Building retrofit and financial innovation – Decarbonising the UK domestic building stock

Tina Schmieder
Welsh School of Architecture
Cardiff University, Cardiff, Wales, UK
schmiedert@cardiff.ac.uk
Presentation structure

* Introduction
* Research aim
* Research background
* Research objectives
* Context
* Proposed methods
* References
My background – business and sustainability

Experience in different industries – real estate, finance, energy sector and environmental consulting – in Germany and UK

Formerly a research assistant at Sustainability Research Institute (SRI) in Leeds, now Welsh School of Architecture (WSA) in Cardiff

EPSRC-funded PhD research – 6 months in

Closely linked to the Retrofit 2050 project
Investigate the possible transition to a decarbonisation of the UK housing stock through deep retrofitting

Research the role of finance as a barrier or enabler to domestic deep retrofitting schemes and investigate the importance of financial innovation for systemic retrofitting in the UK
UK carbon reduction target – 80% by 2050

Energy efficiency will be critical to alleviate fuel poverty, increase energy security, mitigating climate change and support economic growth (DECC 2012)

Energy-related issues translate directly to the local and domestic level with implications for lifestyles and wellbeing

Retrofit: “directed alteration of the fabric, form or systems which comprise the built environment in order to improve energy, water and waste efficiencies” (Eames 2011, p.2)

Policy could help to incentivise and finance retrofitting

Research focus - deep retrofitting of the UK domestic building stock towards emission reductions between 40% to 80% (Jones et al 2013)
Research objectives

* How has the funding barrier been overcome in other European countries, operating within the same EU policy restrictions?
* How are EU policies transposed into national policies and regional and local retrofit schemes?
* How can financial innovations support systemic retrofitting in the UK?
* Theoretical contributions to the literature on socio-technical transitions and transition management theory, as well as co-evolutionary theory
* A typology of financial innovations and assessment of applicability and translation for systemic retrofit in the UK, particularly for scaling up deep retrofits of domestic properties
Housing sector accounts for roughly 28% of the UK’s energy consumption (Palmer & Cooper 2011)

Transition to a decarbonised UK housing stock but finance is a barrier to domestic energy efficiency schemes (Stiess & Dunkelberg 2013)

Diversifying sources of finance and shifting funding models

Examples of financial innovation in other European countries (BPIE 2011)

Can deep retrofit schemes be scaled up within a low carbon transition?
Proposed methods

* Analysis of
  * financing situation in the UK through structures such as ESCo financing or government initiatives like the Green Deal.
  * European schemes to create a comparable selection of deep retrofits
  * financial innovations and their barriers, enablers and possible translation to the UK
* Lessons learned to create a typology of financing solutions
* Interviews with financiers, retrofit providers, policy makers and potentially end-users
Proposed methods (cont’d)

- Qualitative data analysis through two stages of intra and cross-case study analysis, (Eisenhardt 1989)
- Learning from socio-technical transitions and multi-level perspective (Geels 2005), co-evolutionary dimensions (Foxon 2011) and transition management theory
- Study the co-evolution between the institutions and business strategies through their landscape, regime and niche interactions
References

* Palmer, J., Cooper, I. (2011) Great Britain’s housing energy fact file (URN11D866), London: Department of Energy and Climate Change
COMPARING PLANNING POLICY & GUIDANCE

Applying Information Quality assessment in a new way
The Problem

- Anecdotal feedback, surveys and interviews confirm that:
  - “You get different information from different officers.”
  - “You get different information from different Councils.”
  - “Different solutions are allowed in different places.”

- Officers say that:
  - “We can’t control certain window and insulation issues as they are permitted development.”
  - “I would allow that.” and “I would not allow that.”
    (two officers at same Council interview)
  - “National policy does not tell you how to prioritise the issues.”
The Objective

• Compare a selection of Councils for policy and advice on energy efficiency and heritage retrofit.
• First step: to better understand what sorts of policy and advice were available.
The sample

- High proportion of buildings (non-rural).
- High amount of conservation properties.
- Similar growth pressures.

