



Expanding Boundaries: Systems Thinking for the Built Environment

TOWARDS SUSTAINABLE OCCUPANT BEHAVIOUR AND ORGANIZATIONAL CHANGE

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Abstract

Moving office organizations and staff culture towards sustainable practices requires a multifaceted and integral approach. In this paper a model with four focal areas for influencing practices is presented. The focal areas are: (i) bottom-up interventions aimed at promoting the adoption of sustainable practices through co-design, (ii) exploring new opportunities for awareness generation, by providing user centric tools and reflective interfaces, (iii) up-scaling, with a focus on how to transform group level changes in practices across the organization, (iv) top-down, which implies creating policy and recognition to promote sustainable practices. The four focal areas have been derived from a series of ongoing pilot studies in the field using co-design methods.

Keywords:

Sustainability; office; prototyping; co-design; practices; behaviour; energy; comfort

1 INTRODUCTION

The aim of this paper is to describe a method of practice change in the office workplace, with the goal of reducing energy consumption while enhancing occupant comfort. Whereas facility managers may have the technical means to reduce energy use, occupant practices and social, organizational and technical constraints may limit the ability and motivation to change. Energy feedback and comfort insights for occupants and facility managers are often lacking. The facility manager is often situated remotely and not involved in monitoring comfort and energy consumption for given spaces in the building. Furthermore, buildings, management, and raising expectations lead many occupants dissatisfied with the indoor environment [1],

Influencing office practices in terms of sustainability is a complex problem and thus requires an integral approach. The approach taken is based on co-design [4] and in-field methods. In moving organizations and staff culture towards sustainability, there are a number of potential obstacles to change and many players in the loop. For example:

- Office occupant energy consumption awareness: office staff is typically

unaware of actual energy cost, and may assume that it's not their problem. Little or no information on the quality of the office environment is readily available to office occupants, and occupants may lack the knowledge, skills and motivation to reduce energy use and improve their work environments.

- Building management systems: from a technology perspective often do not achieve the desired result in terms of providing occupant comfort. In a study by Moezzi et al. [1], approximately 61% of office workers were found to be unsatisfied with the indoor climate.
- Facility management: typically building facility operators or managers in larger buildings are "hidden away" and have limited interaction and communication channels with office staff [1].
- Policy: the focus on building certification schemes for sustainability, such as LEEDS and BREEAM, are based on building technology, rather than monitoring and assessing occupant behaviour.

- Corporate management: may think of sustainability as a matter of reporting on 'the way we do business,' while lacking a clear understanding of how to embed sustainability in day-to-day practices [1].

2 A MULTIFACETED APPROACH

The presented approach is based on three ongoing pilot tests in a range of organisations. The first pilot location is a large institute consisting of nine buildings on a campus with staff from across Europe, the second place is a flexible work environment with highly mobile consulting staff situated in a high-rise building, and the third site comprises a formal and hierarchically structured building management firm with clear staff roles.

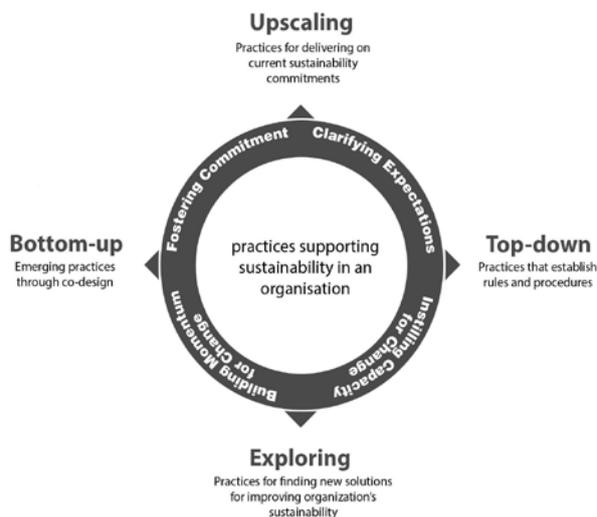


Fig. 1: Model of four focal areas for fostering sustainability in organizations.

When considering different angles in influencing sustainable practices in the organizations studied, four focal areas were identified. The four areas for targeting sustainable change are shown in Figure 1, being Up-scaling, Bottom-up, Exploring, and Top-down. Each of the areas and the corresponding strategies for changing practices are described below. The organizational model was inspired by the framework of the Network for Business Sustainability [2].

