

Cost and Value: fact and fiction

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Assessing the costs and benefits of any building - let alone a green one - can be elusive. This paper considers the triple bottom line of economic, human and environmental costs and benefits. It identifies inertia in the system; perceived and actual risks; areas in which value can most easily be added or subtracted at various stages in the process; and where improvements might be made. Much of the supporting information comes from recent studies of occupied UK buildings, and may not represent the situation in other countries. However, there appear to be growing similarities in today's globalising market.

Introduction

Buildings need to get greener faster. There is no fundamental conflict between this and better human satisfaction and business performance: the triple bottom line. It all comes down to doing more with less: replacing materials, energy and wastage with information. It may not be helpful to think of green buildings as special: what counts is not what they are, but the better outcomes which result from effective combinations of strategy, design, production and management.

If this is all possible, why isn't it happening faster? Change inevitably takes time to gather speed as inertia is overcome, new things get easier to do, and the real costs and benefits get better understood. The processes of procurement and occupation can often ignore green issues, water them down, or give little incentive to the investor. Gaps - or fear of gaps - between promises and outcomes also increase the perceived risks of greener buildings: how can we help to close them?

Ten years ago, we were doing case studies of office buildings which had proved to be energy-efficient in use, and trying to extract the vital ingredients. At a conference [Derbyshire, 1989], we put forward caricatures of the various players, illustrated by Hellman - the architectural cartoonist - and tried to present the facts to dispel the myths expressed:

- 1 DEVELOPER "An energy efficient scheme costs more, takes longer, looks funny, won't let, and then after all that goes wrong."
- 2 DESIGNER "Our clients don't ask for energy-efficiency. We don't encourage them as it would only mean extra work which they wouldn't pay us for."
- 3 LANDLORD "An energy efficient building doesn't command a higher rent and in any case we don't pay the fuel bills."
- 4 TENANT "Our energy bills are trivial in relation to rent, rates and staff salaries. We haven't got the time to bother about energy saving - we're too busy running the business."
- 5 PERSONNEL MANAGER "An energy-efficient building is oppressive and staff don't like it."

We can't have done a very good job: some of the attitudes parodied apply to green buildings today! But they are not expressions of ignorance: but of genuine concerns about cost, value and risk; and sometimes from bitter experience. How robust are the arguments for greener buildings? How reliably can we deliver? Where do motivation, practice and understanding need to be improved?

We consider the costs of greener buildings; how costs and benefits are perceived and assessed; and what can add or subtract money, environmental and human value for different players at six stages in the life cycle.

- 1 Inception. Strategic decisions on the development. The view of the developer.
- 2 Briefing and outline proposals. What the building begins to be like. Client/design dialogue.
- 3 Design development. How well do the ideas survive?
- 4 Construction. Built as intended?
- 5 Initial occupancy. Including selection and fitout by the tenant.
- 6 In use. Final outcomes, with implications for occupants and management.

It draws upon studies of UK commercial and public buildings (e.g. the Probe post-occupancy studies [Probe, 1995-99]), which have been moving from single-issues (e.g. energy) to a broader aspects of building performance, including procurement processes; occupant and management satisfaction; and strategies for success. See also material on the website usablebuildings.co.uk.

Does capital cost matter?

Green buildings can cost more - particularly where green features are tacked-onto otherwise fairly conventional designs - but they needn't: good buildings can be found at all price levels. For example a sound, robust, no-frills platform ("if in doubt leave it out") with a clear adaptability strategy may offer better value than a more highly-featured solution procured on the cheap. Well-integrated green schemes (without manifestly extravagant gestures) can be affordable if everybody is committed to getting a good package for what the client is prepared to spend. Often added costs are a small part of the total and "lost in the noise" of the whole scheme. The secret is often to "go for it" rather than to worry about the cost-effectiveness of every single item.

People often clamour for "real" data on historic costs, but these are elusive¹:

- often they are not published;
- published tender prices may bear little relation to the final out-turn of a project;
- quoted figures may or may not include things like landscape, design fees and taxes;
- nearly ever project has its special features, site constraints and time pressures;
- fit-out may often be excluded or not all counted: often funds trickle in from other budgets;
- local conditions (place and time) are highly influential;
- clients may "bury" costs for commercial or PR reasons.

Even for tenders submitted at the same time in the same area, differences in both the overall price and its breakdown may have little direct relationship to the technical specification, e.g:

- buildability, which can vary with the particular contractor's skills;
- special relationships with particular suppliers and subcontractors;
- improving cash flow by pricing early work high and later work lower;
- hoping for windfalls by putting high prices on items which seem to have been measured short;
- fear of big name consultants and elaborate specifications, particularly by local firms;
- fear of the unfamiliar.