A: Camden  
B: City of London  
C: Greenwich  
D: Hackney  
E: Hammersmith and Fulham  
F: Islington  
G: Kensington and Chelsea  
H: Lambeth  
I: Lewisham  
J: Southwark  
K: Tower Hamlets  
L: Wandsworth  
M: Westminster
DeLone & McLean IS Success Model

**Information Quality:**
Features of the content; policy & guidance provided by Councils.

**System Quality:**

**Service Quality:**
Support delivered by the web hosting providers.

**Intention to Use:**
Effectiveness for retrofit seems low due to lack of information identified barrier.

**Use:**

**Net Benefits:**
Uptake of energy efficient retrofit is low.

**User Satisfaction:**
Low, users identify planning as a barrier to retrofit.
Comparative IQ (C-IQ) Development

IQ Analysis = \( \frac{IQ_1 + IQ_2 + IQ_3 + \ldots}{\text{Total Users}} \)

C-IQ Analysis = \( \frac{CIQ_1 + CIQ_2 + CIQ_3 + \ldots}{\text{Total Local IS}} \)
APPLYING THE METHOD

Getting to the good stuff
Selected IQ Model

• **User**
  - Ultimately decides if information is good or not
  - Many assessments rely solely on users to ‘score’ IQ

• **Query Process**
  - Many technical features
  - Can be independent of user and information source

• **Information Source**
  - The information itself
  - Can be measured on its own

*Figure 1: Three sources of IQ criterion scores*
# Subject/User Criteria Dimensions

<table>
<thead>
<tr>
<th>IQ Dimension</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Believability</td>
<td>Degree to which the information is accepted as correct.</td>
</tr>
<tr>
<td></td>
<td>Also: error rate, credibility, trustworthiness</td>
</tr>
<tr>
<td>Concise Representation</td>
<td>Degree to which the structure of the information matches the information itself.</td>
</tr>
<tr>
<td></td>
<td>Also: attribute granularity, occurrence, identifiability, structural consistency, appropriateness, format precision</td>
</tr>
<tr>
<td>Interpretability</td>
<td>Degree to which the information conforms to technical ability of the consumer.</td>
</tr>
<tr>
<td></td>
<td>Also: clarity of definition, simplicity</td>
</tr>
<tr>
<td>Relevancy</td>
<td>Degree to which information satisfies the users need.</td>
</tr>
<tr>
<td></td>
<td>Also: domain precision, minimum redundancy, applicability, helpfulness</td>
</tr>
<tr>
<td>Reputation</td>
<td>Degree to which the information or its source is in high standing.</td>
</tr>
<tr>
<td></td>
<td>Also: credibility</td>
</tr>
<tr>
<td>Understandability</td>
<td>Degree to which the information can be comprehended by the user</td>
</tr>
<tr>
<td></td>
<td>Also: ease of understanding</td>
</tr>
<tr>
<td>Value-Added</td>
<td>Amount of benefit the use of the information provides.</td>
</tr>
</tbody>
</table>
Concise Representation

*Degree to which the structure of the information matches the information itself.*

- Structure of information is divergent with similar information on different pages between Councils.
  - Possible implications for cross-Council or peer-to-peer communication.
- Planning and building control information generally held within one department.
  - Energy efficiency information located in up to 4 different departments (and on 4-52 pages).
## Concise Representation

<table>
<thead>
<tr>
<th></th>
<th>C-A</th>
<th>C-B</th>
<th>C-C</th>
<th>C-D</th>
<th>C-E</th>
<th>C-F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>6.7</strong></td>
<td><strong>3-11</strong></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>8.2</strong></td>
<td><strong>4-24</strong></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>7.2</strong></td>
<td><strong>4-15</strong></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>1</strong></td>
<td><strong>1</strong></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>1.9</strong></td>
<td><strong>1-4</strong></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>1</strong></td>
<td><strong>1</strong></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>19.4</strong></td>
<td><strong>4-52</strong></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>2.3</strong></td>
<td><strong>1-4</strong></td>
</tr>
</tbody>
</table>

How many pages contain information on planning policies?

How many pages contain information on planning applications?

How many pages contain information on conservation and heritage?

