Managing behavioral risks in large-scale social housing sustainable retrofit projects in the UK

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Abstract
The delivery of sustainable retrofit programmes in the UK social housing sector is gathering pace, driven by emerging policies such as the Green Deal and the Energy Company Obligation. However, there is a real danger that the implementation of sustainable energy efficiency improvements to people's homes does not take account of the many behavioural issues that impact both adoption of improvements and how occupants use them. Adoption factors ranging from basic issues such as inconvenience and disruption to more complex issues of social norms, trust and stories, all have a capacity to derail construction programmes through refusal. In addition, in-use factors drive both the fundamental benefits of the improvement project, as well as feeding back into the wider retrofit adoption decisions of communities. Here we present a model, developed by the University of Salford and Fusion21 as part of a Knowledge Transfer Partnership project, that incorporates both research findings and UK social housing practice to develop a tool to help project teams manage behavioural risk in the pre-delivery, construction and post-occupancy phases of a sustainable retrofit project. The model considers not only behavioural factors of the residents, but also the capabilities of the delivery teams and the pragmatics of resource and project management. This paper discusses the development of the model and some of the feedback from the initial pilot stages.

Introduction
The UK social housing sector is responsible for the management of approximately 18 % of the UK's total housing stock, which currently stands at approximately 26 million units (Davis and Osmani 2011). The social housing sector has been used as a test bed for the deployment of sustainable retrofit projects, where properties fabric, systems or controls are upgraded to improve their environmental performance (Kelly 2009, Bell and Lowe 2000). While this can give us a change in the designed performance, typically through models such as the Standard Assessment Procedure (SAP), the identified gap between the actual and projected performance is well documented in the UK (Wetherell and Hawkes 2011). While some of this might be associated with build quality or the design and specification of systems, there is a growing evidence-base that human behaviour can drive a large degree of this difference (Summerfield et al 2010). When we consider that individual residents do have the right to refuse improvements, the risks of non-adoption also need to be addressed, if the UK's policy objectives are to be met.

The social housing sector has many benefits in terms of large-scale deployment when compared with the private rented or owner-occupied sectors. Professional decision-making and project management, access to funding and grants, and the ability to deliver at scale, all make the social housing sector more amenable to the delivery of large-scale retrofit projects (Jenkins 2010). However, there is a growing evidence-base that many of these projects are not achieving their targets in terms of projected energy savings (Worthing Homes 2010). These project failings are often driven by behavioural factors that mean social housing residents either do not adopt sustainable retrofit, or if they do, they do not use the improvements effectively. There are a number of sustainable retrofit projects in the social housing sector being and to be undertaken in the UK through the Community Energy Savings Programme (CESP) and its replacement the Energy Company Obligation (ECO), UK Government funded programmes delivered through the energy companies. These projects will need effective management if they are to meet their objectives of reducing carbon emissions and addressing fuel poverty in the UK social housing sector and, given the potential impact of behavioural issues to impact both take up and actual energy use, these factors must be part of the core project management activities.

In order to address this issue, the University of Salford and Fusion21, a social enterprise delivering services to social housing, developed a tool to effectively identify and manage risk within sustainable retrofit projects. The tool took a construction management perspective to identify and intervene against different types of behavioural risks that might affect a project. The project was developed with the support of a working group of professional social housing providers with a specific interest in energy and behaviour.

Risk management is a fact of life for construction projects. Working in uncontrolled environments means that there is a constant management of financial, project, health and safety and environmental risks (Akintoye and MacLoed 1997). These are common to almost all construction projects. Sustainable retrofit presents us with a form of risk that, while addressed by professionals who deal with residents on a day-to-day basis, is often ignored by construction professionals who scope and deliver large-scale sustainable retrofit projects. This is often because the skills do not exist to effectively identify, quantify and manage these types of risks. The literature identifies that sustainable retrofit installations fail due to "people factors", but construction professionals do not have formalised tools and processes to manage this risk in the same way they might manage health and safety risks, for example. In addition, the cost associated with the effective management or mitigation of the risk is only rarely quantified. A recent study in UK social housing where an attempt was made to quantify engagement with residents priced it at €550–€1,750 per resident. When compared with retrofit costs ranging from €7,500–€30,000 per property, we can see that these engagement costs are a significant proportion of overall project budgets (Affinity Sutton 2012).

