Soft Landings for Schools

Technical Report on the Case Studies

Feedback from use of the Soft Landings Framework in new schools

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SOFT LANDINGS FOR SCHOOLS PHASE 1

FINAL TECHNICAL REPORT ON THE CASE STUDIES

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EXECUTIVE SUMMARY

Soft Landings has completed its Phase 1 trial on school building and alteration projects. All participants have found it helpful and plan to make more use of it. Partnerships for Schools (PfS) is also considering its use in the schools programme.

There is a major policy imperative to make our buildings perform radically better and much more sustainably. It will be impossible to meet these expectations reliably unless the service given by the industry also changes, with more focus on actual performance in use. *Soft Landings (SLs)* is a process that can help this to happen: when formulating the brief, during design and construction, and especially before and after handover. Soft Landings can be used with any procurement system, and for all types of building work, including new construction, refurbishment and alteration.

The case studies outlined in this report tested the applicability of the SLs *Framework* (published in July 2009) on school projects that a team of practitioners (architects, engineers, project managers and builders) were working on or had completed. The results are encouraging. The organisations involved were already undertaking some SLs activities but found good reasons for doing more. The approach of the SLs *Framework* also helped projects they were working with to take a more unified approach and to bring together previously disparate elements. Valuable insights have been gained, and all team members have decided to make more use of Soft Landings on future projects.

During the design and construction stages, the case studies revealed:

- A clear need for client involvement and commitment from the very beginning of a project.
- The potential to incorporate SLs within normal project management responsibilities. However, because project managers can easily become preoccupied with matters of cost and time, it was suggested that another team member of members should be given the role of SLs Champion, and so help to ensure that the agreed Soft Landings activities receive proper attention.
- A need for closer integration of specialisms (in particular ICT, catering and FM) with the work of design and building teams, to avoid problems, improve performance and cut running costs.
- The prospect that SLs will pay for itself during design and construction, owing to the efficiency gains from a clearer focus and better integration. However, it is also necessary to programme and budget for the agreed activities, and there is a learning curve to be paid for.

In the initial aftercare period immediately after handover, the case studies revealed:

- Major opportunities for making operational cost savings, achieving better occupant satisfaction, and reducing environmental impact. Some projects had been able to realise these. Others identified missed opportunities, owing to insufficient aftercare and FM commitment.
- Recognition by design teams of the value that SLs can add: in building relationships, passing on knowledge, identifying and solving problems, and closing the feedback loop.
- Some contractors were also interested in improving the handover process and in providing initial aftercare, to help improve the quality of their offering and avoid expensive call-backs.
- In spite of this, it proved difficult to fund activities after practical completion, except in phased projects where the design and building team remained on site and the benefits were clearest.

The case studies included longer-term aftercare and post-occupancy evaluation. It proved particularly difficult to organise and to fund these, a matter that is in need of urgent attention:

- Although the advantages of aftercare are clear, the rigid splits that occur between capital and operational expenditure make it difficult for clients to find budgets for these important activities, in spite of the emphasis given to whole life costs in the Treasury's Green Book[1]. The situation is exacerbated by rules and processes that assume one particular way of doing things.
- Many clients felt that the industry should do this as part of their normal service, but the period extends well beyond the normal contractual time horizons of designers and contractors.
- While some team members are already undertaking some post-occupancy activities in order to improve and differentiate their services, this is not the same as engaging the whole team.

Some participants felt the *Framework* was too open-ended. This was intentional. It was written to be relevant to all sectors, all projects (new and alteration) and any procurement route in any country. It was felt best for specificity not to be imposed, but to evolve to suit the context. In the case studies, the fact that teams could review the *Framework* and choose what suited them proved to be a strength: a more rigid approach could easily have been rejected. There may now be a case for developing more specific guidelines to suit the Building Schools for the Future programme; and the team is discussing this with Partnerships for Schools.

[1] HM Treasury, *The Green Book: Appraisal and evaluation in central government,* (TSO, 2003).

1 BACKGROUND

1.1 INTRODUCTION

There is a major policy imperative to make our buildings perform radically better: for people, in terms of value for money, and for the environment, energy use and greenhouse gas emissions. To meet these expectations, the service given by the industry will also need to change, to address what are often major discrepancies between expectations and outcomes[2]. Designers and builders will need to stop going away at practical completion and instead spend time helping occupiers to get the best out of their new or refurbished building. They should review performance in use, get involved in troubleshooting and fine tuning, and take the lessons back to their organisations and the industry.

1.2 SOFT LANDINGS

Soft Landings (SLs) can help everybody to get better buildings by focusing the design, construction and commissioning process more sharply on obtaining good performance outcomes in use. SLs helps to pass on knowledge, capture learning from experiences, reduce credibility gaps between expectations and outcomes, and provide a vehicle for post-occupancy evaluation (POE), feedback and continuous improvement. SLs is not an alternative procurement system: it is a set of attitudes, principles, and techniques that can be incorporated within any procurement system.

SLs was initiated by architect Mark Way. The idea was taken up by the Estates Department at Cambridge which supported research led by Mark in 2002-04. UBT (the Usable Buildings Trust) was also involved and sought ways to bring SLs to a wider audience. In 2008, BSRIA (the Building Services Research & Information Association) offered its support to Mark and UBT to set up an industry group to explore whether SLs could become more mainstream. This led to the SLs *Framework* publication in July 2009[3], which sets down some principles but was deliberately not made too specific owing to its potentially wide application nationally and internationally.

1.3 SOFT LANDINGS FOR SCHOOLS PHASE 1

The industry group recommended that further work should focus on testing the *Framework* with a particular UK sector or client. After a meeting at DCSF, UBT and BSRIA decided to concentrate on schools. UBT then brought together a team of organisations that were active in designing and building schools and keen to explore the potential of SLs. The original members were:

- Buro Happold, engineers.
- Davis Langdon, project managers and cost consultants.
- Feilden Clegg Bradley Studios, architects.
- Max Fordham, building services and environmental engineers.
- Willmott Dixon, contractors.

Technical support was provided by UBT and BSRIA. BCSE (the British Council for Schools Environments) also provided input and hosted a meeting with Local Authorities and Heads at CABE on 25 November 2009. In the course of work, other organisations became involved, in particular Aecom, Ann Bodkin Sustainability + Architecture, Architype, Arup, Building Design Partnership, King Shaw, Kier, Penoyre & Prasad and Ryder Architecture. Further input has also been provided by local authorities and by members of the industry group hosted by BSRIA. The team has also kept in close touch with Partnerships for Schools (PfS). On 25 November 2009, PfS announced its intention to pilot SLs on some projects in 2010-11, and team members have been helping them to prepare its plans.

1.4 ACKNOWLEDGEMENTS AND THANKS

Soft Landings for Schools Phase 1 was funded by the Technology Strategy Board (TSB), with additional financial support from Architecture+Design Scotland, CABE and Willmott Dixon Re-thinking. In-kind contributions of time were also provided by BSRIA, Davis Langdon, Willmott Dixon, UBT volunteers (especially Michael Buckley) and by individual team members and their organisations. UBT thanks everybody for their generous contributions of time and money.

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[2] For example, while the government target is for schools to be zero-carbon within a decade, new "low-energy" schools recently monitored are commonly found to be using two and even three times the amounts of electricity predicted.

[3] The *Framework* document is available as a free download from www.usablebuildings.co.uk and www.softlandings.org.uk .

2 SCOPE OF THE CASE STUDIES

2.1 SOFT LANDINGS REQUIRES FORETHOUGHT

Some people regard Soft Landings as something that starts after handover, with engagement of the design and building team in aftercare, performance monitoring, review, fine tuning and feedback. This alone is not enough. SLs requires a change in attitude and approach - what UBT calls *a new professionalism* - which influences the whole procurement process and lays the foundations for effective aftercare. The design and building team needs to focus on outcomes[4] from the very start, obtain more input from users, and work more closely with the people who will operate the building.

2.2 THE FIVE SOFT LANDINGS STAGES

The Soft Landings *Framework* document identifies five main Stages in need of more attention:

1 Inception and briefing.
2 Managing expectations during design and construction.
3 Preparing for handover.
4 Initial aftercare in the weeks immediately after handover.
5 Extended aftercare, post-occupancy evaluation (POE) and feedback during the first three years of occupancy.

2.3 SOFT LANDINGS AND PROCUREMENT PATH

SLs aims to focus any team or organisation more clearly on outcomes, and join up people and activities which in the past have been too separated. Without such integration, current trends[5] risk fragmenting yet further both the skill base, the communication between the various players in the design and building team, the connections with building occupants and management; and the follow-through from construction into operation. In turn, this will inhibit the feedback that is essential for so-called innovations to be directed purposefully at what really needs improving. A trend to greater independence is also likely to cast many schools adrift, with no inbuilt support from either a FM provider or the local authority, making the need for a process such as SLs even more acute. Early involvement of specialists, in particular ICT providers, is also important: they have often been kept separate in schools projects, and this has led to problems downstream.

One might think that processes like the Private Finance Initiative (PFI) would already include all SLs activities, but this tends not to be so. Within a PFI package one often finds conventional divisions of responsibility, still in need of means of unification; and sometimes with contractual arrangements that distance the providers of buildings yet further from their users. However, with their broader remit, PFI teams are becoming more aware of the benefits SLs can offer.

2.4 FRAMEWORK FOR THE CASE STUDIES

Firms participating in the project were invited to propose case studies that concentrated on one or more of the five Stages in the SLs *Framework*, at one of three different points in time:

- PAST. Things team members had already done, not necessarily as part of something called Soft Landings, but which could contribute valuable experience or useful techniques.
- PRESENT. Where team members, or other members of the teams they were working on, could apply SLs principles to projects currently underway, or were already applying them.
- FUTURE. Considering how to utilise the SLs approach in future projects.

2.5 MAPPING THE CASE STUDIES

Figure 2.1 introduces the case studies, in order of their appearance in the report, which follows the five main Stages of Soft Landings. In our initial planning, the team attempted to get an even distribution over these five Stages and between past, present and future. In the event:

- The coverage was patchier, especially for ongoing projects where, whatever the merits of SLs, clients and colleagues found it difficult to change processes that were already underway.
- Several of the teams dedicated their case studies to reviewing the SLs process as a whole, by evaluating their current processes, recent projects and/or future plans against the guidelines and tables contained in the SLs *Framework,* and identifying opportunities and barriers.

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[4] Outcomes are not the same as outputs. An output is what gets produced. An outcome is how things actually turn out.
[5] e.g. more refurbishment projects, Design and Build procurement and Academy projects.

