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Meeting Society and User Needs for a Built Environment

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Meeting society and user needs for a built environment

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1. Introduction

Everyone has their own specific needs from the built environment. The most basic of these is shelter – preferably healthy and safe shelter. Others look to the built environment to provide a productive environment for wealth creation and a means to move products between production point and purchaser. Others again, especially in more advanced societies, look to the built environment to provide their meeting spaces and leisure spaces.

All of these expectations have a national economic impact, also, because their consequence is that if the building sector is working efficiently, the platform for the whole nation's operations is better-established. This means that everyone, from the humblest home-dweller to the leaders of nations, has a vested interest in making sure that the quality of the built environment is appropriate for that person and time and place.

This means that most people do not just have views about the required function of the built environment. Most people have expectations about its form, too. They look, for example, for the style of housing that will suit their needs, in terms perhaps of disabled access, or of closeness to family members or transport routes or schools or workplaces. They have expectations about the extent to which the internal environment will be controlled mechanically or naturally to provide clean air, appropriate lighting levels, or acoustic separation. There are distinct expectations about appearance and its acceptable change with age of the structure, about the sizes of buildings for different purposes, about the urban planning that places the built elements in the natural environment, and increasingly about the impact on the natural environment of the building process, the built product, and the consequences of use of the built environment.

Further, there is continuing pressure for the built environment to be made 'better' – which again will have a different definition in the minds of each person. Does it mean more durable? Does it mean safer? Does it mean more cost-effective? Does it mean less impacting on the environment?

Everyone in the building and construction industry – from design, through materials supply, through the site creation process, and through maintenance for the life of the built product – therefore has a very wide range of expectations among their customers and among the users of buildings which are expected to be met.

This paper explores some of these expectations, on the part of both the individual and society. It discusses how some of these expectations are controlled by society using formal building codes and the problems that can be caused for introduction of new ideas if the code structure and implementation is wrong. The paper also examines some aspects of the impact of industry structure on the introduction of innovation to the building and construction sector.

2. The effects of globalisation

The building and construction industry is becoming more globalised, in the sense of more widespread use of the same products and procedures. Electronic communications make it easy for citizens of every country to observe what is done in other countries. This seems to be accompanied by a fairly uniform set of goals (such as summarised in Table 1) in a wide range of countries (especially in the OECD – see for example Wright et al (1995), Tupamaki (1997), and NSW Government (1997). The Egan report[1] also proposed a similar set of goals in the UK. To achieve this, customers are being more forthright in specifying what they expect from the built environment.

Table 1. Customer expectations from the building and construction sector

Target	Comment
Shorter delivery time	*Time is money both for customers - especially if normal operations have had to be disrupted to allow the construction process to take place, or if funds have to be borrowed for a project to start - and for the industry.*
Zero defects	*To achieve this will require good industry training regimes, better use of existing information, and timely recognition of the need for, and delivery of, new knowledge.*
Greater durability and flexibility	*That is, capabilities of the building/structure to continue (with appropriate maintenance) its initial performance for a long period, and to adapt to address changes in users needs, because facilities usually last for many decades.*
Lower operation, maintenance and energy costs.	*Energy efficiency is squarely on the political agenda, and we would probably see increasing legislative demand for this as a result of the Kyoto agreements even if customers were not already looking for lower costs in use. The industry has a choice of setting a target of its own, or of having one set for it by others. Increasingly, customers are examining issues of whole-life-cycle costs in their procurement decisions.*
Internal environments delivering higher comfort and user productivity.	*The annual salary costs of the occupants of a commercial or institutional building are comparable to the capital cost of the building. Improvement in productivity of staff is the most important performance characteristic for most facilities.*
Fewer building-caused illnesses and injuries to occupants	*This will contribute to the productivity target; but is also a target in its own right. Building users want designs which deliver a healthy and safe environment. Avoidance of 'sick building syndrome', and safety from fire and falls, are specific focus points.*

Many large customers are changing the relationships which they have with the industry as a means of seeking surer attainment of their expectations (Ogunlana 1999). There is often an attempt to allocate 'risk' between the parties in the building procurement process differently from the traditional ways, using 'BOOT' (build-own-operate-transfer) concepts, so that if the builder does not deliver 'zero defects', or 'low operating costs', the builder will subsequently have to bear some of the costs themselves. We also see moves to 'design and build' and value management approaches, and 'partnering' and 'approved supplier lists'.

