

▶ **MANAGING INDOOR ENVIRONMENT QUALITY and**

▶ **PRODUCTIVITY MEASUREMENT**

▶ **Dr Vyt Garnys & Staff**

▶ **WWW.CETEC-FORAY.COM.AU**

- ▶ **Local - Green Buildings**
 - ▶ Initiation: Design, establish for sustainability
 - ▶ Major Responsibilities: Maintain health and productivity for years thereafter
- ▶ **Global - 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 80%
 - ▶ Refurbish or demolish 5%
 - ▶ Investors 10%
-
- ▶ Use Pareto 80/20 rule to focus on green productivity for major **lifetime** costs
 - ▶ Operating Buildings – 85% of building stock

OPTIMISE GREEN PRODUCTIVITY

- ▶ **NEEDS 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

NATIONAL OFFICE WORKFORCE

ESTIMATED NATIONAL OFFICE WORKFORCE VALUE

	National	Public Sector	Private Sector
NLA m ²	25,418,089	3,977,014	21,441,075
Number of staff		216,495	1,167,088
Estimated income		\$15,482,166,945	\$91,807,903,799
Workforce Value	\$107,290,070,744		

▶ ASSUMPTIONS

- Regional office space estimate is based on same proportions between public and private sector identified across the capital cities (approx. 22% public: 78% private.
- On average private sector incomes approximately 5-10% greater than public sector.
- Office utilisation of approximately 18m² per person.

NATIONAL OFFICE WORKFORCE

1% productivity change	-	\$1,072,900,736 salary value p.a.
	-	\$ 90,000,000 rent value p.a

TOTAL ESTIMATE **\$1.2B per annum**



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), BREAM
- ▶ **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, Sustainability Victoria
- ▶ SA: SA Water

▶ **INDUSTRY**

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

KEY OBJECTIVES OF FACILITY ECOLOGY

- ▶ **RECONCILE THE OBJECTIVE AND
SUBJECTIVE INDICATORS OF:**
 - ▶ **WELLBEING**
 - ▶ **HEALTH**
 - ▶ **PRODUCTIVITY**
 - ▶ **BUILDING PERFORMANCE**

MEASURING KEY OBJECTIVES OF FACILITY ECOLOGY

- ▶ **RECONCILE THE OBJECTIVE AND
SUBJECTIVE INDICATORS BY:**
 - ▶ **WELLBEING** - QUESTIONNAIRE
 - ▶ **HEALTH** - QUESTIONNAIRE
 - ▶ **PRODUCTIVITY** - FINANCIAL KPI'S
 - ▶ **FACILITY** - INDOOR
ENVIRONMENT
QUALITY

CASE STUDY

- ▶ **Umow 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 & POST OCCUPANCY

Indoor Environment Study 2007 - 2009

Umow Lai Consulting Engineers

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



MANAGING INDOOR ENVIRONMENT QUALITY

	Thermal Comfort			Air Quality					
	Air Temp °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

