Strategies for Better Occupant Satisfaction

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Introduction

This paper deals with some conclusions we have reached from studies of building performance. References 1-5 give examples, which in turn refer to a wider set. Although we concentrate mainly on occupants of buildings it is essential to consider the wider context of design, management and operational features. In fact, occupant satisfaction depends critically on strategic choices underlying design and management processes.

Some of our conclusions may appear obvious, or nearly obvious. Perhaps this is why designers and managers pay so little attention to them; or perhaps user needs are never really top of design and facilities management agendas, however much lipservice they now receive.

Figure 1 shows perspectives from which various role players approach buildings: corporate decision-makers often want to benchmark against market criteria; facilities managers often want to keep the show on the road - but are less concerned about optimisation - for instance; designers want to meet targets (often stringent in time and cost terms) without being hobbled by unnecessary constraints; and occupants have a job to do, without wanting to worry themselves about their immediate working environment at all! Developers could also be added: they want good yields from their investments and can again be relatively indifferent to real needs.

Buildings are often ushered through the procurement and design phases by corporate managers and design teams, with little attention paid to facilities and occupants' needs. This separation into supply and demand still bedevils a proper resolution, with too much emphasis on capacity, spatial and technical features (often wrapped up in impenetrable jargon) and not enough emphasis on users' needs (often treated peremptorily or in caricature). The design and briefing process hides behind buzzwords like "flexibility", hinting that buildings should be capable of adapting to uncertain change - much of which is user- or client-induced. But there is little evidence of rigorous analysis of how to deliver the right forms

Figure 1: Roles and their implications

	This role...	... needs or wants to achieve ...	... with these implications for strategy ...	... and these for design.
1	Senior (corporate) manager	Best performance re market norms, investment criteria, business mission etc	Market norms v best practice	Depends on organisational culture: sometimes interventionist, sometimes hands-off.
2	Users and occupants	Fast, on-demand response for critical task support	High context and/or management dependency	Excellent usability, manageability essential for task support..
3	Facilities manager	Service to customer (usually 1 & 2, above)	Can be reactive or proactive, but usually depends on existing organisational culture.	Time and resource-dependent features (eg logistics) critical for good service performance.
4	Design team	Freedom from unnecessary constraints so that complex and often conflicting objectives are achievable within time and cost frames.	Well-managed design process integration versus strongly-framed segregation, often unwittingly / deliberately exporting problems / externalities to others.	Indiscriminate change and cost-cutting often problematical. Conflicting perceptions of non-essential items. Attention to detail often sacrificed, especially when strong integration is absent.

of redundancy, so that there is just enough extra capacity to cope with demand fluctuations without imposing unnecessary capital or operational costs.

Our experience comes from examining how buildings work. Their complexity, inter-connectedness and rich contexts means that usually:

- exceptions can prove the rule (it is impossible to list principles which are applicable in all cases);
- it is better not to speak about causes (far better to stress risk, chance and probability);
- good hunches on the basis of detailed observation can be a better basis for proceeding than masses of statistical analysis (but you need lots of examples to convince people; a few cases or anecdotes are not good enough).

In reference 1 we concluded by saying that it is obvious that good buildings with satisfied occupants need to be well-briefed, well-specified, well-designed, well-built and well-managed. A good and extended handover is also becoming increasingly necessary for the more innovative and technologically sophisticated buildings, to allow the occupier to understand the design intent, the designer to appreciate the occupier's requirements, and for problems to be solved and useful feedback obtained.

A good brief

One of the most noteworthy findings from the Probe studies [reference 3] was that the two buildings (out of the eight studied) that came out best for occupant satisfaction were the most complex and the simplest! Was this a quirk of the small sample, a baffling contradiction or a hint of something more profound?

