



Healthy Building Measurement and Verification Action Framework to Expedite Adoption of Building Wellness Rating Systems

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Background

Interest in promoting and achieving healthy building is growing as evidence shows that there is an intricate relationship between the built environment and the people. It affects people both mentally and physically. Furthermore, for organizations or companies it also means better organizational productivity and performance. To help the design, construction, and real estate industry, International WELL Building Institute and General Service Administration in partnership with the Centers for Disease Control and Prevention developed building health and wellness rating systems.

Objective

The study objective is to develop a Healthy Building M&V Action Framework to expedite and streamline the adoption of building wellness rating systems. A scaled-approach to a M&V process is proposed for all building owners to consider in progressing towards healthier buildings. The ultimate goal is to delegate and empower facility managers to become proactive strategic partners in creating value for workspace inhabitants by creating healthier workplace environment.

Methodology

Researchers conducted systematic reviews of state-of-the-art guidelines from existing building wellness rating systems with lessons-learned from case studies and exploratory ethnographic data.

Systematic Review

- The WELL Building Standard
- Fitwel Reference Guide for Workplace

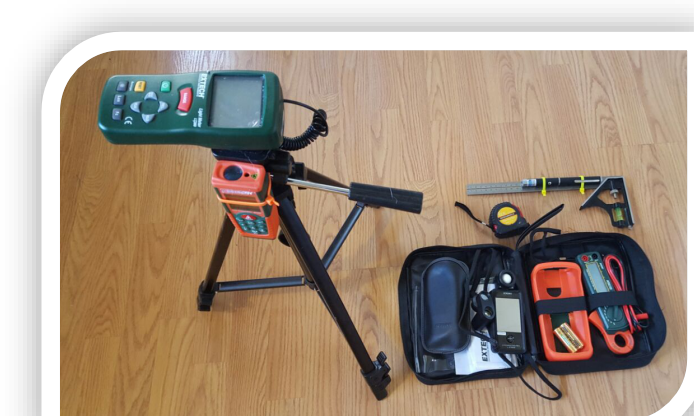
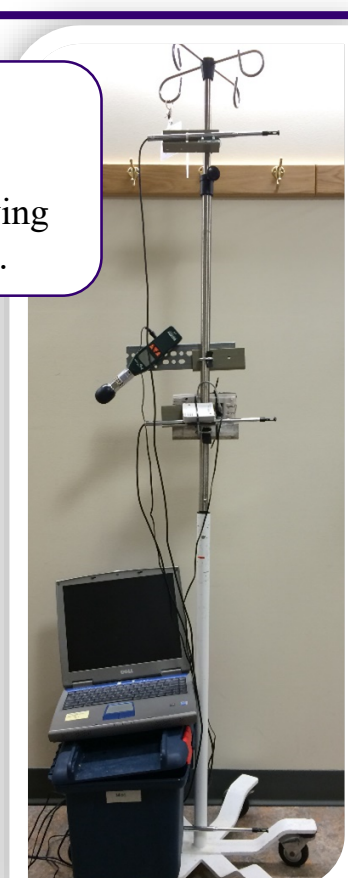
Case Study - Field Experiment

- Overall indoor environmental quality
- Technology-driven human-centric lighting systems and commissioning
- Indoor air quality focused on both large and small pollutants
- Advanced acoustics with sound masking and commissioning
- Human perception and cognitive functioning

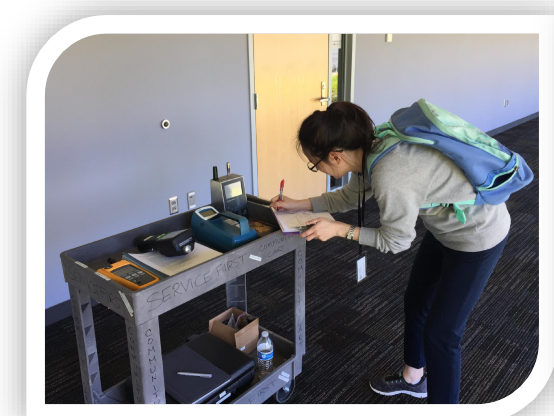
Focus Group Interviews – Stakeholder Feedback

- Occupant’s perception about indoor environment
- Occupant’s perception about healthy building elements and approaches
- Facility management’s perspective on healthy building elements and approaches

IEQ
Fabrication of instrumentation following ASHRAE guideline.