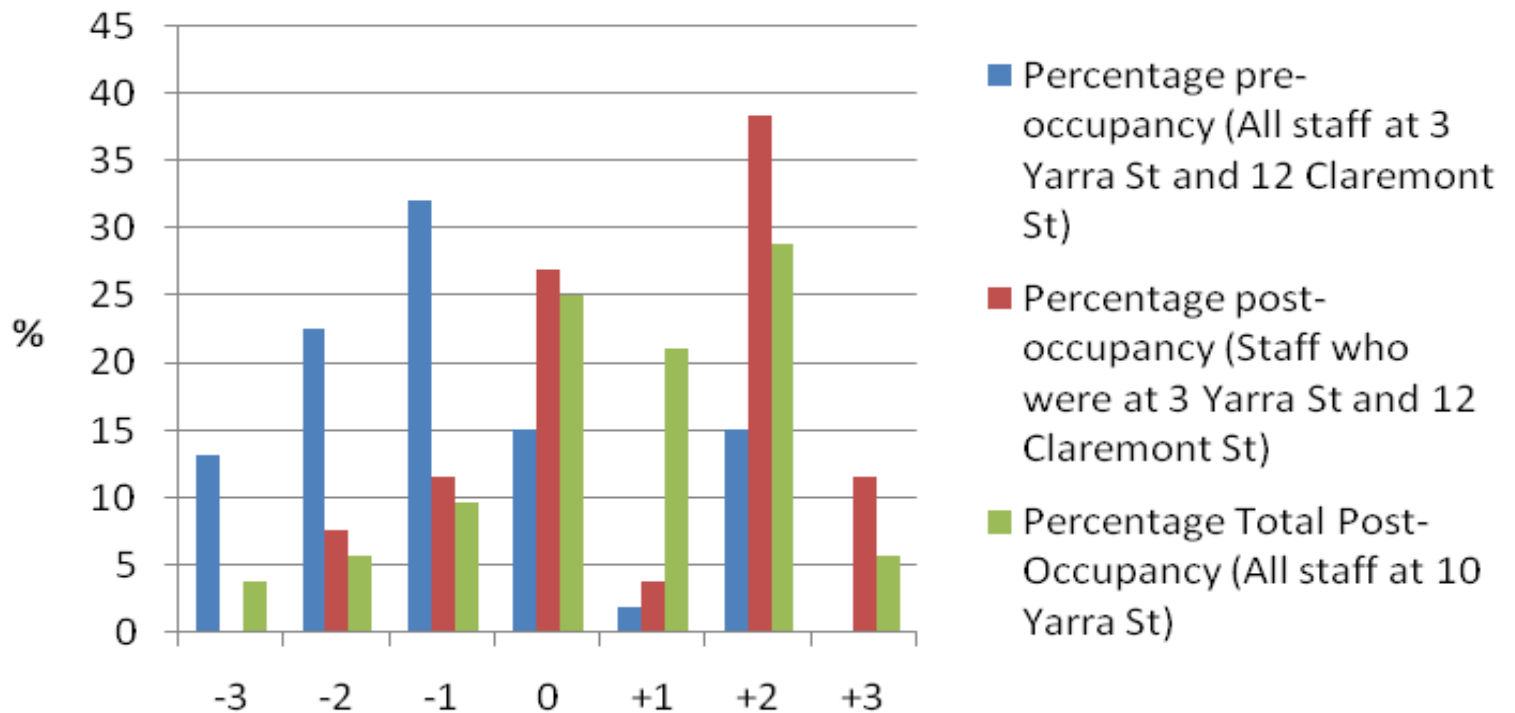
MANAGING INDOOR ENVIRONMENT QUALITY

	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

MANAGING INDOOR ENVIRONMENT QUALITY

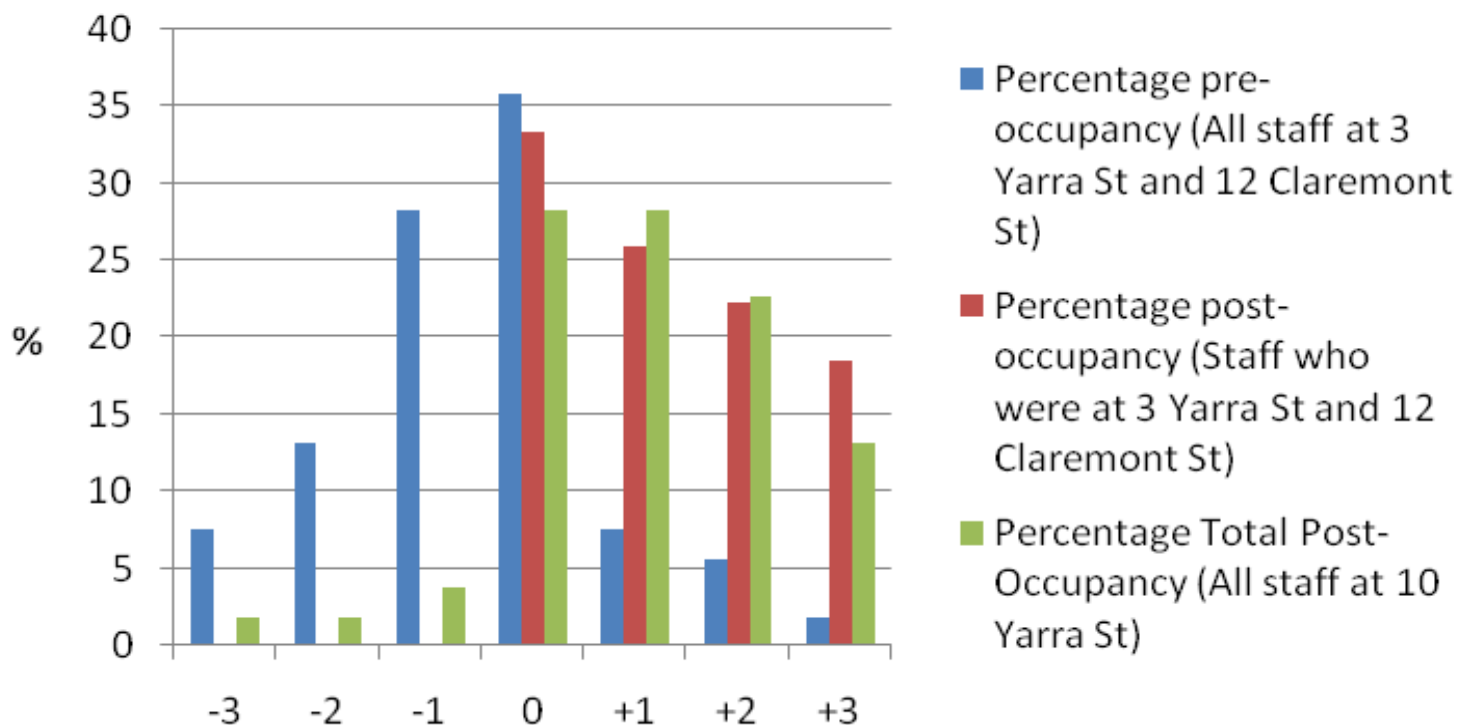