The management of behavioural risk requires us to recognise the potential impact that behavioural issues can have on a project. The first step is to widen out the conception of the project's objectives. Considering carbon dioxide emissions and the reduction of fuel poverty as core project objectives opens up the view of value beyond the construction project, understanding how the sustainable retrofit project needs to address the long-term objectives of all the stakeholders, rather than just considering project delivery factors. The major risks with residents are non-adoption and in-use issues with sustainable retrofit, as well as managing significant relationship hazards at the delivery stage. Non-adoption will mean that reductions in energy use will not occur, as well as impacting the financial viability of the project. In-use factors may have an impact on the performance outcomes of the sustainable retrofit, leading to lower than expected improvements in energy use. These behavioural factors might range from simple issues such as an unwillingness to clear a room in a property to allow work to take place driven by apathy, to more complex issues relating to trust between the parties involved in the project. Finally, we consider the management process that takes this basic risk management model into a more complex process to reduce the impact of behavioural risk on sustainable retrofit projects.

Risk Management

The model developed by Fusion21 and the University of Salford can be viewed as a risk management process. Risk management in construction projects is concerned with the management of uncertain factors that can adversely affect project or wider business outcomes for stakeholders. Risks can be viewed in the context as how they might affect these outcomes. There are a number of risk management processes that address the basic process; here we consider a basic model as identified in Raz and Michael (2001). The model is essentially a four-stage process: identification of risk, analysis of risk, control of risk and reporting.

When we want to consider risk, we need to consider the risk to what? In a study by Akintoye and MacLoed (1997) construction project managers were asked to identify risk factors. These factors focused on risks to critical project and corporate outcomes, or critical success factors, as identified from the contractor perspective. This is a narrow view of how project value can be perceived, focused on project delivery and business issues as directly affect construction companies. A study of client and project team objective setting in the construction industry across a mixture of collaborative new build and infrastructure projects (Swan 2007) identified a broader range of objectives as defined by the project team and wider project owners, such as funders. This perspective considered wider project "critical success factors", which included issues such as sustainability, in terms of environmental and local economic factors, behavioural issues in project teams and the satisfaction of end users. By extending the stakeholder group beyond the core project delivery team, the project objectives were shifted (Olander 2007) beyond the outcomes for the contractor. This was a common in many of the partnering projects, where wider issues of project success were used to improve the quality of project delivery for a larger set of stakeholders (Barlow & Jashapara 1998). It is, perhaps, this kind of conceptual approach we need to adopt when thinking of sustainable retrofit projects in people's homes.

The success or failure of sustainable retrofit, therefore, needs to be considered more widely. Sustainable retrofit is a response to the UK's energy policy objectives of climate change, fuel poverty and energy security (DTI 2006). When considering sustainable refurbishment of the domestic stock, climate change and fuel poverty are the major issues that are addressed. The UK housing stock accounts for approximately 27 % of energy use and 29 % of UK annual carbon dioxide emissions (Swan et al 2010). Much of this is through heating and water use, usually through domestic gas combustion. This indicates why many UK government sustainable retrofit programmes, such as CESP and ECO, address the fabric and heating systems within the property. By making fabric and systems within properties perform more effectively, energy use and ultimately carbon dioxide emissions are reduced. Fuel poverty is identified as where households require more than 10 % of their income to heat their home to an acceptable level, generally identified as 21 °C in the main living area and 18 °C in other parts of the home, although this definition is currently under discussion (Moore 2012, Hills 2012). This concept is also closely aligned with the idea of occupant comfort (Chappells and Shove 2005). Fuel poverty is a function of energy costs, energy consumption and household incomes. Sustainable retrofit attempts to reduce the consumption of energy to heat the home. These two policy objectives underpin the delivery of much of the UK's sustainable retrofit projects in the social housing sector. Both of these issues are a function of reducing the use of fossil and wider fuel sources within the property. In addition, the issue of occupant health is an emerging factor for UK social housing providers with some 25,000 deaths per annum in the UK attributed to cold homes (Hills 2012).

These more expansive project objectives mean that a sustainable retrofit project might be at risk of failure if it does not achieve these goals. By opening up the definition of project success we can see that adoption and in use risks, and the potential behavioural factors that underpin them become a part of the risk register, as an important part of project delivery as the finances, health and safety or other more traditional project risk. This risk register needs to follow similar robust approaches to management of risk as a traditional risk register (Williams 1994), compiling a list of specific events that might affect project delivery. However, to effectively undertake this task we need to better understand the potential impact behaviour can have on the success of a sustainable retrofit project.

How Does Behaviour Impact Sustainable Retrofit Projects?

The relationship between energy, technology and consumer behaviour is complex and multi-faceted (Burgess & Nye, 2008). Adoption and in-use issues are driven by a number of different factors, creating a complex inter-play between intrinsic and extrinsic decision factors, as well as practical barriers.

