

ENVIRONMENT DESIGN GUIDE

GREEN BUILDINGS AND PRODUCTIVITY

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SUMMARY OF

ACTIONS TOWARDS SUSTAINABLE OUTCOMES

Environmental Issues/Principal Impacts

- Fixed built facilities consume significant resources in their construction and use, reshape the natural environment and present challenges for occupant flexibility and productivity improvement.
- The greatest external environmental impacts of improved design are to be realised in use in the creation of more appropriate internal environment conditions for occupants.
- Occupants as employees are required to deliver productivity growth if business is to remain globally competitive.
- Office productivity is increasingly viewed as an efficiency and effectiveness concept.
- The greatest productivity impacts in green buildings come from the combined investments in capital and labour.
- There are few robust models to help designers link building inputs to human outputs resulting in an over-reliance on anecdotal evidence about what green buildings deliver.
- Systems thinking and first rate management practices are the keys to productivity improvement rather than seeking simple linear cause and effect relationships.
- Avoid generalising from the specific. Context is critical.
- Address performance measurement challenges up front.

Basic Strategies

In many design situations, boundaries and constraints limit the application of cutting EDGe actions. In these circumstances, designers should at least consider the following:

- Establish output performance indicators relevant to the specific business situation or context.
- Identify current performance outcomes against these indicators and benchmarks where available using robust evaluation methods.
- Draw on the experience of other professionals including work system designers/managers and engage fully with future users in the strategic/business briefing process.
- Integrate investments in space with people and technology investments to deliver the most appropriate mix.
- Use robust design briefing and management practices.
- Avoid the 'one green solution fits all' approach.

Synergies and References

- Oseland, N. (1999), *TM24 Environmental Factors Affecting Office Worker Performance: A Review of Evidence*, Technical Memorandum, CIBSE, London
- Dess, G. and Robinson, R. (1984), *Measuring Organisational Performance in the Absence of Objective Measures*, Strategic Management Journal, 5(3), 265-273
- *BDP Environment Design Guide: DES 5, DES 6, DES 25, DES 36*

GREEN BUILDINGS AND PRODUCTIVITY

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This note provides building design professionals and other green-building stakeholders with an overview of the complex interrelationships which must be managed if green buildings are to deliver improved human productivity. The note gives a brief background to the relevant issues before discussing two workplace productivity models and addressing a range of challenges facing designers in particular. Evidence of performance links between building elements important in green building design and productivity impacts from various sources are presented as a guide to the likely gains possible. Also included is advice on how to activate these links and the performance management pitfalls to look out for.

1.0 INTRODUCTION

The buildings in which we work provide occupants with protection from nature's variability: cold, heat, wind and rain. But buildings also impact upon and reshape the natural environment as well. During the construction and operation of buildings, significant amounts of energy, materials and water are consumed, and large volumes of waste can be generated. These fixed indoor environments present real challenges for business as they strive to increase their flexibility and performance to remain globally competitive. As the external environment impact of buildings becomes more apparent, designers are turning their attention to *green buildings* to create more sustainable structures with a stronger emphasis on 'whole-of-life' cycle issues.

Definition of green building

Green or sustainable building is 'the practice of creating healthier more resource efficient models of construction, renovation, operation, maintenance and demolition' (see <http://www.epa.gov/greenbuilding>).

The many elements of green building include energy, water, materials, waste and indoor environment (see <http://www.gbcaus.org>). However in the quest to be more resource efficient, the challenge is to ensure the new internal environments that are created are not only healthier, but improve occupant comfort, satisfaction and productivity as well.

Definition of productivity

Productivity is a measure of the rate at which outputs of goods and services are produced per unit of input, usually in the form of labour (number of employees, hours worked) or capital (buildings, machinery, equipment etc.), (see <http://www.pc.gov.au>). Productivity can be expressed as a physical measure (for example output per employee), a monetary measure (for example dollar revenue per hours worked) or an index (for example output per unit of labour).

The focus of this note is on the relationships between green building design as an input, and human productivity as an output, specifically as it relates to the occupancy of commercial or institutional buildings. It builds on existing *BDP Environment Design Guide* notes DES 5 and DES 25 in particular, which provide checklists and key actions for improving building

productivity; that is, delivering more sustainable outcomes in the creation of built facilities.

