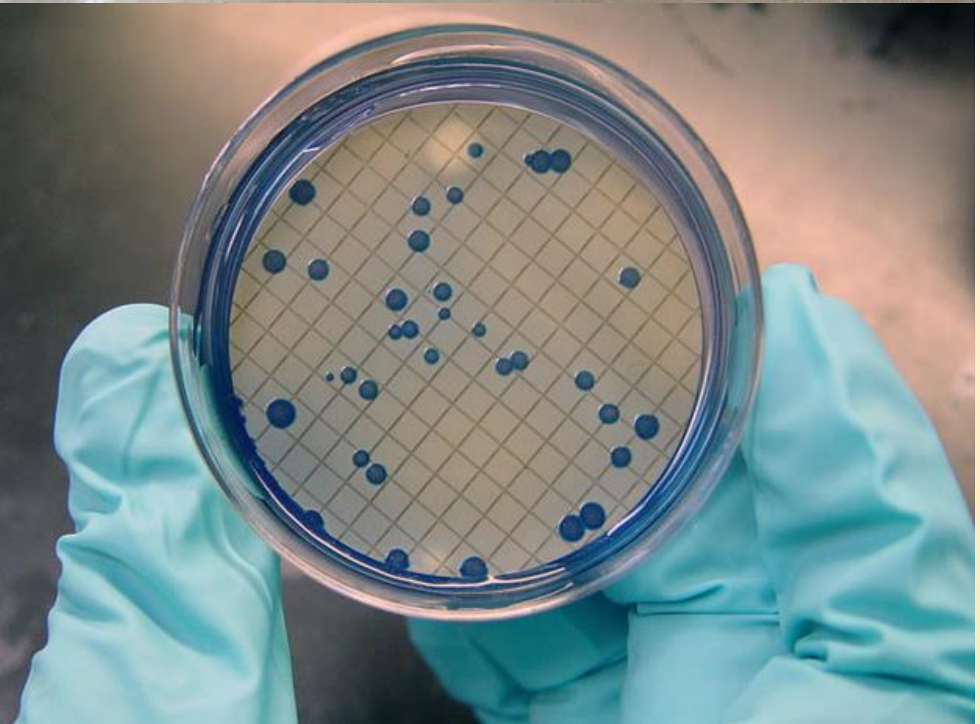
Use of performance contracting and performance-based fees.

- Understanding the complexity of how to incorporate all of the variables fairly and accurately enough to assess performance.
- Devoting more time, energy, and resources to measuring, understanding, and improving building performance.

Habitat (biotic systems other than human)

