

# Making feedback and post-occupancy evaluation routine 2: Soft Landings – involving design and building teams in improving performance

Mark Way<sup>1</sup> and Bill Bordass<sup>2</sup>

<sup>1</sup>The Darwin Consultancy, 'Kingfishers', 1 Linersh Wood Road, Bramley GU5 0EE, UK  
E-mail: markway@kingfishers43.fsnet.co.uk

<sup>2</sup>William Bordass Associates and the Usable Buildings Trust, 10 Princess Road, London NW1 8JJ, UK  
E-mail: bilbordass@aol.com

Once a building is physically complete, designers and builders move on to the next project. Few of them stay around to learn from what they have done and pass on their insights to the occupants. 'Soft Landings' aims to extend the scope of service so that feedback and follow-through can become natural parts of the delivery of a project. It increases designer and constructor involvement before and after handover, and points the 'supply side' to more involvement with users and a careful assessment of building performance in use. The objective is more certainty in delivering buildings that achieve a close match between the expectations of clients and users and the predictions of the design team. A Soft Landings team (designer and builder) is resident on site during the move-in period in order to deal with emerging issues more effectively. It then monitors building use and energy performance for the first three years of occupation: identifying opportunities both for fine-tuning the building and for future projects. This process also creates a coordinated route to post-occupancy evaluation. The cost of the extra work is relatively small and can be balanced against gains from the learning process, less rework and better client references. Soft Landings does not require wide-scale revision of industry-standard documentation: a licensed Scope of Service document set can stand alongside most existing procurement processes.

**Keywords:** building performance, client satisfaction, design quality, feedback, innovation, involvement, learning, predictability, process improvement, professional services, project delivery, quality control

Lorsqu'un bâtiment est construit, concepteurs et constructeurs passent au projet suivant. Peu d'entre eux restent autour de ce bâtiment pour tirer un enseignement de leur réalisation et transmettre les résultats de leur analyse aux occupants. La méthode dite de 'l'atterrissage en douceur' a pour objectif d'élargir le Cadre du service pour que le retour d'information et le suivi deviennent des composantes naturelles de l'exécution d'un projet. Cette méthode accroît l'implication du concepteur et du constructeur avant et après le transfert de propriété et exige du 'fournisseur' davantage d'engagement vis à vis des utilisateurs ainsi qu'une évaluation minutieuse des performances du bâtiment en service. L'objectif est de s'assurer que les prévisions des équipes de conception répondent bien aux attentes des clients et des utilisateurs des bâtiments livrés. A cet effet, une équipe chargée de 'l'atterrissage en douceur', composée d'un concepteur et d'un constructeur, réside sur le site pendant la période d'emménagement afin de traiter avec davantage d'efficacité les problèmes qui se présentent. Cette équipe surveille ensuite l'usage du bâtiment et les performances énergétiques pendant les trois premières années d'occupation; elle repère tous les éléments du bâtiment qui nécessitent d'être peaufinés et dont il sera tenu compte dans la conception de projets futurs. Cette approche permet également d'ouvrir la voie à une évaluation coordonnée après emménagement. Le coût de ce travail supplémentaire est relativement peu élevé et peut être compensé par les gains issus de l'enseignement acquis, avec moins de travaux de

réfection et de meilleures références de la clientèle. L'atterrissage en douceur ne nécessite pas une révision à grande échelle de la documentation standard de cette industrie: un document homologué 'Cadre du service' peut coexister avec la plupart des procédures d'approvisionnement actuelles.

**Mots clés:** performances des bâtiments, satisfaction du client, qualité de la conception, retour d'information, innovation, engagement, enseignement, prévisibilité, amélioration des processus, services professionnels, exécution du projet, contrôle de qualité

## Introduction

Clients and users are united in expecting better performance from the buildings they procure and occupy. Tighter environmental regulation adds pressure for greater predictability of the end product. In practice, however, most clients and users become 'crash test dummies': they are abandoned by the project team after handover just when they are likely to need the most help.

Publications on building performance evaluation, most recently Preiser and Vischer (2005), show how feedback can be integrated into every phase of delivery throughout a building's life cycle. In practice, however, most designers and contractors have traditionally shown little interest in learning from how their buildings actually perform in use; and most clients have certainly not wanted to pay them to do so. It has therefore been necessary to consider how feedback and feed-through can begin to be added onto conventional procurement processes.