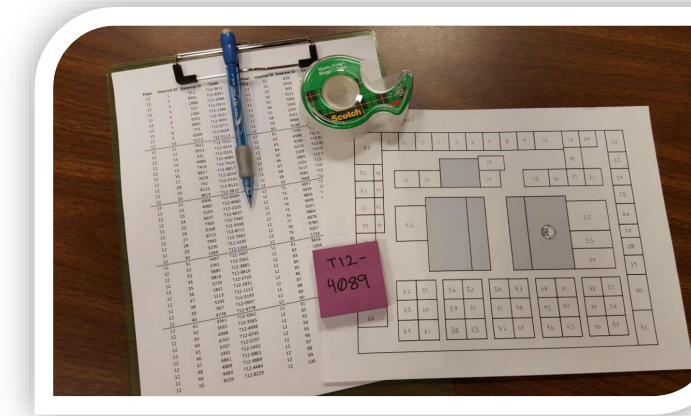
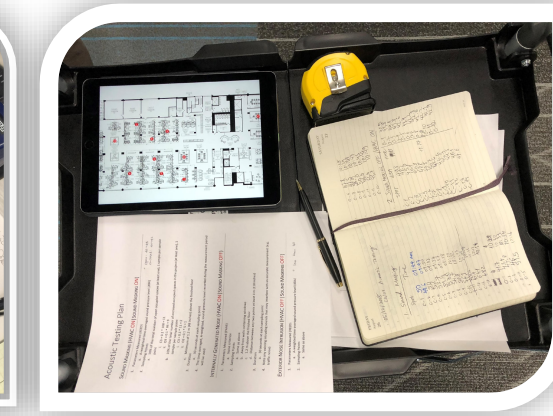
LIGHTING
Lighting measurements following IESNA and ASHRAE guidelines, and iterative lighting commissioning process and operator training.



AIR QUALITY
Measurement of pollutants (PM 0.1-10) and VOCs following EPA, RESET, and WELL guidelines.



ACOUSTICS
Measurement of indoor acoustics following ISO standard. Photo shows measuring sound pressure level and reverberation time using impulse response.



OCCUPANTS
Measuring occupant perception and satisfaction through surveys anchored in environmental psychology and cognitive tests using computerized cognitive assessment tools.



Parameter	Capital Cost	Equipment Maintenance	Data Access	Reference Guideline	Measurement Challenge
Formaldehyde	1	1	3	1	1.5
Total VOCs	3	3	2	1	2.25
Component VOCs	3	2	2	2	2.25
CO	1	2	2	1	1.5
CO2	1	1	1	1	1
PM2.5	3	2	1	1	1.75
PM10	3	2	1	1	1.75
Ultrafine Particulates	3	2	2	3	2.5
Other PM	3	2	2	3	2.5
Nitrogen dioxide	2	2	2	1	1.75
Ozone	1	2	2	1	1.5
Radon	2	2	1	1	1.5
Visual Lighting (Illuminance)	1	1	2	1	1.25
Circadian Lighting (EML)	2	2	3	1	2
Dry-bulb Temperature	1	1	1	1	1
Mean Radiant Temperature	1	2	2	1	1.5
Relative Humidity	1	1	1	1	1
Air Velocity	1	2	2	1	1.5
Exterior Sound Pressure Level	2	1	3	1	1.75
Mechanical Equipment Sound Level	2	1	3	1	1.75
Sound Masking Limits	2	1	3	1	1.75
Sound Reverberation Time	2	1	3	1	1.75
Speech Privacy Potential and Noise Isolation Class	2	1	3	2	2

Capital Cost (\$)	
1	0-500
2	500-2500
3	2500-10000

Equipment Maintenance	
1	Annual field calibration or not required
2	Annual factory calibration
3	Monthly field calibration

