
▶ **MANAGING INDOOR
ENVIRONMENT
QUALITY
and
▶ **PRODUCTIVITY
MEASUREMENT****

- ▶ IAQ, IEQ and Facility Ecology
- ▶ Productivity
- ▶ Case Study Overviews
 - ▶ Queensland
 - ▶ Australia

▶ **Green Gardens**

- ▶ **Initiation:** Design and establish sustainable species
- ▶ **Major Responsibilities:** Maintain health and productivity for years thereafter

➤ **Green Planet**

- **Green footprint**
- **Healthy and**
- **productive sustainability**
- **CITIES HAVE A MAJOR ROLE FOR BOTH GLOBAL AND LOCAL SUSTAINABILITY**

LIFE COSTS OF GREEN PRODUCTIVITY

- ▶ Design and Build 5%
 - ▶ Lifetime operate 85%
 - ▶ Refurbish or demolish 5%
-
- ▶ Use Pareto 80/20 rule to focus on green productivity for major lifetime costs
 - ▶ i.e. Operating Buildings – 85% of building stock

OPTIMISE GREEN PRODUCTIVITY

▶ TEAMWORK

- ▶ Building Owners
- ▶ Designers, builders and refurbishers
- ▶ Facility Operators
- ▶ Facility Occupants

BENEFITS & PAYBACK

Resource	Cost %	Global Benefit %	Local Benefit Saving %
Energy, Water, Waste	5	33	0.5
Maintenance	15	33	1.5
Labour	80	33	8

FACILITY ECOLOGY

interaction of the occupants and the built facility

- optimises sustainable wellbeing and productivity of the occupants
- sustainable environmental performance of the building

includes:

- building and workplace design;
- facility and corporate management;
- risk management; and
- indoor and outdoor environment quality.

INDOOR ENVIRONMENT QUALITY

- ▶ **IEQ as Facility Ecology**
- ▶ **=RESOURCES+FACILITY+MANAGEMENT+WORK
FORCE PRODUCTIVITY**

▶ =

COMFORT IAQ	TEMP, HUMIDITY, VENTILATION
LIGHTING	LOCAL AND OUTLOOK
NOISE	CONTROL & BEHAVIOUR
CONTAMINANTS IAQ	VOC, MICROBIAL, DUST, HAZARDOUS MATERIALS
MAINTENANCE	OPERATIONS & CLEANING
SATISFACTION	OCCUPANT SURVEY
WELLBEING	OCCUPANT SURVEY
PRODUCTIVITY	FINANCIAL ANALYSIS

IEQ TRENDS INTERNATIONALLY

- ▶ **Global:** WHO HEALTH GUIDELINES
- ▶ **Standards:** ISO, ASTM, AS,ASHRAE, ESEPA
- ▶ **European:** RHEVA (32 countries), BREEM
- ▶ **USA:** LEED, USEPA, ASHRAE
- ▶ **Asia:** Korean, China, Japan Guidelines or Ratings or Regulations
- ▶ **Australian:** GBCA and NABERS ratings, PCA Managing IEQ, Green leases, BASIX, Low energy Homes, submetering etc

▶ **PIONEERS: Queensland Public Works**

- ▶ Schools – seamless flooring, Offices – Emissions, HVAC
- ▶ Risk Assessment – All major Government office buildings
- ▶ Asbestos removal, Water management
- ▶ Action Agenda IEQ and Productivity

▶ **OTHER STATES:**

- ▶ NSW: DECC, SPA, Sydney Water
- ▶ VIC: MCC, Building Commission, Sustainability Victoria
- ▶ SA: SA Water

▶ **INDUSTRY**

- ▶ CGU, NAB, Investa, Lend Lease, DB etc

- ▶ **UMO LAI Engineers and Sustainability Victoria**
 - ▶ Pre and Post occupancy-move to new building.
 - ▶ IEQ measurements and Questionnaire
 - ▶ Financial Review
 - ▶ Productivity measures from IEQ, satisfaction and Financials

