



Kevin Kelly, AIA
GSA Public Buildings Service
Office of Applied Science
Rochester, New York, August 2004

Workplace 2020 / Integrated Sustainability
Planning and Design



August 8-11, 2004

www.energy2004.ee.doe.gov



2020: The next step



Most city *talk* is about major buildings, planned public spaces, transit...the city through a car windshield, on a TV screen. This is all seen from the outside, the exterior city: skyline, skyscrapers, windy squares...



Actual city life is interior. Inside rooms, sitting on chairs...No matter how tall the building or magnificent its skin...that soaring feeling is reduced to individual rooms, corridors, compartments, cubbyholes with a eight-foot ceiling.”



August 8-11, 2004

- James Hillman “Interiors in the Design of the City” 1982
www.energy2004.ee.doe.gov



ANNUAL OFFICE COSTS / SF

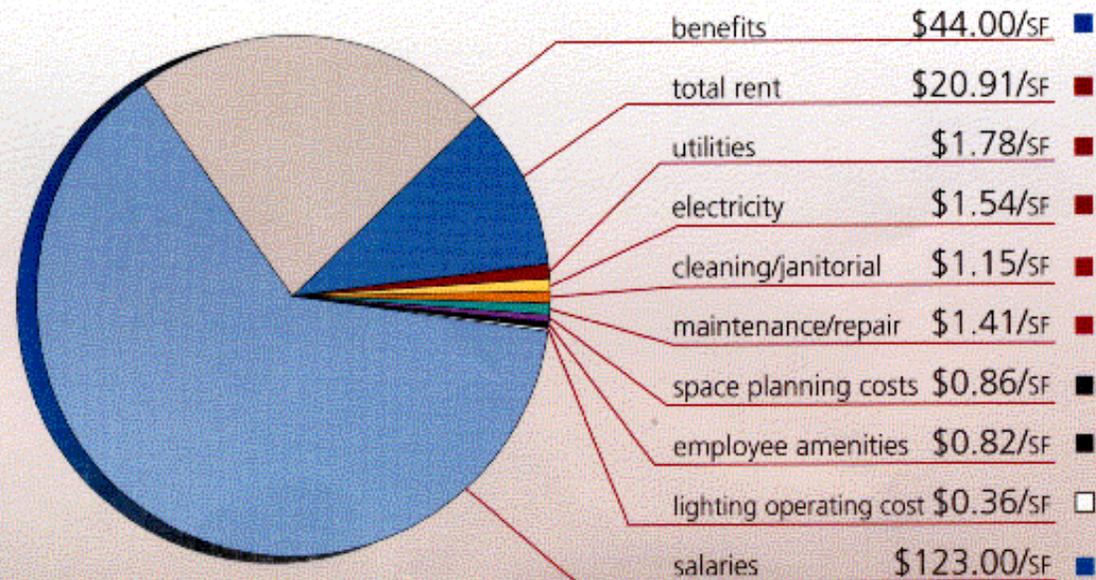


FIG. 2

DATA SOURCES:

- Department of Labor, Bureau of Labor Statistics, June 2000. Based on an average annual salary of \$53,373 and annual benefits of \$14,040. Average office space per worker is 319 sf, from the BOMA International 2000 Experience Exchange report.
- Building Owners and Managers Association, 2000 Experience Exchange Report.
- International Facility Management Association, Benchmarks III, Research Report #18, 1997.
- Assumptions include an energy rate of \$.08 per kWh, annual burn hours of 3,640, and a power density of 0.9 watts/sf.



Why Is Workplace Important to an Organization?

- **The Work Environment Affects:**
 - Satisfaction and Health
 - Hiring and Retention
 - Productivity
 - The Bottom Line
- **Any Organization Should Use Workplace as a Business Tool**

A World-Class Organization **NEEDS to Use Workplace as a Strategic Tool.**



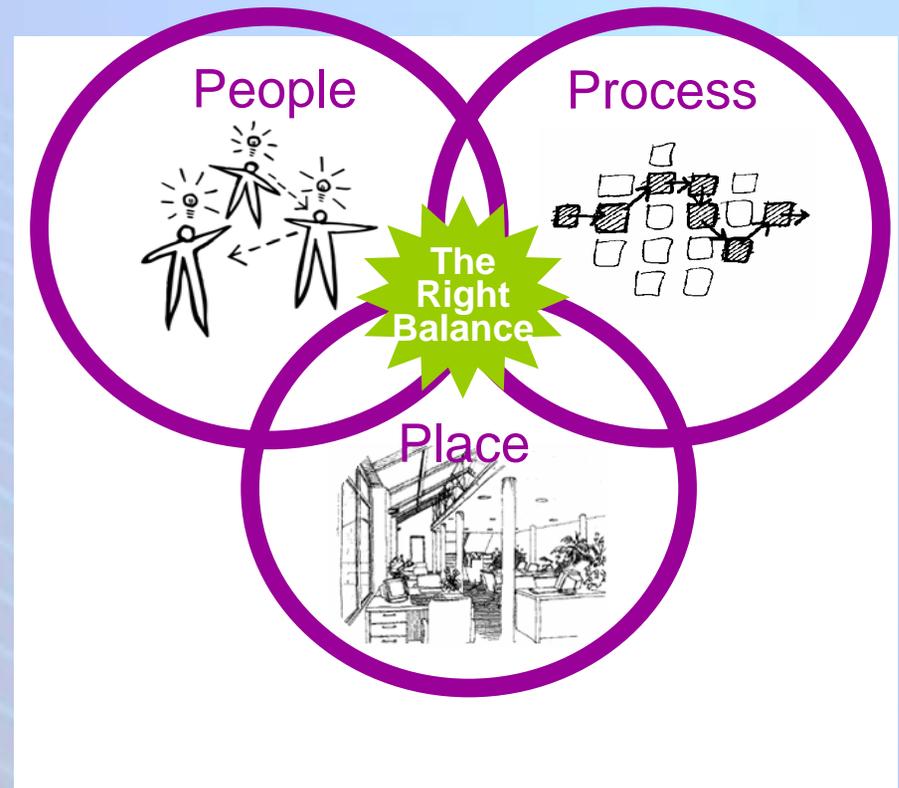
SO...

WHAT IS 20/20, ANYWAY ?

August 8-11, 2004

www.energy2004.ee.doe.gov

- Balance of People, Process & Place
- Linking Workplace to Strategic Business
- Balanced Scorecard Approach
- Innovative Change Management Strategies



People, Process & Place: Frank Duffy



**The moral of the
story :**

**Start wrong and
it may take
you 825
Years to
get it
Right**

!