TABLE 2.1 OVERVIEW OF THE CASE STUDY WORK

Report Para.	PROJECT and STAGE	INITIATOR and STATUS	ACTIVITY	OUTCOME
	STAGE 1 – INCEPTION, INCLUDING OVERVIEWS OF THE WHOLE PROCESS			
3.2	Joseph Leckie School, Walsall.	Willmott Dixon. Occupied in June 2009.	Review of lessons learned and the appropriateness of SLs for future activities.	Opportunities identi-fied for SLs to shape future work.
3.3	South Tyneside and Gateshead (STaG) school building and refurbishment LEP programme.	Ryder Architecture. Major ongoing programme.	Review of the SLs activities already included within the programme, and whether more can be done.	Plans to do more, but some concern about extended aftercare period.
□	Incorporating findings from post-occupancy evaluation in new school projects.	Buro Happold. Continuous improvement in design.	Using understanding of performance in use to influence priorities in engineering design and teamwork.	Preference for simpler technical solutions to avoid unmanageable complication. Need to tackle unoccupied loads and ICT.
	STAGE 2 - DEVELOPMENT			
5.2	Southwark schools PFI programme.	Buro Happold. Major ongoing programme.	Proper definition and management of energy and carbon performance to meet the 27 kg of CO_2/m^2 target.	More effective procedures including early involvement of ICT and catering.
5.3	Sustainability review process.	Feilden Clegg Bradley and Max Fordham	An approach which allows design targets to be established and kept under review.	Adopted on a number of projects by these two firms.
	STAGE 3 - PRE-HANDOVER			
6.2	Hackney City Academy	Max Fordham. Handed over in summer 2009.	Improved pre- and post-handover processes, SLs Stages 3 and 4.	SLs principles partly implemented, but too late for major impact.
6.3	Estover, Plymouth	Feilden Clegg Bradley Studios with Kier.	Managing a phased handover process with a design-and-build contractor.	SLs has informed the process, with design and spec. changes.
6.4	RSA Academy, Tipton, Sandwell	Davis Langdon. Handover in summer 2010.	Review of progress in relation to SLs and lessons for the future.	SLs approach would have helped, and will assist Stages 3 and 4.
6.5	A new secondary school and a primary school to be refurbished in phases.	Buro Happold. New school handover 2010.	Retrofit of SLs, with concentration on handover processes.	It proved too difficult to retrofit SLs into existing arrangements.
	STAGE 4 - INITIAL AFTERCARE			
7.3	Hackney City Academy	Max Fordham, initial year	Raising awareness of staff, students, and FM.	Starting, six months later than anticipated.
□	City Academy	BSRIA. Handed over in 2008.	Attempt to retrofit the initial aftercare period to improve performance. Some problems resolved, but some difficulties in obtaining support.	Reinforces the need to adopt SLs at an early stage and of commitment by contractors, FM and Governors.
	STAGE 5 - EXTENDED AFTERCARE			
8.2	Performance review of a "green" primary school.	BSRIA. School in operation for five years.	Predominantly a survey of energy use in operation.	Sources of wastage identified, with wider implications.
8.3	Long term energy performance of City Academies.	Buro Happold. Schools in use for 4 to 6 years.	Revisits to City Academies that had been reviewed in 2005-07, and some others.	Opportunities taken to reduce electricity use, especially from ICT.
8.4	Routine adoption of Post-Occupancy Evaluation processes for all schools projects.	Feilden Clegg Bradley and Ann Bodkin. In the fourth year of operation.	A new method has been developed and tested at Northampton Academy. It focuses on students, items of architectural interest and CABE's ten points.	The method has proved successful and complements existing techniques.

3 CASE STUDY RESULTS – OVERVIEWS OF THE WHOLE PROCESS

3.1 OVERVIEW

In the overview Case Studies, teams reviewed arrangements for existing or future projects against the suggestions in the SLs *Framework*. The results were encouraging.

- As revealed in case studies of individual Stages, many teams found they were doing some of the proposed activities already, and that a SLs perspective helped to shape their efforts, reveal gaps and overlaps, engage more team members, and identify how projects could be better integrated.
- The response was especially positive in phased projects, where the value of carrying learning forward from early to later phases was most immediately apparent[6]. Here aftercare was also easier to provide, as the building team remained on site and designers were visiting regularly.

Unfortunately, it proved much more difficult for clients for single-phase single-projects to accept the idea of aftercare and feedback. In spite of the evidence of value added, they tended to regard aftercare as an extra cost, with the benefits most likely to accrue to the design and building team and to their future clients[7]. Why wasn't the construction industry doing it already?

3.2 WILLMOTT DIXON RE-THINKING – JOSEPH LECKIE SCHOOL, WALSALL

3.2.1 Willmott Dixon is the contractor for a phased redevelopment of the Joseph Leckie secondary school in Walsall. It is being procured using the SCAPE consortium's partnering framework, in which the whole project team is appointed at the earliest stage and contributes to briefing and design. Phase 1 – a 2400 m^2 building with atrium, classrooms, staff accommodation, meeting rooms and a drama studio - was handed over on 1 June 2009, with zero defects and ten weeks ahead of programme.

3.2.2 In November 2009, Willmott Dixon (WD) chaired a *lessons learned* workshop with the project team, design team, Walsall Children's' Services, the Head, support staff and the FM contractor (Serco). The project was reviewed against the activities in the five SLs Stages, as summarised in the tables in the *Framework* document. The workshop concluded that:

- SLs was as a positive step. The project had already covered many aspects, but not all.
- The SLs approach itself also helped to structure the workshop and capture the learning.
- The SLs *Framework* needed to be adopted on all projects as continuous improvement.
- As a first step, the team agreed to adopt SLs for the next phase at Joseph Leckie School.

3.2.3 More detailed comments at the workshop included, by SLs Stage:

- **In Stage 1,** it was vital to consider roles and responsibilities, and to take account of the abilities of the FM team. In future projects, SLs could be introduced at the *lessons learned* start-up workshop that WD now does routinely. These workshops also needed to put more emphasis on identifying and avoiding past shortcomings. There should also be a sustainability workshop.
- **In Stage 2***,* the designs had been reviewed by a board outside the project. In future, the team recognised the benefit of widening the range of stakeholders present, and to include FM staff.
- **In Stage 3,** scope was recognised for tighter pre-handover procedures, including logbooks and user guides. It would also be useful to identify "buddies" between members of the design and building team and members of the operating staff, who would be encouraged to compare notes.
- **Stages 4 and 5** were not complete, and so not were not reviewed in detail. Points raised included a need for well-minuted reviews and follow-ups; and the difficulty of finding suitable workstations for the aftercare team in many school buildings.

3.2.4 Individuals also drew attention to:

- *Briefing*. It was important for briefs to be clear and robust, and to include room data sheets.
- *ICT*. This needs earlier involvement, better understanding, better handover, and more support.
- *M&E* needs early involvement of consultants, better handover, training and user understanding.
- *Communication*. While there are great benefits from working together, this approach also brings a need for effective structures and protocols.

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[6] At a meeting with Local Authorities and Heads organised by BCSE, the Head of a school in Wolverhampton and the Council's project manager discussed their experiences with a combined site that included a primary school (just handed over) and a special school (under construction). They drew attention to shortcomings in facilities management, ICT and catering, which were echoed by other team members, in the case studies, and at other meetings.

[7] In fact, benefits from better communication and from fine-tuning a building can be enormous. But the opportunity is often hidden.

3.3 RYDER ARCHITECTURE – STaG SCHOOL BUILDING PROGRAMME

STaG is a partnership between South Tyneside and Gateshead Councils to deliver the Building Schools for the Future (BSF) programme through a Local Education Partnership (LEP), with *inspiredspaces,* the private sector partner. In the current wave of the BSF programme, the LEP is delivering nine secondary schools, with a total area of approximately 100,000 square metres. Four schools for special educational needs may also be added. The secondary schools are either new build PFI or refurbished through a design and build contract. The LEP is also delivering ICT through a managed service to all schools across the project and providing FM services to the new build PFI schools for the life of the 25 year concession contract. Construction work is being carried out in three phases. The first school started on site in January 2008 and all schools will be open to pupils in 2012. The LEP will provide further new schools for Gateshead in subsequent waves of the BSF programme. The LEP is also delivering Primary Capital Programme Projects and may also deliver other community regeneration projects, subject to approvals.

3.4 STaG - INITIAL REVIEW BY THE ARCHITECTS

Ryders, architects for STaG, first reviewed projects at different stages, in order to establish which items identified in the SLs *Framework* were already part of the STaG process, which were not, and what difference the Local Authority and the LEP felt that adopting SLs would have made.

An initial workshop with the Design Team in September 2009 revealed that:

- *In Stage 1,* there were opportunities to define roles and responsibilities more clearly, to join things up, and to share lessons from former projects more effectively.
- Insights from SLs could give more structure to STaG's project reviews, and the topics covered.
- STaG also included sign-off gateways, but there could have been more - perhaps with an informal process, reviewed at meetings of Principals.

- *In Stage 2,* design reviews and peer reviews had been held, but not systematically.
- Buildability and manageability was thought to have been covered well in client and design team discussions. Usability had not.

- *Stage 3,* pre-handover, had been left very much to the contractor. There was scope for improved procedures to keep the design team informed and to provide sign-off information for the client.

- *In Stage 4,* the reality varied: some PFI contractors wanted to learn from in-use performance, but Design and Build contractors were not necessarily motivated to follow through.

- The team saw a need for work on introductory guidance, definition of responsibilities, and a more formal approach to walkarounds, which had tended to be casual and unstructured.

- *Stage 5* was not currently included in programme activities, but SLs offered a good framework for incorporating POEs and integrating them more closely into processes for monitoring and improvement.

- It was felt that the client should take more responsibility for extended aftercare and POE, because this extends well beyond the normal Defects Liability Period.

While appreciating the advantages of SLs, the design team felt that it would incur significant additional cost and resource[8]. This made the ownership of and commitment to SLs particularly important, and emphasised the need for proper involvement by all parties, especially clients.

[8] The costs and benefits of SLs are being studied in more detail by the Soft Landings user group at BSRIA. The conclusions to date are that during briefing, design and construction SLs affects the way in which things are done, but that any associated costs are likely be compensated by efficiency gains. However, after handover, there will be additional costs to the design and building team, and for independent evaluations. These costs are modest (a small fraction of one percent of total building costs), but they will still require a budget. This is where problems tend to arise. During the first three years of operation, the benefits of SLs in more effective, efficient and economical building performance will normally cover any additional costs. However, in spite of the undoubted benefits, existing client, industry and funding practices can make it surprisingly difficult to fund this aftercare from either capital or operational budgets, especially with the current economic stringencies.

3.5 MORE DETAILED REVIEW BY THE LEP AND THE DESIGN TEAM

In a second meeting, members of the LEP and the design team audited the STaG process in relation to the SLs *Framework* to determine:

- which elements were already incorporated in the process, and the benefits they had brought;
- which elements had not been incorporated, and the potential impact of including them; and
- potential barriers to the adoption of the complete SLs framework.

3.5.1 **Stage 1** – Inception and Briefing

At the competitive bid stage of the project, not all roles could be clearly defined, because the local authority had its own internal structure of which the bidders could not be aware, owing to commercial sensitivity. Equally, the local authority was unable to know what everybody did in all the teams. It was also difficult to share understanding and learning from previous projects.

Once the bid had been accepted and the LEP established, everything changed:

- The roles of everyone within the team were established, defined and communicated.
- There were opportunities to review past experience. As the STaG programme advances and more schools are built or refurbished, further opportunities for learning continue to arise.
- Stakeholder engagement has been significant, meaningful and useful on all projects, helping to shape both aspirations and targets. Stakeholders have been engaged throughout the process and had opportunities to participate in briefing, design development, construction and handover.

Many targets and milestones are pre-determined by central government or organisations such as PfS. There was a feeling that these targets could be too general and were not always appropriate for the individual schools within STaG. Where there was the opportunity, the local authority and subsequently the LEP had developed targets that were sensible and specific to the local context.

A traffic light system had been developed by STaG to ensure that milestones and project targets were met as the programme progressed. This also allowed the project team to flag up any issues early on. The LEP co-ordinated the process, but the design team confirmed that they had been fully involved and that they had found the approach beneficial.

3.5.2 **Stage 2** – Design Development and Review

- STaG set-up a number of peer reviews within its process to ensure continued learning and sharing of knowledge between members of the design and building team; and involving specialist contractors and suppliers.
- These reviews and meetings are encouraged and supported by the design champion for the project. Quality measures such as the CABE Minimum Design Standards are also adhered to.
- Information on buildability, usability and manageability are informally collected through continued engagement with the schools once they are in use. This is fed back to the design team and others in meetings. However, all agreed that a more formalised approach to obtaining and using this feedback would be even more beneficial.
- As many end users as possible were involved in the whole design process, and not just those who were to be responsible for operation and maintenance. This allowed them to be part of the decision-making process and to understand why certain decisions had been reached. The input was difficult to manage - particularly during the early competitive stages of the programme - but everyone felt it had ultimately proved beneficial and worthwhile.