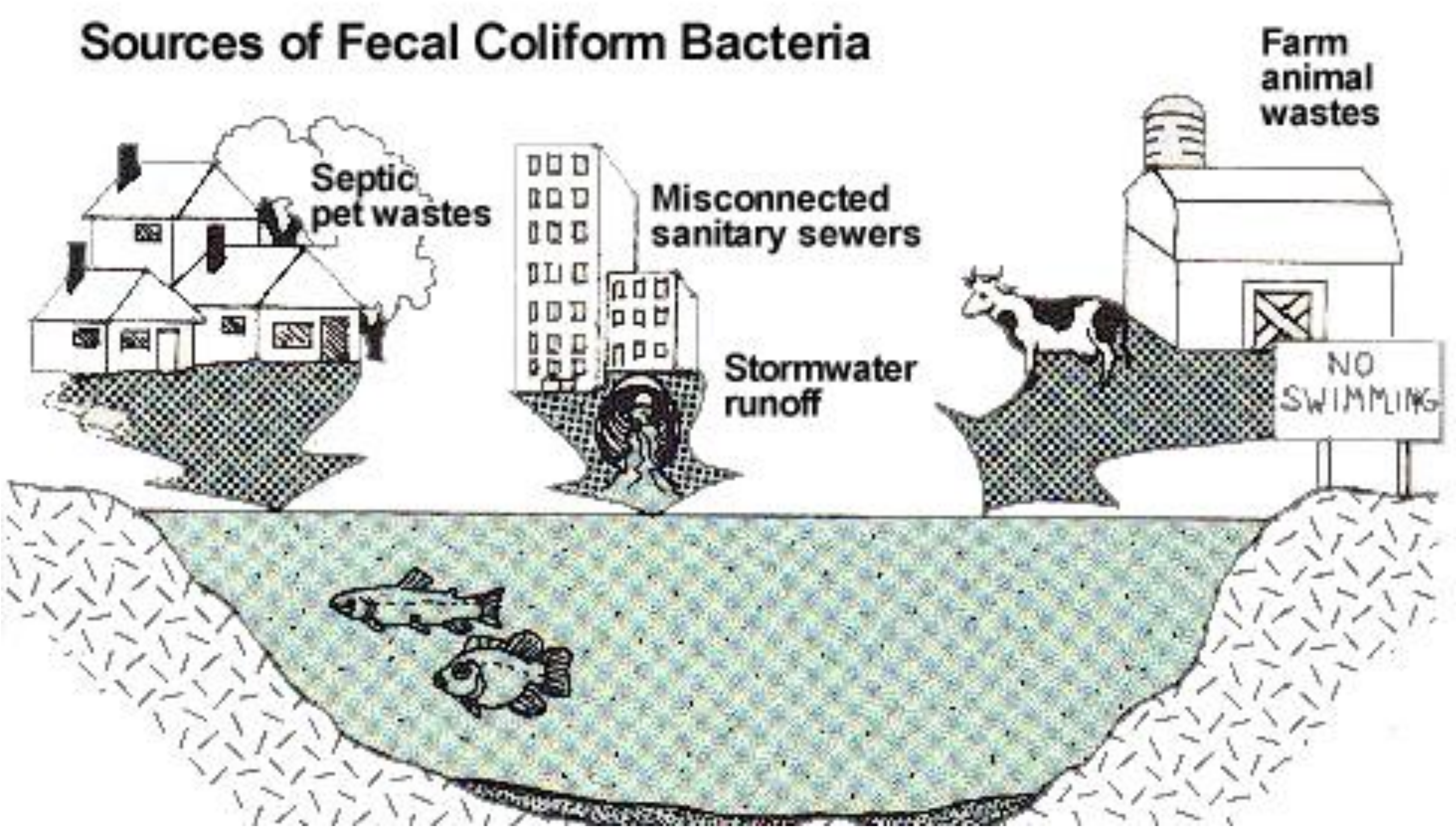
Gather measurements of key indicators of the ecosystem:

- Macro-invertebrate inventories
- Dissolved oxygen, nitrogen, pH levels, and turbidity in surface water
- Soil organic matter, chemical composition, and infiltration testing
- Organic Floristic Quality Assessment and C values (Coefficience of Conservatism) over time.
- Continuously updated assessments of biodiversity.



