

# Building technology's role in health and wellbeing

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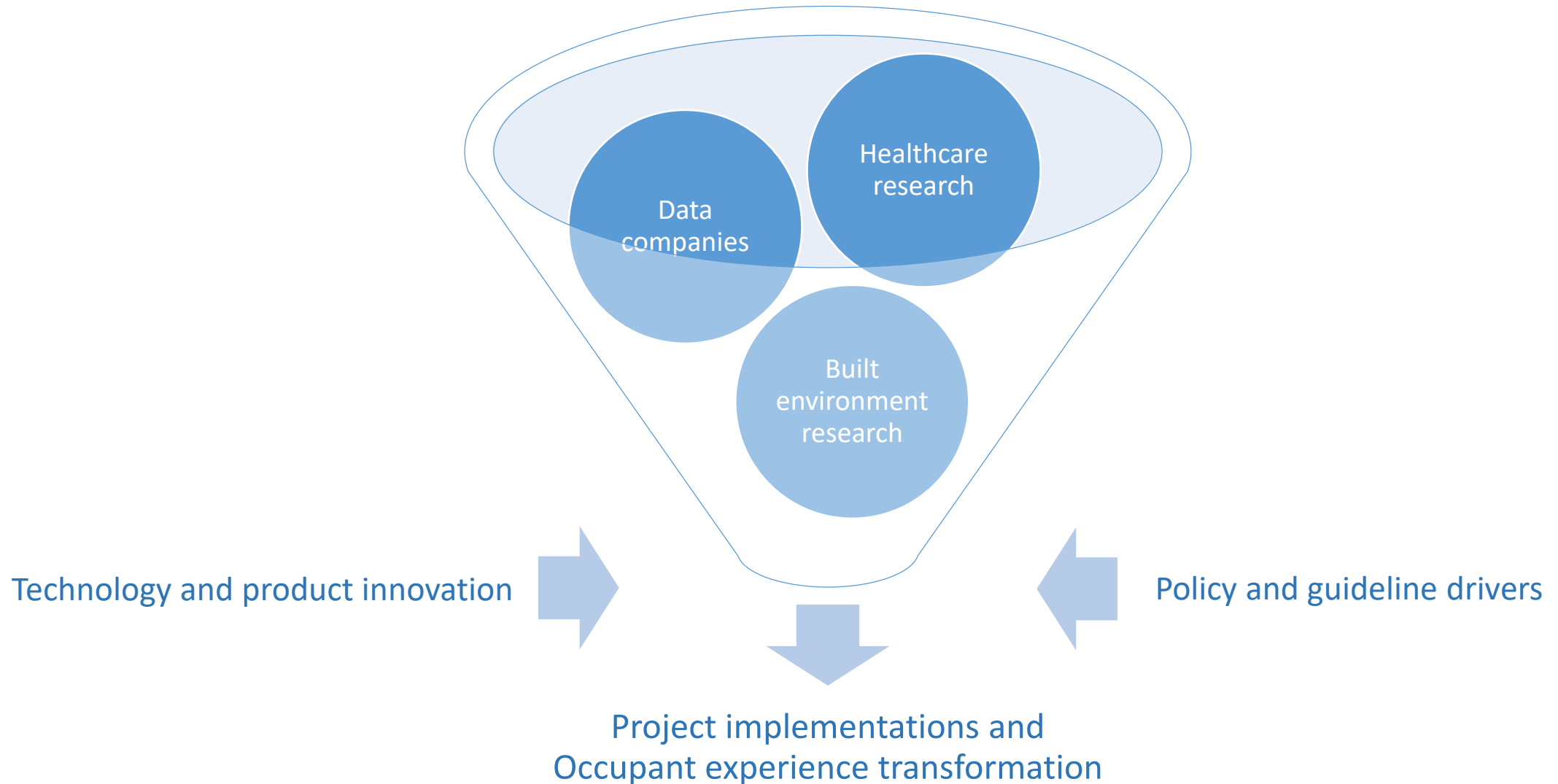
Symposium on Putting Health  
and Wellbeing Research Findings  
into Practice

