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Co-Designing Innovations for Energy Saving in Large Organisations

Evan Morgan
Lynda Webb
Nigel Goddard
School of Informatics
University of Edinburgh
11 Crichton St
Edinburgh EH8 9LE
e.morgan@ed.ac.uk
lynda.webb@ed.ac.uk
nigel.goddard@ed.ac.uk

Janette Webb
School of Social and
Political Science
University of Edinburgh
15a George Square
Edinburgh EH8 9LD
jan.webb@ed.ac.uk

Kate Carter
Edinburgh College of Art
University of Edinburgh
20-22 Chambers Street
Edinburgh EH1 1JZ
k.carter@ed.ac.uk

Abstract

Research indicates that new technologies, such as smart meters, can motivate domestic energy savings via behavioural change. Using participatory and co-design methods, our research is exploring how technological innovations might also facilitate behaviour-based energy savings in large organisations. By establishing 'living labs', we are working closely with two public-sector organisations in order to understand behaviours surrounding energy use, and to subsequently engage relevant stakeholders in a process of co-designing innovations focused upon achieving energy savings. This paper introduces our research approach and describes how initial workshops are informing an ongoing process of co-development within our two living labs.

Author Keywords

Co-design; sustainability; behaviour change; living lab.

ACM Classification Keywords

H.5.m [Information Interfaces And Presentation]: Miscellaneous

Introduction

With the ongoing instigation of the UK's smart meter roll out, there has been much focus upon the roles that digital technologies could play in facilitating sustainable energy consumption behaviours in domestic settings. Studies sug-

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Key Principles of Living Lab Research [9]

Continuity: long-term partnerships enable trust and cross-boundary relationships to be established, strengthening innovation and creativity.

Openness: an open-minded and inclusive approach incorporates varied perspectives and ideas from a broad range of stakeholders.

Realism: conducting research in real-world environments facilitates in-depth understanding, close collaboration, and the generation of ecologically valid outcomes.

Empowerment: stakeholders feel motivated and engaged in the research, shaping its progress and contributing as partners, not just participants.

Spontaneity: there is sufficient flexibility to detect and respond to spontaneous reactions and ideas from stakeholders, as well as circumstantial changes in the living lab environment.

gest that such technologies can bring about energy savings of 3-13% [7]. If the UK is to achieve its ambitious 2050 target of an 80% reduction in carbon emissions then it is important that the potential impacts of these technologies are also explored within non-domestic settings, which account for 18% of the UK's total carbon emissions [3]. Working closely with two large public sector organisations, we are currently undertaking a research project which is investigating organisational behaviours relating to energy use, whilst also exploring how the co-design of innovations might facilitate more sustainable behaviours. This paper documents our ongoing work.

Background and Approach

Owing to their complexity, large organisations present an especially challenging arena in which to approach energy saving opportunities from a behavioural standpoint. Existing research identifies three distinct levels of organisational analysis: 1) institutional structures, rules and policies; 2) social and behavioural characteristics of the organisation; and 3) individual behaviours within the organisational context [1, 4]. At each of these levels, additional barriers to energy saving behaviours are encountered due to lack of direct financial responsibility for energy bills, communal facilities and workspace, and lack of feedback upon the implications of personal actions [6, 5].

In an attempt to understand and address some of these challenges, we are taking a multidisciplinary 'living lab' approach, whereby our research is conducted within real-world settings and shaped through long-term interactions with relevant stakeholders. Living labs have garnered increasing attention in recent years, especially in sustainability focused research, such as the SusLAB project [8]. The living lab approach embraces five key principles, outlined in the sidebar. From a design perspective, living labs provide

an ideal environment in which to identify context-specific opportunities, develop well-informed ideas and prototypes, and undertake iterative real-world testing and refinement. Through the inclusion and contributions of a broad range of stakeholders at each of these stages, the process becomes one of interdisciplinary co-development. This is a particularly attractive feature of the living lab approach in the context of our research. Indeed, the development of successful interactive systems for sustainable behavioural change should be founded upon a sound understanding of the interactions, practices, policies, and cultures that shape energy-impacting behaviours within an organisation. These topics are relatively unexplored in existing research.

Two Living Labs

We have partnered with two public-sector organisations in Edinburgh - the City of Edinburgh Council, and the University of Edinburgh - each employing over 13,000 staff. Early stages of the project involved meeting with managerial staff in estates, sustainability, and energy-related roles to identify potential locations for our living labs. Subsequent building visits and meetings with site-specific managers allowed us to assess the suitability of each location according to a set of criteria outlined in [10]. After considering numerous buildings in each organisation, two sites were selected:

The Assembly Rooms

The Assembly Rooms is a historic cultural venue, built in the late 17th century. It boasts a range of meeting spaces with high ceilings and ornate décor. It was refurbished in 2011 and now regularly hosts performances, conferences, dinners, exhibitions, festivals, and weddings. From the perspective of our project, the Assembly Rooms is an interesting site due to the high levels of control that staff have over the heating and lighting systems.

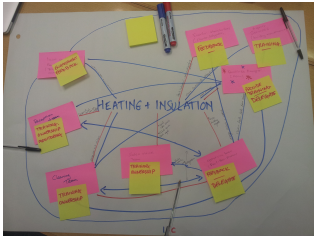


Figure 1: Mapping people and energy use in the Assembly Rooms.

