



## Lean management and supply management: their role in green practices and performance

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### ABSTRACT

Organizations are faced with increasing pressure to engage in sustainable development and to integrate environmental and social dimensions into their traditional performance metrics. Prior research suggests that lean management and supply management are potentially important determinants of environmental performance and can be seen as capabilities that ease the adoption of environmental practices. To help understand the roles of lean and supply management in regards to improving the firm's environmental performance, a conceptual model proposes that the magnitude of environmental practices mediates the relationship between lean and supply management with environmental performance. To test the model, plant-level survey data from a sample of Canadian manufacturing plants is used. The results indicate that supply management and lean activities provide means by which resources are invested in environmental practices. The empirical analysis also confirms that the impact of lean management, and to a lesser extent supply management, on environmental performance is mediated by environmental practices.

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### 1. Introduction

As manufacturing corporations develop know-how and capabilities for cleaner production, research must continue in its quest to better understand potential linkages between operations/supply chain systems and environmental performance. This paper aims to examine how two of these systems, namely lean management and supply management, impact environmental performance. In particular, a conceptual model is developed suggesting that lean management and supply management can have an indirect effect on environmental performance by supporting the development of environmental practices which in turn impact performance — that is environmental practices mediate the impact of lean and supply management on environmental performance.

Several studies fall under the label of “lean and green” (Florida, 1996; King and Lenox, 2001) or “green supply chain” (Vachon and Klassen, 2006a; Vachon and Mao, 2008), but only a few have analyzed both issues simultaneously (Mollenkopf et al., 2010). For instance, some studies have looked at the synergy existing between

lean management and environmental management practices (Florida, 1996) while others concentrated more on the link between lean management and environmental performance (King and Lenox, 2001; Rothenberg et al., 2001).

Similarly, a segment of the literature has linked supply management activities with environmental management (Bowen et al., 2001; Vachon, 2007) while another segment has focused on the link between supply chain management and environmental performance (Rao, 2002; Vachon and Klassen, 2006b). For instance, Vachon and Klassen (2007) present empirical evidence indicating that buyer–supplier integration is related to the type of environmental investment made in the buyer's plant. Building on evidence from case studies in the United Kingdom and Japan, Hall (2000) concludes that a buying organization's understanding of its suppliers' operations and capabilities is key in developing a green supply chain and that such understanding can only be achieved by a sound supply management.

The literature appears to have parallel paths for the research that have addressed the lean–green and supply–green linkages: one series of studies focuses on the fit between lean/supply management and environmental practices and another examines the link with environmental performance. Building on the fact that environmental practices are generally linked to environmental performance (Klassen and Whybark, 1999b; Melnyk et al., 2003), the question becomes, is the link between lean/supply

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management and environmental performance a direct relationship or is it a relationship mediated by environmental practices. Despite a fair number of studies on these topics, very few studies (if any) have simultaneously addressed environmental management practices, operation/supply chain systems, and environmental performance. Hence, this paper's main objective is to empirically assess the effect of lean and supply management on the extent of environmental practices and environmental performance in manufacturing organizations.

This paper contributes to the operations management literature in three ways. First, a theoretical model is developed linking the four constructs of interest for this study: lean management, supply management, environmental practices, and environmental performance. Another contribution is to empirically assess the mediating effect of environmental practices on the relationship between lean management, supply management and environmental performance. Such a mediating effect has not been assessed in the literature and is important in clarifying the role of lean management and supply management regarding environmental management or performance: are lean management and supply management directly linked to environmental performance? Finally, the paper has a managerial contribution because its results can guide managers in setting a suitable operating context for adopting and implementing environmental practices within their organization.

There are five additional sections to this paper. First, the literature streams on lean management, supply management, and environmental management (practices and performance) are reviewed leading to the development of the conceptual model and hypotheses. Next, in Section 3, the survey methodology and construct measurement are detailed. The results are presented in Section 4. In Section 5, the results are contextualized and the research implications are discussed. A synthesis of the paper including the limitations of the study makes up the concluding section.