2.0 BACKGROUND

EDG note DES 5 *Architects and ecologically sustainable design: a client briefing* provides a summary of the key actions for achieving more sustainable outcomes in the creation of built facilities and identifies the following basic strategies:

- Layouts that take maximum advantage of passive design principles, solar access, natural ventilation etc.
- Use of elements in the built form such as windows to increase energy efficiency
- Arranging internal spaces into zones that require similar heating and cooling
- Employing energy saving devices such as low energy lighting and energy management systems
- Considering materials used in terms of occupational health and thermal performance.

EDG note DES 25 *Green building* provides a checklist for green building and suggests that for a building to be 'healthy' attention also should be given to:

- High indoor air quality
- Appropriate lighting for different uses
- Maximising individual controls for working spaces (lighting, climate control, openable windows etc.)
- Maximising the use of daylight
- Minimising unacceptable noise.

Both notes identify as design inputs mainly the energy consuming aspects of the building such as heating, cooling and lighting as important areas for attention, and allude to the qualitative outcomes delivered by more appropriate investments in these aspects, as well as the interfaces between building specific elements and occupants (e.g. layouts, zones, noise and controls). While materials selection in the internal environment is important (e.g. low toxicity paint, furnishings etc) it will not be addressed in this note since these factors have an impact on human health, which may or may not be related to productivity improvement.

The significance of energy consumption as a crucial input impacting on a building's external performance

and potentially impacting human performance, is underscored by the Australian Greenhouse Office report *Australian Commercial Building Sector Greenhouse Gas Emissions 1990-2010*, which concludes that the expanding commercial building sector is expected to almost double its 1990 greenhouse gas emissions of 32Mt of CO₂ per annum to 63Mt of CO₂ per annum in 2010 (see <http://www.greenhouse.gov.au>). However, according to the NSW Sustainable Energy Development Authority (now Department of Energy Utilities and Sustainability) by 2003 the emissions figure had already reached 55Mt of CO₂ per annum, with commercial office buildings the most significant culprits contributing around 15Mt of CO₂ per annum or 27 per cent of the total sector greenhouse gas emissions. Space cooling, ventilation and lighting account for around 52 per cent of commercial building energy consumption in use, but 71 per cent of greenhouse gas emissions (Australian Greenhouse Office, 1999). So while improved base building design has the potential to reduce embodied energy consumption, the greatest external environment impacts of improved design are to be realised when a building is in use, providing appropriate internal environment conditions for occupants.

3.0 HUMAN PERFORMANCE IN THE WORKPLACE

Many green building design initiatives still tend to be focussed on embedding new, 'hard' technologies in the base building itself. Examples of hard technologies include new facades, centralised building automation, energy management and lighting control systems, sophisticated automatic blinds etc. While buildings designed in this way may deliver better external environmental outcomes they are increasingly called upon to deliver improved internal environmental outcomes and support 'soft' technologies in the form of diverse organisational and human systems. These outcomes are typically expressed in terms of improved occupant comfort, satisfaction and human performance.

A key question for green building design and productivity is; will technological determinism on its own - the belief that all will be solved by 'hard' technology - actually deliver the internal and external environmental outcomes required over the life of the built facility?

Independent of where an organization is in the business cycle a major human resources issue is to attract and retain quality personnel. However an even bigger issue is boosting the productivity of those who are actually in employment! To remain globally competitive business must deliver productivity growth as well.

Traditionally, productivity has been measured simply by output per person, as an efficiency concept. In industrial situations this was, and perhaps still is, relatively straightforward. In office environments characterised by 'transactional work activities' this might still be the case. Using simplistic measures, office productivity can be shown to increase just by having people work longer hours. In some sectors this has been the case

and one purported benefit of green buildings is that people enjoy working in them so much that they tend to spend longer hours in them. This practice, referred to as *Labour Intensification* has generally been shown to be unsustainable since it results in increased stress, health problems, absenteeism, presenteeism (the practice of always being present at the workplace often working longer hours even when there is nothing to do), and turnover, which all carry increased costs for business (Birch and Paul, 2003).

But with current economic realities, more dynamic markets, changing customer expectations etc, more employment is becoming knowledge-based as new work structures and processes become the norm. Productivity is now increasingly viewed as an efficiency and effectiveness concept. Business needs people to work smarter, not just harder, and outputs are less clearly defined. Productivity includes service delivered to customers, better value chain management, product innovation, timeliness and quality improvement among other things.