Water- Indicators

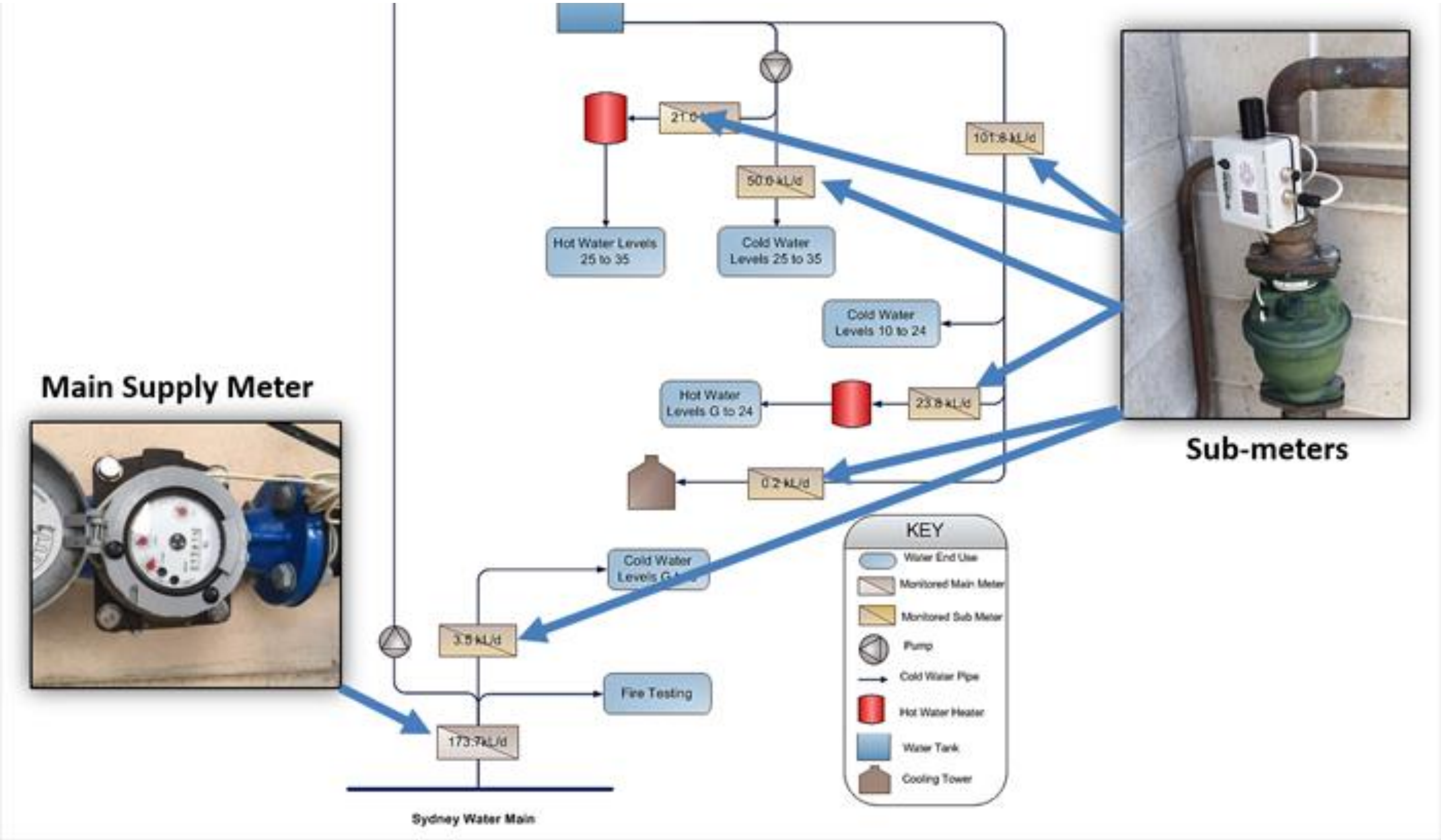
- Biochemical oxygen demand
- Biological monitoring
- Chemical oxygen demand
- Coliform bacteria
- Dissolved organic carbon
- Fecal coliforms
- Hypoxia (Environmental)
- Nitrate
- Oxygen saturation
- PH
- Salinity
- Total suspended solids
- Turbidity



Water

Determining impacts from:

- Improper human waste treatment
- Over fertilization
- Poor agricultural practices
- Erosion of soils
- Chemical pollution from industrial wastes
- Excess animal waste
- Improper chemical treatment of water….



Water consumption

- Monitor building water use and cost
- Benchmark building water use against the original target and calculated prediction or similar facilities
- Gather data required for the M&V effort

Energy

- Monitor Energy use and cost
- Benchmark energy use against the original performance target/ similar facilities and energy modeling results

Evaluating Building Energy Performance - W.S. Cumby & Son

US Department of Energy - Energy Information Administration

Commercial Buildings Energy Consumption Survey, 2003

CBECS data is produced by the US DOE every four years based on a survey of thousands of commercial building from all over the United States. The data is based on actual building energy consumption and cost. This data represents the average of thousands of buildings of various size, age, types of construction, location, and energy sources. It is useful to compare the modeling results to these values as a reality check and to enable realistic goal setting of project energy performance. In addition it is useful for making comparisons to actual building energy use to gauge building energy performance.