August 8-11, 2004

www.energy2004.ee.doe.gov

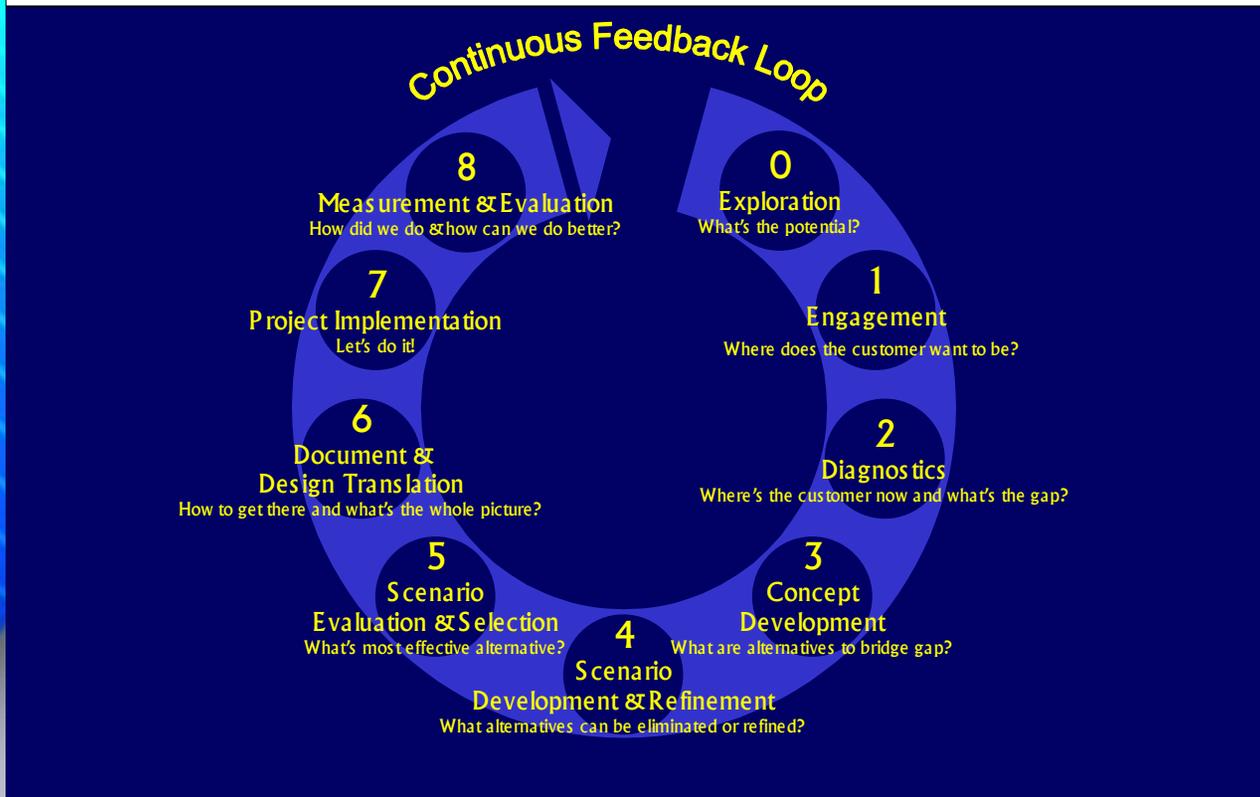




*“Project success is NOT doing the **wrong** thing on time and within budget”*



WorkPlace 20·20 Process



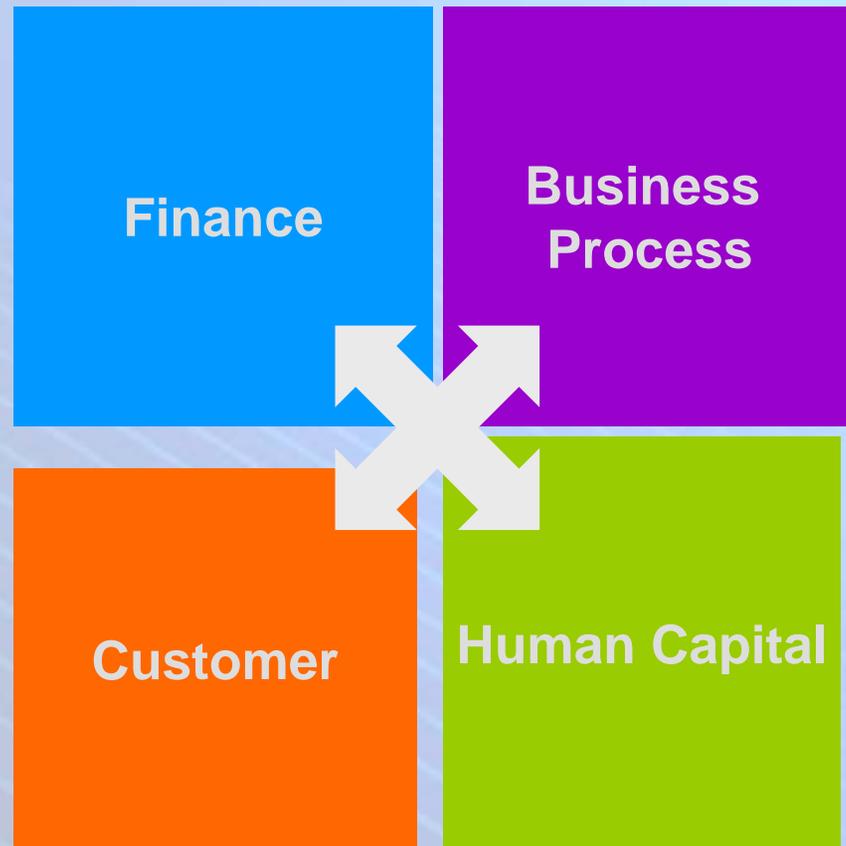
August 8-11, 2004

www.energy2004.ee.doe.gov



Benefits and Value

To Establish
Priorities,
Categorize Value
and Measure
Results,
Workplace 20·20
Uses a Balanced
Scorecard
Approach With 4
Domains



August 8-11, 2004

www.energy2004.ee.doe.gov

Kaplan & Norton, 1992



Balanced Scorecard Measures Spatial Changes

Quadrant	Business Driver/Challenge	Desired Behavior or Process Change	Value of the Change	Space-Related strategy	Organizational Measure	Research Measure
Financial						
Human Capital						
Customer						
Business Process						