2018.04.18

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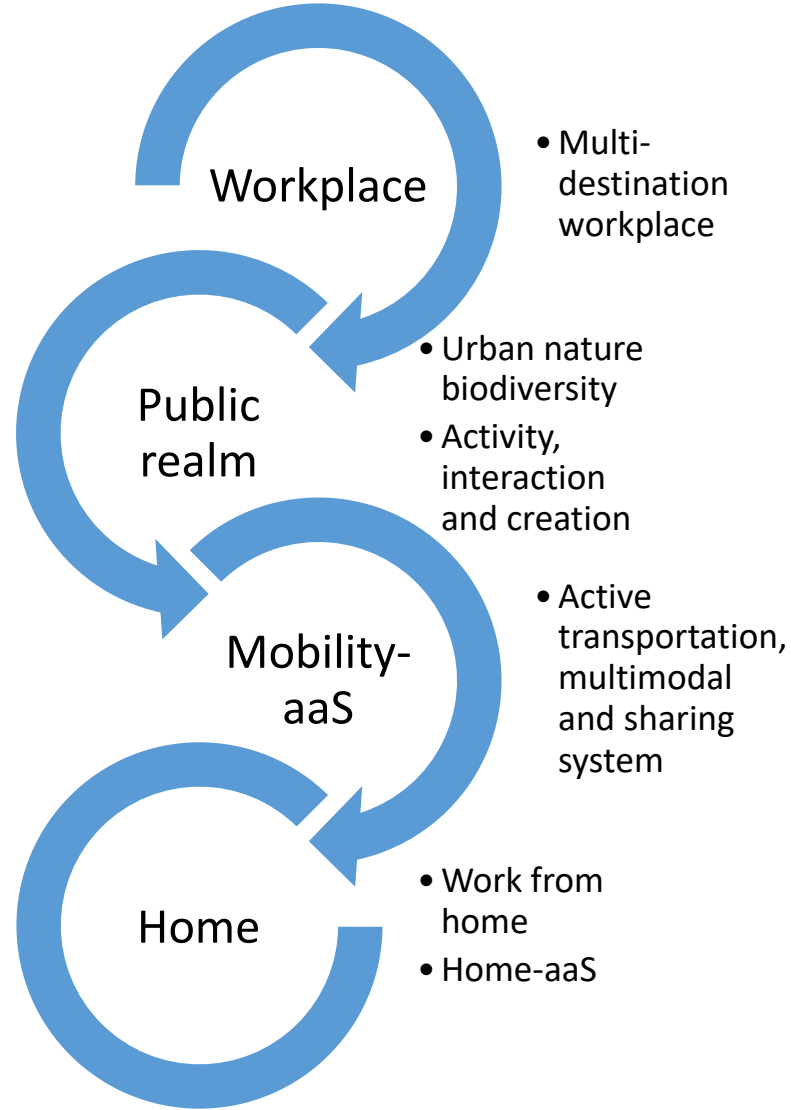
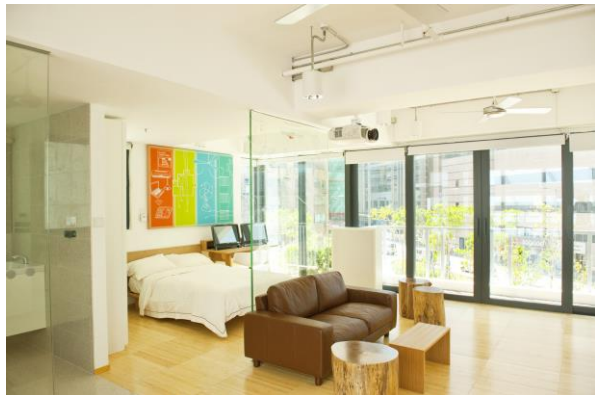