3 PILOT APPROACH

The ongoing pilots follow an intervention approach based on an iterative cycle involving context research, solution identification and solution implementation and user testing. This approach was developed during the SusLab project (www.suslab.eu). As detailed below, a modular prototyping platform [5] supports co-design with users, with self-reporting tools, indoor climate sensors, and customizable feedback interfaces. (Figure 2).

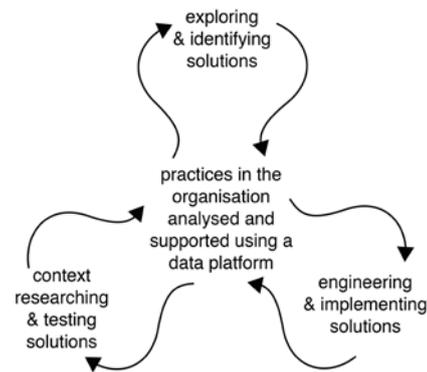


Fig. 2: The pilot intervention approach.

4 MULTIFACETED MODEL FOR FOCUSING PRACTICES

In the following sections each of the identified focal areas for targeting organizational change and sustainable practices are briefly described along with field observations based on the current pilots.

5 EXPLORING WITH OCCUPANTS

Practices focused on "Exploring with office occupants" involve:

- Stimulation of the process of awareness generation, as a prerequisite to organizational change
- Identification and involvement of lead users as change agents in the organization
- Context research to gain deeper insights into the relevant practices, while enabling occupants to reflect on their practices.

For example, ventilating a room is an activity that most occupants were found to engage in, but the way in which rooms are ventilated varies across pilot locations. Certain differences were due to the building type and HVAC installation, or having office windows that could or could not be opened. During co-creation sessions at one of the sites the participating occupants explained that ventilation for them was a social behaviour. For example, opening doors to the corridor in one of the buildings was a way for office occupants to engage in casual chats happening in the corridors, or limiting the amount of noise by closing doors when engaging in focused work. Consequently, the solution idea co-designed for more energy efficient room ventilation involved leaving the doors open, and introducing an interface signalling need for quietness around one's door, or readiness to engage in a chat.

5.1 Exploring: contextual enquiries

To gain insights into the participant's workplace while creating awareness in the process, contextual enquiries were conducted with the

goal of understanding the subjective perception of comfort and energy use in the workplace. Participants filled in a timeline, as shown in figure 3 below. The step included encoding observations by a researcher in-situ and post observation interview to verify the observations.

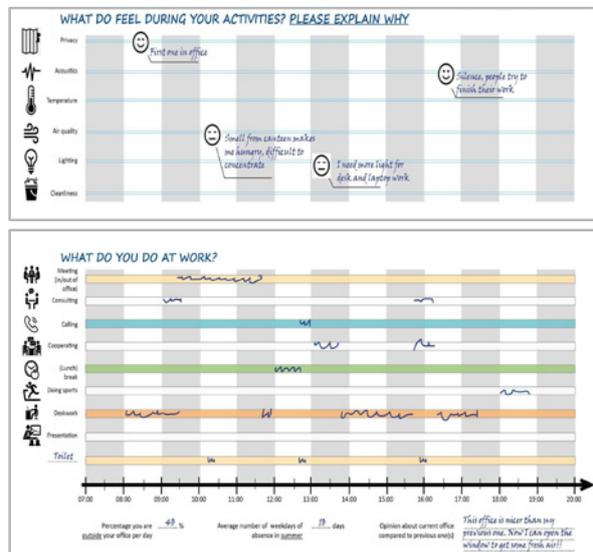


Fig. 3: An example of a timeline filled in by occupants as part the contextual enquiry.

5.2 Exploring: involving lead users

The involvement of lead users in the exploration phase was found to be critical to building momentum for change. Local safety and health officers or sustainability officers were helpful in identifying lead users. Many of the participants were personally motivated having felt the need to improve their indoor comfort levels or a keen desire to follow sustainable practices. Recognition and support of the lead users' role by upper management was also an important motivating factor.