Earlier work involving another six buildings studied with similar techniques [Reference 6] had indicated that the better buildings were those where the occupiers had the opportunity to "take ownership" of some of the problems that are more often thought to be the total province of the design team (such as lighting controls). Where attempts were deliberately made to fit the occupiers' requirements to the building form and technology in advance of occupancy, better performance seemed to result. This process also seemed to be more effective in pre-let than in owner-occupied buildings, possibly because in the former the occupier's task is simpler.

Figure 2 tries to show why this happens. The key is not solely design, but the overall approach to technology and management. For the purposes of the (over-simple) diagram we have split technology into less and more complex and building management into low and high input. When plotted in a two-by-two table, this gives four basic

Figure 2: Basic briefing strategies

Building management input		Technological complexity: More	Technological complexity: Less
	High	Type A	Type D
	Low	Type C	Type B

types. We think that two of these types - labelled A and B - yield buildings with higher chances of satisfied occupants; Type C yields less chance of happy occupants; and Type D is a rare case (but the occupants are probably ecstatic!).

Type A (complex technology, high management input) is exemplified by Tanfield House [Reference 7], the highest scoring Probe building for occupant comfort and perceived productivity. As a large office, with extensive floorplates and a high proportion of clerical staff working in open-plan areas, it could easily be at risk from chronic ill-health problems. In fact, the very opposite! Why? - because Standard Life have deliberately provided resources to manage the complexity inherent in the building's space, use and technology. They do not scrimp on maintenance, cleaning or crucial facilities management functions like the helpdesk. This added resource helps compensate for the intrinsic disadvantages that buildings like this can create: for instance, loss of perceptions of control over their immediate working environment by a relatively sedentary, mainly clerical workforce. In return, the building "delivers" the high level of functionality that is required by an organisation of this sophistication.

Type B (less complex technology, low management input) relies on a completely different briefing and design philosophy. In the case of the Woodhouse Medical Centre [Reference 8] the payoff is low environmental impact. Here, a relatively small-scale built form, with technology of lower sophistication requiring less management intervention, delivers good levels of occupant comfort, and the occupants tend to forgive the occasions when the building does not work very well (in hot, humid spells in summers, for instance). This approach is effective for organisations that have simpler needs, but is much harder to achieve when the client's expectations and performance requirements rise. and the occupants are less able to understand or adapt the situation.

Type C (more complex technology, low management input) holds out the promise that more complex technology is actually cheaper to run and requires less management. In most buildings we have studied, the opposite is the case because the integration between technical and human systems is often very poor and they are operationally more complex than the given management system can cope with. The outcomes, in occupants' terms, tend to be lower perceived satisfaction, which brings with it a cluster of associated effects - lower perceived health and productivity among them - which are hard to disentangle causally. This is what Edward Tenner [Reference 9] calls "revenge effects", of which we show some building-related examples in Figure 3.

Type D (less complex technology, high management input) is a rarer and more exotic species, perhaps exemplified by the Rocky Mountain Institute Headquarters in Aspen, Colorado (a combination of home, research centre for 20 staff and "indoor farm") which we have read about [for example, Reference 10, pages 10-13] but not visited. This has extremely low costs in use for energy (a payback of 10 months on the extra energy-saving features is quoted) but probably requires a much higher level of informed management input than is normal because of the technical features used. (We will be happy to be shown otherwise; in which case the building becomes a Type B!).

Each of the four types implies a different approach to the building brief . Type A, to be successful, requires that continuity is maintained in the management systems, and that high levels of excellence are aimed for in maintenance, problem-solving and in dealing with occupants' complaints. The high management inputs required need also to be protected across the life of the building.

Type B needs attention to design detail so that systems are as usable and trouble-free as possible. Robust, proven and "gentle' forms of engineering are often appropriate here, so that interventions have relatively minor consequences as far as revenge effects are concerned and any that are required are as easy to carry out as possible.