Temperature Satisfaction



Graph 1: Temperature dissatisfaction has decreased

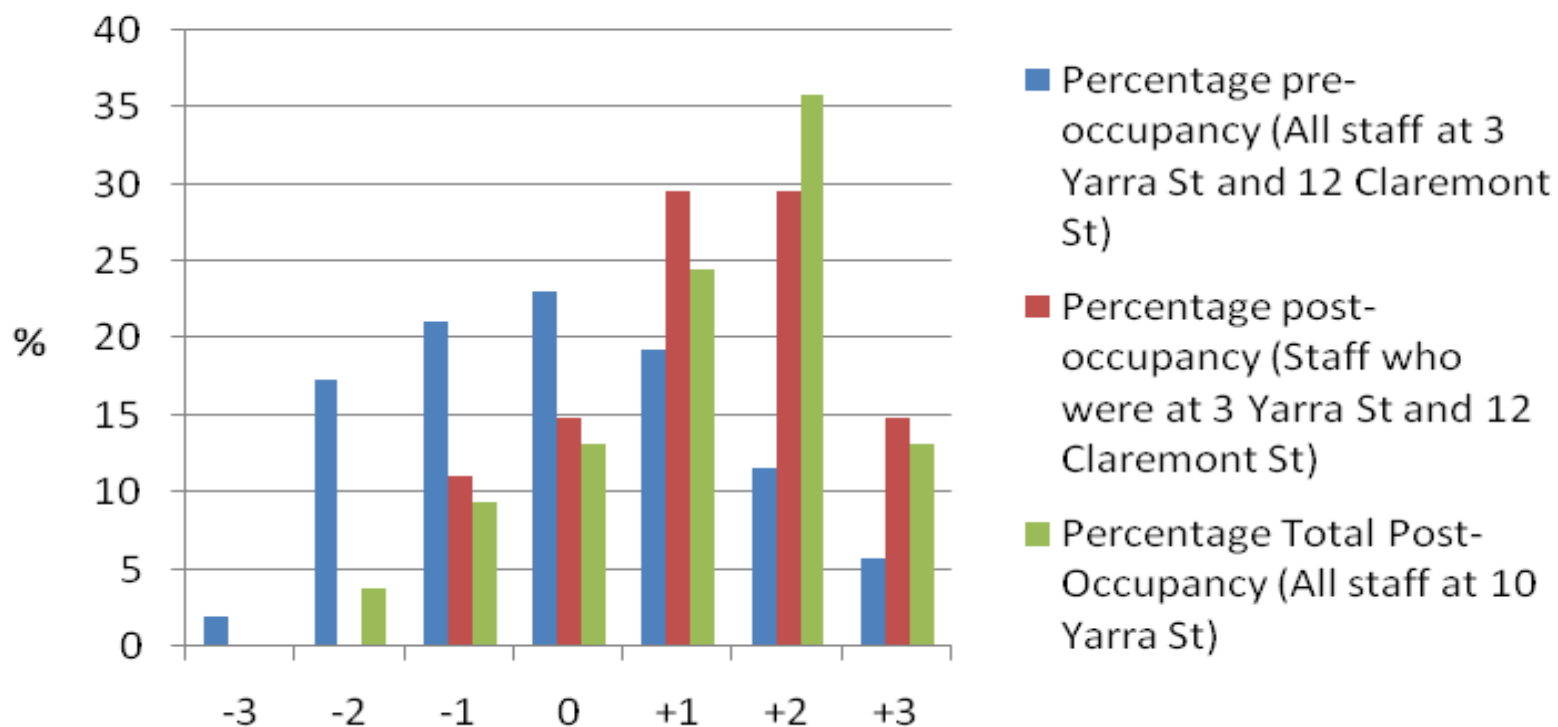
MANAGING INDOOR ENVIRONMENT QUALITY

Air Quality Satisfaction



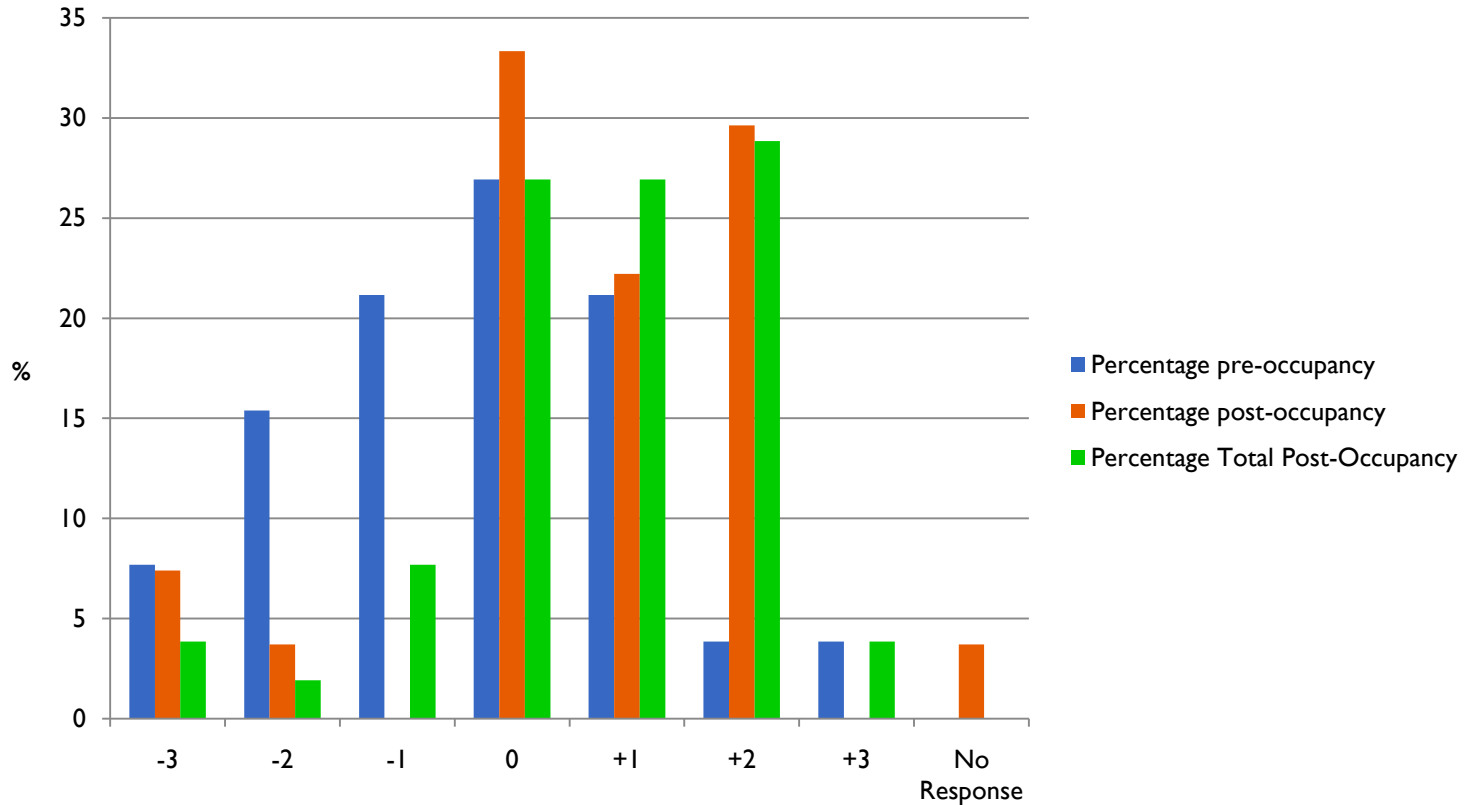
