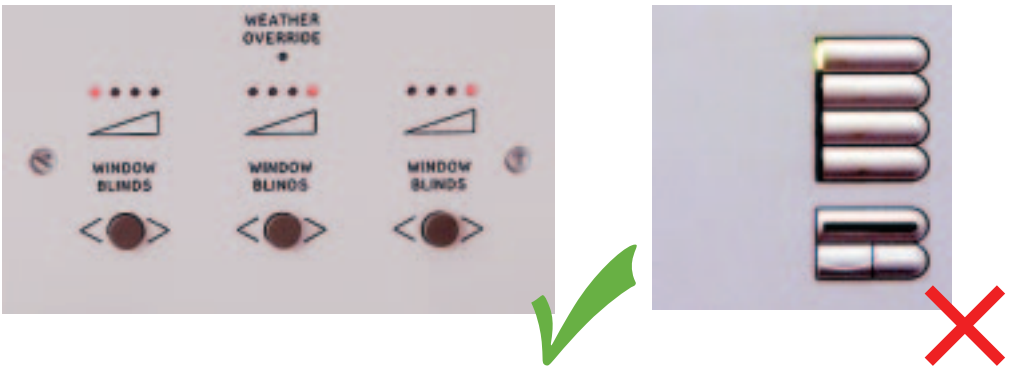
BCIA

Building Controls Industry Association

Controls for End Users

a guide for good design and implementation



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The guidance was drawn from knowledge and expertise in the Usable Buildings Trust (UBT), and was managed by a BCIA task group comprising Doug Robins of Priva Building Intelligence, David Kitching of Siemens, and Adrian Leaman and Bill Bordass of The Usable Buildings Trust. Roderic Bunn of BSRIA was the guide's principal author and research manager. BSRIA's David Bleicher provided quality assurance. Ann Hull of the BCIA acted as the secretariat.

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Controls for End Users: a guide to good design and implementation

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Introduction

This Guide concentrates on the strategy, implementation and the user interfaces of control devices located in occupied spaces and operated by individual users – the people for whom buildings are designed. These users want to make adjustments as quickly and simply as possible to obtain an environment that suits their needs (such as working, living and cleaning). They are not interested in the technology, only the results.

The content focuses on user controls for heating, cooling and ventilation – the main interests of BCIA members. It also covers natural ventilation, which is increasingly important in low-energy buildings but tends to be outside the experience of the HVAC industry. It also touches upon the control of natural and artificial lighting, glare and solar gain, for which the principles are often similar. The Guide is particularly concerned with achieving good results with minimum energy use, especially through good integration of natural and mechanical systems and in ways to avoid equipment running unnecessarily.

This guidance does not cover controls located in plantrooms. However, the principles of good user controls still apply, and not just because many facilities managers are not building services and controls specialists. Well-designed controls with good user interfaces benefit everyone.

The usability of local controls for lights, blinds, heating, ventilation and cooling will affect how well a building performs

Why user controls matter

Control interfaces are where the users and the technology of a building come together. The usability of local controls for lights, blinds, heating, ventilation and cooling will affect how well a building performs in many respects:

- **User satisfaction**. Case studies in non-domestic buildings reveal positive relationships between occupant satisfaction and levels of perceived control
- **Avoiding discomfort**. Occupant surveys suggest that people prefer conditions that are relatively coarsely controlled, provided that at the same time they incorporate control facilities to avoid conditions that are too hot or cold, glary or gloomy, stuffy or draughty
- **Rapid response**.The faster a building responds to human needs, the better occupants tend to like it. Rapid response is key to good user satisfaction and perceived control. The response does not have to be perfect, but it must be rapid, detectable, and in the right direction
- **Assisting management**. Only a small number of buildings have sufficient central control and facilities management support to deliver genuinely rapid response via a helpdesk. It can be more cost-effective for individual users to deal with local problems using local controls
- **Energy efficiency**. Buildings with good local controls tend to be energy efficient because systems are more likely to operate only when occupants need them. Equipment is less likely to be left on

or because people have found the controls too difficult to use or do not understand what they need to do.

Better controls are an important way of saving energy and reducing carbon dioxide emissions. Usually they are a more cost-effective way of saving energy than adding renewable energy systems. To invest in renewable energy without first making sure that the controls are as effective as possible would be a waste of resources.

