Green Buildings Pay: design, productivity and ecology

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Author of books:
- ‘Green Buildings Pay’
- ‘Rough Guide to Sustainability’
- ‘Sustainable Housing’
- ‘Sustainable Architecture’
- ‘Green Architecture’
Key Questions

- What is the mix of Social, Economic and Environmental benefits with green commercial buildings
- Specifically what is the relationship between building certification, energy use, staff productivity and company performance
- What impact does certification have upon design approach, technological innovation, client expectation and user perceptions
- Are there different international approaches
Research method

- 12 primary cases (6 in USA, 3 in Denmark, 3 in UK)
- 6 secondary cases (4 in USA, 2 in UK)
- 90% commercial buildings, 10% educational
- Criteria for cases (POE, high BREEAM or LEED score, architectural quality, client feedback)
- Triangulation of data employed: **Technical** (mainly energy use); **User surveys** (POE); **Interviews** with clients and architects of cases
- 5 large architectural practices surveyed
BREEAM and LEED compared

**BREEAM**
- Main areas assessed and percentage of credits-
  - Energy (19%), Materials (12.5%), Water (6%), Land use and ecology (10%), Pollution (10%), Waste (7.5%), Transport (8%), Health and wellbeing (15%), Management (12%), (optional- Innovation 10%)
- Energy is only about a fifth of credit points
- Notice importance of health and wellbeing

**LEED**
- Main areas assessed and percentage of points
- Energy and atmosphere (24%), Sustainable sites (20%), Indoor air quality (22%), Materials and resources (18%), Water efficiency (7.5%), Innovation and design process (7.5%)
- Under 2012 LEED version energy accounts for nearly a quarter of credit points
- Notice importance of indoor air quality
BREEAM and LEED
The main cases

- **Denmark** – Ramboll HQ, VKR Holding HQ, Green Lighthouse
- **UK** - BDP offices, Wessex Water HQ, Woodlands Trust
- **USA** - Hearst Tower, Bank of America Tower, New York Times HQ, San Francisco Federal Building, Genzyme HQ, US Census Bureau, Kroon Hall, Yale University
Context and Issues

• Growth in environmental assessment and certification schemes
• BREEAM (1990), LEED (1998), DGNB (2008)
• What are the main client drivers for certification (image, life cycle costing, market advantage)
• Key Issue: Global standards or national standards (conflicts across frontiers)
• Increasing dominance of LEED and relative importance of energy credits
• Added value of ‘green’ certification- are there real or imagined benefits
• 200,000 BREEAM buildings, 40,000 LEED
User survey

• **Comfort and Control**
  1. Can you control the environment of the workplace
  2. Are the controls understandable
  3. When would you want to over-ride the BMS

• **Experiential**
  1. What do you like about the workplace environment
  2. What do you not like about it
  3. What 4 key words would you use to describe the workplace

• **Impact**
  1. Does the workplace environment give you a sense of wellbeing
  2. Does it matter where you work in the building
  3. Does the environment support your productivity, creativity or commitment

• **Score**
  What score out of 10 would you give the quality of the workplace environment
Practice survey

- 5 large architectural practices (CF Muller, Foster and Partners, BDP, SOM, HOK)
- Exploration of methods and tools used in green design and views on certification
- Focus on energy modelling tools (physical and digital)
- Parallel interviews with building clients and developers
- Scoping study via professional and practice websites
## Practice interviews

<table>
<thead>
<tr>
<th>Name</th>
<th>% of BREEAM-LEED assessors</th>
<th>Sustainable champions</th>
<th>Specialist teams</th>
<th>Green research</th>
</tr>
</thead>
<tbody>
<tr>
<td>C F Muller</td>
<td>Under 5%</td>
<td>Lone Wiggers</td>
<td>Yes via CFM template and practice Intranet</td>
<td>Case led but no formal structure</td>
</tr>
<tr>
<td>BDP</td>
<td>Under 5%</td>
<td>Richard Buckingham</td>
<td>Concept Modelling Group (CMG)</td>
<td>Case led but no formal structure</td>
</tr>
<tr>
<td>Foster + Partners</td>
<td>Under 10%</td>
<td>Stefan Behling</td>
<td>Specialist Modelling Group (SMG)</td>
<td>Yes mainly with Imperial College, London</td>
</tr>
<tr>
<td>SOM</td>
<td>Over 50%</td>
<td>various</td>
<td>Performative Design Group (PDG)</td>
<td>Yes mainly with UC Berkeley</td>
</tr>
<tr>
<td>HOK</td>
<td>Over 80%</td>
<td>Mary Ann Lazarus</td>
<td>Fully Integrated Thinking (FIT) Group</td>
<td>Yes (various) to support publication and design</td>
</tr>
</tbody>
</table>
Case example 1: Ramboll Head office, Copenhagen

- Energy performance 79 kWh/m²/yr (equivalent to BREEAM Excellent)
- 83kWh in use
- High level of staff satisfaction (8.5 out of 10)
- Key satisfaction points were daylight and indoor air quality, comfort and ease of controls (80%)
- Key words used in user survey- good communication, inspiring, motivating, calm, comfortable, democratic
- Building features most valued- atrium, views and public transport
Case example 2: BDP Office, Manchester

- High energy performance of 75kWh/m²/yr
- BREEAM Excellent
- High level of staff satisfaction 8.6 out of 10
- Annual staff turnover dropped from 21% (old building) to 11% (new building)
- Positive user comments included ease of controls, light, quality of workspace environment
- User reactions cited enhanced productivity, good image, commitment
- Negative points- noise (top floor), security, location
1. Key Findings (Clients)

