



Changing context for environmental knowledge

Raymond J. Cole

To cite this article: Raymond J. Cole (2004) Changing context for environmental knowledge , Building Research & Information, 32:2, 91-109, DOI: [10.1080/0961321042000211396](https://doi.org/10.1080/0961321042000211396)

To link to this article: <http://dx.doi.org/10.1080/0961321042000211396>



Published online: 13 May 2010.



Submit your article to this journal [↗](#)



Article views: 204



View related articles [↗](#)



Citing articles: 19 View citing articles [↗](#)

Changing context for environmental knowledge

Raymond J. Cole

University of British Columbia, School of Architecture, 6333 Memorial Road, Vancouver V6T 1Z2, Canada
E-mail: raycole@arch.ubc.ca

What are the ways that environmental issues have been framed by prevailing societal values and priorities over the last 30 years, and what repercussions have these had for building research and practice? These questions are explored primarily through a review of the critical ideas, positions and agendas as documented in UK and North American building literature. The historical framing reveals a highly dynamic relationship between the proposition and introduction of ideas offered by research and practice, and society's receptivity to them. The environmental debate over the past three decades has shifted from an attitude of 'survival' to one of responsibility and stewardship. It is these two notions, along with other developments, that have indirectly shaped environmental policy, building research and practice. The paper concludes by speculating on future technological developments and overarching notions that may shape future environmental attitudes, receptivity and actions.

Keywords: environment, environmental awareness, environmental research, professional practice, public policy

Comment les questions d'environnement ont-elle été déterminées par les priorités et les valeurs sociétales au cours des 30 dernières années et quelles en ont été les répercussions sur la recherche et la pratique dans le secteur de la construction? Ces questions sont analysées, avant tout, à travers le prisme des idées critiques, des positions et des projets exposés dans la littérature consacrée à la construction et publiée aux États Unis et en Grande Bretagne. Le cadre historique fait apparaître une relation très dynamique entre la proposition et l'introduction des idées qui ont cours dans la recherche et la pratique et la manière dont la société les reçoit. En trente ans, le débat sur l'environnement est passé de la notion de survie à celle de responsabilité et d'intendance. Ce sont ces deux aspects, et d'autres aussi, qui, indirectement, ont configuré la politique environnementale ainsi que la recherche et la pratique dans la construction. L'auteur conclut en spéculant sur les futurs développements technologiques et les notions dominantes qui pourraient modeler les comportements futurs en matière d'environnement, la manière dont ils seront perçus et les mesures à prendre.

Mots clés: Environnement, sensibilisation à l'environnement, recherche environnementale, pratique professionnelle, politique publique

Introduction

It is a time of greater scientific understanding of human-induced stresses on natural systems as well as of unprecedented individual and collective access to information about these impacts. However, information is only a means to an end – it has to be interpreted and translated into effective decision-making, be it in the political realm or within the day-to-day activity of building design and construction. And this interpretation and

translation occurs through the filter of values. 'Our values, theories and preconceptions', Holling (1998) suggests, 'determine the problems we perceive, the knowledge we seek and the actions we take.' Indeed, how one chooses to act on the current understanding of resource use and environmental degradation will prove decisive in any rational transition toward sustainable patterns of living.

Environmental issues and technologies have always played a role in shaping buildings, sometimes quite profoundly. Architecture, however, is more than technology, and new emphases in mainstream practice typically derive from major societal value shifts. Guy and Farmer (2000, p. 77) suggest that sustainability and ethical judgements stem from an:

ecological view of knowledge that respects the moral standing of non-human entities, necessarily extending beyond anthropocentric concerns to encompass a moral concern for the integrity of the natural world.

Nurturing such an environmental ethic will be a prerequisite to creating a comprehensive realignment of priorities but, as Bentley (1990) argues '[t]he need to integrate human and other ecological concerns places us in a complex design situation.' At the 'cultural heart of modern industrial society', he suggests:

lie the values of freedom and personal choice, which currently find practical expression through consumerist lifestyles. Their present urban expression is ecologically destructive.

Assuming that a broad-based environmental ethic can and will mature, it will take a considerable time before doing so, and contradictions and difficulties are inevitable in the interim both in terms of policy and in day-to-day practice.

The present paper explores the continually changing ways that environmental issues are framed by prevailing societal values and priorities, and the repercussions these have for building research and practice. Several specific themes are interwoven throughout, including:

- development of environmental awareness on a political stage and the extent of its social acceptance and adoption
- corresponding development/growth in the complexity of environmental research and its influence and acceptance by practice
- deficiencies in research practice and influences impacting on a more widespread adoption of environmental and sustainable practices

A major part of the paper is devoted to reviewing some of the remarkable events, developments and advances over the past 30 years that have profoundly changed the significance that society places on environmental issues and their subsequent *indirect* impact on building design. See Figure 1. Almost any set of arguments relating to global environmental issues over this period has walked the difficult and fine line between 'doom-saying'

and optimism. Indeed, the notion that as a society 'we are caught between a sense of impending apocalypse and the fear of acknowledging it' (Thompson, 1992, quoting Joanna Macy) has been an indirect, but consistent, tension in the shaping of attitudes towards building design and human settlement patterns over this period. Moreover, over the past 30 years an important shift has occurred with respect to who constitute the protagonists within the environmental debate and the basis upon which their opinions and predictions are made. Whereas the initial concerns were largely speculative and raised by a few, today the consensus is both broadly based and supported by a wealth of scientific evidence. Yet, widely differing interpretations still prevail.

Historical framing, by necessity, can only capture the major threads. It cannot avoid omissions, deal adequately with those ideas that have enjoyed only brief interest, or give adequate justice to the individuals who have been instrumental in creating the knowledge that has defined the environmental context for building design. Nonetheless, the notion that ideas can be ahead of their time and that present-day strategies are often a rediscovery and reinterpretation of those in the past are equally evident in the building-related environmental issues and knowledge explored herein. Moreover, historical framing plays out differently within different countries. As such, the paper draws primarily on developments in the UK and the US. Notwithstanding the different specific histories that have unfolded, the paper has attempted to distil some of the significant underlying ideas.

There are two other conscious limitations on the scope of the present paper, the first related to the accessibility of information, the second to the links between regulation and buildings:

Explicit and tacit knowledge

The broader context explored here affects both explicit and tacit knowledge within the design and research community. The term 'explicit knowledge' is used to characterize the body of knowledge created, documented and communicated through various media. It is provided largely through research and case studies and is transferred primarily through conferences and publications. Tacit knowledge, by contrast, represents the assimilation of explicit knowledge and its subsequent combination with the experience gained through practice. This 'know-how' is largely provided through the individual and collective experience of design team members and transferred through person-to-person contact and individual learning and experience. Explicit knowledge, to a reasonable degree, can be derived by reviewing published sources and this has formed the primary basis for the substantive content of the paper. Tacit knowledge, by contrast, can only