[1] See http://www.construction.detr.gov.uk/cis/rethink/index.htm

These innovations in approach, driven from the 'demand from customers' side of the relationship in construction procurement, are certainly having an impact on industry dynamics at the major client level[1]. While these developments may not have affected the residential market so much yet, except where large State agencies are involved, They are beginning to be applied in the private sector residential field in some countries (Hansen 2000).

Despite the globalisation of products, practices, and expectations, however, there is minimal actual cross-border work by construction companies, especially at the small-scale level. Table 2 shows the total turnover and export sales of the European, Japanese and US construction sectors. There is therefore considerable competition locally between companies to win contracts by building faster, or more cost effectively, or in other ways differentiating themselves from competitors (Duncan 2000).

Table 2 - Distribution of construction activity by industries (all data in billion Euro). (FIEC 1998)

	15 European nations	US	Japan
Total turnover	702	613	590
Export total outside entity's border	26	22	7

3. Concerns about sustainability

There is a new concern which is increasingly being taken seriously, related to sustainability issues. People are increasingly recognising that there is a limit to the resources which we can apply, and that the 21st century will be a crucial time for man to find new ways to operate that can deliver sustainable development – which we should define as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'.

People also recognise that the construction sector is an underpinning element in every economy in the world, no matter how developed, and that it therefore is a key industry in which the 'sustainability' issues of energy and resource conservation must be addressed. CIB's 'Agenda 21' (CIB 1999) said that in the European Union, buildings are responsible for more than 40% of the total energy consumption, and the construction sector is estimated to generate approximately 40% of man-made wastes. There is a range of estimates – from 30 to 50% – of the amount of energy usage in OECD countries that is associated with operation of the built environment Many less-developed countries are making rapid strides toward industrialisation and their contribution to global energy use will inevitably rise. The consequences for CO_2 generation, and therefore contribution to global warming, are likely to be significant.

There are many who now believe that the global climate truly is changing, to become warmer. Several of the 20th century's warmest years occurred during the 1990s. Changes in global climate will have a number of potential local impacts – flooding due to sea level rise or changes in rainfall patterns, or structural damage due to unexpected wind storm patterns, to name two. Further, buildings which may have operated very satisfactorily under colder climates may start to become easily overheated in summer as the climate warms up.

There are regions of the world now where supplies of potable water can be assured only with difficulty. There are also concerns about the extent to which virgin forest is being cut and not replaced, and about the continued availability of some metals. So there is a strong movement sweeping the world toward 'sustainability' – toward design of built environments which use less resource, especially of water and energy (including transport energy to convey residents to their place of work), and toward more use in materials selection by the building and construction sector of the principles of 'reduce, re-use, or re-cycle'.

CIB's booklet 'Agenda 21', which sets out directions for enhancement of the knowledge base on issues of sustainability, arose from the theme 'Construction and the Environment' which CIB adopted over the period 1995-8 under the presidency of Professor Christer Sjostrom. More detailed country-by-country assessments of needs and opportunities for sustainable development are to be found in the report by CIB Working Commission 82 (Bourdeau 1998). Appropriate – and integrated – decision-making at every stage, from planning through materials selection to construction and maintenance, is essential if we are to have sustainable development.

It is relatively easy to deal with conservation of resources such as energy or water, or responsiveness to changes in climate, in the building of new buildings. But in many countries, most of the built environment which will be available for citizens' use in 2020 is already built. Dealing with the sustainability issue means dealing with retrofit and changes to existing buildings as much, if not more than, changing the buildings we begin to build now. Reliable and cost effective delivery of this retrofit is perhaps the biggest challenge facing the industry.

4. Innovation to deliver the built environment that is sought

Each type of participant in the building and construction sector faces particular barriers to the successful introduction of innovation. Seaden (1996) has written at length about the economic barriers which relate to some of these issues. The CERF conference to be held in Washington in August 2000 will look at how innovations are introduced to the industry, and CIB Task Group 35 is presently completing a state-of-the-art report on 'Innovation Systems in Construction', which will provide views from many countries on the systems by which new ideas are introduced to the sector, and the impediments to their introduction. This report will be discussed at the CIB Congress next year and at a separate conference in Canada in early June 2001.

Yet innovation is essential if those expectations of society referred to in Table 1, and regarding sustainability, are to be met. The building and construction sector <u>is</u> innovative (Duncan 2000). Virtually every country has a building code, which sets out minimum levels of performance that new buildings are expected to attain for creating and controlling change in its built environment. In most countries, the underlying rationale is for a healthy and safe environment, and issues such as life cycle cost, or aesthetics, are rarely rigidly controlled. Increasingly, issues of environmental sustainability are finding their way into building codes; many countries now have building codes requirements related to energy use, and to discharge of wastes.

