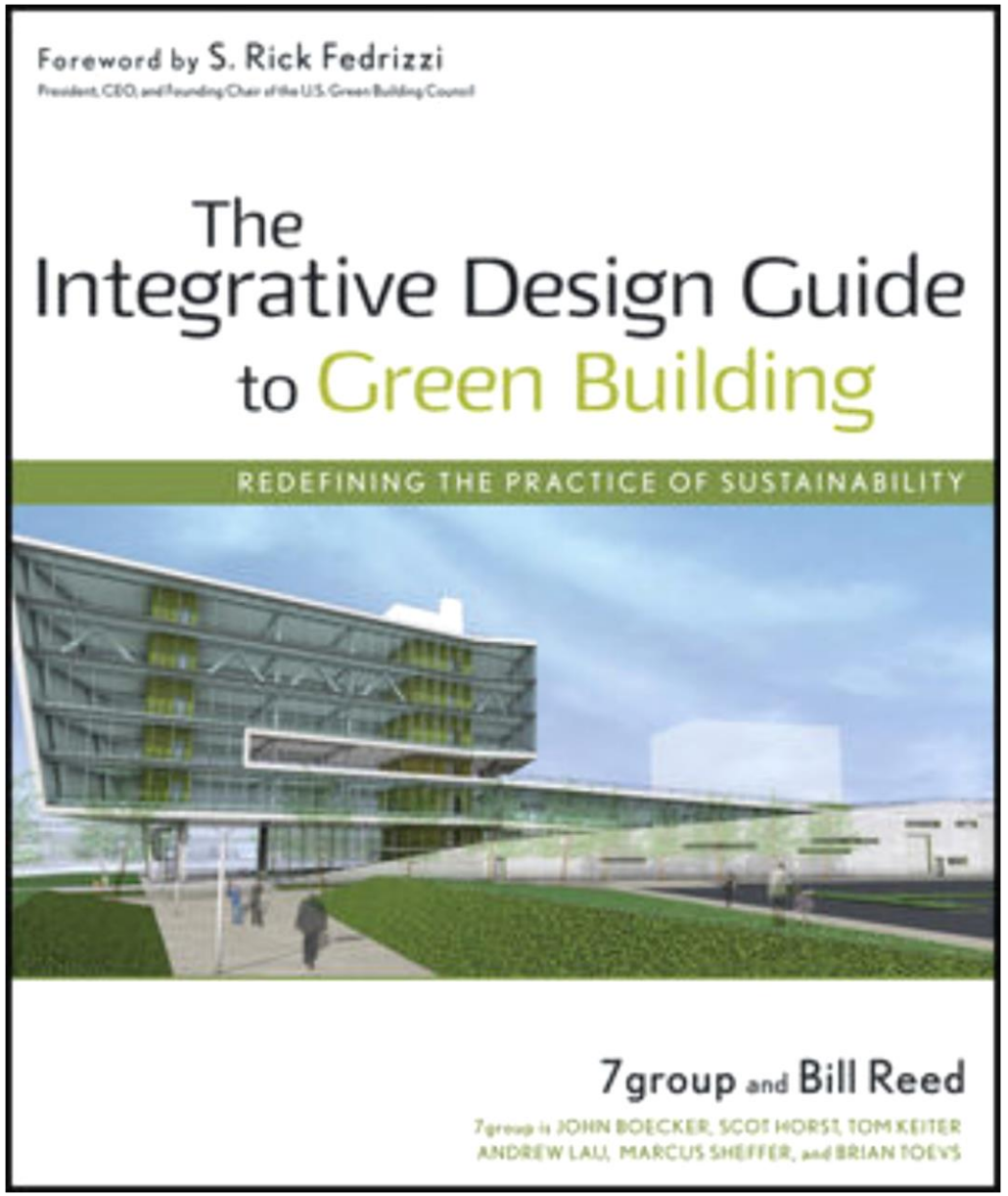
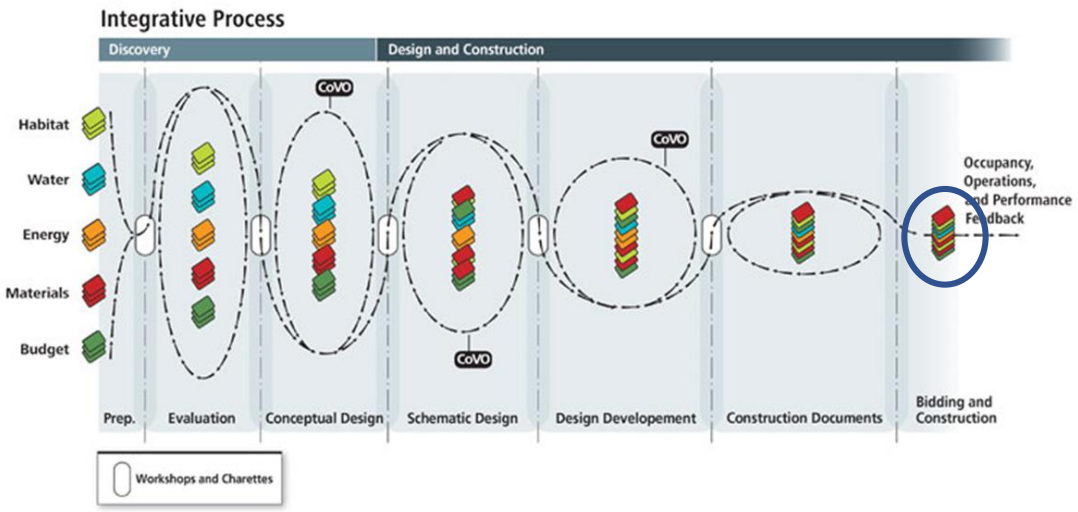
Bidding & Construction, Occupancy, Operations, & Performance Feedback

