Occupant voting systems for continuous feedback

Presenter

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Agenda

01 Why is occupants' feedback important?

02 How do we collect their feedback?

03 Why use occupant voting systems?

04 Considerations for using occupant voting system

05 Example of application of OVS – case study

06 Recap

Assessing building performance in use 4: the Probe occupant surveys and their implications

Intelligent Buildings International

RESEARCH ARTICLE

The value of post-occupancy evaluation for building occupants and facility managers

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User satisfaction studies and measured performance studies re
between the design intent and the performance of buildings an
shifts. Whether this gap is due to failures in the design, construct
however, is often unclear – mandating that user satisfaction studi
and measured performance studies to fully understand the perform
over time. The article introduces the General Services Administr
Assessment Toolkit (NEAT) field study tools and database and
goals of high-performance buildings that meet ongoing occupanc
The NEAT studies undertaken by the Carnegie Mellon University's
the GSA have been used to illustrate the value of instrumented po
occupants as sensors and controllers; identify technologies and
impacts health and productivity; ensure investment where it m
behaviour on environmental gains; and to catalyse innovation.

Keywords: building performance; field evaluation and measure
indoor environmental quality; post-occupancy evaluation; produ
air quality evaluation

PRECEDENTS IN POST-OCCUPANCY EVALUATION WITH FIELD MEASUREMENTS

The addition of physical and environmental measurements to post-occupancy evaluation (POE) has a long-standing tradition, introduced in

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Intelligent Buildings International 1 (2009), 000–000 doi:10.3763/inbi.2009.002
© 2009 Earthscan ISSN: 1750-8975 (print), 1756-6932 (online) www.earthscan

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Building and Environment 68 (2013) 66–76

Contents lists available at SciVerse ScienceDirect

Building and Environment

journal homepage: www.elsevier.com/locate/buildenv

ELSEVIER

Occupant satisfaction in LEED and non-LEED certified buildings

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ARTICLE INFO

Article history:
Received 29 March 2013
Received in revised form
26 May 2013
Accepted 6 June 2013

Keywords:
Leadership in energy and environmental design (LEED)
Occupant satisfaction
Survey
Post-occupancy evaluation
Indoor environmental quality
Rating tools

ABSTRACT

Occupant satisfaction with indoor environmental quality (IEQ) in office buildings has been positively correlated to self-estimated job performance and, potentially, to overall company productivity. LEED is a voluntary, consensus-based, market-driven program that provides third-party certification of green buildings, contributing to promote sustainability in the mainstream of building design and construction. From the literature, however, it is unclear the extent to which LEED certification also improves occupant satisfaction with IEQ. The aim of this paper is to study if LEED certified buildings lead to a higher, equal or lower satisfaction with indoor environmental quality than non-LEED rated buildings. Occupant satisfaction has been evaluated on a subset of the Center for the Built Environment Occupant Indoor Environmental Quality Survey database featuring 144 buildings (65 LEED certified) and 21,477 individual occupant responses (10,129 in LEED buildings). Differently from previous studies of the CBE database, the results show that occupants of LEED certified buildings have equal satisfaction with the building overall and with the workspace than occupants of non-LEED rated buildings. The difference in mean satisfaction scores between LEED and non-LEED buildings for other 15 IEQ parameters investigated is always lower than 6% with a negligible effect size. Therefore, it can be concluded that there is not a significant influence of LEED certification on occupant satisfaction with indoor environmental quality, although the analysis of mean votes of satisfaction reveals that occupants of LEED buildings tend to be slightly more satisfied with air quality, and slightly more dissatisfied with amount of light.

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1. Introduction

The satisfaction of occupants in office buildings is affected by thermal, acoustic and visual parameters, by air quality, and by other features of the workspace – and of the building – such as view, furniture layout, amount of privacy, cleanliness and level of personal control over the internal environment [1]. The satisfaction of occupants has been correlated to the self-estimated job performance of office workers [2], this having an effect on frequency and duration of absenteeism and intention to quit work and, potentially, to overall company productivity [3]. Therefore, occupant satisfaction is an important factor in the design, operation and management of buildings.

LEED (*Leadership in Energy and Environmental Design*) is a voluntary, consensus-based, market-driven program that provides third-party certification of green buildings [4]. LEED is the most popular building rating tool in the United States, and its market share is continuing to grow, both in the US and internationally [5]. Irrespective of the LEED product used for the certification, there is a general perception amongst the actors of the building industry that LEED – as well as other rating tools such as BREEAM in UK, Green Mark in Singapore, Green Star in Australia, etc. – has effectively contributed to bring sustainability into the mainstream of building design and construction [6,7]. However, less clear from the literature is the extent to which the use of a rating tool can actually improve indoor environmental quality and workplace satisfaction for the occupants of the certified buildings. In this context, it should be mentioned that the evidence of the energy savings effectively facilitated by rating tools has also been analyzed by studies that have looked at actual energy use of LEED certified buildings versus a comparable dataset of existing commercial buildings in the US [8,9]. The outcomes concluded that it is complex to provide a comprehensive calculation of the effective reduction in primary (source) energy use in commercial buildings certified by LEED compared to not-rated office spaces.