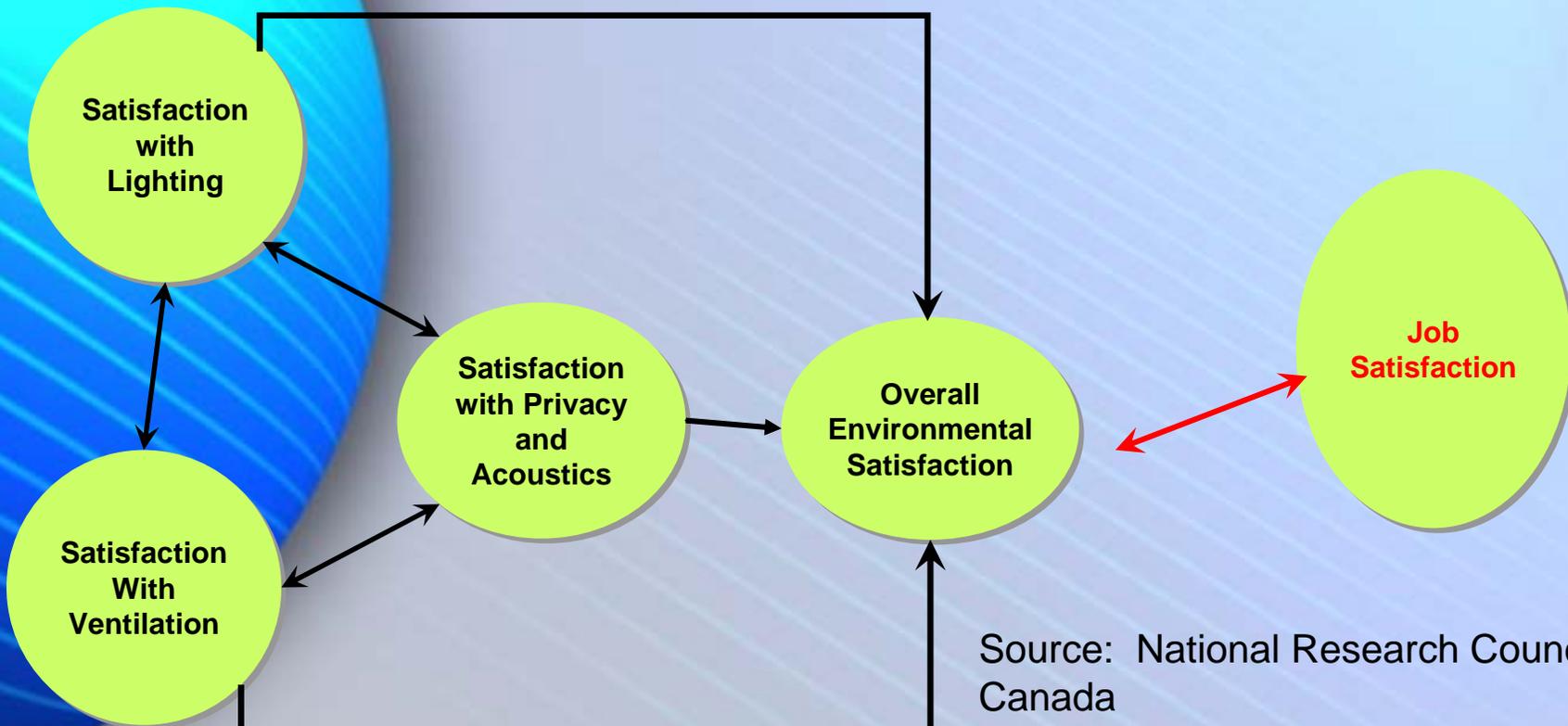
August 8-11, 2004

www.energy2004.ee.doe.gov



Environmental Satisfaction

Links to Job Satisfaction



Source: National Research Council—Canada

August 8-11, 2004

www.energy2004.ee.doe.gov



The "old" zoo



The "present" zoo



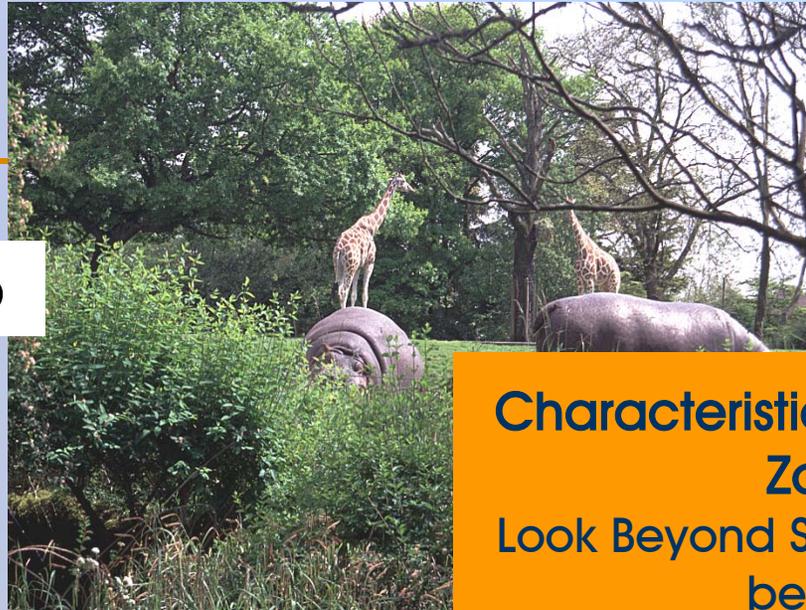
August 8-11, 2004

www.energy2004.ee.doe.gov

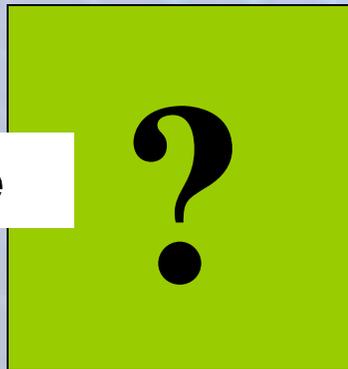
Credit: Judith Heerwagen



The new zoo



The “new” workplace



Characteristics of the New Zoo

Look Beyond Survival to Well-being

Design for Emotional and Psychological Well Being As Well As Function

Understand the Animal's Naturally Occurring Behaviors and Needs

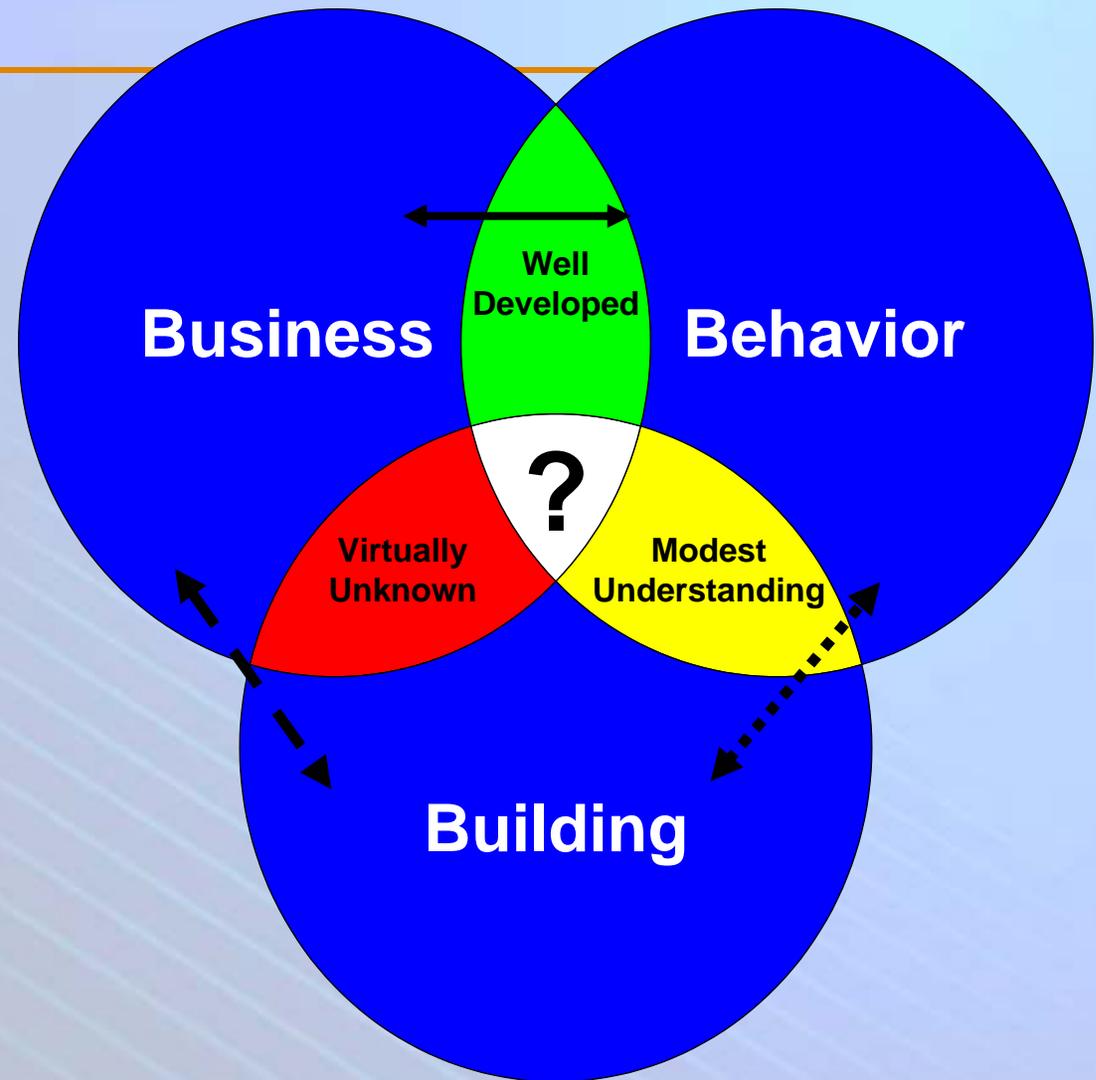
Give the Animal More Control Over Its Behaviors and Environment