جلسه سیزدهم- مبانی طراحی محیطی، نظریه ها و روشها

خرداد 1398





Bidding & Construction

Stage B.7

Bidding and Construction—Aligning with the Builder: Becoming a Team

B.7.1 Bidding and Construction Activities

- Explain unique aspects of project and the integration of all systems at the Pre-Bid and Pre-Construction conferences
- Review with builder's team (all trades and subcontractors) their roles and responsibilities prior to commencing construction regarding:
  - Subcontractors' roles in supporting the integration of their work into the whole
  - Each subcontractor's role in supporting the documentation necessary to demonstrate achievement of Performance Targets
- Review builder submittals through the unique filters of environmental performance
- Commissioning: Coordinate with builder's team installation of all systems regarding achievement of Performance Targets
  - Perform site observations
  - Incorporate Commissioning schedule into construction schedule
  - Review submittals
  - Develop construction checklists and functional tests
  - Witness start-up
  - Perform functional tests
  - Verify training of building operations team
  - Prepare final Commissioning report
  - Produce systems manuals

B.7.2 Principles and Measurement

- Manage the collection of documents that verify achievement of Performance Targets
- Commissioning: Document prefunctional and functional testing results and prepare Commissioning (Cx) reports and Recommissioning Plan

B.7.3 Cost Analysis

- Coordinate with builder to ensure that subcontracts are awarded based on performance requirements, not just price

B.7.4 Schedule and Next Steps

- Ensure systematic communication between design and building teams

Explain unique aspects of project & the integration of all systems at the Pre-Bid Construction conferences

- Attendees primarily consist of estimators who have no involvement with the building.
- The trade supervisors need to attend.
- The competition is in the room!! So, people are reluctant to ask questions or raise issues.
- In addition to the typical logistical issues & contractual obligations, a detailed review of the OPR & BOD should be a primary focus of this meeting.
- Address non-building-related sustainability issues:
  - Landscape-habitat design
  - Site stormwater systems
  - Natural waste systems
  - Operational & embodied-emissions targets
  - Indoor air quality concerns
  - Recycling programs
  - Education programs….

Review with builder's team their roles & responsibilities prior to commencing construction

Topics of interest:

- Subcontractors' roles in supporting the integration of their work into the whole
- Each subcontractor's role in supporting the "documentation" necessary to demonstrate achievement of performance Targets.
- Review builder submittals through the unique filters of environmental performance.

Commissioning

1. Perform site observations

"Collaborating with the installers as systems come together" as opposed to *"policing a project"*

2. Incorporate Commissioning schedule into construction schedule

3. Review Submittals

4. Develop construction checklists & functional tests

5. Witness start-up

6. Perform functional tests

7. Verify training of building operations team

8. Prepare final Commissioning report

9. Produce systems manuals

Specification Section	System	Duration
131100.1.12.B	Swimming Pool	32 Hrs. 2 sessions 1st for 16 hrs. on po systems, 2nd for 16 hrs anytime up to 1 year after acceptance.
142400.3.5.A	Hydraulic elevators	
144200.3.5.A	Vertical Platform lift	
212200.3.9	Clean Agent Fire Suppression System	
230513.13.3.5.	Variable Frequency Drives	
230924.3.9	Direct Digital Temperature Controls	24 hrs
232500.1.6.D	HVAC Water Treatment	2 hrs
235233.14.3.2.A	High Efficiency Condensing Boilers	2 days minimum on separate visits
236400.3.2	Packaged Water Chillers	2 days minimum on separate visits
237413.3.3	Packaged Natatorium Dehumidification Unit	8 hrs minimum over 2 visits
260944.3.3	Digital Network Lighting Controls	
263213.4.5	Emergency / Standby Power Systems	8 hrs per 5 people
265100.3.6	Interior Lighting	2 hrs
265561.2.12	Auditorium Theatrical Lighting System	2 sessions – 1st for hr minimum. 2nd w/ 60 days of owner acceptance for 2 hr minimum
275124.1.7.A & 3.5.C	Intercom & Master Clock	
275124.01.2.5.A	Auditorium Sound Reinforcement System	Each system 2 sessions @ 2 Hrs. ea. & 1 @ 1 Hr with 60 days of owner acceptance.
275124.02.2.5.A	Band/Choral Rooms Sound Reinforcement System	
275124.03.2.5.A	Cafeteria Sound Reinforcement System	
275124.04.2.5.A	Gymnasium Sound Reinforcement System	
275124.05.2.5.A	Natatorium Sound Reinforcement System	
275132.3.2.A	RF Broadband Video Distribution System	2 Hrs.
275132.01.3.2.B	Media Management Subsystem	16 Hrs. Hands on & Hrs. technical.
283100.1.5.A	Fire Alarm Network & Detection System	4 Hrs.

Sample Early phase training Matrix

Conventional Construction Phase

- The large stacks of drawings & specifications are issued for bidding.
- The documents are distributed to all potential prime bidders & subcontractors.
- 4 Weeks or so are given for putting a price on the work.
- Pre-bid conference is convened A series of clarification questions are submitted to the A/E team.
- Responses are issued in the form of addenda to the bidding documents.
- Submitting contractors consolidate the bid numbers & submit their final bid.
- The owners' project team evaluates the bids & awards contracts to the lowest qualified bidders.
- A pre-construction conference is convened with the successful bidder
- The builder mobilizes and construction begins under a command-and-control hierarchy.
- Design team members observe construction to evaluate conformance with CDs.
- The A/E firms staff attend biweekly job-site conferences, review shop drawings & submittals, respond to RFI, approve payment applications & process change orders.
- CxA is brought to the site.
- At substantial Completion, substantial payment is made to all contractors & subcontractors
- Punch-list items are addressed, construction retainage is released/ all membered are paid their final fees.
- The building is turned over to the owner's facilities staff; warranty periods begin.
- Contractors are called back to fix lingering problems during the 12 month warranty period.

What's working?