In the following paragraphs, this paper will introduce the LEED program, the Center for the Built Environment (CBE) Occupant Indoor Environmental Quality Survey, and will analyze the results of previous studies focusing on the relationship between indoor environmental quality, LEED/green rating and occupant satisfaction.

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http://dx.doi.org/10.1016/j.buildenv.2013.06.008

Contents lists available at ScienceDirect

Energy & Buildings

journal homepage: www.elsevier.com/locate/enbuild

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A review of operating performance in green buildings: Energy use, indoor environmental quality and occupant satisfaction

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Building and Environment

journal homepage: www.elsevier.com/locate/buildenv

ELSEVIER

Building energy certification versus user satisfaction with the indoor environment: Findings from a multi-site post-occupancy evaluation (POE) in Switzerland

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ARTICLE INFO

Keywords:
Green buildings
Comfort
Indoor environmental quality (IEQ)
Energy certification
Minergie
Post-occupancy evaluation (POE)

ABSTRACT

Voluntary green-rating systems exist in different forms worldwide to certify the sustainability of residential and commercial buildings and help national policies promote energy-efficient design practices. Despite the general assumption that sustainable buildings also provide high comfort and healthy conditions, existing studies on green-rated buildings led to controversial conclusions in this regard.

This paper aims to report the results of a post-occupancy evaluation (POE) conducted on four Swiss green buildings certified with the Minergie label to analyse their ability in providing comfort to their occupants. The POE protocol included winter and summer environmental monitoring campaigns (long-term and instantaneous measurements) as well as extensive and point-in-time comfort surveys.

From the study it was found that, although the observed environmental factors were most of the time complying with the norm prescriptions, the indoor conditions were never attaining the commonly used 80% satisfaction threshold by the users. Temperature and air quality appeared, in particular, as the most critical factors, with satisfaction rates never greater than 50% in three out of the four case studies.

Design factors related to the personal control on the indoor environment as well as personal factors like gender, climate of origin and duration of residence in the country were also found to have an impact in the comfort rating.

Professionals involved in the design and management of these buildings all agreed that feedback of this kind from building in use could help inform the design and operational process and move towards more effective green building certification systems and regulations.

1. Introduction

Energy performance certification is a strategic policy instrument that assists governments in decreasing the energy footprint of the built environment. Certification schemes can be applied on a mandatory or voluntary base. Voluntary energy labels have spread in different forms worldwide to certify the sustainability of both residential and commercial buildings. For these latter, besides the obvious positive environmental consequences, the main benefits for the companies are the actual cost saving in energy over time and a publicly recognized environment-friendly profile that can largely help in the brand promotion.

Incentives to seek for energy certification also derive from the fact that green buildings are often argued to provide a better indoor environmental quality (IEQ) which should result in a more satisfying and productive workplace for the building occupants. Despite this general assumption, several post-occupancy evaluation (POE) studies conducted globally for more than a decade revealed the absence of a global unambiguous evidence [1]: while some studies comparing occupant comfort satisfaction in green-rated offices against general building stock showed that green buildings definitely provide more satisfying conditions [2–6], other researchers found that certified buildings are not necessarily perceived as more comfortable and productive workplaces [7–9]. For example, some POEs demonstrated that, although IEQ ratings scores for green buildings tended to be globally better than in standard buildings, chronic environmental problems and most of the irritations often reported in conventional offices were still endemic even in sustainable buildings, especially with respect to personal environmental control [10], hot temperature and stuffiness of the air in summer [11], lighting and acoustics [12] or overall workstation designs [13]. In an Australian study, Menadue et al. [14] detected that

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https://doi.org/10.1016/j.buildenv.2019.01.001

...formance of green buildings in ...sfaction. A total of 925 related ...e study also compared the ac- ...nes, with information collected ...ed as follows: 1) Though with ...e average better than the con- ...gap between the designed and ...ved less energy than expected; ...ilding certification level could ...mparable in different countries ...buildings generally had higher ...bjective data from the U.S. did ...orthy further investigations in ...lata collection technologies and