If the built environment that society and users want, especially those elements defined toward the bottom of Table 1, are to be delivered, it will usually mean that the minimum requirements that are set down in the code will need to be exceeded, and that a range of other factors will need to be taken into account. Allowing the ingenuity of the industry to move beyond 'standard' deemed-to-satisfy requirements is an important tool for achieving benefits, and indeed the concept of an 'educated consumer', who knows what the actual above-minimum performance is that is desired, and demands it of the industry, is a vital concept.

Many customers (especially those who are not professional property portfolio managers) do not necessarily know what is required, and so rely on their 'expert' advisers – those they have selected to carry out the task for them. Product innovations are probably easier for customers to understand in this respect than system (or methodology) innovations, because they can see pictures of them, and ask (sometimes inappropriately, however) for them to be used. However, on many projects there is no 'customer pull' to have innovations implemented, and for many purchasers of buildings (especially for home ownership), a person will be a 'customer' few times in their lives, and have little chance to be come an 'educated consumer' by learning from experience. It is therefore important for the industry, in seeking customer satisfaction, to work closely with its customers in helping them to understand the consequences of decisions which they make.

There are often structural barriers to introducing useful innovations. One major barrier can be the building code referred to above. Another can be the nature of the industry itself.

4.1 Effects of building codes on innovation

Building codes set out to protect society from unsafe products and practices, but it is almost inevitable that delivering such safety brings a need to create a balance between allowing innovation, and preventing possible problems by minimising the use of innovative products and concepts. There are two generic approaches to building code structures – using a prescriptive basis or a performance basis. In fact, most countries use a blend of performance and prescriptive requirements.

Specifying requirements in prescriptive terms means there can be exact definition of how the built environment will be created, in terms of products and processes. This is the traditional nature of building codes. While they provided certainty of the nature of the resulting building and its performance, in most formats such codes made innovative ideas very hard to introduce except by changing the code itself.

Performance requirements define the required outcomes, and allow ingenuity to be applied to attain these outcomes. In theory they are much better, therefore, as a means of allowing innovative ideas to be applied, but in fact it may be extremely difficult to verify that a particular design will attain the requirement. Proofs usually need to be based on approved verification methods, such as particular tests or calculation methods. These verification methods are often difficult to develop, and application of verification methods to innovative systems may be too expensive unless the savings that can be attained by using the innovation are very great. Simply seeking 'equivalence' in performance to an existing known solution may be a quite unsatisfactory means of assessing an innovative solution. Long-established systems – which code systems usually do accept as meeting requirements – may significantly exceed the minimum performance that is required, and setting 'equivalence' to the old system as the standard to be met for new ideas may therefore undermine the concept of establishing a performance-based code. Thus, performance-based codes are not without difficulties of their own.

An important corollary is that the people who are administering the building controls system must be well trained, and able to respond creatively to innovative ideas. There is no point in someone devising a new means of delivering a durable, cost-efficient building which meets the requirements of Table 1, if the person who is responsible for allowing its construction to proceed is dominated by a manual of 'Approved' or 'Acceptable' or 'Deemed to satisfy' solutions. Every system must be used for a first time and, unless the 'approvals' system is extremely conservative, there will be some failures.

Therefore processes need to be in place to ensure that innovative building solutions which are not going to work are identified, and stopped in their tracks, and those solutions which have value are implemented as widely as appropriate. These administrative processes should provide efficient and easily accessible routes for ideas to be evaluated and if desirable introduced.

CIB has recognised that these issues of performance, how it is specified and how innovations to deliver improved performance are managed, are crucial for almost every country around the world. Consequently, in 1998-2001 CIB has adopted a second focus, on performance-based building. Many of the issues which are defined above will be addressed in the 15th CIB World Building Congress: Performance in Product and Practice, to be held in Wellington, New Zealand in April 2001[2]. Different streams in the Congress will address issues such as client expectations of performance and how this performance might be measured, delivery of projects by high-performance teams, and innovations to improve performance.

4.2 The effects of the nature of the industry on innovation

The issue of raising the performance of teams delivering the built environment is important. When we are considering barriers to getting new ideas applied in the industry, or even when we are looking to raise standards generally across the industry to try to attain the sorts of goals outlined in Table 1, we should not overlook the effects of the fragmentation of the building and construction industry. FIEC data (FIEC 1998) indicates an average enterprise size of 5.8 employees across 15 European countries, with some countries obviously with an even smaller average enterprise size. The same applies to many other countries outside Europe. The task of teaching the precise details of correct product use to every person – or even every enterprise – in such a fragmented structure is daunting.