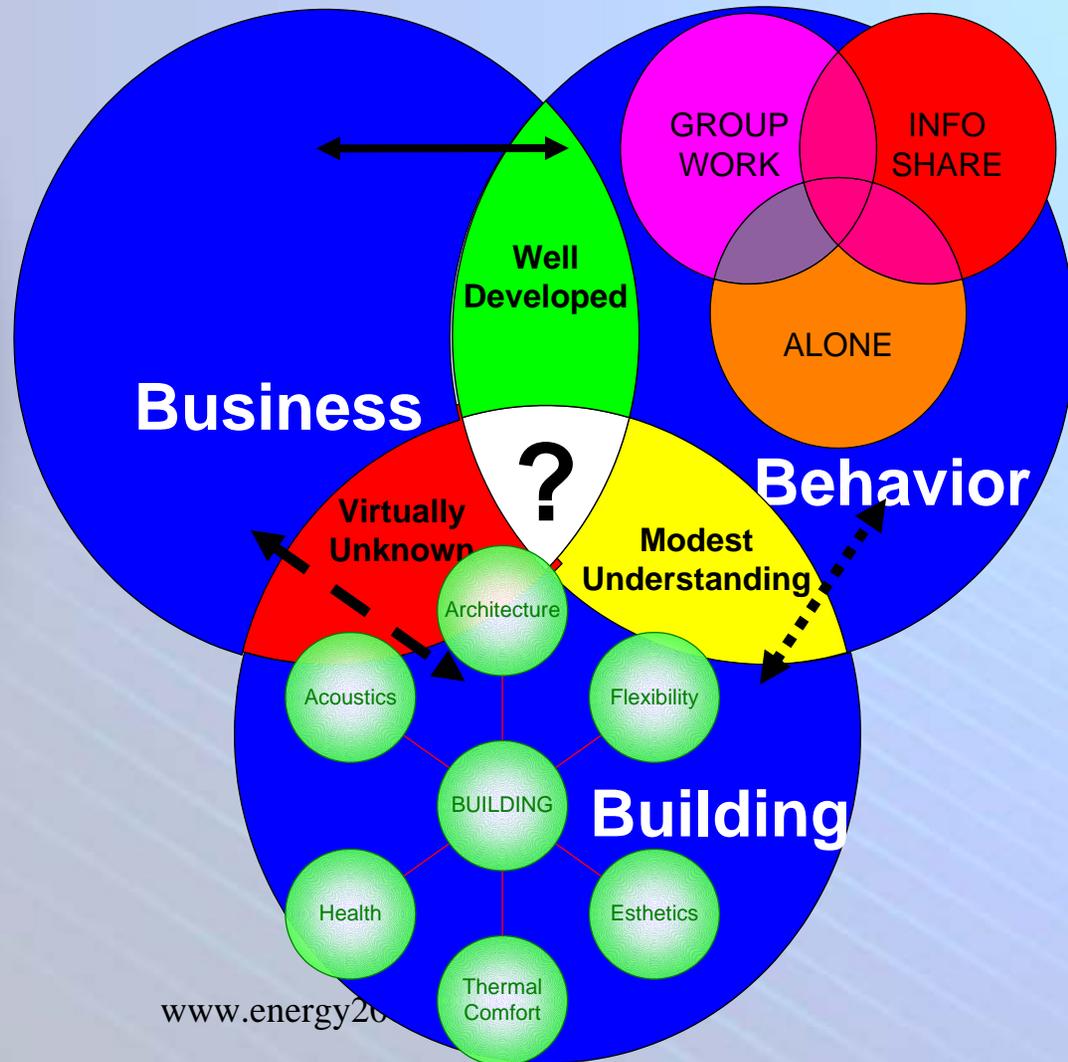
August 8-11, 2004

www.energy2004.ee.doe.gov

Research Framework

- ❖ **Very Limited Data About the Intersections**
- ❖ **Measures and Standards for Each Area**
- ❖ **Different Disciplines and Research Traditions**







PBS Research Program

- Grounded in Business: Imperatives
- Use PBS Space, People and Activities as Research Subjects
 - 60,000 people
 - 2.5 million square meters
- Couple Research Findings to Process Change: Research → New Methods

August 8-11, 2004

www.energy2004.ee.doe.gov



SO...

HOW DOES 20/20 AFFECT ENERGY USE?