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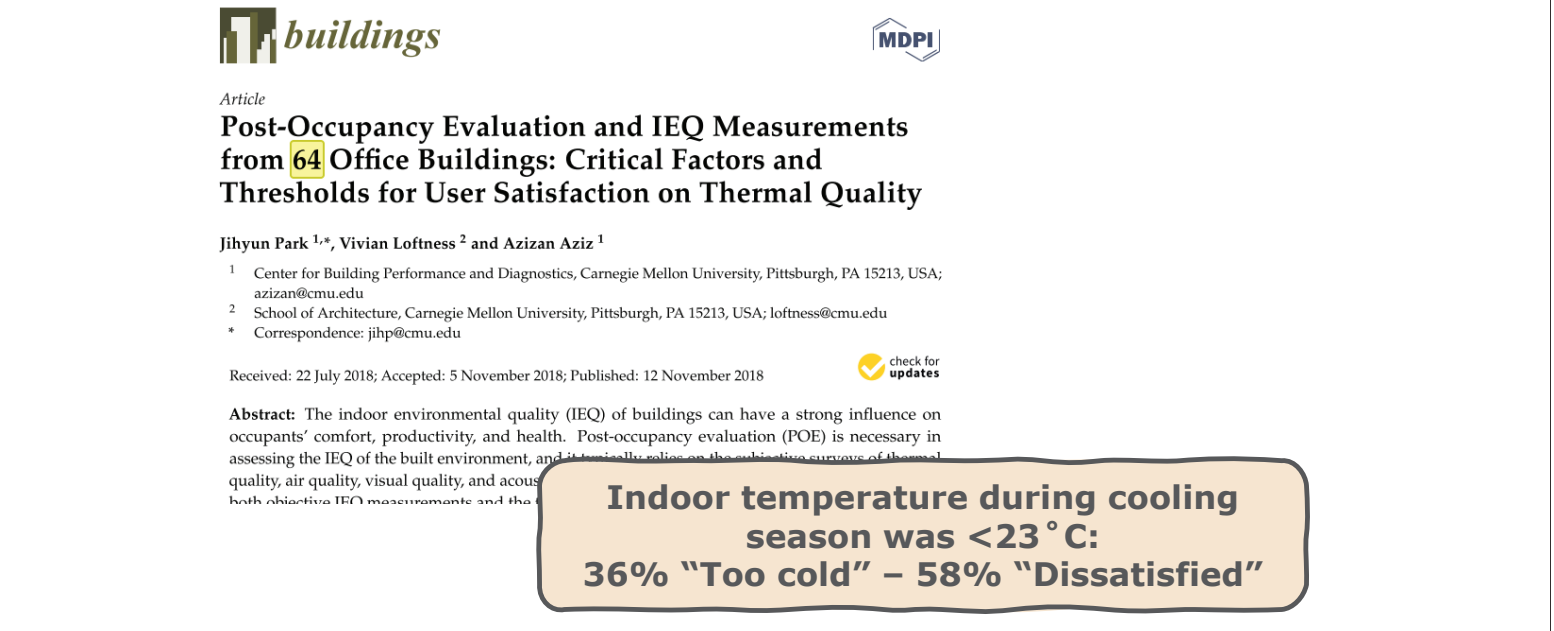
...]. Meanwhile, a number of ...loped to facilitate the green ...es [6,7], such as Leadership ...LEED) in the United States, ...Bauen (DGNB) in Germany, ...d (BREEAM) in the United ...ustralia Green Star in Aus- ...re, Comprehensive Assess- ...fficiency (CASBEE) in Japan ...China. ...een building, an increasing ...ucted on various aspects of ...nethods/tools, technical as- ...pects and economic aspects ...udies were design-oriented, ...nly focused on what tech- ...pt at the design stage and ...during the operation. The ...eline for the design of green ...he expected performance of ...le, Zuo et al. [8] pointed out



buildings

MDPI

Article

Post-Occupancy Evaluation and IEQ Measurements from 64 Office Buildings: Critical Factors and Thresholds for User Satisfaction on Thermal Quality

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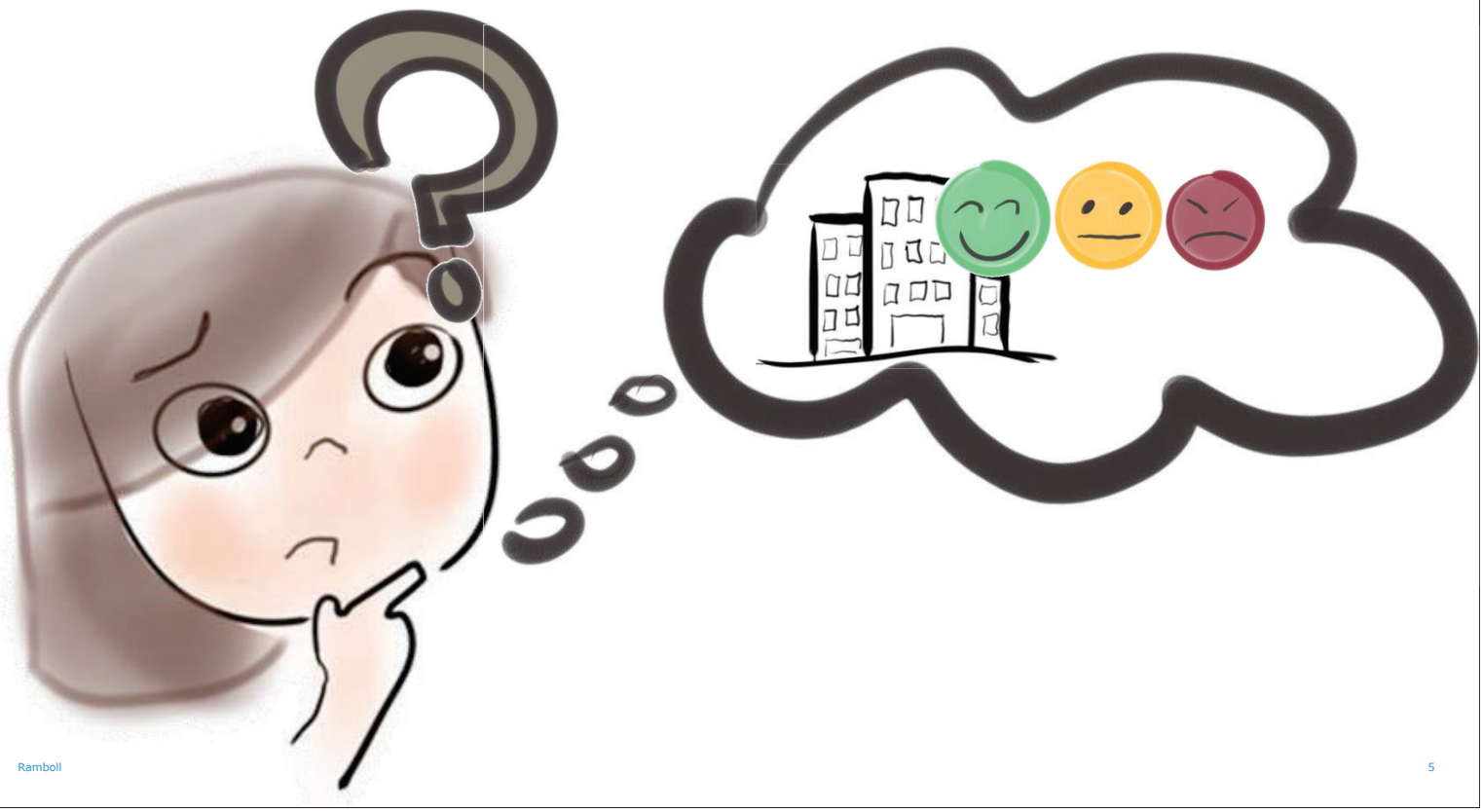
Received: 22 July 2018; Accepted: 5 November 2018; Published: 12 November 2018