# Industry research to practice

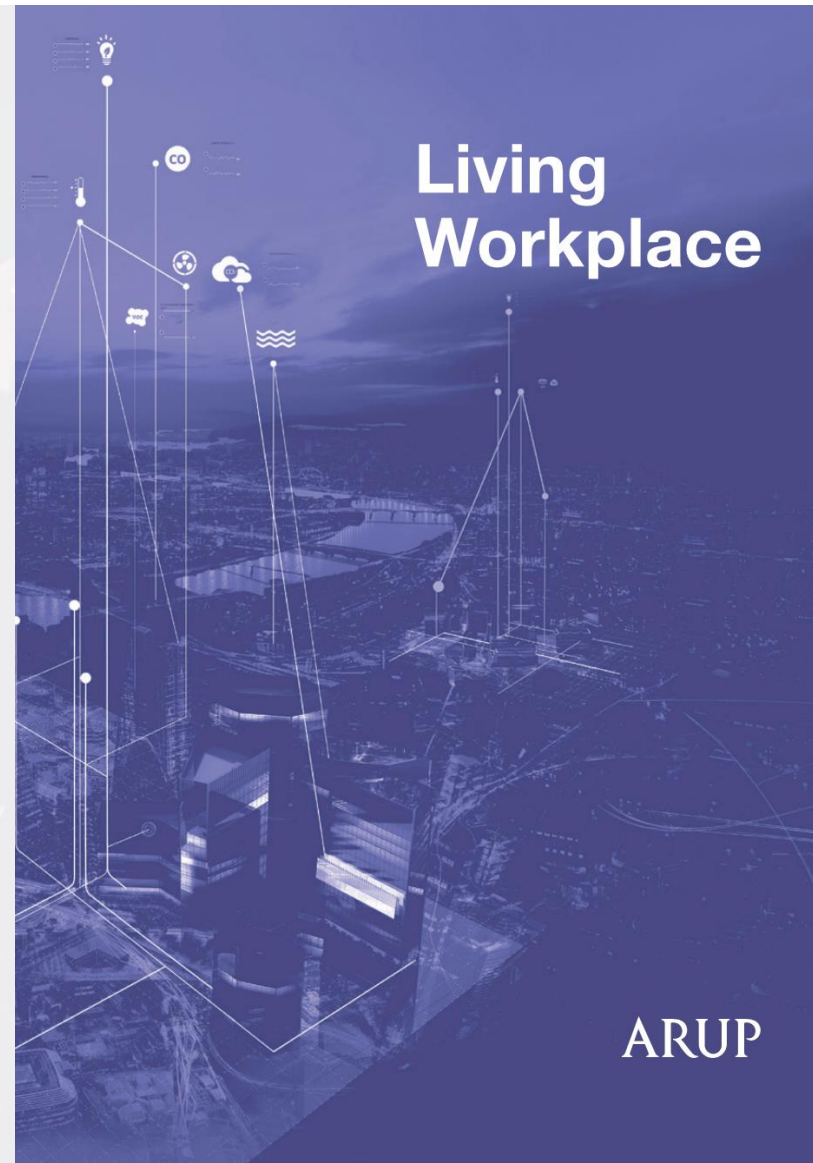
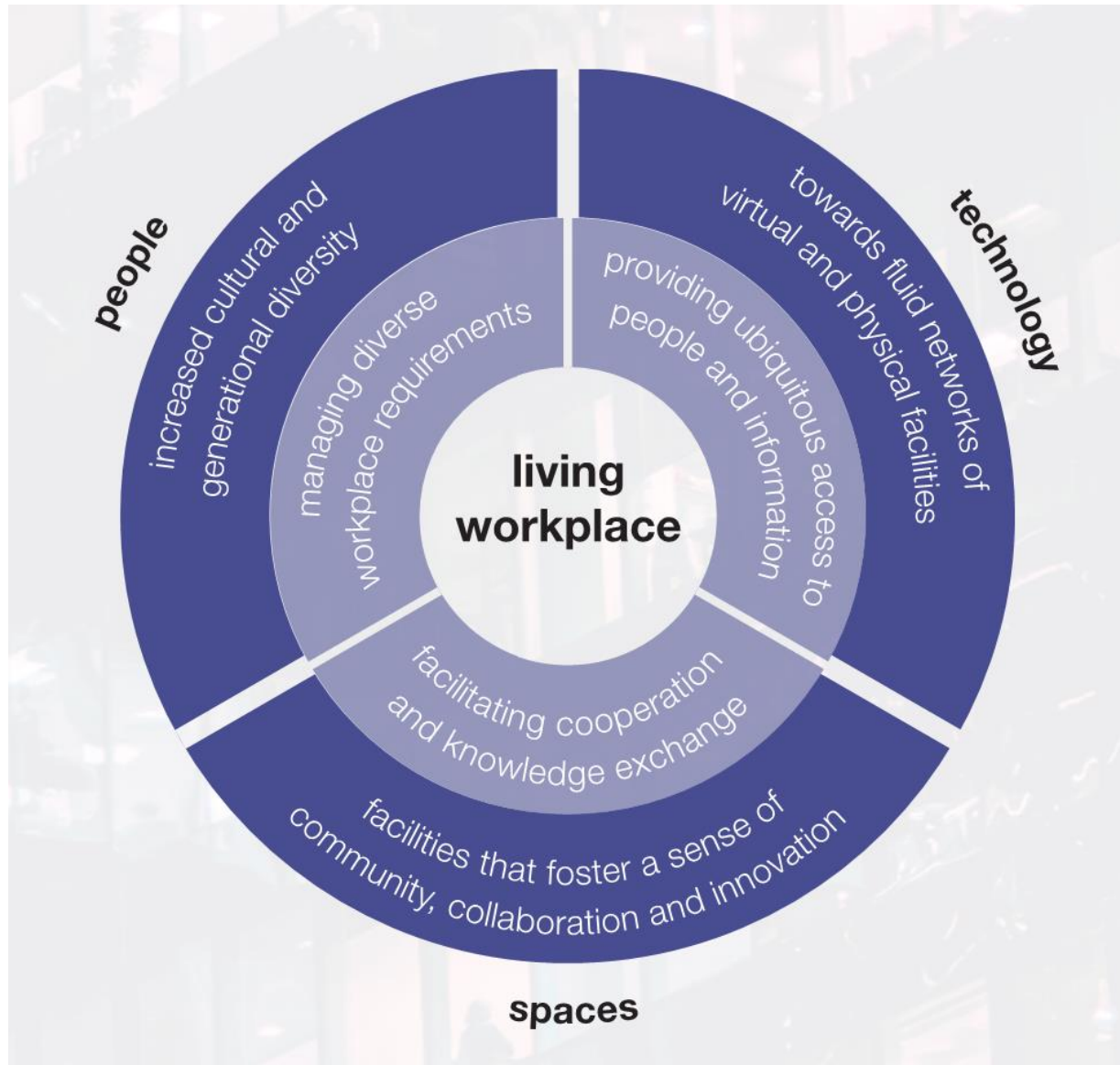




# Digital changes in our spatial journeys



# Understanding the future of workplace





# Understanding the future of workplace

## 1 Multi-functional spaces and service ecosystems

From accommodating rapid change to reductions in size and scale, the character of the workplace is being redefined towards a more fluid entity, capable of expanding and contracting on demand.