Energy Intensity (kBTU/square foot)					Energy Cost ($/square foot)		
Building Type	National Average	Northeast	Middle Atlantic	Climate Zone 3	Building Type	National Average	Northeast
All	89.8	98.5	98.3	98.5	All	$1.43	$1.65
Education	83.1	101.6	103.1	93.5	Education	$1.22	$1.49
Food Service	258.3	272.8	290.2	247.6	Food Service	$4.15	$4.84
Health Care	187.7	212.2	219.0	191.4	Health Care	$2.35	$2.82
Retail	[illegible]	[illegible]	[illegible]	[illegible]	Retail	[illegible]	[illegible]
Office	92.9	101.2	98.0	95.4	Office	$1.71	$2.07
Public Assembly	93.9	89.2	98.0	87.3	Public Assembly	$1.47	$1.27
Public Order & Safe	115.8	132.5	NA	NA	Public Order & Safe	$1.76	$2.09
Religious Worship	43.5	52.1	58.1	52.8	Religious Worship	$0.65	$0.68
Warehouse	45.2	41.6	49.2	49.5	Warehouse	$0.68	$0.69

The 2030 Challenge

The American Institue of Architects, the US Conference of Mayors, US Green Building Council and many other organizations have adopted the 2030 Challenge to eliminate fossil fuel energy use in buildings by 2030. All projects are challenged to obtain an immediate 50% reduction in energy intensity relative to the national average figures above. The reduction is scheduled to increase over time according to the following schedule:

60% in 2010 70% in 2015 80% in 2020 90% in 2025

Carbon-neutral in 2030 (using no fossil fuel GHG emitting energy to operate).

These targets may be accomplished by implementing innovative sustainable design strategies, generating on-site renewable power and/or purchasing (20% maximum) renewable energy and/or certified renewable energy credits. For more information visit - http://www.architecture2030.org

Actual Energy Performance	**31.8 kBTU/sf-year**	**2030 Challenge target**	**46.45 kBTU/sf-year**

Actual performance exceeds the 2030 Challege by 31.5%

Materials- Life cycle Assessment

- Impact Estimator
  - **Sample Building #1 (4.87 KiloTonnes)**
    - Columns and Beams (427.88 Tonnes)
    - Floors (1.1 KiloTonnes)
    - Roofs (19.41 Tonnes)
    - Foundations (232.67 Tonnes)
    - Walls (3.1 KiloTonnes)
    - Extra Materials (13.88 KiloGrams)
  - Sample Building #2 (2.13 KiloTonnes)