Unfortunately, case studies reveal that:

- Many environmental control systems do not work as well as they should – not just electronic ones, but also simple switches, window gear, sunblinds and room thermostats are often not well thought-through or well integrated
- Electronic controls can be too complex. Designs are often driven by the producer rather than the users, and may require more setting-up and commissioning than the design team, the client and the contractor think
- In a completed building, features that users and management do not understand or find complicated or confusing tend to be ignored or by-passed
- Effective user controls can be simple and unobtrusive. Simple does not mean low-technology, but simple to understand, use, operate and maintain
- The better performing systems are not necessarily expensive. However, they tend to have received careful attention to detail in briefing, design, specification, installation, commissioning and handover, and also in the user interfaces.

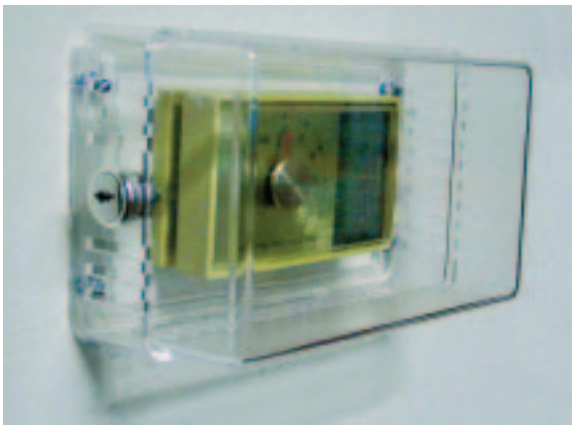
Perhaps the main obstacle to cost-effective, energy efficient and sensible controls is that clients seldom ask for them. They also fail to realise the effort that may be required to deliver a high level of functionality and usability to make user controls obvious and intuitive. Consequently, design and building teams are not united in their response to the usability problem, and control suppliers and installers are not geared-up to meet their needs.

Considerable attention to detail is required to devise effective and durable controls that will do their job well and reliably. This guidance addresses ways in which the technology can be suitably configured, designed, annotated and labelled. Designers and the controls industry will also need to improve their understanding, strategy and attention to detail so that a new generation of user controls offer useful user interaction and information rather than simply extra features.

The psychology of user controls

In his book *Designing Web Usability*, Jakob Nielsen says that usability is essential because people will go away if they cannot find what they want quickly and easily. With web pages, feedback is immediate. With building controls, poor functionality will not be detected until after the designers and installers have left site.

If user controls are ambiguous in intent, poorly labelled, or fail to show whether anything has changed when they are operated, then the systems that lie behind them are unlikely to operate effectively or efficiently. Unsuccessful attempts by building occupants to get the conditions they want may then be read by facilities managers as tampering or even sabotage.



Freely-adjustable thermostats can be a problem because people either turn them up too far and waste energy, or down too far and then complain about being too cold the next morning. Tamper-proof thermostats don't solve the problem: if people are hot they open the window and the thermostat calls for more heat. If it's too cold, the vandals break into the thermostat and turn it up, but the law-abiding won't break in to turn it down, so open windows instead.

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Vicious circles may subsequently ensue where occupants are not allowed to make changes. Controls may be over-ridden and may even be disconnected. As a consequence, both occupant satisfaction and energy efficiency tend to suffer.

The problems that arise include:

- Lack of understanding of users and their needs. This requires more knowledge-gathering by designers and controls specialists
- Lack of clarity of design intent
- Lack of design integration (particularly of natural, mechanical, electrical and control systems)
- Poorly-defined responsibilities for controls development
- Specifications poorly defined and not adhered-to
- Cost-saving pressures. These can be severe because controls are installed late in the construction process and their importance is not well understood
- Poor dialogue between controls specialists, designers, clients and users
- Lack of communication of the design intent of the control devices to users

- Inability of systems to handle low demands efficiently.

Designers, controls manufacturers and systems integrators are rarely aware of such consequences and how to deal with them. The controls specialist may be called back to site to resolve problems, but the lessons learned may not percolate back up the supply chain. Often the facilities manager will side with the controls specialist, as by this late stage neither of them has the opportunity or the budget to get to the root of the problem being complained about by the users.

In his book *The Inmates are Running the Asylum*, Alan Cooper uses the term 'dancing bearware' for feature-bloated software with complicated user interfaces: you can teach a bear to dance, but it won't do it very well. Most controls-rich buildings can also be seen as dancing bears: they are stuffed with features and functions, but always seem to promise rather more than they deliver. The shortcomings are hardly ever put right.