However, while this new approach might be conceptually straightforward office productivity can still be difficult to measure in practice. Measures can vary across industry sectors, and from organisation to organisation, even within the same sector. What's relevant as an output measure in retail banking might be quite different in property management. Even within a given organisation, productivity measures can vary between business units or departments depending on the specific work activities, e.g. total revenue versus new business generated.

But these challenges should not stop us from trying to measure productivity, or at least identifying the common factors that drive productivity growth, irrespective of differing business situations. It is clear from the extensive experience of the author in change management, that productivity improves when investment in human capital is aligned with investments in other business resources; viz information and communication technologies, financial and also physical (including building) resources. Fundamentally a 'green building' provides a unique opportunity to change the investment mix in human, technology and spatial resources and to establish the conditions for more effective management of these resources over the life of the project.

When business realigns its human resources, technology and workspace goals, it becomes open to changing the way the respective supporting strategies are integrated to deliver business value. For example, investing in 'hard' technologies like mobile computing and communications fundamentally changes the way work is (or should be) organised, calling into question not only established 'business processes', but more importantly individual and group 'work practices', the way knowledge is managed and the demand for space over time. In other words, changing the investment in the technology 'system' creates the opportunity to redesign or transform the whole office production process. The initial up front technology investment should produce direct quantitative benefits (efficiency productivity) plus indirect qualitative benefits (effectiveness productivity). Both outcomes combine to drive sustainable long-term productivity growth.

The same could be said for judicious investments in built space. Better workspace layouts, (e.g. reduced distance to centralised office services) facilitated by green design, can improve work practices (efficiency productivity) while increased occupant control over environmental conditions could also enhance work group interaction, potentially leading to effectiveness productivity benefits.

The Australian Productivity Commission refers to these productivity impacts as resulting from either *Capital Deepening* (increasing the ratio of capital to labour) or *Multifactor* effects, (the combined effect of investment in labour and capital). Business productivity growth results from labour intensification, capital deepening and multifactor effects, with the multifactor effect being the most relevant in the context of green buildings and their impact on human performance.

4.0 WORKPLACE PRODUCTIVITY MODELS

Basically, despite the hype about what green buildings can deliver, there are few robust models to help designers link physical design inputs to human performance outputs. In addition, most industry research and case study material is from more traditional buildings, although this is beginning to change. The industry and professions are awash with mis-information, unsubstantiated claims, spin doctored articles and downright untruths about what is, or can be, delivered. An over reliance on 'anecdotal evidence' because designers are under time pressures to deliver, combined with the providers of space 'self evaluating', has the potential to derail the green building movement and its ability to deliver better economic, social and environmental outcomes.

Which models are currently being used to measure workplace productivity?

4.1 The Facility Management model

Almost by default the current definition of facility management in Australia tends to be used as a model to link inputs and outputs in the pursuit of better business results (including productivity) from investment in built spaces. The Facility Management Association of Australia (FMA) defines facility management as:

'the process of integrating the management of people and the business process of the organisation with the physical infrastructure to enhance corporate performance'.

But just how useful is this model in helping designers improve productivity? Firstly the inputs are identified as people, business processes and physical infrastructure. People can be measured by head count (or hours worked); physical infrastructure (in an office setting) usually defaults to space measured in square metres. But what about processes? What is the unit input measure of a 'business process'? On the output side, the definition refers broadly to 'performance' although

this most often defaults to single bottom line financial performance, usually occupancy cost; i.e. hard dollars. The output measures are not explicitly stated in this model. The model also makes no reference to technology as an input variable, although 'business process' is taken as a surrogate for technology by workplace designers (green or otherwise) who sometimes refer to their task as integrating people, process and place.

Further, business processes only deliver outcomes, being broad benefits for relevant stakeholders. This is the realm of performance improvement, of which effectiveness productivity is but one part. Outputs, on the other hand, the essential requirement for the measurement of efficiency productivity, result from improved work practices, something quite different again and not adequately addressed by this model. The bottom line is the Facility Management model is not particularly useful as a design tool, but it's a reasonable place to start as long as one is aware of its deficiencies.