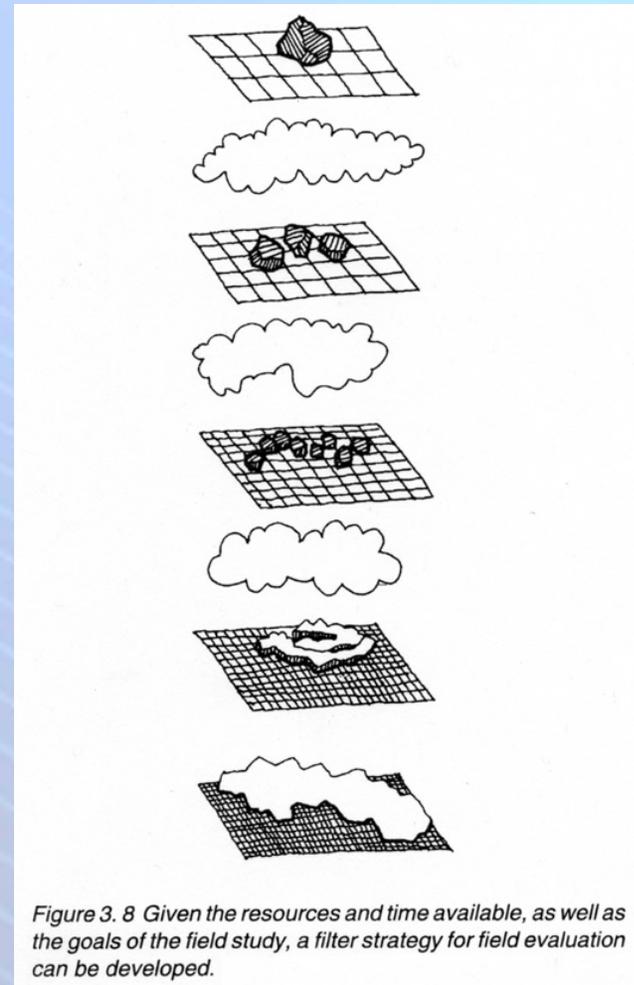
August 8-11, 2004

www.energy2004.ee.doe.gov



Baseline Data Collection - Objective Measures Measuring Environmental Quality

Luminance And Luminance Ratios
Shielded Air Temperature
Air Velocity
Co2
Dba And Dbc With Microphone
VOC And/Or Formaldehyde
Occupancy Sensor



August 8-11, 2004

www.energy2004.ee.doe.gov



4 Indices of Environmental Quality

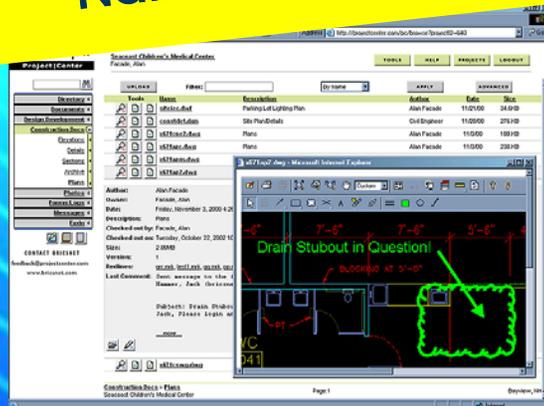
- Thermal Quality** Air temperature, air velocity, MRT/radiant asymmetry, Relative Humidity; levels of control.
- Air Quality** CO₂, particulates, TVOCs, formaldehydes, air flow/ventilation effectiveness, mold/mildew; levels of control.
- Visual Quality** light levels, brightness contrast/ light level variability, glare; levels of control.
- Acoustic Quality** background sound levels, sound attenuation in spaces, speech intelligibility; levels of control.

August 8-11, 2004

www.energy2004.ee.doe.gov



Baseline Tool Development National Environmental Assessment Toolkit (NEAT!)



user
satisfaction
questionnaire

records
collection



field
instruments



expert
walkthrough

environmental tool log

What Environmental Controls and Technology do you have access to in your Workstation?
Fill in the items you have and assign each an importance level from high to low.

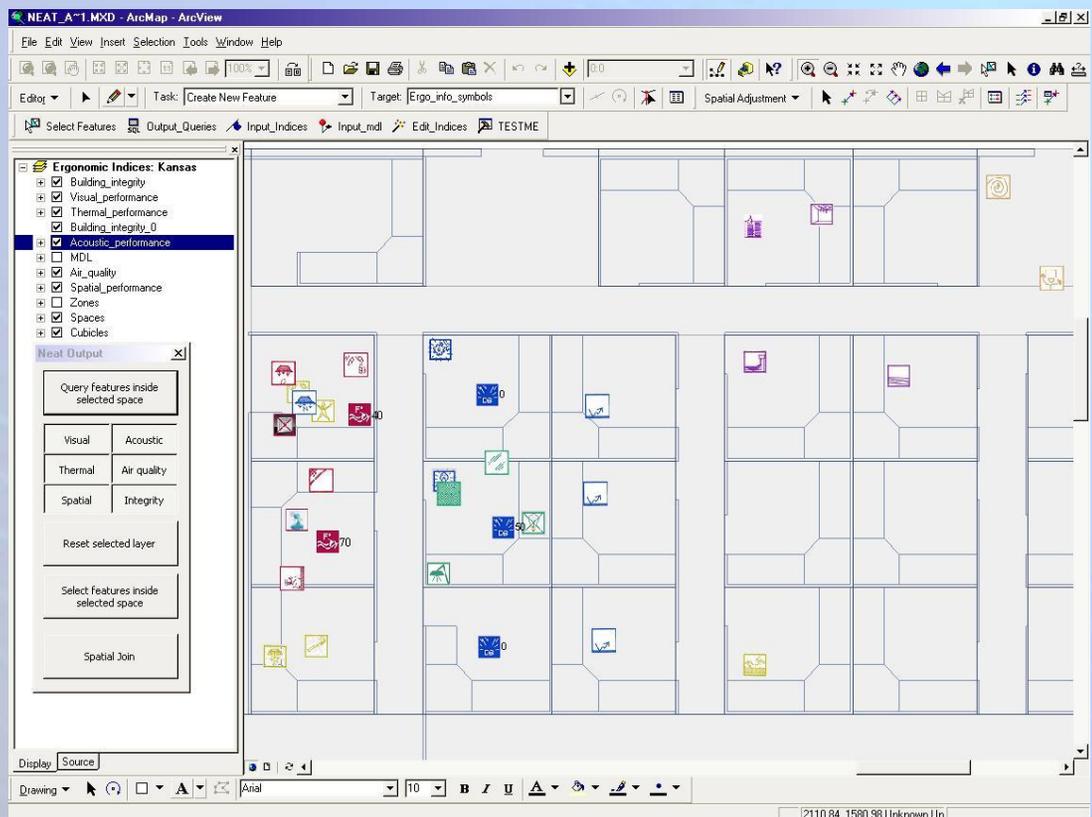
Visual Quality & Lighting (part 1)

Window/Ceiling Type	Importance	Control Type	Importance	Control Type	Importance	Control Type	Control Type	Need or Preference					
Window: Clear Glass	yes <input type="radio"/> no <input type="radio"/>	importance: high <input type="radio"/> medium <input type="radio"/> low <input type="radio"/>	Window: Tinted Glass	yes <input type="radio"/> no <input type="radio"/>	importance: high <input type="radio"/> medium <input type="radio"/> low <input type="radio"/>	Corridorway Window	yes <input type="radio"/> no <input type="radio"/>	importance: high <input type="radio"/> medium <input type="radio"/> low <input type="radio"/>	Skylight	yes <input type="radio"/> no <input type="radio"/>	importance: high <input type="radio"/> medium <input type="radio"/> low <input type="radio"/>	Which forms of sun and light control do you have? vertical blinds <input type="radio"/> vertical blinds <input type="radio"/> roller shade curtains <input type="radio"/> curtains <input type="radio"/> external shades <input type="radio"/> awning/overhang <input type="radio"/> light shade <input type="radio"/> other <input type="radio"/>	Need or Preference <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
Direct Light: Flush Lens	yes <input type="radio"/> no <input type="radio"/>	importance: high <input type="radio"/> medium <input type="radio"/> low <input type="radio"/>	Direct Light: Parabolic Louver	yes <input type="radio"/> no <input type="radio"/>	importance: high <input type="radio"/> medium <input type="radio"/> low <input type="radio"/>	Direct/Indirect Light	yes <input type="radio"/> no <input type="radio"/>	importance: high <input type="radio"/> medium <input type="radio"/> low <input type="radio"/>	Indirect Light	yes <input type="radio"/> no <input type="radio"/>	importance: high <input type="radio"/> medium <input type="radio"/> low <input type="radio"/>	Which forms of ambient light control do you have? on/off switch <input type="radio"/> dimmer switch <input type="radio"/> occupancy sensor <input type="radio"/> daylight sensor <input type="radio"/> timer <input type="radio"/> other <input type="radio"/>	Need or Preference <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>

www.energy2004.ee.doe.gov



NEAT! Input (Tablet PC)