If you try to get rid of this volatility by normalising the data, the true picture can get even more blurred. Better comparisons come from applying standard rates to estimates of materials, plant and labour used: the very technique used in the UK at the design stage. But this still has to get unit rates from somewhere, typically national and regional averages and ranges of tender prices, material quotations and final account costs. This in turn tends to anchor published rates - often used by contractors as well as designers - to work of "average complexity", and not provide explicit rewards at the cost estimation stage for designs which, for example, simplify the contractor's job by improving buildability. The differences may be there, but appear, for instance, at the last moment as a commercial decision by the tenderer ("This looks straightforward, let's knock 5% off").

Estimation procedures are often found wanting when looking at individual green features, which can be picked off one-by-one as not cost-effective, while they would stack up as a package. In theory one can compare the complete packages; in practice there is often not enough time or information.

EXAMPLE: Initial cost estimators tend to know more about buildings than building services, so seek to minimise cost-weighted envelope area regardless of the effect on servicing costs - which may merely be set at a constant rate per unit area. The building services engineer may squeal: but without a similar quality of initial estimation may carry little weight.

Frequently green measures fall victim to such imbalances in information, before even starting to get into life cycle costs. Over 25 years, operating costs of an office building tend to be 5-10 times as much as capital costs [Citex, 1999]; and this in turn is 10% or so of the salaries of the occupants. From this perspective, penny-pinching on capital cost is silly if it increases operating costs; or reduces occupant satisfaction, productivity, and value added. However, for building-providers, the building itself is the end. Unfortunately for the environment, for occupiers too the equation has another solution: if it generates higher profits, a wasteful building with high (and often tax-deductible) fitout, equipment and running costs can be a perfectly affordable business proposition - e.g. the throwaway buildings and rapid refit cycles of some successful retailers.

A life-cycle approach is often defeated in the marketplace because those who pay the upfront costs do not receive the benefits; or those benefits are rapidly discounted. If the market will not pay more for low-impact buildings, only the highly altruistic or farsighted will be able to provide them.

¹ Except in highly repetitive procurement programmes, for example of retail units. The author is grateful to Jim Meikle of the cost consultants Davis Langdon & Everest for help with these points.

Who will invest in greener buildings?

In the UK, pioneering buildings - in terms of use and environmental value - have often been procured by owner-occupiers, who have been less constrained by market norms, and have more to gain from making constraints manageable. These include insurance companies - who ironically seldom seem to have applied the same vision to their property investment portfolios: an example of how people often behave differently as individuals and in a professional capacity.

However, in the rapidly-changing global marketplace, owner-occupiers are a declining breed as clients for new commercial buildings. As the futures of their organisations - let alone their property requirements - become more uncertain, former owner-occupiers increasingly turn to the speculative market, or ask a developer to give them a “pre-let” building, tailored to their specific needs but not losing resale potential by being too bespoke. With a powerful and well-informed client, this combination of user needs, market disciplines and professional support has produced cost-effective buildings which perform well for both the occupants and the environment, viz the Body Shop [Brister, 1993] and One Bridewell Street [DETR, 1991]. However, less-forceful and experienced clients can start out with green ambitions and end up in buildings which are barely distinguishable from normal market offerings in specification, appearance and performance.

The public sector has also innovated, but suffered (between occasional bouts of extravagance) from being too concerned with price and not investing enough in quality, building management and maintenance. Indeed, procuring and managing buildings has been proving increasingly complicated and difficult for both public and private clients, so they have been attempting to park their risks elsewhere. In the UK the most radical initiative is PFI - the Private Finance Initiative - where the public sector invites tenders to design, build, finance, operate and manage a facility (say a hospital, school, or government office), typically for 25 years.

So there is a move in the market from organisations owning and renting buildings to occupying serviced space. In theory, particularly for the PFI, the building operator has a big incentive to invest to minimise operational costs and environmental impact. However, good performance depends on the operator really understanding the needs of the occupier and adapting the system to suit. This may well be too difficult for operators to bother; and in practice there is little information to help them make reliable predictions in any event. In the short term, contractors may well seek to minimise their exposure by providing a standard (but not necessarily appropriate or efficient) service; passing on “unforeseen” costs; and applying heavy penalties to changes in occupier requirements. The portents from past behaviour of landlords, managing agents and contractors are not good. *EXAMPLE: Rented and particularly multi-tenanted office buildings in the UK tend to be less energy efficient than occupier-managed ones.*

Will the provider invest ... or the occupier pay? This depends on the degree to which occupiers are prepared to insist on the buildings meeting green criteria ... and the providers wishing - or being required - to compete on the levels of performance that they deliver. And all this needs better incentives and clearer ways of understanding and comparing performance in use.

