ACHIEVING LOW CARBON SOCIAL HOUSING THROUGH INNOVATION

KEITH JONES[i1], APEKSHA DESAI[1] and YAMUNA KALUARACHCHI[2]

[1] SCHOOL OF ARCHITECTURE, DESIGN AND CONSTRUCTION, UNIVERSITY OF GREENWICH, AVERY HILL CAMPUS, MANSION SITE, BEXLEY ROAD, ELTHAM, LONDON, SE9 2PQ, UK.
[2] SCHOOL OF SURVEYING & PLANNING, KINGSTON UNIVERSITY, KNIGHTS PARK, KINGSTON, KT1 2QJ, LONDON, UK.

Achieving a low carbon future continues to be one of the most challenging issues facing today's built environment professionals. While significant advances have been made in the area of new build, the same cannot be said for the existing housing stock. In the UK 70% of the housing that will exist in 2050 has already been built. If the UK is to have any chance of meeting its 2050 carbon reduction targets, effective refurbishment strategies that significantly reduce the carbon footprint of existing housing need to be developed. However, whilst it is generally acknowledged that retrofit to existing buildings is more complicated than new build, the issues that need to be addressed are not primarily technical, but organisational and managerial. The combination of attitudes towards risk and awareness of innovative solutions result in organisational barriers to the wide uptake of low/zero carbon technologies.
This paper presents the findings of a research study into the level of perceived organisational sustainability and factors that influence refurbishment decision making amongst 57 UK social housing providers. It identifies a range of maturity indicators from Initiation, through Contagion and Control, to Maturity that can be used to distinguish between approaches to sustainable refurbishment. A research questionnaire was used to establish the level of maturity (in the sustainability innovation context) and decision making characteristics of the responding organisation along with their experiences of sustainable refurbishment of their housing stock. The paper identifies a range of organisational characteristics and maps these against the organisation's position along a "general" innovation journey through an S curve maturity model. The paper identifies a shift from national level drivers and barriers to local level interpretation of the wider sustainability agenda as the key differences between Initiator and Mature organisations. The paper concludes that it is possible to profile UK social housing providers and develop management instruments to accelerate their journey along the sustainable innovation curve. This in turn will accelerate the uptake of sustainable refurbishment programmes.

Keywords: sustainability, housing, refurbishment, existing stock, innovation, low carbon housing

INTRODUCTION

The UK housing stock comprises approximately 21,333,000 dwellings of which 14,537,000 are privately owned, 3,159,000 are private rented and 3,637,000 are social housing (DCLG 2011). It is considered to be inefficient (as measured through the Standard Assessment Procedure) and, despite improvements to its thermal insulation over the past 35 years, achieving a meaningful reduction in associated CO_2 emissions will require the greater uptake of innovative technologies (BRE 2008). Further, given the low rate of demolition and new build, approximately 70% of the dwellings that will exist in 2050 have already been built (SDC 2006). As such, if the UK Government is to reach its stated 80% reduction in CO_2 emissions by 2050 (Climate Change Act 2008) it will have to do so by addressing the contribution that existing housing makes. Whilst it is generally accepted that retro-fitting low or zero carbon (LZC) solutions to existing buildings is more complicated than installing them in 'New Build', these complications are largely socio-economic rather than technical (Broadman 2007). Whilst it is true that certain LZC technologies require consequential changes to be made to the building fabric or services (e.g. ground source heat pumps) these changes are not beyond our current technological abilities. More importantly it is the potential impact that retro-fitting LZC technologies have on the economic and social well-being of the occupant, and for private and public rented accommodation, on the landlord organisation where there is a disjuncture between who pays for, and who benefits from, LZC technologies, that is the real barrier to widespread uptake. Thus, understanding these barriers and identifying suitable drivers that can overcome them is essential if the UK housing sector is to have any chance of reducing its CO_2 emissions in line with Government targets.