5.3 Learning from objective data

To gain deeper insights into the actual building performance in relation to subjective experience, wireless sensor nodes were placed in a representative range of offices at each of the pilot sites to measure key indoor climate parameters such as air temperature, radiant temperature, draft, humidity, light level, sound level, movement activity and CO₂ concentrations. The data was then shared with the pilot participants and gaps in perceived versus actual comfort levels were identified (Figure 4). For example, at the European institute site in the Netherlands, staff from northern European countries generally felt too warm, while staff from southern Europe found the indoor climate to be too cold. In short, some staff was influenced by their past climate culture, despite being in a new location.

6 BOTTOM-UP

The bottom-up focal point lies at the intersection of building momentum for change and fostering commitment. It involves identifying approaches that stimulate the bottom-up engagement of building occupants towards sustainable practices. In the current pilot self-reporting tools were co-developed with the pilot participants. For example, a noise (hall-way chatter) button, air quality (smells) and mood slider was requested and implemented within one week using rapid prototyping techniques based on a modular design (Figure 5). A customizable indoor climate data feedback dashboard was also created (Figure 6).

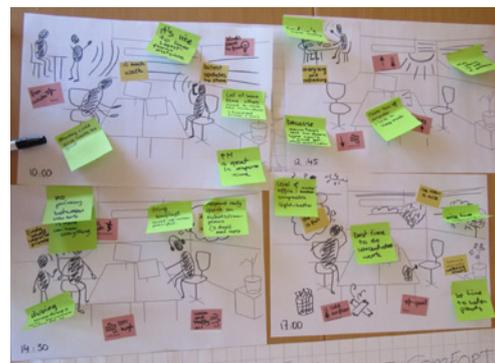


Fig. 4: A sketchy storyboard is used to explain to participants the research findings and the correlation between observed practices and measured data.

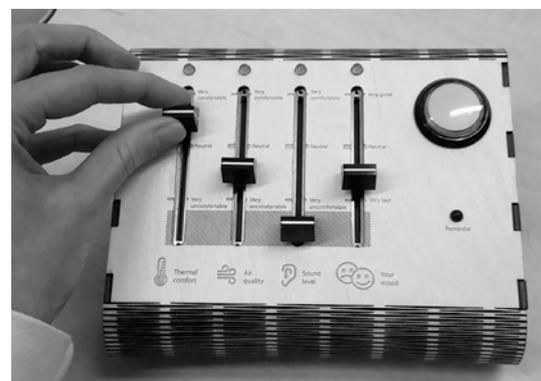


Fig. 5: Custom self-reporting tool based on co-design sessions with office occupants, built using rapid prototyping techniques.

An example of how the self-reporting tools became embedded in practices was the monthly clean-up afternoon organized by office workers to socialise with each other, remove sources of dust and organise the building wing better. The clean-up afternoon was also proposed as an opportunity to exchange reflections on energy consumption and indoor climate quality based on data collected by occupants in the preceding weeks.

6.1 Context research: prototyping with users

A co-design driven approach was sought in the pilot to actively engage occupants in workshops

to create tools which would assist them in reporting and reflecting on their indoor comfort and general wellbeing. The co-design workshops were focused on creating self-reporting tools that were combined with information from the networked wireless climate sensor nodes. The basic assumption here was that by actively engaging users in the co-design of their self-reporting tools, they would be more likely to adopt the resulting platform, while at the same time the system requirements could be defined.