At present there can be big differences between what a building is worth in the market (“the exchange value”) and the benefits it brings to its users (“the use value”):

- Distinctive buildings - even good ones - can be a poor sellers. Their unfamiliarity makes them difficult to value; special features may demand - or be seen to demand - too much from users; and property advisers and agents may not understand them. More standard buildings - with the odd tweak to give them a special identity - can be more reassuring, and so more saleable.
- The market is often driven by features and fashions rather than functionality. *EXAMPLE: The current international trend to glassier buildings - frequently supported by green claims but less often by satisfactory outcomes: big windows can mean big problems!*
- A building with visible green tokens but which actually delivers mediocre performance may be more marketable than a well-performing, quietly and carefully done, low-key building. Even experts may be convinced, at least before monitored performance data becomes available².
- Conversely, the system does not necessarily value things which add value for the user and the environment. For example, in the UK, simple things like airtightness and plant efficiency are widely overlooked, as discussed later.

² For example, the author audited one winner of the UK Green Building of the Year Award and found it used three times the predicted amount of energy. Meanwhile, Elizabeth Fry - a building subsequently shown [Standeven et al, 1998] to have very high levels of occupant satisfaction and energy performance - did not even make to the shortlist.

1 Cost and value at inception

For many developers - and although developers will always be interested in saving money - capital cost is not the biggest thing. What counts is the return on investment, which means maximising lettable area and rental value; and minimising time to completion and occupancy. Provided the location can stand it, a more expensive building can often be more profitable. At this stage, the practicalities of greener building may well be ignored, not clearly understood (designers tend not to be around during the early deal-making); and so the potential may already start to leak away. Any cost estimates used at this stage will tend to be based on past experience and not take account of the ingredients necessary for greener buildings, for example perhaps higher design fees or different site and building configurations: this can set the scene for trouble later on.

For commercial success, the features in the developer's specification must feed through into resale or rental value in the marketplace. But at present green features don't necessarily add market value (the hidden assets are - by definition - not readily visible and the visible ones not necessarily liked); and sometimes they may reduce it.

EXAMPLE: in the UK climate one can often design acceptable naturally-ventilated or mixed-mode (MM)³ alternatives to air-conditioned offices. However:

- i At present they seldom command the same rental as air-conditioned buildings, so they are not the preferred choice in locations in which air-conditioning has become the norm.*
- ii Obtaining natural light and ventilation tends to reduce the amount of lettable area that can be fitted on a constrained site - typically 15% less in a redesign study [Fordham, 1992]. Mixed mode designs are less restricting.*
- iii Access to windows may also stop the lettable area (or the windows) being used as effectively.*

A developer may nevertheless wish to take a long-term view and incorporate green aspects, even if they are not reflected in initial market standards and valuations. For most, this is commercial suicide: their businesses depend on selling their recently-completed buildings to institutional investors who will be looking at specification largely in relation to industry standards, tenant quality and rental level! A BREEAM environmental label on an otherwise relatively familiar product may provide a market edge, but to go beyond that can be risky.

More interested in building performance into the future are the property companies who build and keep their buildings. However, if this adversely affects their balance sheet, their shareholders may lose patience - just like those of the institutional investors.

EXAMPLE. MM offices have worked well for some owner-occupiers and the public sector; often (though inevitably not always) with better occupant satisfaction and energy consumption (though this is a reflection of the imagination and commitment of those who commissioned and use them, and not just the building itself).

On the right sites, MM ought to be a developer's dream, offering buildings with greater intrinsic efficiency and wider market options at similar or lower initial cost. However, major developers⁴ who have recently built speculative naturally ventilated and mixed mode office buildings, have found their tenants putting in air-conditioning to meet their business requirements or property advisers' recommendations. Was all that natural ventilation and passive cooling a complete waste of money; or was the market not yet able to rise to the occasion? The more distinctive and environmentally innovative of these (at Leeds [Bunn, 1995] and Doxford [Winter, 1997]) which had their origins in government-funded design studies were also more difficult to let; at least the the prices being sought.

A more positive commercial outcome was obtained at 3 The Square, Stockley Park, a mixed-mode building on a site where all previous offices had been air-conditioned. However, this was equipped, marketed and priced as an air-conditioned one with the added potential to use natural ventilation. Maybe this is the safe way forward, easing the market through the transition from conventional to greener approaches, with less perceived risk to user and rental value. Again, the marketable solution was not the lowest-cost one.