Pre and Post Occupancy Indoor Environment Study 2007 - 2009

Umow Lai Consulting Engineers

Levels 4 &5, 10 Yarra Street,
South Yarra Victoria



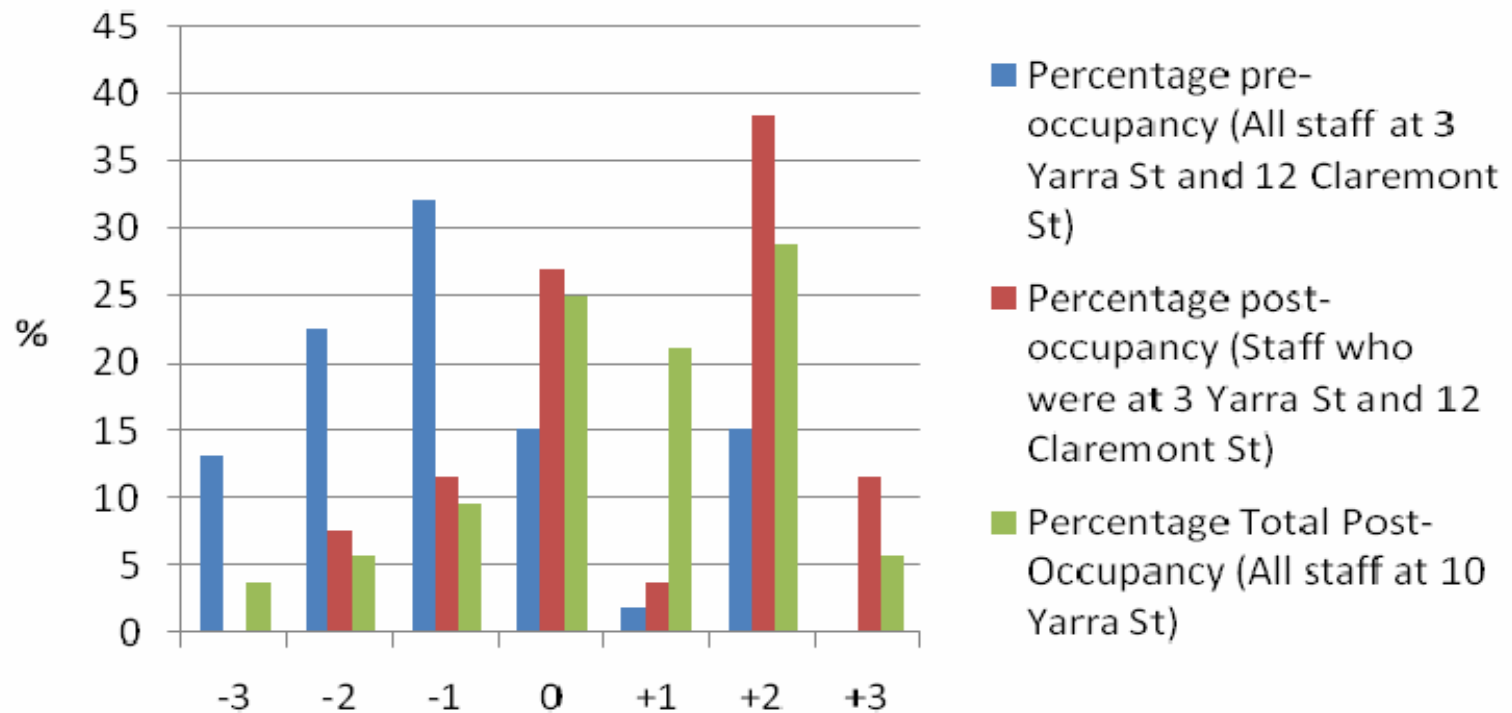
	Thermal Comfort			Air Quality					
	Air Temperature °C	Relative Humidity %RH	Air Movement m/sec	Carbon Dioxide ppm	Carbon Monoxide ppm	Dust PM ₁₀ mg/m ³	Airborne Microbials cfu/m ³	Formaldehyde mg/m ³	Total Volatile Organic Compounds mg/m ³
Pre Occupancy (Average results from 3 Yarra Street and 12 Claremont Street)	24.7	38.8	<0.1	999	<1 (5 at 12 Claremont)	0.005	343 Ambient: 450	0.03	0.28
Post Occupancy (Average result from Levels 4 and 5, 10 Yarra Street)	23.3	51.6	<0.1	605	<1	0.008	213 Ambient: 460	0.01	0.05

