

**Comfortable and liveable
buildings
—concept of environmental
quality and well-being**

The Business Case for Green Buildings

--World Green Building Council (WGBC) 2013 Report

- **Green buildings do not necessarily cost more** and appeal to tenants because they **command higher rents and sale prices.**
- **Operating costs lower** because of reduced energy and water use plus reduced maintenance
- Better environments affect employees and lead to **higher staff retention rates**
- **Workplace illnesses and hence absenteeism are reduced** ---well-being is higher than in conventionally designed offices where high quality environments have not always been a priority.

Requirements from WGBC 2014 Report

- create greater public awareness of the health impacts of buildings;
- increase the focus on better tools and methodologies to collect data and measure healthy impacts;
- encourage building codes to place increased emphasis on healthier building practices.
- If we only concentrate on energy we are in danger of neglecting the real purpose of architecture which is to provide for people's well-being.

Happiness and Well-Being

- UK All-Party Parliamentary Group (APPG) issued Well-being Economics Report 2014 in respect of Labour Market; Planning and Transport; Mindfulness in Health and Education; Arts and Culture
- World Happiness Report 2013 edited by Helliwell (Vancouver School Economics), Layard (LSE), Sachs (Columbia University)

**Environmental Design
Affecting
Health and Well-Being
of People**

Maslow's Hierarchy of Needs in the Workplace

Need	Achieved by
Physiological	Good working conditions, attractive salary, subsidised housing, free catering
Safety	Private health care, pension, safe working conditions, job security.
Social	Good relationships, team spirit, company sports, office parties, informal activities, open communication.
Esteem	Regular positive feedback, prestige job titles, write-up in company news sheets, promotion and reward.
Self-actualisation	Challenging job, discretion over work activity, promotion on opportunities, encouraging creativity, autonomy and responsibility

PERMA MODEL

- **P**ositive Emotion
- **E**ngagement
- **P**ositive **R**elationships
- **M**eaning
- **A**ccomplishment/Achievement

Martin Seligman in book Flourish 2011

HAPPINESS BY DESIGN by Paul Dolan 2014

- **MINDSPACE-Enable,Engage,Encourage,
Exemplify to Explore and Evaluate**
- **SALIENCE-attention drawn to what is
novel and relevant**

MINDSPACE

- M-essenger
- I-ncentives
- N-orms
- D-efaults
- S-aliience
- P-riming
- A-ffect
- C-ommitments
- E-go

Rating Health and Well-being

- WELL Standard from USA
- Home Quality Mark BRE (Gwyn Roberts)
- Included as a part only in BREEAM and LEED
- Operational Performance Management in Canada
- UK-GBC metrics for offices, retail and homes


WELL-BEING STANDARD

- Provides a model for design and construction to integrate human health features with the built environment
- Is a performance based system to measure impact of built environment on human health


Seven Concepts




air




water



nourishment



light



fitness



comfort



mind

WELL STANDARD 2015

- AIR—fresh clean air, IAQ
- WATER-clean water quality
- NOURISHMENT-healthy diet
- LIGHT-circadian lighting
- FITNESS-exercise; active working
- COMFORT-distraction free environment
- MIND-stress, sleep, emotional health

Home Quality Mark BRE 2015

HQM gives a 5 star rating

- **Running costs** —

energy, maintenance, insurance

- **Health and Well-Being**— air , light, amenities

- **Environmental Footprint**--

CO₂, materials, access to Nature

- **Resilience** —flooding, overheating

- **Digital connectivity**

Performance Metrics

- **Economic** – productivity, profitability and predictability
- **Customer satisfaction** – quality of service, overall performance, value for money
- **Environment**- energy, CO₂ emissions, transport, waste reduction, water usage.
- **People** – safety at work, sickness, absenteeism.
- **BCO Guide to Post-Occupancy Evaluation 2007**

Metrics in WGBC 2014 Report

- Absenteeism
- Staff turnover/retention rates
- Medical complaints and costs
- Physical environment complaints
- Self reported attitudes via perception studies
- Physical environment measures

***Health, Well-being and Productivity in
Offices 2014***

QUALITATIVE

Physical



QUANTITATIVE

Perceptual



Economic



- Perceived Health and Well-being
- Happiness and Satisfaction
- Security
- Empowerment
- Achievement
- Relationships
- Community

- national* — Decreased Public Health Costs
(*illness, injuries, therapies*)
- developers* — Increased Asset Value/Sale Price
- landlords* — Higher Rental Rates
Better Occupancy Rates/Tenant Longevity
- occupants* — Productivity
Performance
Prosperity
Social Capital

Flourish Model

OBJECTIVE FACTORS

- *ENVIRONMENTAL FACTORS-*

daylight, air, noise, dampness, pollution, ergonomics, temperature

- *ECONOMICS*—days off work/school; doctors visits; affordability; musculoskeletal; building sickness syndrome; stress

FLOURISH

SUBJECTIVE FACTORS

- *FEELINGS*; happiness; security; community; employment; functionality; accessibility; connectivity
- *ENVIRONMENTAL FACTORS*; greenery; views, décor; colour; aesthetics

Post Occupancy Evaluation

- BUS- building user studies using satisfaction scores
- Leesman Index- e-survey data from office users
- BSRIA-Building Performance Evaluation in Non-Domestic Buildings BG63/2015 by Michelle Agha-Hosseini et al.,

POE Methodologies

- Measure physical environment
- Measure resource use—energy and water
- Questionnaires to occupants
- Interviews with occupants
- Use of wearables by occupants to collect health data