How many departments are the above pages located in?

How many pages contain information on building control applications?

How many departments are the above pages located in?

How many pages contain information on energy savings or energy-sustainability issues?

How many departments are the above pages located in?
Relevancy

*Degree to which information satisfies the users need.*

- Covers many aspects of the context.
- Different sets of questions developed to look at specific contextual elements.
  
  1. Information that assists with planning and building control permission/application processes.
  2. Specific information or guidance on energy efficient retrofit of conservation properties.
  3. Information regarding permitted development and the use of Article 4 directions.
  4. Linkages between planning, building control, and energy efficiency.
  5. What energy efficiency measures are identified and suggested?
Relevancy 2

Specific information or guidance on energy efficient retrofit of conservation properties.

<table>
<thead>
<tr>
<th>Relevancy</th>
<th>C-A</th>
<th>C-B</th>
<th>C-C</th>
<th>C-D</th>
<th>C-E</th>
<th>C-F</th>
<th>C-G</th>
<th>C-H</th>
<th>C-I</th>
<th>C-J</th>
<th>C-K</th>
<th>C-L</th>
<th>C-M</th>
<th>Mean/ % Rating</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Is specific information/ guidance provided on energy efficient retrofit for heritage buildings?</td>
<td>Y</td>
<td>P&lt;sup&gt;a&lt;/sup&gt;</td>
<td>N</td>
<td>P&lt;sup&gt;b&lt;/sup&gt;</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>38%</td>
</tr>
<tr>
<td></td>
<td>&lt;sup&gt;a&lt;/sup&gt; Provides an advice note on window replacement including historic windows. Weighted rating .5</td>
<td>&lt;sup&gt;b&lt;/sup&gt; Provides an information sheet on works to window and doors in CAs. Weighted rating .5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Are external sources used for advice on what is appropriate for heritage properties?</td>
<td>Y</td>
<td>Y</td>
<td>P&lt;sup&gt;c&lt;/sup&gt;</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>P&lt;sup&gt;d&lt;/sup&gt;</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>77%</td>
</tr>
<tr>
<td></td>
<td>&lt;sup&gt;c&lt;/sup&gt; For CAs only. Weighted rating .7</td>
<td>&lt;sup&gt;d&lt;/sup&gt; Link only to Planning Portal regarding Article 4 permitted development. Weighted rating .3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>How many external sites do they link to?</td>
<td>8</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>10</td>
<td>6</td>
<td>0</td>
<td>7</td>
<td>1</td>
<td>1</td>
<td>2.9</td>
</tr>
<tr>
<td></td>
<td>Sites and number of Councils linked: English Heritage (10), 20&lt;sup&gt;th&lt;/sup&gt; Century Society (4), Georgian Group (4), SPAB (4), Victorian Society (4), Buildingconservation.com (2), NPPF (2), British History Online (1), Conservation Directory (1), HELM (1), Idea Store (1), Planning Portal (1), RAABC (1), RIBA (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Is information provided on the conflict between energy efficient improvements and heritage?</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>38%</td>
</tr>
<tr>
<td>19</td>
<td>Does the Council encourage contacting a planning officer for help with energy efficiency improvements?</td>
<td>Y</td>
<td>P&lt;sup&gt;e&lt;/sup&gt;</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>42%</td>
</tr>
<tr>
<td></td>
<td>&lt;sup&gt;e&lt;/sup&gt; Only in the advice note for window replacement. Weighted rating .5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Assessment

Consistency

• An authoritative source
• Communicating with diverse stakeholders
• Planning and building control application information
• Use of the Planning Portal
• Use of Article 4 Directions
• Lack of connectivity between planning, building control and energy efficiency

Divergence

• Promotion of retrofit measures
• Specific information on permitted development
• Encouragement to contact an officer
• Organization and presentation of information
• Location of energy efficiency information and no. of pages
IMPLICATIONS

So what?
Applied C-IQ Assessment

- Evidence that information is not being delivered in a consistent manner.
  - Reproducible
  - Expandable
- Learning to be gained from longer established systems
  - Planning and building control applications
- Learning to be gained from use of National guidance
  - Use of the Planning Portal
  - In conflict with localism?
Comparative IQ Assessment