ADOPTION

Values, or how individual householders consider, make decisions and connect with their energy use is an important factor for sustainable retrofit adoption. Chahal (et al 2012) identified that values driving adoption in a survey of 250 social housing residents were around the family home, health and finances, rather than more community oriented models of climate change or "being green". This should not necessarily be seen as a negative issue, but rather an effective identification of the triggers that might cause people to adopt sustainable retrofit. *Social norms*, the influence of perceived shared values, can encourage the adoption of new behaviours, as there is a tendency for people to adopt the opinions, judgements and behaviours of others (Shultz et al 2007). One way of trying to tackle reinforced commonly held beliefs and attitudes that are having a negative impact on society, is to render those beliefs morally unacceptable. The ESRC (2009) suggest, "Over the last 40 years we have changed behaviour and attitudes on drink driving, unprotected sex, seatbelts and smoking in confined public spaces". Behavioural interventions using social norms have been successful in a number of areas in studies in the UK (Cabinet Office 2011). *Trust* between the parties involved in the project is a major adoption factor. Much of the sustainable retrofit within the UK is being delivered through the energy companies who have been identified as having trust issues with consumers. One energy company explicitly stated that it delivered an improvement project through a local municipality, as it perceived it had trust issues within the market place that might have impacted the project (E-On, 2010). The Green Homes Warmer Homes Strategy (HM Government 2010) undertook a study regarding the barriers for adoption of cavity wall among a sample of owner-occupiers. This identified a range of issues connected with the *practical decision barriers* to adoption such as time, finance and understanding how to gain access to services. The major issues for non-adoption within this survey were financial issues of access to funds and perceived financial payback. Other issues included those around disruption, where individuals felt it was too much hassle, or were waiting for other works to be undertaken. The other category of issues were connected to *knowledge*, where there was a lack of awareness about the nature of improvements, as to whether they were already installed and a lack of understanding how to have it installed. In many case the social housing sector can easily address some of these practical problems through effective project management (Jenkins 2010). Peleneur and Cruickshank (2012) also identify reluctance to adopt in terms of resistance to change; particularly where patterns of living might have to be adapted to accommodate new technology.

IN-USE

In-use issues are an important factor for the success of sustainable retrofit projects. The project should not be viewed as complete at handover, as is often the traditional view, but should consider energy efficiency into the long-term. In-use factors also link to the complex issue of comfort theory. Complexities around the way individuals experience and manage their comfort makes understanding and managing in-use factors difficult (Chappels and Shove 2005). However, if we can start to recognize that comfort theory helps us identify risks then we can start more effectively understanding, identifying and managing in-use risks.

Even the most advanced and efficient building fabric and technologies will not perform to their optimum level if poorly-informed occupants undermine their intended use. The potential energy savings from improved energy efficiency that are realised in practice generally fall short of those predicted. Many project teams will assume that energy use will remain constant in the face of improved energy efficiency. Jevons Paradox describes a situation whereby improvements in energy efficiency are offset by greater consumption. Many energy efficiency improvements make energy services cheaper in practical terms so consumption of those services increases, "if fuel is used more efficiently, the user can consume more fuel for no increase in the cost of fuel purchased" (Vale & Vale, 2011). The evidence does not suggest that energy efficiency improvements routinely lead to increases in energy consumption, but indicates that focusing too much on energy efficiency as opposed to energy consumption can lead to a reduction in consumption being overlooked (Diamond *et al.,* 2007). *Habits* are engrained patterns of behavior that are unconsciously formed. While an individual may understand the linkages between energy use and their behavior, they may not easily change their habits (Neal, Wood & Quinn 2006). *Knowledge* as to how to use and engage with energy saving is an important factor. The Missing Quarter Report (GM LCEA 2011) identified nine separate barriers to an individual's understanding of the knowledge, causes, impacts and solutions of climate change identified by:

- Lack of knowledge about where to find information;
- Lack of desire to seek information;
- Perceived information overload;
- Confusion about conflicting information or partial evidence;
- Perceived lack of locally-relevant information;
- Format of information is not accessible to non-experts;
- Source of information is not credible or trustworthy, particularly the mass media;
- Confusion about links between environmental issues and their respective solutions; and
- Information conflicts with values or experience and is therefore ignored.

When considering risk of adoption or in-use failures, we cannot look at behavior as hazard factors, as we might look at a trip hazard or hazardous material. We should consider them as potential levers that have the potential to be a barrier in the project or drive it forward. Parallels could be drawn with safety culture, a risk category that the construction industry is well used to managing. Issues such as norms, values and related attitudes are seen as an essential part of managing this kind of risk, and have been recognized as an underpinning factor of safety (Choundry et al 2007); understanding resident-related risk in the same way can help translate this concept in a way that might be more easily understood by the construction industry.