- Different client types have different motives for building certification (BREEAM, LEED etc)
- Corporate HQ is main arena for certification
- Private clients leading public clients
- Different business models in USA compared to Europe and China
- Green clients are green across a broad front (not just building)
- 78% of case study clients required high certification in brief (highest in USA, then UK, lowest in Denmark)
- Example ‘British Land’ only builds BREEAM Excellent offices in London (eg Ropemaker Place)
2. Key findings (Architects)

- BREEAM, LEED certification has led to much innovation in design.
- Innovation is most marked in facade engineering, atria design and roofs.
- Certification has encouraged design practices to develop a wide range of environmental simulation tools. These are changing design approaches and solutions.
- Architects are expected to be 'green' by clients.
- BREEAM and LEED have led to integration of architectural and engineering objectives.
- Renewable energy is biggest design driver especially in emerging markets.
- Some major architects dislike growth of certification schemes.
Innovation

- Façade design (climate control driven)
- Roof design (energy design driven)
- Atria design (ventilation driven)
- Change in practice structures (specialist energy teams, research divisions)
- Software tools (energy modelling, daylight simulation etc)
Innovative facades
Innovative roofs
Innovative atria
3. Key findings (Users)

- High level of user satisfaction with certified buildings (typically around 85% as against 75% with non green offices)
- Higher the level of BREEAM/ LEED certification, higher the satisfaction level
- Users most like good indoor climate, views and green space (inside and out)
- Users acknowledge productivity benefits of green workspace
- Users like social benefits of atria (meeting and networking)
- Users like simple controls and natural materials
- ‘screen’ knowledge encourages good environmental behaviour
Typical examples of surveyed working space
Key Findings 4: Building Certification

• BREAAM started with building environmental assessment, moved to certification and now leverages innovation in energy design and related fields.

• 3 main arenas of innovation- design, construction, simulation (modelling).

• Competitiveness and international adoption of certification is raising global environmental standards.

• Trend towards ‘adaptation’ (new ways of designing) as against ‘mitigation’ (reducing impacts).

• Certification has broadened and deepened environmental awareness especially with clients (78%) and users (65%).
Current Problems

- **Clients** - buildings do not perform as well as expected. Energy use can be 1.5-2 times predicted level of consumption in spite of certification (unregulated consumption, servers, user behaviour)

- **Designers** - risks and complexity of green design. Certification is driving design solutions and leading to extra design costs and technical risks. Poor convergence of software simulation programs

- **Users** - noise is problem in open plan and around atria; ground floors and top floors are less attractive; lack of workplace control inhibits good behaviour; densification is stressing green workplaces
Future Trends (architectural practice)

• Environmental assessment is moving towards sustainability branding
• Certification matters as much (to clients) as design quality
• Certification costs are rising (typically 1% of budget)
• Growth in environmental assessment software costs
• Renewable energy is driving built form, especially in emerging economies
• Skill in accreditation and green research is migrating into architects offices
• Green innovation is seen as a company (not public) resource
• Higher the certification the deeper the innovation but the higher the design risks and costs
Future Trends (Certification)

- Global accreditation schemes can erode national characteristics. Loss of critical regionalism.
- LEED is becoming the global ‘brand’ and has led to USA practices dominating emerging markets.
- Certified buildings are much greener than under national laws – hence future practice is found here.
- In Europe there are big differences driven by different certification schemes (should there be EU standards to encourage free movement of professional services).
- BREEAM and LEED have broadened and amplified sustainability leading to much innovation and knowledge transfer.
- Altering the credit weightings has big impact on design and engineering approaches.
Future Issues

• Should building environmental certification be for life (should POE be conditional on keeping the plaque)
• How can user preferences be better understood and incorporated into certification schemes
• Can design variety exist in highly energy regulated and certified green world
• Are the design professions moving fast enough to meet client and user needs (as against technical needs)
• How can the credit points be more supportive of technological and design innovation (as against tick boxing compliance)
Conclusions 1-
Does Sustainability Pay?

• Yes but...
• Green buildings produce tangible business benefits. These benefits are improved with certification
• The benefits are found mainly in increased valuation, lower utility costs and improved user productivity
• Green offices have marketing and image appeal
• Energy cost savings are relatively small but good energy design leads to important secondary benefits with big cost-benefit consequences
• Life cycle model therefore has to consider social, economic and environmental factors, not just energy performance
• High levels of certification leads to design and technological innovation
• Where energy standards are slack (in USA, China, India) BREEAM, LEED, DGNB etc have a bigger influence than elsewhere
Conclusions 2: Life Cycle models

- Business benefits of enhanced productivity (4%) outweigh energy cost benefits of green design by a factor of about 2 to 1 (at current energy prices)
- Image (of building) and marketing (of company) through sustainable design brings big benefits (to company and community)
- Certification reinforces and amplifies the business benefits in real terms
- Energy is not the only measure (ecology and other environmental resources matter too)
- Life cycle models must include users hence POE should be conditional on certification
- The neglected user holds the key to building performance (and to company productivity)
Conclusions 3: Sustainability Pays when

\[ En + Ec + Ev \leq U(w + h + pr) + C(i + pe + r) + B(v + lcc + i) \]

Where
- **En** - energy costs and impacts (financial and otherwise)
  - Ec - ecology costs and impacts
  - Ev - environmental costs and impacts

Where **U** - User costs and benefits
  - w - wellbeing
  - h - health
  - pr - productivity

Where **C** - Company costs and benefits
  - i - image
  - pe - performance
  - r - recruitment and retention

Where **B** - Building costs and benefits
  - v - value
  - lcc - life cycle costing
  - i - innovation and design quality