The post-handover period is the most neglected stage of construction, often looked upon as a nuisance and a distraction. Ironically, this is precisely when much can be fed forward into the completed project, for the benefit of the client and the occupants; and much can be learnt, recorded and fed back for reuse on future projects, to the benefit of all the stakeholders. Instead, during this crucial phase, client goodwill and profit margins often tend to be eroded, the hard-won experience squandered, and the potential commercial and productive advantage is lost.

Learning from how buildings perform in use – and fine-tuning them to perform better – remain central to the systematic improvement of the end product. It is the fastest and surest way to improve the economic and environmental performance of buildings; and to achieve greater user satisfaction. In spite of this, recent UK industry initiatives have tended to concentrate on greater efficiency in producing buildings faster, more cheaply and more predictably. For the most part, they have not engaged directly with the performance of the end product.

Two recent UK projects have therefore been considering how to make follow-through and feedback routine over the life cycle of a building and of a

project. The first (Bordass and Leaman, 2005) looked at what techniques could be used and how people might be encouraged to use them. The second, 'Soft Landings', has been developing a scope of service that could make feedback and follow-through a natural part of the delivery of a project. The objective is more certainty: a far closer match between the expectations of clients and users and the predictions of the design team. The approach increases designer and constructor involvement both before and after handover, getting the 'supply side' closer to the users of its products and encouraging it to become involved in a careful assessment of building performance in use.

## Background to Soft Landings

Soft Landings was developed by one of the authors (M. W.) after being a resident during a client's migration and early occupation period of a corporate headquarters project for which he was the lead architect. He reported the experience in a paper given to the University of Cambridge, where the Director of Estates sponsored research to formalize the idea into a practical guide and documentation set. The work was funded by an interested group of architects, engineers and other consultants.

A Soft Landings team (designer and builder) is resident on site during the move-in period, allowing it to deal with emerging issues more effectively. It then monitors building use and energy performance for the first three years of occupation: identifying opportunities both for fine-tuning the building and for the future. The process also creates a coordinated route to post-occupancy evaluation (POE). Revision to industry-standard documentation is not necessary: a licensed Scope of Service document set can stand alongside most existing procurement processes.

The extra cost is not high: the only true net increase is for visiting after handover, and undertaking any surveys. For the architect, this represents less than 0.25% of construction cost on a full-scope appointment. However, this cost should be balanced against the net gains of less rework and snagging revisits for the design and building team, together with the commercial advantage of the intelligence gathered for future use, and the likelihood of better client references.

The University of Cambridge's Estates and Buildings Service is currently piloting Soft Landings on a range of projects. The full documentation set is available under licence. The Director of Estates describes the University of Cambridge's initial experience of operating Soft Landings as follows:

Ever since early discussions about meeting the challenges of handover of capital projects and optimising the use of new buildings for those who work in them, the benefits of the Soft Landings approach have been clear. Right from the start of procurement there is in nearly all cases a better understanding by members of the team that they will be required to take a personal interest in, and have some professional responsibilities for the building after it has come into use: this helps a great deal in the psychology and team-working of all those involved. Secondly, we have found there is a more relaxed and constructive rapport between future building users, designers, and constructors, partly because of early liaison and partly because there is some confidence that designers and constructors will not just disappear like snow off a dyke at practical completion. Having an office or a space in the building for at least the first few weeks with representatives of the designers and constructors present, and getting good relationships with the building users, has helped a lot. We have not always managed to achieve it, and when we don't, we miss it. As regards the option of having a limited degree of risk/savings shared between the designers, the constructors and the client in relationship to actual running costs in years 2–4, we have only had limited success in getting this set up, partly because this approach is relatively new and partly because, so far, we have wanted to concentrate on the benefits on the fundamental Soft Landings methodology of keeping designers and constructors involved in the building after practical completion – and generally we have found that good professional companies have themselves seen the benefit to them of this approach so that they have not needed to add a percentage to their changes to the client. Before too long, I hope that Stage M of the RIBA system will be restored so that much of the Soft Landings philosophy can be read across to the RIBA framework.