3 Mixed mode solutions combines natural and mechanical ventilation and cooling systems, and have tended to provide better occupant satisfaction with less energy use. [Leaman, 1999].

4 Including Akeler, Argent, British Gas Properties, and Slough Estates.

2. Briefing and initial design

This is where designers start to be involved, though not always as a full team. For example, a client may ask an architect to prepare a scheme - perhaps even speculatively - to get planning permission, while involving other skills (except perhaps cost consultants) as little as possible. Needless to say, this process is unlikely to provide all-round best-value solutions.

Getting a good building is a relay race with hurdles. To get a good result, you need to know your team and where you are going ... and something may still trip you up! The first problem is the briefing process: understanding the client needs and translating them into requirements for a building. Will this contain the right information to get a good balance of environmental, economic and human value at acceptable levels of cost and risk?

A good brief requires an effective dialogue between the ends (what the client and other stakeholders - including the environment and the public interest - want from the building) and the means (the building and the way it works). It is not a one-way or one-time process ("collecting the brief"), but one of the team and the client getting to know each other; their improved mutual understanding of the requirements being informed by the developing design proposals.

In practice, the briefing process is often weak, as confirmed in the report of a recent research project [Barrett & Stanley, 1999]. The ends seldom get clearly defined (other than crudely as schedule of accommodation, technical requirements and a cost level) and the subsequent dialogue is not explicitly managed. The result is that for the design team the means (the building) themselves turn into the ends, and client and other performance requirements tend to fade even before they have been understood.

Poor briefing can seriously erode performance outcomes, including environmental performance, because requirements and targets are not clearly set and the freedom for manoeuvre understood. *EXAMPLE. The team proposes designing the lighting to the illuminance standards in the Code. Calculations show that the layout preferred by the architect may not quite meet the standard in some parts of the space, so the engineer selects twin-tube rather than single-tube fittings. On moving in, the client complains that the space is too bright. The lighting also cost more (fittings, electrical supply and cooling load) and is wasting electricity. So the cost went up and the environmental performance went down. Why wasn't the client asked?*

A poor ends-and-means dialogue can lead to false expectations by the client of the demands the building will make on the user; and by designers of the capabilities of the users and management. Figure 1 [Bordass & Leaman, 1997] summarises the situation. It assist the briefing dialogue, and help to get the right people to "own" the problems relevant to them. The vertical axis has physical measures at the top and behavioural at the bottom; the horizontal axis context-free to the left and context-dependent to the right. These divide the diagram into four quadrants, to which we have given names.

- A *Fit and forget* (top left). This is where clients hope that most things will go, so that the building can support what they want without making demands on them. Often, however, both designers and clients hope that more will go in this box than actually does.
- B *Fit and Manage* (top right). These are things which need looking after in order to work. Designers should aim to minimise these, but must also draw the client's attention to what the occupier will still need to do. Sadly, however, this seldom happens, so often occupiers are poorly-prepared for the demands the building makes of them, and may not wish - or ever have wished - to provide the input that the building demands. The consequences are often to reduce value for occupants and the environment, as wasteful operation is the easy way out.
- C *Implement and internalise* (bottom left). Sometimes designs require their occupants to behave differently, but do not take good account of the way occupants normally behave; nor make design or management provision to promote or assist desired behaviour. Consequently occupants become irritated, reducing satisfaction and productivity [Baker, 1997]. Again the remedy is often operating systems wastefully, reducing their environmental value.
- D *Risk and freedom* (bottom right). Designs often provide, even in "flexible" buildings, for a narrower range of possibilities than materialise. While nobody has second sight, things can go particularly wrong if a building is optimised to suit one set of assumptions and falls apart under another. For example some recent offices in the UK, designed for natural cross- and night-ventilation, have been defeated by occupants wanting cellular offices and/or multi-shift working. A robust "good enough" solution can be better value than a fragile "just right".

3. Design development

Design development should tie down all the all the loose ends in the initial design; detail and specify them in such a way that the building can be put together appropriately; and sort out problems which inevitably arise. In practice, difficulties and changes can occur which upset the cost/value balance.

EXAMPLE: An energy survey of an award-winning “green” office revealed an installed lighting load of 26 W/m² (a good practice standard at the time would have been 12). In addition, all the light switches in a cul-de-sac off the corridor - causing the lights in cellular offices to be switched on all the time in the whole (well-daylit) room, rather than as-needed, increasing lighting energy consumption by a factor of 4. How could this have happened?