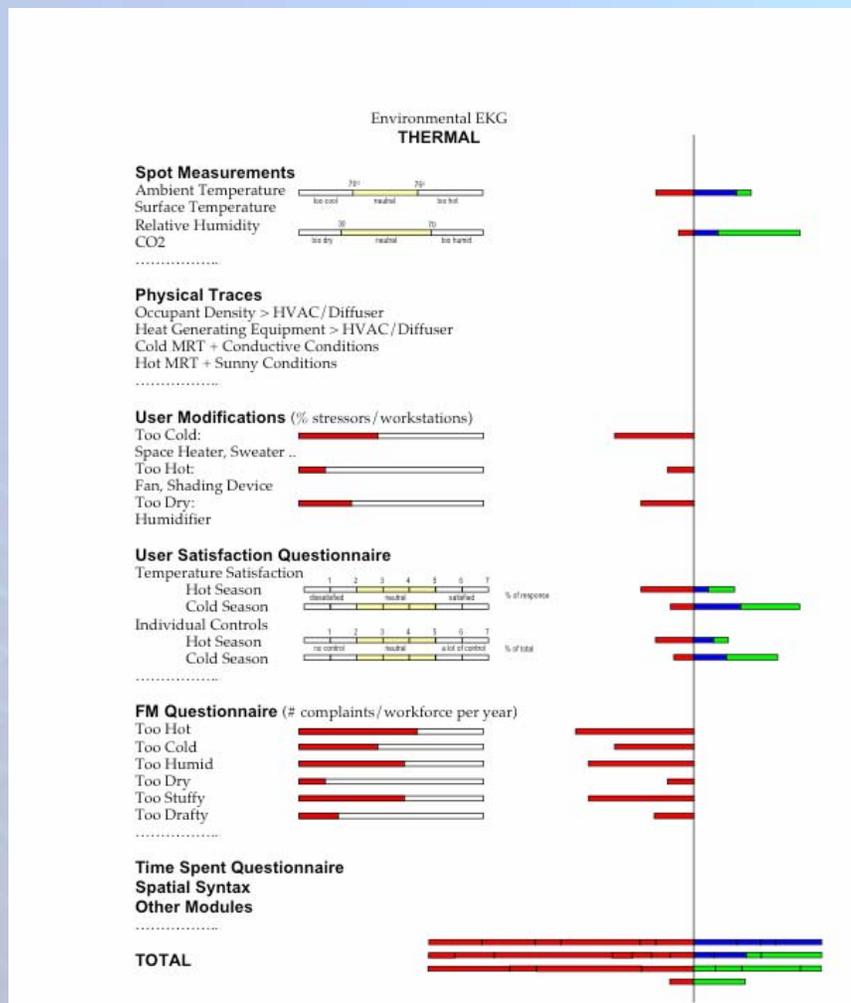


August 8-11, 2004

www.energy2004.ee.doe.gov

NEAT!
Output:

EKGs for
Thermal,
Air Quality,
Acoustic,
Visual,
Spatial





Soffer Study: Cost benefit!

	Standard/ Alternatives	First Cost	Life-Cycle Benefits
Window Glazing	Standard1: Sungate w/ grey tint	base	
	Standard2: Dark reflective glass	\$30,000 over base	
	Alternative1: High-visibility glass w/ 25% reduced area	(\$18,000) saving over base	\$341/year energy savings Increased daylight/views
Facade Shading	Standard: No shading	base	
	Alternative1: 3-layer light redirection device	\$340,000 total \$5.32/ft ²	\$3151/year energy savings Glare control
	Alternative2a: Internal fixed light direction	\$42,540 total \$0.6//ft ²	Increased daylight/ Glare control
	Alternative 2b: Inverted 1" mini blinds	\$16,173 total \$0.25//ft ²	Increased daylight/ Glare control \$400/year energy savings
Roof Insulation	Standard: R-14 rigid insulation on metal deck	base	-
	Alternative1: R-20 rigid insulation	\$5231 over base	\$1024/year energy savings
	Alternative2: R-30 rigid insulation	\$17,500 over base	\$1586/year energy savings
Roof Color	Standard: Black/dark EPDM surface	\$37,000 base	-
	Alternative1: White/light surface (acrylic top coating)	\$11,200 over base	\$1898/year energy savings
Lighting	Standard: direct fixtures, rated at 1.6 W·ft ⁻²	\$255,600 base \$4.0/ft ²	
	Alternative1: Split lighting, rated at 1.1W·ft ⁻² (Does not include task lights)	\$171,200 total \$2.68/ft ²	\$11,857/year energy savings User Control
	Alternative2: Daylight-based dimming	\$187,900 over base \$2.94/ft ²	\$7291/year energy savings
HVAC and Networking Infrastructure	Standard: Ceiling-based VAV, poke-throughs	base	
	Alternative1: Raised floor system - Floor-based air supply w/ relocatable diffusers; structured wiring and relocatable boxes	\$0.27/ft ² (incl. \$5.03/ft ² raised floor cost)	User Comfort & Productivity \$4.66/ft ² savings per churn \$875/year energy savings