4.2 The Integrated Systems model

This model addresses some of the limitations of the Facility Management model and incorporates a fundamental principle that underlies any serious effort to increase productivity; that is the need for business goals and strategies to be aligned in investment decisions about the allocation of resource inputs. As mentioned above, technology is a key input resource and is included. The enabling impact of technology on human and spatial systems is also acknowledged. Technology can be viewed as including 'hard' (computers and communications) or 'soft' (learning and knowledge management) investments. While this integration is depicted graphically in Figure 1, in the context of an organization it should take place in both the vertical and horizontal structures; i.e. from strategic through to tactical levels and across the functional domains; operations, technology, space and finance.

This model has its genesis in 'systems thinking', rather than looking for simple linear cause and effect relationships. This conceptual difference is critical to understanding the challenges involved in designing for human productivity improvement, whether the built space is considered green or otherwise.

5.0 THE PRODUCTIVITY MEASUREMENT CHALLENGE

Performance measures tend to be more tangible (objective) at the total system or corporate level, but the number of influencing factors and time required to generate the measure means that it is nearly impossible to attribute a change in performance to a specific factor such as improvement to the workplace. Equally, measures at the individual level are more immediate, relate to individual outputs and therefore are more easily ascertained, but they are more difficult to

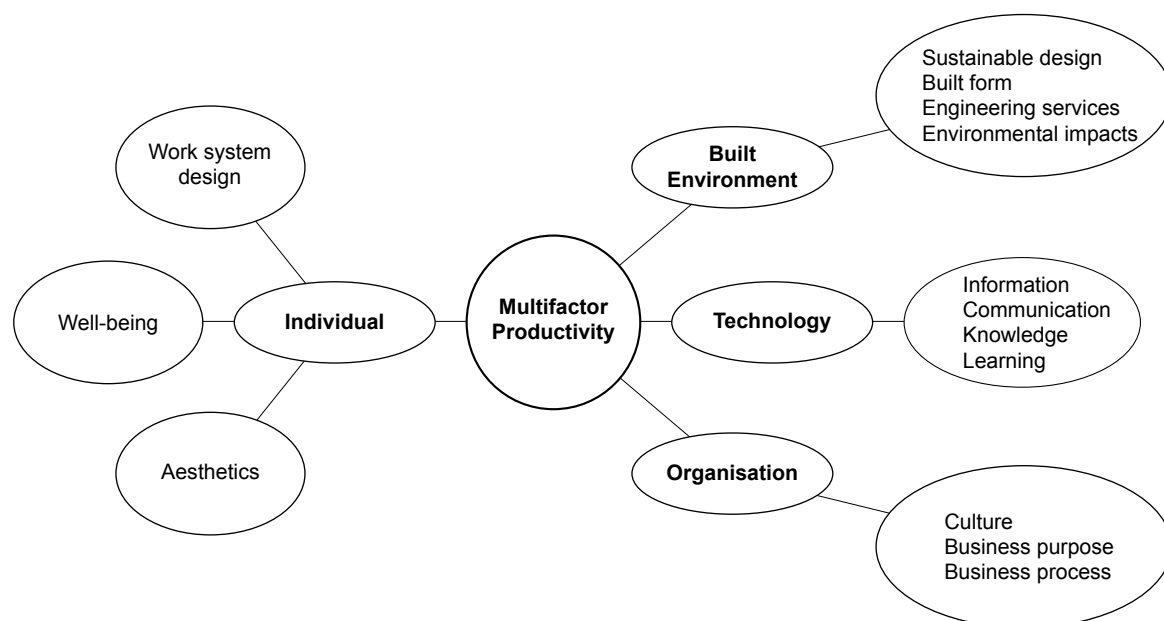


Figure 1. The integrated systems model

interpret in terms of higher-level team, departmental or organisational performance, which are usually the key areas of interest to those seeking to enhance workplace productivity.

The most appropriate measure depends upon the business of the particular organisation. The performance of an information services business is more difficult to evaluate than one in manufacturing which produces a tangible output/product. In some cases the specific measures may also be objective and quantifiable e.g. claims processed in an insurance company, average call-waiting time in a call-centre. However, objective measures are usually only available in businesses where the work involves single or repetitive tasks (e.g. transaction processing), and are inappropriate for most dynamic office environments where the work involves multiple tasks, creativity and utilisation of knowledge. Despite this, Table 1 illustrates that productivity can be measured in most organisational situations, by providing examples of useful productivity measures for three very different business sectors.