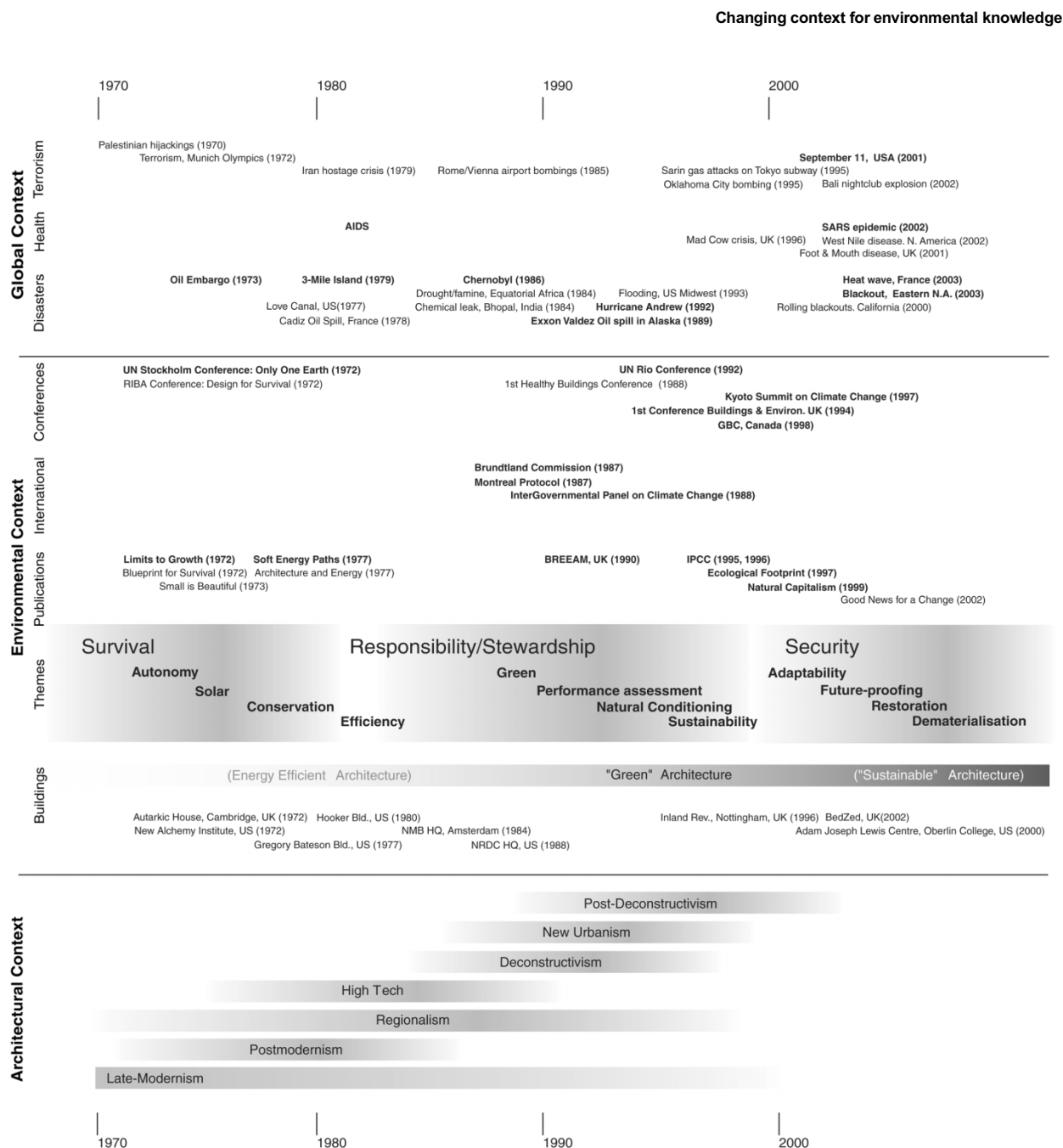


Figure 1 The changing context over the past 30 years

be gauged through its manifestation in built works and, as such, is less accessible.

Regulatory context

Legislation, if possible to enforce, has historically been viewed as the most appropriate means of combating acute, localized environmental transgressions, particularly if sufficient information is available to formulate workable regulations, set targets and measure their effectiveness. Although regulation will remain important, more innovative measures, a greater level of co-operation and voluntary agreements between industry

and regulating bodies are increasingly required to address emerging environmental problems that are more dispersed and global in nature (Aggeri, 1999). Indeed, since the 1990s, there has been a visible emphasis on mechanisms that are cooperative and solution oriented. A major role of the environmental movement continues to be one of drawing society's attention to the rate and scale of global environmental degradation, but with increasing emphasis on instituting effective and sustained stewardship. Despite its clear relevance to the present paper, a difficult thread to trace over the past 30 years is whether major environmental events, public concern

and lobbying have resulted in any 'sensible' policies and regulation, and the effectiveness of their implementation.

Context of survivalism

Following the post-war period of affluence and growth, the 1960s witnessed a period of turmoil and unprecedented reaction and opposition. A new generation openly challenged numerous social norms and practices – a context that signalled the emergence of the environmental movement. Texts such as Rachel Carson's seminal book on pesticides – *Silent Spring* (1962) – heralded an era of increasing awareness of the local and global environmental degradation associated with human activity. By the early 1970s, this matured into visible environmental activism with the creation of Friends of the Earth, Green Peace and other environmental institutions. Several 'alternative' publications were also launched at this time, including *The Ecologist* in the UK and *Co-evolutionary Quarterly* in the US to reinforce a growing 'grass-roots' awareness of environmental values.

Two works published in 1972 – The Ecologist's *Blueprint for Survival* and The Club of Rome's *The Limits to Growth* (Meadows *et al.*, 1972) – perhaps best characterize the sentiment of the day. The *Blueprint* was a call to action ultimately leading to the formation of the Green Party (Pearce, 2000). *The Limits to Growth* firmly established that there were natural limits to human activity. Its authors concluded that:

If the present growth trends in world population, industrialization, pollution, food production, and resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next 100 years. The most probable result will be a sudden and uncontrollable decline in both population and industrial capacity... It is possible to alter these growth trends and establish a condition of ecological and economic stability that is sustainable far into the future. The state of global equilibrium could be designed so that the basic material needs of each person on earth are satisfied and each person has an equal opportunity to realize his or her individual human potential... If the world's people decide to strive for this second outcome rather than the first, the sooner they begin working to attain it, the greater will be their chances of success.

Although Meadows *et al.* considered their work to be a 'conditional warning' to society and a challenge and opportunity to reshape its future, *The Limits to Growth* was widely interpreted as a 'prediction' of doom. The 1973 oil embargo and ensuing energy 'crisis' reinforced this growing sentiment of doom and created an overwhelmingly 'survivalist' emphasis to the environmental debate.

Environmental concerns at this time were of sufficient significance to enter the political realm as an explicit and distinct agenda. The 1972 United Nations Conference on the Human Environment in Stockholm, Sweden, for example, laid out broad and far-reaching principles that are now embodied in the current environmental and sustainability debate. As with subsequent summits, however, its credibility depended largely on resolving major contradictions between actions and words, and the distrust that the developing world had for the developed world. Over the subsequent decades, Northern Europe has consistently provided the strongest and most concerted commitment to addressing environmental issues in comparison with North America. For example, the European Union

through a mixture of legislation, directives, economic incentives, and subsidies, is attempting to redirect its vast bulk toward a less damaging relationship with the environment, built or natural. (Hagan, 2003)

That stated, there remains an enormous time lag between the aspiration/rhetoric and demonstrable action/results.

Role of technology

The role of technology was, and continues to be, central to the environmental debate. 'For what separates environmental activists, pessimists, and militants from those who are complacent to such issues,' Coddington (1973) argued, 'is their attitude to technology.' E. F. Schumacher's *Small is Beautiful: Economics As If People Mattered* (1973), for example, challenged the doctrine of economic, technological and scientific specialization and proposed a system for Intermediate Technology based on smaller working units, cooperative ownership and regional workplaces using local labour and resources. By contrast, Herman Kahn *et al.* (1976) presented a vision based in large part on the continuing evolution of a form of technological progress that would serve to push back the natural limits until they were no longer limiting. The issue of individual and collective choice is clearly evident in this debate. 'In the end we must make choices,' Summit (1993, p. 92) argues, and

[t]he most critical choices will involve technology: which technology to pursue, which to avoid as too costly or damaging; what goals technology should be harnessed to serve.

Some technologies *directly* influence and impact on building form and construction practices, e.g. photovoltaics and rainwater-harvesting systems. Issues of concern for architecture have centred on their technical and formal integration, their cost, how they might be accepted within current regulations and whether they meet or conflict with user expectations. Other technologies, such as information and communications

technologies, can change the context in which building design occurs and can profoundly influence society's expectations and demand and desire for different building types. Just as technology is not value free, environmentally progressive buildings implicitly carry attitudes toward technology. Moss (1985, p. 23) suggests that:

[t]echnology must be acknowledged as the crystallization of capitalist social relations. Struggles for technological change that do not call into question social relations are thus, inefficient. Social change struggles that do not call into question existing technologies are also lacking.

Moreover, he argues that:

[w]hereas appropriate technology provides the material and technological basis for creating humanistic technologies, self-reliance provides the ideological and political visions of the communities in which appropriate technologies would exist. (p. 22)

Building research and professional activities

The architectural and professional press during the 1970s reflected a broad range of considerations. Interspersed were two qualitatively different strands of building environmental research and practice:

- Notion of integrated environmental design, supported by the UK Electricity Council (1969) and championed by Hardy and O'Sullivan (1968), sought a more concerted integration of the building envelope and systems in the provision of a

controlled thermal, luminous and acoustic indoor environment. This required a 'special kind' of collaboration with:

the client, his professional and technical advisors, and the building team undertaking to integrate design factors for which they are normally separately responsible. Decision thus becomes a concurrent and not sequential process. (Shepard, 1971)

- The 'survivalist' mindset translated into more radical architectural responses that sought 'autonomy' and 'self-reliance' at the individual building and community levels. The University of Cambridge Department of Architecture's Autonomous House project legitimized a host of alternative technologies, for which the rationale and contextual arguments are still remarkably prescient (Figure 2). The Royal Institute of British Architects (RIBA) 1972 Annual Conference 'Design for Survival' provided a stage for the meeting of this new generation of researchers and students with those engaged in 'conventional' practice.