August 8-11, 2004

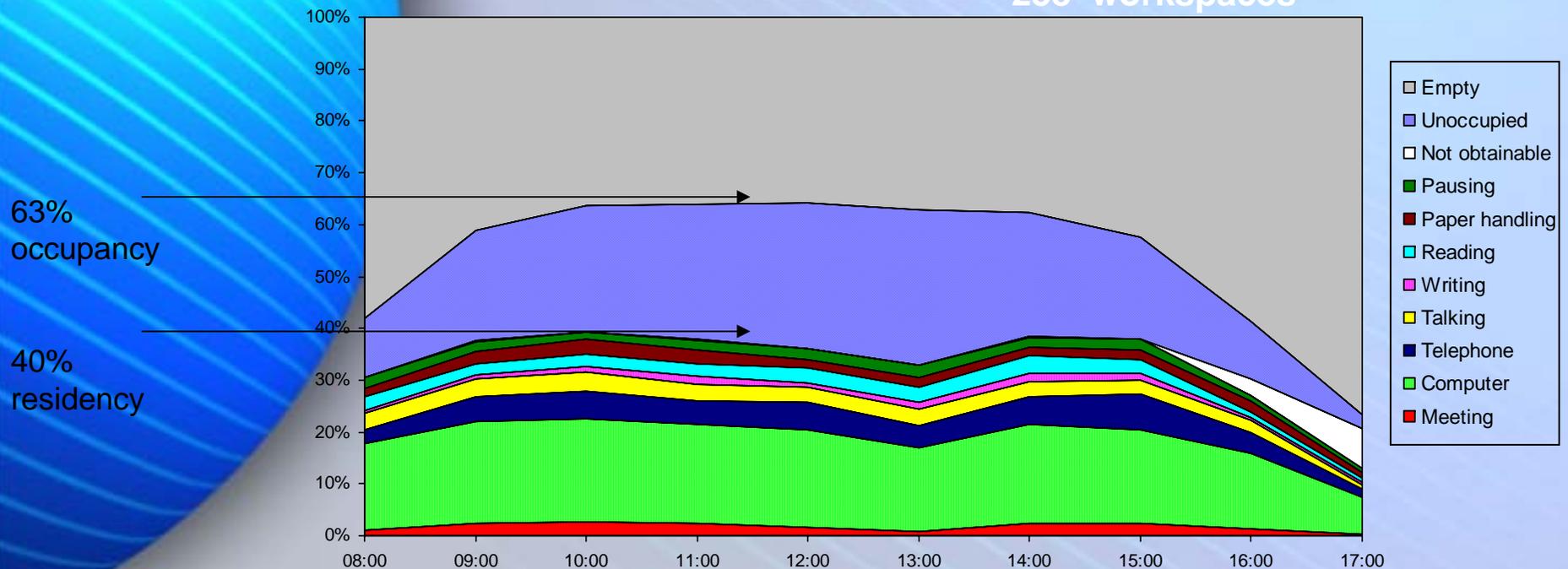
www.energy2004.ee.doe.gov



Daily Activity Pattern Implications for Energy Use?

- Workspaces are temporarily unoccupied 23% of the time on average
- Consistent workflow throughout the day, minimal lunch dip
- Computer work is the dominate activity at the desk – approximately half the time

238 workspaces



63%
occupancy

40%
residency

August 8-11, 2004

www.energy2004.ee.doe.gov



Lighting Advances: Win/WIN

Some thoughts from the Light Right Consortium (www.Lightright.org)

“When new lighting systems replace older technologies the energy savings typically ranges form 25 to 50%.”

“Ones size fits all approach of standard building lighting falls far short of preferences of most workers”

“Designs that are most supportive of a changing work environment will reduce churn costs that occur with restructuring and growth.”

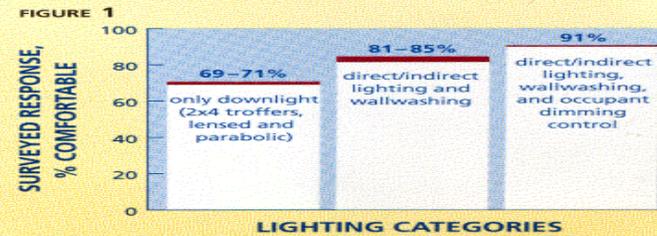


Light Right CONSORTIUM

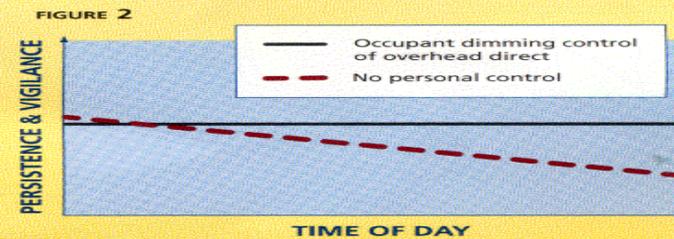
RESEARCH STUDY | Albany, NY

The Light Right Consortium brings together interested parties and researchers to work toward a common goal—to use research as a basis for market transformation towards quality energy efficient lighting.

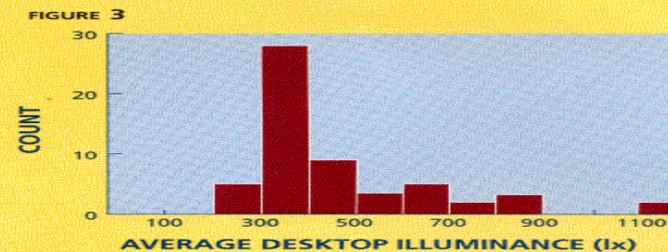
www.lightright.org



Six conditions were provided and rated by comfort level. The addition of room surface brightness and personal control improved occupant comfort.



Occupants with dimming control had increased motivation and were able to sustain their persistence and vigilance over time, as compared to those without any control of the lighting.



Mean desktop illuminance chosen by participants with dimming control. Includes data from both between-groups and within-groups designs.

August 8-11, 2004

www.energy2004.ee.doe.gov



With reference to lighting, the Soffer Study advises:

“Next generation offices are beginning to offer **split task and ambient** lighting provided by a soft (30 footcandles) uplighting system that washes ceilings, walls and coves. Combining this ambient light system with high efficiency task lights **can reduce the rated power demands to 1.1 watts per square foot (0.8 W sq ft. ambient and 0.3 W sq ft. occupancy.** (in this 64,000 gross sq ft building) It translates into an **energy savings of \$11,900 per year with a first cost savings of \$84,400** (excluding the cost of task lights)”

August 8-11, 2004

www.energy2004.ee.doe.gov



A CBPD/DOE study has shown that health complaints in daylit office areas are 23% fewer than in internalized workplaces (ABSIC/DOE 1994). With poor daylight access, some occupants suffer from clinical sunlight deficiency syndrome, while others complain of depression, conditions that result in lost productivity and health costs

August 8-11, 2004

www.energy2004.ee.doe.gov



- One laboratory study gave subjects dimmable ceiling lighting and found that the control feature was well-used with positive results. The subjects who had the controllable lighting were more satisfied with the lighting, felt more comfortable in the room, rated the tasks as less difficult, and rated the lighting quality as higher than subjects who did not have control. Importantly, having the control system produced a 35 — 42% decrease in electrical consumption.⁵

A split lighting systems is also advantageous with regard to visual comfort and health, since users can set the task environment to their preferences and tasks. Cornell studies have shown higher user satisfaction with uplighting than with conventional downlights, especially with parabolic louvers (Hedge et al. 1989)

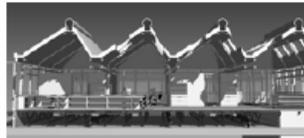


Research Starting Point: What Do Organizations Care About?