check for updates

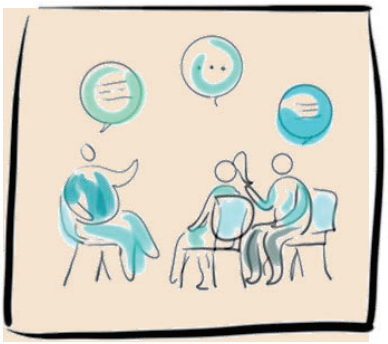
Abstract: The indoor environmental quality (IEQ) of buildings can have a strong influence on occupants' comfort, productivity, and health. Post-occupancy evaluation (POE) is necessary in assessing the IEQ of the built environment, and it typically relies on the subjective surveys of thermal quality, air quality, visual quality, and acous... both objective IEQ measurements and the ...

Indoor temperature during cooling season was <23°C:
36% "Too cold" – 58% "Dissatisfied"



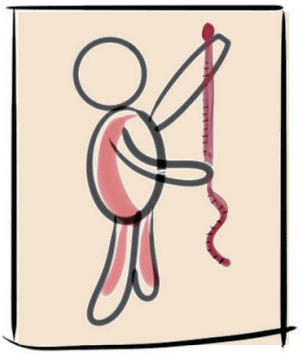
Systematic data collection

Social-idealist



- Observations
- Interview
- Focus group
- Logbook/ photovoice

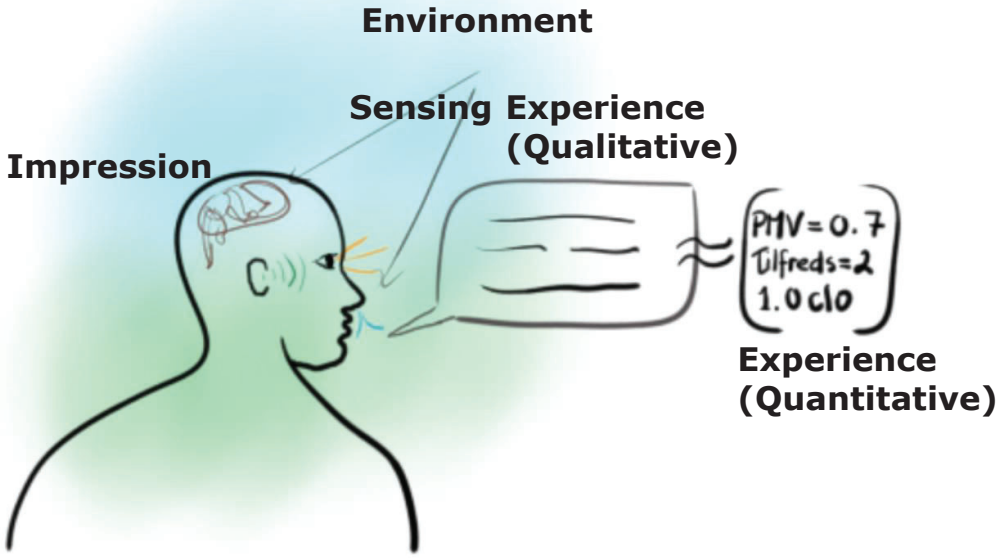
Technical-idealist



- Questionnaire
- Voting
- Sensor
- Interaction

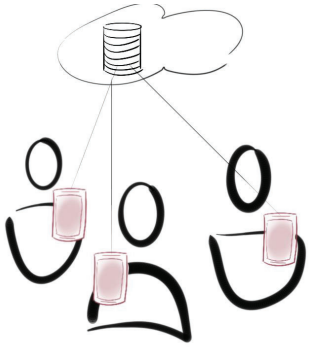
The terms social- and technical-idealist is based on M. Earl, Jour. of Management IS, 18, 1 (2001)