Four other key ideas communicated at that conference have considerable importance today:

- RIBA's President, Alex Gordon, opened the conference with a remarkable set of challenges to Institute members including:

to make no demands on nature that nature cannot continue to answer, and to refrain

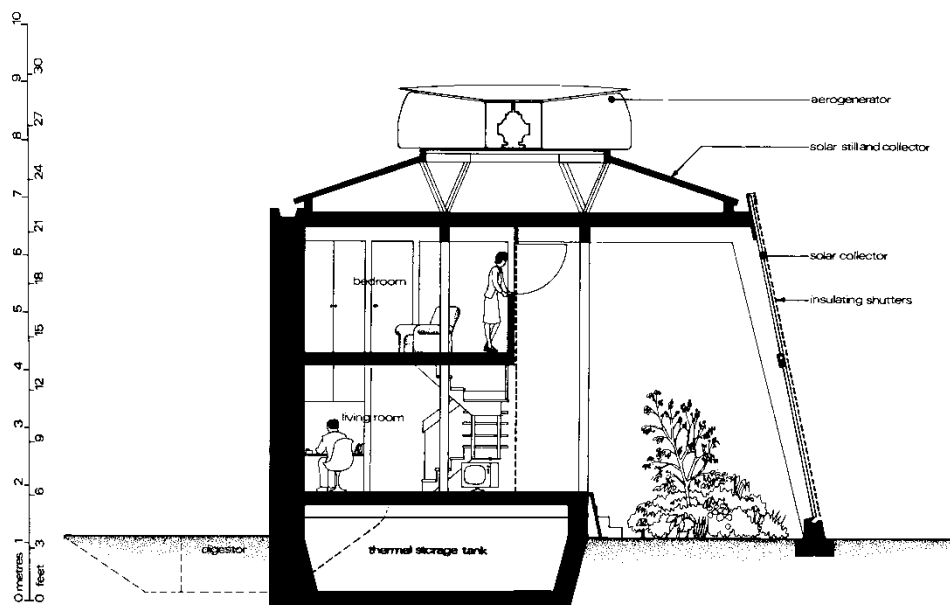


Figure 2 Section of proposed Autonomous House (Pike, 1974). Courtesy of Martin Centre, University of Cambridge

from squandering the limited resources, whether of material biological capital, on which all future generations, as well as ourselves, depend for survival. (Gordon, 1972)

These notions are central underpinnings to some of the most significant contemporary environmental texts, e.g. Wackernagel and Rees's *Our Ecological Footprint* (1996) and Hawken *et al.*'s *Natural Capitalism* (1999).

- Kasabov (1972) reported that:

architects could work towards a way of building in which different elements helped each other synergistically, to produce economies not available with our present fragmented approach.

This notion, together with those within integrated environmental design, is a central tenet of the currently advocated practice of Integrated Design.

- The concluding paper at the 1972 RIBA Annual Conference by the Bishop of Kingston – Hugh Montefiore – argued that:

[w]e are trustees and stewards for posterity, bound to pass on the world no worse than we found it. This ethical issue, so seldom articulated, lies at the root of the environmental problem. Are we accountable to posterity? If so, to whom and why, and to what extent?

Furthermore, he suggested that:

It is natural for us to provide for our children, and perhaps grandchildren who we can see: it is not so natural to provide for those generations which we cannot see. Yet the actions taken now will effect them either benevolently or disastrously.

This sentiment would emerge within the definition of 'sustainable development' 15 years later.

- The underlying issue throughout the conference was whether the environmental debate could remain apolitical and whether design professionals should begin to raise questions about the larger social purpose they serve. This sentiment was also explicit in American Institute of Architects' (AIA) president Max Urbahn's inaugural address of 1972 where he beckoned members to 'participate in the development of policies that determine the processes that really shape the man-made environment' (Urbahn, 1973).

Within his year as President of the RIBA, Gordon launched a 'Long Life, Loose Fit, Low Energy' study

(McKean, 1973) with ideas that are again central to current strategic thinking in 'Green' building. However, although (or perhaps because of) the study included participants from a wide range of positions, it failed to gather sufficient momentum. Although the AIA at this time was also demonstrating a:

split personality being pulled one way by the younger generation concerned about race, war, pollution and environment, and another by practitioners who have to survive in the hard competitive world of private enterprise, (MacEwen, 1971)

It launched a programme to engage architects in energy conservation. Following the appointment of a special task force to explore the links between energy and the built environment, the 1974 *Energy and the Built Environment: A Gap in Current Strategies* established a general framework for a long-term approach to energy conservation. The following year, the AIA's *A Nation of Energy-Efficient Buildings by 1990* outlined a programme and argued the economic and administrative feasibility of improving building performance. The AIA maintained commitment to energy efficiency into the early 1980s (AIA, 1981).

Environmental issues were also being addressed within other disciplines including the social and behavioural sciences. The Environmental Design Research Association (EDRA), for example, was founded in 1968 to advance and disseminate environmental design research, thereby:

improving understanding of the interrelationships between people, their built and natural surroundings, and helping to create environments responsive to human needs.

Its annual conferences are a major forum for the presentation of research by academics within the social and behavioural sciences, either within Schools of Architecture or other disciplines having an interest in the built environment. The preface to the first EDRA conference in 1969 was critical of the existing body of research in environmental design, describing it generally as the product of, on the one hand, scientists who are too specialized to inform one another's research and lack a common body of theory and, on the other, 'designers cum scientists' who:

lack a strong background in the methods and theory of the sciences' and have a tendency to be 'strong on relevancy and weak on scientific rigour. (Sanoff and Cohn, 1969)

Papers at subsequent EDRA conferences have attempted to interpret and inform changing environmental issues.

Pirages, for example, explored the social meaning of limited growth and outline an approach for using 'social design' to help cope with environmental problems. 'The onset of a period of relative scarcity and economic dislocation', he projected, would 'gradually begin to alter many of the expectations and common wisdoms that have been created by the industrial revolution' (Pirages, 1974, p. 42). He further suggested that the new context of limited growth would require two distinct sets of design skills. First, the ability to work within additional constraints with regard to materials, energy, etc. Second, and perhaps more interestingly, rethinking contemporary definitions of design and designing a social environment as opposed to a physical one (Pirages, 1974, p. 46). This latter point implied the design of a set of processes rather than artefacts – a notion central to current ideas of ecological design. These two sets of design skills are discussed later.

Energy 'crisis'

The environmental debate through the late 1960s and early 1970s was broad in scope – embracing resource use, environmental impacts, population growth, food production, social and community structure. After the 1973 oil embargo, this collapsed into a singular and dominant focus on energy supply and use that persisted into the 1980s. The rapid escalation and instability in the cost of energy, and the political sensitivity of its supply and distribution, created urgency in finding short- and long-term solutions. Within the debate of both energy supply and demand, there was increasing recognition that energy has social, economic, environmental and technological dimensions (Craig *et al.*, 1978). In *Soft Energy Paths* (1977), Lovins, for example, proposed a transition from 'hard' and unforgiving and centralized technologies of nuclear power and fossil fuels to 'soft energy' technologies based on 'energy income' from renewable sources. He demonstrated the viability of this alternative using a host of reasoned arguments including reduced environmental disruption, greater social equity and economic benefit.

Although 'conservation' and 'efficiency' became prevalent notions in building regulations, guidelines and mainstream practice, more astute critics were framing energy considerations within a 'life cycle' context. Stein (1977), for example, presented a simple graphic that illustrated the initial embodied energy, operating energy and demolition energy. The implications were significant – design decisions had energy implications for decades ahead. Similarly, Foley (1976) emphasized that the poor insulation standards in UK building would have profound future social and economic consequences, arguing that the:

energy consumptive buildings of today are the poverty traps of tomorrow: those who are forced to live in them will be so bled of income in the

struggle to stay warm that opportunities for saving and betterment will be dramatically curtailed.

The profound future socio-economic implications of poor environmental standards anticipated by Foley are now evident in the realities of 'fuel poverty' in the UK. Rudge and Nicol's *Cutting the Cost of Cold* (2000), for example, provides a graphic portrayal of the current health and mortality among the poor and elderly in the UK that may be a legacy of decades of poor energy performance standards of houses.

Surprisingly, the value of the collaborative approach to design that was deemed central to integrated environmental design a decade earlier was not considered a critical requirement within the *Architect's Journal's* 1982 Energy Primer. Its design methodology still alluded to the primacy of the architect and the necessity for him or her to offer a 'clear statement of design parameters to which all members of the design team can work' (Welch and Spooner, 1982). Certainly, there were pockets of collaboration and cross-disciplinary meetings, but the potential of 'systems thinking' and collaboration failed to mature within day-to-day practice. It is possible to speculate reasons for its demise:

- Although the 'energy crisis' provided a stark reminder of the dependence of industrialized countries on the continuous supply of cheap oil, and despite activity and directives within the professional associations, interest waned within mainstream practice in the UK and US once 'normality' resumed and the need to reassess approaches to design diminished. Despite political rhetoric, ambiguous signals to both the practitioner and research community tempered interest in adopting new approaches to energy-efficient design. By contrast, in Denmark, the impacts of the 1973 oil embargo on energy policy and building design lasted until the recent change in government.
- Mainstream practice considered the aspiration of integrated environmental design largely as the achievement of a controlled indoor environment created by mechanical systems within an improved building envelope. This was primarily aimed at the design and construction of highly serviced, deep-plan, energy intensive, all-electric buildings.
- Passive approaches, which require a greater integration and collaboration, were largely pursued at a small, residential scale that did not require comprehensive design teams. Mainstream architectural engineering practice was dominated by 'conventional' mechanical environmental control strategies and, although they enjoyed visibility within the popular and professional press, the impact of passive approaches was modest.

- Simulation tools were in their infancy and could not confidently evaluate complex interrelationships between building envelopes and systems.
- Prevailing models and attitudes of architectural and engineering were based on clear realms of responsibility and knowledge that curbed the inability of both educators and practitioners and educators to engage in interdisciplinary collaboration.

Context of responsibility and stewardship

The mid-to-late 1980s can now be seen as a formative point in which several events created a context for *re-establishing* a more comprehensive view of environmental concerns and an elevated sense of environmental responsibility. It was a period of an increasing visibility and influence of environmental lobbying on the shaping of international and government policies and legislation, and changing social attitudes and patterns of behaviour. After almost a decade in which energy had dominated, the environmental debate would again broaden.