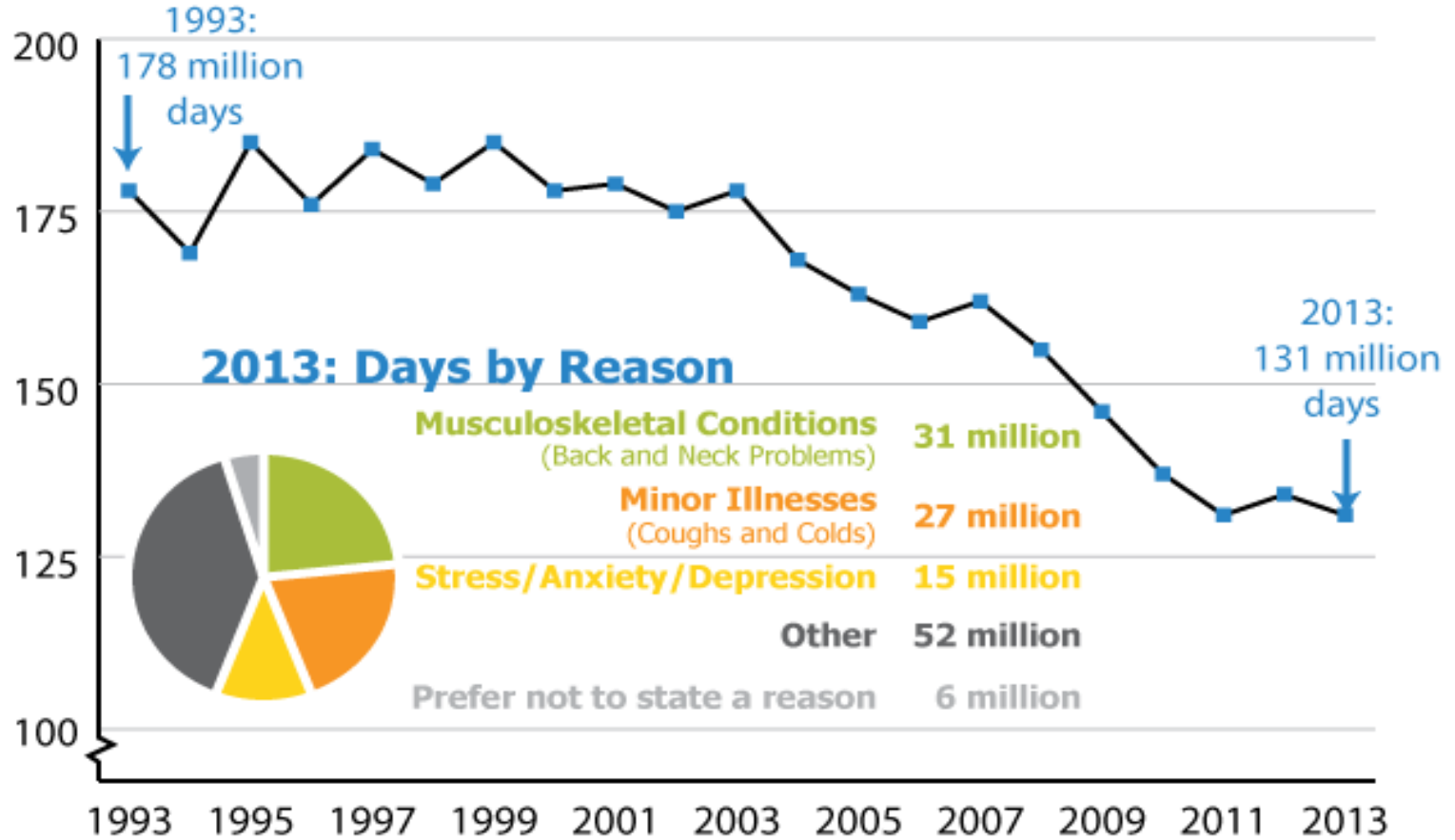
Relation between environmental quality and human health

Good Health and Well-Being Lead to Increased Productivity

- Occupants want an enjoyable experience in their workplace not just a functional one
- Workplaces need to be kind to people's health, mood and well-being
- This leads to happier and more creative and productive people

Number of Working Days Lost

Millions



7.2 days per worker



4.4 days per worker

Sickness Causes and Days Lost

■ Musculoskeletal	30.6 m/year
■ Minor symptoms	27.4
■ Other	21.7
■ Stress, depression, anxiety	15.2
■ Stomach	8.7
■ Respiratory	5.3
■ Eye ear nose throat dental	5.2
■ Heart	5.0
■ Headaches and migraines	1.7
■ Serious Mental health	1.0

PRESENTEEISM

- 60% of office workers say if they felt happy and well at work they would be more productive (BUPA/One Poll)
- For UK this means for 18m workers on an average salary of £26,000 pa a 1% drop in productivity equates to about £5bn and 10% would be in the order of £50 bn.
- For the total working population of 30m these figures would be over £8bn and £80bn respectively.

Building Sickness Syndrome

- Includes respiratory, eyes, nose, throat, headaches, dry skin irritations all of which can be aggravated by the internal environment
- Ergonomic design of furniture essential to reduce musculoskeletal problems
- Greenery helps to give calmer environments

Direct effects of poorly performing environments

Lost work hours due to sickness

Inability to reach true operational potential.

Reduction in gross domestic product

Reduced company profit

A demoralised workforce

Increased Facilities Management costs

Increased staff turnover

Lack of sustainability

MAT model of Behaviour (Fogg 2008)

- **Behaviour=Motivation x Ability x Opportunity**
- **When mind concentrating and focussed the Behaviour is effectively Performance**
- **Facilities and support systems afford opportunity**
- **Healthy sensory environments help motivation**

Healthy Environments

- Fresh thermal ambience with good ventilation
- Natural light and views of Nature
- Acceptable acoustic climate
- Flexible agile space allowing collaborative or quiet working
- Space layout to permit active movement so encourage a mix of sitting and standing
- Ergonomic furniture
- Landscaping inside and outside the building
- Blend of factors like colour, greenery, outside views, décor and furnishings go beyond comfort

More recent aspects

- **Spatial settings** to suit various types of working: more contemplative spaces
- **Encourage active sit/stand working.**
- **Ergonomic workplaces** that have been designed to minimise musculoskeletal disorders;
- **Landscaped biophilic surroundings** should be part of the internal and external space design.