MANAGING INDOOR ENVIRONMENT QUALITY

Lighting Satisfaction



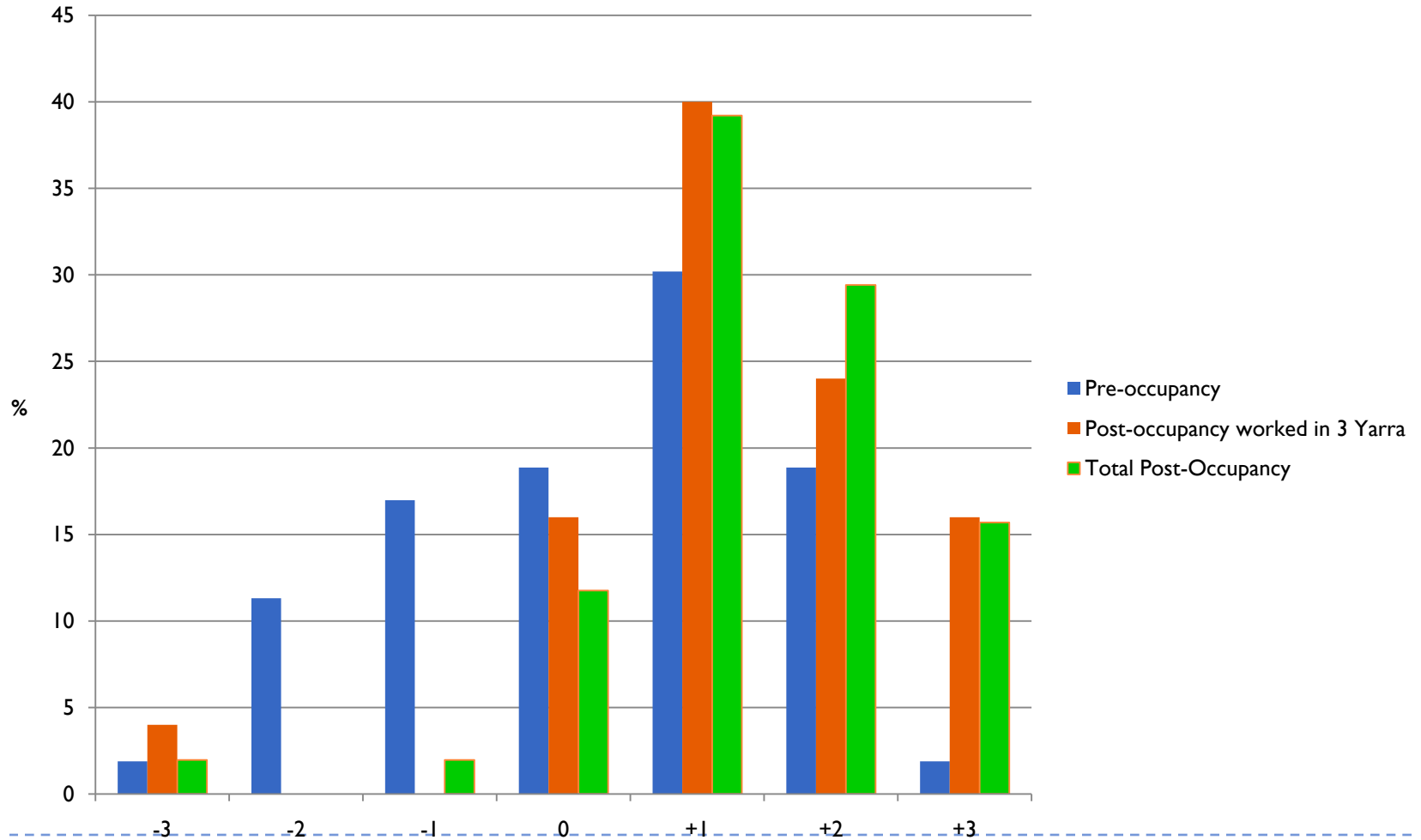
MANAGING INDOOR ENVIRONMENT QUALITY

Noise Level Satisfaction

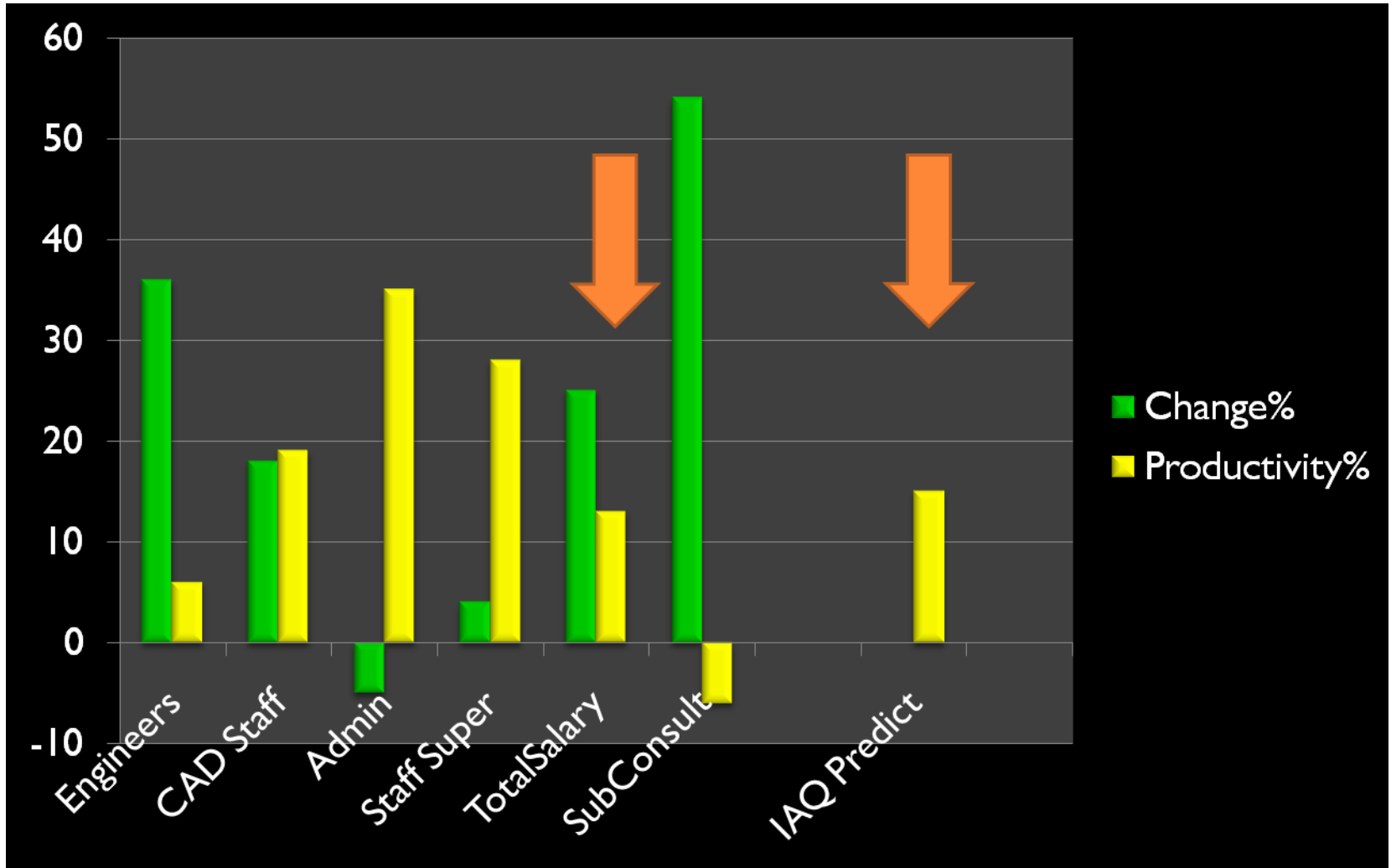


