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Strategic sourcing in the UK bioenergy industry

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ABSTRACT

Successful supply chain management requires the management of a complex, multi-stakeholder, multi-criteria system. Stakeholder inclusion in the supply chain design and decision making processes is an area of growing interest for companies looking to design sustainable supply chains or produce sustainable products. This paper demonstrates the use of the integrated quality function deployment and analytic hierarchy process (QFD–AHP) method for the inclusion of a wide group of stakeholder requirements into the supplier selection process. The method provides a weighted ranked list of evaluating criteria which can be used to assess potential suppliers in the UK renewable bioenergy industry. The bioenergy industry is suitable as there are many stakeholders placing various requirements upon potential biomass suppliers. The paper uses a mixture of literature review and semi-structured industry interviews to answer three research questions: which stakeholder groups are important when selecting biomass suppliers for the UK? What requirements are made by these stakeholders on the supply of biomass fuels and feedstocks? Which evaluating criteria are most important?

1. Introduction

The UK has backed bioenergy or energy from biomass as a major contributor to realizing various carbon reduction commitments (DECC, 2009). Although there is scope for targets to be reached using various low carbon and renewable technologies, biomass has great potential given the technology is well understood and the finances and structure of schemes are similar to traditional combustion power stations. In addition to combustion conversion technologies, several advanced conversion technologies are becoming commercially available as interest in biomass and bioenergy increases. Gasification and pyrolysis as well as anaerobic digestion attract significant government incentives for the production of gas, electricity and heat. The result is an expected surge in the demand for biomass resources (DECC, 2009).

Biomass appears from a wide variety of sources ranging from those usually considered waste products, such as municipal waste or treated sewage waste and agricultural arisings, bi-products and commercial organic waste streams through to woody biomass or energy grasses specifically grown for energy conversion (E4tech, 2009; AEA, 2011). Biomass for energy schemes also tends to operate best at the low value end of the biomass scale. Whilst a broad oak tree can make a fine house or a straight pine can make a table top, rice husks, olive pits, branches from thinning's, food waste, leaves and bark are more difficult to find viable value adding processes for. Conversion to bioenergy can offer added value for these materials diverting them from waste streams. It is therefore likely that the UK will see a sharp and dramatic increase in the use of biomass for energy in various guises including international imports.

As with most energy resources and technologies, bioenergy is not without controversy, the carbon-reduction and sustainability credentials of these materials have come under scrutiny along with the rising interest from government and investors. These issues are recognized in EU legislation on sustainability for biomass which has been mandated by the UK at the time of writing. The sustainability assurance certificate process is split into two main sections, first the carbon emissions impact of the material, and second the change in land use criteria. However, there are many requirements made of biomass supply chains and suppliers over and above the sustainability assurance certificate, additionally they are made by a variety of parties with influence over the long-term success of a bioenergy facility.

Supplier selection for biomass schemes is a multi-stakeholder, multi-criteria system that is very sensitive to sustainability issues. The incorrect choice of supplier can lead to an unsustainable system, for instance, refusal of project finance, unreliable operation of the bioenergy plant, depletion or failure of fuel supply, and extensive environmental damage through deforestation and greenhouse gas emissions. To ensure successful supplier selection in this complex industry, this paper uses a mixture of literature review and semi-structured interviews to identify the concerned stakeholder groups, their requirements, and evaluating criteria from a UK perspective.

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An integrated quality function deployment and analytic hierarchy process (QFD–AHP) method is then applied to quantify their interrelationships and measure their importance ratings based on a real case of the bioenergy development company located in Birmingham, UK.

There are three research questions addressed by this paper. First, which stakeholder groups are important when selecting biomass suppliers for the UK? Second, what requirements are made by these stakeholders on the supply of biomass fuels and feedstocks? Third, which evaluating criteria are most important? The contribution of this research is to demonstrate the application of the QFD–AHP method for incorporating stakeholder opinions into the supplier selection process for bioenergy schemes in the UK. The paper also identifies the specific supplier evaluating criteria used by stakeholders when assessing supplier suitability.

This paper is organized as follows. Section 2 reviews the literature concerning the current practice in sourcing and managing biomass suppliers as well as theoretical background to supplier selection and the management of stakeholder requirements. Section 3 describes the QFD–AHP method in a step-by-step approach. Section 4 applies the method for the biomass supplier selection in the UK bioenergy industry. Section 5 discusses the findings, whereas Section 6 concludes the paper.