3.5.3 **Stage 3** – Pre-handover

STaG recognised the benefits of Stages 3-5 for the SLs approach, running through from pre-handover to extended aftercare. However, issues of contractual responsibility and team continuity affected the extent to which the *Framework* could be followed in practice. For example:

- In a PFI contract, where the team is also responsible for providing FM services in the completed school, it is easiest to plan for effective operation, to work with FM team members from the briefing stage onwards, and to incorporate effective training of FM staff.

- However, where FM services do not form part of the contract, there is a disconnect in the responsibilities of those involved in the project.
- Central control of energy monitoring, etc. was the responsibility of the local authority, not the LEP. The LEP therefore had no direct influence over whether effective record keeping and monitoring would take place. This created a gap in the necessary feedback loop.
- It took a huge amount of time to plan the move of a school into a completely new environment, and to make the migration strategy as effective and efficient as possible. Previous projects were reviewed to capture learning about the move, in order to improve the process for future projects.

Technical and O&M manuals had been produced, together with guides for users. However, it was felt that the user guidance provided needed to be expanded, made more user-friendly, and not to be just about technicalities but how to make the best use of the environment for teaching and learning. The review recommended that resources were sought to allow the LEP and design team to do this.

3.5.4 **Stage 4** – Initial Aftercare

Although not always present on site, senior members of the FM and ICT teams have local offices. A helpdesk has also been set-up, so that people in the school can contact the relevant people when they need to. While informal visits to the schools are made by the LEP and the design team, at present these are not formally registered as aftercare activities. The benefits of more assistance to users was recognised, but this would need greater resource allocations.

The team acknowledged that communication with users after move-in could have been made more effective. It would be very helpful to produce a leaflet or report to welcome people to the new school, and to have a means of keeping them informed about building-related issues. STaG is now considering doing this on future projects.

3.5.5 **Stage 5** – Extended Aftercare and POE

The first schools under STaG were only completed in 2009, so extended aftercare has not yet been addressed. There is no official aftercare team. However, frequent visits and an ongoing relationship within the BSF programme for 25 years ensures that members of the LEP, and to some extent the design team, can be seen and engaged with as they visit the schools informally.

A great deal of monitoring is required within legislation or BSF contracts, e.g. logging environmental data. STaG will follow these requirements, and also has aspirations to carry out post-occupancy evaluations of all their buildings. However, STAG is reliant on the local authority for feedback on the engineering systems performance and energy monitoring. Close liaison is desirable, for the general good.

3.6 CONCLUSIONS FROM THE STaG REVIEW

3.6.1 As part of its processes, STaG was independently implementing many things SLs recommends. In spite of this, the team saw that additional benefits would arise if they were to adopt the whole SLs *Framework*. Where SLs components are currently missing (e.g. communicating with users once they had moved into the building), STaG is now considering incorporating them in future projects.

3.6.2 STaG identified two barriers to adopting the entire SLs *Framework* on a BSF project:

- The first is responsibility. Even with the long-term relationship developed through the LEP, no single person or organisation was available that could take responsibility for implementing SLs across a whole project. At bid stage, the local authority has the greatest opportunity to take this role. Once the LEP is formed, this becomes more difficult; and once the users move into their building, the local authority has much less responsibility than in the past. Unless the scheme is a PFI project, the LEP also regarded itself as unable to take on the role of SLs co-ordinator, as things such as energy monitoring and use were outside their control.
- The second barrier is funding. Everyone agreed about the benefits of a SLs approach, but activities like conducting a POE require additional funding, which is difficult to obtain.
- Some client members expressed the view that the construction industry should be providing SLs as part of its normal service. Why should clients have to pay extra for it?

3.7 BURO HAPPOLD – INCORPORATING THE FINDINGS FROM FEEDBACK

3.7.1 In 2005-07, a research student on a Knowledge Transfer Partnership (KTP) sponsored by the engineers Buro Happold (BH) had investigated the performance of five City Academies for which BH had been the engineers[9]. The insights from these POEs are now being fed into these buildings and into newer projects in which BH is involved[10].

3.7.2 This feedback has influenced not just the engineering itself, but the ways in which projects are organised. For example, BH has successfully advocated engagement of specialist consultants at an early stage, especially for catering and ICT, both of which can have major repercussions on a building's services, internal environment and energy performance, but which are frequently handled in isolation, at a late stage, and very much outside the influence of the design and building team. Proper integration of ICT and catering allows building performance and energy management to be considered fully during design and construction, whilst historically only the parts subject to energy-related building regulations tend to have been taken into account. A comprehensive approach has now become even more important, since there is a national target for new schools to have total annual CO_2 emissions in operation from fuel and electricity used for all purposes for core operating hours and out of hours baseload to be no more than 27 kg of CO_2/m^2. BH is applying this approach to a programme of PFI schools in Southwark, see Section 5.2.

3.7.3 BH has also been reviewing how SLs can be applied to other schools projects in their earlier stages. As reflected in other case studies, the greatest interest is coming from phased projects where the design and building team has a continued presence on site already; and where the benefits of continuity, feedforward and feedback are most readily appreciated by all concerned.

3.7.4 BH has found it more difficult to graft SLs onto single-phase projects at a late stage, particularly where tensions have built up for various reasons, for example owing to delays and/or cost increases. If a project had adopted SLs from the start, it might also have been possible to deal more amicably and creatively with the problems that so often tend to arise. However, where a situation had already become fragile, clients and teams were understandably reluctant to add complications by suggesting changes to the processes already underway.

3.7.5 Buro Happold has learnt from its POE work that the primary energy use and CO_2 emissions from a typical modern school are heavily weighted towards electricity – especially for ICT, and lighting, and sometimes also from special areas, fans, pumps, controls; and from kitchen and other equipment. This contrasts with the DfES 2002-3 figures, which are often used as a benchmark and which are based on returns from all schools. In the stock of older school buildings, the energy required for heating and hot water tends to be much larger, while electricity use is often lower; so the priorities are completely reversed.

3.7.6 A major contributor to the high annual electricity consumption in many recently-completed schools is excessive hours of use of ICT and of lighting, in some instances owing to night security concerns. In many schools computers were also left running at night and through weekends, with no policies for their control or use. Mechanical systems such as ventilation and heating were often also left running for longer than required, partly because the building managers did not have the time, the training or the skills necessary to operate a modern building and its control systems[11]. It should be remembered that schools are generally heavily occupied for only around 2000 hours out of an annual total of 8760, so unnecessary running has a disproportionate effect, with nearly half the annual electricity use often occurring when the building is empty.

3.7.7 User satisfaction was improved where the design and building team had give teachers some basic training in building operation. As a result, the teachers not only understood better how things worked and what adjustments they might need to make, but they also had a greater sense of commitment and motivation from having been more closely involved in the process.

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[9] This work is summarised in I Pegg, A Cripps and M Kolokotroni, *Post-occupancy performance of five low-energy schools in the UK,* ASHRAE Transactions **113**(2), 3-13 (2007).

[10] One of BH's newer academies, has also been revisited by its architects, Feilden Clegg Bradley Studios, see Section 8.4.

[11] UBT's experience is also that the management and user interfaces of these control systems, and their customisation to meet the real needs of the users and management of the buildings, also leaves a lot to be desired.

4 CASE STUDY RESULTS – STAGE 1: INCEPTION AND BRIEFING

4.1 SLs thinking, processes and procedures can be incorporated into a project at any stage. However, as discussed in Section 3, all team members involved in the case studies have found that it is far easier to build a collective sense of purpose if there is shared commitment to SLs from the very beginning. This in turn requires dedicated support from clients, so that SLs can be built into the overall approach to a project and into the conditions of engagement of all team members.

4.2 Not all clients were convinced by the argument that they should take ownership of SLs. For example, in Ryder's case study (Section 3.3), some client representatives tended to feel that the industry should be providing a SLs service anyway. UBT's opinion is that there are practical problems in getting an industry and its clients to break out of entrenched procedures, and that clients are best placed to provide the leadership. At present, SLs is not the industry standard, and clients have not been asking for it[12]. In addition, clients frequently do not make good arrangements for building operators to be appointed and trained, let alone for them to be involved creatively in the early stages in providing advice on making things more manageable.

4.3 There are signs that client attitudes are beginning to change. For example:

- Following the initial SLs research, the University of Cambridge has written aftercare requirements into its specifications, at least during the first year of occupancy. It has found that any additional costs that there might be, were actually lost in the overall spread of tender prices.
- Feilden Clegg and Max Fordham were part of a PFI team bid for a further education project. They responded to a client request for post-occupancy evaluation (POE) by offering a broader SLs approach. Their bid was successful, though it is impossible to tell to what extent the proposal to use SLs affected the client's final choice, if it did at all.
- Hampshire County Council has been considering how the SLs concept can bring together procedures they are currently applying. It thinks that SLs will save money by streamlining the briefing, design and construction process and helping to unify other activities which have previously been seen more as disconnected add-ons. In spite of this, funding conventions could still make it difficult to find the cash for aftercare activities, particularly now local authorities are under heavy pressure to make savings. Some other councils also commented that Hampshire did more in-house than most, putting them in a better position to take an overview, and to transfer budgets between different heads. In local authorities where here less is done in-house, these avenues could be closed, as there are strict standard legal and contractual procedures which assume a particular way of doing things, and which can easily reinforce the rigid (and often highly counter-productive) splits between capital and operating expenditure.
- In selecting teams, clients are recognising the value of Buro Happold's use of insights from its POE work to influence design strategies, e.g. to improve the robustness of its designs and to save money by omitting things that have been found not to work well, e.g. complicated controls.

4.4 The general conclusion from all the case studies was the vital importance of convincing clients to adopt SLs from the very start of a project. This view was reinforced at the stakeholder consultation meetings at which the team's preliminary findings were reviewed with wider audiences: a technical group in October 2009 and local authorities and heads in November. At the November meeting, the team was asked to put some effort into a pocket-sized awareness-raising document that would outline the benefits of SLs for clients, designers, contractors and occupiers, and which could be used to help them spread the word amongst their colleagues. A draft document has now been produced on SLs generally. There may also be scope for one dedicated specifically to schools.

4.5 The benefits of SLs appear to be most readily apparent to clients and teams that have phased projects, serial programmes with frameworks and partnering agreements, or for design-build-operate PFI contracts. In all these, there are good business reasons for the learning to be embedded, which are directly related to the success of the specific project, while any added costs also tend to be lower.

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[12] Even where clients have procurement departments, staff often have a construction background and behave in a similar manner to the traditional one for designers and builders, with a focus on getting the project delivered on time and to budget, little interest in its performance outcomes in use, and a tendency to move on as soon as a building is handed over.

5 CASE STUDY RESULTS – STAGE 2: DESIGN AND CONSTRUCTION

5.1 OVERVIEW

5.1.1 The original SLs research in 2002-04 considered that if the right objectives and processes were put in place during Stage 1 (Inception and Briefing), then the team could be left to manage them during design and construction, and SLs activities could be explicitly resumed in preparation for handover. However, POEs such as Probe have repeatedly revealed how easily performance can drift away from client and design intent, making major credibility gaps between predicted and actual performance commonplace. It is no good blaming the industry for this outcome, which is endemic. However, it is important that we learn from it – by managing expectations better during the process of design and construction; by making comparisons between expectations and outcomes more transparent; and by approaching the whole exercise in a spirit of learning not blaming.