Ergon Space Saving Desk



STAND –SIT WORKPLACE



Building Related Satisfaction Factors

- Jobs in which people are not tied to one place.
- Shallow building depth, in particular with a high proportion of window seats.
- Small workgroups
- Low occupation densities
- Good perceived control
- High management responsiveness

Beyond Environmental Comfort

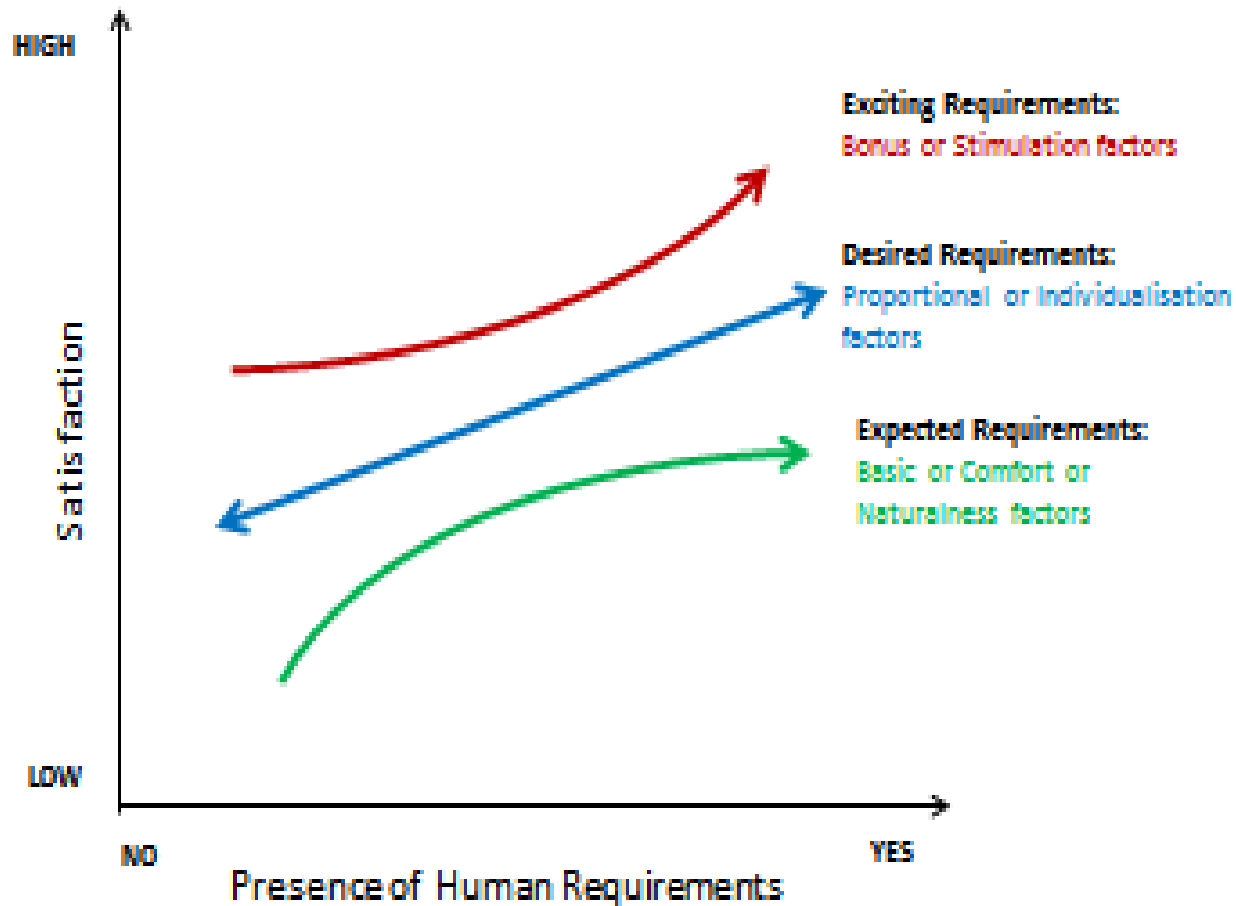
REFERENCES

**See References in EU Report 2014 by
Clements-Croome**

**eg Book by Ong 2013; WGBC Report
2014**

**UKGBC Report 2016 page 14 Health
and Wellbeing in Homes**

Beyond Environmental Comfort



LIGHT

- Hue
- Saturation
- Chroma

Layers of light:

Temporal-

Essence of change, fragility and invincibility and the most fundamental measure of the passage of time, identifying our place in the cosmos. The human eye is tuned to twilight, our eyes are not just for seeing, our retina contains non-rod, non-cone receptors that absorb twilight and signal the brain to entrain with the oscillations of the daylight and dark cycle.

Hormonal –

Since the dawn of the 20th century, exposure to artificial and irregular light schedules has become commonplace. The increase in exposure to light at night parallels the global increase in the prevalence of obesity and metabolic disorders. Because the circadian system regulates metabolic function, some studies have linked these disorders to exposure to light at night.

Chromatic –

reveals the relative and interactive nature of colour.

Colour is not a property that exists independently in the sky or the grass, but is a reciprocal interaction between our bodies and the world.

Shadow –

Interdependence of light with shadow.