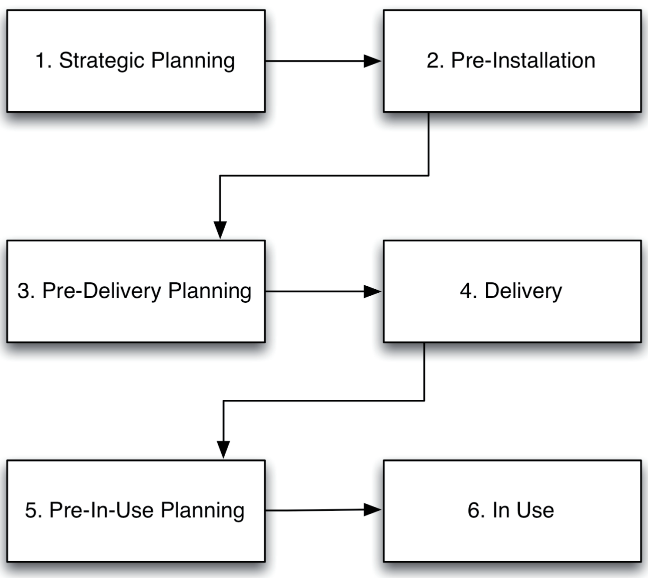

Figure 1. Outline of resident management process.

Outline Behavioural Risk Management Process

The Sustainable Retrofit Resident Toolkit is designed to formalise the behavioural issues identified into a structured approach. It is not designed to be a one-size fits all; it recognises that project teams may have different project needs, residents and resources to deliver a specific project. It provides a structured process to ask specific questions. The focus of the tool is to ensure that where a sustainable retrofit project is being undertaken adoption is maximised and in-use risks are mitigated.

The model follows as simplified construction process outline, which is shown in Figure 1. This process model runs alongside the simple risk management process by identifying where both risks might occur and when they might be effectively managed.

The decision to follow a construction process was a conscious one in order to directly link the management of residents with core project team activities, both in terms of the process and with the project team in mind. This view was strongly supported by the professional working group. This ensured that behavioural risk management processes were an embedded part of wider project delivery. More detailed flowcharts were developed for each stage. In Figure 2, we see the detailed process for Stage 2 – Pre-Installation. This gives a detailed breakdown of where data may be collected, or where specific interventions may be adopted.

While it was recognised by the project team that the toolkit could be applied at any point in the delivery of a sustainable retrofit project, here we discuss the full version. This reflects a project team that considers the behavioural factors from an early stage and builds these considerations into the project.

The key principles of the Sustainable Retrofit Resident Behaviour Tool are:

- Understanding the Objectives of the Project
- Understanding the Scope of the Project
- Understanding the Residents within the Project
- Identification of Existing Plans and Resources
- Identification of Risks and Appropriate Interventions
- Monitoring and Evaluation

The *objectives of the project* must be explicit. Quite often the physical nature of the project, focusing on the delivery rather than the desired outcomes, will take precedence. As stated previously, all of the project team need to be aware of the broader goals of the project and how they will contribute to it. Tools such as partnering charters, which can include residents (Barlow and Jashapara 1998), are a useful way of including behavioural issues explicitly as part of the project outcomes. As was common with many housing projects within the UK, these objectives and broader success factors may be used to form an evaluation framework. The *scope of the project* identifies the physical nature of the works to be done in terms of number of properties, technology adopted and time frames within the project. As highlighted by Affinity Sutton (2012), it is easy to underestimate the amount of work that might need to be undertaken to address large numbers of properties. A large-scale retrofit project may require several visits to an individual property, and these need to be properly planned for. In addition, understanding what technology options are available forms