## 2 The city as a network of workplaces and workspaces

There is a shift from a highly-centralised workplace model to one characterised by constellations of distributed 'urban innovation nodes', where workers congregate in order to use facilities and collaborate on the delivery of projects.

## 3 Improved space utilisation as an ever-growing priority

New business- and operational models deliver a highly-flexible approach to commercial space utilisation, including co-working spaces, new leasing models, new forms of community living and 24-hour workplace access.

## 4 Digital redefines the value of property portfolios

Adding a digital layer across commercial assets and portfolios allows property owners and operators to offer new services, create new revenue streams, and enable more flexible on-demand access to space.

## 5 Towards tailored and targeted approaches to employee wellbeing

Sensors and data analytics are providing a more granular picture of the actual performance and quality of commercial spaces, thereby increasing our ability to create healthier and more productive workplace environments.

## 6 The strategic need for workplace curators

Workplace curators operate at the intersection of HR, corporate strategy and facilities management in order to manage the changing requirements of stakeholders, and utilise the workplace as a strategic tool for the business.

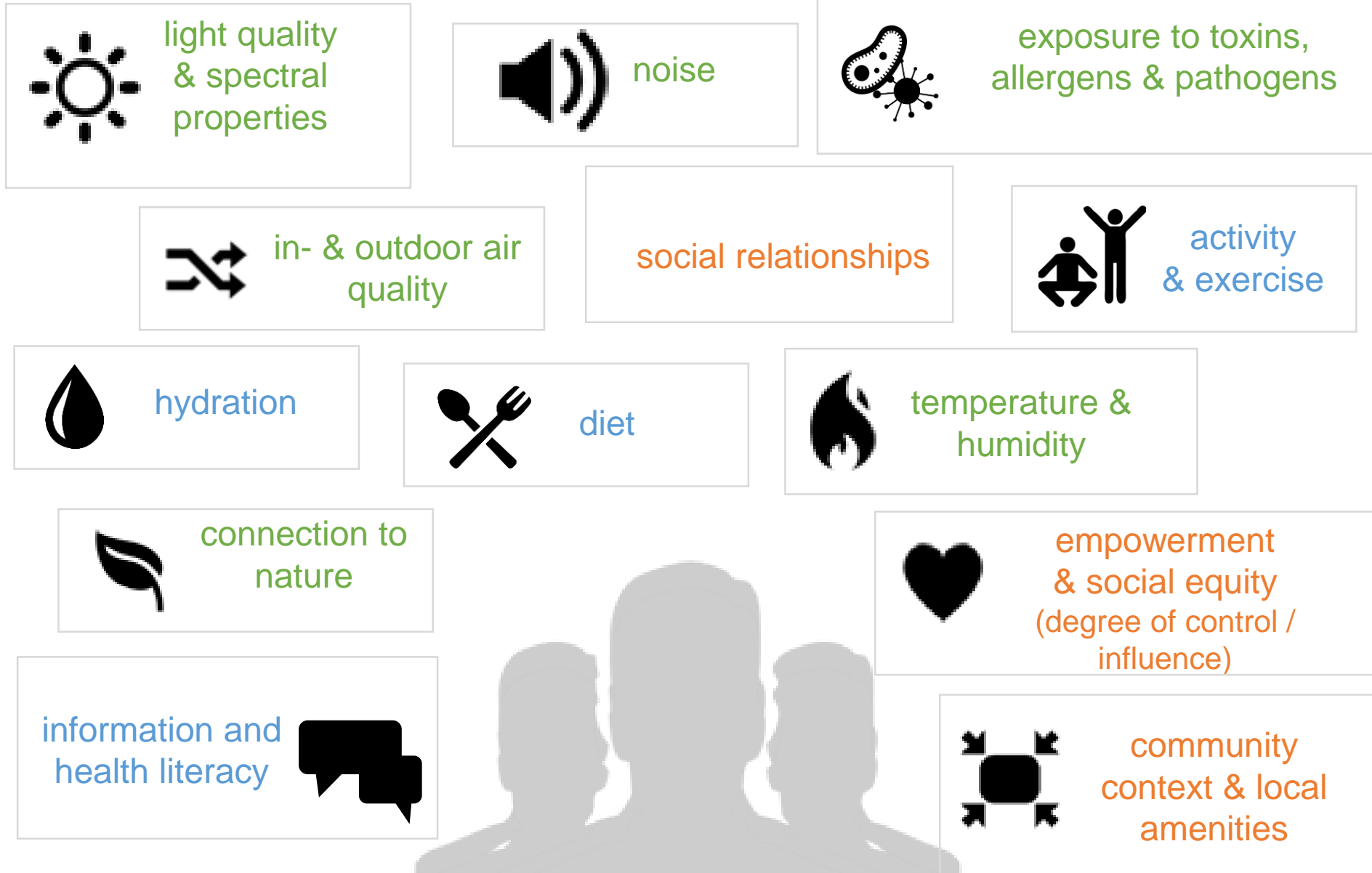
## Living Workplace



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# Key environmental & lifestyle factors



# Buildings for people

“...the time has come to elevate human health and comfort to the forefront of building practices and reinvent buildings that are not only better for the planet – but also for people.”