Information technology may eventually provide us with the key for delivering precise instructions to the person on the building site, but we are years away from this yet. The olden-days concept of a builder who took responsibility for the realisation of the whole building using just his own team is almost gone. More often now, the builder manages a complex matrix of small contractors who are specialists in one aspect of the trade, and move on to work with other matrices as soon as their role in the project is complete. Maintaining a 'learning organisation' becomes difficult in such environments.

This second potential barrier is made worse by the fact that innovations which are more sophisticated often have less room for error in how they are used. Examples are high-performance concretes and stainless steels. These are routinely used in the building and construction sector, are more costly than the mass materials they replaced, are extremely cost-effective when used appropriately, but must be installed and maintained more carefully than the materials they replaced if they are to achieve these benefits. A decade ago there was a warning from a major building materials manufacturer in Australia (Kean 1990) about this: ""*As performance is pushed further and further out, so the need for narrower and narrower performance limits becomes critical. … As designs are pushed to the limit, quality control and maintenance become critical elements in the construction and life of the structure."* Thus as new technologies are introduced the capability is becoming limited for one person, or indeed one company, to know all the necessary information for the use of these technologies.

[2] See http://www.branz.org.nz/cib/

Another aspect of the issue is that innovation in the building and construction sector is usually incremental, which means that it is often slow to permeate the industry. (Exceptions do occur to this, especially when a change is required by a prescriptive code change – an instance where innovation can be promoted by prescriptive codes, but a path which in most jurisdictions is extremely difficult to use, and mostly only available in response to basic health and safety issues.) This slow incremental introduction is driven by a reluctance on the part of the huge majority of customers to have an 'experimental' building delivered to them. Their reluctance is justified when one considers the extent of, for example, weathertightness problems which seem to occur with supposedly established systems, let alone when an incompletely-thought-through innovative cladding system is introduced.

Most innovation in the building and construction sector is carried out in full public view. Thus, new ways of organising building sites, or of carrying out tasks, can rapidly be observed and used by competitors. There is therefore a low impetus for companies to invest their own funds in development of new techniques, as Seaden (1996) pointed out. (The same arguments may not apply to product manufacturers, who have the opportunity to develop products in some secrecy.) When coupled with the small average enterprise size, and so an inability to pay for formal research (unless there is some form of collaborative funding pool (Duncan 1994)), this reduces most firms in the sector to on-site 'innovation' which they may apply only to that one site unless there are very formalised procedures for capturing the information – which usually can be afforded only by larger construction companies.

Further, most OECD governments now regard their building and construction sector as 'mature', and invest disproportionately small fractions (compared to the impact of the sector on their GDP) of their research budgets on improvements in this sector. In many countries this funding has been falling in real terms for some years, which is changing the nature of the building research organisations (Duncan 1998). This has the capacity to increasingly over coming years, hinder the delivery of the innovations needed to meet the requirements of Table 1 on a national basis.

I am a devoted advocate of international collaboration in this sort of research, and absolutely agree that every country can learn from every other one, no matter how developed. But I am also a devoted advocate of the concept that the climate, geophysical conditions and social expectations in each country means that the ideas that come from other countries must be assessed for their local relevance before implementation in a different country from their origin. As we move through the 21st century, and as we survey the apparently declining willingness of governments to invest in research in our sector, we will need to ensure that we work cooperatively, through international bodies such as CIB and the like, to ensure that all countries are able to participate in the changes which will lead to a better built environment, and that all countries have a commitment to global sustainability.

5. Conclusion

There seems an international convergence of expectations by customers of the building and construction sector toward requirements of faster delivery of a built environment which is more cost-effective over its whole life cycle, and contributes to the concepts of a sustainable world. The building and construction sector is ready to deliver these new types of buildings, but some building code systems may create barriers to innovations being applied. Therefore, care must be taken in development and operation of code systems to ensure that they assist rather than hamper the delivery of a built environment which meets these customer needs.

The fragmentation of the industry may also create a barrier to innovations being taken up and applied throughout the industry. The many small enterprises involved makes industry education difficult, and the inability of companies to capture for themselves the 'intellectual property' of new ways of doing tasks means that research is not a strong driver for innovation on the worksite.

Networks such as CIB can work together to assist all nations to learn from the experiences in other nations, and ensure that all nations have a common knowledge base, and speed attainment of the goals that all in the world have of a better built environment.

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