MANAGING INDOOR ENVIRONMENT QUALITY

Satisfaction with Individual Workspace



MANAGING INDOOR ENVIRONMENT QUALITY



Major Telco

Changed Diffusers

Changed Tubes

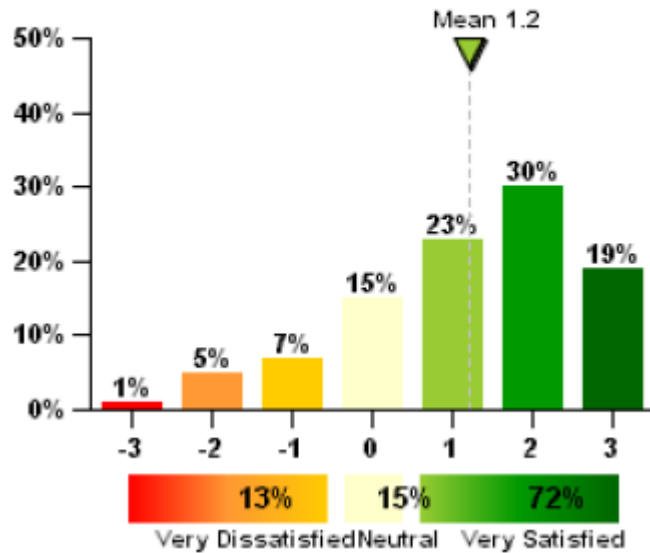