## 2. Literature review and conceptual model

Drawing from lean management, supply management and environmental management literatures, the four constructs of interest as well as a series of hypotheses linking these constructs are presented in this section. According to the research question and objective of this paper, lean management as well as supply management can lead to improved environmental performance, but their influence can be mediated by the level of a firm's environmental practices.

### 2.1. Environmental practices and environmental performance

An overview of the different environmental technologies potentially adopted by manufacturing organizations can help to better appreciate the notion of environmental practices. Environmental technologies, widely defined to include managerial techniques and procedures which control or eliminate the negative impacts of products or services on the natural environment (Shrivastava, 1995), have been classified in the literature into three mutually exclusive categories of pollution prevention, pollution control, and management systems (Klassen and Whybark, 1999a). The profile of environmental investments can take the form of any combinations of these three technologies; it is important to note that the total investment (the level of resources invested) is independent of its form (Klassen and Vachon, 2003; Klassen and Whybark, 1999b; Vachon and Klassen, 2007). While all three categories aim at improving environmental performance, technologies that address pollution at the source are generally recognized generating other benefits such as cost reduction and the

development of valuable resources (Hart, 1995). This type of technology is of interest for this paper and would generally be associated with pollution prevention (structural investments to reduce pollution at the source) and management systems (infrastructural investments) (Klassen and Whybark, 1999a,b; Vachon and Klassen, 2007). Therefore, we define *environmental practices* as the level of resources invested in activities and know-how development that lead to pollution reduction at the source. It includes efforts to implement environmental management systems (e.g., ISO 14001), reduce waste, or recycle materials.

Environmental practices and organizational performance (including environmental performance) have been theoretically linked through the natural resource-based view (NRBV) of the firm (Hart, 1995). The NRBV proposes that organizations, through proper environmental management, can develop capabilities that are valuable, rare and difficult to replicate by competitors (Russo and Fouts, 1997). Therefore, according to the NRBV, a firm can gain competitive advantage by pursuing environmental strategies such as pollution prevention or minimizing emissions, effluents and waste (Hart, 1995; Russo and Fouts, 1997). Within the NRBV framework, several studies have provided empirical evidence to support the linkage between investment in and adoption of environmental practices within a firm or across its supply chain and its environmental performance. For instance, manufacturing structural investments aiming to reduce pollution at the source (Klassen and Whybark, 1999b), facility-level resource conservation practices (Pullman et al., 2009) and environmental proactivity (Russo and Fouts, 1997) were all positively linked to environmental performance.

*H1: The extent of environmental practices is positively associated with environmental performance.*

### 2.2. Lean management and the environment

The term *lean production* is associated with the Toyota Production System where it is integrated with just-in-time tactics in order to improve quality and delivery time. Many researchers argue that lean management encompasses a set of inter-related, complementary and mutually reinforcing operating practices — often referred to as bundles — that aim at reducing or eliminating non-value-added activities throughout a product's entire value stream, within an organization and along its supply chain network (Narasimhan et al., 2006; Shah and Ward, 2003, 2007; Vonderembse et al., 2006). They also suggest that the implementation of these practices is associated with higher operational performance, such as a reduction in customer lead time, manufacturing cycle time or manufacturing costs, and an improvement in labor productivity and quality (De Treville and Antonakis, 2006; Hopp and Spearman, 2004; Sherrer-Rathje et al., 2009; White et al., 1999).

Given that manufacturing operations through product design and process technologies can critically influence environmental performance (Hart, 1995), the relentless pursuit of waste minimization embedded in lean management practices (Womack and Jones, 2003), opens doors for continued efforts in reducing the risk for the environment (Florida, 1996). In fact, waste is the common denominator for lean and green management (Porter and van der Linde, 1995). The continuous effort through lean management to reduce operational waste either from discarded materials, consumption of energy, or water usage translates into lower environmental harm, thus enhancing environmental performance (King and Lenox, 2001).

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