- i The architect envisaged particular tubular light fittings, which were not affordable.*
- ii The engineer designed a similar-looking fitting which could be made by a local workshop for the money available.*
- iii Unfortunately the locally-made fitting was optically much less efficient.*
- iv At no time was the W/m² calculated and the trade off between cost, appearance and efficiency drawn to the attention of the client, architect or cost consultant.*
- v If it had been, cost and appearance would probably have won because the brief had contained no suggested criteria for lighting energy efficiency.*
- vi The architect did not want the walls of the cellular offices to be disfigured by switches. What price usability?*

Such problems are widespread, and often cause gaps to open-up between preliminary estimates and as-designed or as-built performance, cutting into the estimated levels of benefits. Agreed - and if possible quantified - criteria would assist day-to-day briefing and design decisions, and help make sure that pressures of time or money do not trump environmental quality. We need a clearer “language” which can be used throughout the project to communicate required, estimated, specified and achieved environmental performance; and permit clearer and more rapid feedback from achieved performance into briefing and design.

4 Construction

Predictions often assume “built as intended”, when neither the intentions nor the means of achieving them are clear. *EXAMPLE: Energy models often make automatic default assumptions about building use, system control and plant efficiency which are not checked against the actual context of use or the equipment actually specified or installed. Specifications also miss out essential features, such as the specific fan power (in Watts/(litre/sec)) of an air handling unit, allowing contractors to make less-efficient substitutes in order to save money or space.*

Another widespread problem in the UK is poor airtightness of the building envelope. Indeed, recent trends to faster construction and greater prefabrication (to save time and money and to improve build quality) have themselves created new air infiltration problems (because airtightness of the total envelope has seldom been part of the quality criteria): some nominally sealed buildings leak more than those with openable windows. Post-occupancy surveys such as Probe shows that such deficiencies can have a disproportionate effect on energy consumption, particularly of mechanically-conditioned buildings. The increase in energy consumption can be much greater than the greater loads during the operating period, because plant running hours are also increased - sometimes radically - to overcome comfort problems: particularly in better-insulated buildings in which unexpected air infiltration is a major wildcard.

Interestingly, such quality of construction and detailing issues - or air pressure test requirements - do not figure explicitly in BREEAM environmental assessments [viz, Baldwin et al, 1998], which is concerned with technical and management features, but not with the processes of procurement or the relevant quality standards: another example of implicit “fit and forget” assumptions.

At present the UK has a major initiative - the Movement for Innovation - to improve the performance of the building industry. This originated from the report of a committee in 1998 “The Egan Report” [DETR, 1998], which had quite a lot to say about improving product quality and saving time and money, but very little about design quality and environmental performance; or indeed anything beyond the point of delivery. These aspects are now hastily being retrofitted. However, this oversight again confirms the widespread perceptions of a building as an end, not a means.

5 Completion and occupancy

UK buildings are often handed over with shortcomings, many of which might have been avoided by better specification, management, and a “right first time” culture, as advocated in the Egan Report. Chronic, low-level problems are also widespread (e.g. noise, poor usability and energy wastage), as repeatedly revealed by post-occupancy surveys, e.g. [Leaman, 1999] - but tend to persist, because they are not high on anyone’s priority list. Further inadequacies often arise because occupiers are poorly-prepared to operate the building (often a consequence of both the requirements not having been made clear and them preferring not to listen).

In addition, there are things that could not be anticipated or which need fine-tuning, e.g. to meet changing conditions or because the occupier uses the building differently. If the building contains unique or innovative features - as many do - there may well be emergent properties and unintended consequences: Murphy’s Law, as anyone working in R&D and prototyping knows [Tenner, 1996]. Not everything is predictable, particularly where people/technology interaction is concerned.

In the UK, the legal and contractual situation after a building is handed over (“practical completion”) makes it difficult to provide effective after-sales support. The ensuing one-year “defects liability period” implicitly assumes that a building is operationally complete when it is physically complete; denies the need for fine-tuning. This critical period for the user then becomes pass-the-buck time in which it is very difficult to get anything done. This open loop often stops a building achieving its potential environmental and user value, and sets the scene for further decline. To bring the physical and the operational together, Probe advocates a “sea trials period” in the first year in which the occupier is helped to get the best from the building; the designers appreciate the occupier perspective (which will also help them with the next job); and there is a budget to get things put right quickly.

6 In use

In use, occupiers become aware of emerging constraints, manageable and unmanageable. For example, the deep space procured to meet corporate demands for flexibility and interaction often demands unexpectedly high levels of support for its technical and furniture system; and to deal with the complaints of occupants caught in a dependency culture and unable to make adjustments for themselves. If too much is unmanageable, vicious circles of progressive decline are inevitable.