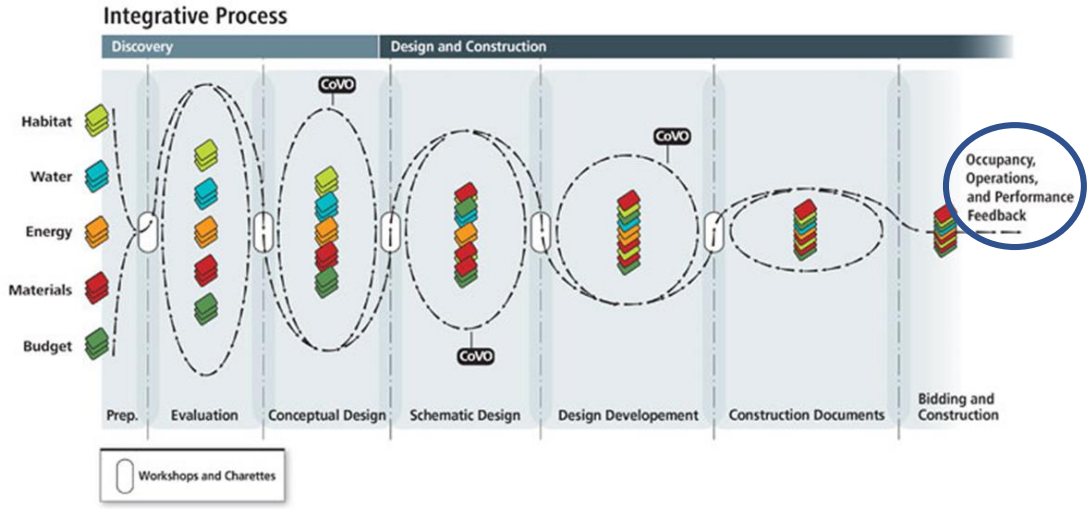
- The process allows everyone to proceed with minimum amount of communication.
- It allows everyone to proceed doing what they do best.
- Procedures rest on collective understanding of common practices, convention, & assumption=> Everyone is comfortable.
- Each trade has specific & clearly defined task within their contract.
- Market driven competitive pricing generally keeps costs within fairly predictable ranges.
- The feedback of the marketplace ensures that artificially low prices & low-quality construction are not repeated too often.

What’s not working?

- The short frame of bidding process=> Further fragmentation.
- Specifications sections are distributed to subs and venders as independent pieces.
- Additional 10-20% in the form of addenda or change order depending on the quality of bidding documents.
- Communication is slow & needs to go through the hierarchical system.
- No feedback mechanism to inform & adjust the decision.
- Subcontracting trades often get in each others’ way.
- Product Substitutions frequently occur=> performance may suffer.
- Environmental impacts associated with the construction process are rarely count.
- Construction usually remains uncompleted.
- Operations staff usually inherit a building that they do not understand.

How can we think about this differently?

- Dispelling the mystery by getting builders involved early.
- Contractors, Subs, & suppliers become part of the co-learners design team.
- Designers & Contractors as equal partners.
- BIM could help in solving the mystery.
- Changing the low-bid policy
- Engage a Quality control process that bridges the gap between abstract representations & the reality of actual construction.
- Addressing fragmented expertise with Composite master builder mind.
- Moving from selling a commodity to providing a professional service.
- Ignore the lawyers!! Accept responsibilities for problems & solve them together as a team.
- The will to change & a clearly defined purpose (won't happen overnight!)
- Retooling the process & people
- A shift to a mental model that understands all design & construction team members functioning as an organism to build a functioning organism.



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

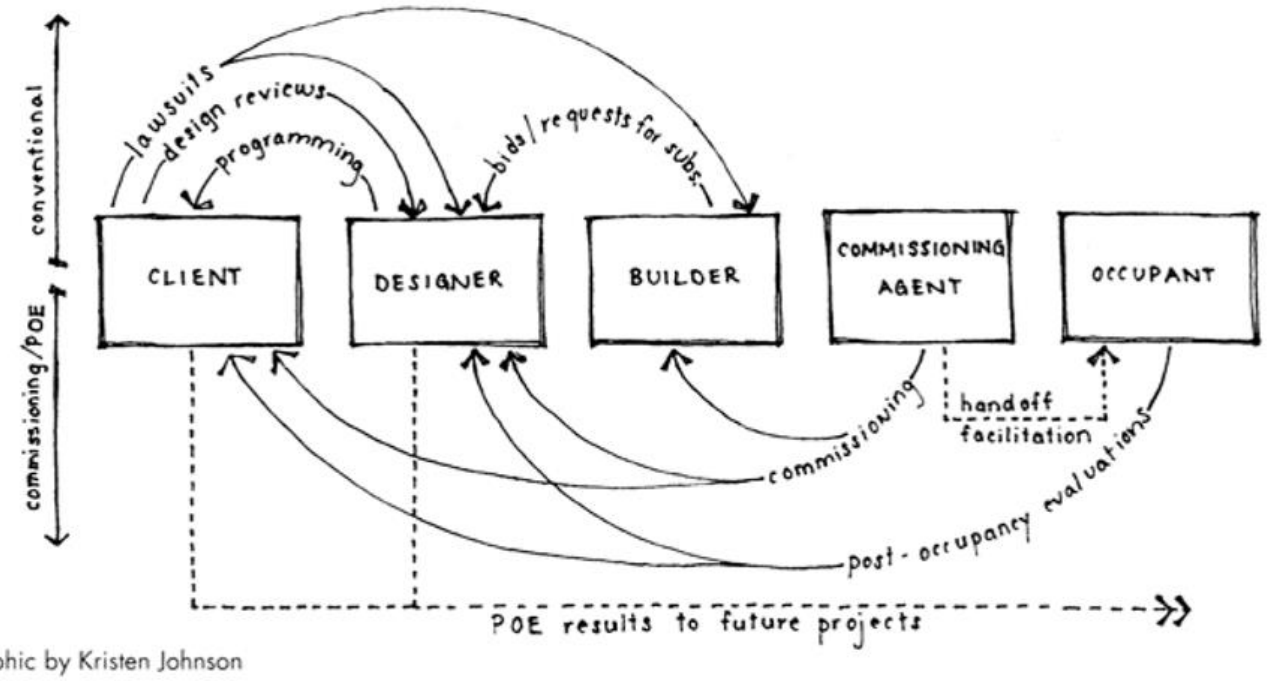
C.1.3 Cost Analysis

- Track economic performance of the four key subsystems

C.1.4 Schedule and Next Steps

- Implement all of the above forever

Occupancy, Operations, & Performance Feedback



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.

