Chapter 83
Measuring Low Carbon Supply Chain

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ABSTRACT

The threat of climate change is due to increasing carbon emissions of manufacturing production and transportation. Currently, government is encouraging manufacturing to reduce carbon emission and conduct low carbon supply chain management (LCSCM). In order to solve the greenhouse gas emission dilemma, LCSCM is essential for manufacturing firms' stakeholders. Supply chain partners are expected to know the proper measurement of emissions to solve this problem. This chapter's aim is to review literature on how to measure LCSCM. In the past, the concept of green supply chain management (GSCM) was practiced to promote and reduce environmental risks. However, GSCM is a driver or practice to achieve environmental outcomes. The extended model of GSCM currently practices LCSCM through carbon footprint (CF) concept. In other words, LCSCM is an outcome that both interests researchers and persuades practitioners.

INTRODUCTION

Environmental management is an important issue that has attract numerous scholars and practitioners especially the issue of climate change. Recently, scholars and practitioners are concerned with raising greenhouse gasses (GHGs) especially carbon emission and its impact on climate change (Palak, Ekşioğlu, & Geunes, 2014). GHGs are dangerous but the world governments have taken initiative to control the release and used of these gasses except Carbon Dioxide. Carbon emissions are not specifically produce by manufacturer but almost by all activities. Thus, climate change mitigation strategy, which carbon emission as the main threat has been regard as very important. The mitigation strategy includes carbon taxes, carbon trading, clean development and joint implementation that can be found in Kyoto Protocol

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mechanism. The mitigation strategies for carbon emissions are adopted by government by introducing government regulation (Choudhary, Sarkar, Settur, & Tiwari, 2015). On the other hand, firms also need to adhere to government regulation and adopting carbon reduction strategies to meet their customer requirements and to remain competitive (Seuring, 2013). To do so, firms are expected to increase their competitiveness through Low Carbon Supply Chain Management (LCSCM) by practicing Carbon Footprint (CF). The definition of CF is the recording of carbon emissions throughout the life cycle of a product (Wiedmann & Minx, 2007).

In order to record carbon emissions, the concept of LCSCM need to be understood. As proposed by Böttcher & Müller (2015), LCSCM consists of three groups of practices. The first is development of low carbon products in all product development process by assessing and reducing carbon emissions as well as achieving eco-design. The second practice is low carbon production process where monitoring and reduction of carbon emissions should apply in all production process until the final goods. The third practice focuses on low carbon logistics because transportation activities contribute significantly to increasing of carbon emissions. These practices are helping firms to develop carbon mitigation strategy and choose the best strategy to be implemented. As a result, firms now are able to identify and measure carbon emissions at operational and management settings.

BACKGROUND

As LCSCM is recently growing in importance, scholars and practitioners have started to put more interest in measuring carbon emission. In the literature, there are many scholars focusing on carbon emission measurement methods but lack of empirical data (Lee, 2011). Scholars then shift their focus in developing measurement methods and model to help practitioners to record and measure their carbon emissions using data generation (Bai, Sarkis, Wei, & Koh, 2012; Schmidt, 2009). However, there are also a few studies done by scholars using real firm or industrial data (Burnett, 2011; Cadarso, Gómez, López, & Tobarra, 2016; Lee, 2012; Nakajima, Kimura, & Wagner, 2014; Palak et al., 2014; Pelletier, Ibarburu, & Xin, 2013; Rahman & Khondaker, 2012; Tsai, Lin, Hwang, & Huang, 2014; Yusuf et al., 2013; Zhao, Neighbour, Han, McGuire, & Deutz, 2012; Zubelzu & Álvarez, 2015). Yet, the difficulty to get real data have seen many scholars using qualitative studies to measure LCSCM (Dadhich, Genovese, Kumar, & Acquaye, 2014; Dayaratne & Gunawardana, 2015; Gopalakrishnan, Yusuf, Musa, Abubakar, & Ambursa, 2012; Lee, 2012; Pueyo, 2013).

Difficulties in getting data also complicates the study of LCSCM. For example, in the study of Bai et al. (2012), environmental performance measurement does not give any information that can be implemented by practitioners. Another important gap in the literature is that scholars are divided between management and engineering focus when measuring LCSCM. There are a few scholars in management focus where their interest of studies are contributing to top management firm, policymakers' regulation and using management theories (de Sousa Jabbour, Jabbour, Latan, Teixeira, & de Oliveira, 2015; Fernando, Shaharudin, & Wahid, 2016; Gunasekaran & Spalanzani, 2012; Jabbour, Neto, Gobbo, de Souza Ribeiro, & de Sousa Jabbour, 2015; Lee, 2011; Matthews, Hendrickson, & Weber, 2008; Sarkis, Zhu, & Lai, 2011; Seuring, 2013; Shaharudin & Fernando, 2015; Zhu, Sarkis, & Lai, 2013). On the other hand, engineering focus scholars measure LCSCM using engineering theories such as Game Theory (Zhao et al., 2012), Chaos Theory (Stapleton, Hanna, & Ross, 2006), Swift Even Flow Theory (Seuring, 2009), Graph Theory (Wagner & Neshat, 2010), Neo-Institutional Theory (Genus & Mafakheri,