Of the four, Type C is much the most problematical because it is inherently unstable - the interaction and possible breakdown of systems always threatens to outrun the capability of the management to deal with them. Often, the temptation is to layer on even more technology in an attempt to solve the problem, rather than tackle its root cause, which may often be behavioural or managerial. The answer here is a more conservative approach: less design innovation, more standardisation, careful reviews of usability, a willingness to learn from others, more what-if? questions and a greater capacity to nip problems in the bud before they develop into something serious.

Type Ds often masquerade as Type B, because their promoters overestimate other people's expertise and motives to keep buildings running comfortably and efficiently. This is especially so if technical features intrude without seemingly needing to: for example, if an automatic lighting control system turns off the lights without any apparent reason for doing so. Such systems will be overridden for good if they make people feel stupid. People soon tire when constant vigilance is required to keep things operating properly.

The lesson here is that effective operation of buildings - and hence the comfort and satisfaction of their occupants - depends on technological functions which in turn depend on inputs of management resources to keep them operating properly. The myth is that technology usually operates independently of labour resource inputs or just needs commissioning and maintaining. This may work for stand-alone cases, but in complex systems like buildings where interdependencies greatly increase the risks of faults, inefficiencies and unintended circumstances this is manifestly not the case. The symptoms are widespread chronic and

Figure 3: Examples of revenge effects in buildings

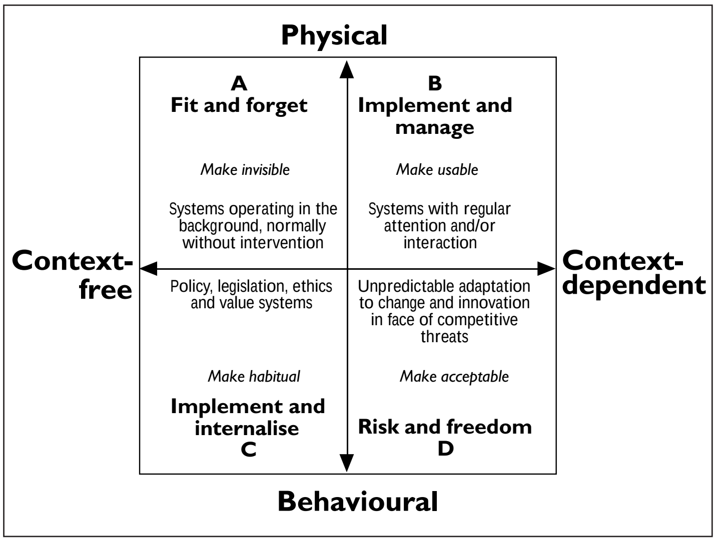
Measure	Intended consequence	Revenge effect	Possible solution	Comments
GENERAL:				
Improve comfort provision and energy efficiency	Automated windows, blinds, lights etc. can be controlled to provide optimum conditions.	Reduced occupant tolerance. Increased dependence on management. More complaints.	Include occupant over-ride facilities.	Imposition of automatic control can be very irritating. Try not to sacrifice adaptive opportunity.
Increase technology to provide added "flexibility"	Less management input necessary to make alterations from time to time.	More management input to look after the additional systems. Still requires some alterations too.	More realism. Better integration between physical and human systems.	Careful discussion of brief and design options to avoid fantasies.
Increased BEMS control	Better control and management information provided.	More load for operator, who may not be fully familiar. Local interventions more difficult.	Don't over-centralise. Allow for local decisions on over-rides etc..	Particularly important to have local over-rides in mult-tenanted buildings.
Outsourced facilities management and BEMS operation.	Professional service. Leaves occupiers to concentrate on their core business.	Business requirements for environmental services not so well understood, so systems run generously, wasting energy.	Tighter contractual requirements or retain in-house control of operation.	Third parties often not on site out-of-hours when anomalies tend to occur. Don't outsource the feedback loop!
LIGHTING:				
Occupancy-sensed lighting in offices	Lights switched off when people absent.	Lights switch on unnecessarily when occupant does not need it, or for passers-by.	Include manual ON switches, except where lighting is required for safety or convenience.	Also include manual OFF switches if possible. Control lighting of circulation routes separately.
Occupancy-sensed lighting in meeting rooms.	Lights come on only when required.	Can't switch lights off for slide presentations etc.	Include local over-ride switches.	Local manual control plus absence sensing only may be preferable.
Automatically dimmed lighting	Reduces artificial illuminance level when daylight is sufficient.	Increases artificial illuminance level when daylight fades.	Bring on at a low but reasonable level. Try to leave adjustments to increase brightness to the occupants.	Constant illuminance may also bring dissatisfaction owing to eye adaptation. Photocells sometimes confused by reflections.
Local switching of lighting	Greater responsiveness to need	Difficult to switch off lights left on inadvertently.	Absence sensing or "last out-lights out" facility at the exit.	The switch at the entrance should only activate circulation and safety lighting.
High intensity discharge lighting	Efficient point source.	Run for extended hours owing to extended run-up and particularly restrike times.	Use instant restrike ballasts or substitute fluorescent lighting.	Compact fluorescent fittings can also take some time to run up to reasonable brightness.
Lighting to suit VDUs	Reflected glare minimised.	Dreary-looking environment.	Added wall-washing etc.	Uplighting also worked well.
HVAC SYSTEMS:				
Displacement ventilation	Reduces cooling loads	Increases air tempering loads	Heat recovery	Minimise parasitic losses and avoid recovering unwanted heat.
Generous provision of cooling capacity	Deals with possible increases in internal gains.	Oversized systems can operate inefficiently and may cause discomfort.	Contingency planning, or systems which work effectively and efficiently at low capacity.	Needs care in design and management.
Full fresh air systems	Improves air quality	Increases heating loads and makes humidification likely.	Avoid over-ventilation and consider heat recovery, including latent.	Cleanliness may be more important. Don't operate ventilation just to provide heating or cooling.