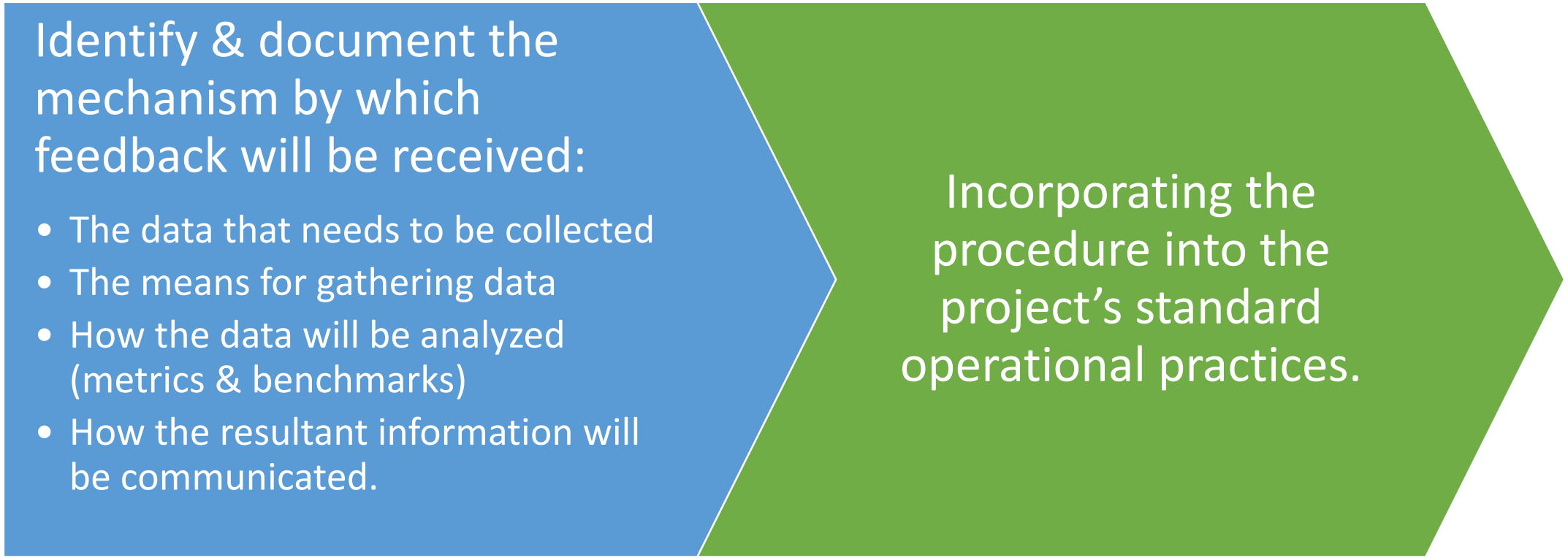
The specific key team members responsible for performing the required monitoring tasks vary, usually lead by the owner's facilities managers + the company responsible for providing and/or installing the building's control systems.

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



Habitat (human)

Post- Occupancy Evaluation (POE) performance measures:

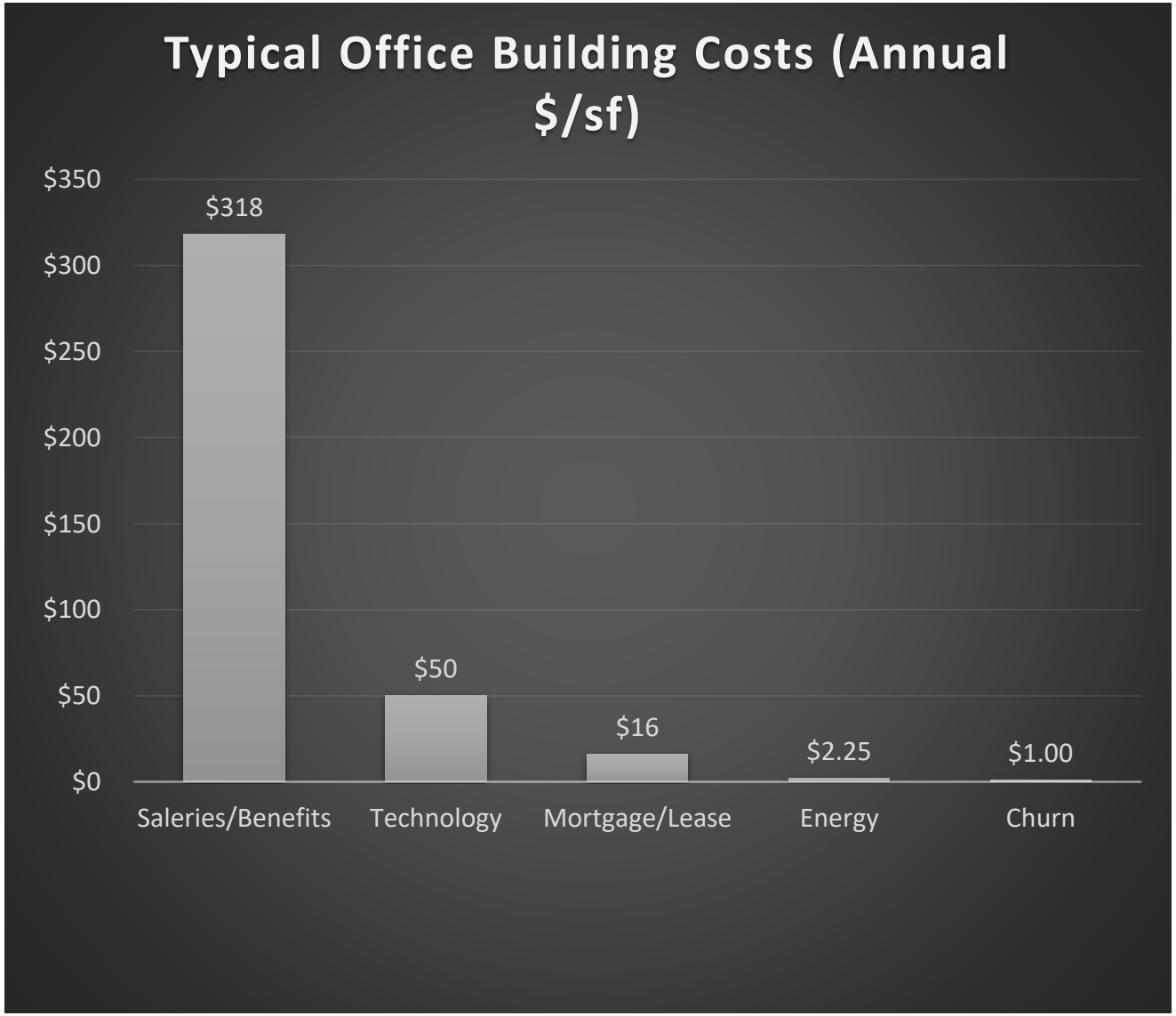
- Utility billing data
- Factors that influence human performance
  - indoor air quality
  - Daylighting
  - Acoustics
  - Thermal comfort level,…
- Human performance itself
  - Productivity
  - Absenteeism
  - Turnover rates
  - Reduced error rates