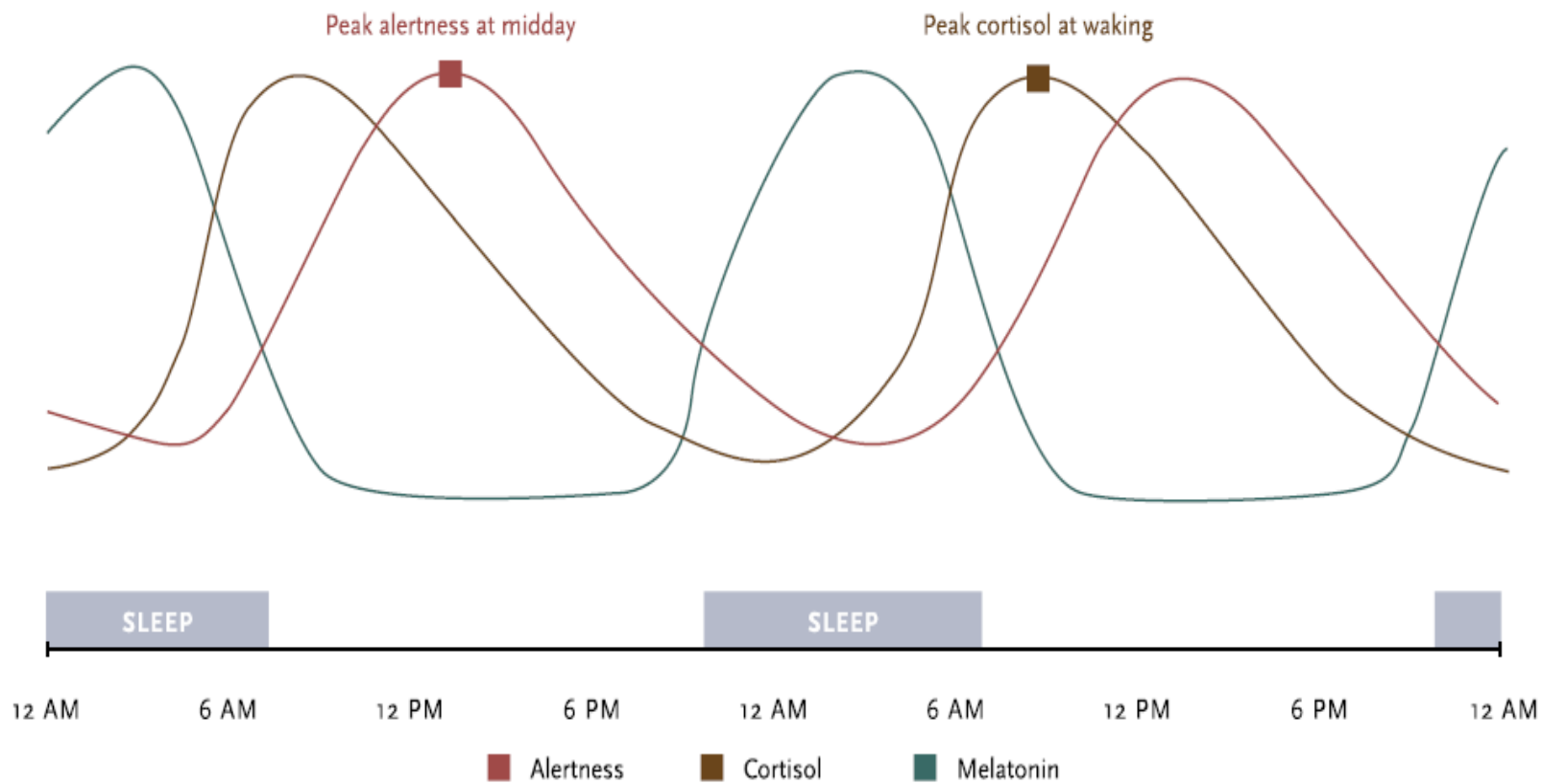
Shadow engages our imagination.

Circadian Lighting Emulates the Natural Environment



LIGHTING AND OUR BIOLOGICAL RHYTHMS

Daily Cycle of Cortisol and Melatonin over Two Days



92%

*said the new space
has created a positive
effect on their health
and well-being*

94%

*said that the
new space has a
positive impact
on their business
performance*

83%

feel more productive

100%

*said that clients
are interested
in their new way
of working*

93%

*said that they are able to
more easily collaborate
with others*



CBRE Headquarters
Los Angeles, CA | USA



“New York’s Healthiest Building”

425 Park Avenue
New York, NY | USA

Developing good environmental quality

Technology

- Upsides v Downsides debate needed
- Choose and select wisely
- Plan for updating
- Keep simple and reliable

Personalisation

- Personal control improves productivity
- Helps increase awareness about habits and effects on health but also energy and water use

SENSORY WORLD

**Embedded Sensors in
Buildings, Equipment and
Clothing**

Sensors Measure

- ✓ Motion
- ✓ Heat flux
- ✓ Temperature
- ✓ Galvanic skin response
- ✓ Heart rate/pressure
- ✓ CO2 partial pressure
- ✓ Blood O2 Saturation
- ✓ Muscle tension
- ✓ Respiration
- ✓ Brain rhythms
- ✓ Mood and stress

Solar Charging Clothing



Portable solar chargers like the ***U-Powered solar charger*** from Kiwi Choice are a handy way to keep mobile devices like smartphones, cameras and media players topped up with electricity while on the go. GO Solar Power comprises a range of clothing items that feature pockets to house solar panels to charge up mobile electronic devices.

HUMAN SENSORY INTERFACES

Body Movements

Body Electricity

Gesture Recognition

Personalisation

Accessory Nerve is a Bluetooth mono-sleeve accessory for mobile phones that changes pattern (creating pleats on the fabric) when a user receives phone calls

M-Dress by Adam Chang works with a standard SIM card. When the dress rings, you raise your hand to your head to answer the call.