### Design versus innovation

With the current emphasis on reducing energy wastage and making better use of natural lighting and ventilation, building design has to be more innovative. However, the closer design gets to the cutting edge of performance, the more crucial it becomes to get the whole system right: the concept, construction and

correct operation of all components and controls; and the skill, insight and effectiveness of the operation and management regime. Innovation and new techniques often have unintended consequences. For example, if usability is a problem, the occupiers may be unable to operate the systems as the designers had anticipated. While it is important to get as much as possible 'right first time', all but perhaps the smallest, simplest and most standard buildings also need a bedding-in period, where systems can be fine-tuned, problems addressed quickly and mutual understanding achieved more widely. The feedback comes free.

Users occupying new buildings just want to get on with their lives and their business. If teething problems become embedded, even if minor and correctable, irritation and dissatisfaction increase dramatically. Even if problems are ultimately resolved, it can take a long time for the experience to disappear from the occupiers' collective memory.

The unexpected does and will happen. Occupants need help both to avoid getting into trouble and to get out of it. For most construction projects, there is a gap in the scope of services currently provided by the designers and constructors: services that were formulated when buildings were simpler, average skill levels in the industry were higher, mechanical and electrical services were less sophisticated, and client expectations less demanding. Some change or augmentation is now essential.

### Learning from feedback

Feedback of experience is particularly important in buildings as they are largely customized products of which the prototypes are built and occupied. However, the construction industry has been slow to learn from buildings in use because it does not get close to its user clients. The Construction Task Force led by Sir John Egan (1998) reporting on UK construction firms said 'the industry has no objective process for auditing client satisfaction . . .'. Seven years on, there is still little evidence that the industry as a whole has taken this to heart, even where the contractor takes the responsibility for running the project well into subsequent occupation. Generally, services usually stop at 'practical completion' apart from dealing with defects; and even these can be difficult to remedy once the team (particularly the suppliers) has dispersed, while smaller but chronic problems seldom receive the attention they deserve.

Soft Landings provides the means for designers and builders to achieve all-round benefits: to clients, to users and not least to themselves by improving their reputations, retaining more clients, and enhancing their skills and insights. It includes regular monitoring of the actual building performance for the first three years, creating a natural lead-in to POE.

Compared with the many feedback techniques that have developed in the UK and elsewhere, Soft Landings is unusual as it covers the whole process from briefing to design, construction and beyond building delivery into occupation. Other techniques tend to focus on particular aspects of the procurement process, for example as categorized and outlined by Bordass and Leaman (2005). Typically, these centre on briefing (e.g. the Design Quality Indicator), energy (e.g. CIBSE TM22), regulation (e.g. the HOB0 handover protocol) (Graves *et al.*, 2002) or POE (e.g. Probe). As a ‘process carrier’, Soft Landings can both stand alone and provide a framework for bringing in one or more of these techniques at the appropriate stages if they are deemed necessary to enhance the process. Based as it is upon field experience, the strength of Soft Landings is not by relying on any single course of action, but by anticipating problems and making sure that ‘safety nets’ are in place to deal with anything that slips through. With Soft Landings, learning and sharing feedback is a contractual obligation and not optional (when it is unlikely to happen). It also involves both the supply and demand sides equally.

Not only are buildings becoming more complex, but also regulation (particularly of energy and environmental performance) is adding to the pressure to ensure much greater predictability of the end product. Procurement routes that claim to reduce or remove some of the burdens of delivery and running the building rarely attempt to deal systematically with the soft issues that affect the comfort and satisfaction of the users and the effective use of their new ‘home’.

POE has its part to play and helps us understand where things fall short of expectations, but it is inherently retrospective. Meanwhile, users have often been reluctant participants in sharing the design team’s ‘learning curve’ and they may not be able to make use of the insights gained for some time, if ever.

There is talk of a ‘zero-defects’ approach to construction. Comparisons are also made with the supply chain management techniques used by the automobile industry. However, these ideas do not take proper account of the true characteristics of the industry. Construction builds prototypes, which creates a need for follow-through and feedback. However, traditionally the industry is appointed to build a product and not to examine how it performs, and so perhaps inevitably has a low customer focus. Any change will have to be both pragmatic and incremental.

### How Soft Landings works

Soft Landings focuses on the need for more involvement of designers and builders during and after the

handover of buildings – where under traditional forms of procurement the contractual obligations of the project team are minimal. It aims to get better buildings, which achieve far closer matches between the expectations of the client and the users and the predictions of the design team. It also helps occupiers to get the best out of their new or improved buildings and to reduce the tensions and frustrations that so often occur during initial occupancy. There is also an option to add a financial incentive for meeting agreed targets for performance in use.