Table 1: Pre and Post Occupancy Indoor Environment Results

	Lighting		Acoustic
	Horizontal Lux	Vertical Lux	Ambient Sound dB
Pre Occupancy (Average results from 3 Yarra Street and 12 Claremont Street)	445	319	47
Post Occupancy (Average result from Levels 4 and 5, 10 Yarra Street)	483	400	51
Recommended Guidelines	320 min	160 min	45 to 50

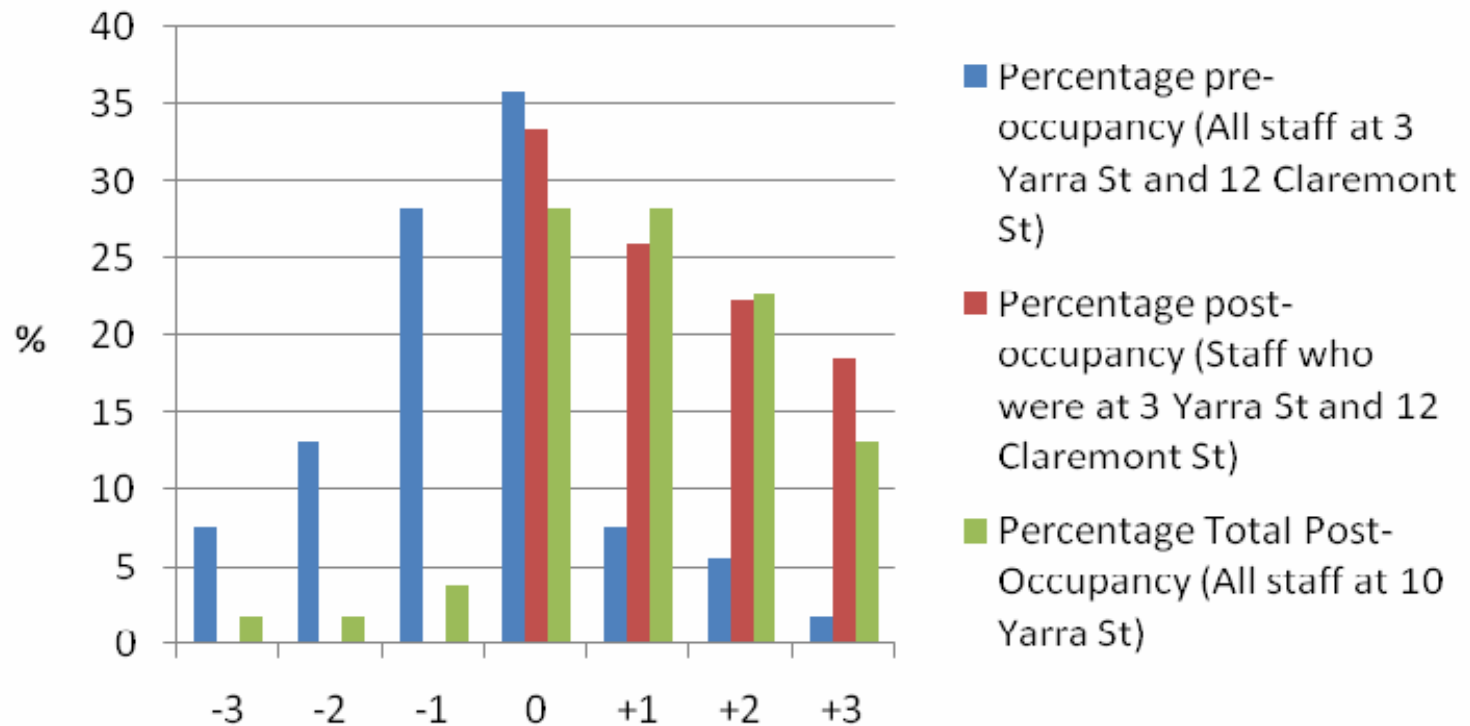
Table 1 (continued): Pre and Post Occupancy Indoor Environment Results