Attempts at creating a measure of productivity, which is generic, straightforward, convertible to a financial

saving and therefore useful in assessing the impact of the workplace on the business performance, results in the use of qualitative measures such as self-assessed productivity. Self-assessed productivity is an extremely relevant measure and has been shown to correlate highly with other objective measures of business economic performance. Building occupants tend to view their own productivity in terms of the time lost carrying out unnecessary work tasks or work-system design elements that 'get in the way' of effective working (Oseland and Barlett, 1999; Leaman, 2000; Oseland, 1999; Dess and Robinson, 1984). That said, independent performance evaluation using robust methodologies is unavoidable if the measurement is to have any credibility.

Oseland's review of research and field studies indicates some quite large effects of the built environment on productivity, and it is generally accepted that typically workplace design and management factors can have up to a 15 per cent effect on performance (Venkatraman and Ramanujam, 1987) with a most likely range of minus 17.5 per cent to plus 12.5 per cent (Leaman, 2000). If a green building is to

Table 1. Examples of performance measures for different business sectors

Call Centre	(Academic) Research	Consulting
Talk/contact time	Secured research budget	Revenue (gross and net)
Lead generation	Number of projects	Profit margin
Win rate	Utilisation rates	Aged debt – cash flow
Revenue	Number of published papers	Utilisation (individual and project)
Time to process (e.g. claims)	Number of references	New clients
Customer satisfaction	Number of students	Repeat business
Attrition rate/staff turnover	Peer recognition (awards)	Meeting personal objectives
Absenteeism		Delivering within fee budget

Source: Dr Nigel Oseland, Director of Workplace Solutions, Johnson Controls, 3 December, 2001

deliver superior productivity outcomes, building/workplace designers must collaborate with those who are more knowledgeable in work-system design and management. The modern built environment is now a purposeful combination of people, business processes/work practices, resources, (technologies, workspace, finances) and intellectual capital (knowledge) designed to achieve planned business results (Bruce-Smith, 2003).

The following sections look briefly at the three major aspects of work system design; the people, technology and spatial dimensions.

5.1 Human behaviour and improved business performance

There is general agreement that productivity is the key to competitiveness in higher wage countries like Australia. In this context, the productivity focus tends to be at the macro level related to such factors as technological and organization change, including the provision of new building types. While these factors are important, productivity gain essentially emanates from the workplace, at the micro level. The links between workplace design, work practices and productivity become crucial.

As indicated above, green building design has emphasised the benefits of improved amenity and indoor environment with performance evaluation focussed on measures of job satisfaction, absenteeism or turnover, with the presumption that improvements in these measures automatically lead to improvements in productivity or business performance. One of the problems here is that there is a mix of macro level factors (amenity) and micro level factors (job satisfaction), with cause and effect relationships automatically assumed.

The human resources literature does generally indicate a positive relationship between job satisfaction and performance, albeit there is certainly no consensus on the 'happy-productive worker' thesis (e.g. Gunderson, 2002). However, the links between these intermediate measures (i.e. satisfaction and motivation) and improved business performance can be very weak. Employees who are absent less often may be physically present, but not productively present. A high level of staff turnover is not necessarily bad turnover, as is evident by the conscious employee churning that goes on in some industry sectors (Gunderson, 2002). Often green building designers will claim improved amenity reduces staff turnover (a positive productivity result!), with little regard to other factors affecting this outcome.

5.1.1 Job redesign

Creating new workplaces, whether in green buildings or otherwise, provides a unique opportunity to redesign the features of the job. All too often this opportunity is squandered or trivialised in the workplace design process, degenerating into providing more open plan and higher densities (e.g. to give maximum access to

natural light), or to encourage more team working in a flexible space.

As the KODO probe© surveys of Australian commercial and institutional green buildings show, the outcome is usually lower, not higher, productivity, due to the combined effects of heat gain, glare, noise and organisational dysfunction resulting from larger workgroups and higher space density. These results indicate that the short-term attractiveness of cost saving (efficiency productivity), based on a poor understanding of organisational dynamics, overrides the opportunity to achieve ongoing performance improvement through work system redesign. Very few green building designers seem to be aware that in most organizations only a small percentage of the workforce actually needs constant access to natural light to improve their work performance. The key to improving productivity using natural light is to know which employees? The KODO probe© surveys demonstrate that thoughtfully redesigned work systems directed to achieve clearly defined outcomes in a green building context results in improved job satisfaction, motivation and sustained productivity increases.