2. Literature review

According to Prajogo et al. (2012) and others, including Narasimhan et al. (2001) and Talluri and Sarkis (2002), supplier assessment and performance measurement is a key part of supply chain management. They also explain that as competition has moved from a firm level to a supply chain level, suppliers have become important to the performance of the buying firm. Huang and Keskar (2007) discuss the importance of formalizing this supplier assessment using performance metrics as well as aligning the supplier selection process with business strategy and product life-cycle stage. Elsewhere in the theoretical literature the discussion between taking a resource based view and a relational view is influencing the way that suppliers are assessed, selected and managed. These theoretical ideas are directly relevant to the management of biomass supply chains, however, perhaps due to the immaturity of the biomass for energy industry sector biomass has not been fully discussed in these terms. Rather managers have attempted to extend practices from other areas such as solid energy procurement such as coal or oil or practices from the forestry industry have been extended.

These more established industries have been well studied in the literature as documented by D'Amours et al. (2008) for the pulpwood industry although the case study by Koskinen (2009) finds that supply chain management practices are not fully integrated with the procurement process of a large paper manufacturer. This is supported by a further case study by Carlsson and Rönnqvist (2005) which illustrates how operational management modelling assisted with the logistics design and customer integration at a large wood products company in Europe. Waste resources have attracted less attention regarding its strategic procurement as would be expected given that it has traditionally not been viewed as a product for procurement. However, the area of waste combustion is well studied from a technical and life-cycle perspective, most relevantly by Fruergaard and Astrup (2011) and Burnley et al. (2011) as are the collection and logistics of waste management (Haastrup, 1998; Caputo et al., 2003; Skovgaard et al., 2005; Longden et al., 2007; Beigl et al., 2008; Karagiannidis et al., 2009; Cheng and Hu, 2010; Iakovou et al., 2010).

de Brito et al. (2008) provide an interesting review on the progress of sustainable supply chain management and focus on the fashion industry. The paper identified two major themes of sustainable supply chain management, first supplier management for risks and performance, and second supply chain management for 'sustainable' products. The bioenergy industry is an interesting case as at first inspection it appears to be about producing a 'sustainable' product, electricity, heat or transport fuel. However, in order to produce this sustainable product, it is the management of risks and performance of the supply chain which must be done in a sustainable way. de Brito et al. (2008) also identify that pressures and incentives for sustainability in supply chains come from a variety of sources, namely legal demands, customer demands, responses to stakeholders, competitive advantage, environmental and social pressure groups, and fear of reputation loss. Also, in the fashion industry, Caniato et al. (2012) discuss the "influence of stakeholder pressures on the adoption of environmental practices" referencing Ciliberti et al. (2008) and Sarkis et al. (2010). These pressures are also seen in the solid bioenergy industry where practitioners are keen to avoid the controversy which has surrounded the use and production of biofuel; this has been extensively discussed for the UK (Chalmers and Archer, 2011; Upham et al., 2011; Boucher, 2012).

Considering this importance of stakeholder requirements in setting the tone for sustainable supply chains and their influence on company performance along with the growing importance of supply chain management to company competitiveness, a question remains about how stakeholder requirements regarding sustainability, or other salient areas, can be incorporated into supply chain management processes. This paper contributes to this section of the literature by demonstrating a method of supplier selection that incorporates a blend of stakeholder requirements to generate a decision that can be considered as holistically successful as possible considering all stakeholders. The aim of the presented method is not to select the supplier that would be considered most sustainable, but rather to find a supplier that best meets the requirements of the wider stakeholder group, this may include sustainability requirements but the aim is to show how the most holistically successful supplier can be selected. The paper also documents the criteria used by stakeholders to evaluate the suitability of particular suppliers.

The QFD–AHP method has been applied previously in several studies (Ho, 2008; Ho et al., 2011). The most popular application of the QFD–AHP method was found to be for manufacturing decision making especially for product design selection (Wang et al., 1998; Hsiao, 2002; Kwong and Bai, 2002; Madu et al., 2002; Kwong and Bai, 2003; Myint, 2003); Higher education (Köksal and Eğitman, 1998; Lam and Zhao, 1998) and logistics (Chuang, 2001; Partovi, 2006). To our best knowledge, the QFD–AHP method has not been applied in the bioenergy industry (Ho, 2008; Ho et al., 2010; Scott et al., 2012).

3. Methodology

To better align supplier selection (and sourcing strategy) with corporate/business strategy, the QFD–AHP method is developed. The QFD is used for various stakeholders to express their requirements, and also to translate the conceptual stakeholder requirements into multiple comparable evaluating criteria for supplier selection, which are used to benchmark the suppliers. The most important information that the QFD provides is the weights of evaluating criteria, which are derived by the importance ratings of stakeholder requirements together with the relationship weightings between stakeholder requirements and evaluating criteria. Generally, both importance ratings of stakeholder requirements and relationship weightings are determined by the decision makers arbitrarily. This may result in a certain degree of inconsistency, and therefore degrade the quality of decisions made. To overcome this drawback, the AHP is used to evaluate them consistently. To summarize, the QFD–AHP method ensures successful strategic sourcing because the supplier selected