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Environmental projects and financial performance: Exploring the impact of project characteristics

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ABSTRACT

In several manufacturing organizations, environmental management systems are often operationalized through a series of green projects that can lead to a reduction of waste or a more efficient use of the resources. In turn, these types of green projects contribute directly to the bottom line. Using detailed reports of 79 environmental projects that took place in manufacturing organizations in the Province of Quebec over the last decade; this paper examines the influence of four project characteristics on the project's financial outcome. The results suggest that projects related to the main product or its underlying production process (as opposed to peripheral projects) can be financially more beneficial despite their disruptive nature. Evidence was also found that green projects involving changes in the management systems are more profitable than the ones that entail a structural transformation. Finally, a positive linkage between organizational size and project's financial performance has been supported, as larger organizations have more capabilities to implement such green initiatives.

1. Introduction

Over the last decade, manufacturing organizations have been scrutinized in regards to their impact on the natural environment. While some organizations have been proactive by embracing green manufacturing practices without being forced by regulatory obligations, others have not. *Green manufacturing* focuses on the implemented sets of practices and resources deployed by organizations to address environmental challenges (de Ron, 1998). Several studies related to green manufacturing have emphasized environmental management systems (Barla, 2007; Melnyk et al., 2003), environmental technologies selection (Klassen and Whybark, 1999b; Vachon, 2007), and internal pollution reduction (King and Lenox, 2002). This segment of the environmental management literature has also explored the linkages of green manufacturing with activities pertaining to quality management (Curkovic et al., 2000; Pil and Rothenberg, 2003), lean management (Florida, 1996; Rothenberg et al., 2001), and product design (Chen, 2001). All of these studies are using the plant, the business unit/division or the firm as unit of analysis examining environmental management as bundle of different green practices. The different characteristics that can affect (or not) the positive outcome of environmental projects taking place in manufacturing organizations have not been widely studied thus, constituting the main motivation behind this paper (Cagno et al., 2005).

Several manufacturing giants have adopted company-wide green manufacturing programs with documented success. These programs are largely project-based. For example, General Electric's *Ecomagination* has embodied the organization's vision to supply cleaner technologies to their customers around the world (Fisher, 2005). 3M's *pollution prevention pays* program generated several million dollars in savings through employee-driven projects (Reed, 2002). Even within an ISO 14001 certified managements system, corrective and preventive actions would take the form of experimental and/or improvement projects (Kitazawa and Sarkis, 2000).

Using the data from 79 environmental projects conducted in manufacturing organizations in the province of Quebec (Canada), this paper aims to examine the impact of four characteristics—type of the project, focus of the project, project size, and organization size—on the project's financial performance. The project type is linked to the kind of investments and expenditures (i.e., structural vs. infrastructural) deployed for the project. The project focus is related to the operational criticality of the project. For instance, a project can target directly the core products or its underlying production process or, in contrast, target less critical and peripheral elements of the operations (e.g., ventilation, cleaning, etc.).

This paper contributes to the operations management field in a variety of ways. First, there are very few studies (if any) that have addressed the linkage between green manufacturing and financial

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returns using the project as an unit of analysis (Cagno et al., 2005), most of the studies are at the organizational level (Yang et al., 2011). Such a unit of analysis allows testing a direct link between financial performance and environmental management which eliminates the noise from more general organizational setting. Hence, it also establishes a direct and causal link between environmental management and financial performance, an empirical contribution to the field. By developing the argument that brings together specific aspects of environmental projects (particularly the project type and focus) and project financial performance constitutes a theoretical contribution. Finally, it is also noteworthy that all of the projects included in this study had a positive financial return as they were all creating a net benefit through reductions in pollution at the source (e.g., reduction in energy consumption, packaging, inputs, etc.).

In the next section, a brief literature review will set the stage for a series of hypotheses to be tested. In Section 3, the research methodology including the measurement aspects of the study is presented. The empirical analysis takes place in Section 4 followed by a discussion of the results and concluding remarks in Section 5.

2. Literature review and research hypotheses

The positive benefits from green manufacturing have been theorized in the literature either through Porter's Hypothesis or the natural-resource-based-view (NRBV) of the firm. The Porter Hypothesis suggests that pollution is a form of waste, that if eliminated will improve productivity (Porter and van der Linde, 1995). The NRBV proposes that capabilities difficult to replicate by competitors can be developed with proper environmental management practices (Hart, 1995; Russo and Fouts, 1997).

