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Energy efficiency retrofitting services supply chains: Evidence about stakeholders and configurations from the Yorskhire and Humber region case

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ABSTRACT

Interest in energy efficiency has risen rapidly in the last few years. In particular, Government institutions have launched several initiatives for improving housing energy efficiency through the implementation of retrofitting measures. As a result, the UK Energy Efficiency Retrofitting Services (EERS) market (estimated at around £2bn in 2010) has significant growth potential related to such large government initiatives. Despite this rapid growth in interest, research into the EERS sector has historically been limited, especially concerning supply chain implications. The supply chain of the EERS sector involves multiple stakeholders. It involves public and private bodies as a significant portion of work is undertaken within large publicly funded projects. This research is the first to examine empirically and theoretically the distinctiveness of the supply chain configurations in the EERS sector. A Delphi-like method is adopted to collect a wide range of data from the organisations operating in the EERS supply chain and government bodies (Local Authorities) in the Yorkshire and Humber region in the UK. These data were used to capture and characterise the EERS sector in the region. Stakeholder theory is used to theorise on the public–private interaction mechanisms shaping the supply chain structure in the EERS sector. Three ideal types of supply chain configurations were identified based on the size and scope of the energy efficiency retrofitting project. The influence of these configurations on the performance of the supply chains was also explored.

1. Introduction

Energy efficiency improvement has been an important global climate change mitigation strategy over the past 30 years. Without energy efficiency improvements, the OECD nations would have used approximately 49% more energy than was actually consumed as of 1998 (Geller et al., 2006). In the UK, the transition to a low carbon economy is expected to be driven by maintaining secure energy supplies, cutting emissions from energy intensive sectors and adopting energy efficiency improvements. The construction industry is one of the key targeted sectors since it contributes to nearly 47% of the UK's total emissions (Carbon Trust, 2008). Therefore, this paper focuses on improvements in the energy efficiency of the UK's housing stock, which forms a key part of the UK's efforts to meet its carbon emissions reduction target (Milne and Boardman, 2000). A number of policies are in place to drive improvement in the housing stock over the period to 2020 (Gaterell and McEvoy, 2005; Communities and Local Government, 2007, 2008a). These include:

- A requirement for all new homes to be zero-carbon buildings as soon as practically possible and preferably by 2016;
- Improving the energy efficiency of consumer electronics and domestic appliances, and the possible phase-out of inefficient light bulbs;
- Increasing the carbon emission reduction target for the electricity and gas industries;
- A requirement that new domestic electricity metres should have real time displays from 2008, and a commitment to upgrade existing domestic metres on request;
- The requirement for energy suppliers to support energy efficiency improvements in existing housing stock;
- A large number of grant schemes, initiated by Local Authorities (LAs) and the central governments specifically targeting the fuel poor and low income households with a variety of financial incentives for the installation of various energy efficiency retrofitting technologies. These schemes have focused on the installation of the energy efficiency retrofitting measures reported in Table 1.

The wide spectrum of measures being offered by the various energy efficiency initiatives are generating an increase in demand for Energy Efficiency Retrofitting Services (EERS) in existing and brand new housing stocks.

It has to be noticed that the EERS sector is a multi-faceted sector that addresses the design and construction of homes and buildings, and the installation, use, and maintenance of high-efficiency

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Table 1
Energy efficiency retrofitting measures list.

Category	Measure
Insulation	Cavity wall insulation Loft insulation Solid wall insulation internal HEA underfloor insulation Flat roof insulation
Traditional windows/Doors	Glazing/Windows Draught proofing
Heating systerms	Fuel switching Heating controls CHP wood pellet boiler Air source heat pump Boiler replacement Ground source heat pumps
Renewables	Solar water heater Domestic wind turbines Solar power photovoltaic panels

equipment in homes, buildings, and industrial processes. It does *not* constitute an independent industry, since its activities, rather than being new initiatives typically consist of a shift from standard practices to a more energy-efficient approach. Hence, the rationale for using the term "Energy Efficiency Retrofitting Services Sector" rather than Energy Efficiency Industry (Goldman et al., 2010) in this paper.