"pathological" features such as ill-health amongst office workers and wasteful use of energy.

An appropriate specification

Appropriate strategies are obviously affected by goals (not mixing up means and ends) and context (knowing which strategy will work best in which situation, now and for the future). Surveys including Probe [eg Reference 3] suggest that comfort standards are also affected by context. While this has long been appreciated in applying different temperature standards to air-conditioned (AC) and naturally-ventilated (NV) buildings, the components of this in terms of adaptation, tolerance and responsiveness are now beginning to be understood. For example, occupants of close-controlled AC buildings in which there is less opportunity to fine tune their surrounding environment can be less tolerant of seemingly superior conditions to those in more free-running NV spaces [Reference 11]. More dialogue is required during design development of the standards appropriate to the evolving building and its control and management strategies. A strategy that aims to improve adaptive opportunity [Reference 11] and forgiveness may sometimes be more robust and cost-effective than one which aims to improve physical comfort standards, particularly if the latter threatens to make the design less robust and more management-dependent, and the occupants less tolerant. Some of these considerations are shown in summary in Figure 4 [from Reference 2]. As our knowledge of how building occupants react in real (that is, not laboratory) situations, it is becoming clearer how context dependency may work. For example, in Britain office occupants overall seem to be happier in NV buildings in winter and AC in summer [Reference 13]. Judging from recent Australian work, the trigger for switchover from natural ventilation to air conditioning (in situations where occupants have the choice between systems) is outside air temperature, as might be expected, plus a smaller contribution from enthalpy - the heat content of the air [Reference 14].

Figure 4: Four strategic requirements for excellence in building performance



The importance of context on user satisfaction implies that in the UK mixed-mode (MM) buildings (hybrids of AC and NV) might often offer an effective way forward for occupant satisfaction, as well as other factors such as energy efficiency [Reference 15]. Mixed-mode buildings have several advantages, although there are downsides as well, particularly if they enter Type C territory!