5.1.2 In preparing the SLs *Framework* document, the SLs process was therefore augmented to include Stage 2, *expectations management during design and construction*. Since it had not been dealt with explicitly in the original concept and research, the *Framework* charts Stage 2 less well charted than the four other stages; and coverage in the case studies is limited. Nevertheless, there has been some valuable thinking, together with examples of what might be done:

- There was widespread agreement that SLs requirements needed to be built into the system of project management for all projects, so that expectations could be managed routinely.
- However, project managers tend to give priority to cost and time. Quality can suffer.
- Quality can also be undermined by "value engineering", which in practice often seems to be more about capital cost reduction than achieving good life cycle value; and can easily strip out features that POEs have shown to be vital to achieving good, robust long-term performance.
- It was therefore a felt important for a suitable team member to be designated as the "SLs Champion" and be devil's advocate, challenging the project manager and other team members. In fact, the client, designers and builders might each want their own Champions.
- The case studies in Stages 4 and 5 had shown that facilities management had often been a weak link in the value chain, so an appropriate FM Champion might also be valuable.
- There was a need for tools and techniques to support expectations management. Some of these have already been developed by team members, or are being considered by BSRIA's group and others. However, team members had encountered practical difficulties in making realistic estimates, in the face of a growing number of theoretically-based approaches (e.g. the schools carbon calculator), which tend to give over-optimistic results. What price experience?
- Some teams also expressed an interest in training and facilitation to help them implement SLs.

5.2 BURO HAPPOLD – SOUTHWARK PFI PROGRAMME

BH is working on a batch of secondary schools in Southwark as part of the BSF process. They have reviewed the application of SLs with the contractor, Balfour Beatty, especially in relation to the specific challenge of the "27 kg of CO_2" target now set for BSF schools. The approach includes ways of establishing the target at an early stage in the process, identifying how it is likely to be met, managing expectations through design, construction, commissioning and fine tuning, and addressing realistically the implications for building users and operators.

In PFI projects, BH is finding that SLs principles help to encourage a continuity of thought about building performance throughout a building's life – from briefing through design and construction and on into use, including fine-tuning and alteration. However, BH has found the best way is not to introduce SLs as a radically new way of doing things, but as a source of ideas and procedures that can be used to help tackle the challenges of the PFI process more effectively. It remains to be seen how SLs will be applied if the balance of school work changes from PFI to D&B over the coming years, as is currently anticipated. Handled well, it could help to create the continuity which might otherwise easily be missing as things become more fragmented.

5.3 MAX FORDHAM – SUSTAINABILITY MANAGEMENT MATRIX

5.3.1 In its schools projects, Max Fordham has been using a sustainability management matrix, first developed by Feilden Clegg Bradley Studios and used with Max Fordham to support projects, including the award- winning National Trust Heelis building[13], see Figure 5.1 below.

5.3.2 With the passage of time, more calculation procedures and benchmarks have become available, e.g. DCSF's carbon calculator. Whilst this assists standardisation, the prescribed calculations tend to have a more theoretical basis, and so produce very different numbers from those gained from experience gained over the years by applying the matrix through briefing and design development and reviewing the outcomes in use. For example, the carbon calculator estimates the CO_2 emissions from a new school at only about half the value that Max Fordham's feedback usually indicates. What does one then do: follow the rules using the calculator, be more realistic, or both?

5.4 The current situation has great potential for confusing clients and others. It also makes it difficult for designers with experience in evaluating performance in use to apply their professional realism to their estimates, when less experienced people can just use the carbon calculator and demonstrate much better results, if only in theory. This underlines the importance of having better ways of communicating and managing energy performance, and for improving transparency between expectations and outcomes, all of which can be applied and reinforced through the SLs approach. At present we are getting much better at calculating low-energy than at delivering it, and this is leading to a distortion of priorities, with buildings that are too complicated and difficult to manage.

FIGURE 5.1: EARLY EXAMPLE OF THE SUSTAINABILITY MANAGEMENT MATRIX

	1. GOOD PRACTICE	2. BEST PRACTICE	3. INNOVATIVE	4. PIONEERING	NOTES
1. CO_2 Emission Target	40kgCO$_2$/m^2/yr	30kgCO$_2$/m^2/yr	15kgCO$_2$/m^2/yr	"Carbon neutral" 0kgCO$_2$/m^2	Industry standard EEO targets
2. Heating Load Target	79kWhr/m^2/yr	47kWhr/m^2/yr	30kWhr/m^2/yr	20kWhr/m^2/yr	Industry standard EEO targets
3. Electrical Load Target	54kWhr/m^2/yr	43kWhr/m^2/yr	35kWhr/m^2/yr	25kWhr/m^2/yr	Industry standard EEO targets
4. U Values: Wall Average Window Roof Ground Floor	0.35 2.2 0.2 0.25	0.25 1.8 0.18 0.22	0.2 1.4 0.15 0.2	0.1 0.9 0.1 0.1	good practice=current building regulations pioneering=Bedzed values
5. Airtightness	<10m^3/hr/m^2	<8m^3/hr/m^2	<5m^3/hr/m^2	<3m^3/hr/m^2	All measures require careful attention to details and monitoring construction.
6. Ventilation	Natural ventilation where possible. Mechanical ventilation where not.	Designed natural ventilation with automatic openers, mechanical ventilation to WCs etc.	Mechanical ventilation with heat reclaim in winter and BMS controlled natural ventilation in summer.		BMS with manual overrides preferable on all windows.
7. On Site Energy Generation		Solar domestic water heating to WCs.	Solar domestic water heating to WC cores. Cost effective PV installation using PVs to shade rooflights. Gas fired CHP installation.	Solar water heating to kitchens. Maximum PV installation using most efficient PVs. Wood/waste fired CHP.	Potential 50% grant available from DTI for solar water heating, up to 65% for PV installation.
8. Daylighting	"Reasonable" to BS8206 part 2. A 2% daylight factor.	80% office space daylit to meet criteria of BS8206: part 2.	100% of office space daylit to BS8206 part 2		Ensure prevention of solar heat gain/glare by building form/shading systems
9. Artificial Lighting Controls	PIR detectors in WCs etc. Low energy fittings throughout.	Luminance and presence detectors throughout building. No dimming.	Luminance and presence detection at all fittings with dimming to zero and BMS override.		Personalised controls strongly recommended by the client
10. Cooling Systems/Sources	Zero ozone depletion refrigerants in high efficiency comfort cooling/air conditioning systems.	Night time structural cooling with automatic window vents.	Evaporative cooling to rooms with high internal heat gains.	Borehole/ground water cooling to rooms with high internal heat gains.	Need to provide for areas where cooling is required and provide upgrade path for entire building.
11. Embodied Energy in Structural Materials	Steel and concrete frame engineered to minimise mass of materials.	Use of cement replacements e.g. GGBFS in concrete. Use recycled steel.	Timber structure in lieu of steel or concrete but retaining concrete floors. Use of recycled aggregates in structural concrete.	All timber structure with thermal mass provided using minimum amount of concrete.	NB. Client is particularly keen on use of timber for low embodied energy

[13] See W Gething and W Bordass, *Rapid assessment checklist for sustainable buildings,* Building Research & Information 34(4), 416-426 (July - August 2006). The paper is downloadable free from www.usablebuildings.co.uk

6 CASE STUDY RESULTS – STAGE 3: PREPARING FOR HANDOVER

6.1 OVERVIEW

Several firms concentrated on this stage, all for current projects: Max Fordham at Hackney City Academy; Feilden Clegg Bradley Studios at Estover; and Davis Langdon at the RSA Academy.

- It proved easiest to get teams to concentrate on handover in phased projects, where the SLs approach was seen to offer clear benefits in helping to tackle what are often complicated transitional arrangements and to avoid problems and complaints. Here the support costs are also lower because everybody remains on site, at least until the end of the final phase. At Estover, Plymouth (Section 6.3) the phasing is very complicated and extends over a long period, so the team was also able to review and plan for activities in the aftercare Stages 4 and 5.
- There were also undoubted benefits where the client, design and building team had high levels of commitment, as at Hackney City Academy (Section 6.2). The SLs approach increased the emphasis on the occupier, which was especially important for this completely new school community, starting from scratch. However, because construction was already near completion, it was not possible to change the pre-handover process much. The main benefits were preparing better for move-in, aftercare, and better staff and student awareness of how to use the building. Yet again, another important lesson was to get FM more involved before handover.
- The need for early preparation was even clearer from Buro Happold's experience on attempting to retrofit Stage 3 to two schools, see Section 6.5. Here initial enthusiasm by both designer and client became blunted by the difficulties of making changes. At one school this was because the work was about to go to tender. At the other, the school was nearing completion, and there had been contractual difficulties. Consequently, in spite of the undoubted benefits, it was deemed too dangerous to change the rules.
- The RSA Academy in Sandwell is approaching completion in summer 2010. Its team reviewed the whole project in relation to all the SLs stages. It concluded that a SLs approach would have smoothed design and construction; and that by doing Stage 3 well, many of the problems that so often occur after handover would be minimised.

6.2 MAX FORDHAM - HACKNEY CITY ACADEMY

6.2.1 Hackney City Academy was handed over in summer 2009, shortly after the SLs for schools project started. Nevertheless, Max Fordham thought the insights from the *Framework* would benefit the handover process, and so concentrated on seeing what they could do in a modest way to influence the upcoming Stages 3 and 4. The practical results were to influence:

- The series of pre-handover meetings (about ten in all), to cover not just the physical building, but the logistics of how the school would be used. These helped to smooth the occupancy of the building, and in particular who would be trained to do what and when.
- The checklists of things the consultants needed to look at before handover.
- Arrangements for taking-over the building and moving-in the furniture and equipment.

6.2.2 It was also agreed that, in the initial aftercare period following handover, there would be:

- Meetings for the designers to explain to teachers how best to use the building. A one-page introductory note for teachers was also prepared.
- Meetings with the students, showing how to use the systems in classrooms; and encouraging them to make use of the other facilities, to avoid waste, and to have ideas.
- An environmental club for students, to help establish and maintain momentum.

6.2.3 Since the school was a completely new organisation, it proved have been particularly important to have these careful discussions about moving-in. Unfortunately, the involvement of FM before handover had not been thought through early or thoroughly enough; and so the right FM people were not always available for comment and training in the run-up to handover. This was disappointing: the FM contractor had been appointed in good time, and might have been expected to raise its own questions in relation to pre-handover activities, but it had not been planned for.

6.3 FEILDEN CLEGG BRADLEY STUDIOS – ESTOVER, PLYMOUTH

6.3.1 Estover Secondary Community College is a new combined campus on the site of an existing secondary school at the north-eastern edge of Plymouth. It will include:

- a single-form entry primary school;
- a 7-form entry secondary school with a visual arts specialism;
- integrated special school provision for both primary and secondary students; and
- fully accessible community facilities including a public library, theatre and sports provision.

The new college is being constructed in seven phases around the existing secondary school, which will remain in full operation throughout the construction work. After the new work is completed in summer 2012, the existing school will be demolished to form a large courtyard which will connect the different schools and contain shared space and facilities. Complex phasing arrangements have had to be developed to minimise disruption.

6.3.2 The ultimate client is Plymouth City Council, but the project is being procured under a competitive design and build contract, won by Kier Western, with a design team which included FCBS and Aecom. When the project started on site, Aecom became sub-contractors to the services subcontractor Mitie. FCBS has been working with Kier, Mitie and Aecom to establish the approach to phasing, handover and aftercare. The project is required to achieve BREEAM Excellent and some of the SLs activities mirror the BREEAM credits. The school also received extra funding to achieve a 60% reduction in CO_2 emissions over Building Regulations AD Part L2 2006.

6.3.3 Phase 1 was already under way when the SLs for Schools project started, and is due for completion in summer 2010, with some blocks handed over in advance, as they are finished. The SLs review focused on Stage 3 (preparation for handover) for Phase 1 and the ensuing Stages 4 and 5. To translate the SLs *Framework* into action, FCBS developed one-page summary checklists for each SLs Stage, and discussed them with the Kier Western site team. The review revealed that:

- Kier had proposed to follow its standard handover processes. The review found these to be good. Kier also has a zero defects policy, which should reduce the need for initial aftercare.
- FCBS has been reviewing its designs and specifications with Kier, with the aim of making changes that will make the handovers smoother.
- The forward planning revealed that the client needed to give urgent consideration to ICT provision. Otherwise this would almost certainly lead to difficulties for the design team and the contractor. These could affect servicing strategies, energy use, comfort conditions, and possible conflicts with arrangements for the introduction and control of daylight. This echoes problems that many other team members had encountered on their projects, and which clients and occupiers have also drawn to the team's attention.
- Some team members felt that the SLs *Framework* was too open-ended, making it difficult to know when one could say "job done". However, the idea of the *Framework* was allow teams to choose where to set the limits. There may be a case for more standard approaches, e.g. for BSF.
- It might also be helpful to organise the issues that were identified into more of a hierarchy.