Human as a sensor



CMMS (Helpdesk)

Questionnaire



Occupant Voting System (OVS)

Tablet or panel of feedback buttons

Wearable

Smartphone

Interface & User friendliness

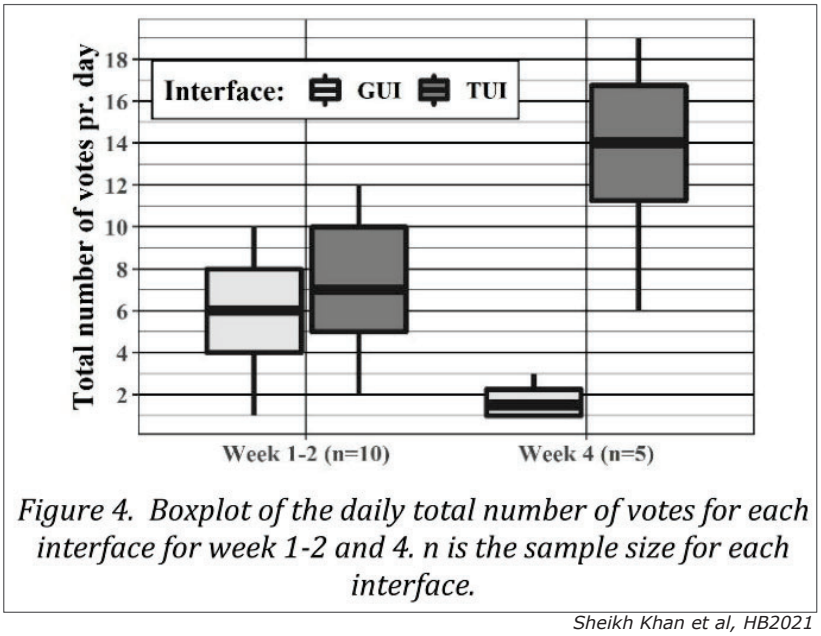
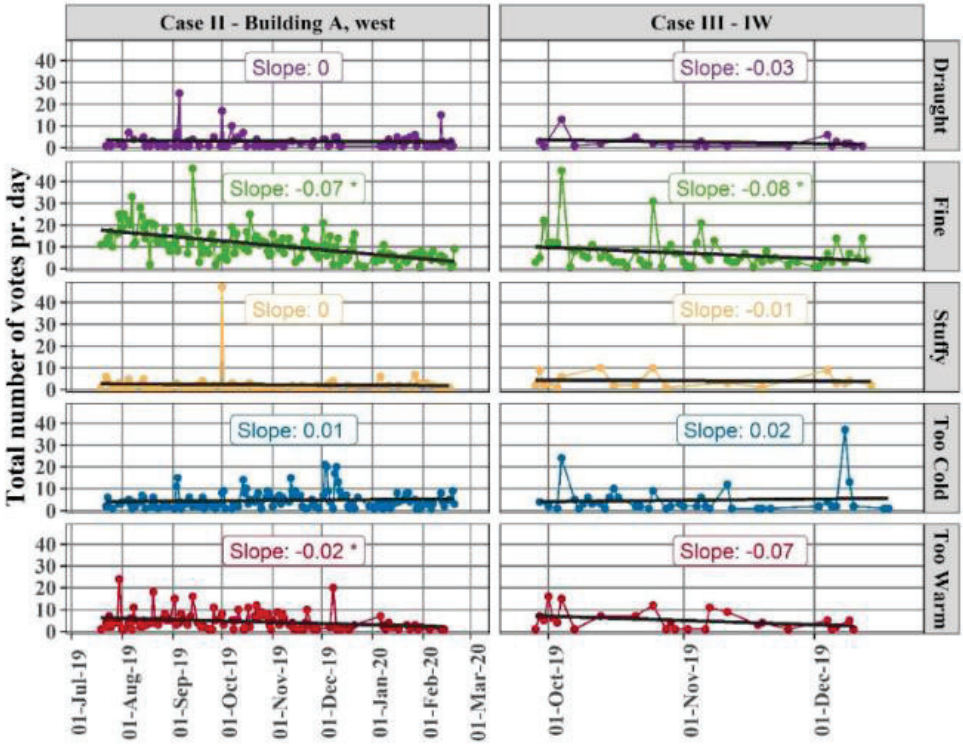


Figure 4. Boxplot of the daily total number of votes for each interface for week 1-2 and 4. n is the sample size for each interface.