KineticDress is a Victorian inspired evening gown reactive to the wearer's activities and mood.



jumpsuit with built-in iPod control and pocket



The Hug Shirt™ is a Bluetooth accessory for Java enabled mobile phones

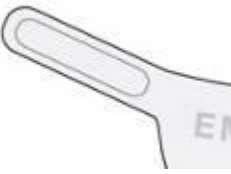


ET System



Bluetooth ET Sensor headset

Bluetooth ET Belt with wireless network access



Mystique (the shape shifter): dress changes shape and length during the course of an evening

Embedded Theater) is a system that allows to interactively navigate audio-augmented environments and create mobile storytelling experiences

Wearables Technology

Some examples which measure several factors include:

- Fitbit
- Jawbone
- Apple Watch
- Airo
- Lumolift
- Emotiv

FITBIT

- Steps
- Heart bpm
- Walk distance
- Calories burnt/eaten
- Floors
- Active minutes
- Exercise
- Water intake
- Sleep pattern

SOME OTHER EXAMPLES

- IAQ/Comfort---Tzoa
- Fitness, blood pressure, O2 saturation—
Scanadu
- Light, UV—Sun Sprite
- Nourishment-food, glucose--Heale BeGoBe
watch
- Water--Hydracoach



Cybertecture Egg-Shaped Building

■ Indoor comfort

- “Best space to work in”
James Law
‘Cybertecture Health’
provides

➤ Interactive features

Presents people’s health statistics such as blood pressure and weight



CONCLUSIONS

TRENDS

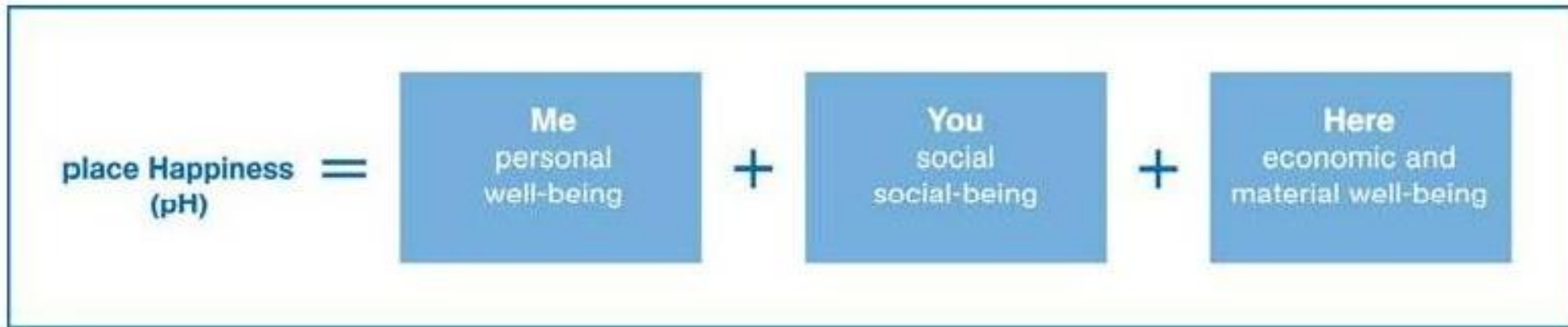
1980s Processes

**1990s Process and
Technology**

**Today—
Process+Technology+People**

Key Neighbourhood Features Promoting Well-being

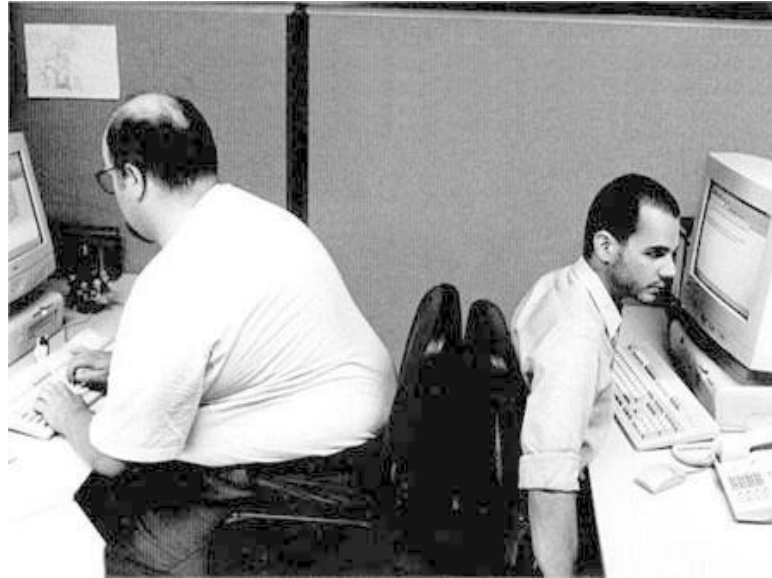
- **Personal functioning**
- **Social functioning**
- **Personal feelings**
- **Social feelings**



The components of place Happiness (pH)

Productivity

- Working in an office with good natural lighting could help you think more clearly
- Working in a space with good sound insulation can help concentration