Soft Landings is spelt out in detail in a licensed Scope of Service document set. It can stand alongside most orthodox procurement systems: wide-scale revision of industry-standard documentation is not necessary. The added services include the following:

- greater clarity of the duties of all parties during key stages
- increased designer and constructor involvement before and after occupation
- a resident Soft Landings team on site during the users’ initial settling-in period
- monitoring and review of building performance for three years.

Soft Landings affects three critical stages: briefing/programming, handover and aftercare, as summarized below and as set out in detail in the Preambles and Work Plans of the Scope of Service. Activities during critical stages of the design and construction process and the method and subjects of actual performance measurement are defined in a series of Work Stage Programmes.

### Who gains?

The advantages for the client are clear enough. For those on the supply side, they include the following:

- greater clarity and better communication during briefing and early design stages reduces ‘rework’ by the design team
- more effective building readiness
- better fine-tuning to improve the product, its performance and the experience of the building for both the client and the users
- better feedback to improve future products.

Involvement after handover also facilitates a natural route to building evaluation.

## Stage 1: Briefing stage

Too often the seeds of future discontent are sown early on. The more time there is for constructive dialogue, the more is chance of success. To get the most value from Soft Landings, it is vital that the expectations and performance targets that emerge from this stage are arrived at within a well-structured, logical and recorded context. The following key items help ensure that critical issues are not lost along the way:

### Definition of roles and responsibilities

Roles and responsibilities must be set out clearly from the very beginning, for both the ‘supply side’ design and building team and the ‘demand side’ client team. This will highlight any gaps and possibly even the unsuitability of individuals in their assumed roles.

### Intermediate evaluation workshops

Workshops during the briefing and early design stages can flush out misconceptions on all sides, ensuring that stakeholders are fully engaged and that input from key users is not lost en route. They also help to fix decisions incrementally on many small, but important, issues.

### Sign-off gateways

Premature decisions can blunt innovation, but leaving loose ends undermines the ability of the project to achieve optimum success. Sign-off gateways create the structure for fixing decisions. Different criteria are applied depending whether the gateway is being entered or left.

### Setting environmental performance targets

All targets have to be unambiguous, measurable and of some value. Remember that:

- some common sense must be applied to averaging out expectations
- good outcomes increasingly depend on good electronic control and management systems, effectively used
- design solution must be within the ability of the users to control it.

Before the design starts, it is vital to agree what expertise the occupiers are likely to have to operate, maintain, and control mechanical and electrical systems and other moving parts, so that ‘design for manageability’ can be realistically undertaken (Bordass and Leaman, 1997).

## Incentives

An independent occupant survey forms part of the Post Handover Aftercare stage. This will be benchmarked against the survey database and against client and design intentions (if possible calibrated with a ‘before’ survey) and the results published. Any problem areas will be identified and actions to help improve the situation agreed.

A financial incentive could be attached to the achievement of the environmental or energy performance target – giving a reward to the design and construction team if the target is met and a penalty if not (subject, of course, to appropriate allowances for the use and management of the building). Arrangements must be kept simple, or any potential advantages will be overwhelmed by attempts to make them legally bullet-proof, or by counter-productive defensive action by any of the parties involved. The authors recommend that users start without financial incentives and grow into taking such responsibilities once they have become confident in the system and in the performance that is capable of being delivered.

### Getting facilities management plugged in

Often in-house teams are under resourced, under pressure, understandably reluctant to move away from what has worked before, and only get introduced to a new building at or shortly before handover. Instead, the individuals who will operate the installed systems need to be involved from the outset. They will then gain confidence in the team and have more ownership of the product; and design solutions can be tailored more closely to the ways in which they need to work.

Early dialogue with Facilities/Estates Management (FM/EM) will often include the following:

- regular maintenance issues, e.g. frequency, cost and access requirements
- access and safety generally
- spares and furniture storage
- deliveries, recycling and waste disposal
- security; people and personal transport
- soft and hard landscape maintenance
- management and user interfaces for engineering and control systems.