These positive outcomes have also been shown to be more pronounced when the workplace change programs are integrated with other corporate or business improvement strategies. The findings point to the importance of genuine stakeholder engagement with the strategic/business briefing process, pre-occupancy evaluation, setting desired performance outcomes against established benchmarks and ongoing performance monitoring. As one might expect, results are easier to obtain in green-field sites, where there are few, if any, historical precedents. While this augurs well for the design of new green buildings, the 'cookie cutter' one-green-solution-fits-all approach must be avoided. In essence, 'business context does matter'.

5.1.2 Occupant health and well-being

Employers and the property sector are paying increasing attention to the possible links between workplace design and broader issues of occupant health and well-being. Productivity gain generated through increased hours of work, stress or loss of control in the workplace can be a false economy in that it can generate negative health outcomes and increased health expenditures in the medium to longer term. On the other hand productivity improvements, achieved through more positive workplace mechanisms normally associated with green buildings (improved indoor air quality, bike racks, gyms, family friendly facilities) could in turn enhance health and well-being.

The point to note here is that if green building design delivers better indoor environment quality for example, and measurable benefits in terms of occupant health outcomes, the performance link may have simply been established to health outcomes. This may be quite different to productivity outcomes although the two could again be linked in some way. Business and designers need to be clear about which outcomes they are aiming to achieve and not to confuse the

two. In general, health and well-being programs, of which green building benefits are a part, appear to be beneficial to employees who utilise these programs, but the link to productivity and competitiveness (if such a link is necessary) is tenuous (Gunderson, 2002; Purdey, 2004).

5.2 Technology and performance

Integral to improved work system design is the consideration of the most appropriate technology. Conventional wisdom holds that investment in new technology leads directly to improved productivity. This view tends to be accepted by designers who opt for higher levels of building automation in the belief that this will lead to better environmental outcomes (e.g. reduced energy consumption) and better occupant performance as well. Automatic lighting controls are a good example of this. In the case of green building design this conventional wisdom needs to be challenged.

Firstly, as the aggregate productivity Australian figures show, capital investment in technology accounts for less than one third of aggregate annual productivity growth. Secondly, there is typically a two- to three-year lag before technology benefits are realised and continued reinvestment is required to sustain performance improvement as the benefits fall away over time (Gretton et al., 2003). Thirdly, it is well known that new technologies create entirely new categories for human error and more automated environments contribute to increased stress, and a breakdown of clear cut definitions as to who does what at any given time and who is responsible for what (Purdey, 2004, Australian Financial Review, 2004). In the case of more automated buildings a culture of 'fit and forget' has prevailed with a consequent reduction in the number of facilities personnel considered necessary to 'maintain' the system (Leaman and Bordass, 1997). Research consistently shows more complex systems require more, not less, management resources to deliver their promised value, despite what technology suppliers would have us believe (Leaman, 2000). The evidence is clear that speed and effectiveness of facility management responsiveness makes a significant contribution to human performance outcomes.

Technology investment on its own also runs the risk of dis-empowering those who actually use the space. Strategies for performance improvement become embedded in the building design itself, not in those who occupy the building. Automatic lighting controls with motion sensors are an example of this. The briefing process is again crucial in ensuring business derives maximum social, economic and environmental benefit from its use of these new kinds of spaces.

Research carried out by internationally respected strategic management consultants McKinsey & Co supports the KODO probe® survey findings that information technology expenditure may also have little impact on productivity unless accompanied by first-rate management practices. Their research, undertaken in partnership with the London School of Economics,

offers evidence that specific management practices foster higher productivity regardless of a company's location, size, sector, or historical performance (Dorgan and Dowdy, 2004).

Of course this is not all bad news for green building designers, since these first-rate management practices are more likely to exist in companies with more 'enlightened' leadership, which in turn is more likely to embrace values associated with sustainable business and buildings. A more integrated approach to performance evaluation (briefing/re-briefing, building commissioning/re-commissioning, active engagement of users and facility management) is indicative of such practice.

5.3 Buildings workspace and performance

Some evidence of performance outcomes achieved in human productivity improvement related to the specific green building design inputs identified above is summarised in Table 2.

Table 2 shows that the greatest impact on human performance in buildings does not necessarily result from design attributes normally associated with 'green', but, as highlighted above, the factors relating to work system design, e.g. noise intrusion and workplace functionality.