1 of 1 100% Find | Next

Summary Measure Table By Life Cycle Stages

Project Sample Building #1

	Manufacturing			Construction			Maintenance			End - Of - Life			Operating Energy	
Summary Measures	Material	Transportation	**Total**	Material	Transportation	**Total**	Material	Transportation	**Total**	Material	Transportation	**Total**	Annual	**Total**
Fossil Fuel Consumption (MJ)	3.33e+07	1.53e+06	**3.48e+07**	1.56e+06	1.80e+06	**3.36e+06**	8.93e+06	6.20e+05	**9.55e+06**	1.92e+06	6.73e+05	**2.59e+06**	6.04e+06	**5.98e+**
Global Warming Potential (kg CO2 eq)	3.32e+06	8.80e+04	**3.41e+06**	1.07e+05	1.30e+05	**2.37e+05**	9.96e+05	4.57e+04	**1.04e+06**	1.29e+05	5.18e+04	**1.81e+05**	3.52e+05	**3.48e+**
Acidification Potential (moles of H+ eq)	1.36e+06	3.58e+04	**1.40e+06**	5.12e+04	4.20e+04	**9.33e+04**	7.28e+05	1.46e+04	**7.43e+05**	6.93e+03	1.59e+04	**2.28e+04**	1.43e+05	**1.41e+**
HH Criteria (kg PM10 eq)	2.33e+04	4.69e+01	**2.34e+04**	4.24e+01	5.46e+01	**9.70e+01**	2.25e+04	1.90e+01	**2.25e+04**	9.29e+01	2.06e+01	**1.14e+02**	5.00e+02	**4.95e+**
Eutrophication Potential (kg N eq)	1.75e+03	3.91e+01	**1.79e+03**	4.96e+01	4.57e+01	**9.53e+01**	2.52e+02	1.59e+01	**2.68e+02**	6.95e+00	1.50e+01	**2.20e+01**	1.86e+01	**1.84e+**
Ozone Depletion Potential (kg CFC-11 eq)	1.52e-02	3.59e-06	**1.52e-02**	7.55e-07	5.20e-06	**5.96e-06**	4.41e-03	1.82e-06	**4.41e-03**	5.64e-06	2.06e-06	**7.70e-06**	2.97e-07	**2.94e-**
Smog Potential (kg O3 eq)	3.24e+05	1.98e+04	**3.44e+05**	2.78e+04	2.25e+04	**5.03e+04**	1.02e+05	7.81e+03	**1.10e+05**	6.74e+02	8.44e+03	**9.12e+03**	1.81e+03	**1.79e+**

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Materials

- The Operational impacts of a building's Material choices stay relatively static.
- The exception: impacts resulting from their maintenance and replacement.

Initial solution:

- To purchase materials that are known to require low maintenance.

Problem:

- The idea is completely subjective.

Proposed solution:

- Including maintenance staff in design decision.

Problem:

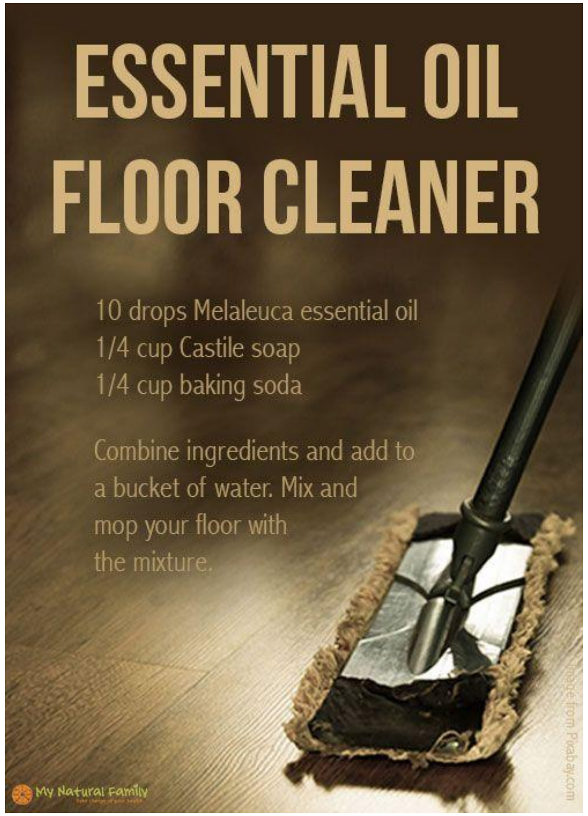
- Tendency to select and maintain materials to fit within their current maintenance pattern.
- Generating significant impacts on indoor air quality, time, energy, and money.

Solution:

- Exploring ways to lower environmental impacts and cost, while establishing a maintenance and replacement schedule that ensures longevity, cleanliness, and beauty.