  
**BETTER PLACES  
FOR PEOPLE**  
| PUT WELLBEING AT THE  
HEART OF YOUR BUILDING



Source: <http://wellcertified.com>



Source: <http://betterplacesforpeople.org/>



# Core architectural themes





# Core SMEP themes

## circadian lighting

dynamic & varied  
spectral output: biologically-  
appropriate in line with natural  
hormonal cycles driven by  
diurnal sun path

## ventilation strategy

OA rates  
moisture/ mould control  
filtration / purification  
nat vent / mixed mode

commissioning,  
handover &  
maintenance

feedback &  
transparency

## exemplary water quality

safest contaminant levels  
quality control  
taste properties

## daylighting

air quality  
water quality

leak detection  
& prevention

flexibility &  
personalisation

material  
safety

## comfort

thermal  
acoustic  
olfactory  
glare control  
colour rendering

biophilic design  
strategies

post-exercise  
facilities

user control /  
influence

increased access to  
drinking water



# Wellness expectation driven by Consumer Electronics industry

- Sound machine → Soundscape
- Voice assistance and smart home hub → Building Automation System
- Motorized blinds → Façade automation
- Smart light bulb → Daylight and circadian lighting control
- Smart refrigerator → Smart vending machine
- Smart speakers/TV → AV over IP
- Fitness tracker → Wellness program

# Key Building Technology Pilot Projects

IoT Desk: Integrated Sensing and Control with Open Source development

Acoustic Soundscape and Immersive Environment

Fitting for WELL and FitWel: Arup Boston and SF offices



## Internet of Things Desk

### Why

WELL/Fitwell compatible sensing

Low power/DC compatible

Interactive graphical user interface

Close the loop between design and operation Demonstrate

IoT approach vs traditional integration

### How

Off-the-shelf vendor-independent sensors

Open source controllers

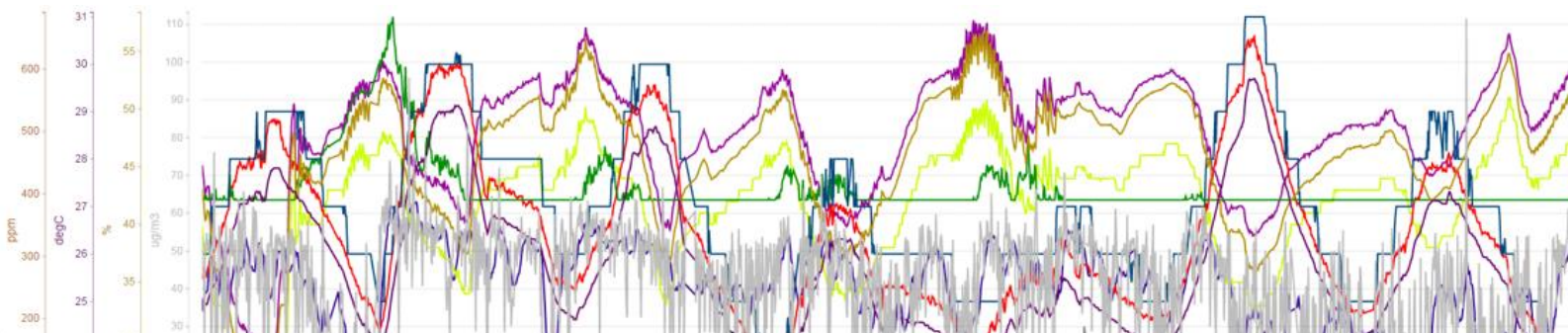
Open source integration platform

In-house configuration and maintenance



## Internet of Things Desk– Wellness data source explore

	Landlord provided	Tenant Procured
Air	Often no	Own sensor kit (PM, VOC, NO2)
Water	No	Drinking fountain data (future)
Nourishment		Food order and vending machine data (future)
Light	Smart ambient lighting controls	Own sensor kit for ambient lighting color and illuminance level  Task light control  Programmable blinds with glare and sunlight control
Fitness		Office wellness classes / Stairs usage data (future)
Comfort	Temp/RH on BMS or local display	Acoustic controllability Thermal controllability Own sensor kit for personal Temp/Mean Radiant Temp/RH/Acoustic monitoring Occupant feedback (future)
Mind		Personal schedule and location-based recommendation and navigation (future)