Recent reports released by various institutions estimate that the UK EERS is continuously growing and currently valued at around £2bn as of 2010 (DTI/DEFRA, 2006; DTZ, 2009). The economic impact of this demand growth could be significant job creation prospects, especially for small and local businesses operating in the EERS sector. Indeed, the EERS sector accounts for a significant quota of the green jobs market, with building retrofitting accounting for the majority of these jobs (Devonish, 2009). Retrofitting and construction projects often rely on labour-intensive and locally-implemented projects, hence they can help reduce local unemployment levels (DECC, 2011). For example, insulation services account for 27,000 jobs in the UK (DECC, 2011). New energy efficiency technologies require a high level of expertise for their development, implementation and servicing. Moreover, achieving the necessary market capacity can also boost the associated retail and consulting industries.

Nevertheless, there is a concern among policy makers that supply chain capacity is insufficient to meet the energy efficiency goals being put in place by local and national policies. If attention is not paid to the stakeholders and supply chain, the potential economic benefits of these large-scale energy efficiency retrofitting projects will be lost, and the objective of creating jobs within local communities will not be achieved.

Despite the growth potential, research in the EERS sector has historically been limited. For this reason, and given the complexity of the interactions between public and private stakeholders, understanding the characteristics of the sector and its supply chain configurations is critical. This study therefore aims:

i. To understand (from an empirical point of view, through a field analysis conducted in the Yorkshire and Humber region in the UK) the nature and characteristics of the EERS sector supply chain, its main stakeholders, and to analyse opportunities and barriers for its development driven by the approval of large-scale government and community projects focusing on the installation of EERS.
ii. To draw out (from a theoretical point of view) the influence of public–private interaction mechanisms (for example, through procurement practices) in determining the shape of the supply chain of the EERS sector, by identifying several supply chain configurations and their influence on expected performance across relevant economic and social indicators.

A Delphi-like methodology adapted from Okoli and Pawlowski (2004) is employed to perform the field analysis. Stakeholder theory (Freeman, 1984) is also used to explain the role of public and private entities in the identified EERS supply chain configurations.

The remainder of the paper is organised as follows: The next section provides a literature review; in the first subsection, an overview of extant studies regarding EERS and related sectors supply chains is presented; then, some generalities about stakeholder theory are illustrated. In Section 3, the context of the empirical analysis is presented, with some details about the Yorkshire and Humber region (object of the study). The methodology of the study and the results are presented, respectively, in Sections 4 and 5. Thereafter, some key findings regarding the emergent ideal types of EERS supply chain configuration are discussed; finally, conclusions, limitations of this study and recommendations for future research are provided.

2. Literature review

2.1. Previous studies about the EERS sector

The EERS sector is a wide field that addresses the design and construction of homes and buildings, and the installation, use, and maintenance of high-efficiency equipment in homes, buildings, and industrial processes. The stakeholders in the EERS sector include both public and private organisations, such as government bodies, contractors, engineers, designers, economists, marketers, tradesmen and so on. There is a general lack of specific studies addressing supply chain configurations within the EERS sector, because the sector has often been seen as a sub-sector of the construction industry.

However, even the construction industry has been slow to employ supply chain constructs and measurements (Chen and Paulraj, 2004), perhaps because of its unique organisational structure which consists of individual elements in the form of a conglomerate, termed "thetemporary multiple organisation" (Cherns and Bryant, 1983). In fact, the complex interactions and relationships between the various players in the construction sector supply chains make it more vulnerable to disruption. Cherns and Bryant (1983), Gosling and Naim (2009) and Gosling et al. (2010) all suggest that the two most important aspects of the construction industry are customer specificity of the "bespoke" final product and the involvement of numerous value-adding organisations. The construction industry is by nature an investment service wherein the customer wields great influence on the final product in relation to its physical aspects (dimensions, application of materials, etc.) and the value of logistic parameters (delivery date, project duration, etc.) (Gosling and Naim, 2009). In some cases, the customer selects the manufacturer (contractor), the suppliers of specialist parts and the material suppliers (Kornelius and Wamelink, 1998). Longstanding, efficient supplier–contractor relationships are therefore vulnerable to disruption in this context.

Dainty et al. (2001) state that supply chain integration within the construction industry is also difficult due to the small size of the majority of the players within the industry itself. Fernie and Thorpe (2007) also found supply chain management within the