Aged Tubes

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

SATISFACTION SURVEYS

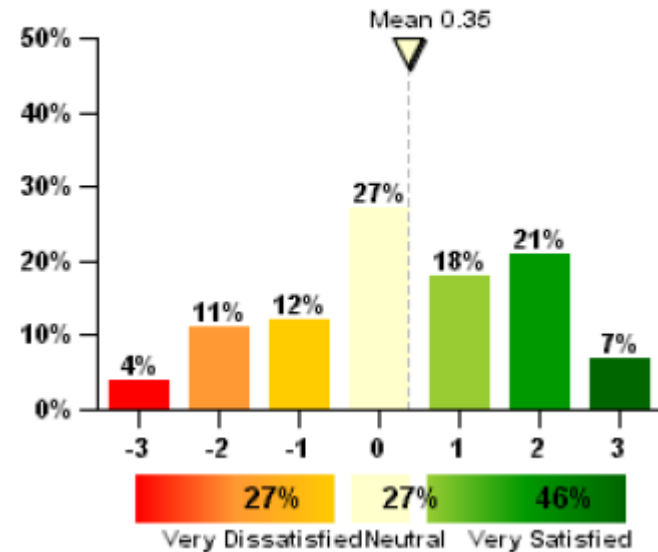
► Good Visual Comfort

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