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

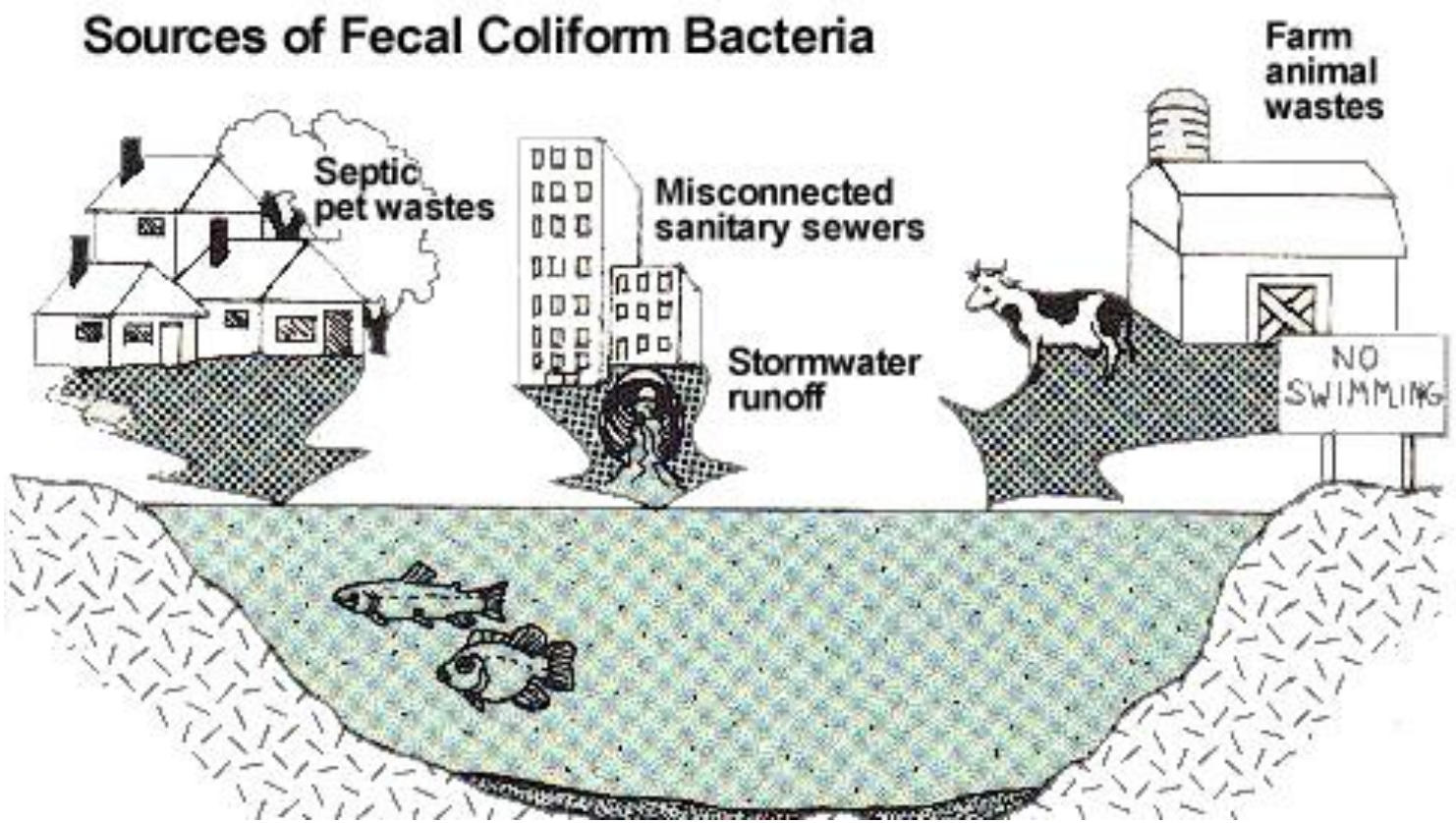
- Owners can alter operations and/or future design pursuits for the benefit of their employees and their bottom lines.
- Designers can apply the implications of these results to their future work.
- The sustained relationship between owners and designers can inform their future work.