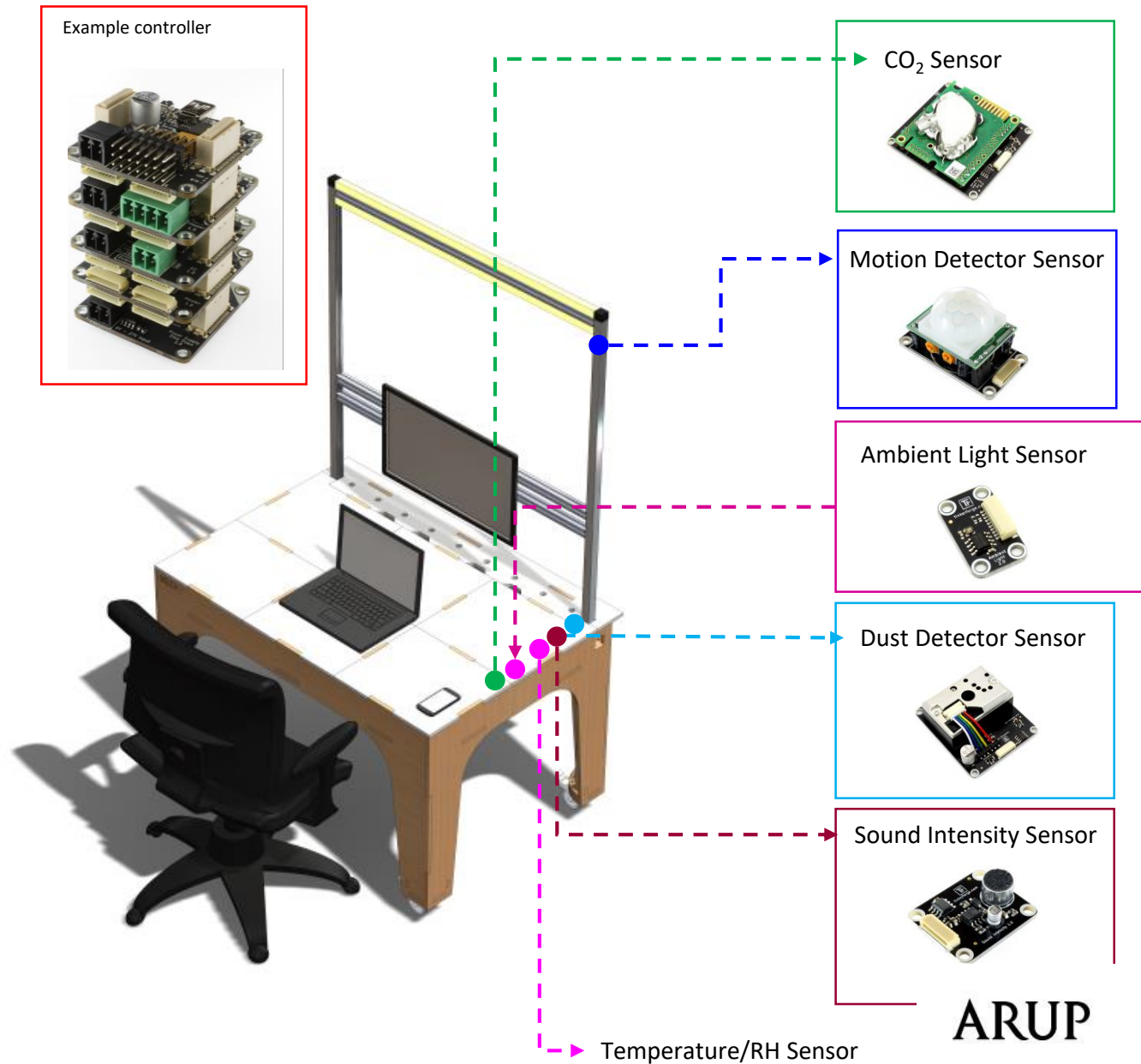
## Key IAQ monitoring parameters

For health:

1. **PM2.5 and PM10** – effectiveness of air filters
2. **Total Volatile Organic Compounds (TVOCs)** – in a new office to check 'off-gassing' or to check VOC content in cleaning products
3. **Nitrogen Dioxide** – to check if being drawn into building from street

For Comfort

4. **Dry Bulb Temperature** – for comparison with Building Management System
5. **Mean Radiant Temperature** – more closely models the temperature a human feels
6. **Relative Humidity**
7. **Carbon Dioxide** – to check if ventilation rates are sufficient





## Sensor technology watch-its

- **PM2.5 and PM10** – optical sensor technology provides required accuracy
- **Volatile Organic Compounds (VOCs)** – MOS sensors not recommended. PID sensors better but more expensive – tuned to particular VOCs
- **Nitrogen Dioxide** – electrochemical sensors expensive, require regular calibration and exhibit drift
- **Dry Bulb Temperature, Mean Radiant Temperature and Relative Humidity** – mature sensor technology
- **Carbon Dioxide** – NDIR technology provides required accuracy
- It must be noted that not all sensors perform equally. Calibration against a known entity is required to have confidence in results



<https://www.epa.gov/air-sensor-toolbox>

Tier	Application Area	Pollutants	Precision and Bias Error	Data Completeness
I	Education and Information	All	<50%	≥ 50%
II	Hotspot Identification and Characterization	All	<30%	≥ 75%
III	Supplemental Monitoring	Criteria pollutants, Air Toxics (incl. VOCs)	<20%	≥ 80%
IV	Personal Exposure	All	<30%	≥ 80%
V	Regulatory Monitoring	O3 CO, SO2 NO2 PM2.5, PM10	<7% <10% <15% <10%	≥ 75%