Resource use to ecological loadings

By the mid-1980s, it was becoming increasingly clear that equal if not more attention should be directed at the absorptive and assimilative capabilities of natural systems to human wastes than to the issues of resource depletion that had dominated the earlier environmental debate. This was evidenced in the initiating of several international protocols:

- By 1985, increasing scientific evidence and concern about damage to the ozone layer prompted governments to adopt the Vienna Convention on the Protection of the Ozone Layer, which established an international legal framework for action. In 1987, international negotiators reconvened to adopt legally binding commitments in the Montreal Protocol on Substances that Deplete the Ozone Layer, requiring industrialized countries to reduce their consumption of chemicals harming the ozone layer within declared time frames. During the evolution of the Montreal Protocol's implementation, improved information and greater sense of urgency led to the subsequent adoption of a series of amendments in London (1990), Copenhagen (1992), Montreal (1997) and Beijing (1999) (UNEP, 2003).
- The World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) established the *Intergovernmental Panel on Climate Change* (IPCC) in 1988. The IPCC's first Assessment Report in 1990 played a central role in establishing the Intergovernmental Negotiating Committee for a UN Framework Convention on Climate Change (UNFCCC).

UNFCCC, adopted in 1992 and operational in 1994, provides the overall policy framework for addressing climate change. The IPCC continues to provide scientific, technical and socio-economic advice through its periodic assessment and special reports. Its Second Assessment Report, *Climate Change 1995*, provided key input to the negotiations culminating in the 1997 Kyoto Protocol.

The political and societal receptivity to these two initiatives has been quite different. The reduction of Ozone Depleting Substances (ODSs) moved relatively easily through the international ratification process. This is perhaps due to the following:

- In comparison with fossil fuels that are central to almost every human enterprise, ODSs are relatively peripheral to the modern industrialized economy and replaceable.
- Satellite imagery providing unambiguous evidence and these visual images were found compelling by the wider public.
- The staged phase-out, and less powerful industry lobbying than those affected by greenhouse gas reductions.

Although the direction of the construction industry as a whole has barely wavered, the refrigeration industry has produced a succession of drop-in replacements for ODSs, as regulation tightened, so that nothing fundamental has needed to change at the building design level. The elimination of ODSs, however, has triggered the necessity to engage in qualitatively different approaches to conditioning building interiors and added significant weight to passive strategies. By contrast, the perceived uncertainties in the scientific support, lack of participation by and differentiated requirements for developing countries, the perceived economic burden resulting from the required targets and timetables of implementing reductions, collectively created enormous resistance to the implementation of effective climate change, particularly within the US.

Links to human health and well-being

Human health concerns historically have played a dominant role in shaping buildings be it the provision of adequate sanitary services or access to sunlight and daylight. Through the 1960s and 1970s, however, environmentally related human health issues were largely cast in the context of industrial pollution: toxic industrial emissions, pesticides, asbestos, dioxins, etc. Building-related issues at that time remained largely centred around occupant comfort and the creation of appropriate thermal, lighting and acoustic conditions. This would change significantly in the 1980s. Reduced ventilation rates introduced to conserve energy resulted in poor indoor air quality, a condition that

was exacerbated by the volatile organic compounds and other emissions from the increasing number of synthetic interior finish materials and adhesives. High-profile incidents of Legionnaires' disease and litigation associated with Sick Building Syndrome initiated extensive research into indoor environmental quality and, by the late 1980s, occupant health and well-being had become an increasingly explicit design consideration. The casting of environmental issues within a legal framework adds 'duty of care' to ethics and legislation as another mechanism by which values become woven into society.

The links between occupant health and well-being, heating, ventilation, air-conditioning systems, maintenance procedures, material choices, etc., reinforced the need to view environmental strategies in combination rather than singularly. Perhaps more significantly, this, together with the requirement to reduce or eliminate ozone-depleting substances, challenged the primacy of mechanical systems for conditioning building interiors. Passive systems – natural ventilation and daylighting – would subsequently emerge as key strategies within Green design.

Although the social and economic dimensions of environmental issues and the ideas of life cycle and assuming responsibility for the future were all evident in earlier works, the 1987 Brundtland Commission's report, *Our Common Future* (WCED, 1987) first used the term 'sustainable development' explicitly to frame human responsibilities to each other and to natural systems. Although remarkably difficult in both definition and implementation, the use of the term 'sustainability' can now be seen as a necessary and critical focus to the current environmental debate and one of the most significant notions to emerge over the past 30 years. Agenda 21 – the comprehensive plan of action emerging from 1992 UN Conference in Rio de Janeiro – emphasized taking responsibility and searching for solutions for reducing the rate and scale of global environmental degradation, social inequity and other key requirements of sustainability. These required unprecedented international political cooperation and the recent struggles to ratify the Kyoto Accord represents a clear

reminder of the difficulties that lie ahead in arriving at effective solutions.

The notion of 'responsibility' thus embedded within approaches at this time stands in marked contrast to the 'survival' mentality of the 1970s. In 1992, Meadows *et al.* released *Beyond the Limits – Confronting Global Collapse: Envisioning a Sustainable Future* that not only reaffirmed the notion of limits, but also illustrated that now 20 years on from the original study, many had been surpassed. Though not nearly as provocative as the 1972 'Limits' study, it again emphasized that alternative futures were a societal choice and not inevitable. Similarly, Stewart Brand – former Editor of the *Whole Earth Catalogue* and *Co-Evolutionary Quarterly* in the 1970s – has focussed efforts on instituting mechanisms that engender the recognizing, accepting and instilling of an enduring responsibility for the future. Throughout *The Clock of the Long Now – Time and Responsibility* (1999), Brand offers constructive direction by suggesting how problems can be reframed to make them mesh with current planning strategies such as casting natural systems as 'natural infrastructure' or using feedback mechanisms as a primary tool for tuning systems. However, until environmentally responsible building design is perceived to be economically viable, it may, as Ingersoll (2003) suggests, 'only appeal to the righteous, the frightened, or the enlightened.'

Research activity and practice

Within this context, there has been an enormous amount of research activity and practice directed at the environmental performance of buildings. This evolving collective understanding has been captured at several key international conferences over the past decade – from the 'First International Conference on Buildings and the Environment' held at the Building Research Establishment, in 1994 to 'Sustainable Buildings 2002', Oslo. See Figure 3. The content of these conferences shows the general progression from the ideas of "green" buildings – defining their scope, the development of guidelines and the development of assessment tools – to, in the most recent, an increasing use of the



Figure 3 International Green and Sustainable Building Conferences 1994–2002

term ‘sustainability’ and emphasis on policy and marketing.

It is possible to define the changing boundaries of the field with sufficient confidence to identify areas of progress, deficiencies and omissions. Whereas building environmental assessment, life cycle analysis and, more recently, urban sustainability have been dominant themes during these conferences, sociocultural and human issues remained poorly covered.

Building environmental assessment

Until the release of the Building Research Establishment Environmental Assessment Method (BREEAM) in 1990, little, if any, attempt had been made to establish an objective and comprehensive means of simultaneously assessing a broad range of environmental considerations against explicitly declared criteria, and offering a summary of overall performance (Yates *et al.*, 1998) The field of building environmental assessment has matured remarkably quickly since the introduction of BREEAM, and the past 12 years have witnessed a rapid increase in the number of building environmental assessment methods in use world wide. Initially, the development of building environmental assessment methods was largely an exercise in structuring a broad range of existing knowledge and considerations into a practical framework, rather than requiring or demanding new research. Now building environmental assessment is, in and of itself, a defined realm of enquiry with more rigorous explorations into weighting protocols, performance indicators, etc.

The emergence of building environmental assessments can now be understood as an outcome of the convergence of several threads alluded to above including the need to understand performance more comprehensively and benchmark progress. Building environmental assessment methods are *voluntary* in their application and current success (both in terms of the amount of total new construction floor area being assessed and of practitioner acceptance) can be either taken as a measure of how proactive the building industry is in creating positive change or its responsiveness to market demand. Certainly, these tools have done the following:

- Given focus to Green building practice. Whereas design guidelines provide a broader range of issues, assessment methods give structure and priority, and as such provide greater strategic advice to the design team. The structure and organization of environmental knowledge is proving to be as important as the individual elements.
- Enabled building performance to be described comprehensively. Performance-based indicators are where actual amounts of resource use and loadings enable improvements to be demonstrated relative to known or declared benchmarks and to be aggregated

to establish overall patterns of consumption or environmental loading. Since the field is still maturing, it is not possible to formulate performance-based indicators for all the issues covered within a comprehensive building environmental assessment. As such, prescriptive requirements are often specified as proxies for actual performance values, e.g. proximity to public transit stops is often used as a proxy for reduced use of automobile for commuting.

- Assisted in redefining the design process. Improving the environmental performance of buildings within current cost and time constraints requires a different approach to the design process. Assessment methods play a valuable role by providing a clear declaration of what are considered the key environmental considerations and their relative priority.

