



An integrated buyer initiated decision-making process for green supplier selection



Vipul Jain^a, Sameer Kumar^{b,*}, Amit Kumar^c, Charu Chandra^d

^a School of Management, Victoria Business School, Victoria University of Wellington, 23, Lambton Quay, Pipitea Campus, PO Box 600, Wellington 6140, New Zealand

^b Department of Operations and Supply Chain Management, Opus College of Business, University of St. Thomas, 1000 LaSalle Avenue, Minneapolis, MN 55403-2005, USA

^c Supply Chain Systems Analyst, Amazon, 31-, 33 Rives de Clausen Lëtzebuerg, 2165, Luxembourg

^d University of Michigan – Dearborn, College of Business, FCS 183, 19000 Hubbard Drive, Dearborn, MI 48126-2638, USA

ARTICLE INFO

Article history:

Received 2 January 2016

Received in revised form 24 June 2016

Accepted 14 September 2016

Keywords:

Data Envelopment Analysis

Green supplier selection

Carbon markets

Cap and trade

Carbon footprinting

Multi-criteria decision making

Analytic hierarchy process

Strategic sourcing

ABSTRACT

Organizations have been under growing pressure to reduce emissions across their supply chains while cutting supply costs to remain competitive. This paper proposes a Carbon Market Sensitive (CMS) and a green decision making approach based on Data Envelopment Analysis (DEA) called CMS-GDEA. It builds on an existing Green DEA model and modifies it to include a carbon market model. Results from the model validation in a well known automobile spare parts manufacturer in India indicate that the “Pay Up” factor from carbon trading adds a new dimension to competition among suppliers and increases overall supply chain profitability. The proposed approach encourages suppliers to go green and cut down their carbon footprints or “Pay Up” to comply with the emission norms along with cutting costs, which adds to healthy competition.

© 2016 The Society of Manufacturing Engineers. Published by Elsevier Ltd. All rights reserved.

1. Introduction

Supplier selection process involves review, evaluation, and picking to become a part of the organization’s supply chain. Traditional supplier selection approaches tend to reduce supply chain costs. A majority of these approaches ignore environmental criteria. This may have been feasible a few years ago, but with the advent of the “Green Movement”, the emission activities across the supply chain have definite cost components attributed to them. These cost components need to be factored into the overall supplier selection approach. As more environmental norms and compliance standards are enforced in practice, organizations which are simply looking at cutting supply chain costs are most likely to get stranded as there is no guarantee to assure that the suppliers would conform to these norms. Among many criteria prevalent today for environmental impact, the most comprehensive is the carbon footprint

which provides a precise, accurate and robust measure that can fit in as an environmental impact criterion for supplier selection. Thus, the decision making approach in supplier selection must take into account the environmental impact of the suppliers vis-à-vis their carbon footprints [1–3].

Organizations are beginning to respond to environmental management obligations in many ways. These responses can be grouped as reactive or proactive tactics [4]. Not only are organizations aiming to reduce their own carbon footprint, but they are also beginning to demand the same from their suppliers.

A well known environmental policy mechanism which the suppliers can utilize to stay competitive on the “Green” front is Carbon emissions trading, also known as cap and trade. In a cap and trade system, government or regulatory authority also sets up a cap, or a limit, on how much carbon each company can emit. Companies may then reduce their emissions to stay below the cap, or they can operate above the cap and buy emission rights from another company. These emission rights, in terms of carbon emissions, are referred to as carbon credits. The fact that these credits can be traded across a variety of platforms presents an interesting arbitrage opportunity. A carbon cap and trade optimization model would essentially expose the optionality within such a trading scheme and utilize the

* Corresponding author.

E-mail addresses: Vipul.Jain@vuw.ac.nz (V. Jain), sameerkumar724@gmail.com (S. Kumar), amit.hooda.1511@gmail.com (A. Kumar), charu@umich.edu (C. Chandra).

economic arbitrage to earn maximum profits. This is essentially the theme of the proposed CMS–GDEA model, wherein the Carbon Market Model leverages the carbon market dynamics to make it profitable for suppliers while keeping the supplier competition intact.

The origins of cap and trade can be traced to the Kyoto Protocol. In response to the impact of emissions from organizational activities on the global environment, the Kyoto Protocol of 1997, since signed by 187 countries, introduced various measures. Since the Kyoto protocol ended in 2012, the fate of regulatory carbon markets has been uncertain. Experts believe that post 2012; a “Regulatory Gap” will result. This essentially means that there would be no legally binding commitments applicable for some duration. However, that has not been the case. For example, Ju et al. [5] presents carbon trading as a critical solution in the climate change solution mix and presents cases from U.S., Australia and China to support the fact. In fact, developing economies like India and China have been leveraging carbon trading as an effective tool for emission reductions [6,7].