Data Access	
1	Remote access
2	Local data logging
3	Manual

Reference Guideline	
1	Well defined
2	In development
3	Unclear

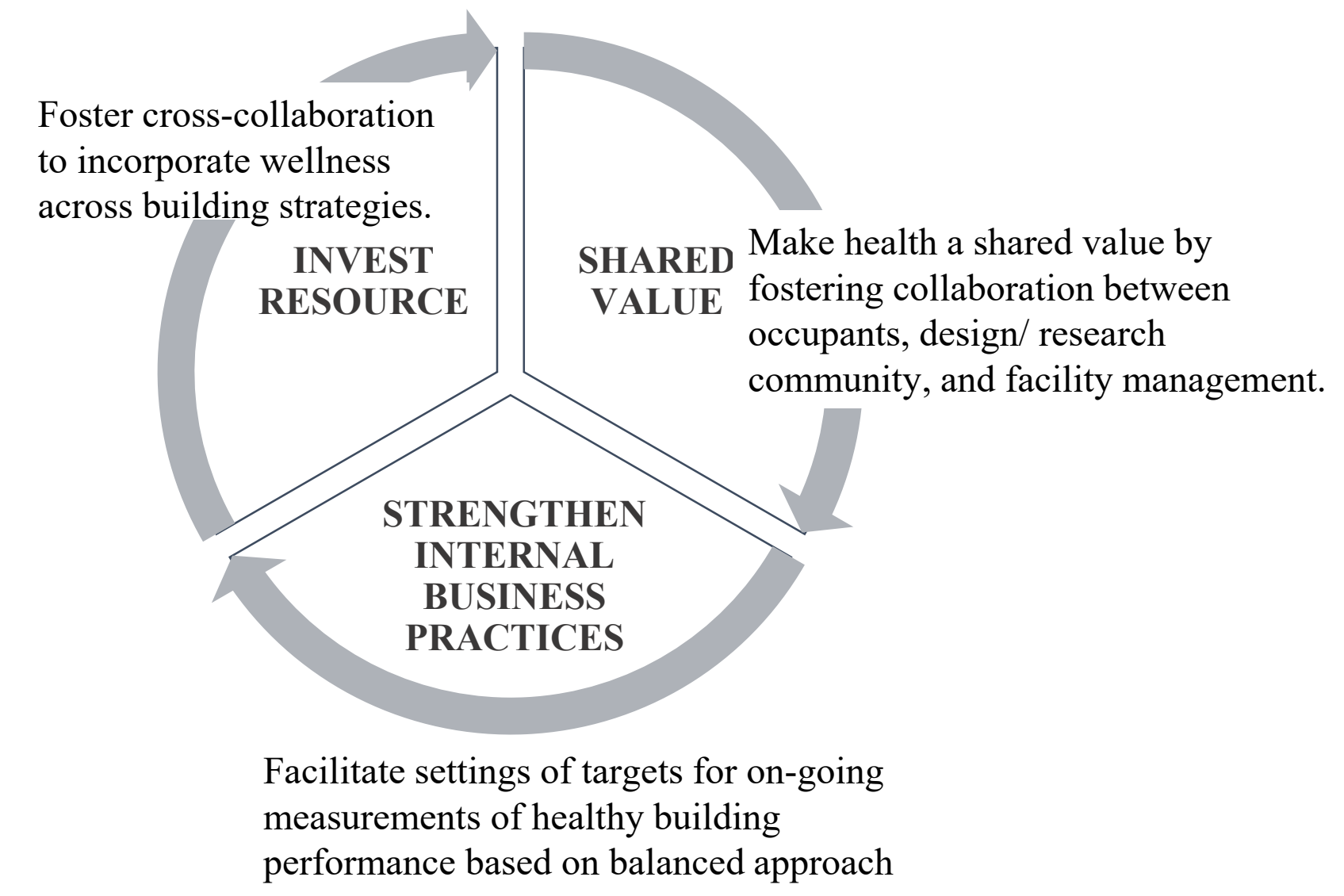
For each health related parameter, the measurement challenge is calculated as the average score of equipment cost, ease of equipment maintenance, ease of data access, and the existing reference guideline.

For water quality parameters, the measurement challenge is estimated based on interviews with experts in the field.

Parameter	Measurement Challenge
Sediment	1
Microorganisms	2
Dissolved metals	2
Organic pollutants	2
Herbicides and pesticides	3
Fertilizers	1
Disinfectants	1
Disinfectant byproducts	2
Fluoride	1
Drinking water taste properties	3

Results

Healthy Building M&V Action Framework



Parameters	Existing Guideline		Scaled Approach		
	Fitwel	WELL	Basic 1	Intermediate 2	Detailed 3
Formaldehyde		✓	● 1	● 2	● 3
Total VOCs		✓			● 3
Component VOCs		✓		● 2	● 3
CO		✓		● 2	● 2
CO2		● 1	● 1	● 1	● 1
PM2.5		✓		● 2	● 2
PM10		✓		● 2	● 2
Ultrafine Particulates					● 3
Other PM					● 3
Nitrogen dioxide		✓		● 2	● 2
Ozone		✓		● 2	● 2
Radon		✓		● 2	● 2
Sediment		✓	● 1	● 1	● 1
Microorganisms		✓		● 2	● 2
Dissolved metals		✓		● 2	● 2
Organic pollutants		✓		● 2	● 2
Herbicides and pesticides		✓			● 3
Fertilizers		✓	● 1	● 1	● 1
Disinfectants		✓	● 1	● 1	● 1
Disinfectant byproducts		✓		● 2	● 2
Fluoride		✓	● 1	● 1	● 1
Drinking water taste properties		✓			● 3
Visual Lighting (Illuminance)		✓		● 2	● 2
Circadian Lighting (EML)		✓			● 3
Dry-bulb Temperature		✓	● 1	● 1	● 1
Mean Radiant Temperature		✓		● 2	● 2
Relative Humidity		✓	● 1	● 1	● 1
Air Velocity				● 2	● 2
Exterior Sound Pressure Level		✓		● 2	● 2
Mechanical Equipment Sound Level		✓		● 2	● 2
Sound Masking Limits		✓		● 2	● 2
Sound Reverberation Time		✓		● 2	● 2
Speech Privacy Potential and Noise Isolation Class		✓			● 3

Scaled approach based on resource intensity. Resources include human expertise, time, and equipment requirements.

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