## Stage 2: Pre-handover

When it is time to occupy a new building, expectations are often high; as are tensions associated with the

trauma of moving. Users want to 'get back to normal' as quickly as possible. Too often, a host of relatively minor problems will go unresolved and overwhelm the goodwill that has been built up with the team during the long slog to reach this point. Potential success is not only parked (or lost), but also the credibility of the new 'home' (and anyone associated with it) can easily be terminally damaged. The following key factors are spelt out in the Soft Landings Preambles.

### **FM training**

It is essential that there are no reasons why the facilities management team cannot assume the operation of the project in a timely fashion. Too often training up (and even recruitment!) is left until after Practical Completion.

### **BMS and controls interface completion and demonstration**

Many of the common post-handover problems can be traced back to inadequate demonstration of interfaces and systems. In addition, too often these interfaces have not taken proper account of the real needs of the operators and users. Time spent on discussion during the briefing, design and installation stages, followed by demonstration and training by the Design Team and key constructors, will avoid problems and assist future cooperation.

### **Migration planning**

Plans for moving in are often affected by business activities at the time, which are often unknown to the design and construction team. A relatively small involvement by those providing the building in the occupier's logistics planning can help minimize the inevitable upset to users caused by unforeseen clashes between organizational priorities and site activities.

In the run-up to handover, a 'migration' team needs to be established, separate from the technical snagging team. This will include representatives from the estates/property team, the users, the design and construction team, the FM/EM team, and the removals team. Its purpose is to minimize the irritation of occupiers before, during and in the first few weeks after moving. Its tools include careful planning to avoid problems and having remedial plans in place to deal with any which still arise.

### **Communication**

A user guide to the building is invaluable. It illustrates how the building has been designed, how it is intended to work, where to get help and how to operate the local control facilities for heating, lighting, ventilation, etc. This needs to be written in consultation with

representatives of the users in order to maximize its relevance to them.

A regular contribution to the client's company newsletter not only sustains interest in the project, but also helps dispel the usual rumours that thrive on a lack of information. The move must be portrayed positively – highlighting the benefits to users and the business. Everyone will have presumed the downsides and knowing people are trying to relieve the pain is reassuring.

### **Stage 3: Aftercare during the first weeks of occupation**

The primary focus of this stage is for people to be available on site after handover, to assist the occupiers, and to help prevent minor problems developing into longer-term chronic irritants for the users and client alike. It is also an opportunity to observe and learn from initial feedback and problem-solving.

### **Aftercare team and its 'home'**

It is crucial that design and construction team representatives not only help to ease the lives of the users during the first weeks of occupation, but also are seen to be doing so. They need a regular presence on site (this will depend on the size and complexity of the project and the rate of moving in, but is typically two days per week for six to eight weeks; and may be more to start with). An accessible and preferably visible 'home' must be prearranged and available from the first day of occupation.

The resident team will include a key liaison person (often the architect), with regular support by other team members, in particular the building services contractor, designers and commissioning engineers, and, of course, the building's facilities manager. Team members should have good 'people skills', a hands-on approach to problem-solving and continuity with the project. This is not an administrative or superficial marketing exercise (though much goodwill can be generated). Being seen to be on the users' side helps a lot – and it ensures a meaningful invitation to the official opening.

### **Building user guidance**

The User Representative must organize informal Focus Group user meetings, at which Design and Construction Team members explain why they are there, present key information (e.g. the Building Users guide, the Helpline/Bulletin Board, etc.), report on progress, and deal with questions and comments.

**Technical guidance to operators**

Initial guidance should have been given before move in. However, more support is often needed to take account of issues that emerge over the first eight weeks of operation, and to brief new people who may have transferred as part of the move.

**Communication**

An email ‘helpline’ is used to assist with marshalling the day-to-day problems that arise, with regular team coordination meetings to help ensure ‘balls are not dropped’. Problems raised and solved are recorded for future feedback. Publishing progress and success in a positive manner help. People like to know that somebody cares, no matter how minor the remedial action was. A public folder on the company network is simple and effective.

**Celebrate success**

Finally, there should be a ‘house warming’ party, preferably in the new building, so that plaudits can be fairly acknowledged. If there are any remaining difficulties, these should be acknowledged too, so the occupants know that work is in hand. All this will help ensure that the new building, its sponsors, occupiers and creators are seen in a worthwhile light.