Temperature Satisfaction

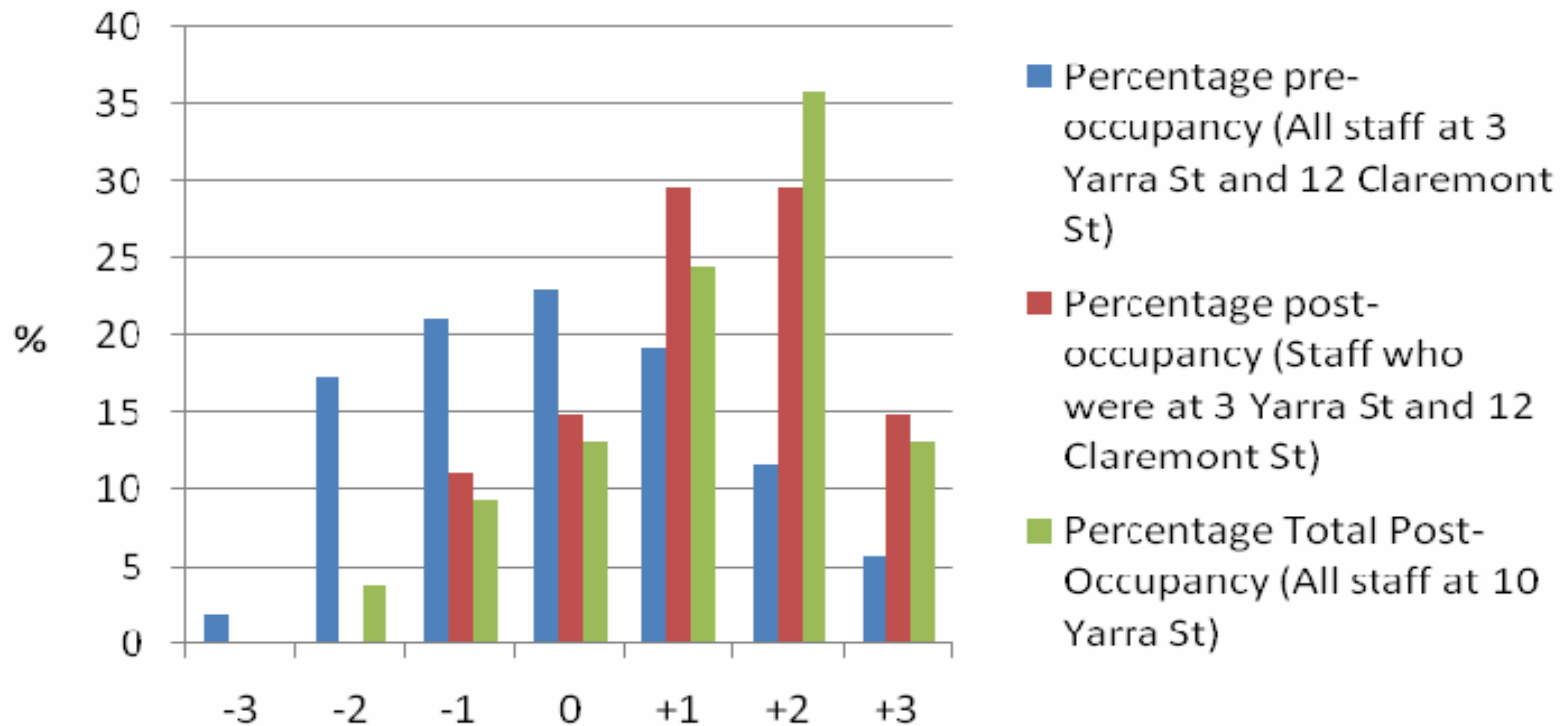


Graph 1: Temperature dissatisfaction has decreased

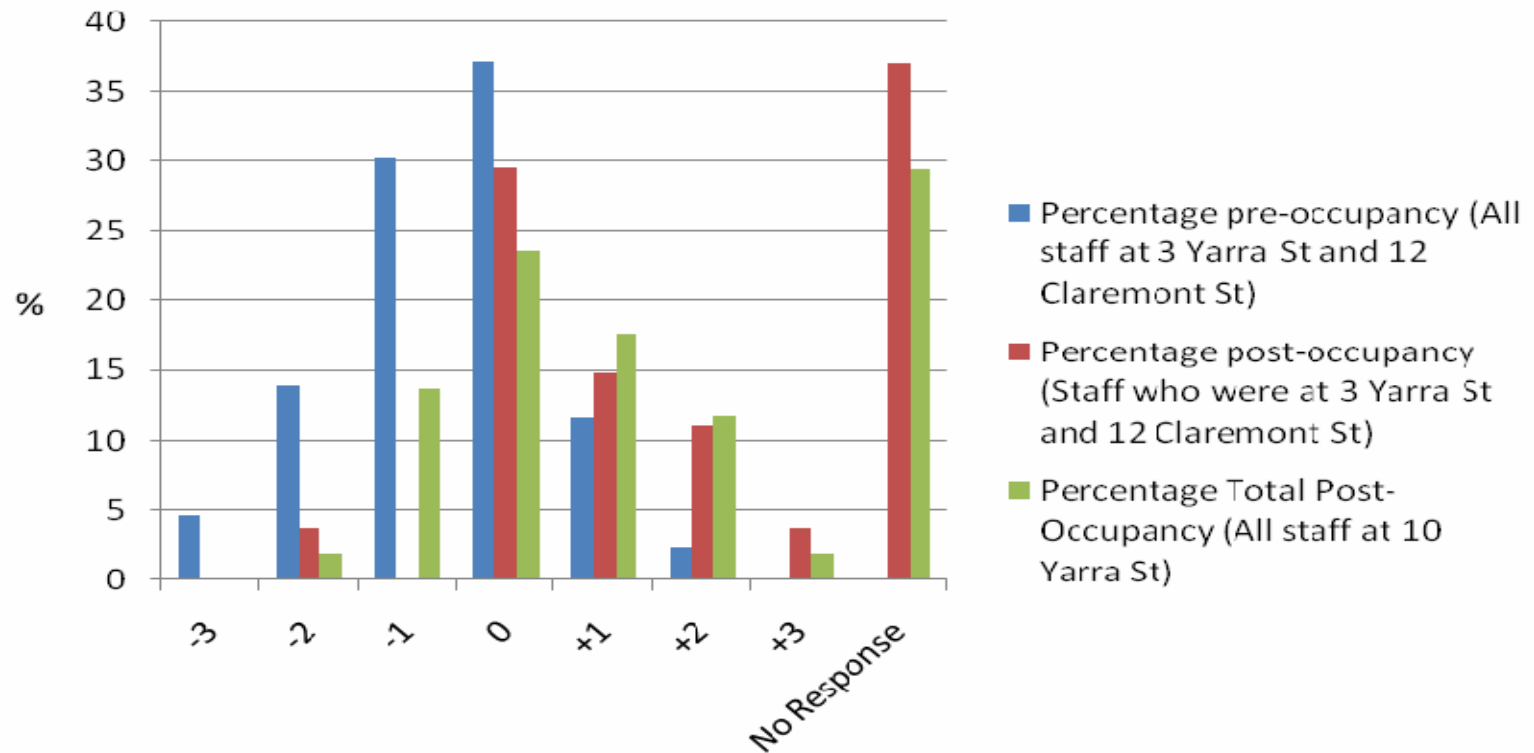
Air Quality Satisfaction