• A new way to systematically investigate, articulate, and address the qualities of information that is disseminated in a complex IS.
• Requires more research use to refine the technique.
• Wide reaching potential beyond this application.
Value & Limitations of the Research

• Provide ability to move conversation from accusatory to productive.
  • Provide a method to further examine these questions.
• Difficult to test hypotheses as it requires coordination and agreement between multiple independent entities.
• Energy efficiency is a wicked problem.
  • Every barrier has significance and addressing no one barrier will ‘fix’ it!
THANK YOU!

Have a cookie.
Development of guidelines for improving production management of refurbishment projects

Sergio Kemmer
PhD Researcher | School of the Built Environment

Lauri Koskela (supervisor)
Professor in Theory Based Lean Project and Production Management | School of the Built Environment
Definition of refurbishment

“Refurbishment refers to such works as improvements, adaptation, upgrading, rehabilitation, restoration, modernization, conversion, retrofit, and repair which are carried out on existing buildings for a variety of reasons.” (Egbu et al., 1998)
A missing link in the refurbishment’s research agenda

- Researches are not addressing the issues regarding the management of refurbishment works
  - The production management methods usually applied are not appropriate to cope with the complex environment inherent to refurbishment projects
  - Waste has not been addressed properly

- Refurbishment projects still suffering from the same old problems
  - Cost overruns
  - Long lead times (low productivity)
  - Wastes (rework, waiting time, disruptions on site, double handling, space conflicts, etc.)
  - Tenant’s annoyance
On what foundation does my claim rest?

The production management of refurbishment projects needs an appropriate approach, specifically tailored and in line with lean tenets, to be able to cope with the complexity and uncertainty inherent to those projects.

Lean is the way forward
  - Transformation, flow, and value
  - Better approach regarding waste
  - Appropriate methods, tools, and techniques
Research Questions

Main question

- How to improve the production performance of refurbishment projects?

Secondary questions

- What makes production management of refurbishment projects different from the management of new build projects?
- What are the current methods adopted by companies for managing production of refurbishment projects?
- What are the typical problems encountered in the production phase of refurbishment projects?
- What are the managerial solutions suitable for managing production of the different types of refurbishment projects?
Aim and Objectives

Aim

- Develop guidelines for improving production management of refurbishment projects

Objectives

- Develop a method to characterize refurbishment projects with regards to the production management
- Identify what solutions are best for managing production of refurbishment projects as well as identifying enablers and barriers for practical adoption
- Implement the guidelines in real cases in order to assess their practical usefulness
Lean solutions

- Value Stream Mapping (1)
- Target Value Design (2)
- Production System Design (3)
- Last Planner System™ (4)
- Line of balance (5)
- Visual Management (6)
- Cellular Manufacturing (7)
- Multiskilling (8)
- Prefabrication / Standardisation (9)
- Mass customisation (10)
- Benchmarking (11)

Types of refurbishment projects

- Houses
- Flats
  - Converted
  - Low rise
  - High rise
- Hospitals
- Offices
- Department stores
- Building’s components
  (e.g. roof, pipes, facades, windows, etc.)
## Primary components of the study and their linkages

<table>
<thead>
<tr>
<th>Research question</th>
<th>Case Study Findings</th>
<th>Recommendations (Guidelines for improvements)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Houses</td>
<td>Banks</td>
</tr>
<tr>
<td>Project characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Managerial methods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Typical Problems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Candidate Solutions</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Research Strategy

Phase 1 (literature review / exploratory case studies)
- Understanding the refurbishment process
- Identify what are the typical problems encountered in the production
- Identify what are the current managerial practices adopted by construction companies for managing production
- Characterise the potential refurbishment projects for the implementation phase
- Identify solutions to be adopted in the selected projects
- Define indicators to assess the production performance
- Developing the guidelines for improving production management (initial version)

Phase 2 (in-depth case studies)
- Implement the solutions in the selected projects
- Assess the effectiveness of these solutions
- Devise guidelines for improving production management of refurbishment projects