More detailed findings from the review are summarised in Table 6.1. Kier is also piloting SLs on another site, Writhlington School, near Bath.

The approach to phasing at Estover has similarities to Willmott Dixon's work at Walsall (see Section 3.1), Davis Langdon's at RSA Sandwell (Section 5.7), and Buro Happold's in Essex (Section 5.8). Phased projects do seem to offer the most fertile territory for early adoption of SLs, because the players involved will be remaining on site in any event, and the benefits of planning, feedforward, feedback and fine tuning are more readily apparent to the client and all team members.

6.3.4 Estover is not the only Devon school to which SLs may be applied in 2010. After attending the workshop at CABE on 26 November 2009, Devon's head of strategic planning said the County had been doing similar things at Bideford Academy (now under construction), where it might now be possible to apply SLs more systematically. SLs might also be used at the Montgomery Primary School in Exeter, which is to Passivhaus standards and is programmed to start on site in July 2010.

TABLE 6.1 REVIEW OF THE ACTIVITIES IN SLs STAGES 3 TO 5 AT ESTOVER

STAGE	ITEM AND COMMENTS
Stage 3	**PRE-HANDOVER**
P1	ENVIRONMENTAL AND ENERGY LOGGING REVIEW
P1.1	As part of the BREEAM process, site energy consumption is being logged and reported on weekly, as are transport emissions, including site visitor emissions.
P1.2	Seasonal commissioning is a contract requirement. Each block is submetered, to fit the multi-phase nature of the project. Electricity use is split down to show IT and lighting consumption. Information is provided via the BM. The school also plans to use this in teaching.
P1.3	There is a requirement to achieve relevant ENE criteria levels to meet BREEAM Excellent, but there are no specific energy in use targets against which to compare actual performance.
P1.4	This is a Design and Build contract, so there is no ongoing commitment by the contractor to monitor or reduce energy consumption after each handover.
P2	BUILDING READINESS PROGRAMME
P2.1	Kier has an established Target Zero Defects strategy that is developed through a series of meetings with the client, the Clerk of Works and the design team.
P2.2	A Quality/ Defects Technical Risks Review picks up a number of potential problems based on previous experience of the building type and construction method. These include airtightness, poor interfaces between services and building construction, the identification of a client champion for handover, coordination of fittings, furniture and equipment procured by the client, appointment of a School Site Manager, and post occupancy fine tuning of M&E systems.
P2.3	Quality meetings have been held every two weeks between Kier, the Clerk of Works and the project architect. These will increase in frequency as a phase nears completion.
P2.4	The Zero Defects strategy also includes a requirement to develop a Countdown Programme at least three months before handover.
P2.5	The Zero Defects strategy is informing the development of Kier's specific Soft Landings programme which is being trialled at Kier's Writhlington School project just outside Bath.
P2.6	Items like handing over keys and O&M manuals are programmed to occur over a period of time allowing information to be assimilated in manageable chunks, and not as a deluge.
P3	COMMISSIONING RECORDS CHECK
P3.1	An independent commissioning engineer is appointed (to fulfil BREEAM criteria). Tests will be staged and each block fully commissioned before it is handed over.
P4	MAINTENANCE CONTRACT
P4.1	Maintenance contracts are the responsibility of the client's business manager and are intended to operate from each sectional completion.
P4.2	Cleaning contracts are also put in place at each sectional completion with a detailed regime for cleaning and maintenance and all relevant information included in the O&M manuals.
P4.3	The contractor sat in on the interview for the client's site manager who has been in place since September 2009.
P5	TRAINING
P5.1	The Contractors Proposals document requires the contractor to make sure the teachers know how to operate the building.
P5.2	The control strategy is to prompt occupants to control their environment manually. A simple display in each classroom prompts the teacher and students to open the windows, for example.
P5.3	A set of ideogram instructions is being prepared.
P5.4	Training sessions are videoed and issued as DVDs so that newcomers can be brought up to date.
P6	BMS INTERFACE COMPLETION AND DEMONSTRATION
P6.1	The contractor is liaising with the school's building manager, who will bring in key staff as appropriate in anticipation of the BMS being commissioned.

P7	MIGRATION PLANNING
P7.1	FF&E and ICT equipment are outside the contract and handled directly by the ultimate client (Plymouth Council) who do not seem to see the urgency of progressing procurement.
P7.2	The contractor is taking a proactive approach. Although not a contractual requirement, they are involving their in house FF&E team where decisions need to be made during construction, e.g. agreeing locations for digital projectors that will require fixing points, containment etc.. This will avoid having to return to areas, and reduce the risk of damage to completed finishes.
P8	AFTERCARE TEAM "HOME"
P8.1	The contractor's site set up will remain in place during the next phase and will be the point of contact for the school after handover rather than a location within the completed phase. This is felt appropriate given the need to maintain safe and clear segregation between site operations and the working school.
P8.2	A handover pack will be prepared covering the point of contact, what to do about defects and maintenance items, logging and monitoring problems.
P9	COMPILE A GUIDE FOR OCCUPANTS
P9.1	This is a Kier commitment and is identified as a specific milestone in the Countdown Programme (in addition to a required BREEAM criterion) and will involve the architect.
P10	COMPILE A TECHNICAL GUIDE
P10.1	A technical guide will be compiled to an agreed format.
P11	O&M MANUAL REVIEW
P11.1	There is a contractual provision for subcontractors to provide the information for O&M manuals within two weeks of the completion of their work on a date identified at their subcontract pre-let meeting. They will not be paid until this information is received and checked.
P11.2	The format of the O&M manuals has already been agreed with the Planning Supervisor.
P12	PREPARE POST-COMPLETION FINE-TUNING PROGRAMMES
P12.1	There is no contractual requirement to carry post completion fine tuning. Kier felt that Mitie and Plymouth City Council would need some convincing to pay for the service.
P12.2	For this to be successful, Kier felt the school's FM staff would need to commit to monitoring the building actively and were best placed to lead the process. This is particularly appropriate here, because it was always the intention that the building's environmental performance would feed into the teaching curriculum.
Stage 4	**INITIAL AFTERCARE** *(RIBA Stage L2)*
A1	AFTERCARE TEAM MEMBERSHIP. No special provision required: the team remains on site.
A2	AFTERCARE TEAM HOME & DATA LINKS. No special provision required, see P8 above.
A3	INTRODUCTORY GUIDANCE FOR BUILDING USERS. No comment, see in P9 above.
A4	TECHNICAL GUIDANCE. No comment, covered in P10 above.
A5	COMMUNICATE PROGRESS AND CHANGES TO USERS. The teaching staff are considering a competition between users of different blocks, as part of an awareness raising and dissemination programme.
A6	WALKABOUTS. It was felt that these should be led by the school's FM staff.
Stage 5	**EXTENDED AFTERCARE** *(RIBA Stage L3)*
Y1	AFTERCARE REVIEW MEETINGS
Y1.1	Kier's standard aftercare service includes review meetings every 3 months in the first year.
Y1.2	Kier is very much in favour of the new requirement for the post construction review, which is now included in the BREEAM process.

6.4 DAVIS LANGDON – RSA ACADEMY, SANDWELL

6.4.1 Davis Langdon (DL) reviewed the potential for SLs in relation to the procurement of the RSA Academy in Sandwell, which is due for completion later in 2010. Commitment and leadership is strongly evident in this project. The main objective of the review was to see if handovers could be made smoother, by establishing a SLs approach early on in the process. DL started by reviewing the past projects and standard procedures of the design team and the contractors. This confirmed that if a SLs approach had been adopted, it would have assisted the management of the project generally.

6.4.2 The cost manager representative from DL then held a review meeting with the employer's agent (Gardiner and Theobald) and the contractor (Willmott Dixon), at which each of the tasks identified within the tables of the SLs *Framework* was reviewed systematically in relation to procedures currently in operation at RSA Sandwell. Unfortunately, the project manager (from Schal) was not able to attend. As well as the discussion itself, the participants completed an Excel questionnaire electronically, and the responses were reviewed afterwards. The questions asked included:

- Has the activity been carried out. If not why not, and what impact would it have on the project?
- Would things have been better if the SL *Framework* had been adopted from project inception?
- Does the activity have any tangible benefits, or raise issues for the client or design team?
- Would the activity have an impact on current duties and associated fees?
- Is the initiator of the activity correctly identified?
- Are the participants in the activity correctly identified?
- Are the notes on the Example Worksheets in the *Framework* useful and informative?

6.4.3 Various issues arose when conducting the review:

- Participants had been asked to assume that the project manager would be responsible for championing and programming the SLs activities. They wondered who was best suited to be SLs champion; and whether it should be the client or the design team project manager[14].
- Participants were reluctant to compare performance for activities in which they had not been involved, e.g. the briefing and design stages for the employer's agent.
- Similarly, some participants were reluctant to speculate about activities not yet undertaken, and in particular the final three stages of the SLs *Framework*.

The general conclusions reached are reviewed below, by SLs Stage.

6.4.4 While setting up for SLs in **Stage 1**, inception and briefing:

- The participants thought that implementing Stages 1 to 3 of SLs would not cost extra.
- However, once the building had been handed over, there would be additional costs: for designers in Stages 4 and 5, and for contractors in Stage 5 only. Would clients pay for these?
- In programming the work, it was felt that some of the activities identified in the *Framework* would need additional players as participants and sometimes as initiators, e.g. subcontractors and specialists. It would help if the *Framework* were to identify this.
- To relate financial incentives to performance outcomes might well have detrimental effects on a project, particularly if the targets set were too onerous, or if they were poorly defined.
- There was also scepticism about whether outcomes would be monitored in use, probably reflecting a concern that clients might not be prepared to pay for longer term aftercare, Stage 5.

6.4.5 For **Stage 2**, review during design development and construction:

- A system of reality-checks and sign-off gateways was not being operated at present. However, participants felt that if SLs was adopted, these would fall into place naturally, and that they would be a definite help in ensuring greater client satisfaction.

[14] Recent thinking on SLs is that it is sensible for project managers to incorporate agreed SLs activities in their programming. However, the SLs Champion should be an independent role for another team member who is committed to making sure that the SLs perspective is properly embedded within a project. It might even be possible to have several SLs Champions, e.g. one for the client, one for the design & building team, and one for the occupiers or operators.

6.4.6 If planning for **Stage 3** (preparation for handover) were to take place in good time, it was felt that this aspect of the SLs process would allow all parties to understand the project better and would improve the commissioning programme:

- Producing better and more relevant handover material, including O&M manuals, was seen to be a good way of limiting the time the design and building team would need to spend on aftercare. Review and verification of this material might best be initiated by the CDM coordinator.
- The proposed review of building readiness and commissioning records might be best initiated by the occupier and their FM team. To undertake this activity rigorously might delay handover, but it would allow important issues to be addressed more realistically.
- If there was a design, build and operate contract, many of the Stage 3 activities would be internal to the contractor, but SLs would allow them to be undertaken more methodically.
- At Sandwell, the team felt that there was scope to improve by taking early account of the needs of a programme of building readiness, with careful planning for commissioning record checks; discussion and demonstration of the BMS and its user interfaces; and training for operators.

6.4.7 For **Stage 4**, initial aftercare, the team felt that better operational readiness, better recorded information (as outlined in the paragraph above), and planned briefing sessions for occupiers and operators by the design and building team would go a long way towards overcoming the problems which frequently arose. It would also help to reduce the number of queries the design team would need to respond to during the aftercare period. The contractor will be more involved with post-handover support at Sandwell, owing to the terms of this particular design-and-build contract.