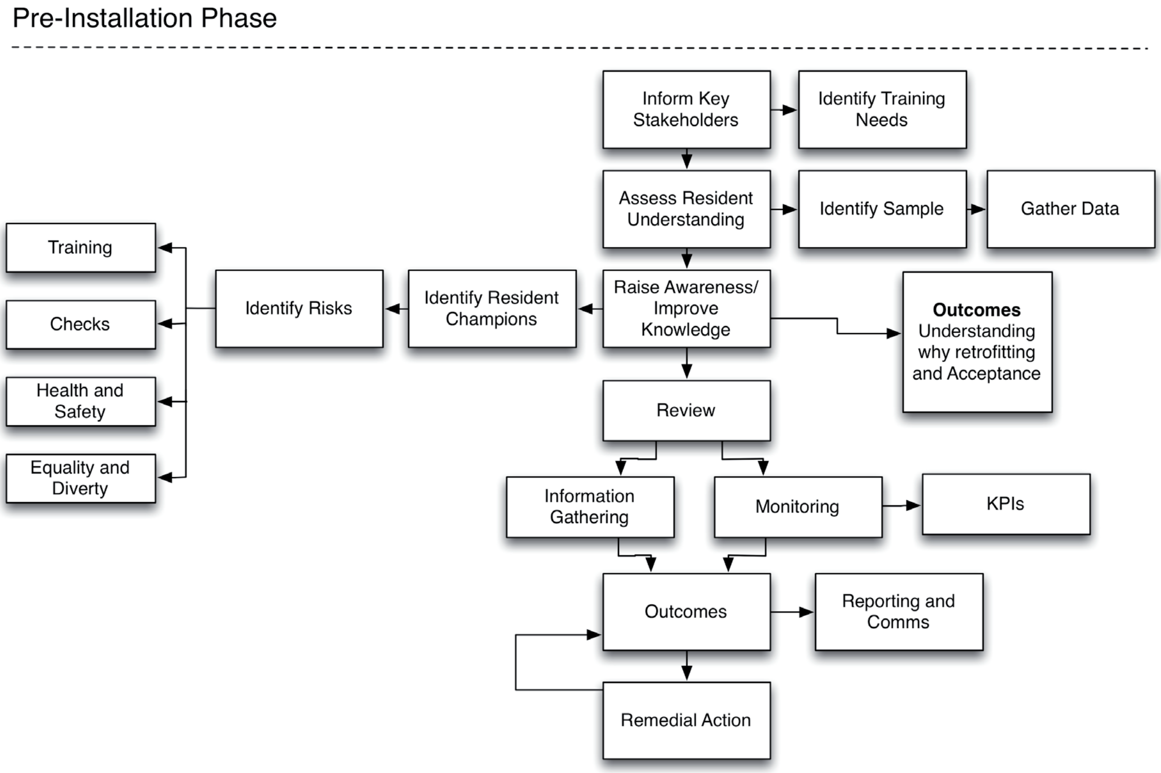

Figure 2. Pre-installation detailed process.

the basis of a specific category of risk around resident interaction with technologies' installation and use. The next issue is to understand the *resident needs* that are being supported. It may include individuals who are elderly, have learning difficulties or are from ethnic minorities, all of whom will have their own specific needs. For example, disabled people may not be easily decanted from their property if there are to be extensive works, or individuals with learning difficulties might not be able to engage with certain forms of communication. Additionally, understanding where residents are in terms of their engagement with the idea of retrofit is important. Where there have been previous projects, residents may have a good understanding or even be keen to engage with the project. Where a project might have failed, there needs to be recognition that significant work might need to be done to win back trust. Understanding the constituency that is being supported is essential. The next issue is to understand what *existing plans, policies or resources* may be in place. Effective engagement can be expensive, so assessing whether there are existing resources and processes can be an important part of the planning phase. Charities, local authorities and healthcare bodies can have projects in place that may be used to support the implementation of sustainable retrofit. They might be effectively engaged to support the wider project, particularly if it addresses their own strategic objectives. It is not only external bodies that might be considered. There are often internal activities with residents that might be made use of to support the delivery of the project. "Touch points" such as gas safety checks or other residents' engagement activities can be used to improve the delivery of the project at little extra cost. All of these factors provide a detailed context in which risk and potential interventions might be identified.

The effective identification and management of risk lies at the heart of the Sustainable Retrofit Resident Engagement Toolkit. *Understanding the risks* is enabled through the use of a generic risk register, which highlight the different risks and where they might occur in the project. The risk register was developed through a literature review, including the academic literature and case studies on sustainable retrofit in the UK. Adoption and in use risks are all identified as potential risks for the project team to consider and potentially address through interventions.

These core principles identify and analyse the risk in terms of the potential interventions that may be undertaken to ensure that they do not impact the project. In the next section we consider the main interventions that might be undertaken at different stages of the project. Much of this work is undertaken during a base line study, where relevant information is gathered and used as a basis for the identification of risk.

Interventions

Interventions are those activities that have been designed to control the risk. They work by either managing the risk, often through effective communication with residents, or by removing the risk altogether, such as through the delivery of clearance services to allow access to properties, rather than relying on residents to do the work. While many of these interventions are behaviourally driven, some are practical measures that address an underlying issue that might influence behaviour. A simple checklist to consider the following issues that may influence application supports each intervention,

- What is the risk being addressed?
- What is the intervention design to do?
- When should it be applied?