In addition to the necessity to view environmental performance more comprehensively, it is possible to identify other circumstances that have contributed to the current revival of integrated design approaches that enjoyed only a brief presence in the early 1970s:

- A continuous thread of research and practice that has focussed on reducing fossil fuel use, which is reflected in the efforts of the International Solar Energy Society (ISES) and Passive and Low Energy Architecture (PLEA), can be traced from the 1973 oil embargo. Though initially focussing almost exclusively on passive solar housing, current passive strategies employing natural ventilation, daylighting and passive solar systems are applied to buildings of all types and scales. Passive approaches have required and generated an improved understanding of the dynamic performance of buildings and systems and a reassessment of what constitutes appropriate indoor comfort conditions.
- Increase in sophistication of prediction tools and the increasingly powerful simulation capabilities of engineering consultants.

With many countries either having or being in the process of developing domestic assessment methods, international exchanges and coordination are increasingly evident:

- The Green Building Challenge (GBC) has been an important and consistent stream within the past three major international conferences. GBC is an international collaborative effort to develop and test a building environmental assessment tool that exposes and addresses controversial aspects of building performance assessment. Building projects from the participating countries are showcased at the conferences having all been assessed using a common assessment system – GBTool – developed

collectively through the process. GBTool users are encouraged to take structural features or criteria, in whole or in part, as they deem relevant to developing their own assessment methods.

- In 1997, the International Organization for Standardization's Technical Committee 59 (ISO TC59) – Building Construction resolved to establish an ad hoc group to investigate the need for standardized tools within the field of sustainable building. This subsequently evolved and was formalized as Sub-Committee ISO T59/SC17 – Sustainability in Building Construction, the scope of which includes the issues that should be taken into account within building environmental assessment methods.

Life cycle analysis

Although life cycle energy analyses in the 1970s had provided a broader view of performance, it failed to enter mainstream environmental discourse at the time. Research by Kohler (1987) and other Europeans in the late 1980s heralded the beginning of a much more rigorous and comprehensive understanding of life cycle building impacts. The notion of Life Cycle Assessment (LCA) has now been generally accepted within the environmental research community as the only legitimate basis on which to compare alternative materials, components and services, and is firmly rooted in European tools such as EcoQuantum (Netherlands) and EcoEffect (Sweden) adhere to the rigours of LCA. Meaningful LCA assessment methods are data intensive and can involve enormous expense of collecting data and keeping it current, particularly in a period of considerable changes in materials manufacturing processes.

Currently none of the existing simplified building environmental assessment methods are comprehensively or consistently LCA-based, nor do they necessarily need to be given their primary role in market transformation. While some performance criteria in these methods are increasingly based on conventional LCA data, their strength lies in bringing a broader range of considerations to the assessment process while being respectful of simplicity and practicality to make them more widely accessible. Provided that selection process and the relative number of points assigned to them are derived through a transparent, consensus process, widely different criteria can be legitimately combined and aggregated to offer overall building performance scores. A recent study has attempted to use LCA techniques to evaluate the intents and requirements of four credits in the US Leadership in Energy and Environmental Design (LEEDTM) (USGBC, 2001) rating system when applied to a case study building project. (Scheuer and Keoleian, 2002). Although the authors infer that the LEED intentions may not be actually fully realized by their current

specified requirements, the study is more illustrative of the difficulties of meaningfully applying and interpreting LCA methodologies of singular performance criteria to those that are comprehensive in scope and based on seeking a balance between rigour and practicality derived through a consensus process.

A critical but relatively unexplored issue within this dominant direction in environmental analysis is the pros and cons of the categorization of environmental issues. While the organization of environmental issues within building environmental assessment methods has provided clarity and structure, Franck (1986, p. 51) discusses the negative effects of rigid categorization within the field of environmental design research, arguing that:

[b]uilt environments are implicitly viewed as fixed, non-changing and non-interactive artifacts. Thus processes of chemical reaction, physical decay or other types of change are not easily associated with buildings. Similarly, the process of change in buildings as a consequence of social change is discouraged by the assumed fixed quality of built environments.

Urban sustainability

While the present paper has focussed on the evolving environmental agenda and its interpretation in *building* research and practice, an equally compelling history could have been unfolded for cities and urban development. However, until relatively recently, these have been largely parallel histories. It is increasingly clear that the level of the 'individual' building is an inappropriate scale with which to address many issues and that the emergence of sustainability has provided the necessary conceptual framework to bridge building performance and urban development. Ingersoll (2003) suggests that:

[w]hat is certain is that any theory of design and ecology must acknowledge that the bottom line of sustainability is not the individual building but urbanism.

The city/municipality has emerged as perhaps the most relevant scale at which to address sustainability issues and, as such, sustainable urban development is an increasingly significant realm of enquiry for the framing of building design strategies. A key requirement lies in the more explicit definition and understanding of links and relationships between buildings and their larger context, both environmental and social. Tjallingii (1995), for example, explores energy use, water, waste and transport across a variety of scales, from the building, urban district/neighbourhood, city, region and country to a series of 'chains'. By contrasting the existing systems for delivering these services with 'guiding models' for the long-term, Tjallingii

elegantly conveys the root of current problems and identify appropriate scales for addressing them.

Discussion and conclusions

The present paper has explored how prevailing societal values and attitudes toward environmental issues create a context that indirectly, yet profoundly, influence approaches to building design and construction. The ideas have been cast in a historical framework that reveals a highly dynamic relationship between the proposition and introduction of ideas offered by building research and practice, and society's receptivity to them.

The paper has argued that the environmental debate over the past three decades can be generally defined by a shift from an attitude of 'survival' to one of responsibility and stewardship and that these, along with other developments, have indirectly shaped environmental policy and building practice. Many persuasive appeals over this period have stressed the negative consequences of failing to ameliorate environmental problems. Although potent, such 'threat' and 'fear' appeals have always run the risk of instilling feelings of powerlessness and lack of control (Eagly and Kulesa, 1997). Ingersoll (2003) argues that:

[w]e could no longer struggle against impending doom if it had already occurred. From that moment on, my ecological consciousness ceased to be a narrative steeped in guilt, and became merely a question of maintaining dignity during an inevitable decline.

Moreover, the absence of an anticipated 'apocalyptic' collapse envisaged in the 1970s has provided enormous leverage to those who consider environmental issues to be exaggerated (Anon., 1997).

Key omissions

Two important questions are what issues are not currently represented at the major sustainable buildings conferences? And why not? A consistent feature of recent major international conferences is that the majority of the discussion is technically framed. The conferences emphasize the technical systems and advances that are being made in buildings and make scant reference to how users interact with technical features and systems or cultural acceptance of Green building practices. Several reasons may create this emphasis – technical issues can be easily quantified whereas human impacts are not easily explained or elucidated, and industrial societies, particularly in North America, are predominantly founded on a science and technical paradigm that places enormous faith in technological prowess.

Despite the number of sociocultural critiques of broader environmental issues that have been offered as well as specific works of direct consequence to design, they have largely coexisted with, rather than informing technical developments in, building environmental issues. This unfortunate gulf that may derive from overall qualitative differences in emphasis and scope, agendas and language, has meant that a great deal of critically important work within the social and behavioural sciences remains distant. Bridging these worlds is of immense importance.

The Preface to EDRA 19 positioned the organization relative to new concerns about the importance of the natural environment, as made apparent by 'recent alarm over increasing damage to the ozone layer and the possible intensification of the Greenhouse Effect' (Lawrence *et al.*, 1988, p. vii). The Editors emphasized the importance of sociological research in helping to implement solutions arising from scientific data. 'While the technical information reporting modern society's destructive effects on the natural environment grows', they argue:

little attention has been paid to how to effectively implement solutions that will allow us to survive on this planet. These are behavioural issues that include such diverse areas of environmental design as studies in perception and cognition, motivation and behaviour, ethics and values, and planning and design. (Lawrence *et al.*, 1988, p. vii)

The importance of recognizing and resolving technological and cultural advance has been declared in other EDRA papers. Schnorr *et al.* (1983, p. 238), for example, argue that:

the pattern of excessive energy consumption by American consumers will be solved by modern technology only if accompanied by social engineering.

Similarly, Klein *et al.* (1985, p. ix) suggest that:

[i]f we want a better society we must consider the environment's role; to make meaningful change, we must also enter the process of social change.

The need to recognize and accommodate user needs and expectations in building design has also been a recurring theme within EDRA, but less so within the major building environmental conferences. Mann (1989), for example, suggests that the design paradigm used by contemporary architects is too far removed from the experience of everyday building users and proposes 'intermediate-level' paradigms to narrow this

gap and which embrace 'timeless and temporal concerns'. Such a framework, Mann argues:

should allow its users to address both timeless, universal laws and principles in architecture, but also the ephemeral, temporary, transient concerns that influence how people design, use and understand the built environment. (p. 78)

Choriki (1990) discusses the inadequacy of present models of environmental ethics actually to inform peoples' day-to-day lives. He argues that an 'adequate theoretical perspective concerning individuals and the condition of the biosphere must not only focus on the activities of daily life', but also include analyses relating to four general areas of environmental ethics: the 'Rights of Nature', 'Conservation and Appropriate Technology', 'The Spiritual Connection With Nature' and 'Critical Theories' (p. 245).

An important implication is that although it has been difficult for design professionals to embrace the increased range of environmental considerations required within current building assessment methods, these must be expanded even further to accommodate social and behavioural issues. While the notion of 'integrated design' – engaging the full design team at the outset of projects – is enabling performance improvements within current time and cost constraints, this too could be enriched by a broader interdisciplinary understanding in both education and practice.