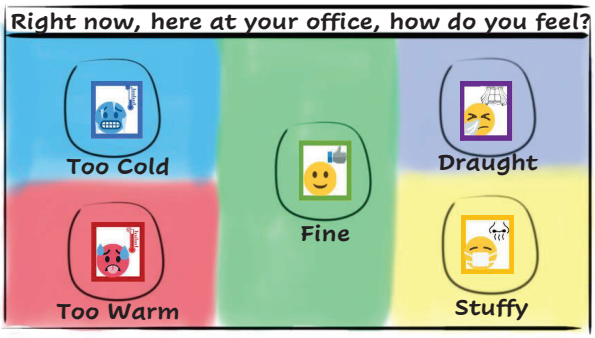
Sheikh Khan et al, HB2021

”Novelty” effect

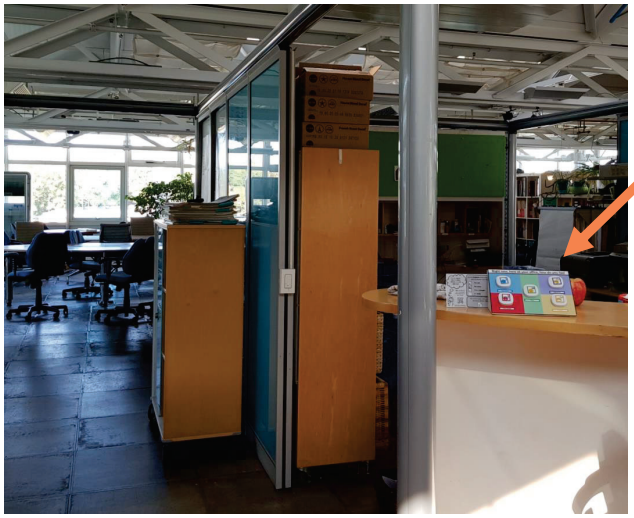


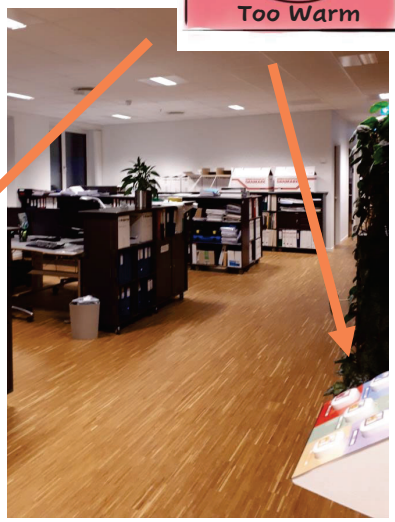
Sheikh Khan et al, Frontiers in Built Environ., March, 2021

Non-intrusive



TiAQ, Sheikh Khan





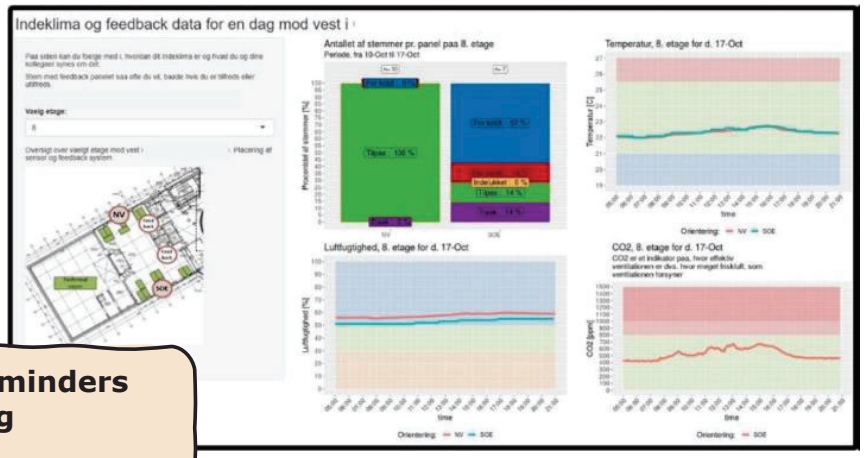
Mini-Orb, Rittenbruch et al

Feedback on Feedback

Expected that TiAQ would be used to control the indoor climate

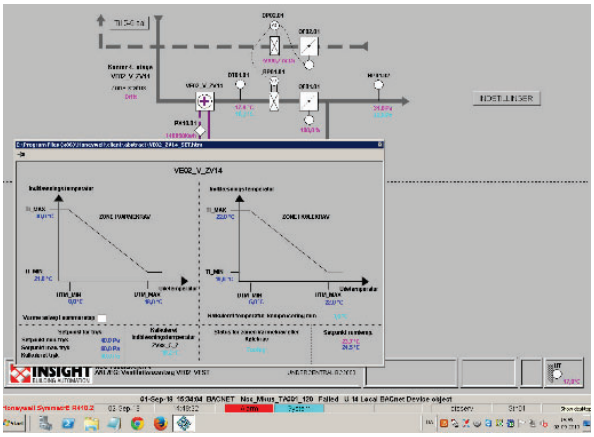
Expected reminders for providing feedback