**Stage 4: Aftercare during the first three years of occupation**

After the migration and aftercare period (typically eight weeks), the Facilities Managers must become completely responsible for operating the building – though they are sometimes reluctant to grasp this particular baton. In conventional projects many have been reluctant even to enter into maintenance contracts until the end of the Defects Liability Period – leaving fertile ground for argument about whether a failure was due to the design, the construction or the occupier’s ignorance and neglect.

The on-site presence of design and construction team members will taper off quickly, but regular reviews will continue. The primary focus in the first 12 months is on settling everything down, fine-tuning (with seasonal tuning of heating and cooling systems) logging usage and change, and reviewing the internal environment, occupant satisfaction and energy performance in relation to design targets. In the process, the team can also help the operators get the best out of the building, and check that they and the monitoring are being resourced properly.

When the traditional Defects Liability Period is complete (normally at the end of the first year), the emphasis in Years Two and Three will concentrate on recording the operation of the building and reviewing performance. An independent Occupant Survey will

occur during the first part of Year Two and will help to inform future action: if responses do not reach the target levels agreed at the outset, the design and building team will be obliged to investigate the problems and report on the potential for improvement.

**Logging environmental and/or energy performance**

The Facilities Manager must take the lead in monitoring energy consumption and usage. For large UK buildings with utility meters, half-hourly electricity readings are often available from the supplier. These (together with the submeters now required in the UK for larger, new non-domestic buildings) can be very helpful when analysing usage patterns. Regular review meetings will continue.

**Record fine-tuning and usage change**

Allowing for seasonal change, after nine months or so of moving in, a pattern in the usage and performance of the building will begin to emerge. Dependable comparison of actual and forecast performance will be impossible without regular recording of changes by the Facilities Manager. The Operation and Maintenance Manuals will also need to be kept up to date to reflect changes to systems and equipment.

**Helpline/newsletter**

The email helpline should continue, but updates will be less frequent and may cease before the end of Year Three if felt appropriate. Publishing issues arising and the results of investigations and interventions on the company network also continues.

**Walkabouts**

Regular visits to the site to monitor performance will still happen and can be invaluable for spotting abrupt or emerging changes that may otherwise go unnoticed. For example, changes in energy usage compared with the forecast can sometimes be traced to unexpected sources.

For example, at a large-scale world headquarters project, it was noticed that the trees in the internal atrium were growing unexpectedly vigorously and needed pruning earlier than planned. It emerged that the default control for the lights around the atrium had been switched to constant when a company team was working around the clock – and no one had ever changed the settings back!

**Closeout review**

A final closeout review is held at the end of the Soft Landings period. This is the opportunity for a properly structured wrap-up of lessons learned for future collaboration.

## Conclusion

Post-occupation studies have shown how little can be taken for granted. Buildings are not automatically airtight, plant efficient or controls usable or effective: they have to be made that way. In use, few things are completely 'fit and forget'; they also need to be operated, maintained, reviewed and checked. The best results tend to be where monitoring and feedback forms part of the culture. However, learning from feedback is not yet embedded in many processes affecting the procurement and use of buildings. 'Making knowledge sharing a common principle and remembering peoples' needs' (Birkinshaw and Sheehan, 2002) is not on the radar of nearly enough firms and individuals in the industry.

The current environmental initiatives and regulation are an opportunity to change the process and achieve better all-round value. But to do so, we all need to become better informed on how buildings really work and where true value needs to be added. Soft Landings provides a means for designers and builders

to do this, providing all-round benefits: to their clients, to the users, and not least to the design and building team, by improving their reputations, retaining more clients, and enhancing their skills and insights.

## References

- Birkinshaw, J. and Sheehan, A. (2002) Managing the knowledge life cycle. *MIT Sloan Management Review*, 44(1), 75–83.
- Bordass, W. and Leaman, A. (1997) Design for manageability. *Building Research & Information*, 25(3), 148–157.
- Bordass, W. and Leaman, A. (2005) Making feedback and post-occupancy evaluation routine. 1: A portfolio of feedback techniques. *Building Research & Information*, 33(4), 347–352.
- Egan, J. (1998) *Rethinking Construction: The Report of the Construction Task Force*, DETR, London.
- Graves, H., Jaggs, M. and Watson, M. (2002) *HOBO Protocol – Handover of Office Buildings Operations*. BRE Digest No. 474, BRE Bookshop, London.
- Preiser, W. and Vischer, J. (eds) (2005) *Assessing Building Performance*, Elsevier, Amsterdam.