



# Integrating sustainable development in the supply chain: The case of life cycle assessment in oil and gas and agricultural biotechnology

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## Abstract

It is widely accepted that firms play an important stewardship role in addressing sustainable development concerns. A key challenge in this role is to balance the often conflicting pressures created by sustainable development—firm-level economic performance versus environmental degradation and social disruption. Drawing on complexity theory, risk management, stakeholder theory and the innovation dynamics literature, we discuss the problems of integrating sustainable development concerns in the supply chain, specifically the applicability of life cycle assessment (LCA). Many authors have emphasized the importance of the “cradle to grave” approach of LCA in optimizing closed-loop supply chains, improving product design and stewardship. Based on two case studies (an agricultural biotechnology and an oil and gas company) with supporting data collected from key stakeholders, we argue that sustainable development pressures have increased complexities and presented ambiguous challenges that many current environmental management techniques cannot adequately address. We provide a framework that addresses these deficiencies and discuss implications for practitioners and management theory.

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*Keywords:* Life cycle assessment; Sustainable development innovation; Complexity theory

## 1. Introduction

It is widely recognized that firms play an important stewardship role in addressing sustainable development pressures, and such concerns have become part of many companies’ operational and competitive strategies (Angell and Klassen, 1999; Bansal and Roth, 2000; Hart, 1995, 1997; Hart and Milstein, 1999; Porter and Van der Linde, 1995; Shrivastava, 1995; Sharma and

Vredenburg, 1998). A number of authors have emphasized the importance of such tools as life cycle assessment (LCA) to optimize closed-loop supply chains as well as improve product design and stewardship (e.g. Krikke et al., 2004; Sarkis, 2001; Sroufe et al., 2000). The “cradle to grave” approach of LCA that extends throughout the supply chain represents an evolution over environmental assessments focused on firm-specific impacts and end-of-pipe analyses, and is now part of many organizations’ broader sustainable development efforts (Mihelcic et al., 2003). Such an approach is theoretically elegant when key interacting variables and boundaries of responsibilities are well understood. Unfortunately, such situations are rare, while the benefits from sustainability efforts have been

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