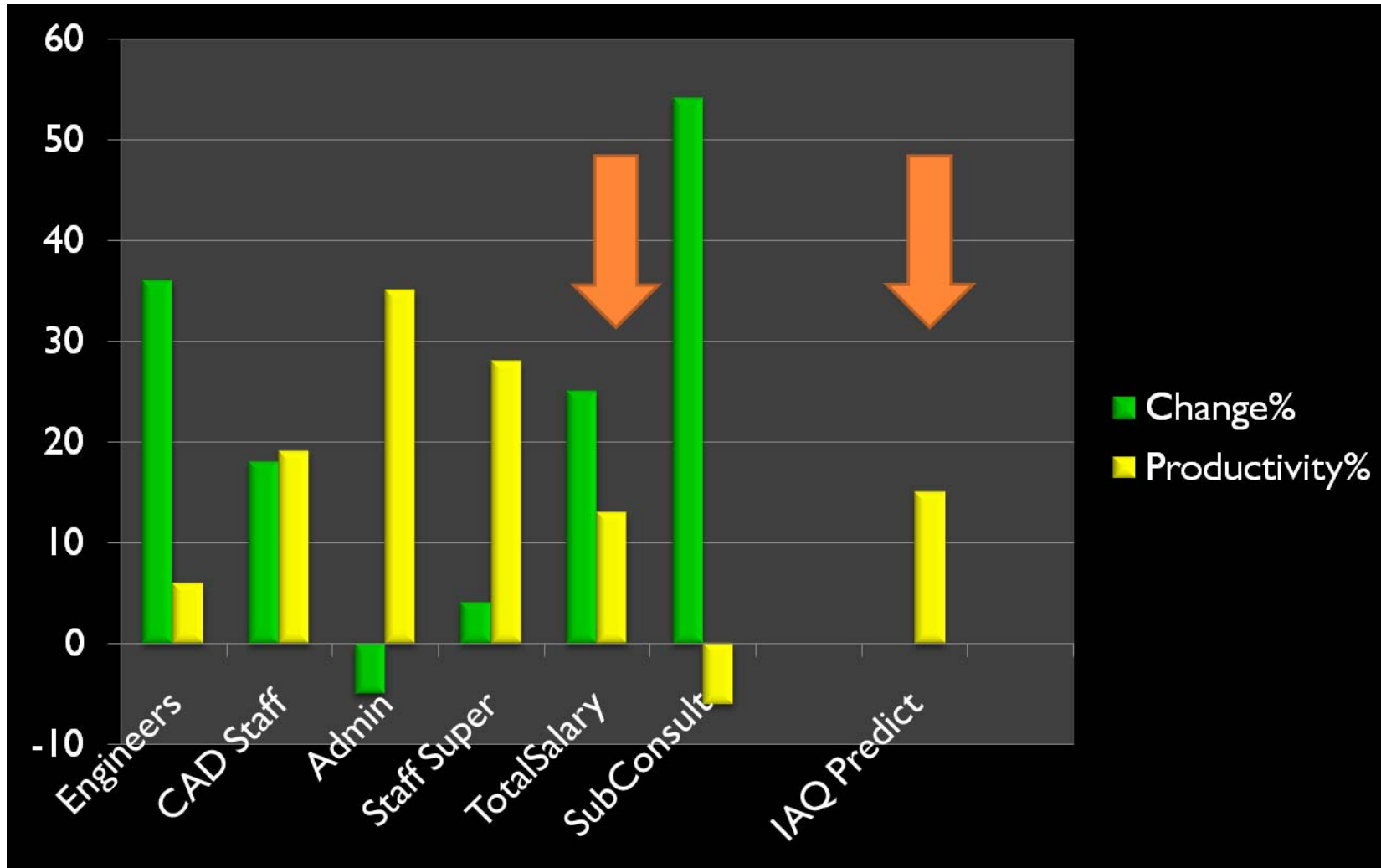


Lighting Satisfaction



Acoustic Quality: Enhance or Interfere





Optus

Changed Diffusers

Changed Tubes

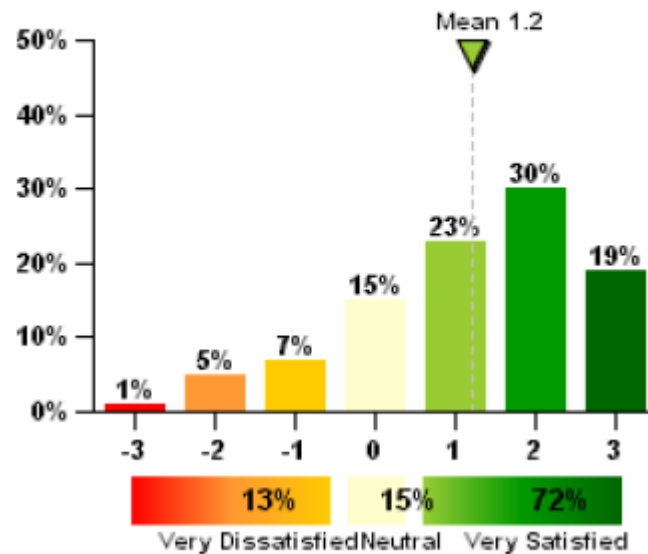
Aged Tubes