The works cited in an earlier paragraph also point to the fact that voluntary markets would be thriving. In the context of supplier selection based on environmental criteria, this could very well define the competition. As suppliers would look to offset their carbon footprints in order to stay competitive, carbon markets would offer them a unique opportunity to stay competitive and would open up an economic avenue for suppliers as well. The methodology proposed in this study is largely based on this competitive advantage which would put the suppliers and buyers in a win–win situation on the environmental front.

Another way to look at it is the pressure applied on suppliers by the carbon trading mechanism. The suppliers are pushed to reduce carbon emissions across their operations and this provides Green ways to conduct their businesses. The resulting carbon market created out of this mechanism would make way for a fierce competition among suppliers in their bid to remain Green and make a positive impact [8]. In such a scenario, if a supplier chooses to cut costs only and not go Green they would lose a definite competitive edge. This is due to three reasons:

1. The inherent DEA model penalizes a supplier for not opting into a carbon management process such as carbon footprinting.
2. A supplier would also be penalized on ratings for not meeting the prescribed cap. For a supplier going heavily above the prescribed cap, the model is calibrated to give near zero ratings.
3. The DEA model has the carbon footprint as a dual role factor, which would impact the supplier rating hugely.

For an approach like CMS–GDEA to succeed, such a stringent approach is required to weigh in all the suppliers. Also, this approach has to be integrated into the buyer fraternity for large scale success. Success of approaches like GDEA [1], GA–GDEA [9] and GIS–GDEA [10] at a buyer level is an indicator that such approaches have potential if implemented across a region. There would tend to be buyers who would still continue to engage with cheap and nongreen suppliers, but the fact that approaches like GDEA and CMS–GDEA offer an economic arbitrage opportunity for suppliers to remain green, would soon overshadow the common viewpoint that being green is costlier. In the Green DEA (GDEA) methodology by Kumar et al. [1], a carbon footprint sensitive model for green supplier selection is implemented. This paper proposes an integrated buyer initiated approach for supplier selection considering both the objectives: cost cutting and environmental efficiency. The current study modifies the GDEA approach by incorporating a carbon market model and quantifying environmental violations as definite costs which would play a role in the supplier selection process. The

advantages of the proposed CMS–GDEA approach over the previous GDEA approach are:

- As the environmental violations are quantified as costs, these can be direct inputs to the DEA model. This eliminates the need to calibrate the violations (using absolute weight restrictions) to suit the DEA formulation. This is a certain improvement over GDEA as it eliminates the need for emission penalties in GDEA which tend to make the pure DEA approach unstable by introducing an additional calibration step to account for allowances in the DEA objective itself.
- A more comprehensive Carbon Trading Model is proposed. The GDEA approach permitted allowance trading as a penalty for violation of emission norms. The proposed carbon trading model takes all types of carbon markets into account.

The modified approach is referred to as CMS–GDEA (Carbon Market Sensitive GDEA). The CMS–GDEA approach is applied to a well-known automobile spare parts manufacturer in India as a buyer and the results are presented. The results indicate that CMS–GDEA is a relaxation over GDEA and boosts supply chain profitability by extracting favorable arbitrages out of the carbon trading mechanism.

The rest of the paper is structured as follows. Section 2 presents the literature reviewed and the gaps in literature along with the motivation for this research. Section 3 presents the CMS–GDEA model in detail. Section 4 provides a numerical industrial example to substantiate the CMS–GDEA approach. Section 5 describes research findings and implications of this research study. Finally, Section 6 presents the conclusion and scope for further work.

2. Learning from the literature

This section presents literature review generally in the areas of supplier selection and DEA; carbon footprinting and carbon trading; green supply chain management; and green supplier selection.

2.1. Supplier selection and DEA

Various mathematical approaches have been proposed in literature for supplier selection. Kumar et al. [1] review some of these approaches and point out a major flaw with the majority of these approaches in that they assign arbitrary weights which are subjective and based on surveys and questionnaires. This can lead to inaccurate results, as it is very difficult to accurately assign numbers to preferences. Also, these models do not scale well as the number of performance criteria are increased. Thus, Kumar et al. [1] suggest DEA as a robust approach to supplier selection. Unlike the previous approaches, the proposed approach builds on the existing Green DEA model [1] and adjusts it to include a carbon market model. The proposed approach encourages the suppliers to “go green” and cut down their carbon footprints or “pay up” to comply with emission norms along with the cutting costs, thus adding to a healthy competition. It is worth mentioning that the proposed CMS–GDEA approach also provides a modest structure for integrating region specific emission norms and compliance standards.

2.2. Carbon footprinting and carbon trading

This section presents selected literature on carbon footprinting and carbon trading.

Carbon footprinting provides accurate measure to assess a supplier's eco-efficiency [11,12]. Wiedmann and Minx [13] examine the inconsistency with different usages of the term “Carbon Footprint” and suggest a definition based on normally accepted

Download English Version:

<https://daneshyari.com/en/article/8048482>

Download Persian Version:

<https://daneshyari.com/article/8048482>

[Daneshyari.com](https://daneshyari.com)