While these results *give an indication as to the likely gains possible*, it must be remembered that they are context specific in terms of building type, organization, culture, the management processes and practices, and the methods used to measure the performance outcomes. The brackets indicate the level of confidence that can be associated with the findings (low, medium, high). Generalising from the specific is always dangerous but the results in Table 2 point to the quantum of improvement possible if all goes well.

The findings also point to the importance of individuals being able to exercise some control over their indoor environment conditions. Given that occupants invariably have a preference for being in the natural environment but for practical business reasons are expected to work in artificial or air-conditioned environments, it is not surprising that the link between occupant control and productivity is consistently raised in evaluations of building performance, including the KODO probe® surveys. Control is a surrogate for individual choice, which in turn reflects how power in organizations is distributed. Automated building controls are physical manifestations of centralised, hierarchical management control, which tends to contradict an often cited organisational preference for flatter management structures, more autonomy, individual empowerment and flexibility accommodated in a more environmentally friendly building.

6.0 ACTIVATING THE PERFORMANCE LINKS

If design and management principles are so inextricably interlinked in the quest for increased human productivity in green buildings, where should one's attention be focussed?

Table 2. Examples of performance links

Building/workplace element	Productivity impact
<i>Indoor environment quality</i>	
increase fresh air to dilute pollutants	+3 per cent (low)
bringing offices up to Indoor Air Quality standards	+4 per cent (low)
moving from naturally ventilated to air conditioned offices	-6 per cent (low)
ventilation strategies	+0.5 to +11 per cent (high)
<i>Lighting</i>	
task up lighting for Video Display Unit	+3 per cent (medium)
increased illuminance for paper based work	+3 per cent (medium)
<i>Noise</i>	
sound absorption in typing pool	+29 per cent (low)
increasing noise 10db in mail room	- 25 per cent (high)
<i>Work system</i>	
properly designed workstation	+10 per cent (low)
increasing privacy	+12 per cent (low)
Green Building Environment	-1.4 to +9.6 per cent (high)
new furniture	+15 per cent (high)
control over environmental conditions	+3 to +9 per cent (medium-high)
downtime due to poor layouts	-12.5 per cent (medium)

Source: KODO probe© surveys of Australian green buildings, 2002-2004; Dr Nigel Oseland, Director of Workplace Solutions, Johnson Controls, (from various) 3 December, 2001; Center for Building Performance Diagnostics, Carnegie Mellon University, 2004).

6.1 Use robust design briefing and management practices

While better overall integration of investments in people, technology and space leads to performance improvement, the green building is a complex system in its own right. There are differing skill sets, time frames and agendas for the various phases of the life cycle of facilities and the conflicts inherent therein are often irreconcilable, perhaps even more so in green buildings with higher levels of occupant involvement in their operation.

The point is that to focus on one aspect, like design, is to lose sight of the fact that a building will present particular issues for resolution at different points over its entire life cycle, in much the same way that the occupying organization or human system does. Too many resources might be dedicated to something that in the whole scheme of things is relatively unimportant, and this applies to the pursuit of productivity improvement derived from specific green building design inputs.

The 'systems' view highlights the need for a well-articulated performance improvement and management strategy over the life of the total investment. The application of this principle helps explain why some buildings deliver better occupant performance than others, and often regardless of whether they are air-conditioned, naturally ventilated or mixed mode, have large or small sized floor plates, are tenanted or owner occupied and whether facility management is performed in house or out-sourced (Cole and Lorch, 2002). Integration and alignment of business resource investment goals and strategies in the design briefing

process is therefore the single most important factor affecting human productivity in buildings.

6.2 Address the measurement challenges up front

A business demand to be accommodated in a 'green building', may signal the time to modernise certain work practices or technologies. In the process, both the designer and the client face the challenge of establishing the links between workplace design inputs and desired performance outcomes. Both must address the challenges of trying to account for the myriad of other factors that could also affect human performance. When these factors are correlated with the workplace factors, the 'design' may be 'picking up' the effect of these other factors. Things to look out for include:

6.2.1 Reverse causality

The link between design and productivity conventionally is thought of as a causal link in the direction of the improved workplace affecting productivity. However, causation can also work in the other direction, from productivity and performance back to workplace. In the 'happy-productive employee' thesis, for example, the causality may be working in the direction of a productive, thriving organisational environment being able to afford more innovative workplace solutions (including green buildings) and other practices such as employee well-being programs, bonuses, training or flexible work time arrangements. In such circumstances, the work system design may be a by-product of the prosperity of the productive organisation, rather than one that is introduced to enhance productivity.