Productivity Losses in Offices

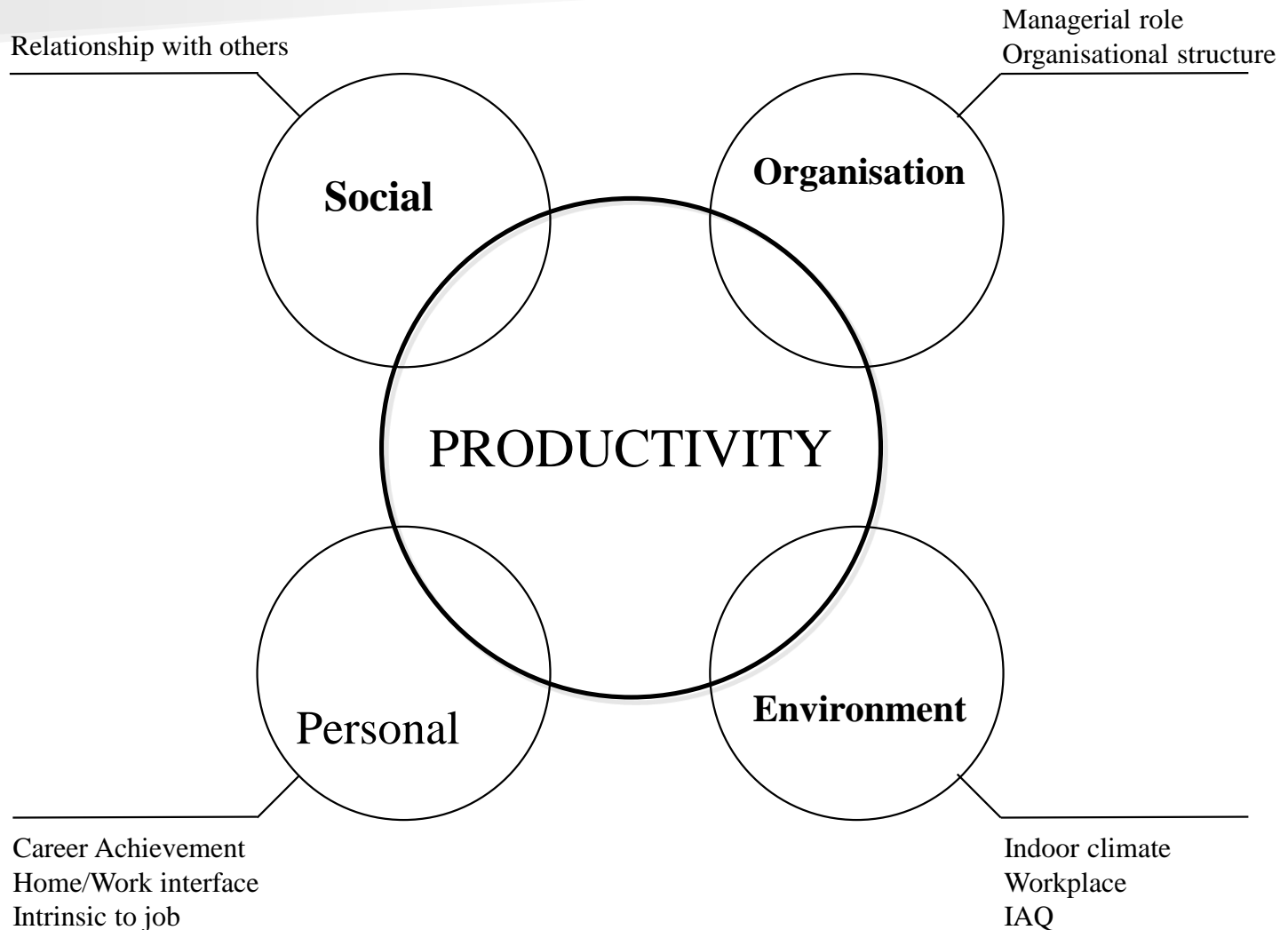
Office workers are distracted by phone calls, emails and text messages. Constant interruptions reduce productivity and leave people tired and lethargic and less creative.

TNS Research (Hewlett Packard)

Dr Glenn Wilson, Kings College, London in The Guardian, April 22 2005

Professor Sir Cary Cooper Daily Mail page 5 on 7 May 2015 article by Jenny Hope

Conceptual Basis for Impact of Environment on Productivity



Clements-Croome (2000 , 2006, 2004, 2013)

Subjective

Objective

Environmental Factors

greenery

daylight

views

clean fresh air/temperature

decor

noise

FLOURISH

dampness

colour

pollution

aesthetics

Ergonomics-
musculoskeletal
problems

Feelings

Economics

security
happiness
employment choices
community
functionality (ergonomics)
accessibility – connectivity
services
transport

doctors visits
days off school/work
affordability –Fuel, water, Council Tax
Rent/Mortgage

Designers, Facilities Managers and Executive

- Spaces for mind refreshment
- Open Communication with occupants
- Calming Features—greenery/colours/décor.....
- Spaces arranged for 'people flow and interaction'; mingle space important.
- Flexible working office/remote/mobile
- Encourage active working—walking/contemplation/exercise
- Make workplaces fun, joyful and soulful

Changing World

- **Transdisciplinary serendipity**
- **Choice and Autonomy**
- **Business Agility**
- **Clear Identity and Brand**
- **Work Life Blend**
- **Awareness of social and technological changes**
- **Global Connectivity**
- **Community Interaction**