## Soundscape and immersive experience

### Personal choice of acoustic environments

- Sound level
- Sound content (music, nature sounds, white noise)

### Considerations

- Privacy
- Concentration
- Relaxation
- Social

### Technology

- Sound masking
- Soundscape
- Controlled reverberation

Arup Soundlab



Boston office WELL Certified Gold

POE survey before and after shows:

- WELL certification aids office communication and staff engagement through a retrofit
- Circadian lighting improved Satisfaction and Comfort of the lighting environment to over 70%
- Standing desk reduces sitting time for 30% of staff
- Noise distraction 30% down
- Client visits up 60%

**68%** of staff said that their **productivity is positively impacted** by the office's environmental conditions (comfort, lighting, air quality)



## Boston office WELL Certified Gold

- **Active design and space planning**
- **End-of-pipe water filtration** on tap water
- **Dynamic ventilation** with air quality filtration optimization
- **Material selection** that promotes good indoor-air quality through the use of products proven not to emit harmful contaminants, and that disclose health and environmental impacts.
- **Circadian lighting** systems that automatically adjust color and brightness based on the position of the sun to replicate daylight.



WELL/FitWell in-door air quality sensing kit – Aura





# SF Office WELL Silver/FitWel Certified

Healthier vending options

Art integration

Flexible charrette spaces

Non-emitting and low-emitting materials

Expanded pantry, kitchen, and dining spaces

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## Arup SF: WELL/FitWel Lessons Learned

**Materials:** selecting inherently non-emitting materials simplifies VOC precondition compliance.

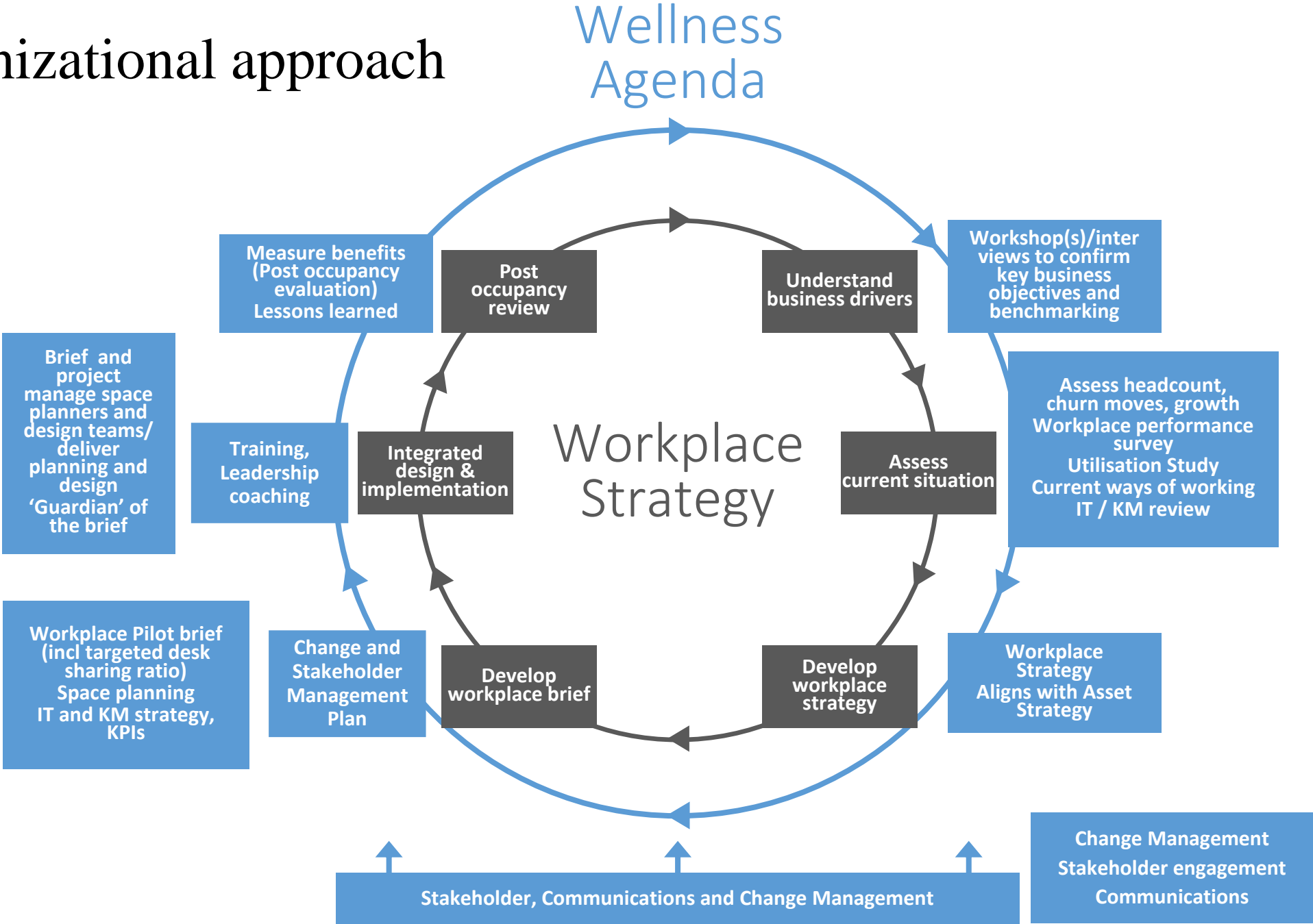
**Occupant surveys:** surveys are required for both FitWel and WELL.

