

## Building Controls (for People, not Robots)

### What are user-centred building controls?

More than 50% of the building industry's energy consumption and emissions is attributed to the use of Heating Ventilation and Air-conditioning (HVAC) systems. The successful installation and operation of building services control systems have been broadly recognised as key factor for maximising the buildings energy performance if used efficiently.

Looking at the controls development process in a building development, this includes a number of complex stakeholders being involved in different project phases - from the Client commissioning the design work, to the design team, and to the contractor and sub-contractors, prior to the handover to the end-users. Surveys have shown that this dis-engagement of the final end-user from the controls designers and the manufactures, has led to users experiencing severe difficulties in programming their heating/cooling controls. A key consequence of this being increased energy consumption in comparison to the design intent.

An alternative approach to this is developing control systems that are user-centred. In this case, the controls are designed and developed around user needs, utilising real-time operational data, and feedback loops in the development phases. The user needs are defined, and fed back into the controls software or hardware design process. The revised designs are then tested and evaluated, and potentially lead to a new round of development. Each development feature can go around the loop  $n$  times, until the required performance levels are achieved. For software features each loop may take approximately 2 weeks, whilst for hardware development this may take up to 2 years.

Following this approach ensures users can understand the controls system and successfully utilise it to manage both their energy use and costs. Therefore, user-centred controls can assist in achieving energy savings in the building sector, while these can also trigger behaviour changes.

Maria-Anna Chatzopoulou, Imperial, April 2016

### Key Issues & Considerations

- When designing and installing controls, it is important to understand whether there will be a trained facilities energy manager on-site, or whether this will be done by others, possibly non-specialists;
- User-centred controls design with available feedback loops can greatly assist in improving the efficiency of the installed energy systems;
- Agile product development incorporating users' feedback in order to improve the system performance;
- Providing the users with controls override options is highly desirable, since it allows them to tailor their system usage to their lifestyles;
- It is important to demonstrate the association of controls with the energy use, and costs;
- Other controls features usually required by users include: zonal operation; feedback indicating the system is on/off;
- Full automation of systems especially in domestic setting are often not desirable for end users;
- Offering the users simple controls that assist them to understand, how their usage patterns affect their energy use, can inspire behaviour changes.

### Further Information

- [The Carbon Trust: Building controls-Realising savings through the use of controls](#)
- [CIBSE Guide H: Building Control Systems](#)
- [CIBSE Journal article: Knowledge in Power](#)
- [Hive Active Heating](#)

## Case Study: Whitbread hotels controls strategy

Whitbread PLC is the UK's largest budget hotel and restaurant company. The company's projections for their energy consumption and expenditure show increasing trends in line with their development activities. In this context, Whitbread have focused on setting a commercially viable energy management strategy. The key targets of the company's strategy include; i) continual investment in their energy efficiency plan; ii) decentralisation of the energy and power generation in their estates; iii) improvement of the facilities operational efficiency; iv) create a system to manage the energy consumption; and v) engage team members to energy efficiency.

To achieve these targets, Whitbread have undertaken surveys in a number of representative sites to evaluate the opportunities available for improving energy performance. Areas identified requiring further improvements include: i) local heating/cooling controls, found in conflict with each other; ii) absence of centralised energy controls; iii) un-necessary 24/7 operation of lighting/heating/ventilation etc.; iv) zonal controls, such as lighting; and v) staff training related to energy efficiency measures.

Based on the above the controls system requirements to be deployed were defined. These include, among others, aspects such as wireless/hardwired systems, open/closed source protocols, and bureau or in-house management. The key areas and services requiring control have been also selected. The company have installed sensors, and meters on the boiler and pumps to operate only when there is demand. Also, they have installed time-controls on the AHUs, fans, and the LTHW system. Additionally, controls are installed to prevent simultaneous operation of the the AC and the boilers.

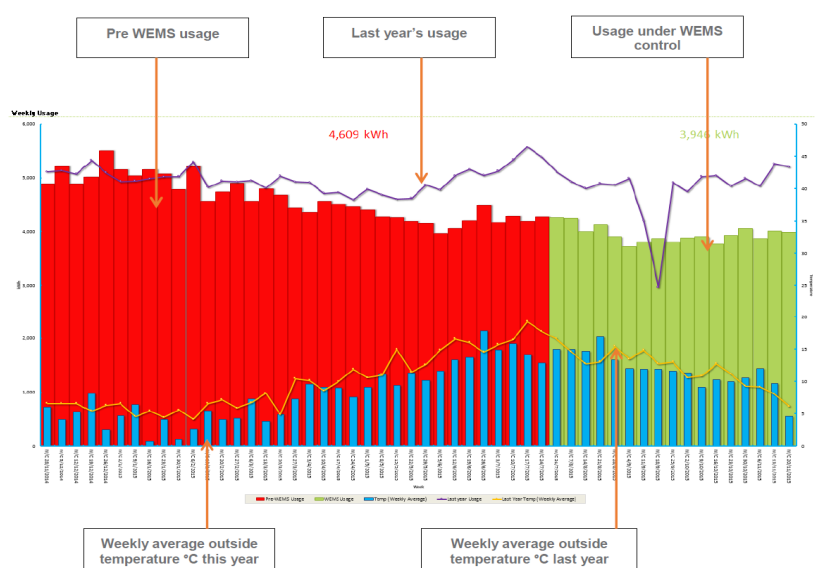
In the figure below, the energy savings obtained after the installation of the sensors, and the BMS are illustrated. With reference to the results, it is easily noticeable that the installation of BMS has resulted in significant energy savings. Finally, the ROI estimated is equal to 2.88 years, based on electricity savings only.

Maria-Anna Chatzopoulou, Imperial, April 2016

### Key Lessons Learnt

- Specification of the controls system requirements prior to procurement is very important;
- Installation of controls and BMS resulted in significant energy savings;
- ROI=2.88 years, based on electricity only;
- Staff required training in energy efficiency measures.

### Energy Saving via BMS Deployment



### Further Information

- [Whitbread energy efficiency plan](#)