UpRight

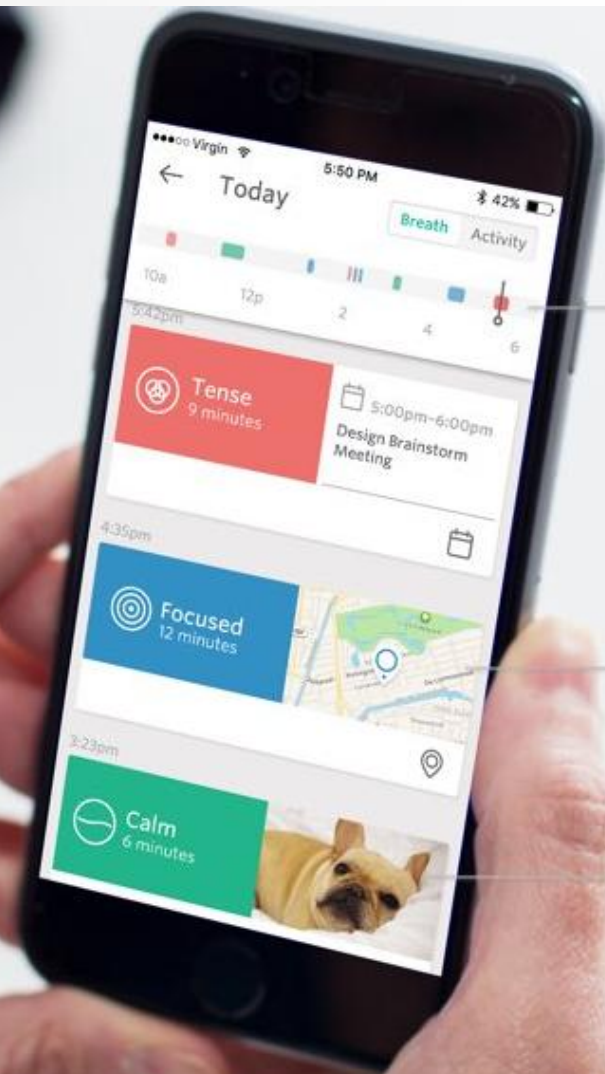
COMFORT

The right balance of ergonomic, acoustic, thermal and visual comfort together with good air quality improves health, wellbeing, workplace productivity and learning outcomes. Posture tracker can help users correct their posture and improve their health.

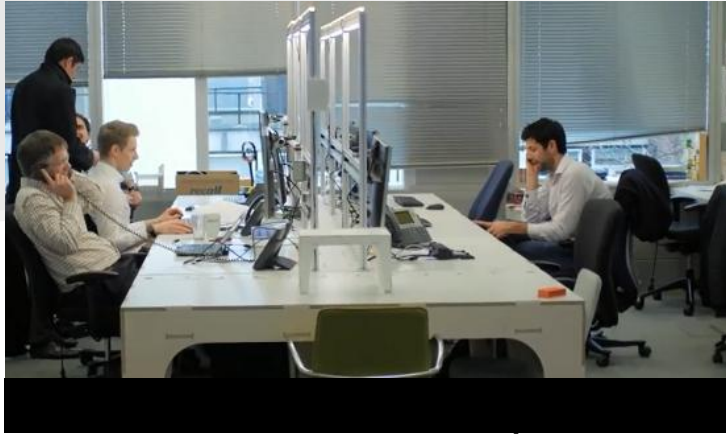


STRESS

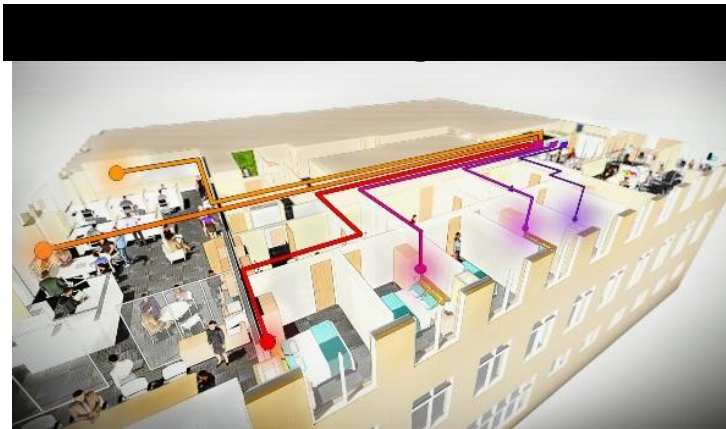
Through measuring brainwaves and/or respiration rate, devices and apps are aiming to help people measure their cognitive health and wellbeing, gauge stress and attention, encouraging meditative practices, provide constructive advice for reducing tension or increasing focus and calm.



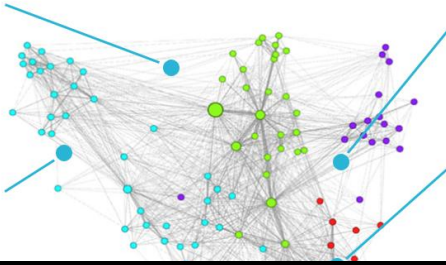
Spire



Technology



Teamwork and Engagement

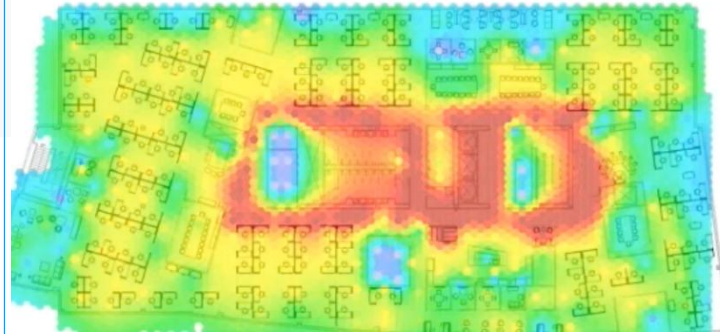


How do leaders behave differently?

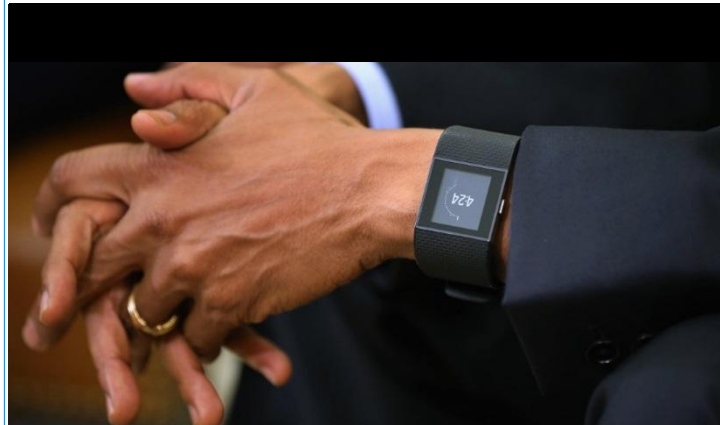
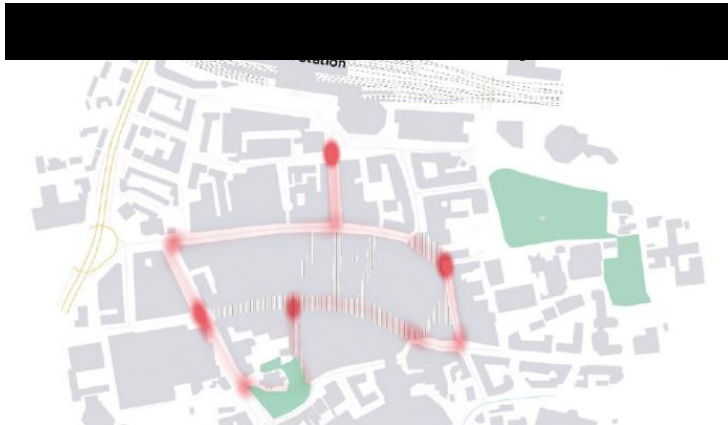
It has been shown that leaders do in fact have different behavior, and tend to have the broadest networks.