- Commute survey [FitWel]
- Occupant satisfaction survey [WELL]
- Pre-fit out survey conducted; post-fit out survey to be conducted.

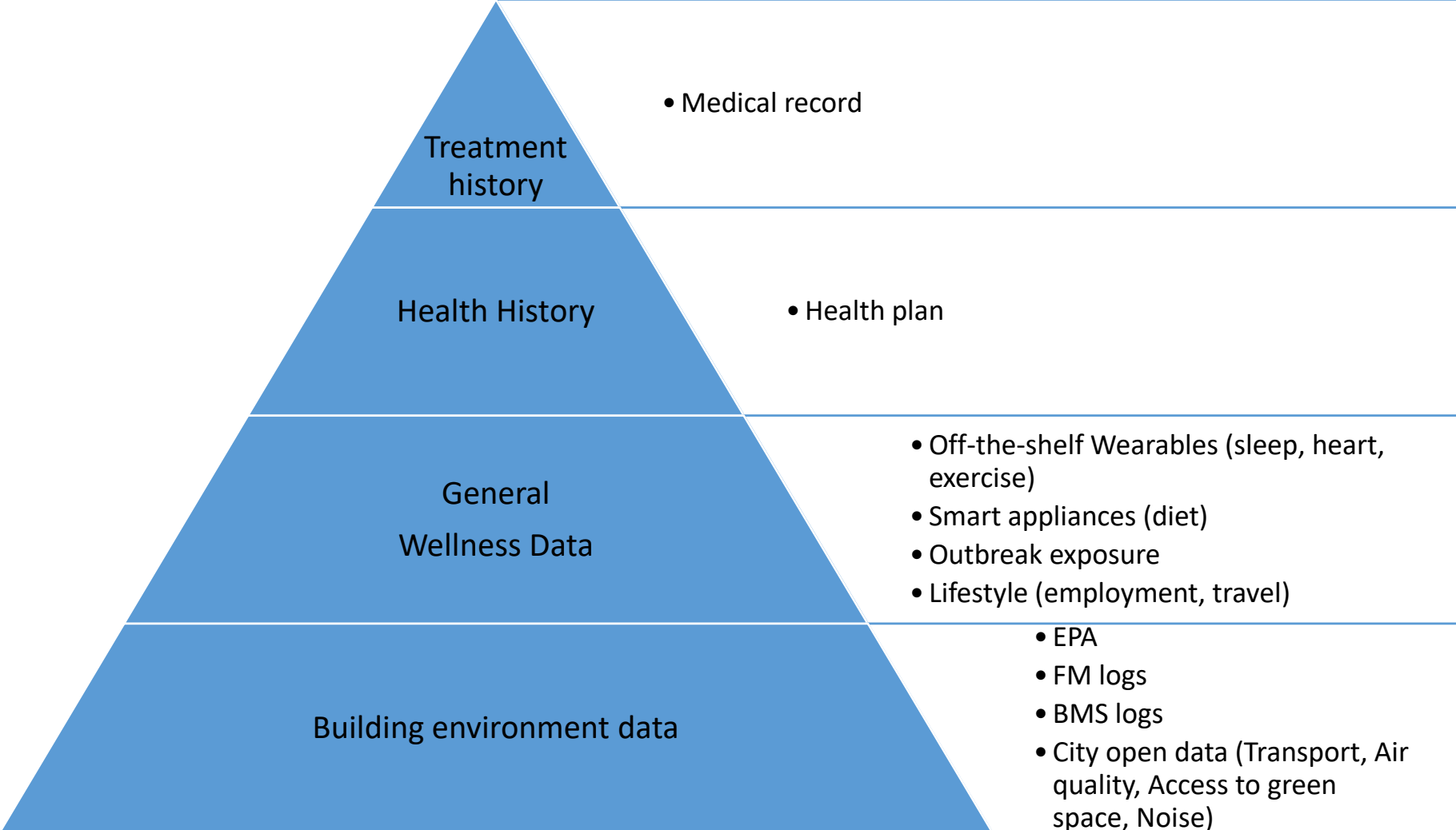
**Requirements as aspirations:** The requirements in both WELL and FitWel can be used to set reach goals to inform design, even if the required thresholds cannot be achieved.



# Organizational approach



# Health and wellbeing data landscape





# Current opportunities