- Good practice guidance on how to apply it.
- What are the desired outcomes of the intervention?

The list of interventions discussed here is not exhaustive; it is designed to give an indication of the broad array of tools available for project teams in managing potential behavioural risk.

INTERVENTIONS FOR ADOPTION RISK

Adoption risks will change in relation to sustainable retrofit and energy awareness activity within the members of a community and their wider social networks. If you have a group of residents that are new to sustainable retrofit, there may be a number of stages that are gone through to encourage widespread adoption. Often individuals do not know if they have had improvements or not (Chahal et al 2012), which might be considered a failure in communication. The early stages of engagement require high levels of communication to "sell" retrofit to residents. The community that the project will be undertaken with may have history with retrofitting, which is why an initial base lining activity is suggested. It will be very difficult to engage with residents who have no knowledge using interventions that are designed for individuals and groups who have existing knowledge. Simple approaches such as town hall meetings, focus groups or even short films can create an initial awareness prior to higher levels of engagement (Figure 3). Often, the initial finding out stage can be used as an opportunity to both build relationships with residents as well as introducing the idea of sustainable retrofit to them. The team also considered internet-based approaches. This approach can be cheap and data can be collected and disseminated quickly, but project teams should consider the issue of the "digital divide", where certain groups may not have access to the Internet, a situation more common in social housing than the general population (Winchester 2009). The research undertaken with social housing providers indicated that face-to-face engagement was essential. This could be done using existing infrastructure such as Tenant Liaison Officers, a common role in UK social housing, or dedicated teams focused around energy, and particularly issues of fuel poverty. The approach that was perceived as highly effective was the use of community champions, trained residents who were designed to communicate with and support their own community with regards to energy efficiency, such as the Groundworks Green Doctor Programme. While this formal approach is a powerful way of creating sustained engagement, the social housing providers also recognised the importance of informal local networks to provide support and serve as ambassadors for sustainable refurbishment. The role of local people plays into issues of trust and social norms, which can be powerful ways to address adoption risk.

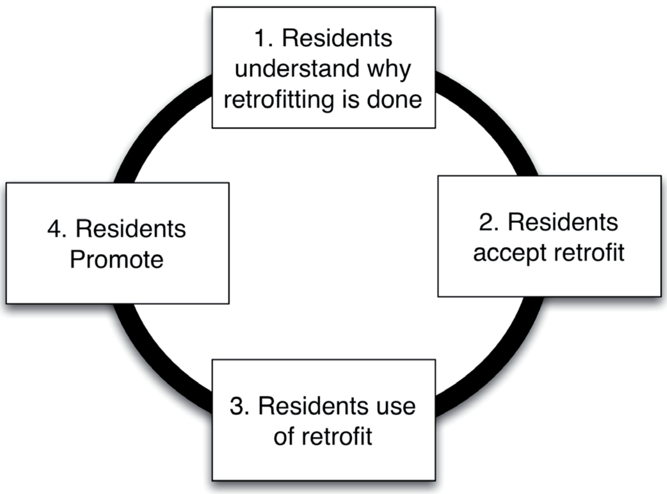

Figure 3. Levels of resident engagement.

INTERVENTIONS FOR DELIVERY

The delivery phase is where many issues with retrofit can go wrong. Ultimately, the failings at this stage will either impact adoption, through refusals at a later stage, based on poor interaction with the residents, or in-use risks, usually driven by poor communication and handover procedures. The delivery phase also contains much of what we would identify as traditional construction risk. However, failings at this stage play into the behavioural aspects of the project, damaging or creating goodwill, as well as providing multiple touch points where residents may be engaged.

Poorly trained installers and contractors can derail even a well-communicated project with early buy-in. The social housing sector has benefited from the Decent Homes Programme, a large-scale refurbishment of the social housing sector. Lessons learned from this programme of improvements, such as new kitchens and bathrooms, boilers and fabric improvements, has led to the development of interventions to manage risk at this stage, many of which were being applied as part of the sustainable retrofit agenda. Good contractor training to ensure that residents are treated courteously, communicated with clearly and that sites are left clean are a major part of ensuring that early engagement efforts are not lost. Figure 4 shows the delivery management process. This highlights the processes must be in place to manage resident communication, health and safety and contractor training, shown as TPAS (Tenant Advisory Participation Service) Accreditation, which addresses issues such as resident engagement, appointment management, site management, and the use of identity cards. The process may be iterative with refusals needing to be effectively managed through more specific interventions. It should also be noted that each type of technology would come with its own specific issues for delivery. Some technologies may be simple to install, while some may be disruptive and require careful management of relationships. Understanding potential pitfalls of specific technologies is essential and as part of the toolkit the main technologies were analysed and a list of behavioural risks was highlighted.