If so, conventional estimates of the impact of the workplace (independent variable) on productivity (dependent variable) may be picking up at least some of this reverse causality. The two can also feed on each other. That is, a new workplace can enhance productivity, which in turn enables the organisation to afford other new workplaces.

6.2.2 Bias from selection into the green building program

In these situations, those who occupy the new workplace may be a select group in terms of unobserved characteristics (e.g. highly motivated) that can influence productivity and performance outcomes. There are statistical procedures for dealing with possible selection bias, but they are imperfect and usually involve very onerous data requirements.

6.2.3 Bias from industry publications

Bias may also occur in the reporting of results in that there is a tendency in the design community to focus on 'winners'. Workplaces that are 'well designed' (i.e. meet the design brief criteria), but do not meet the performance expectations of occupants/users are not likely to be published in design journals, even though we can learn as much from failures as successes. The experience of the author is that often the human performance outcomes are not clearly articulated in the design briefing documents in the first instance and, for example, when energy consumption has been shown to have been reduced due to automatic lighting controls or more natural light, the leap of faith is made to 'improved productivity' as well. In the absence of any independent post occupancy evaluation against any pre-determined human performance criteria, the view is often; 'if people weren't happy you'd hear about it' - meaning (paternalistically) the definition of occupant satisfaction is the lack of expression of dis-satisfaction! Again one should be wary of this kind of anecdotal evidence of improved productivity and the tenuous links between satisfaction, motivation and performance as discussed above.

6.2.4 The Hawthorne effect

The study of the physical environment of organizations in the twentieth century was to a large extent constrained by the ubiquitous Hawthorne experiments, conducted within the Western Electric Company in the 1920s. The primary conclusion from these studies was that social factors are far more important determinants of employee satisfaction and productivity than physical factors. However, later studies have challenged the methods and validity of the Hawthorne experiments.

A 'Hawthorne effect' might occur if the positive response of occupants to the new workplace is simply due to *change* and not to the ingredients of the new workplace itself. Hence, the users of the new workplace may be responding to the stimulus of the 'new', or because they know they are being monitored and evaluated. It may be the change or monitoring or evaluation, rather than the workplace itself that is causing the performance improvement.

This is why the need for extended commissioning of green buildings (or more correctly an ongoing program of commissioning, re-commissioning or fine tuning) needs to be accompanied by ongoing workplace performance evaluation, not a one-off 'productivity measurement'. A performance management program (again integrating people, technology, and space if possible) will help ensure the green building design investment continues to deliver on its promise.

7.0 CONCLUSION

Even if most of the above principles are applied in practice, to the point of the economic benefits exceeding the costs to the organisation, it may be that improved productivity from green building design can be achieved in certain environments, but this does not mean it will be achieved in all environments.

In fact, it is to be expected that business executives are likely to adopt green building design and management principles only in organisation environments where they would be expected to work in practice. After all, they are in the business of making such risk management decisions.

Human performance outcomes are likely to be achieved mainly in environments where the above-mentioned principles are already adopted in practice and this success may not necessarily be transplanted into other design situations. Built environment productivity improvement strategies seem to work best when they are integrated into the overall business strategy of the organisation. Not all organisations have this capacity, and not all business strategies are likely to be capable of such integration.

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Web-based resources

- Australian Greenhouse Office
<http://www.greenhouse.gov.au>
- Green Building Council of Australia
<http://www.gbcaus.org>
- Productivity Commission
<http://www.pc.gov.au>

BIOGRAPHY

Brian Purdey (BE (Hons), MBA) is an innovative business strategist and change manager with an international reputation for creativity in addressing complex business problems. He is the Managing Director of KODO, a professional services company that aligns business strategy, change management and facility planning to improve workplace performance.

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Brian is a Life Member and past National Chairman of the Facility Management Association of Australia and represents the facility management profession on the Academic Advisory Committee for Building at the University of Technology in Sydney (UTS). He is also a member of the national steering committee for the Australian Building Greenhouse Rating Scheme (ABGR), and the FM Industry Action Agenda Sustainability Working Group.

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