**Measured at two locations before
and after move**

Satisfaction Surveys

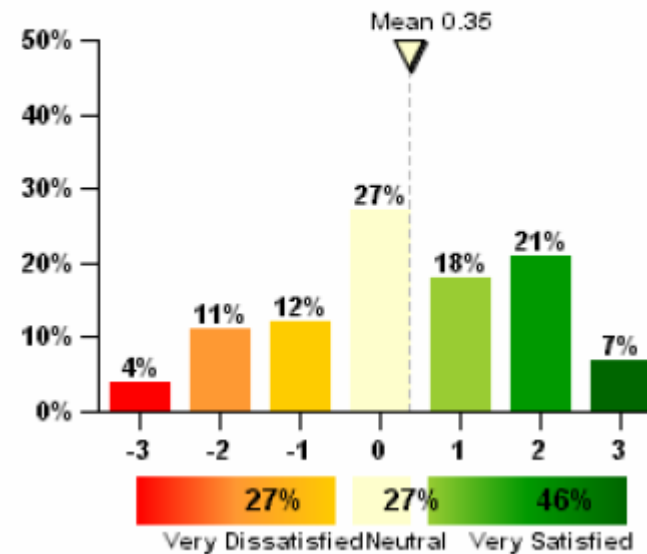
Good Visual Comfort

How satisfied are you with the visual comfort of the lighting (e.g., glare, reflections, contrast)?



Poor Visual Comfort

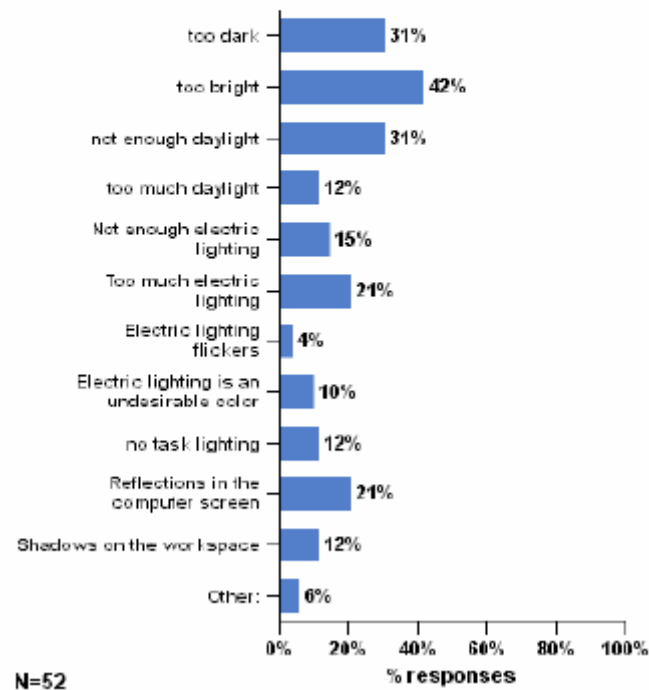
How satisfied are you with the visual comfort of the lighting (e.g., glare, reflections, contrast)?