From evidence compiled from over 60 MM buildings built in the UK over the past 15 years [Reference 15], there is greater potential for creating looser-fit, more generic, less specialised buildings which should be more future proof because they can be more readily adapted to the needs of different occupiers. Mixed-mode buildings may need more design time "up front", but even this may turn out to be an advantage rather than a cost because the added effort to achieve better design integration should pay for itself many times over with higher human productivity. The problem is who gets the benefit: occupiers will tend to benefit more than the designers or landlords. For example, if there is no added incentive for the design team to spend more effort at the briefing and design stages, then they will obviously think twice about the extra cost involved.

Evidence is beginning show that occupants may be happier in MM buildings. Figure 5 shows (albeit for small samples, but the statistical analysis takes this into account) that people might prefer MM for overall comfort.

A good design

Design issues are covered in an accompanying paper [Reference 1] so only a few points will be made here:

- Keep things simple, efficient, robust and usable where possible, concentrating especially on

Figure 5: Differences in occupants' overall comfort between ventilation types

	Count	Mean	Std. Dev.	Std. Err.	
NV	26	4.19	0.47	0.09	
AC	13	4.33	0.48	0.13	
MM	4	4.73	0.42	0.21	
ANV	5	3.74	0.22	0.1	
Vent type	DF	Sum of Squares	Mean Square	F-Value	P-Value
Residual	3	2.35	0.78	3.85	0.0157
	44	8.94	0.2		

Source: Building Use Studies, based on 48 buildings from the BUS database.
NV=natural ventilation; AC=air conditioned; MM=mixed mode; ANV=advanced natural ventilation. Mean scores are for occupants' perceptions of overall comfort on a 7-point scale (1=low; 7=high).
The probability (p) value (p=0.0157) indicates significant differences between the ventilation types. Inspection of the means shows MM to be highest (=most comfortable). Note, though, that the sample of buildings for MM and ANV is small. The analysis, however, takes this into account.

those "interfaces" where users are involved, particularly for environmental controls (see below), management and maintenance.

- While a design should be integrated, often the most effective form of integration is at the strategic level which then should allow different individuals and systems to operate relatively independently of each other. Thus needless (especially dangerous) interactions are eliminated. Where interactions do occur, they should be managed properly, especially if they involve risks. This is easier said than done. The reasons why designs are often poorly integrated is that this involves careful planning, scenario testing and attention to detail in the right places many of which are currently ignored, or virtually so (viz: controls interfaces and usability). Poor integration often affects occupants in a chronic, but not catastrophic, way: for instance, they can continue working and put up with the glare on their screens, but it reduces their capabilities long term.
- Plan for change, whilst avoiding over-specification, over-complication, energy-wastage and increased burdens of vigilance upon management. The problem here is that achieving this effectively may mean abandoning past design pre-conceptions and starting again from scratch,which may be perceived as too risky and/or costly, in spite of greater possible benefits later. But it is not necessary to take too many risks with occupants. Is it really necessary to re-engineer the light switch every time a lighting system is designed? Users prefer predictable, simple systems which behave in the ways they expect. Surprise, unwanted change, uncertainty and lack of response are the main enemies as far as occupants are concerned.
- Be alert to possible Achilles' heels, downside risks and revenge effects (see Figure 3). This can only come from an effective system of review and feedback, so that designers learn from mistakes or surprises and re-inforce their successes.

Well controlled

Control, and the relative lack of it, is top of most occupants' concerns, particularly if their environment is unsatisfactory in some way - when it is good enough, you don't need to change it.

Figure 6 shows how occupants' perceived control is related to the cluster of well-being variables - comfort, health and satisfaction. It has three routes by which perceived control (and hence satisfaction) may be improved:

1) physical zoning (especially the zones for heating, cooling, lighting and ventilation which should both coincide reasonably and relate well to - "map on to" - occupants' activities);
2) trade-off (especially giving occupants the choice of the lesser of two evils like between being too hot or too noisy) and fine-tune capabilities (people often say that their environment is never "just right"); and
3) speed of response of management when problems occur.