The Probe studies, figure 2 [Probe, 1999], suggest that two types of situation perform particularly well for their occupants:

- Type A Relatively complex-to-operate buildings which are very well managed.
- Type B Relatively simple-to-operate, stable, self-managing buildings in which occupants have the ability to solve their own problems.

Type B tends to be less energy-intensive than Type A. Managements of Type A may or may not be interested in environmental and energy performance; but if they are, they can achieve all-round excellence - the triple bottom line.

Environmental performance predictions frequently assume “fit and forget”, even for issues which dependent on design/management and people/technology interactions. However, management - even where they have procured buildings with green features - does not often give high priority to buildings and environmental performance. So many buildings fall into the “Type C” category: they require effective management but are too demanding for the management resources available. Hence they do not achieve their potential, both for occupant satisfaction and human performance. While the designers can blame the management, often the fault lies with a poor ends-and-means dialogue which has not properly explored the properties of the building and the priorities of the occupiers.

In the past, Type C situations have mostly afflicted air-conditioned buildings, but in recent years some green buildings have also succumbed. In the UK, so-called Advanced Naturally Ventilated buildings have been particularly susceptible. These have used advanced methods (e.g. thermal modelling, computational fluid dynamics and computer control) to push natural ventilation into deeper, more complex, and more densely occupied spaces. Problems have arisen, because:

- designers and occupiers expected more to go into the “fit and forget” box than actually has;
- the buildings have turned out to be more innovative than anybody thought; for example:
- shortcomings in typical building practice (e.g. airtightness and controls) are exposed by designs which are more highly dependent on their correct performance;
- but there was no allowance for increased management and “sea trials support; and
- often the solutions have turned out to be somewhat unfriendly to the user.

Discussion

The building industry tends to see its products as ends, rather than as means to wider ends. Provided they are “good enough” for their purpose, in-use performance of any kind has not figured highly. Location, appearance and specification features have been the main determinants of value, while patterns of institutional investment in the market have fostered an increasingly limited range of building types and reinforced the *status quo*. [King, 1990].

Although a change is overdue - and occupiers are now becoming more concerned with performance and value for money - the quality of information and the levels of analysis are still crude: and often compared more with market norms (the ends for the building industry) than with delivered performance (the ends for the occupier and the environment).

For example, a “good” industry benchmark for space use efficiency in an office building in the UK is a nett:gross ratio of at least 80%. This may make sense for a developer, but occupiers’ advisers often use the same yardsticks. Is the cart before the horse? Are we sure that a “less efficient” use of space might not be more effective? For example, one downside of this target is cramped plant rooms (or exposed plant outdoors or on the roof), which tends to lead to skimmed maintenance; and hence poorer internal environments and higher energy use and pollution.

Similarly a lighting installation may not be regarded as “good” if it does not meet the book standard of 500 lux on the desktop. Yet when you interview the occupants, you may find them much happier and more productive under their well-designed, low-illuminance scheme than the property market’s typical offering. What should be helpful means of assessing the building have instead turned into tyrannical ends which can even undermine the potential for deeper insights.

Energy benchmarking, where applied, can be equally crude. For example, a building can be rated “poor” for using 50% more electricity than typical, when in fact it contains a large computer room (not included in the norm) which uses 60% of all the electricity. The computer room itself may or may not be efficient in its own right, but the initial judgment about the electrical efficiency of the building was also poor. But then again, why were there no electrical sub-meters on the computer room and its air-conditioning: there seldom are

Often the energy argument is also played in reverse: designers demonstrate how green their building is by juxtaposing their theoretical estimates (for building services only) with “actual” figures which include office equipment, computer rooms etc. Often the green claims are at least partly a fiction, reflecting different assumptions which have not been made explicit. Indeed, the different languages used by different players often seems designed to obscure what is going on.

Conclusions

In this situation of poor information, market lock-in, uncertain risk, mixed motives, wooly government leadership and contradictory price signals, it is not surprising that people find it difficult to know if they really want greener buildings, and how much they should be paying for them. Many fear the unknown and are reluctant to make the first move. They prefer to wait and watch the pioneers open up the new territory and make all the mistakes. Then they can move in!