INTERVENTIONS FOR IN-USE RISK

In-use risk is a major issue for retrofit. Some technologies may be viewed as passive; they may not require behaviour change in their use, so behavioural training may be limited to more generic energy awareness. However, some technologies may require changes in heating patterns, such as air source heat pumps (Singh et al 2010) that operate differently from the gas central heating that many households are familiar with. Changes in the way a property performs, such as major improvements in airtightness and the introduction of mechanical ventilation can also create issues. Macintosh and Steem-

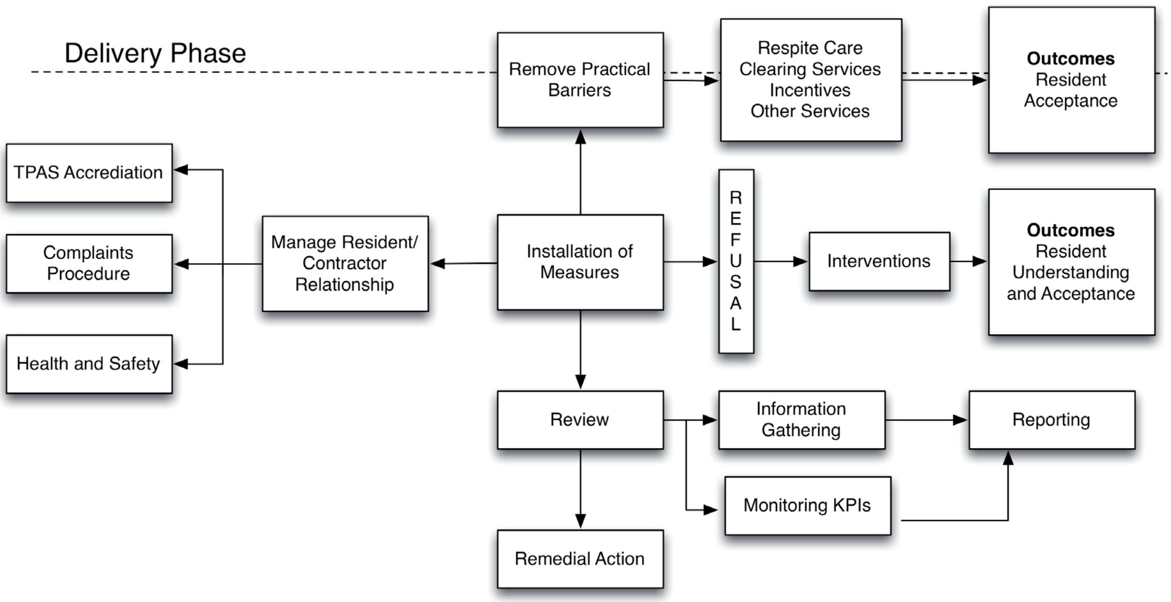

Figure 4. Delivery management process.

ers (2005) identified a number of resident-based factors that caused dissatisfaction and under performance of the system due to its use by residents, particularly around window opening behaviours. The greater the change in behaviour required, the greater the risk that in-use behaviours will cause a deviation between modelled and actual energy use. The bigger this shift the greater the resource that will be required to ensure that this is effectively managed. This issue can be tackled early, with open days to allow people to engage with mock-ups of their heating systems or show homes, allowing them to ask questions and identify practical issues they may have for their own home. At the delivery phase, effective handover procedures for the resident, as well as provision for on-going support, particularly if the heating season has yet to start, is essential. On-going support and engagement might be improved by good feedback systems for energy consumption (Darby 2006), which might be used as a basis for neighbourhood benchmarking or competitions, providing a basis for the formation of norms around energy use.

Monitoring and Evaluation

A major issue that needed to be addressed during the design phase was the lack of monitoring and evaluation that was in place to assess whether interventions had worked as expected. This meant that social housing providers were doing what they felt might work, rather than working from a specific evidence base, and this appeared to be a widespread problem. However, the participants in the working groups identified that this could prove onerous in terms of data collection and analysis. The approach taken was to borrow from the Constructing Excellence Key Performance Indicator methodology (Beatham et al 2004), using high-level indicators to assess critical success factors; those factors that linked to project success or failure. While this did suffer from making it difficult to assess the individual success of some of the individual interventions, it provided a framework in which the overall behavioural risk management strategy could be assessed and create a context for "management by exception", where additional resource may be applied if high level measures indicate an issue. The identified Key Performance Indicators selected are shown in Table 1. The KPIs can be seen to focus around project outcomes, such as number of properties accepting retrofit, and satisfaction indicators. It also had the benefit of being a framework that many project delivery teams were familiar with.