Overcoming the barriers

Figure 1 summarises the barriers that tend to come between the intention to provide good controls and the user experience in practice.

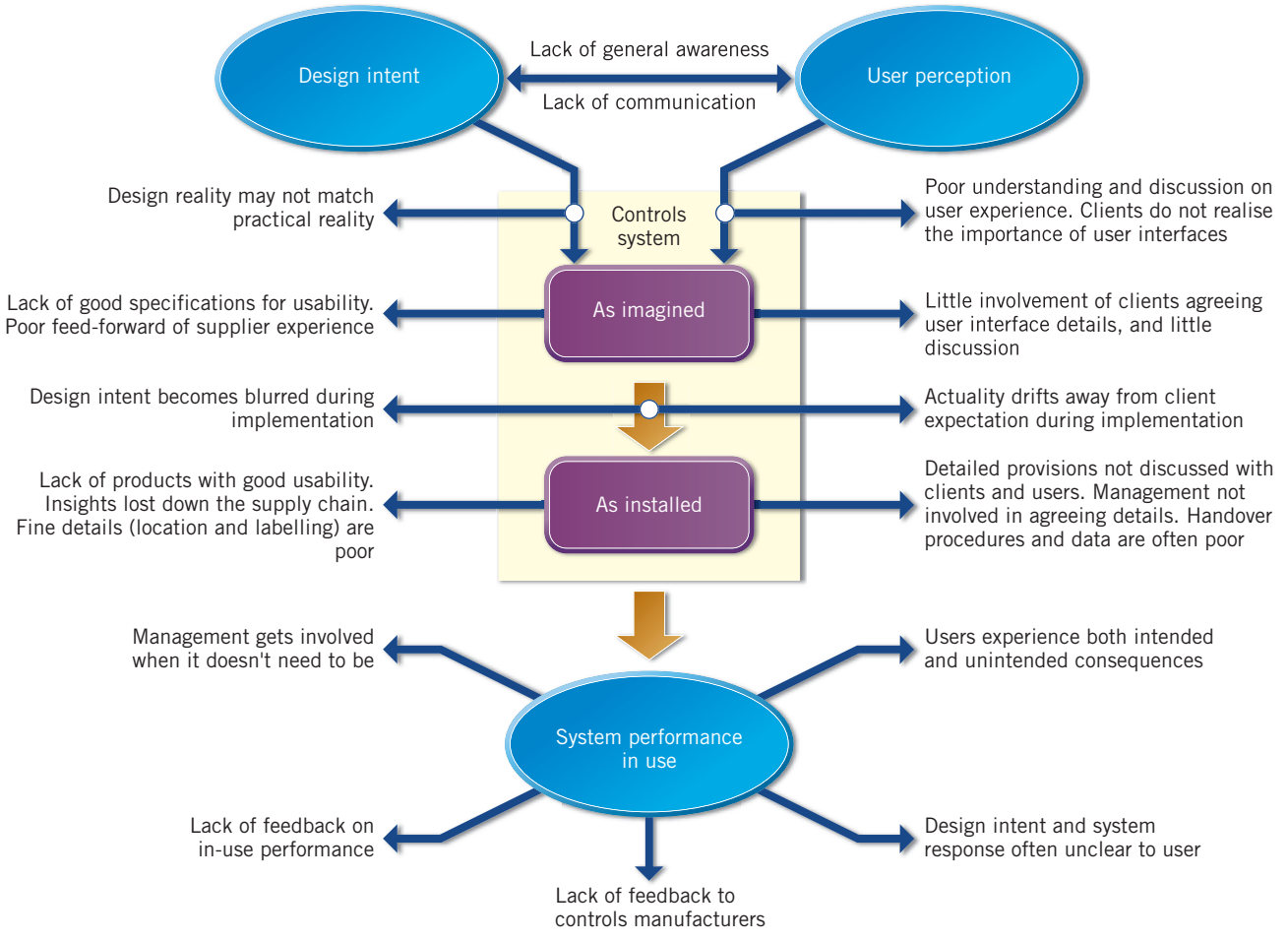

Figure 1: To the left are the intentions and activities of the design and building team. To the right are the perceptions and activities of client and users.