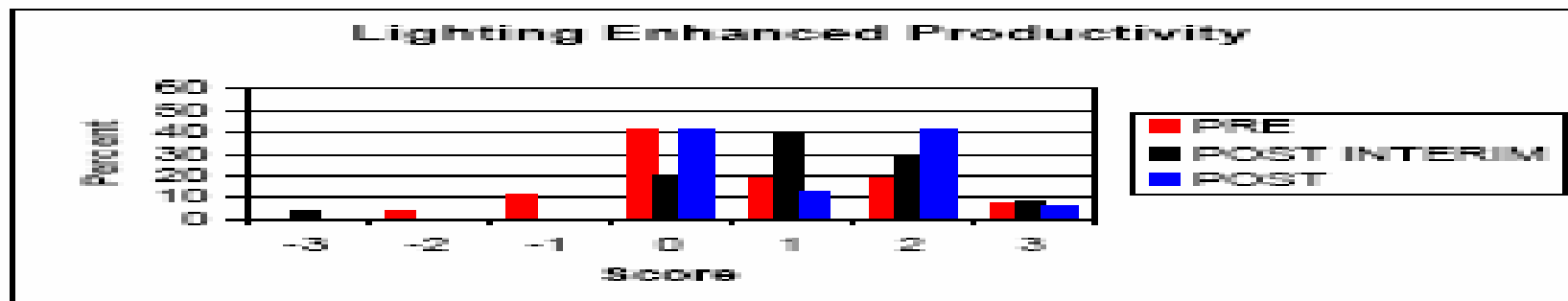
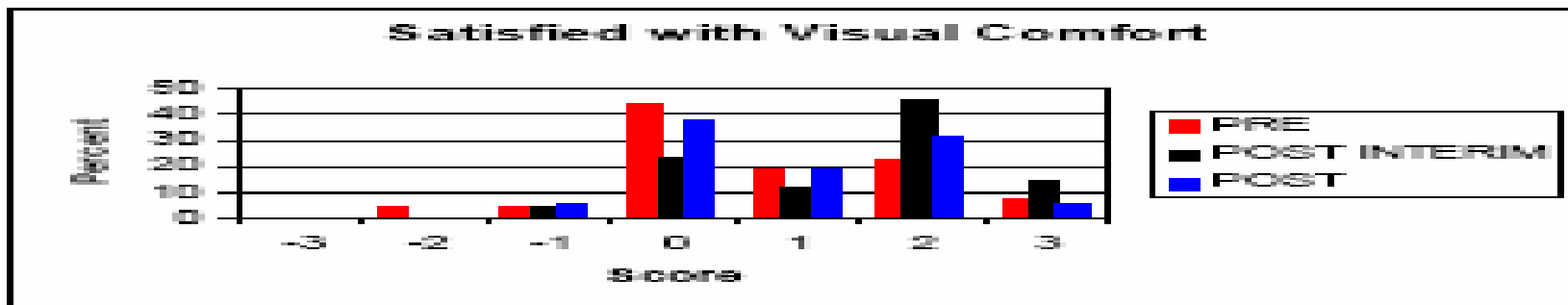
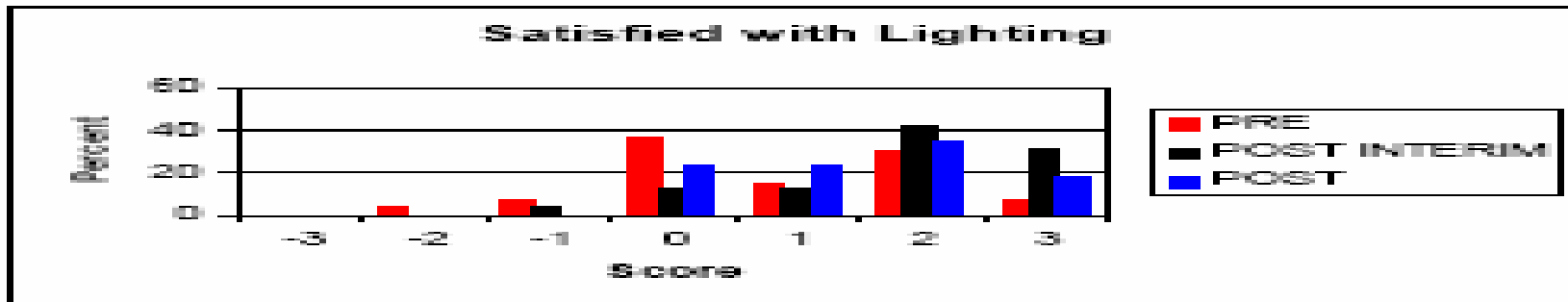
Why People Are Not Satisfied

You have said that you are dissatisfied with the lighting in your workspace. Which of the following contribute to your dissatisfaction?

(check all that apply)



Evaluating Productivity Effects



PRODUCTIVITY

PROJECTED	Gained Productivity
NOT RELOCATED	+5
RELOCATED	+10
AVERAGE	+7



OHS & Environmental Care

Sustainability

Advanced Laboratory/Analytical Services

Technology & Innovation