A good building with satisfied, comfortable occupants would have all three. However, even when 1) and 2) are relatively poor it is still possible through excellence in facilities management to keep occupants happy (see below).

There are also differences between individual and group effects to consider. People with their own office are much more likely to have more options with 1) and 2). Those constrained by their colleagues in workgroups or sitting in open-plan spaces may be much more circumspect about their use of controls like window blinds, taking their colleagues' likely responses into consideration, for example. In general, the larger the open-plan area you sit in and the bigger the working group you are a member of, the less likely you are to perceive (and to actually have) good control over your indoor environment. This is why it is imperative for building management to compensate, for example, with fast and effective response when complaints are made.

Many controls operate in the background and are largely taken for granted by occupants and operators alike. But are the systems controllable, are they controlled and operated efficiently, and are problems being detected? Frequently not. In spite of advances in control technology, effective human application of controls in buildings requires care, skill and understanding.

Controls also form the vital interfaces between the building's environmental control and engineering systems and its occupants and management. Even the smallest thing, for example a window control which is inaccessible or gives insufficient fine adjustment, can lead to major shortcomings in performance and occupant tolerance. It is vital to make controls comprehensible, effective, responsive, and in the right place; and to be sure that in their operation they will assist and not annoy. Careful analysis is required but is often absent: frequently the BMS (building management system) specialist is told very little about the design intentions and how the building is likely to be used. They may not care either!

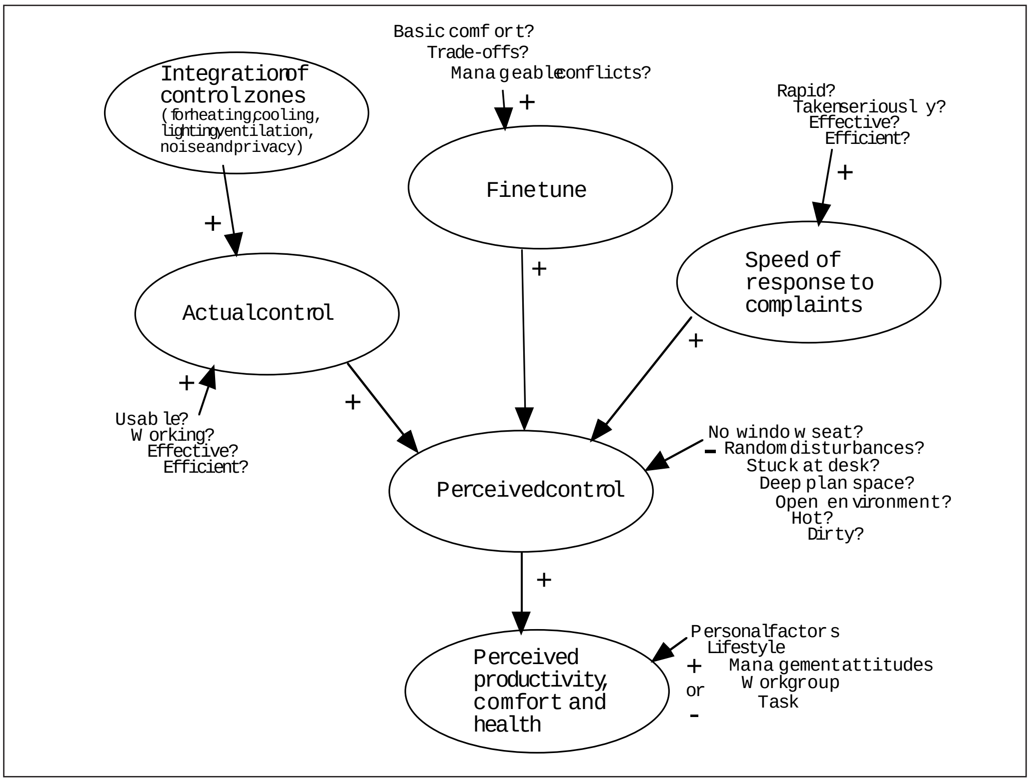
Well built

This goes without saying, but can be difficult in today's competitive market, with an increased range of products (plus the disappearance of some traditional skills and products), and in which designers often also have less power on site. This tends to throw the burden back on design and specification, on the basis that if one hasn't asked for something one is unlikely to get it. But new things will need specifying, like pressure testing for air leakage, component energy efficiency benchmarks, usability criteria, and post-completion support. This will require some new infrastructure of standards, acceptance procedures and so on.