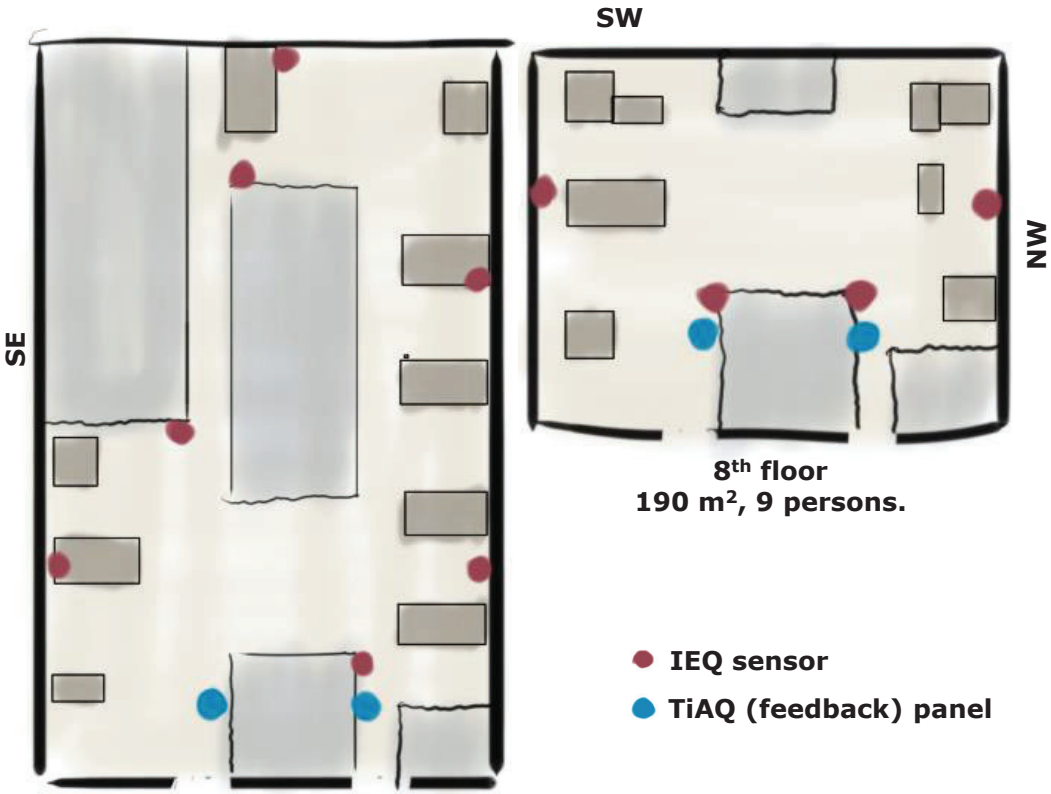
Expected feedback to be used by the building operator

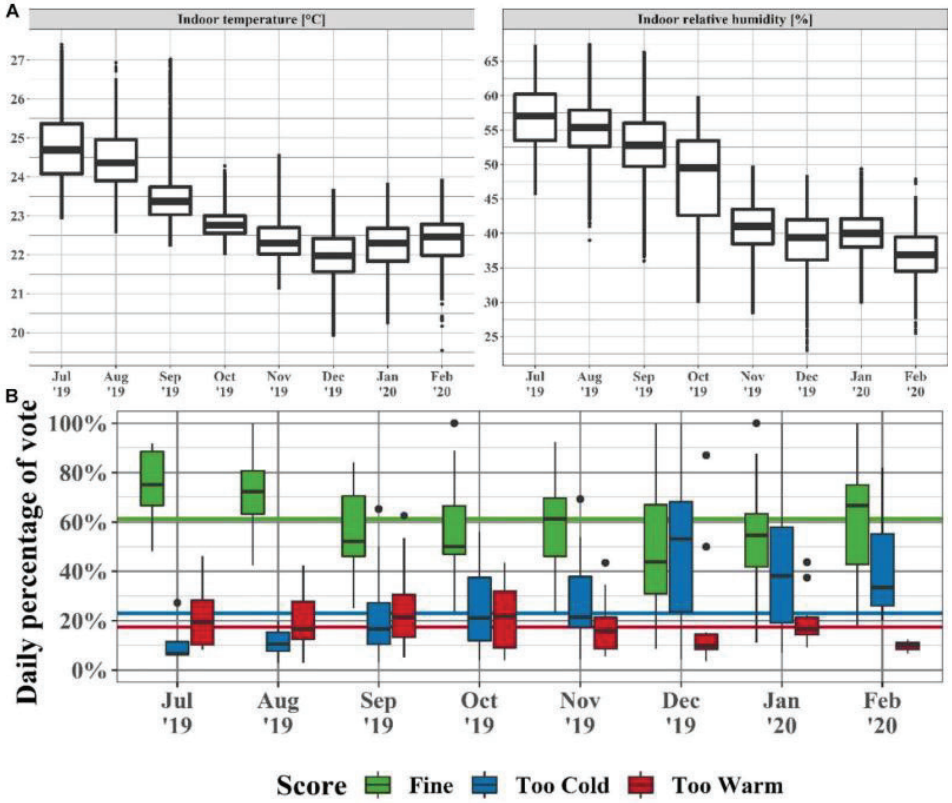


Dashboard for users showing indoor climate and feedback, Sheikh Khan

- **Occupant feedback**
- **TVOC, CO_2, RH, Ti**
- **Airflow, Tinlet.**
- **Energy consumption**
- **Tout, sunshine-hours**