Prevailing notions in architecture

Built works, the formal debates and positions represented and practised by the perceived architectural avant-garde, represent an important context and inspiration for current practice. If these embody the architectural aspirations of the day, they can also provide a benchmark to judge environmental practice.

Over the past 30 years, Modernism has remained the dominant paradigm. In its search for universal principles and to further technological innovation, the Modern Movement jettisoned vernacular environmental strategies and attempted to transcend history and place. And, within this construct, attitudes of human domination of nature, the provision of a controlled environment and faith and expression of technological sophistication were largely unquestioned or challenged. Canter (1991) suggests that:

[d]esign consultants, architects and planners can all too readily believe that research which leads to the creation of more sophisticated buildings, more complex technological solutions to more obscure corporate and municipal objectives, are using knowledge in a productive way.

However, he argues that their 'smart' buildings 'can be highly destructive and produce an enormous amount of collateral damage' and the

intellectual imperialism that has produced International Style buildings with their curtain-walled windows and demanding air conditioning systems has done more to destroy cities like Mexico and Caracas than was ever done by conquistadors. (Canter, 1991, p. 23)

The exponents of Post-Modernist architecture during the 1970s and 1980s – with their greater interest in history, context and ornament – were equally ambivalent toward social and environmental issues (Koh, 1985).

Although not explicit in the embracing of environmental principles, the notion of 'regionalism' continually reappears as a potential remedy to the 'homogeneity and mediocrity of the current built environment' (Buchanan, 1983; Buchanan, 1984). In *Towards a Critical Regionalism: Six Points for an Architecture of Resistance* (1983), for example, Frampton laid down criteria deemed relevant to a regionalist architecture and attempted to focus the architectural debate in the notion of 'place'. 'Critical regionalism' is offered as a 'strategy to mediate the impact of universal civilization with elements derived indirectly from the peculiarities of a particular place'. Frampton suggested that regionalism:

may find its governing inspiration in such things as the range and quality of the local light or in a tectonic derived from a peculiar structural mode, or in the topography of a given site.

Feedback

The considerable increase in the growth of published building environmental information, coupled with fewer checks and balances on its quality, profoundly compromises both its credibility and value to practitioners. Given the rapidly emerging field, the building environmental research community faces increased pressure to present its findings. It does so often prematurely and quality ideas are often buried amidst work of modest value. Leading building designers similarly face increased pressure to have their work published. Designs are often published in their formative stages that may or may not be followed by actual built work, and built projects are published immediately after completion without any track record of achieved performance. Actual performance data derived from concerted and consistent monitoring and post-occupancy evaluations are rare. As such, design progresses without informed feedback.

Vernacular and indigenous buildings are often presented as exemplary approaches of responding to local

climate, and regional resources and culture that can offer important lessons for contemporary sustainable building. Spreckelmeyer (1984, p. 25), for example, argues that:

[w]hat the vernacular has to offer modern design is a link between the person and the environment that is flexible enough to allow a continuous and intimate manipulation as the need or whim of the person dictates. It is assumed that one of the major failings of contemporary design – especially in office buildings, congregate housing, and other institutional settings – is the sense of estrangement it creates within those it to serve.

However, such practices evolved within the context of shared community values, a broader skill base and continuity of players, and on a stable but highly restricted technological foundation. More importantly, their development involved a slow evolutionary process that allowed mistakes to be rectified through a process of trial and error. Direct feedback on building performance was seemingly key to the gradual and successful refinement in technique until conventions were established. Contemporary building, by contrast, occurs within constrained time frames, involves the phasing of numerous skills and trades, and their operation and use can compromise the initial design intentions. More confounding, contemporary design progresses with little, if any, feedback of performance. Sustainable building, however, may offer several positive benefits over and above the direct environmental improvements.

At a fundamental level, Green buildings represent a reinstatement of design principles founded on natural systems and cycles, a greater dependence on on-site energy and water supply, and an implicit commitment to the future. As such, they should be less influenced by the short-lived and often trite influences of passing fads. Perhaps more importantly, a significant portion of the debate and conferences on sustainable building currently centres on 'performance' with increased scrutiny and feedback occurring through building environmental assessment methods. This may institutionalize the value and necessity of systematic ways of identifying and rectifying any design flaws.

Speculation on the future

Although forecasting carries obvious risks, it is interesting to speculate on the next overarching notion or notions that will shape environmental attitudes and actions. There are a number of developments that will create a new context for discussing environmental and sustainability issues and the possible directions that society may take to address these issues.

Scientific advance: discovering natural processes

Addington (2003) suggests that:

most architects believe that solutions are known and straightforward, and that their implementation requires only the will and commitment of a few extra dollars

and that this has had consequences on what and how knowledge is conveyed. Although the adoption of currently recognized best practices would significantly improve building performance, it is unlikely to be sufficient to meet the dictates and requirements of environmental sustainability. New models and new thinking will be necessary. Over the past 30 years, environmental concerns have been subject to increasing enquiry within a host of other disciplines – both in the natural and social sciences – and also spawned interdisciplinary studies that transcend traditional realms and boundaries of conventional research. Indeed, the capacity to cope with emerging complex problems depends on an increasing range and combination of complimentary fields of technical knowledge and firms are

becoming increasingly 'multi-technology', incorporating a growing number of fields of knowledge into their problem-solving armoury. (Pavitt, 1998)

Moreover, the sciences providing new insights and the industries dependent on them:

are once again racing ahead of architecture to meld ever more deeply and inextricably with natural processes. (Hagan, 2003)

Technological advance: redefining the notion of limits

The underlying message in the environmental debate over the past two or three decades, above all, has been about respecting natural limits and understanding how to live within them. Other significant technological advances are occurring in parallel with the emerging understanding of sustainability:

- Although information and communications technologies have permeated almost every facet of human enterprise, it is only recently that the unfolding futures of Information and Communications Technologies (ICT) and sustainable urban development have been cast together. The European INTEL CITY project (2003), for example, has begun to identify possible future visions and scenarios for the intelligent application of ICT to enable cities to become more sustainable and to map out the research paths that offer the

most potential in assisting society to implement them.

- Rifkin (2002) postulates the emergence of a hydrogen economy and, with it, the 'distributed generation' of power. Here, millions of end-users would connect fuel cells into local, regional and national hydrogen 'energy webs' to share energy. Ausubel (1996) also anticipates a steady trajectory toward a hydrogen economy. However, he also illustrates that the growth of per capita energy consumption has been historically keyed to the adoption of cleaner fuels and in the past it has 'tripled before the energy services desired outgrew the old fuels or portfolio of fuels', be it economic, social, technical and environmental limits. As such, within Ausubel's scenario, the promise is for yet another significant *increase* in energy use per capita.

The emergence of the Internet and the promise of the hydrogen economy may well change human preference, expectation and action. They may also transform the understanding of energy and environmental problems, future environmental policy, the strategies implemented, and what is built and how it is achieved.

Global instability: an emerging context of security

Although still in its infancy, considerable strides have been made in building environmental research over the past decade and in the extent that environmental considerations have entered into the parlance of mainstream building design and construction. The notions of sustainability and life cycle analysis have begun to extend the timeframe of decision-making from immediacy to long-term and building environmental assessment methods have broadened the scope of environmental issues and extended the boundary of considerations beyond the individual building. However, a widely held position has been that until natural disasters resulting from environmental instability set in, ecological issues will be compromised in the political realm by economic, social and military priorities (Ingersoll, 1991). The increasing geo-political tensions associated with global terrorism and responses to it would seem to support this notion. However, the statement issued by the Nobel Laureates (2001) on the occasion of the 100th anniversary of the Nobel Prize suggest that these current focussed efforts may be masking the fact that solutions to world security are complex, long-term and lie in fundamental environmental and social reform. 'The most profound danger to world peace in the coming years', they suggest, 'will stem not from the irrational acts of states or individuals but from the legitimate demands of the world's dispossessed.' The issue of 'equity' is central to the UN Rio Declaration (1992) on Environment and Development, which emphasizes that special priority shall be given to the 'most

environmentally vulnerable.' Increasing disparities between developed and developing nations and worsening environmental conditions will likely be manifest in mass migration and associated social and economic disruptions in the receiving country. This will further exacerbate global instability and insecurity (Kaplan, 1994).

For the vast majority of the world's population, day-to-day survival dominates human activity. Homer-Dixon (1995) suggests that as scarcity worsens, some poor societies will face a widening 'ingenuity gap' further compounding their abilities to respond, adapt creatively to changing conditions and chart a path to recovery. This is compounded by the necessity of the investment of public expenditure on academic research in a country's capacity for technical change (Pavitt, 1998). By contrast, depending on how they are deployed, the collective intellectual and economic resources of the industrialized nations provide a seemingly more secure future. Yet, it is difficult to imagine an easy transition to a low-carbon economy by requiring industrialized countries to break their dependency on fossil fuels and simultaneously encouraging developing countries aspiring to similar 'wealth' to 'leapfrog' over the current polluting and resource-intensive technological base (Manzini, 1997). In the 'catching-up process', developing countries do not necessarily simply follow the path of technological development of the advanced countries, but often skip some stages or even create their own individual path. The increasing tendency toward globalization and development of information technology perhaps makes the leapfrogging argument ever more plausible (Lee and Lim, 2001). Irrespectively, any solution will require an unprecedented degree of commitment and international cooperation and communication, and sharing of sound environmental practices at a variety of levels will be increasingly necessary and demanded. Moreover, such solutions are as much, if not more so, sociopolitical as they are improved technological efficiency.