Materials: Design Team Considerations

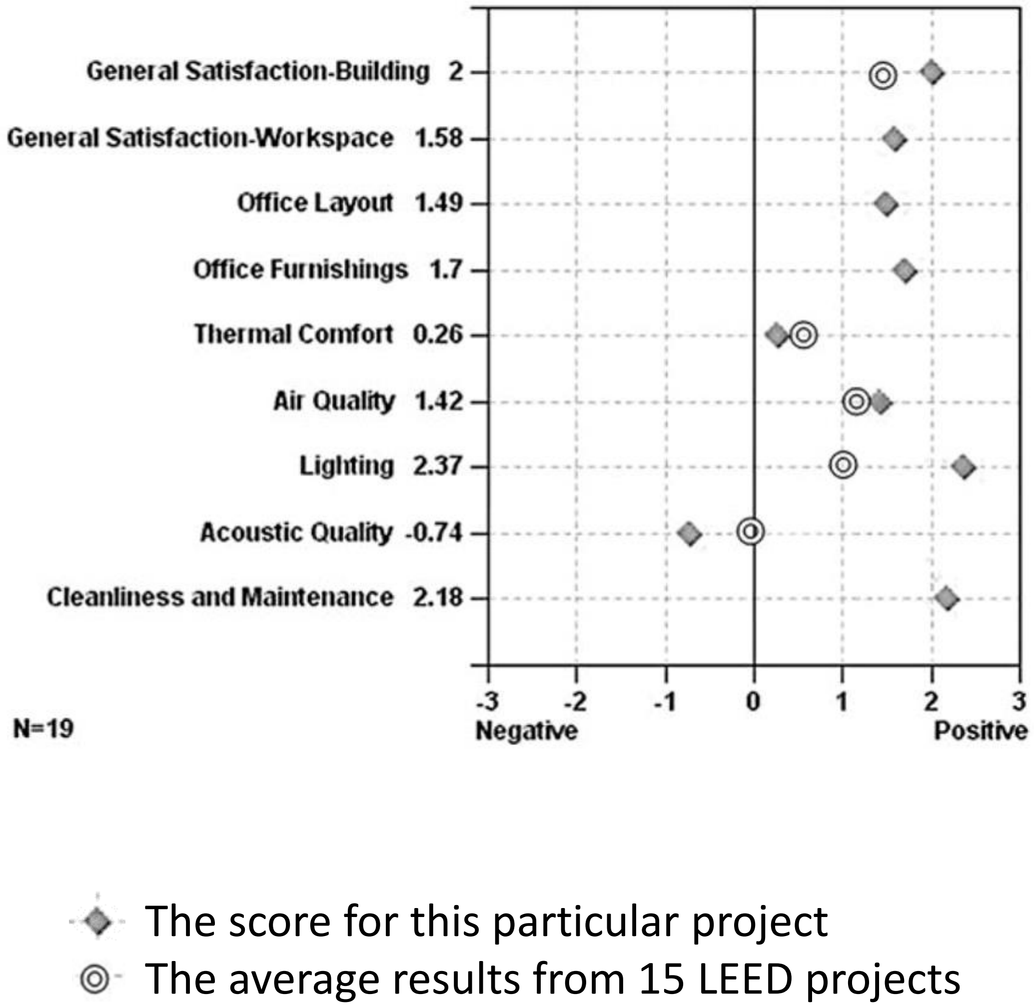
- Alignment with service-life Planning
- Maintenance and replacement
  - Being aware of/or involved with how materials are intended to be cared for
  - Knowing the expected replacement of materials
- Green housekeeping
  - Using cleaning products that contain no toxicants and low VOCs.
  - Training



Commissioning: Conducting periodic Recommissioning in accordance with Recommissioning Manual

- Hiring the original CxA, other firms, or Operation staff
- Discovering issues that would have remained undetected by the conventional construction process.

=> The systems would never be in tune => additional energy would be wasted over the life of the facility



Document occupant surveys & reconcile results with building systems performance

- Sharing the results with the design & construction team.
- Greater value: sharing the results with the larger building industry.

Reluctance due to:

- Proprietary information
- Revealing their mistakes to the world!

Solution:

- Aggregating the results from multiple projects into a larger data set.