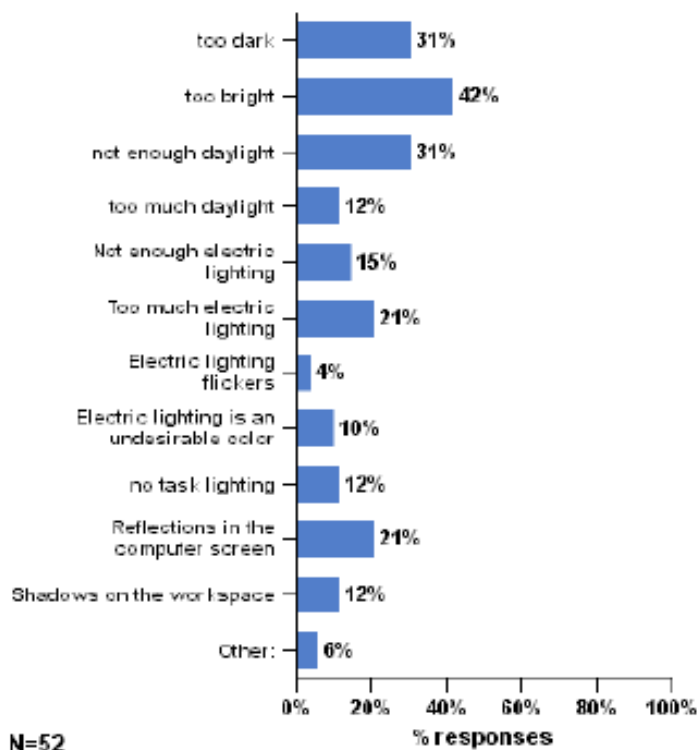
► Poor Visual Comfort

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

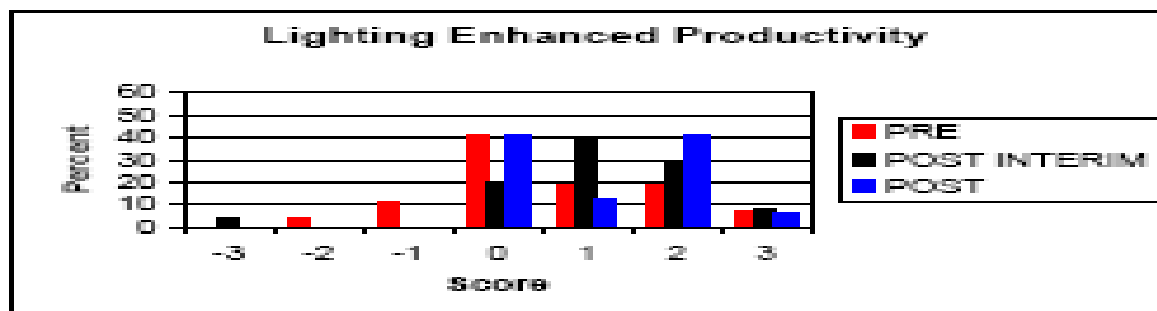
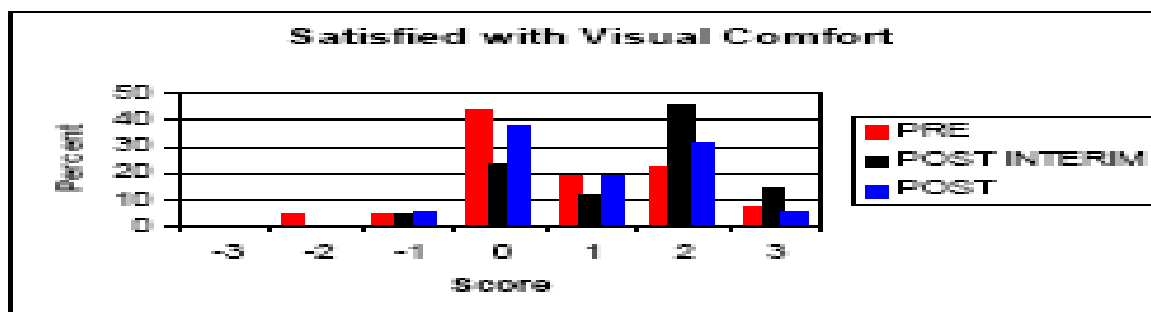