Habitat (biotic systems other than human)

Gather measurements of key indicators of the ecosystem:

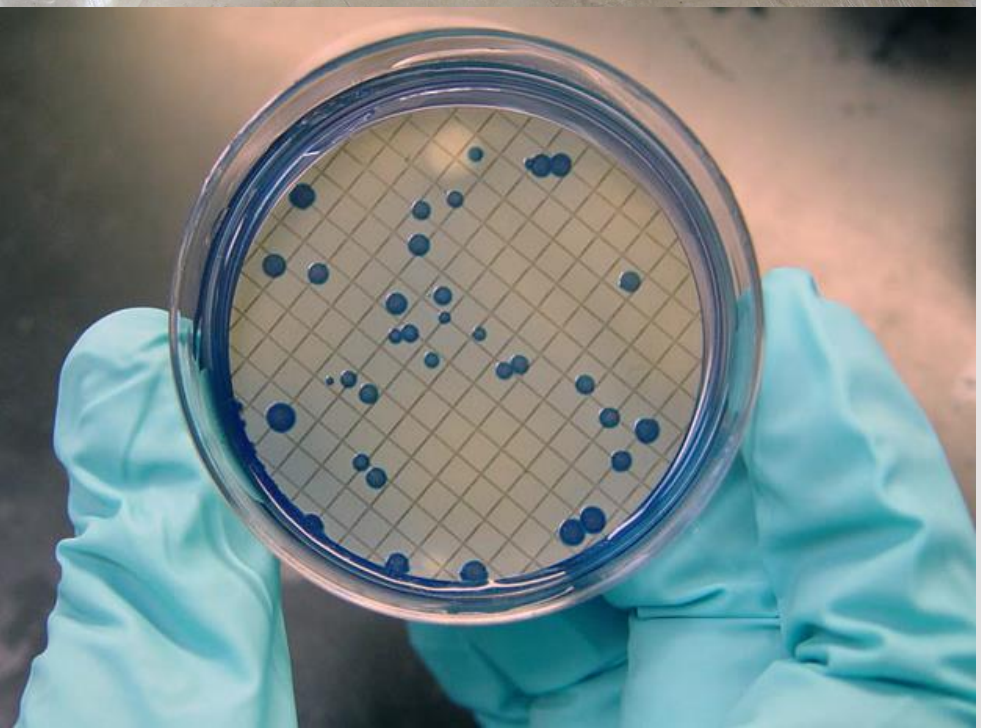
- Macro-invertebrate inventories
- Dissolved oxygen, nitrogen, pH levels, and turbidity in surface water
- Soil organic matter, chemical composition, and infiltration testing
- Organic Floristic Quality Assessment and C values (Coefficience of Conservatism) over time.
- Continuously updated assessments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



Water

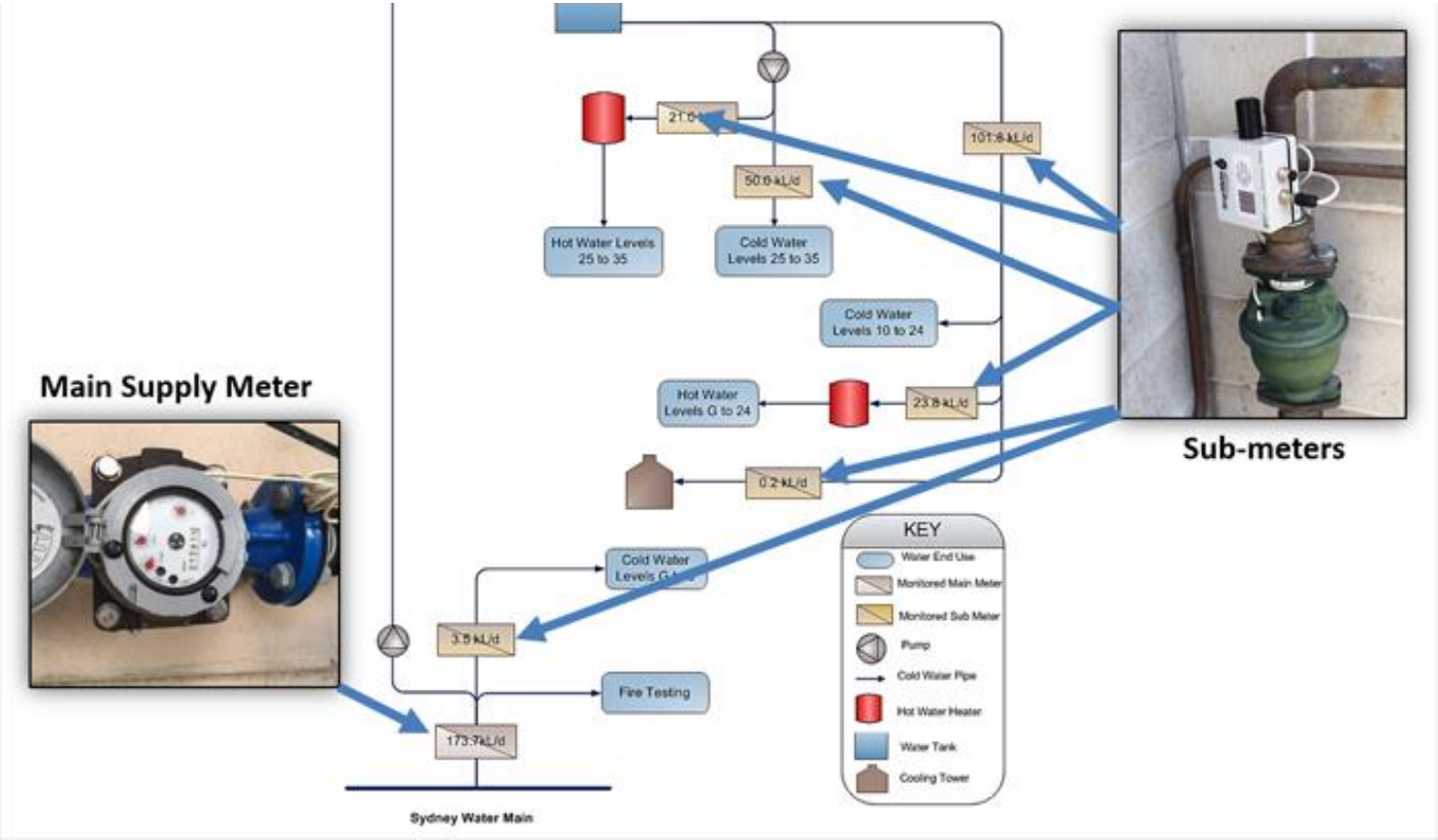
Determining impacts from:

- 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- 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 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	78.8	85.8	72.8	87.1	Retail	$1.38	$1.38
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

- 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.