In the owner occupied sector the UK Government has identified initial cost of procuring and installing LZCs as the major barrier to their uptake and has developed the 'Green Deal' as a fiscal driver to overcome it (DECC 2010). The Green Deal will allow home-owners to off-set the initial costs against a long term payback through an increased tariff on their energy bills. The initial funding for the LZCs will be provided by third-party organisations (at the time of writing it is unclear exactly who will constitute a third-party organisation,

i. k.g.jones@greenwich.ac.uk

but the expectation is that energy supply companies and high street retailers will provide the majority of funding) who will then receive a return on their investment through increased meter tariffs. Homeowners will be able to use the energy they generate and sell any surplus back to the grid and, as such, they should see a decrease in real terms in their fuel bills. This latter scenario however will only be realised if the energy generated reduces fuel bills by more than the increased tariff. This condition is known as the 'Golden Rule' and an initial assessment needs to be made by the home owner as to whether their particular house satisfies this rule (ibid).

Whilst the Green Deal was initially intended for the owner-occupier sector, it could also prove attractive for social sector landlords. In the social sector, whilst initial costs are seen as a barrier to LZC refurbishment they are not the only issues that landlords consider when making refurbishment decisions. Attitudes to innovation and risk, impact on tenants' quality of life (both during the refurbishment period and over the operational lifecycle), return on investment, legislation and knowledge/skills have all been identified as barriers to the uptake of LZC technologies (Kaluarachchi & Jones 2008). However, these barriers are not consistent across public sector landlords with a number of landlords delivering ambitious LZC refurbishment projects whilst others undertake only minimal projects to satisfy basic legislation.

The project reported in this paper explored the reasons for these different approaches. The aim of the project was to explore the decision making process for sustainable refurbishment in the UK social housing sector. In particular the project sought to: understand the role that sustainability played in refurbishment decision making; identify the drivers and barriers to sustainable refurbishment; and relate these drivers and barriers to other influencing factors in the refurbishment decision making process.

The research identified a series of organisational characteristics that were associated with an organisation's position along the innovation journey from which management interventions could be developed to help accelerate the uptake of LZC technologies in the UK social housing sector. The project formed part of a much bigger multi-disciplinary Sustainable Urban Environment project which examined the role of Innovation in the Design, Construction and Operation of buildings for People (IDCOP) funded by the UK Engineering and Physical Sciences Research Council.

THE INNOVATION JOURNEY

There are numerous theories that seek to explain the innovation process. The Carbon Trust Business Model of innovation identifies four parallel journeys (technology, company, market and regulation) that must be completed if LZC solutions are to be effectively integrated into organisations. At each stage of these journeys, barriers need to be overcome before the journey can continue. As such, achieving successful innovation is a complex mix of competing activities where a step forward in one journey often requires a preceding step forward in a parallel journey (Carbon Trust 2008).

Rogers (2003) examined the factors that governed the uptake of innovation, identifying: the degree of relative advantage; compatibility with existing values and practices; simplicity and ease of use; trialability; and observable results as key drivers that influence the speed of uptake of innovative solutions. Rogers (2003) also identified five different population segments (innovators, early adopters, early majority, late majority and laggards) and suggested that an innovation would need to appeal to generic characteristics of those in each segment if it was to achieve a wide uptake (Robinson 2009). Earl (1989) applied a similar approach to Rogers (2003) when he investigated the uptake of Information Technology in data processing organisations.

Earl (1989) identified a multiple S curve model to describe uptake of the then innovative technology, attributing positions along the S curve to stages of organisational maturity (Initiation, Contagion, Control and Maturity). By observing organisational characteristics at each stage of the S curve Earl (1989) identified operational and strategic policies and management orientations that governed the degree to which IT had effectively been integrated into the business. Where Earl's (1989) view differs from Roger's (2003) is that Earl suggests an organisation can move through each stage of the maturity curve whereas Rogers argued that an individual is pre-disposed to be in a specific stage. As such Earl (1989) argued that that management intervention could be used as a driver to accelerate the innovation journey. Finally, Hinks et al (2007) applied the S curve model to facilities management, using it to distinguish between sustaining and disruptive innovation.