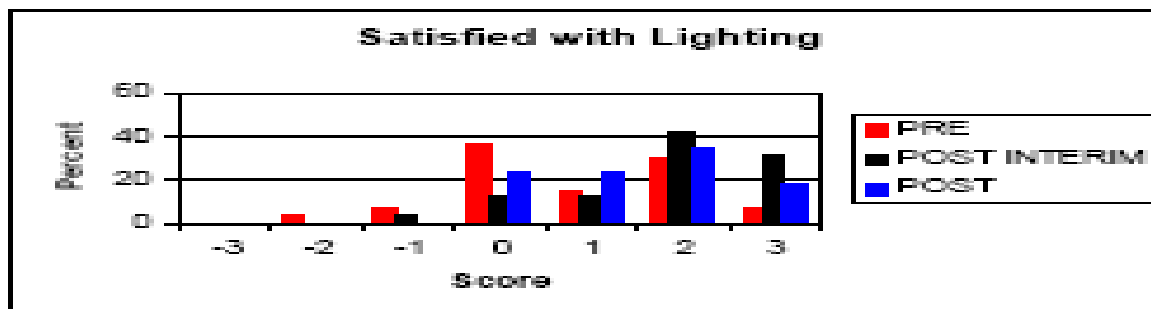


WHY PEOPLE ARE NOT SATISFIED

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	+10
RELOCATED	+5
AVERAGE	+7

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