- ❖ Communication And Information Flow
- ❖ Effective Collaboration
- ❖ Adapting To Organizational & Technological Change
- ❖ Cultural Alignment Quality Of Work Life
- ❖ Image And Reputation
- ❖ Capacity For Innovation
- ❖ Attraction & Retention Of High Quality Workers
- ❖ Customer Satisfaction

August 8-11, 2004

www.energy2004.ee.doe.gov



Center for Building Performance and Diagnostics
School of Architecture • Carnegie Mellon University
Pittsburgh, PA 15213

(412) 268-2350 • www.arc.cmu.edu/cbpd

Sustainable Development Alternatives for
Speculative Office Buildings:
A Case Study of the Soffer Tech Office Building

Final Report
20 April 1999



Figure 2. External view of 3-tier 1 ft. deep external shading devices proposed for Tech Office building

August 8-11, 2004

www.energy.gov

“Pressurized plenums allow tenant layouts and densities to change continuously, with thermal conditioning ensured by the continuous addition and relocation of VAV diffuser “pots” in the floor”



Figure 3. The Owens Corning headquarters building features an underfloor air plenum with Titus™ swirl-plate diffusers providing a flow rate between 0 and 90 cfm each.

Combining floor plenum air supply with user-centered air management components such as Johnson controls PEM's has shown **as much as 2% increased productivity** in the West Bend Insurance Company headquarters – justifying the cost of the individualized system in one year for the employer.



Soffer Study Recommendations

- *Facade:* Use argon filled, low-e, low shading coefficient, good visible transmission, untinted glazing with 25% reduction in glass area throughout. Also consider Azurlite™ and Evergreen™ products with higher visible clarity than Sungate™ with grey tint. Use interior upturned venetian blinds on south and north facades, with vertical blinds on east and west facades.
- *Roof:* Increase roof insulation to at least R-20 and ensure white (or very light) surface color.
- *Lighting:* Introduce to tenants the opportunity of modular and relocatable task-ambient lights with continuous dimming ballasts and user controls. Alternatively, introduce a split task-ambient lighting system with ambient uplighting system (appropriate to ceiling shape and reflectivity), with separate articulated arm task light. Select high efficiency T-5 lamps, high efficiency fixtures/reflectors, continuous dimming high energy efficiency ballasts, and user reconfigurable controls.
- *HVAC:* Introduce plenum floor based air system with distributed damper boxes, and the ability to add additional VAV zones for local requirements and tenant subdivisions.



Soffer Study Recommendations, cont'd

- **Energy Recovery:** Use desiccant wheels in the roof-top air handling units.
- **Networking:** Introduce a structured wiring system for power, and for data/voice under a raised floor, with ability to relocate and add outlet boxes as needed.
- **Equipment Power loads:** Promote Energy Star ratings for tenants, illustrating the cost-savings from 1 to 3 W·ft⁻² of plug loads.
- **Modular components:** Utilize modular, plug and play components rather than redundancies or embedded solutions for HVAC, connectivity and lighting, as well as carpets (must be same size as access floor).
- **Reconfigurable furniture:** Promote relocatable walls and horizontally and vertically stackable furniture to support tenant reconfigurations without waste.
- **Benign materials:** Promote low outgassing and environmentally responsible fabrics, carpets, acoustic ceilings. Avoid paints and adhesives.



Pilots Underway

Project

- ❖ Chicago
- ❖ Ft. Worth
- ❖ Kansas City
- ❖ Denver
- ❖ EEOC
- ❖ FAA
- ❖ VA
- ❖ Atlanta
- ❖ GSA HQ Pilot
- ❖ Field Office
- ❖ Coast Guard
- ❖ Corps/Engineers

Area of Focus

- ❖ Organizational Development
- ❖ Call Center Performance
- ❖ Sustainability & Light
- ❖ Social Networks & Stress ↓
- ❖ Telecommute & Share Info
- ❖ Form Teams & Streamline Work
- ❖ Reinforce Business Processes
- ❖ Performance Improvement
- ❖ Improve with Constraints, (\$)
- ❖ Integrate Outsourced Functions
- ❖ Expand Operations & Effectiveness
- ❖ Institute Business Measures

August 8-11, 2004

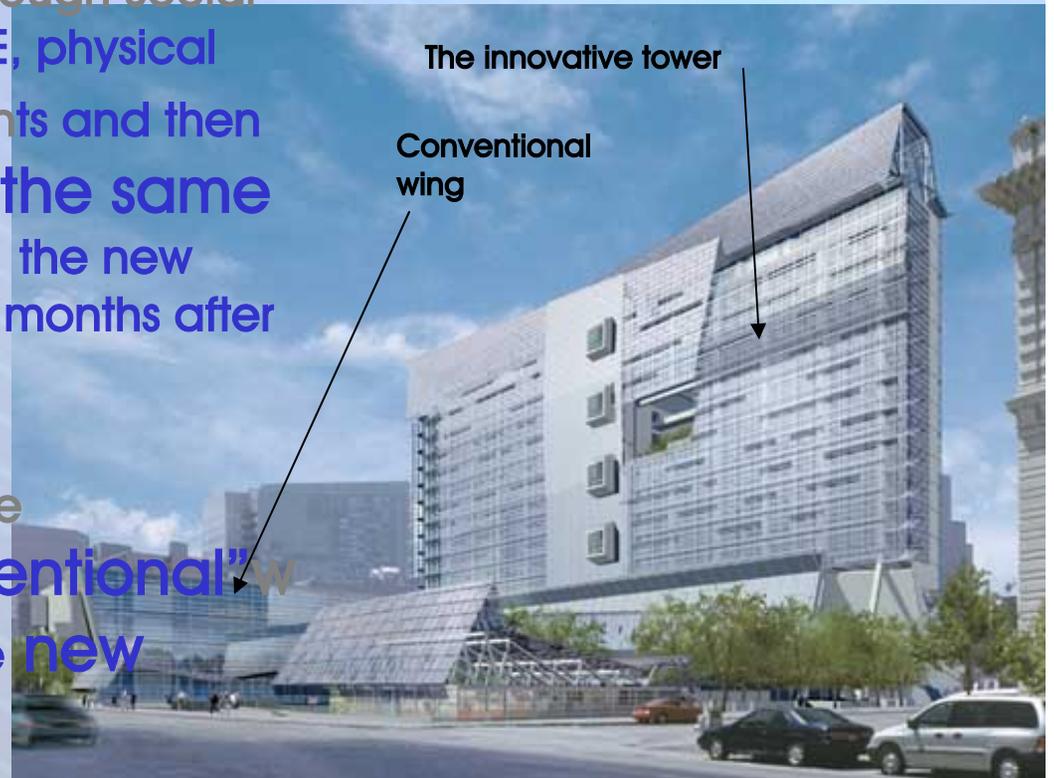
www.energy2004.ee.doe.gov



San Francisco Study – research on new construction

1. Study the existing location
Of clients through Social network, CBE, physical measurements and then measure the same indicators in the new location 6-8 months after occupancy.

Compare the new “conventional” wing with the new tower.





SOLICITATION FOR OFFERS

THE GENERAL SERVICES ADMINISTRATION

FOR

United States Department of Veterans Affairs
Regional Office

IN

Reno, Nevada

NAME: Robert W. Nimmo

TITLE: Contracting Officer

Reno NV Pilot project

- LEED gold certified
- Specific desires called out for the organizational goals: Windows with specific transmissivity above and below light shelves, Under-floor air distribution recommended because of sedentary workers.
- Contrast with “conventional construction and value analyzed as part of pilot project

August 8-11, 2004

www.energy2004.ee.doe.gov