Hinks et al. (2007) argued that if innovation follows a continuous S curve (sustaining innovation) then it can only produce innovation that is incremental on what has gone before. As an innovation reaches the end of the S curve journey then the ability of the next incremental improvement to deliver meaningful advantage will diminish and as such its uptake rate will decline. At some point a

step change will be required (disruptive innovation) if continuous improvement is to be maintained. At this point innovation 'jumps' from one journey (sustaining) to another journey (disruptive) and the S curve cycle starts again. These theories were combined in this project to investigate the uptake of sustainable technologies in the refurbishment of UK social housing.

METHODOLOGY

A questionnaire survey was undertaken in 2008 to identify the role that innovative technologies and processes played in the sustainable refurbishment of UK social housing. The questionnaire, which was sent to Chief Executive Officers of Registered Social Landlords and Heads of Estates for Local Authorities, examined the barriers and drivers to sustainable refurbishment projects and related these to organisational characteristics and management attributes. In particular the questionnaire sought to measure level of organisational maturity (as far as sustainability was concerned) and establish whether this was an appropriate tool for profiling the effectiveness of sustainable (refurbishment) built asset management. To this end organisations were asked to indicate where they believed they were located on an innovation S curve (Figure 1). As a guide, qualitative statements were attached to each stage of the S curve.

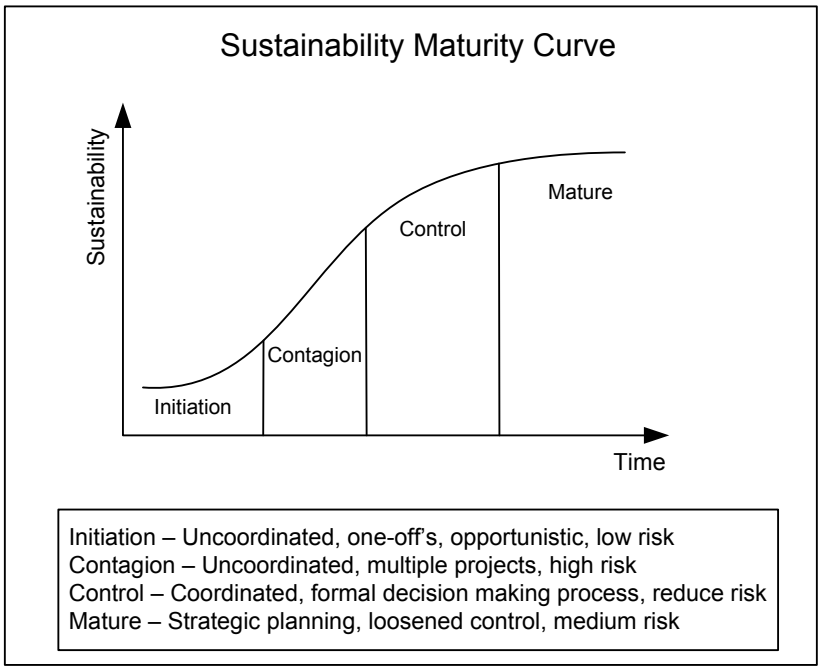

Figure 1: Sustainability Maturity Curve

The questionnaire comprised 15 questions covering: interpretation of the sustainability agenda; formal policies and business procedures; perceived drivers and barriers to sustainable refurbishment; and the decision making process / business case for action. A total of 500 questionnaires were distributed and 57 responses were received, representing the response rate of 11.4 %.

RESULTS

Of the 57 respondents, 17 placed themselves at the Initiation Stage; 20 at the Contagion Stage; 14 at the Control Stage and 2 at the Mature Stage. Four respondents avoided answering this question and they have been excluded from the analysis presented in this paper.