Well managed

Good management can procure a good building and make it better in use. While such paragons are rare, they are increasingly evident, particularly in today's air conditioned buildings where they are sometimes able to overcome deficiencies created by poor design or build quality. The Probe survey

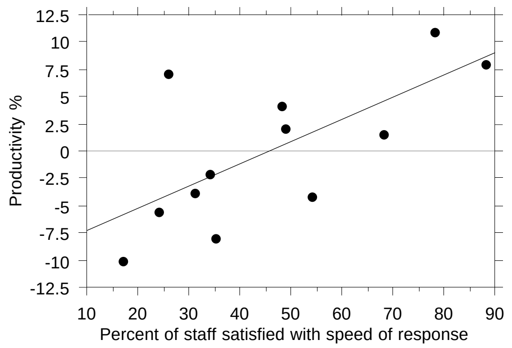
Figure 6: Three routes for better occupant satisfaction



Plus signs show positive effects (ie an increase in one normally produces an increase in the other). Minus signs are decreases.

Source: Reference 4

Figure 7: Perceived speed of response and productivity.



Source: Building Use Studies, based on 12 buildings from the BUS database.
This shows the association between the percentage of staff in 12 buildings who are satisfied with the speed of response of facilities management when they made a complaint about the heating, cooling, lighting or ventilation systems (bottom axis) with the perceived productivity of staff (vertical axis). The association is both strong (r=0.69) and significant (p=0.0129), showing that faster response brings better reported productivity. For definitions of productivity and more details of the survey method used see Reference 5.

[Reference 3] indicates that customer (i.e: occupant) service often comes higher on priority lists than energy management, for example. Service trumps efficiency. However, a few have been able to complete the virtuous circle and to provide both satisfied occupants and low energy bills. The key is not simply assiduous management, but the presence of monitoring systems which provide timely and understandable feedback on key indicators, plus, of course, systems which are intrinsically low-energy and capable of being effectively operated and managed.

Often the medium is as important as the actual message because effective monitoring channels also carry richer informal feedback. For example, feedback from cleaners through routine reporting may help both energy management and security functions - ostensibly outside the cleaners' responsibility. Informal feedback loops on space use, maintenance and deterioration, cleaning and waste provide vital sources of data to help provide rapid diagnosis and fixing of problems. Where this feedback and rapid response is present, occupants are happiest, as Figure 7 shows. The best buildings tend always to have it, although many people do not realise it!

Figure 7 includes preliminary findings from the Probe survey and related studies [References 1,3, 7 and 8] which examines occupants' perceived productivity at work in relation to their perceptions of speed of response. Although the sample of buildings is relatively small, there are detectable effects: the faster people think facilities managers respond the more productive they say they are! We would also expect that other variables known to be associated with productivity - control and health, for example - would also show similar positive relationships [Reference 19].

Here again is evidence which supports the importance of the context within which people carry out their work: managers who act on complaints quickly and who are seen to take people seriously can be shown to produce a real payoff.

In the more advanced naturally-ventilated buildings, managers (and possibly designers) seem to be taking too much for granted and are not yet aware of the increased vigilance that such a building may demand, perhaps especially now, whilst the concepts and techniques are still unfamiliar.

Our conclusion is a plea not only for better management, but:

- more realism on behalf of designers and their clients about likely management burdens;
- the importance of designing for usability, so that - where they can - individual occupants and tenants can sort out their own problems; and also …
- designing for manageability.