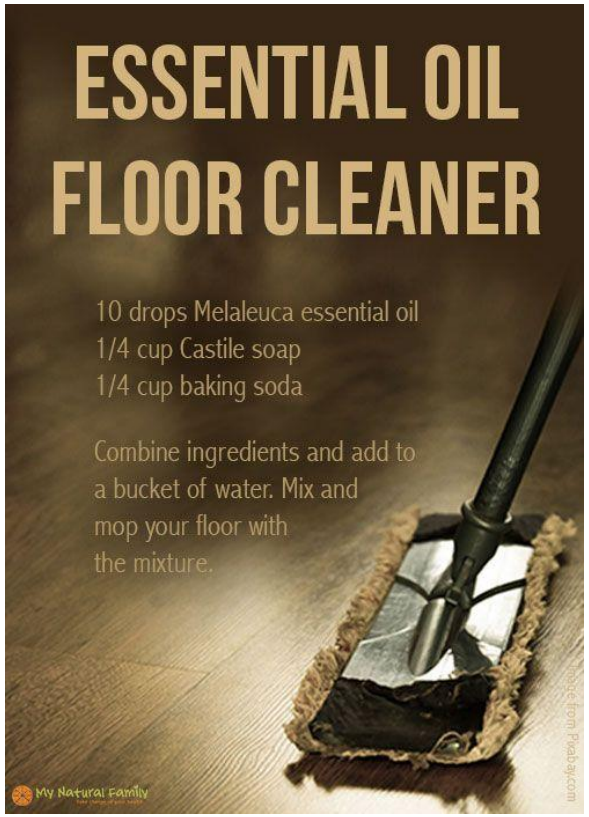
Solution:

- 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

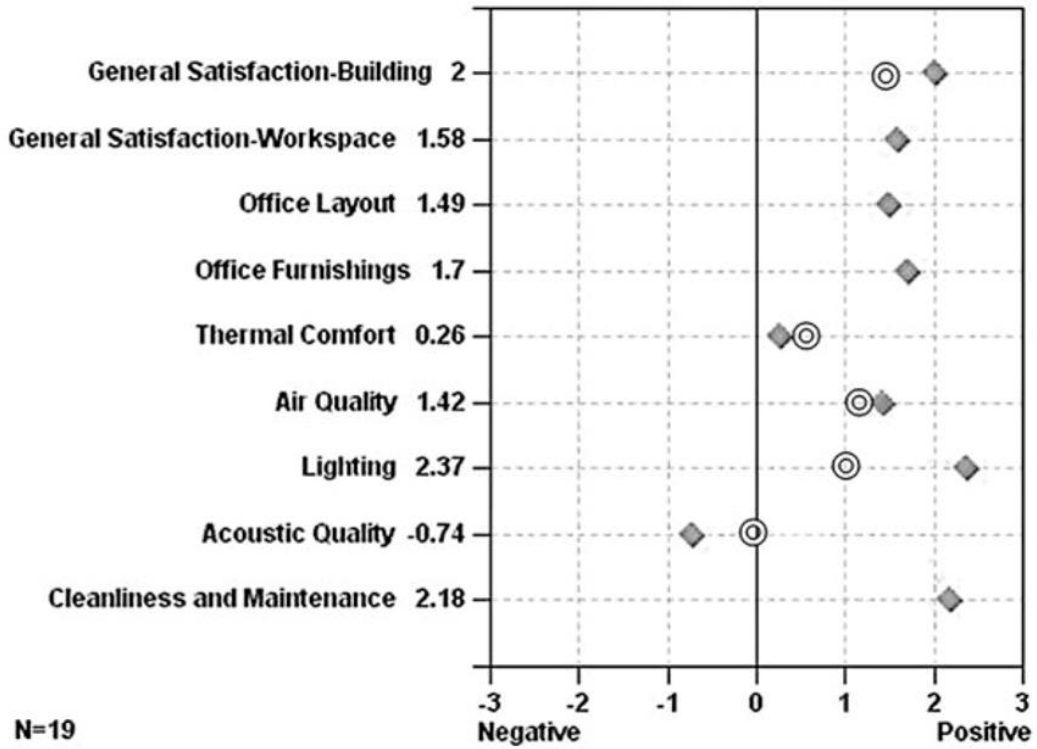
- Green housekeeping
  - Using cleaning products that contain no toxicants and low VOCs.
  - Training



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



The score for this particular project

The average results from 15 LEED projects

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.

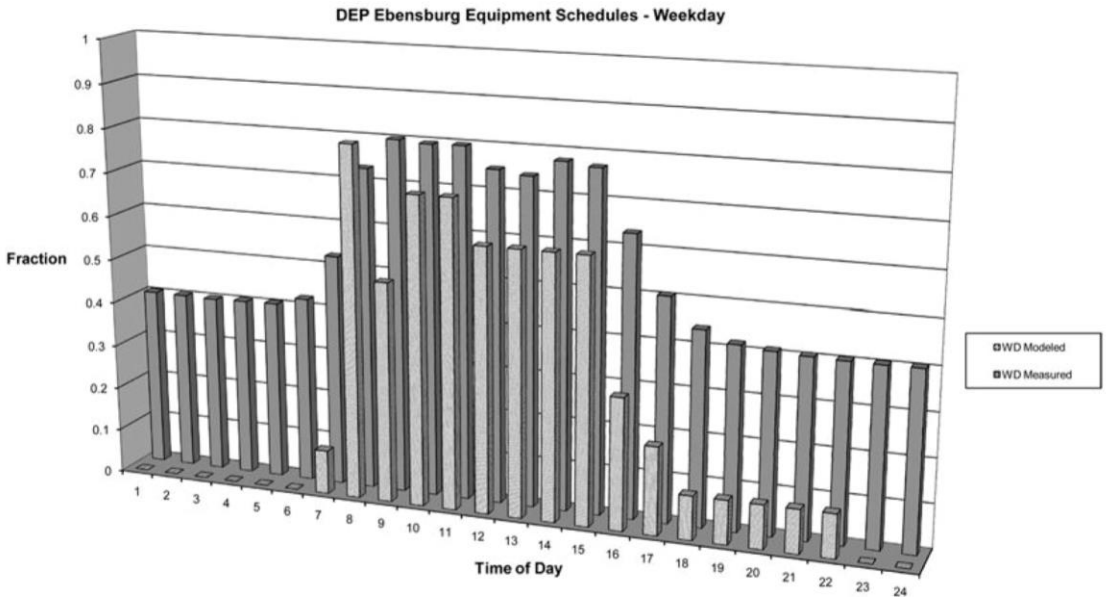
Implement M&V plan continuously over the life of the building

- Calibrated Simulation, Reconciled Simulation, Revised baseline
- 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.