MEANING OF SUSTAINABILITY

Respondents were asked a series of questions about their understanding of sustainability and the relative importance that they believed each attribute should contribute towards a sustainability assessment. All respondents identified that sustainability was about balancing environmental, social and economic performance of their housing stock, but the relative importance that they attached to each attribute varied depending on where they placed themselves on the sustainability maturity curve.

Those at the Initiation Stage tended to rate each attribute as of equal importance (environmental – 34%; social – 33%; economic – 35% in levels of importance) when assessing whether a solution was sustainable, whilst those at the Contagion and Control Stages placed more importance on economic (39% and 31% respectively) and social (38% at both stages) attributes. Those at the Mature Stage had the most unequal balance between the attributes, rating environmental attributes lowest (20%) and social attributes highest (45%).

THE ROLE OF SUSTAINABILITY POLICIES

Eighty-seven percent of respondents had a formal sustainability policy within their organisation. Of those that didn't, all placed themselves as at the Initiation or very early Contagion Stage of the sustainability maturity curve. Although a few respondents had had a policy for many years, the majority had implemented their policy between 2006 and 2008. Whilst all the distributions followed a similar pattern (no pattern can be determined for Mature organisations due to low numbers) the distributions for both Contagion and Control Stages appeared offset to the Initiation Stage suggesting a possible relationship between time and level of maturity. However, the shift was not as pronounced as expected and as such could indicate that factors other than time were affecting levels of maturity.

THE ROLE OF STRATEGIES AND POLICIES

Of those organisations that had a sustainability policy, 19.3% ranked it as 'very important' and 24.6% as 'moderately important' when making decisions about refurbishment options. This was particularly true of those organisations that placed themselves at the Initiation Stage of the sustainability maturity curve who tended to use their sustainability policy as the most important decision making criterion whereas those at the Contagion and Control Stages took a more balanced view, considering their sustainability policy alongside other policies and strategies.

Those organisations that classed themselves as Mature used a range of policies and strategies of roughly equal importance when making refurbishment decisions. For those organisations where the sustainability policy was not the primary driver: legislation; tenant satisfaction; and the overall business case were all identified as either equally, or more important, than the sustainability policy when making refurbishment decisions. Other factors identified as important when funding refurbishment programs included: lifecycle analysis; commercial return; available finance and environmental impact (note: this was free text data and, as such, relative importance between the factors cannot be determined).

DRIVERS AND BARRIERS FOR SUSTAINABLE REFURBISHMENT

Respondents were asked to indicate which of nine potential drivers and ten potential barriers (listed in the questionnaire) they believed were relevant to their refurbishment decisions and to rank these in priority order. The most important drivers were: tenant satisfaction (20.5%); government policy (20%); available funding/business support (13.9%); legislative support (9.4%); and education/knowledge (9.4%).

With regards to the barriers for sustainable refurbishment: lack of funding [17.7%]; high initial capital cost [17.3%]; long payback periods [13.8%]; value for money [12.1%]; fear of risk [8.3%]; and lack of knowledge [8.3%] were perceived as major barriers. An analysis of the drivers and barriers across the maturity stages (Table 1) shows variations in the relative importance of each attribute at each stage. With regards to the drivers, the further along the sustainability maturity curve an organisation is, the more important locally focused drivers become. Whilst a similar trend can be seen for the barriers, access to funding was an issue for all respondents.

Table 1: Drivers and Barriers to Sustainable Refurbishment

Stage	Drivers (1 – most important)	Barriers (1 – most important)
Initiation	1. Government policy; 2. Funding support; 3. Tenant satisfaction; 4. Legislation.	1. Capital cost; 2. Lack of funding; 3. Legislation; 4. Long payback periods
Contagion	1. Government policies; 2. Tenant satisfaction; 3. Funding support.	1. Lack of funding; 2. Capital cost; 3. Long payback periods; 4. Value for money; 5. Fear of risks.
Control	1. Tenant satisfaction; 2. Government policies; 3. Organisational hierarchy; 4. Funding support; 5. Legislation.	1. Lack of funding; 2. Capital costs; 3. Value for money; 4. Lack of knowledge.
Maturity	1. Tenant satisfaction; 2. Other – Life cycle performance; 3. Government policy.	1. Capital cost, value for money; 2. Funding; 3. Long payback periods.