6.4.8 **Stage 5**, extended aftercare, is not currently addressed to any significant degree at Sandwell. As in STaG, there was a feeling that closer involvement and feedback activities would benefit design and building team members and their future projects more than the project concerned[15]. However, though not a contractual requirement, the contractor is planning to revisit the building from time to time and review its performance informally with the occupiers.

6.5 PROJECTS BY BURO HAPPOLD

6.5.1 Buro Happold (BH) had hoped to retrofit SLs Stages 3 and 4 to two very different projects.

- A new secondary school in Yorkshire, where BH are the engineers. This is being built as a Pathfinder project under the BSF programme, and will be handed over in 2010. Initially the project team was enthusiastic, but with contractual problems and pressures to get the building completed on time, SLs has slipped down the priority list. The council is still committed to a programme of aftercare and POE, but no arrangements have yet been finalised.
- An Edwardian primary school in Essex, where BH are sustainability advisers but not designers. With a mix of buildings about to be refurbished and upgraded to a phased programme, SLs offered advantages in organising the contract and in allowing the school to prepare better for operating the existing and refurbished buildings. However, for SLs to work effectively, the scopes of service of the different professions would have needed to be changed. It turned out not to be practical to consider making adjustments at a time when the construction work was about to go out to contract.

Both these case studies confirm how important it is for SLs to be incorporated when a project starts. As a result, BH is now incorporating the SLs process in a number of other BSF bids in which they are currently involved.

[15] UBT has frequently encountered this view from clients and the supply side of the industry. From our experience of evaluating building performance in use, we do not agree. Closer involvement of design and building teams with the buildings they have produced, their occupants and their managers can give enormous benefits for all concerned.

7 CASE STUDY RESULTS – STAGE 4: INITIAL AFTERCARE

7.1 OVERVIEW

The initial aftercare period occurs over a short time interval, typically 8 weeks or less. While a number of teams took account of Stage 4 as part of their forward planning, only one was able to address it directly in the course of their project – Max Fordham at Hackney City Academy. BSRIA also contributed its insights from another Academy where they were invited to investigate problems that had arisen because there had originally been no initial aftercare.

This and other experiences by team members confirmed the importance not only of having an initial aftercare period, but of planning for it in all sorts of ways: not just programming it, but making sure that clients, contractors and others appreciated why it was happening, why they needed to take it seriously, and how much support each should plan to provide. All this has important implications for time budgets and costs, which may not be appreciated as a team breaks up and moves on. In practice, costs of a similar magnitude are frequently incurred, owing to random call-backs, which often get dealt with ineffectively and uneconomically. Where aftercare work is planned and prepared for, it can be undertaken more professionally, and offer the prospect of benefits for all concerned in terms of relationships maintained, understanding and feedback obtained, and the better performance and occupant satisfaction achieved, with a lower environmental impact.

On the other hand, if a building is handed over with work outstanding, some initial aftercare activities may need to be delayed. For example, when Hackney City Academy was handed over, the controls and BMS were not complete or fully functional, so fine tuning was impossible. It is therefore important to retain flexibility about timing Stage 4 activities. The capacity of the occupier to respond to any feedback also needs taking into account: for example, if you are forging a completely new organisation and culture - as in the first term at Hackney - occupiers may not have much time to think about the finer details of building performance.

7.2 DEALING WITH COMPLICATION

A major problem is that new buildings tend to be more complicated technically than their predecessors and so need more skilled and committed levels of user understanding and/or facilities management. However, such levels of management are rarely available to run school buildings. More rarely still, have suitable FM staff been available to assist during design, construction or commissioning; or even to participate fully in the immediate pre- and post-handover Stages 3 and 4. The conclusion is double-edged:

- on the one hand, there is a need for FM to be more highly skilled and better resourced;
- on the other, the resources anticipated by the design and building team (and by their clients) may not be affordable, particularly in schools.

This makes it vitally important that new and refurbished buildings, especially public buildings, aim to be as simple and easy to look after as is practicable. This is particularly difficult when government policy seems to be conspiring to push them in the opposite direction, e.g. with more complicated operation and user requirements, and added technical systems. There is a severe danger that supporting complicated buildings through increasingly difficult times will prove unsustainable.

7.3 MAX FORDHAM - HACKNEY CITY ACADEMY

The Stage 3 pre-handover activities at Hackney City Academy are outlined in Section 6.2. These identified a need for the design team to review performance, and provide more information to FM, staff and students in the first two months of occupancy in autumn 2009. In the event, this work did not start until six months later, in April 2010, because:

- In the first school term, the focus was very much on getting the school to work as a completely new community, making fine-tuning building performance much less of a priority.
- The control and BMS systems were incomplete or dysfunctional in many respects at the time of handover. The priority for the design team was therefore to be sure that the contractor had got the systems working at all. Many problems that emerged could not have been anticipated.
- It was therefore too early to initiate SLs monitoring and fine tuning activities; or even to make demonstrations to staff and students, e.g. where room controls were not yet fully functional.
- In the circumstances, the FM has also found it difficult to come to grips with the controls.

7.4 BSRIA - A CITY ACADEMY

7.4.1 At another recently-completed Academy, electricity bills were much higher than anticipated and there were issues with user satisfaction. At the suggestion of the client's architectural advisers, an Aftercare period was therefore retrofitted. BSRIA was invited to coordinate the work, with support with monitoring and user education from a local energy advice centre. BSRIA arranged a Building Use Studies (BUS) occupant questionnaire, followed by two focus group meetings with staff to discuss the findings and to explore these and related issues. Some of the concerns identified were dealt with, e.g. problems with window blinds. Others could be worked around, but were particularly relevant to future projects (e.g. lack of storage, and some classrooms being too small). Other aspects of the school pleased the staff, especially light and airiness.

7.4.2 BSRIA also initiated a detailed energy analysis, which should have been relatively straightforward, owing to the sub-metering now installed in new buildings to meet the requirements of Building Regulations AD Part L2. However, some of the electricity sub-meters proved to be faulty or incorrectly calibrated, something which UBT finds to be widespread where metering schemes have been installed to meet a regulatory requirement, not a business need. BSRIA asked for the meters to be repaired and re-commissioned, but the contractor dragged its feet. The FM could have brought pressure to bear and helped by taking readings, but this did not happen. This lack of good information also meant that a Display Energy Certificate could only be issued at the default level.

7.4.3 Some electricity waste was readily apparent, including:

- A lobby between the school and the courtyard, where the external double doors were left open permanently while the electric door heater in the lobby ran continuously. It was also unclear why an electric heater should have been installed inside a draught lobby in the first place[16].
- Lighting operated by presence detectors, regardless of daylight levels. UBT and BSRIA again find this commonplace, particularly in circulation areas. While sophisticated controls are specified, they have often been installed, programmed and documented in ways that make it difficult for occupants and management to use them as intended.
- Laptop recharging cupboards which each had their individual air conditioning units. The design team did not know these had been installed and, when they found out, did not think they were necessary. Presumably they had been specified by the ICT advisers, who can be a law unto themselves, as many other case studies and comments have also revealed. These units could probably have been switched off or taken out.

A committed FM should have been able to deal with the above problems rapidly, but in the event nothing happened. With a lack of support from either the contractor or the FM, electricity use failed to decrease, so sadly the Governors decided to terminate the exercise.

7.4.4 While disappointing, as a case study the experience provides many instructive lessons for SLs, in particular:

- A vital need for SLs, particularly where contractual arrangements fragment continuity.
- Difficulties in introducing SLs late in the process. If there had been early client commitment and a SLs Champion, the school might well have been able to avoid some of the problems.
- The importance of getting support for SLs both top-down and bottom-up; and indeed by middle-management which can find itself constrained within organisational rule systems that are not yet up to date with new thinking, even where the changes have been endorsed at the top.
- The need to ensure that the Governors appreciate what is happening. If BSRIA had been able to appeal to the Governors directly, it might have been easier to unstick the blockages that had occurred with the contractor, FM and ICT, and avoid the situation that ultimately developed.
- The vital importance of FM, both the arrangements and the personalities. This issue came up in many other case studies and in related observations and discussions, e.g. with local authorities.
- The importance of coordinating ICT closely with the building programme; and for the client and design team to be able to review and challenge its energy use and other requirements. ICT tends to come on board late and then go its own way, as other case studies have also confirmed.

[16] The project was a design-and-build, with a different executive team to the one that did the concept design.

- In the first year of occupation, conflicts between the hands-on nature of SLs and the historic precedent of contractors not wanting to do things during the Defects Liability Period; or at least wanting to put them off until near the end. In SLs projects, it will be important to make sure the contractual position is resolved. Contractors may also need to develop troubleshooting skills.
- If SLs does not produce some quick wins during implementation, support may dwindle. This leads to another potential problem in defining the benefits. If a project proceeds more smoothly by using SLs, and the building works better, and in closer accordance with design intent, then nobody may appreciate how different things might have been, had SLs not been adopted!

7.4.5 In spite of these disappointments:

- The exercise provided a useful forum at which design team members (both executive and advisory) could meet each other and the school staff after handover. This also helped to resolve some issues that might otherwise have lingered on for years. The architects are now keen to adopt SLs on future projects.
- Some things will eventually happen, like getting sub meters to work. However, in UBT's experience, rather than being fixed within a few days (which is often technically possible) this work can easily slip out of the defects liability period and might not get finished off for years.
- At this late stage, it may be impossible to produce effective solutions to other problems such as lack of space. However, it is vitally important to identify strategic problems like this as quickly as possible, and to discuss them frankly, so the feedback loop can be closed. Otherwise, subsequent projects by client and design team members may easily fall into the same traps[17]. Ideally results would also be disseminated widely into the sector and the industry, improving wider understanding of what constitutes good practice as rapidly as possible.

[17] One designer commented that fundamental problems such as small room sizes are often occasioned by external pressures which it has not been possible for design teams to resist adequately. This can apply particularly in current processes such as PFI which effectively reduce the leverage of the design team and enforces separation between designers and users.

8 CASE STUDY RESULTS – STAGE 5: LONGER-TERM AFTERCARE AND POE

8.1 OVERVIEW

Stage 5 was well populated with results from recent post-occupancy evaluation (POE) work. The lessons tended to be similar, including problems with procurement systems, high electricity use, complex technologies, user understanding and facilities management, echoing independent work that was done several years ago, but is taking some time to make an impression. Sadly, and as revealed in the studies of Stages 1 to 4, in spite of the undoubted benefits, Afterecare activities seem to be those that clients find most difficult to fund. A major problem appears to be that the work extends beyond the normal on-year defects liability period, so is not seen as a responsibility of those involved in the construction work; nor of those providing the capital investment; nor of the occupiers, who feel that they should be entitled to a new building that works perfectly.

8.2 A PRIMARY SCHOOL INVESTIGATED BY BSRIA

A "green" primary school was carefully designed and built, and well-insulated. Surveys showed it to be well-liked by staff and students. However, in spite of possessing a photovoltaic array, solar thermal panels and a biomass boiler to help reduce its carbon footprint, its DEC was a disappointing grade D. The contractor asked BSRIA to investigate.

BSRIA found that night and weekend loads were high – something that is sadly commonplace in new schools, as also confirmed by all the other case studies where electricity demand profiles were collected. In this building:

- All the external lights were on every night, and so night use accounted for as much electricity consumption as all indoor lighting in this well-daylit building. Partly this was because both the car park and building's security lighting were operated by a single time switch.
- The wood chip boilers (now run on pellets) were unreliable, and fuel storage inadequate.
- The backup gas boilers operated quite a lot too, but their energy use had not been recorded because the gas meter had stuck. The caretaker had read the meter regularly, and each time sent the reading through to the County, but nobody had noticed that all the readings were identical. Meanwhile, the County continued to pay the gas bills, which were based on estimated readings.
- The FM company managed the boilers to be available constantly, in order to keep the domestic hot water sterilised – a very conservative approach. When the boilers were warm, water also circulated in the primary system which served the kitchen's air handling unit. This both wasted energy and caused overheating at nights and weekends when the ventilation plant was off.
- Largely as a result, the biomass boiler used about a tonne of fuel every single week, whatever the weather. Daily pasteurisation of the hot water would have been more than enough.