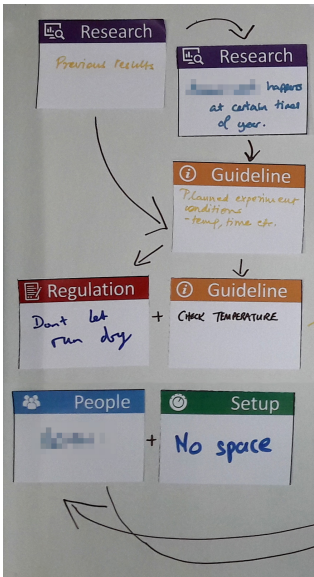


Figure 2: Mapping people and factors that influence lab equipment use at the Roslin Institute.

The Roslin Institute

The Roslin Institute is a modern-built animal sciences research institute, which was completed in 2011. The building is split into office space and laboratories, the latter of which make a substantial contribution to the overall energy use. Unlike other institutes within the University, the Roslin Institute is financially responsible for its energy consumption. Staff have been lauded for their approaches to sustainability in the labs, but recognise that further opportunities for behaviour-based energy savings exist.

Workshops: Insights into Energy Use

In their sustainable living lab research Baedeker et al. [2] adopted a three-phase approach comprising i) insight research, ii) prototyping, and iii) field testing. We are taking a similar approach within our living labs. The first step - insight research - involves exploring and documenting the existing status-quo with respect to the topic of interest. In our case this translated to a desire to map out people's existing experiences and views on the intersections between behaviour and energy consumption in their buildings. We achieved this by conducting a number of workshops with staff in each of the living labs. Each workshop lasted around one hour and began with a short presentation on the aims and approach of the project. The remaining content was tailored for each living lab, as described below.

In the Assembly Rooms our aim was to identify the pathways of influence and control that determine how different people have an impact upon material forms of energy use (e.g. lighting, insulation, electrical devices). Six workshops were held with 4-8 staff members in each, representing a cross-section of roles within the building. During the workshops individual staff members were initially asked to list five material factors within the building that contribute towards energy use and to select a) the factor that presented



Figure 3: Staff at the Roslin Institute engage in a workshop.

the best opportunity for energy saving; and b) the factor they thought would be most interesting to investigate further. Selections were then shared amongst the group, and the two most prevalent factors were taken forwards for further consideration. In groups of two, the participants were then asked to identify people who have influence or control over these factors, and to arrange them using post-it notes on a large sheet of paper, with the energy usage factor written in the centre. Participants were subsequently instructed to draw pathways of influence and control between the people and the energy use factor, as well as between different types of people (see 1 for an example).

In the Roslin Institute, initial staff interviews and building visits led us to focus upon lab equipment as a potential opportunity for energy saving. Consequently, we conducted workshops with 17 staff members who hold designated po-



Figure 4: People most commonly identified in the workshops at the Assembly Rooms as having influence or control over lighting related energy use.

sitions of responsibility within the labs. Participants were split over three workshops, which were designed to explore factors and people that influence the use of lab equipment. We used a card-based format, whereby cards were prepared for two main categories: *devices* and *people*; and four influencing factors categories: *research*, *guidelines*, *regulations*, and *setup*. Similarly to the workshops at the Assembly Rooms, participants were initially asked to individually identify specific types of equipment that present opportunities for energy saving, and to write them on the *device* cards. For each of the three most prevalent devices the participants were then asked to fill in *people* cards to denote individuals or groups who have influence over the use of that device. Following this, everyone was asked to complete at least two of each of the influencing factor cards and assign them to whichever of the three devices they applied to. For example, 'defrosting on a regular basis' could be written on a *guideline* card and assigned to the device 'fridge'. Wildcards were also provided to account for factors that didn't fit the supplied categories. Having generated various *people* and factor cards for each device, workshop attendees were then split into three groups and each assigned a specific device. The subsequent task for each group was to arrange the people and factor cards on a timeline spanning pre-use, in-use, and post-use, and to draw out any links between them (see Figure 2 for an example).

From Insights to Co-Design

The workshops described in the previous section were designed as a means of transforming the implicit knowledge and experiences of our living lab partners into explicit insights relating to behaviour and energy use. We are currently analysing audio recordings and written materials from the workshops using a combination of qualitative methods, such as thematic analysis; and loosely quantitative approaches, such as counting the occurrences of particular

themes. Figure 4 shows some of the findings from our analysis of the workshops at the Assembly Rooms, which indicate that staff identify *clients* as having the greatest influence over lighting-related energy use, whilst their employer - the Council - is seen as far less influential. Additionally, when asked to think of interventions that could lead to energy reductions, the three most common forms of intervention were training, information, and feedback. This finding supports previously highlighted research, suggesting that lack of feedback on personal actions presents a barrier to energy saving in large organisations.

Generalised findings, such as those reported above, can be seen as valuable beacons, guiding the overall direction of our research. However, of equal or greater value are the individual stories and realisations awakened through the process of engaging in the workshops. For example, having created a complex map of people and factors that influence lab equipment usage, one workshop participant commented "it's far more interconnected than we would have ever imagined". Such realisations have the potential to empower living lab stakeholders as the gatekeepers of valuable knowledge and insights. As we shift our focus towards the innovation and prototyping phase of our research, these insights will establish the foundations of an informed and engaged process of co-design.

We are currently establishing 'innovation teams' within each of the living labs. These teams will work closely with designers and researchers on the Enhance project to design, develop, and prototype innovations for behaviour-based energy savings.

Acknowledgements

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