Nevertheless, change is in the air and it is vital we break the vicious circles and make buildings become greener faster. There is massive potential for doing so, even without radical change - there is so much avoidable waste in the system. To make progress we need:

- A changed mindset: greenness will only improve rapidly when it becomes a major priority in procurement, investment and building management.
- A focus on ends rather than means, with better means of keep projects on course, e.g with design brief management for the client⁵, and independent “reality checks” at critical stages.
- An understanding that we need to look at process and players, and not just product.
- Seeking to put more in the “fit and forget” box, while making sure that the remaining problems are “owned” by the players most capable of dealing them.
- Greater visibility of intentions and outcomes: supported by better information, benchmarking and feedback; and expressed in ways that all can understand.
- A marketing approach with can smooth the transition to greener buildings and reassure agents, investors and occupiers that both short and long-term risks are being effectively managed.
- Mechanisms which can deliver virtuous circles of continuous improvement.

Postscript 1: it's the context, stupid!

Traditionally, buildings have responded to and created contexts: they have used local materials to modify the local environments to provide better internal environments of all sorts of purposes; and at the same time have made places what they are. Part of the green building movement wishes to restore this type of responsiveness, most particularly through climate-responsive passive design.

In this there is a major potential conflict with the forces of globalisation, which tend to want to destroy context in developing mass market industrial processes and products. We have a strong taste of this in the UK at the moment, with major clients and government wishing to overhaul the industry and move it to a modern and efficient industrial base. Although mass-customisation is now possible, this tends to be within a fundamentally limited palette of options. Air-conditioning America [Cooper, 1998] describes how the growth in air-conditioning led to a debased form of building, driven more by profitability and convenience for the supply-side than value for the users. Will we be able to bring means and ends together more closely this time?

Postscript 2: it's the context, stupid!

Although most of this paper is based on work in the UK, we have also made comparisons with buildings in other countries, including one between energy used in the offices by Probe in Britain with some comparable data from Sweden [Bordass & Jagemar, 1998]. In Britain, it is received wisdom that Swedish buildings are much more energy-efficient than ours. The comparison, figure 3, told a somewhat richer story. For the similar offices at the bottom left of the diagram:

- The Swedish offices were better-insulated and more airtight, and most did indeed use less heating energy than the British ones (particularly the more recently-completed or refurbished ones), and in spite of Sweden's colder climate. However, a direct comparison was not possible because many of them were district-heated (and the plotted consumption was metered heat) while the British ones surveyed all used metered gas.
- For electricity, however, consumption in the buildings in the two countries was more similar.
- 20% of the electricity in CAF and over 40% in Marston Books was used in their air-conditioned computer rooms. Many buildings in the Swedish sample did not have these.
- The Swedish offices had typically 50% more floor area per occupant than the British ones, increasing their energy density per person.
- The British building - Elizabeth Fry [Standeven et al, 1998] which had imported Swedish technology used less energy than its Swedish peers, and also delivered unusually high levels of occupant satisfaction.

Further discussion indicated that although Swedish buildings had always tended to be better thermally owing to the colder climate, much of the effort following the 1970s oil crisis had been to reduce oil consumption by better insulation and district heating using waste heat and refuse. Electricity saving had not been a priority owing to the availability of hydroelectric and nuclear power: scarce and expensive oil was the strategic threat. Indeed, Sweden's better-insulated buildings tended to be more self-heating and so required more electricity for mechanical ventilation and cooling.

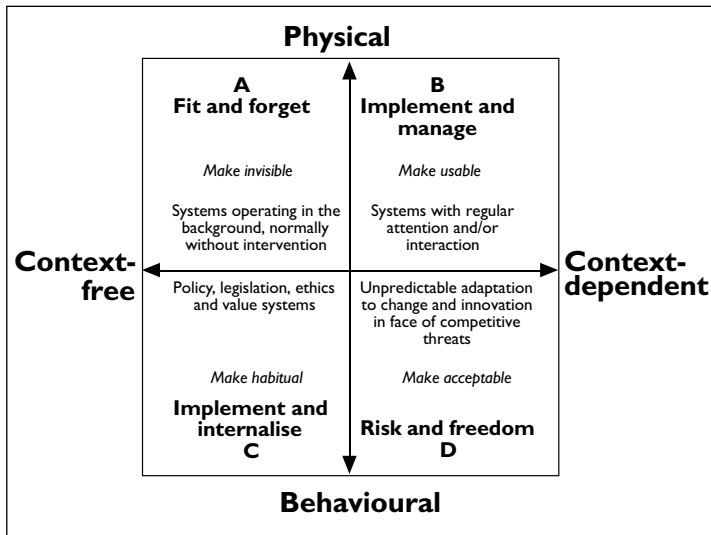
The British sample did however also contain some very high-energy office buildings, to the right of the diagram. However, these tended to be head offices of financial services companies, often with high computer room loads and long hours of use; a type not represented in the Swedish sample. A recent survey of a bank headquarters in Holland, however, revealed a similar pattern of energy consumption to the British ones; and rather poorer levels of occupant satisfaction.