GOVERNING FACTORS FOR SUSTAINABLE REFURBISHMENT

Respondents were asked to identify the governing factors that determined the level of sustainable refurbishment that they believed was required (Table 2). Eighty percent of respondents identified the state of their housing stock followed by organisational leadership (56%), return on investment (56%), tenant buy-in (52%), and confidence in the solution (52%) as the most important factors when identifying which sustainable refurbishment projects to undertake. Whilst this pattern is similar at all stages of the sustainability maturity curve it appears more pronounced amongst mature organisations, where a combination of local and community issues, rather than organisational issues, govern their decision making.

Table 2: Governing Factors Affecting Sustainable Refurbishment

	INITIATION	CONTAGION	CONTROL	MATURE
Deprivation	23%	35%	56%	50%
Housing state	69%	82%	89%	100%
Confidence	54%	53%	56	0
Legislative support	38%	18%	50%	0
Tenant buy-in	38%	47%	67%	50%
Organisational focus	62%	41%	72%	0
Return on investment	77%	47%	50%	0

DECISION-MAKING PROCESS

The final section of the questionnaire sought to identify differences in the decision-making hierarchy or implementation routes between organisations at different stages of the sustainability maturity curve (Table 3). It appears that, whilst many management and decision making attributes are common to all respondents, the degree to which they influence sustainable refurbishment decisions varies.

At the Initiation, Contagion and Mature Stages decision-making is devolved and reporting/monitoring is relaxed. At the Control Stage, management approaches are more prescriptive and reporting more formal.

Table 3: Management Systems for Sustainable Refurbishment

Stage	Decision making process
Initiation	Organisations at the lowest level of the Initiation Stage had no executive manager responsible for overall delivery of sustainable refurbishment.
Contagion	Organisations in the Contagion Stage had: overall responsibility for sustainable refurbishment located at the executive level: a short development time between board level decisions and local implementation: based their decisions on the outcomes of a stock condition process: a long term plan and vision for their housing.
Control	Organisations at the lower end of the Control Stage had: begun to devolve responsibility for decisions to lower-level technical managers; developed specific procurement routes for innovative technologies; begun to involve tenants in decision making; a semi structured option appraisal process in place to distinguish priorities. Organisations at the midrange of the Control Stage had: devolved decision making to mid-management teams with formal reporting mechanisms back to senior management; a consistent decision making process with formalized procedures (e.g. lifecycle analyses); an agreed annual program for sustainable refurbishment activities. Organisations at the top end of the Control Stage had: fully devolved decision making to the operational level with formal reporting mechanisms to senior management and board level staff; engaged tenants in most phases of the decision making process; initial feasibility assessments that identified key performance indicators and formalized progress monitoring; some level of end of project review.
Maturity	Organisations in the Mature Stage had: a senior-level manager responsible for the overall delivery of the sustainability activities; devolved operational issues to operational teams; a short period between strategic decisions and on-site implementation; high levels of tenant involvement throughout the process; individual project monitoring against a long term asset management plans.

DISCUSSION

A detailed questionnaire survey of 53 UK-based social housing landlords identified a number of organisational and managerial characteristics that differentiated landlords' attitudes and approaches to sustainable refurbishment. These characteristics are summarized in Table 4.

Those organisations at the Initiation Stage of the sustainability maturity curve sought to achieve an equal balance between the three sustainability attributes, relying heavily on national drivers and organisational aspirations to identify sustainable refurbishment options. Decisions on whether to include sustainability in a refurbishment project were primarily tactical, with little senior management or tenant involvement. No systematic monitoring of the performance of the sustainable refurbishment was undertaken and no long-term strategies or plans existed.