Habitat (biotic systems other than human)

- Difference in site-construction costs due to use of topography & biological systems rather than hardscape, pipes & technological solutions for stormwater management
- Property value due to the health of the ecosystem
- Speed of environmental reviews (time to market) for zoning approvals & entitlements
- Maintenance costs for meadow grass “lawns”
- Frequency of roof replacement with living roof

Habitat (Human)

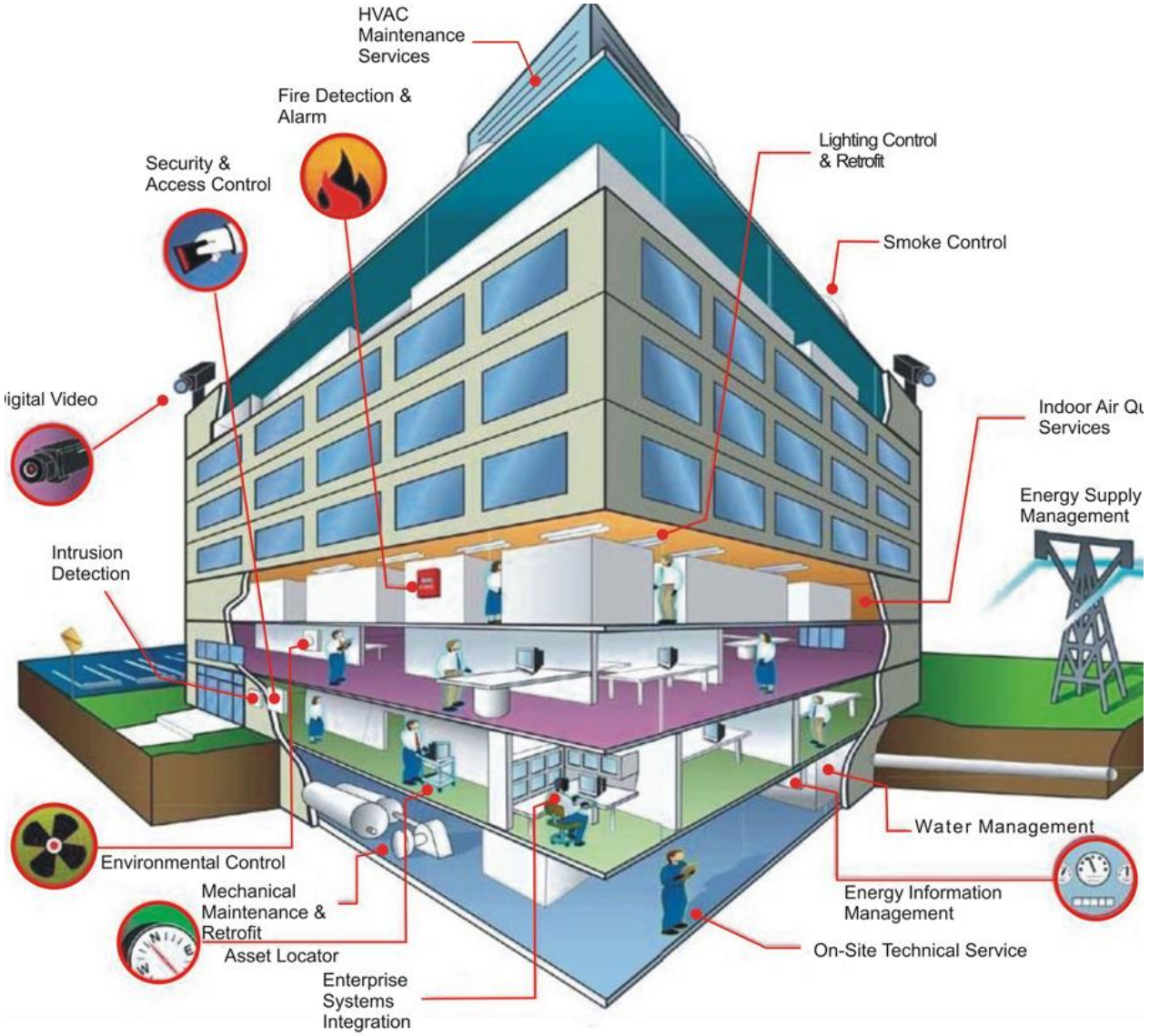
- Productivity studies due to individual control of HVAC at workstations
- Absenteeism
- Rate & cost of workmen's compensation claims
- Health of occupants due to daylighting
- Employee turnover from the implementation of many of these strategies

Water

- Difference in site construction costs due to use of topography & biological systems rather than hardscape, pipes & technological solutions for stormwater management.
- Reduced first cost & operating costs for natural systems waste treatment, such as constructed wetlands
- Water bills

Energy

- Energy costs for thermal comfort
- Energy costs for nonregulated, process energy loads
- Maintenance frequency related to energy savings & equipment service life
- Reduced lighting costs due to daylighting
- Energy bills
- Continued functionality of buiding control systems
- Operational procedures to address energy use



Materials

- Maintenance costs
- Replacement costs (related to service life)
- Cost of maintainability

Questions to Consider for writing the Reflections:

WHAT ARE THE MAIN DIFFERENCES BETWEEN CONVENTIONAL & INTEGRATIVE DESIGN PROCESSES IN CONSTRUCTION & OCCUPANCY PHASE?

DESCRIBE THE IMPORTANCE OF PERFORMANCE FEEDBACK IN CONSTRUCTION PROJECTS.