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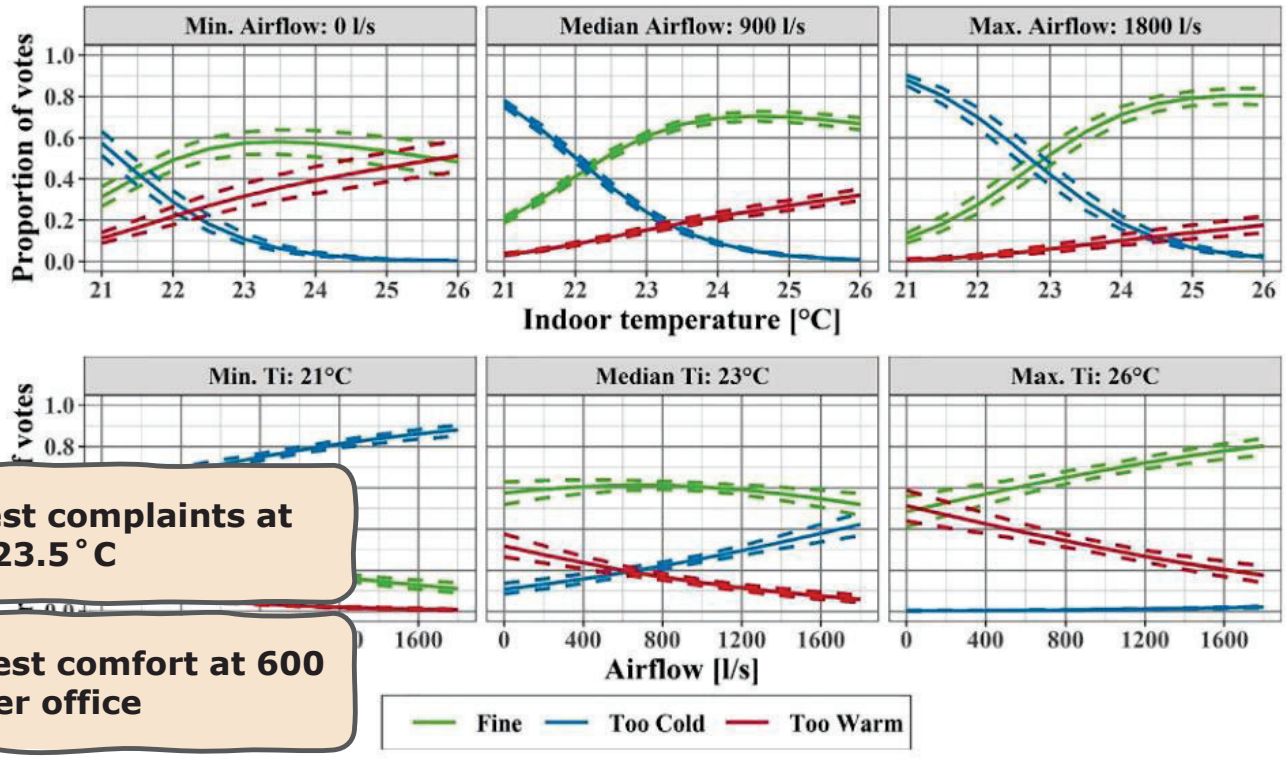


Lowest complaints at Ti = 23.5˚C

Highest comfort at 600 l/s per office

Sheikh Khan et al, Energy & Buildings 251 111363, 2021

Lowest complaints at Ti = 23.5˚C

Highest comfort at 600 l/s per office

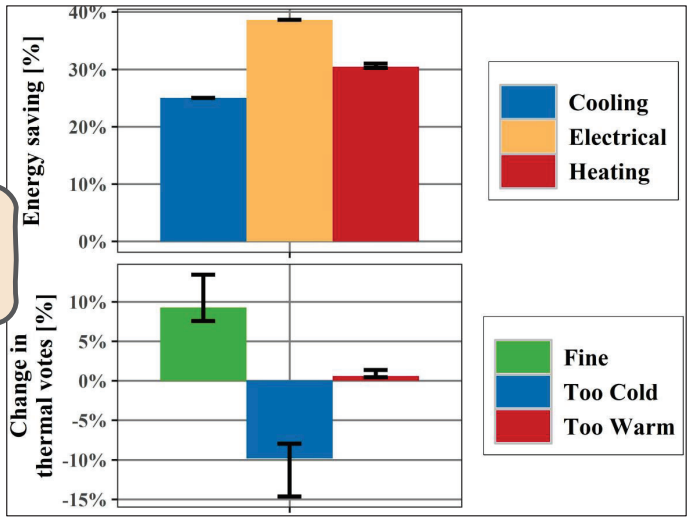
Suggested control:

Current airflow reduced by 25%

&

Temperature set point changed from 24˚C to 23.5˚C

~40% energy reduction & ~10% increased comfort



Recap

1. Occupant feedback is important information to include in optimizing HVAC operation
2. Solicited and unsolicited here-and-now feedback can be collected with OVS
3. OVS design and implementation is important for getting quality feedback data
4. Feedback data used by building operator, can identify control settings for improving energy consumption and occupant comfort

Thanks

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