Several studies have empirically linked organizational performance to environmental management (King and Lenox, 2002; Klassen and McLaughlin, 1996). It is particularly true with green activities that reduce pollution at the source (Vachon and Klassen, 2006; Zhu and Sarkis, 2004) also known as pollution prevention activities. Environmental management that puts an emphasis on pollution prevention was linked to better cost performance (Christmann, 2000), better financial returns (King and Lenox, 2002), and higher stock price (Konar and Cohen, 2001). While these studies are insightful they remain at the organizational level and often, they make very little distinction among the different environmental management approaches adopted and implemented in the organization (e.g., environmental technologies, management systems, voluntary code of conduct, pollution abatement, etc.). In this paper, the unit of analysis is the environmental project and a characterization of these projects is proposed in order to assess the link with the projects' financial performance. The characterization is developed along the project's (i) type, (ii) focus and (iii) size.

2.1. Type of environmental projects

The concept of environmental management at the organizational level can be defined by considering the way resources (e.g., money and time) are deployed within environmental management efforts (Klassen and Whybark, 1999a; Shrivastava, 1995). At the most basic level environmental management efforts are categorized as either pollution abatement (assuring that pollution does not reach the natural environment) or prevention (reduction of pollution at the source) (Hart, 1995; Sarkis and Cordeiro, 2001). A more refined typology using the nature of the investments/spending in environmental efforts (widely defined to include equipment, materials and managerial procedures) was proposed in the literature. The typology makes a distinction between structural investments and infrastructural investments (Hayes and Wheelwright, 1984; Klassen and Whybark, 1999a; Vachon and Klassen, 2007) and categorizes environmental investment and spending into three main groups: (i) pollution control, (ii) pollution prevention and (iii) management systems (Klassen and Whybark, 1999a). For Klassen and Whybark (1999b) there is a fundamental difference between pollution prevention technologies and pollution control technologies. While both imply *structural changes* in the production processes or product specifications, pollution prevention aims at reducing the pollution at the source and therefore, can create value, which is not necessarily the case with pollution control (Angell and Klassen, 1999; Shrivastava, 1995; Vachon and Klassen, 2006).

The first type of project considered here are projects that are reducing pollution at the source using essentially structural changes to the product or the process in a manner consistent with the literature we term these types of projects as pollution prevention projects. The second type of project refers to infrastructural changes reducing pollution at the source and is labeled as a management system project.

In their study of the furniture industry, Klassen and Whybark (1999a) found that a greater emphasis on pollution prevention technologies lead not only to better cost performance but also better delivery performance. It is noteworthy that investments in management systems were not statistically linked to operational performance in their study. Similar results were found by King and Lenox (2002). They used the toxic release inventory (TRI) data in the United States and firms' financial data to assess the linkage of different approaches of waste management (prevention, treatment, transfer) with financial performance (returns on assets and the Tobin's q): their key finding was that waste prevention led to a financial gain. However, their study was not able to distinguish between structural and infrastructural aspects of waste reduction. Finally, Zhu and Sarkis (2004) presented evidence that product eco-design (i.e., structural investment) was positively related to economic performance using data collected in China.

While pollution prevention technologies (*structural changes*) reduce pollution at the source, management systems (*infrastructural changes*) can also be conducive to pollution reduction at the root through procedural changes and/or different ways of conducting the operations. However, a pollution prevention technology with structural changes in either the products (input substitution, specifications, design, etc.), process (equipment retrofits, machine replacement, etc.), or on the building (heating and ventilation, retrofits) requires potentially more important changes than modifying procedures or working habits (management systems). This primary distinction between both types of projects becomes important when we consider the degree of complexity and uncertainty implied in a project.

Project complexity can be viewed as the degree of organizational and technological interactions between the different steps in order to complete a project and this is also referred in the literature as structural complexity (Baccarini, 1996; Geraldi et al., 2011). Organizational complexity is often linked to the number of different departments or business units involved in the project (Baccarini, 1996). Technological complexity emerges from the number of tasks/components and the degree of interdependence among them (Vachon and Klassen, 2002). Technological complexity can also be linked to the knowledge needed to complete the project: for example, complexity in a six sigma improvement project increases with the level effort in the data collection and the knowledge needed to perform the analysis (Nair et al., 2011). Empirical evidence examining the linkage between project complexity and its performance suggest that structural complexity is negatively correlated with project performance (Xia and Lee, 2004).