If developing countries tend to follow whatever the West aspires, then leadership in providing different aspirations will be central. Throughout the present paper, a host of questions has arisen about the extent to which professionals, and the research community supporting them, can respond to social values and exert influence as exercised through individual projects. Exemplary projects, such as the BedZed eco-village in the UK, have enormous potency to generate widespread interest and debate – both in terms of the physical and operational features of the completed built work as well as the process by which it was created: the project goals, participants, negotiations and hurdles. Unlike other innovative projects, BedZed references a globally equable 'ecological footprint' of 1.9 hectares/person as a performance aspiration

(Figure 3), one that is only attainable through new approaches to building that permit, and are accompanied by, life style changes by its occupants (Desai and Riddlestone, 2002). See Figure 4.

Uncertainty and stability

An initial and obvious response to the current global uncertainties has been increased demands for domestic security measures, requirements that will become a dominant and, in all likelihood, permanent part of future policy. The questions that now emerge are in what ways will these developments shape societal priorities and how will these subsequently affect the current inertia in environmentally responsible building design and sustainable urban development. 'Future-proofing' buildings to make them less vulnerable to uncertain energy cost increases and supply is already

an increasingly used notion that may evolve into a much greater emphasis on 'self-reliance' akin to that in the early 1970s. If so, it will probably operate at a scale larger than the individual building and be complemented by the current and emerging developments in ICTs.

Adapting to climate change over the coming decades will invariably shape future environmental attitudes and actions. In times of uncertainty, logic suggests that buildings capable of being adapted as circumstance dictates may be most appropriate. Indeed, flexibility, adaptability and open building are considered to be strategies that have environmental benefits. However, other seemingly less rational responses can be posited. This paper suggests that a countervailing need to instil and communicate a strong sense of stability and security may emerge.

Based on a 4-person household		Car mileage	Car ownership (manufacturer, maintenance, road infrastructure)	Public Transport	Air Travel	Electricity and gas	Water	Domestic Waste	Office Footprint (energy and paper)	Food (including transport but not packaging)	Overall eco footprint
Typical UK lifestyle	Owns car Holidays by plane every year Recycles 11% Eats out-of-season, highly packaged, imported food	0.90	0.41	0.00	0.30	0.45	0.002	1.70	0.80	1.63	6.19
		10,000 km/yr				22,500 kWh electric and gas	140 litres/day		non-renewable energy and virgin paper		
BedZED with conventional lifestyle	Owns car and commutes to work by public transport Holidays by plane every year Recycles 60% Moderate meat eater and some imported food	0.45	0.32	0.30	0.30	0.10	0.001	1.02	0.80	1.06	4.36
		5000 km/yr		4000 km/yr		Waste wood CHP including credit for landfill diversion	91 litres/day		non-renewable energy and virgin paper		
BedZED ideal	Lives and works at bedZED Recycles office paper No car (member of ZEDcars club) Holiday by plane every 2 years Recycles 80% at home Low meat diet with local fresh food	0.09	0.04	0.30	0.15	0.10	0.001	0.34	0.16	0.72	1.90
		1000 km/yr	20 people per club car	4000 km/yr		Waste wood CHP including credit for landfill diversion-wood CHP	91 litres/day		Joins closed loop office paper scheme		
Global average											2.40
Global available	Leaving 10% of bioproductive land for wildlife										1.90

Figure 4 Ecological footprints for UK lifestyle in hectares per person

This could reinforce Pallasmaa's (1994) notion for an architecture that:

rejects momentariness, speed and fashion; instead of accelerating change and a sense of uncertainty, architecture must slow down our experience of reality in order to create an experiential background for grasping and understanding change.

A host of direct and rational arguments – environmental threat appeals, health and comfort benefits, and life cycle cost savings – are currently used to 'convince' sceptics and create positive change. An implicit issue throughout the present paper has been the *ethical* underpinnings of environmental responsible building design. Indeed, the environmental movement and practitioners seeking higher levels of environmental performance are often seen as presenting their position 'as morality, a system of beliefs that guides every design action and the way we live and make decisions' (Sarkis, 2003). An ethical position is seemingly insufficient to garner widespread support at this juncture and perhaps, therefore, a qualitatively different approach to framing environmental issues may prove more effective in promoting change.

There is sufficient evidence that choices made by individuals or society are not derived from a rational evaluation of options. Moreover, even though most people may seemingly espouse pro-environmental attitudes, they engage in environmentally destructive behaviour. Bazerman *et al.* (1997) suggest that knowledge about the physical state of the environment will not solve this 'attitude-behaviour' puzzle. Nonetheless, a crucial area for research and policy will be to improve the understanding of both the limits of global carrying capacity and the implications of how this could be apportioned. This suggests that technical appraisal has to be integrated within a system of social equity. The result will provide an improved understanding of what the limits of human consumption need to be at different levels: national, city, neighbourhood, building and household.

The surprising and rapid increase in the numbers of Sports Utility Vehicles (SUVs) in North America illustrates how performance issues such as fuel efficiency, environmental impact or even practical necessity are subsumed by aspirations of perceived safety and security that extend beyond those attributable to potential road accidents. Equivalent ideas are evident within building and urban design. For example, the continued aspiration for increasingly large suburban houses and the perceived need for a second or third bathroom within a single-family home often bear little relationship to performance needs or requirements. Fowlow *et al.* (1996) similarly feel that part of what attracts people to New Urbanist designs is a feeling

of familiarity and stability. This occurs largely because of the aesthetic connection to old-fashioned ways of life that are yearned for nostalgically. They describe one development as 'still a typical suburb, dressed in old-fashioned clothing, an apparition of the good, safe life' (p. 66).

The public's priorities will invariably change as environmental degradation become more evident and people become aware of their individual and collective influence on the environment and the options available to them. Notwithstanding, the debate about environmentally responsible building design has yet to acknowledge the potency of the overarching values and concerns that society holds or, indeed, how to harness them to effect positive change.

Acknowledgements

The author would like to thank Paul Crowley at the University of British Columbia School of Architecture for assisting in researching EDRA proceedings, Nigel Howard of the USGBC for clarifying the role of LCA analysis in market based assessment tools and Robert Carter at the Martin Centre, University of Cambridge for assisting in gathering information on the Cambridge Autonomous House project.

References

- Addington, M. (2003) Rethinking sustainable design. *Harvard Design Magazine*, 18, 18–21.
- Aggeri, F. (1999) Environmental policies and innovation – a knowledge-based perspective on cooperative approaches. *Research Policy*, 28, 699–717.
- AIA (1981) *Energy in Architecture*, American Institute of Architects, Washington, DC.
- Anon (1997) Environmental scares: plenty of gloom. *Economist*, 345(8048), 19–21.
- Ausubel, J.H. (1996) Can technology spare the Earth? *American Scientist*, 84, 167–179.
- Bazerman, H., Messick, D.M., Tenbrunsel, A.E. and Wade-Benzoni (eds) (1997) *Environment, Ethics, and Behaviour*, New Lexington Press, San Francisco, CA.
- Bentley, I. (1990) Urban design series 3 – ecological urban design. *Architect's Journal*, 24 October, 69–71.
- Brand, S. (1999) *The Clock of the Long Now – Time and Responsibility*, Weidenfeld & Nicolson, London.
- Buchanan, P. (1983) With due respect: regionalism. *Architectural Review*, 1035, 15–16.
- Buchanan, P. (1984) Only connect. *Architectural Review*, 1052, 23–25.
- Caldwell, L.K. (1973) Changing contexts of environmental politics, in W.F.E. Preiser (ed.): *Proceedings EDRA 4*, Dowden, Hutchinson & Ross, Pennsylvania, PA, pp. 3–17.
- Canter, D. (1991) Safety, health and environmental design: changing rules of place through cognitive ecology, in J. Urbina-Soria, P. Ortega-Andeane and R. Bechtel (eds): *Proceedings of EDRA 22: Healthy Environments*, pp. 22–35.
- Carson, R. (1962) *Silent Spring*, Houghton Mifflin, Boston, MA.
- Choriki, D. (1990) Current trends in environmental ethics as they relate to the daily lives of individuals, in R.I. Selby, K.H. Anthony, J. Choi and B. Orland (eds): *Proceedings of EDRA 21: Coming of Age*, pp. 245–251.