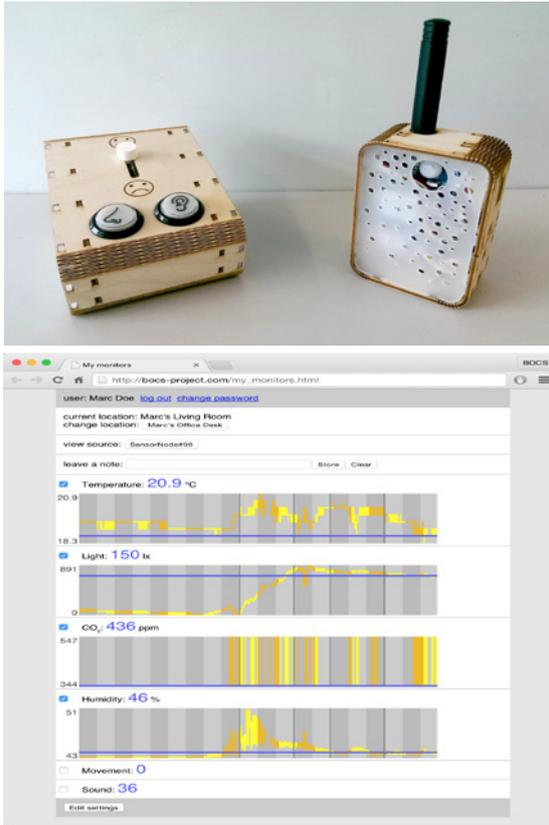


Fig. 6: Basic self-reporting controller with flexible enclosures to accommodate different button and slider formats and a climate sensor node (top), and a personalised web interface with the indoor climate feedback display (bottom).

In order to support the co-design process, a rapid prototyping approach was developed based on supporting rapid changes through a flexible and modular design. As in the case of sensor hardware, the self-reporting devices were developed using modular electronic components. These components in combination with rapid-prototyped enclosures permitted production of small batches of fully customized devices within several days. Turnaround time was considered key to ensure user motivation. A similar approach was adopted in designing online feedback interfaces. Each information display type was developed as a modular building block which could be combined with other information display blocks, depending on user needs articulated during co-design sessions (Figure 5).

7 UP-SCALING

The results from the self-reporting applications and resulting changes in practices have been shared and communicated with other groups in each of the pilots. Currently testing is underway to consider the transferability of resulting practices to groups not actively involved in the co-design workshops. In each of the pilot sites corporate communications have been active in communicating the pilot work across the organization. A front-end user interface affording rich data visualizations for perceived and measured comfort and energy consumption as part of an integral facility information system is currently under development.

8 TOP-DOWN

There is a clear potential for certification and recognition schemes that can stimulate organisational change and sustainable practices. The focus should be on the potential for energy savings and improved comfort, resulting in higher staff productivity and wellbeing. Along these lines, GRESB recently launched a health and wellbeing building certification module. The module is an optional supplement to the GRESB Real Estate Assessment, which is an annual survey on behalf of a large group of institutional investors that captures information regarding the environmental, social, and governance performance of property companies, fund managers and developers.

9 CONCLUSIONS AND NEXT STEPS

There is generally a lack of tools and methods for workplace professionals to engage office occupants in working towards improving comfort and sustainability. Classical methods such as questionnaires or elaborate and expensive indoor climate measurement devices are limited in terms of their potential impact on behaviour and organizational change. There is a wealth of opportunities in the emerging field of Sustainable Human Computer Interaction in deploying prototyping and co-design methods in the office workplace. The ongoing pilot work has demonstrated the potential of SHCI interventions to promote sustainable practices, while involving facility managers, office staff, and upper management in the process. As noted by Sliberman et al. [3], when viewing user through the lens of practice one can see in which way behaviour is constrained. SHCI needs to look beyond the individual and consider how changes in practices at the organizational level and policies can be addressed in the real world context.

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11 REFERENCES

1. Mithra Moezzi, Christine Hammer, John Goins, and Alan Meier. 2014. Behavioral strategies to reduce the gap between potential and actual savings in commercial buildings. Contract Number: 09-327. Sacramento: Air Resources Board.
2. Network for Business Sustainability, Embedding Sustainability in Organizational Culture. 2010.
<http://nbs.net/wp-content/uploads/Executive-Report-Sustainability-and-Corporate-Culture.pdf>
3. M. Silberman, Lisa Nathan, Bran Knowles, Roy Bendor, Adrian Clear, Maria Håkansson, Tawanna Dillahunt, Jennifer Mankoff
Next Steps for Sustainable HCI.pg 67-69
SEPTEMBER–OCTOBER
INTERACTIONS.ACM.ORG 2014
INTERACTIONS
4. Ingrid Mulder, Pieter Jan Stappers. 2009. Co-creating in practice: results and challenges. In Collaborative Innovation: Emerging Technologies, Environments and Communities, Proceedings of the 15th International Conference on Concurrent Enterprising: ICE 2009, 22–24
5. Peter Coughlan, Jane Fulton Suri, and Katherine Canales. "Prototypes as (Design) Tools for Behavioral and Organizational Change A Design-Based Approach to Help Organizations Change Work Behaviors." *The journal of applied behavioral science*