These minor but debilitating faults are endemic in UBT's experience, so such inefficiencies really do need to be addressed as part of every building project. A routine SLs aftercare process including night and weekend surveys would have a triple benefit: improving building performance; saving energy, carbon and money; and teaching the designers and builders what to watch out for next time.

8.3 CITY ACADEMIES INVESTIGATED BY BURO HAPPOLD

8.3.1 Amongst other things, the research student's review of five City Academies (see Section □) revealed disappointingly high levels of energy use, particularly for electricity. Reasons included wasteful ICT systems, high levels of mechanical ventilation, systems running 24/7, and in many cases ineffective lighting controls. Often at least half the annual electricity consumption occurred at night, weekends and during holiday times. It is easy to forget the importance of out-of-hours loads in schools, which are often unoccupied for 75% of the year, so the hours mount up.

8.3.2 The findings have been fed back not just into BH's newer designs, but into improving the performance in use of these and other school buildings. They have also been fed into the conclusions of DCSF's Zero-Carbon Task Force. Various issues have been identified and sometimes resolved. In particular:

- A change in focus from reduced winter heat loss to better daylighting, with well-configured controls and effective zoning of systems to reduce the cost and CO_2 emissions of electric lighting, which can easily dwarf those from heating and hot water generation.
- A greater awareness of where energy is used and why. One school had an overnight electricity baseload of 120kW, chiefly due to ICT left running unnecessarily. A new ICT management system that disabled equipment when not in use was able to reduce this by over 40%.
- Another school was found to have been heated over the Christmas holidays as if occupied.
- Since automatic lighting controls had often led to energy wastage, in the design of Northampton City Academy, BH had planned an improved system. However, when capital costs had to be reduced, money was saved by reverting to a manual system with clearly-visible controls. In practice, this has performed quite well.

8.3.3 Another City Academy was found to be using more energy than the highest of the five BH had originally surveyed. After a review and action by the school, the performance was as good as the best, with a bill £20k per month approximately halved. Most of the savings were achieved by the bursar encouraging the facilities manager to avoid waste, by reviewing settings and avoiding unnecessary operation of plant, equipment and lighting.

8.3.4 In the earlier schools surveyed, new "green" features had often proved troublesome. However, the benefits of BH's POE feedback are now being revealed in real improvements in the performance of their newer schools. For example, in one school:

- Using recycled rainwater in the WCs had worked well. In conjunction with other water-saving measures, mains water consumption in use was less than one-third of the school's design target.
- Using largely passive measures, overheating had been well controlled through good use of orientation, construction, envelope specification, thermal mass, shading and ventilation. The result was that peak summer temperatures were well below external values and well within the requirements of BB87, even though the occupants were not making the best use of the night ventilation facilities. This gave confidence in the resilience of the design to warmer summers.
- Biomass boilers had been problematic in some of the earlier schools, but here the woodchip boiler worked well and contributed a high proportion of the heat when operating. However, there were management issues, not helped by an immature fuel supply chain. For example, the supplier started to operate a regular schedule of fuel deliveries that took no account the seasonal fuel use pattern, and which led to difficulties with gluts and shortages. There were also issues associated with fuel quality, but these now appear to have been overcome.

8.3.5 However, BH is also finding that certain problems keep on recurring, in particular:

- Where architectural sketches submitted at outline planning stage have not had the benefit of good advice on building physics and engineering. The proposals then get approved, and engineers are asked to find ways of achieving good natural ventilation and to control excessive solar gains. Too often this proves difficult, and the performance of the school suffers. It is therefore vital for teams to obtain good environmental advice at an early stage, before crucial decisions are made.
- Daylight is still problematic. Achieving an appropriate daylight factor with fixed external shading is a struggle. Movable shading is potentially better, but in practice it can easily reduce daylight, obstruct ventilation, and run into problems with poor reliability and high maintenance costs. We need a different way of defining daylight requirements and provision.
- A widespread lack of attention to getting the basics right, e.g. orientation, building form and facade design; and insufficient attention to detail, e.g. in construction, lighting control, window opening and controls, zoning, and commissioning of mechanical and electrical systems, controls and BMS.

8.4 FEILDEN CLEGG BRADLEY STUDIOS – NORTHAMPTON ACADEMY

8.4.1 As part of its standard service, FCBS has decided that it should undertake routine POEs on all its school projects, concentrating on the architectural aspects. With the assistance of Ann Bodkin: Sustainability + Architecture, they have been breaking new ground with a method based around the ten CABE Schools Design Review assessment criteria[18]. With the Schools Council, they have also developed a questionnaire and structured discussions about how the building supports the students' educational experience across the range of the school's spatial scales. The four scales chosen are:

- Setting and outdoor space
- Communal spaces
- Circulation and cores
- Learning spaces.

These spatial scales are typical of almost all projects and FCBS thinks they could provide a useful framework for future post occupancy studies.

8.4.2 The technique was piloted on Northampton Academy, where FCBS were architects, and which in 2009 was nearing the end of its fourth year in occupation. The academy sponsor is the United Learning Trust, which operates a series of academies across England. The new secondary school for 1400 pupils has sport, business and enterprise as its specialisms. It was built on the site of an existing upper school. Structural and environmental engineering was by Buro Happold and landscape architecture by Plincke Landscape.

8.4.3 The new survey technique provided useful feedback on detailed issues, e.g. whether students could see whiteboards clearly and how well the environmental control strategies were working. It also threw up some interesting tensions between the design and operation of the building. For example:

- Students found it very easy to find their way around the school. However, the design intent was sometimes frustrated, where routes had been closed off as part of the school's security strategy.
- In the interest of space efficiency, the brief required the dining space to seat about a third of the school at any one time, in a series of sittings. In practice, dining felt overly rushed. Students felt that non-teaching staff were standing over them, pressing them to finish so the next session could start eating, and compromising the dining space's social function.
- The design team has found the feedback from students invaluable in developing and thinking about current school projects with clients, educationalists and users.

A full report on this study is in preparation.

8.4.4 As with many POE surveys, the study looked at energy consumption and CO_2 emissions in practice. It also compared them with predicted figures and between different parts of the school.

- The overall energy performance of the school compared favourably with the lowest energy consumer of the set of five academies evaluated by Buro Happold in December 2006.
- However, electricity use has been increasing year-on-year since the Academy opened.
- There was a high constant electrical base load, at about 45% of peak load. While this was a surprise to the architects, out-of-hours electricity use of this magnitude is often found by those who undertake POEs and energy surveys in recently-completed schools. This is a vitally important area for attention in briefing, design, commissioning, management and operation. It also affects policymaking, which has tended to be more concerned with the performance of the building envelope and on renewable energy supplies, than with avoiding waste in the electrical systems and equipment.

8.4.5 In comparison to general teaching space, the electricity used per unit area in other spaces was about:

- 1.5 times as much in specialist teaching spaces like music and science
- Twice as much in the library, drama and hall block
- Three times as much in the specialist IT space.

[18] CABE's ten points are: Identity and context, Site plan, School grounds, Organisation, Buildings, Interiors, Resources, Feeling safe, Long life, loose fit, Successful whole.

8.4.6 The Academy's sponsor had become very concerned about rising electricity costs. However, in 2009 it was able to negotiate a very advantageous contract arrangement as a bulk consumer, which reduced their energy bill by almost half at a stroke. One unfortunate consequence of this dramatic cost saving through commercial measures has been that the architects have found it more difficult to convince the Academy and the Trust that they should also investigate the potential to fine-tune performance and reduce consumption by a combination of technical, motivational and management measures.

8.4.7 Lessons learned at Northampton Academy included:

- *For the governors:* to resource an energy reduction strategy including an examination of base loads; a policy for ICT; and a review of the BMS, including an improved night cooling strategy.
- *For students and staff:* to implement a switch-off policy, learn how to control comfort better, and to develop strategies to cope with "tension points" where problems had been revealed.
- *For designers:* to develop best practice designs of toilets with open handwash areas; to estimate energy performance of "unregulated" loads not covered by the building regulations and to explain these to clients; to take more account of ICT loads and possible growth; and to use SLs.

8.4.8 In more general terms, FCBS found the survey developed for them by Ann Bodkin to be very helpful. It complemented other techniques[19], and addressed issues which architects did not feel had been covered well enough before. Strategic conclusions from their analysis included:

- The insights that POE can provide into the success or otherwise of a building design, and in particular the tensions between design intent and the way the building is used and managed in practice, whether from a misinterpretation of the users' requirements or a difference between what the brief said and what the users actually wanted.
- Whoever holds the purse strings needs to be convinced how a SLs approach really does help to provide better value.
- The importance of a clear definition of objectives by the client.
- If architects are to learn to do better, they need real immersion in outcomes. For example, witnessing a pressure test for airtightness brings home to the designer the need for strategic attention in the early stages of design, followed through carefully in detail.

[19] This is in line with UBT's "portfolio" approach, where instead of trying to do too many things, you start out with one or two core techniques which are agreed to be the most pertinent and subsequently broaden out into any further topics which prove to be of interest. See W Bordass and A Leaman, *A portfolio of feedback techniques,* Building Research & Information **33**(4), 347–352 (Jul-Aug 2005) and www.usablebuildings.co.uk/fp/index.html . The portfolio is currently being revised to support Soft Landings more directly.

9 CONCLUSIONS ON THE SOFT LANDINGS FRAMEWORK AND ITS STAGES

9.1 OVERVIEW

In all case studies, team members and colleagues found that using the SLs *Framework* would add value, both during procurement and in use. They identified many ways in which SLs could improve understanding, processes, relationships, and in particular the buildings and their performance.

- All members are adopting, or planning to adopt elements of SLs, using the *Framework* as a sourcebook to help structure the approach to a project and choose what best suits the situation. This is encouraging, and supports the decision not to make the *Framework* too prescriptive.
- Some are including SLs in bids in which they are involved.
- Some have been obtaining performance feedback from a number of their buildings for several years, and think this experience is beginning to improve their success in tendering.

In spite of this general support, members often found it difficult to convince clients and other team members to incorporate SLs in ongoing projects – apart from those which had complicated phasing arrangements, when the advantages of better handovers and embedding learning were evident; and any additional costs small, with design and building teams still on site. In terms of costs generally:

- Most teams thought that Stages 1-3 would be affordable within normal budgets. However,
- Aftercare Stages 4 and particularly 5 needed extra funding, which proved difficult to find.

The paragraphs below review specific issues that arose in relation to each of the five SLs Stages.

9.2 STAGE 1 – INCEPTION AND BRIEFING

The case study experiences strongly underlined the importance of embedding SLs at the very start of a project, and obtaining leadership from the client. In particular:

- SLs is about changing attitudes as well as procedures, so ideally it should be in the brief, and definitely in the responses of all team members. It is much easier if everybody joining a team knows it will be a SLs project, and can agree collectively how best to implement the principles.
- Once the idea of SLs has been accepted, activities can be planned and resourced properly, and potentially dealt with as part of routine project management, but with the challenge of a SLs Champion or Champions who help to make sure that the issues receive enough attention.
- SLs becomes much more difficult to accommodate as time goes on, more people are involved, more is written down, and especially where any contractual difficulties have been encountered.
- There is a need for high level support and understanding, e.g. from school governors, so that decisive action to be taken where difficulties arise, particularly between parties (e.g. FM and ICT) that do not have direct contractual relationships with the design and building team.