An extended handover

Occupants often have to put up with chronic - small but enduring - problems. These can amount to a "tyranny of small decisions" [Reference 16] in which occupants' performance and satisfaction can be seriously affected. Many of the chronic problems could be solved by better commissioning. Basic or repetitive buildings can be handed over to the client at practical completion and that is that, bar the snagging or unexpected problems. But many of the more sophisticated buildings we see today need more than this. Designers, clients and occupiers need so be aware that teething problems are a normal part of innovation, and should be planned for.

At present it can be very difficult to get even a trivial problem fixed once a building has been occupied: nobody has a budget, the problems and the potential within the building to solve them may not be clearly diagnosed, and there can be massive inertia and growing misunderstanding. But if not nipped in the bud, niggles can easily turn vicious.

A plan and a budget for "sea trials" and reviews during the first year of occupation could be extremely rewarding. This would include hand-holding during occupancy and fitting-out - a process which can often ride roughshod over the environmental control opportunities and constraints, and can be disastrous for advanced but fragile concepts. It would improve mutual understanding and provide grist to the post-occupancy feedback mill.

So what makes a satisfied building occupant?

Our conclusions are more strategic than tactical, and more concerned with contexts than general principles. This runs against the tide of the usual approach with building occupants, which is heavily tactical and always looking for general principles. For example, we encounter time and again the same (apocryphal?) story that introducing dummy controls has a remarkable effect on lowering building occupants' complaints about their poor working environment: probably untrue but bad tactics if the occupants ever find out!

Equally, whatever the general principle there will always be an exception that proves the rule: the problem is that the exception always seems to be your building! For example, a building has many openable windows, but nobody ever uses them although the theory says they should.

Buildings tend to have so many features which differ from case to case that something that may be an important constraint in one - like the location of the lift shaft - will be irrelevant in the next because the context - the mix of variables - produces a different outcome. This effect of "emergence" - the total being greater than the sum of the parts - is often very pronounced, but not well understood. Does this mean that buildings, and the people and organisations within them, are so different from each other that we can never generalise?

No: because we should focus on the emergent properties - as we try to do here - not simply on their constituents. We can normally deal with rich and unpredictable contexts by a simple basic strategy: make things as usable and manageable as possible.

Michael Young called habit "the flywheel of society" [Reference 17, chapter 4]. We all behave habitually to deal with the complexities of everyday life and our surroundings. If human behaviour was not habitual, we would be overwhelmed with the ever-present need to rethink how to do things. In modern buildings, we keep being confronted with events which present themselves as unnecessary fresh challenges rather than just being ordinary. For example, some new offices have lights which are switched on and off via a graphic interface on a computer screen: this may seem sensible to the lighting engineers, but it appears extremely silly and frustrating to the people who have to use it - especially those who do not have access to the computers!. Donald Norman suggest simple principles for designers:

- make sure that users can figure out what to do;
- they can tell what is going on!

If an explanation of how something works leads to the user thinking "How an I going to remember that?", the design has failed! [Reference 18, page 188]. Norman gives many examples of user-hostile designs - non-intuitive taps (faucets) and unintelligible telephones are his favourites.

People want certain (ie predictable), fast outcomes when they make changes to things. They like speed and certainty. They do not like to be slowed down or made to look foolish, especially in front of the peers or bosses. They like to be able to do simple things for themselves and not be bothered with calling in others.

The relationship between people and technology is a vital part of the success of modern buildings. Success comes where gratuitous technology is removed or kept to a minimum (the building has been made "simpler" and more predictable in operation) and where more thought and care has gone into the people-machine interfaces so that users' time is not wasted unnecessarily. The time dimension - especially the cost of wasting people's time - is becoming more important.

The best buildings have control devices and systems which not only work perceptibly quickly, but give also users feedback on whether they are operating properly. This is why building occupants love openable windows: they may not make the environment inside much better, but at least they do it very quickly and perceptibly, and offer choices, trade-offs and fine-tuning!

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