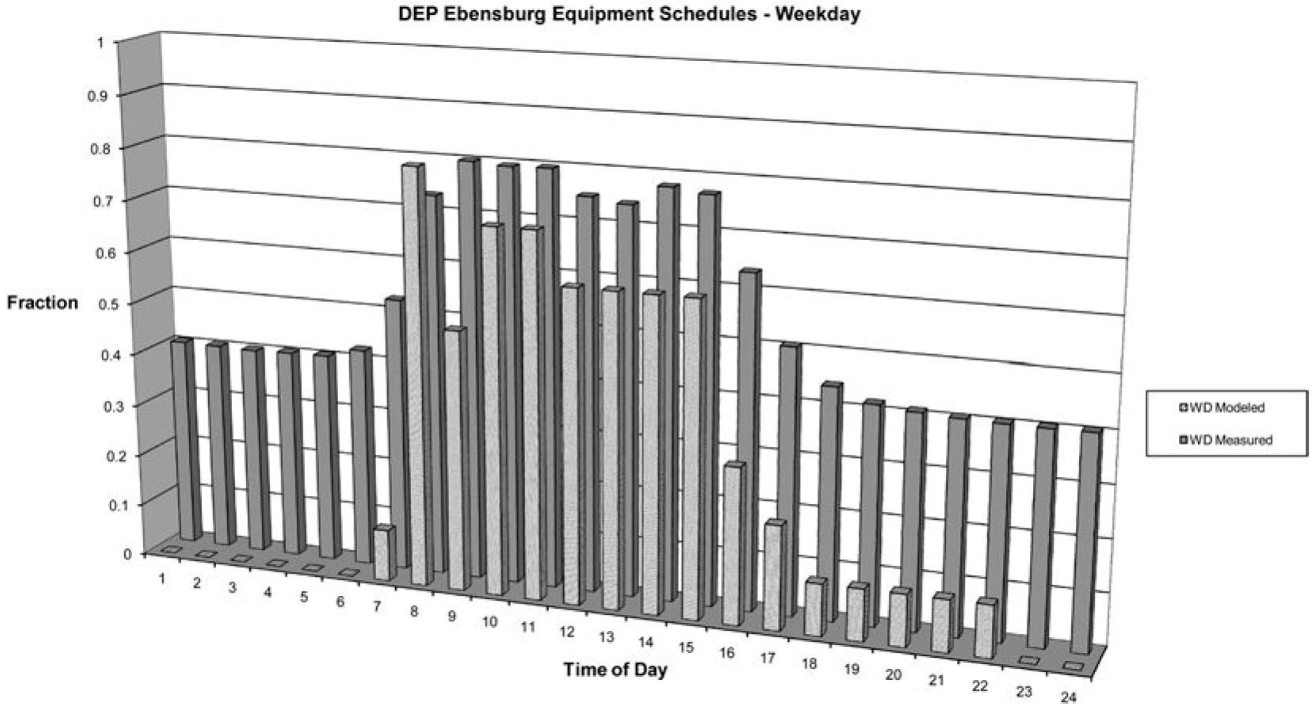
Implement M&V plan continuously over the life of the building

- End game: determination of actual savings
- Real value: lessons learned!

Report includes:

- What worked & what did not
- The reasons

M&V becomes a continuous monitoring effort over the life of the project.



Cost Analysis

- Track economic performance of the four key subsystem:

- The real opportunity to demonstrate how quality design, long term ecological health considerations, and diligent maintenance can improve the return on investment of projects, & inform cost-benefit evaluations for future projects.

Questions to Consider for writing the Reflections:

WHAT IS COMMISSIONING? ITS BENEFITS, DRAWBACKS, AND CONDITIONS?

HOW IS COMMISSIONING CONDUCTED IN OUR COUNTRY? WHAT CHALLENGES DO WE FACE IN CONDUCTING FULL SCALE COMMISSIONING IN OUR COUNTRY?

PRESENT A CASE STUDY OF A PROJECT WITH VARIOUS FEEDBACK METHODS AND HOW THEY HAVE LEARNED FROM THE FEEDBACKS?