9.3 STAGE 2 – EXPECTATIONS MANAGEMENT DURING DESIGN AND CONSTRUCTION

Today's procurement systems can often interrupt the dialogue between designers and users, fragment tasks and responsibilities, and make it difficult for anybody to pay attention to critical detail. In Stage 2, many opportunities for improving the process were identified. In particular:

- Better engagement with building users and their service providers, especially FM, ICT, catering and FF&E. Clients often handle some or all of these independently, and do not always appreciate the importance of careful coordination of the approach carefully with the building work. Not doing this had led to reported difficulties in many case study buildings.
- A more unified approach, to help bring together activities previously seen as independent. For example, a narrative about the user experience can develop in the course of briefing and design, be used to review what is finally specified and selected, and evolve into handover documentation. Similarly, energy estimates can be made consistent with metering strategies, and relate for example to the CIBSE Logbook, energy certificates and on-site monitoring.
- More realism in design estimates, to take more account of actual performance in use. Here firms that had already monitored building performance and incorporated the findings in their design and management processes reported difficulties, because predictions (especially for energy and carbon performance) based on this experience tended to be less optimistic that the (often theoretically-based) procedures which people are now required to use, e.g. DCSF's Carbon Calculator. This difference between these "real" and the "virtual" viewpoints puts the knowledgeable at a disadvantage and confuses clients. Theoretically-based energy and carbon calculations also tend to bias priorities towards complicated solutions, which tend to be more fragile and need more management support, flying in the face of messages from POE to keep things simple, usable and manageable, and to pay more attention to detail. We need much more transparent ways of comparing things, whether measured or calculated.

9.4 STAGE 3 – PREPARATION FOR HANDOVER

The case studies provided good support for better handover planning:

- Better integration between issues related to the building, the organisation and its equipment can really help the occupier. This broader approach is particularly valuable where a completely new school occupies a completely new building, and has to deal with everything from scratch.
- Awareness-raising, documentation and training helped both technical and non-technical staff to understand more about the building they were occupying, and to feel more a part of it.
- It can strengthen FM involvement and capabilities. There were widespread reports of little engagement by FMs before handover, even where firms had been appointed in good time.
- Fewer problems and call-backs if inspections, sign-offs and documentation are improved, leading to better operational readiness. Contractors particularly welcomed the prospect of this.

9.5 STAGE 4 – INITIAL AFTERCARE

The case studies confirmed definite prospects for improved performance from better aftercare. Together with Stage 3, team members also saw the advantages of an extended handover process (albeit with a single practical completion date) in which information could be given to occupiers and management in stages, and feedback could be obtained. Practical issues that emerged included:

- Frequent disappointment by designers, occupiers and assessors about support available from facilities management (in-house or outsourced), in terms of resources, skills and motivation.
- A need for flexibility in programming. For example, if a building is handed over with the controls not fully operational, the priority must be to get them working as specified. Until they are functional, some fine-tuning and user education activities may well need to be put off.
- The value of keeping people informed. They are more supportive if they know what is going on.
- Finding a home base for the aftercare team proved more difficult in schools than in offices or higher education, where SLs has been used before. Contractors and designers were happy to use the site hut instead, but UBT fears that this remoteness may reduce the insights gained.

9.6 STAGE 5 – LONGER TERM AFTERCARE AND POST-OCCUPANCY EVALUATION

This stage proved critically important:

- It can unlock the latent potential of a design, inform occupants and management; include troubleshooting and fine tuning; and allow performance to be compared with design intent and with other buildings and benchmarks. It can also provide feedback for the client, the design and building team, and the industry; and reduce running costs and environmental impact.
- The potential for improvement is huge: in one case study, annual electricity consumption was halved – largely by better management and control avoiding unnecessary out-of-hours operation of HVAC, lighting and ICT systems; and it is by no means unusual to find avoidable waste of this magnitude. In another, issues arose with room sizes, usage and circulation which need to be disseminated widely, if other projects are not to repeat the same experiences.
- Designers who had POEs done in their own buildings had their eyes opened to problems familiar to those who study building performance, e.g. poor occupant satisfaction, facilities management, usablilty, manageability and control systems; electricity consumption two or three times the design estimates; and the dangers of introducing complication. One member said that architects needed an immersion in outcomes to bring these matters home. One engineer said he had heard about the dangers of complication and had sought to avoid them, but only recently realised that although things looked simple to him, the user perspective could be very different.

In spite of the clear advantages of aftercare, obtaining the funds to do it was a different matter:

- The design and building team's view was that the project had been delivered and aftercare was over the horizon. Organising and funding aftercare should be an issue for the client.
- However, procuring and occupier clients tend to be separate organisations and cultures. For the procuring client, responsibility stops with project delivery. Meanwhile, the occupier expects its brand new building to work perfectly, and not to have to pay to evaluate performance, even if the tuning-up pays for itself through savings in utility costs alone. So aftercare seldom happens.
- The situation is further exacerbated because responsibilities for building operation are now often split between a number of parties, so no single organisation quite sees the whole picture.
- Even where everybody agrees they would like to do the aftercare, it was still difficult to obtain client funding for it. Contracts and funding rules seem to have been drawn up with a particular process in mind; and the associated checks and balances can inhibit new ways of doing things.
- Without SLs, team members feared that the situation might get worse in the future, owing to the likelihood of a move towards design-and-build. The problem needs addressing urgently.

10 NEXT STEPS

10.1 BUILDING THE MOMENTUM

The case studies have revealed widespread support for Soft Landings, especially to provide a new perspective with a focus on outcomes, together with a kit of parts that can help client, design and construction teams to improve integration and continuity, and achieve buildings that perform significantly better in use. All the firms involved in the Phase 1 project are keen to continue in various ways, and to work with Partnerships for Schools (PfS) on its proposed trials of SLs.

10.2 ENCOURAGING CLIENT LEADERSHIP

A clear conclusion from the case studies was that it was best to adopt SLs at the very beginning of a project, and that clients should take the lead. Clients were less enthusiastic:

- Some felt that the building industry should undertake SLs a matter of course. However the industry, clients and government are currently locked into a system which it is difficult to break out of, even where one or more of the parties involved wants to. It needs client leadership to get everybody involved in a construction project to agree to do things in a rather different way.
- Some thought SLs should be mandated. UBT thinks this would be premature, feeling that SLs needs driving forward by teams who are committed to developing a different and effective way of doing things. Otherwise there is a danger that it will become yet another set of boxes to tick.
- Others said they would like to lead, but needed help making the case to colleagues and others. The team has therefore drafted a pocket-sized awareness-raising document on SLs in general, outlining its benefits to clients, designers, builders, operators and occupiers. There may be a case for a flyer specific to schools, but this will partly depend on discussions with PfS.
- In spite of the advantages, clients were not sure how they would be able to fund the exercise. The team's view is that, seeing the value added, they can't afford not to.

10.3 PROVIDING PRACTICAL SUPPORT

Clients also sought practical support in applying SLs, especially for:

- Raising awareness, e.g. using the leaflet mentioned in Section 10.2 above, and an illustrated summary of this case study report. BSRIA is providing help in editing and publishing this.
- Finding ways of changing the culture to focus on in-use outcomes. The idea of SLs Champions looks helpful here.
- Obtaining technical guidance of various kinds. Some already exists or has emerged from the current project. The SLs user group hosted by BSRIA is looking into other aspects. A schools working group could be added, together with links to PfS.
- Finding ways of removing some of the barriers, particularly in resourcing aftercare, which proved particularly difficult to fund from either capital or operating budgets, see Section 10.7.
- School-specific material could also be developed in collaboration with PfS.

10.4 INITIATING SLs DURING BRIEFING, DESIGN AND CONSTRUCTION, STAGES 1 to 3

Since case study participants expected the costs of SLs in Stages 1-3 to be small, it would be possible to get this started under client leadership, first in projects where team members already have some experience and enthusiasm, and then spreading to others.

10.5 SUPPORTING INITIAL AFTERCARE, STAGE 4

Stage 4 is about observation, hand-holding and troubleshooting immediately after handover. One can regard it as part of an extended finishing-off process, with Stage 3 beforehand and Practical Completion in the middle. Experience from offices and higher education indicated that Stage 4 could often be undertaken over the first 6-8 weeks. However, the examples were in established organisations with reasonably well-resourced estates and facilities management departments. Schools usually have less of this infrastructure, less time to spare, and many other things to do when they move into a new building: so the case studies suggest that it could be more practical to provide less intensive support over a longer period, perhaps even the first year. This would also coincide with the traditional defects liability period, and simplify coordination with building contracts. During this stage, the foundations for longer-term aftercare could also be laid, including the agreement of routine data collection and review to be undertaken by the occupier.

10.6 SUPPORTING LONG TERM AFTERCARE IN THE FIRST THREE YEARS, STAGE 5

The case studies confirmed the benefits of aftercare and POE, and the opportunities lost if this did not happen or was not sufficiently well supported. In particular, aftercare allows:

- The building to be tuned-up, improving performance, understanding and occupant satisfaction; informing users and management; reducing environmental impact, benchmarking it against client and design expectations and against other buildings, and saving running costs.
- Designers, builders, clients, occupiers and mangers to learn on the job, and close the feedback loop directly. Since we are being encouraged to make buildings more innovative, "right first time" is not enough. We also need to find ways of moving forward, building on deeper understanding of what actually happens in practice, and where the real strengths, weaknesses and opportunities are.
- Share these experiences to improve general insights into what works, what doesn't, and what needs to be improved. This will help clients, industry and government to focus on what really adds value in practice, so improving performance, sustainability and cost-effectiveness.

In spite of all these advantages, Stage 5 has proved particularly difficult to fund.

10.7 FINDING THE FUNDS

The cost impact on the work in Stages 1 to 3 up to practical completion appears to be small, so clients just need to ask for it. The service requested could also include some initial aftercare. The main barriers come in finding the resources for longer-term aftercare and POE, in particular:

- No provision for aftercare in normal capital budgets; and funding rules (or perceptions of them) that make it difficult or impossible to do it. Can the rules be changed or guidance provided?
- Design and building teams think in terms of building contracts, and find it difficult to see how it is possible to resource work beyond the first year after handover. It may well be better to fund longer term aftercare separately, particularly as much of the required activity is by the occupier or independent assessors, with design and building team members in more supporting roles.
- Split responsibilities, which make it unclear who the "owner" of aftercare and POE really is, and difficult for all the parties who might benefit to arrange to share the burden.
- Difficulties in assigning operating budgets to aftercare, even where paybacks are good, e.g. with reasonable prospects of costs being paid back within a year or two by energy cost savings alone.
- Difficulties in quantifying the benefits in a world in which feedback is rare. For example, if a project proceeds more smoothly by using SLs, and the building works better, nobody may appreciate how things might have been had SLs not been adopted!

10.8 OBTAINING WIDER SUPPORT

Clients, government and others need to be convinced of the benefits SLs can bring in terms of improved outcomes and better value for money; so they can provide leadership and encourage what UBT calls *the new professionalism,* with much more focus on obtaining good performance in use. The case studies also found that SLs offered a broader perspective, helped to build understanding and consensus, and allowed people to appreciate how other requirements could be linked together.

Wider uptake could be encouraged by:

- Partnerships for Schools, which seems particularly interested in working with local authorities.
- Professional institutions, especially RIBA, CIBSE and the Association of Project Managers.
- Influencing bodies, including Architecture+Design Scotland, BCSE, CIC and CABE (for example through design reviews, and in the work of CABE enablers with local authorities).
- Liaison with the Office of Government Commerce in relation to procurement systems.

10.9 DEVELOPING GUIDELINES

Clients will need guidelines on what to ask for, how to evaluate responses, and how to obtain resources. Local authorities could collaborate in developing a standard Soft Landings approach (perhaps with the support of PfS and CABE) which they could plug into any project. This could provide useful continuity and reduce costs of implementation. It could also improve connections between schools and local authorities in support of the Carbon Reduction Commitment, for which local authorities remain responsible, however a state school is actually being managed. Team members look forward to confirming actions with PfS and the industry group.