Those organisations at the Contagion Stage of the sustainability maturity curve placed high importance on the economic and social attributes of sustainability (compared to the environmental attribute), but were still largely governed by national drivers and organisational focus when making sustainable refurbishment decisions. Management of projects tended to be at the executive level with some monitoring of post project performance being undertaken against embryonic long term plans. There was some tenant involvement in the decision making process.

Those organisations at the Control Stage of the sustainability maturity curve placed high importance on social and environmental attributes of sustainability (compared to the economic attribute) when making sustainable refurbishment decisions. Long term sustainability plans had been developed and decisions about which projects to pursue were beginning to be devolved to local managers. Multiple policy drivers, including local drivers, tended to inform the decision making process and formal reporting mechanisms were in place to monitor project performance. Increased tenant involvement, particularly initiatives for tenant buy-in, was considered important.

Those organisations at the Mature Stage of the sustainability maturity curve placed highest importance on the social attribute of sustainability (compared to economic and environmental attributes) and although they had a formal sustainability policy in place, this tended to be only one of a number of policies that they used to inform their sustainable refurbishment decisions. In interpreting the social needs of their tenants, these landlords demonstrated a community focus with long term strategic objectives informed by tenant involvement at all stages of the sustainable refurbishment decision making process. Their vision was strategic and their monitoring was against long-term benchmarks.

Table 4: Management Characteristics Associated With Each Stage of the Sustainability Maturity Curve

Characteristic	Initiation	Contagion	Control	Mature
Balance of sustainability attributes	Equal	Economic/ Social	Social/ Environmental	Social
Sustainability Policy	x	✓	✓	✓
Importance of sustainability policy	Higher ----------Lower			
Drivers	National ----------Local			
Barriers	National ----------Local			
Governing factors	Organisation focus ----------Community focus			
Decision making	Tactical	Executive	Devolved	Strategic
Monitoring	None	Limited	Formal (short term)	Formal (Long term)
Tenant involvement	None ----------High			
Long term plans	None ----------Strategic			

CONCLUSIONS

Whilst the findings in this paper suggest that the uptake of sustainable technology can be understood by the use of innovation theory, the relatively low response rate and the UK focus of the study would need to be taken into account before generalised conclusions

can be drawn. This said however, from the results of the questionnaire survey it does appear possible to differentiate management characteristics of UK social landlords in their attitudes toward sustainable refurbishment depending upon their position along the sustainability maturity curve. Initially, an organisations uptake of sustainable innovative technology is governed by ad hoc decisions made against national level drivers. There is little strategic focus and no long-term evaluation of the performance of the technology in use. There is also no tenant involvement in decision-making. As organisations become more familiar with sustainable innovative technology their decision making process evolves. At this stage organisations have a formal sustainability policy which differentiates between the level of importance of the economic, social and environmental drivers. The decision making is focused towards local needs and solutions informed by tenants and the community. Formal monitoring of the performance of the technology is made against long term plans. Organisations that are experienced users of innovative sustainable technology demonstrate a maturity of decision making in which decisions are made against long term strategic objectives, informed by tenants' and community needs, and not driven by national edict or organisational imperative. As such, it is possible for an organisation to identify where it is on the sustainability maturity curve and develop appropriate interventions that could accelerate their journey from their current position to a more mature status. Given the current low-level of sustainable housing refurbishment in the UK this should increase the speed of uptake of innovative technologies and support the UK in achieving lower carbon emissions associated with the social housing sector. In this way UK social landlords will truly benefit from their investment in LZC technologies. This said, the existence of barriers, particularly financial, cannot be underestimated and a solution to provide access to funding is needed alongside management interventions. The Green Deal, if effectively applied to social landlords, could provide such fiscal stimulus.

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