This demonstrates the danger of making comparisons without having good reference information. It's the context, stupid!

REFERENCES

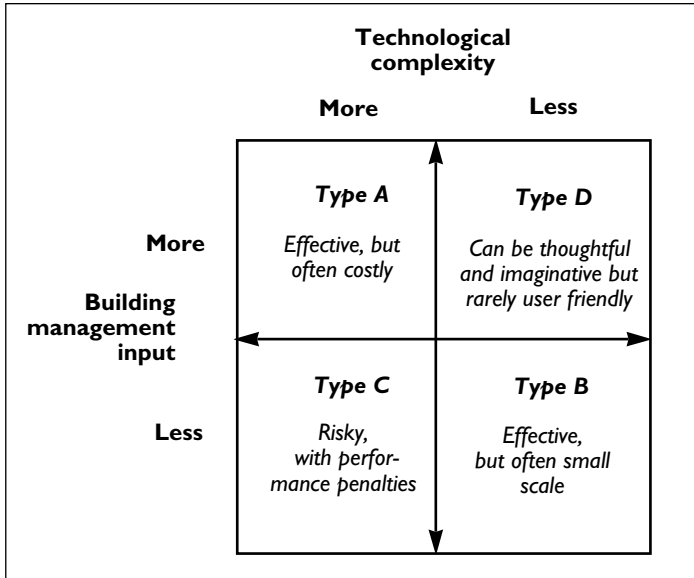
- Baker, N (Winter 1996) *The irritable occupant: recent developments in thermal comfort theory*, *Architectural Research Quarterly*, 2, 84-90.
- Baldwin, R, Yates, A, Howard, N and Rao, S. (1998) *BREEAM 98 for offices*, London: Construction Research Communications.
- Barrett, P and Stanley, C (1999) *Better construction briefing*, Oxford: Blackwell Science.
- Bordass, W and Jagemar, L (April 1998), *Guidance from Göteborg: Building Services in the UK and Sweden*, *Building Services* 33-34.
- Bordass, W and Leaman, A. (May/June 1997) *Design for Manageability*, *Building Research and Information*, 25 (3) 148-157.
- Brister, A, (April 1993) *Body-building* *Building Services* 14-18.
- Bunn, R (Nov 1995). *Natural Speculation*, *Building Services* 20-25.
- Citex (15 January 1999) *Whole-life cost model*, *Building* 65-71.
- Cohen, R, Standeven, M, Bordass, W and Leaman, A. (2000) Assessment of Building Performance in Use: the Probe process, *Building Research and Information*, Forthcoming.
- Cooper, G. (1998) *Air-conditioning America*, Johns Hopkins University Press.
- Derbyshire, A. (22 March 1989) *Good design is energy efficient design*, The Office Revolution Conference, Energy Efficiency Office (now DETR EEWD), London.
- DETR (May 1991) Good Practice Case Study No 21, *One Bridewell Street*, BRECSU for Energy Efficiency Office.
- DETR (July 1998) *Rethinking Construction*, London: Department of the Environment, Transport and the Regions.
- Fordham, Max and Partners, (1992) *Specification and design for building depth: why people specify deep-plan buildings*, Contractor report to BRE, EMC 43/92, unpublished.
- King, A. (1990) *Architecture, capitalism and the globalisation of society*, in Featherstone, M. (ed), *Global Culture*. London: Sage
- Leaman, A. (June 1999) *Comfort and joy*, *Building Services* 33-34
- Probe (1995-1999). Fifteen PROBE studies and a variety of introductory and review articles have been published over this period in *Building Services Journal*.
- PROBE 19 (March 1999) *Designer Feedback*, *Building Services Journal*, 38.
- Standeven, M, Cohen, R, Bordass, W and Leaman, A. (April 1998) *Probe 14: Elizabeth Fry Building*, *Building Services* 37-41 .
- Tenner, E. (1996) *Why things bite back: Technology and the Revenge Effect* London: Fourth Estate.
- Winter, M. (1997) *Solar synthesis*, *Architecture Today*, 89, 24-30.

Figure 1: Fit and forget?



Source: BORDASS, W. & LEAMAN, A, Design for Manageability, Building Research and Information Journal, May, 1997, No. 3 © A Leaman & W Bordass

Figure 2: Design/management interactions



Source: PROBE 19 (March 1999) Designer Feedback, Building Services Journal, 38.
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Figure 3: Energy consumption of Probe offices in comparison with Swedish data

