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 Research Questions

• What is the mix of Social, Economic and Environmental benefits of green buildings

• Specifically what is the relationship between building certification, energy use, staff productivity and company performance

• What impact does sustainability have upon design approach, technological innovation, client expectation and user perceptions
Research method

• 12 new primary cases (6 in USA, 3 in Denmark, 3 in UK)
• 6 secondary cases (4 in USA, 2 in UK)
• Total cases 45 (since 1997)
• 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
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
The new 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
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
Context and Issues

- Growth in environmental assessment and certification schemes
- 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
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 sustainability and 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 accredited assessors</th>
<th>Sustainable champions</th>
<th>Specialist teams and methods</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 and UCL 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...</td>
</tr>
</tbody>
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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 access and indoor air quality, thermal comfort and ease of controls (80%)
- Key words used in user survey- good communication, inspiring, motivating, calm, comfortable, democratic
- Features most valued- atrium, controls, 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, daylight, 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 green
- Corporate HQ was main arena for certification (BREEAM and LEED)
- Private clients leading public clients (untill recently)
- 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 and design methods.
- Innovation is most marked in facade engineering, atria design and roofs.
- Certification has encouraged design practices to apply or develop new environmental simulation tools.
- Architects are expected to be 'green' by clients.
- Renewable energy is biggest design driver in emerging markets.
- Some major architects dislike certification schemes claiming it leads to standardisation and eats into design fees.
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
Drivers for change: Innovation

• Façade design (climate control and energy driven)
• Roof design (energy design and ecology driven)
• Atria design (air quality, daylight and ventilation driven)
• Change in practice structures (specialist teams, research divisions)
• Software tools (energy modelling, daylight simulation)
Innovative facades
Innovative roofs
Innovative atria
Typical examples of surveyed offices
Key Findings 4: Building Certification

• BREAAM-LEED started with building environmental assessment, moved to certification, then branding and now levers innovation (in design and construction)
• Adoption of certification ‘brands’ is raising global environmental standards
• Trend towards ‘adaptation’ (new ways of designing) led by BREEAM as against ‘mitigation’ (reducing impacts) led by national laws.
• Certification has broadened and deepened environmental awareness especially with clients in USA (78%) and users (65%) but less so in Europe
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 (and knowledge) inhibits good behaviour; densification is stressing green workplaces
Future Trends (architectural practice)

- Certification costs are rising (typically 1% of budget)
- Renewable energy is driving built form, especially in emerging economies
- Skill in accreditation and green research is moving into large architect practices
- 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.
- LEED is becoming the global ‘brand’ and has led to USA practices dominating emerging markets.
- Certified buildings are much greener than under national laws.
- In Europe there are big differences driven by different certification schemes (should there be EU standard to encourage free movement of professional services).
- Altering the credit weightings has big impact on design and engineering approaches.
Green schools

- 40 green schools surveyed
- 2 clusters: Hampshire and Essex
- 4% improvement in learning (SATS results)
- Less staff turnover
- Less staff absenteeism
- Better pupil behaviour
- Eco messages in curricular and to community
Conclusions 1-
How Does Sustainability Pay?

- 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 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
- Life cycle models must include **users** hence POE should be conditional on retaining certification
- The **neglected user** holds the key to building performance (and to company productivity)
Conclusions 3: Sustainability Pays when

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

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

Where U- User benefits
   w- wellbeing
   h- health
   pr- productivity

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

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