- Coddington, A. (1973) The cheermongers: or how to stop worrying and love growth. *RIBA Journal*, 80, 133–138.
- Craig, P. et al. (eds) (1978) *Distributed Energy Systems in California's Energy Future*. Interim report No. HCP/7405-02, UC-13, US DOE, Washington, DC.
- Desai, P. and Riddlestone, S. (2002) *Bioregional Solutions for Living on One Planet*, Schumacher Briefings 8, Green Books (on behalf of The Schumacher Society), London.
- Eagly, A.H. and Kulesa, P. (1997) Attitudes, attitude structure, and resistance to change, in H. Bazerman, D.M. Messick, A.E. Tenbrunsel and Wade-Benzoni (eds): *Environment, Ethics, and Behaviour*, New Lexington Press, San Francisco, CA, pp. 122–153.
- The Ecologist (1972) *Blueprint for Survival*, The Ecologist, London.
- Electricity Council (1969) *Integrated Design: A Case History*, Electricity Council.
- Foley, G. (1976) Insulated savings. *Architectural Design*, 8, 502–503.
- Fowlow, L.D., McMordie, M. and Stein, S. (1999) Who's afraid of authenticity?, in T. Mann (ed.): *Proceedings of EDRA 30: The Power of Imagination*, pp. 63–65.
- Frampton, K. (1983) *Towards a Critical Regionalism: Six Points for an Architecture of Resistance. The Anti-Aesthetic*.
- Frampton, K. (1996) Universalism and/or regionalism. Untimely reflections on the future of the new. *Domus*, 782, 4–8.
- Franck, K.A. (1986) The cost of knowing: a call for examining categories in environmental design research, in J. Wineman, R. Barnes and C. Zimring (eds): *Proceedings of EDRA 17: The Costs of Not Knowing*, pp. 47–53.
- Gordon, A. (1972) Designing for survival. The President. *RIBA Journal*, September, 366.
- Guy, S. and Farmer, G. (2000) Contested constructions: the compelling logic of green buildings and ethics, in W. Fox (ed.): *Ethics and the Built Environment*, Routledge, London.
- Hagan, S. (2003) Five reasons to adopt environmental design. *Harvard Design Magazine*, 18, 4–11.
- Hardy, A.C. and O'Sullivan, P.E. (1968) *Designing a Climate*, Electricity Council.
- Hawken, P., Lovins, A. and Lovins, L.H. (1999) *Natural Capitalism, Creating the Next Industrial Revolution*, Little, Brown, New York.
- Holling, C.S. (1998) The renewal, growth, birth and death of ecological communities. *Whole Earth*, Summer, 32–35.
- Homer-Dixon, T. (1995) The ingenuity gap: can poor countries adapt to resource scarcity? *Population and Development Review*, 21(3), 587–612.
- Ingersoll, R. (1991) Unpacking the green man's burden. *Design Book Review*, Spring, 19–26.
- Ingersoll, R. (2003) A post apocalyptic view of ecology and design – thirteen recent books. *Harvard Design Magazine*, 18, 12–17.
- INTELCITY (2003) [<http://www.scri.salford.ac.uk/intelcity/>].
- Kahn, H., Brown, W. and Martel, L. (1976) *The Next 200 Years: A Scenario for America and the World*.
- Kaplan, R.D. (1994) The coming anarchy. *Atlantic Monthly*, February, 44–75.
- Kasabov, G. (1972) George Kasabov reports. *RIBA Journal*, September, 377–378.
- Klein, S., Wener, R. and Lehman, S. (1985) Preface, in S. Klein, R. Wener and S. Lehman (eds): *Proceedings of EDRA 16: Environmental Change/Social Change*.
- Koh, J. (1985) Success strategies for architects through cultural changes leading into the Post-Industrial Age: an American perspective, in S. Klein, R. Wener and S. Lehman (eds): *Proceedings of EDRA 16: Environmental Change/Social Change*, pp. 10–21.
- Kohler, N. (1987) *Energy Consumption and Pollution of Building Construction*, Proceedings, ICBEM 28 September–2 October 1987, Ecole Federale Polytechnique de Lausanne.
- Lawrence, D., Habe, R., Hacker, A. and Sherrod, D. (eds) (1988) Preface, in *Proceedings of EDRA 19: People's Needs/Planet Management. Paths to Co-Existence*.
- Lee, K. and Lim, C. (2001) Technological regimes, catching-up and leapfrogging: findings from the Korean industries. *Research Policy*, 30, 459–483.
- Lovins, A.B. (1977) *Soft Energy Paths: Toward a Durable Peace*, Friends of the Earth International/Ballinger, Cambridge, MA.
- MacEwen, M. (1971) Service to the people, the environment, or mammon? *RIBA Journal*, 78, 60–63.
- Mann, T. (1989) The need for intermediate level paradigms, in G. Hardie, R. Moore and H. Sanoff (eds): *Proceedings of EDRA 20: Changing Paradigms*, pp. 75–81.
- Manzini, E. (1997) Designing sustainability. Leapfrog: anticipations of a possible future. *Domus*, 789, 46–48.
- Meadows, D. et al. (1972) *The Limits to Growth*, Universe, New York.
- Meadows, D.H., Meadows, D. and Randers, J. (1992) *Beyond the Limits – Confronting Global Collapse: Envisioning a Sustainable Future*, Chelsea Green, Vermont.
- Montefiore, H. (1972) Designing for survival. *RIBA Journal*, September, 383.
- Moss, D. (1985) Energy future Santa Cruz: a case study in the relationship between technological change and social change in the appropriate technology movement, in S. Klein, R. Wener and S. Lehman (eds): *Proceedings of EDRA 16: Environmental Change/Social Change*, pp. 22–30.
- Nobel Laureates (2001) Statement by Nobel Laureates on the occasion of the one-hundredth anniversary of the Nobel Prize [<http://www.utoronto.ca/jpolanyi/nobelstatement/>].
- Pallasmaa, J. (1994) Six themes for the new millennium. *Architectural Review*, 196(1169), 74–79.
- Pavitt, K. (1998) The social shaping of the national science base. *Research Policy*, 27(8), 793–805.
- Pearce, F. (2000) The spirit of the age: 30 years of *The Ecologist* [[http://www.theecologist.org/archive_article.html?article=158 & category=42](http://www.theecologist.org/archive_article.html?article=158&category=42)].
- Pike, A. (1974) SRC/DOE autonomous housing study: the autonomous house research programme, Cambridge University, Department of Architecture, October 1974.
- Pirages, D.C. (1974) Social design for limited growth, in D.H. Carson (ed.): *Proceedings of EDRA 5: Man-Environment Themes*, Environmental Design and Research Association, pp. 37–50.
- Rifkin, J. (2002) *The Hydrogen Economy: The Next Great Economic Revolution*, Jeremy P. Tarcher/Pitman, New York.
- Rudge, J. and Nicol, F. (eds) (2000) *Cutting the Cost of Cold*, E&FN Spon, London.
- Sanoff, H. and Cohn, S. (eds) (1969) Preface, in *EDRA 1: Proceedings of the First Annual EDRA Conference*, Environmental Design and Research Association.
- Sarkis, H. (2003) What can we do? *Harvard Design Magazine*, 18, 57.
- Scheuer, C.W. and Keoleian, G.A. (2002) *Evaluation of LEED: Using Life Cycle Assessment Methods*. Report NIST GCR 02-836, National Institute of Standards and Technology.
- Schnorr, J., Levi, D. and Kantrowitz, M. (1983), in D. Amadeo, J.B. Griffin and J.J. Potter (eds): *EDRA 14: Proceedings of the Fourteenth Annual EDRA Conference*, p. 238.
- Schumacher, E.F. (1973) *Small is Beautiful: Economics As If People Mattered*, Harper & Row, New York.
- Shepard, C. (1971) Eastergate: the integrated design school. *RIBA Journal*, 78, 282–286.
- Spreckelmeyer, K.F. (1984) Design and familiarity, in D. Duerk and D. Campbell (eds): *Proceedings of EDRA 15: The Challenge of Diversity*, pp. 25–29.
- Stein, R.G. (1977) *Architecture and Energy*, Anchor/Doubleday, Garden City.

- Summit, J. (1993) Environmentalism on the high frontier: nature, technology and a sustainable future, in R.M. Feldman, G. Hardie and D.G. Saile (eds): *Proceedings of EDRA 24: Power by Design*, pp. 92–96.
- Thompson, E. (1992) On a mission to save the planet. *Guardian*, 20 May, 37.
- Tjallingii, S. (1995) *Ecopolis – Strategies for Ecologically Sound Urban Development*, Backhuys, Leiden.
- UN (1992) United Nations Rio Declaration on Environment and Development [<http://habitat.igc.org/agenda21/rio-dec.htm>].
- UNEP (2003) The Ozone Secretariat. United Nations Environmental Program [<http://www.unep.org/ozone/index-en.shtml>].
- Urbahn, M.O. (1972) An architectural credo. *AIA Journal*, January, 10.
- USGBC (2001) *Leadership in Energy and Environmental Design (LEED) Environmental Building rating System – Version 2.0*, US Green Building Council, Washington, DC.
- Wackernagel, M. and Rees, W. (1996) *Our Ecological Footprint: Reducing Human Impact on the Earth*, New Society, Gabriola Island.
- WCED (1987) *Our Common Future* [The Brundtland Report], Oxford University Press for the UN World Commission on Environment and Development, Oxford.
- Welch, L. and Spooner, N. (1982) Energy Primer Part 4: Design methodology. *Architects Journal*, 175(23), 79–84.
- Yates, A., Baldwin, R., Howard, N. and Rao, S. (1998) BREEAM 98 for offices. BRE report no. 350.