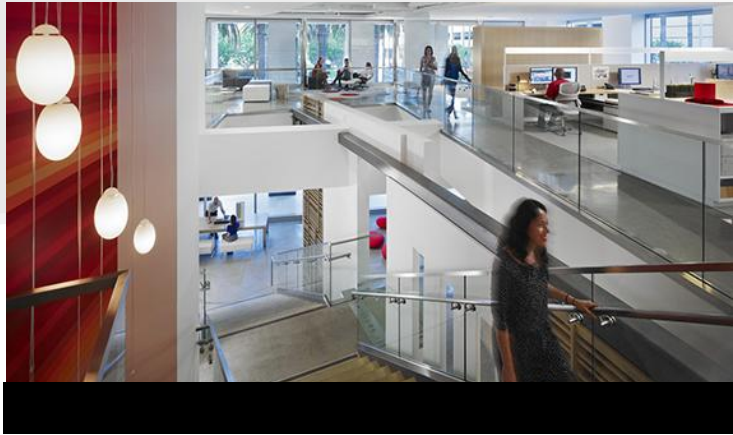
Do my top teams collaborate differently?

The most productive teams have a tight communication network which increases cohesion among the team members.

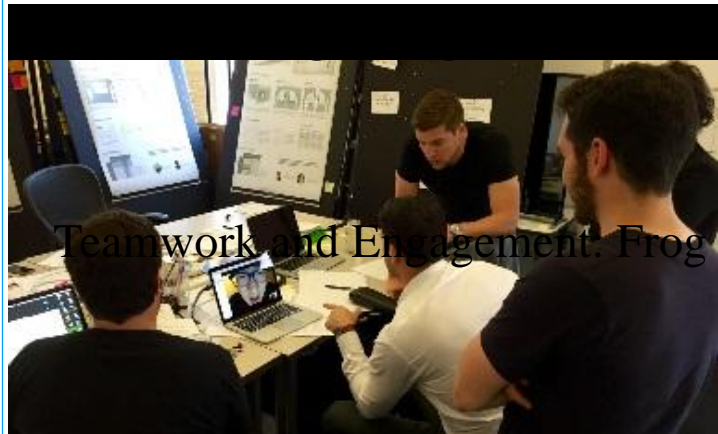


Behaviour





Design



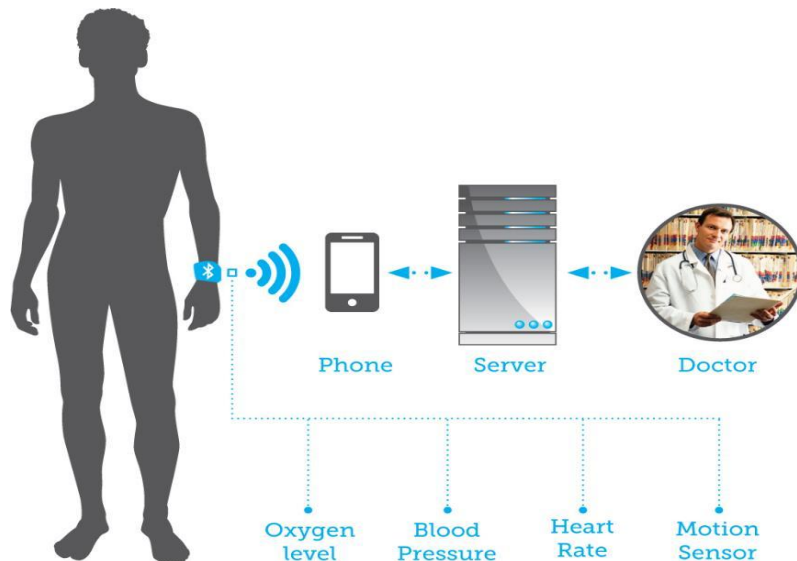
Teamwork and Engagement. Frog

Recommendations

- **Initiate discussions within management on what degree of employer support or engagement** should be taken with regards to the potential resource and data stream from wearables.
- **Develop an approach to how wearables can improve business in addition to health;** drive value through digital transformation.
- **Establish a 'Wellness Integrator' role** to work across company silos to coordinate health and wellbeing initiatives at a management level within organisations.

Recommendations

- Consider the rich insights and potential value in data streams, but avoid 'data for data's sake'.
- Encourage an approach that fosters implementation as a **collaborative journey** towards healthier living and working.
- Maintain a focus on **enhancing** convenience, user experience, and individual wellbeing.
- **Educate, empower and respect** individual autonomy, rather than mandate desired behaviours.



The future of wearable technology is not about the gadget on the wrist but *what is done with the big data they collect.*

[Source: Samuel Gibbs. "The future of wearable technology is not wearables – it's analysing the data" The Guardian, Jan 2015]

THANK YOU!