Lessons from the Pilot Study

A pilot study was undertaken with 3 social housing providers undertaking live retrofit projects who self-selected from the initial working group. While the studies are not discussed in detail here, the process had some important lessons for the research team, who revised the toolkit during the validation stage. The first lesson is concerned with the *resource and capability of the delivery team*. While it is important to be aspirational about the delivery of sustainable retrofit projects, one needs to recognise the capacity of the individual housing provider to deliver. Even within the three pilot studies, there was a range of experience between the organisations. Some had well-developed resident engagement skills, that enabled them to undertake and manage quite sophisticated interventions, while others recognised that they were not able to deliver some forms of intervention. This led to a categorisation of interventions using a basic capability maturity model, to identify the level of sophistication that might be needed to effectively deliver them. The project teams aspirations must be aligned with capability. The second issue is concerned with the *message used to "sell" retrofit* to residents in an effort to ameliorate adoption risk. While carbon emissions may be the objective of the project, it is not a major concern for social housing residents. Successful engagement with residents was generally around issues of cost, comfort and health, rather than longer-term environmental issues. All of the pilot projects teams identified that selling the retrofit concept had to address issues of direct relevance to the individual resident in the majority of cases. The final major issue was the need to *balance resource and outcomes* in the effective management

Table 1. Behavioural interventions KPI suite.

Pre- installation	**KPI 1:**	% of properties accepting retrofit
	KPI 2:	Number of residents involved in consultation exercises
	KPI 3:	Resident satisfaction with engagement opportunities
Delivery	**KPI 4:**	Resident satisfaction with the level of notice given prior to installation
	KPI 5:	Resident satisfaction with contractor services
	KPI 6:	% of properties retrofitted within agreed timescales
	KPI 7:	Number of measures not being installed correctly the first time
	KPI 8:	Part a: Number of complaints about the process Part b: % of complaints dealt with in standard response time
	KPI 9:	Client (RP) satisfaction with contractor services
In-use	**KPI 10:**	Resident satisfaction post- occupancy
	KPI 11:	% decrease in energy usage
	KPI 12:	Reduction in fuel poverty
	KPI 13:	Number of complaints arising due to installed measures

of risk. The partners in the pilot studies were clear that while the tool provided a framework, if applied fully, would require considerable resources. However, they also recognised that the costs for not engaging were not clear so it was difficult for them to make decisions as to what level of resource to apply in order to effectively manage the risks.

Conclusions

This initial pilot study highlights the emergent nature of our understanding of how to effectively manage behavioural risk in construction projects. The social science and associated research projects have clearly identified behavioural risk as an issue when undertaking sustainable retrofit. The problem lies in how we quantify and embed this within the project management processes of the teams that deliver the improvements to people's homes. The wide number of interventions available that have been trialled in the UK and abroad, provide a working toolkit, but until we can quantify the risk in terms of costs it is difficult to understand how to meaningfully resource any management of that risk. As with the partnering movement of the last decade, it can be a difficult cognitive leap to invest in what is essentially social capital, the intangible goodwill that makes projects work. This said, project failings due to breakdowns in trust are well documented. However, the financial argument is far from easily established. It is clear that the resident sits at the heart of the process, and should be viewed as an essential part of the project team. They are a core stakeholder who has the power to make or break a project, either through non-engagement or in-use behaviours, but they must be supported and engaged if projects are to succeed. Fusion21 and the University of Salford recognised the toolkit as work in progress and is being taken forward as a business stream by Fusion21. From the academic perspective saying behaviour is an issue in energy efficiency is not sufficient, we must be prepared to translate this understanding into useable forms that deliver benefits for our communities.

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Acronyms

The following acronyms have been used in this paper. Below is a list of the main acronyms and a definition.

Community Energy Savings Programme (CESP) is the outgoing programme of UK Government funding for area-based sustainable retrofit projects. This is funded through a levy on energy bills of consumers.

Energy Company Obligation (ECO) is the incoming programme of UK funding for sustainable retrofit of properties. This is funded through a levy on energy bills of consumers.

Standard Assessment Procedure (SAP) is one of the UK standard models used to assess the as designed energy performance of domestic properties.

Tenant Participation Advisory Service (TPAS) is an independent advisory body designed to support the interrelationship between social housing providers and their tenants.

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