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Understanding environmental-operations integration: The case of pollution prevention projects

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ABSTRACT

To achieve environmentally sound manufacturing processes, environmental management (EM) and operations management (OM) need to be implemented in an integrated manner. The literature characterizing the relationship between EM and OM has broadly investigated the positive effects of environmental practices on plant performance, but has paid little attention to their implementation. However, there is not a unique way to implement EM–OM, and different levels of integration might be attained. We draw on the contingency approach and project management literature to study how and under what conditions EM–OM might be integrated. Based on the analysis of six pollution prevention projects at three large multinational firms, we find that EM–OM integration is contingent upon the degree of project uncertainty and project complexity.

1. Introduction

Environmental programs, such as the ISO14001 certification standard, Responsible Care in the chemistry industry, McDonalds' replacing Styrofoam containers, and Dow Corporations' WRAP, have been acclaimed worldwide both by scholars and practitioners. Literature classifies these initiatives as pollution prevention projects (PPPs) that, compared to pollution control projects, draw on activities and technologies that change the structure of manufacturing processes or products through the adoption of environmentally friendly resources (Hart, 1995; Klassen and Whybark, 1999b). Several contributions highlight the opportunities of these projects in terms of improved resource exploitation, better product quality, more productive workforce, etc. (Porter and van der Linde, 1995; Hart and Ahuja, 1996; Sharma and Vredenburg, 1998; Christmann, 2000; Pil and Rothenberg, 2003; Gonzalez-Benito and Gonzalez-Benito, 2005; Sharma et al., 2007; Schoenherr, 2011). In many cases, such opportunities are enhanced by the adoption of advanced manufacturing techniques (e.g., just-in-time, total quality management, continuous improvement), which reduce costs and time related to the introduction of environmental management practices (Aragon-Correa and Sharma, 2003; Russo and Harrison, 2005; Pagell and Gobeli, 2009; Huang and Wu, 2010; Yang et al., 2011). While these studies have provided considerable insights into our understanding of the benefits of the interaction between environmental management (EM) and operations management (OM), very little attention has been devoted to the underlying contextual factors that possibly affect such interaction and characterize it.

The present study explores the EM–OM relationship by focusing on how environmental and manufacturing practices are implemented together. To thoroughly capture the complexity of this phenomenon, we build on the construct of integration between EM and OM decision areas. In particular, EM–OM integration is analyzed by drawing on the contingency approach within the project management literature. We adopt a case study methodology to investigate six pollution prevention projects (PPPs) by three large multinational companies. Projects are temporary organizational structures that undertake special and *ad interim* decisions and actions by using a set of resources to realize a unique scope within budget and time constraints (Turner, 1993). Hence, our focus is the environmental project whereby environmental strategies are operationalized (Klassen and Whybark, 1999a; Vachon and Klassen, 2007). The project level of analysis allows us to adopt a micro approach to decision-making processes encompassing environmental and operations actions and practices. Our results highlight that project characteristics, namely uncertainty and complexity, affect the extent to which EM and OM are implemented in an integrated manner within the plant.

This research makes significant contributions to different streams of literature. First, extant literature has barely investigated the project itself, but has instead focused on organization or the

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business unit (Cagno et al., 2005; Thoumy and Vachon, 2012), thus neglecting an important *locus* for environmental management strategies. Second, it enhances our understanding of how environmental practices interact with manufacturing practices (Sharma and Vredenburg, 1998; Aragon-Correa and Sharma, 2003; Sharma et al., 2007; Gonzalez-Benito and Gonzalez-Benito, 2008). In particular, we highlight that the integration between environmental and operations decision areas greatly affects the implementation of environmental and operational practices. Third, the research provides original insights into the contingency approach by investigating the effects of project contextual factors on PPPs, which allows us to explore how such factors affect the implementation of environmental management initiatives (Aragon-Correa and Sharma, 2003; Puranam et al., 2012).

2. Theoretical background

2.1. The relationship between EM and OM

The relationship between EM and OM has generally been studied to assess its existence and synergy on plant performance (e.g., Florida, 1996; King and Lenox, 2001; Rothenberg et al., 2001; Pil and Rothenberg, 2003; Yang et al., 2010; Galeazzo et al., in press). Several authors advocate that EM has to be integrated and may benefit from the joint implementation with OM (e.g., Christmann, 2000; Hajmohammad et al., 2013). In her empirical study, Christmann (2000) finds that environmental practices need to be complemented by organizational and operational assets in order to gain a competitive advantage. Going one step further, Gonzalez-Benito (2008) suggests that successful plants implementing a continuous improvement approach and having a flexible and skilled workforce show a proactive environmental attitude towards production processes and external logistics. Moreover, Yang et al. (2011) maintain that plants with a JIT production system are more likely to adopt a proactive environmental approach. Likewise, Gonzalez-Benito and Gonzalez-Benito (2008) find that cultural proactivity leads to the adoption of the standard ISO 14001 and technical proactivity facilitates its implementation within the plant. Advanced manufacturing techniques, thus, create organizational routines that facilitate the implementation of environmental practices (Gavronski et al., 2011; Zhu et al., 2013).

Overall, scholars agree that the joint implementation of environmental practices and manufacturing practices leads plants to ultimately improve their performance (Christmann, 2000; Klassen, 2000; King and Lenox, 2001; Rothenberg et al., 2001; Pil and Rothenberg, 2003; Yang et al., 2010).

2.2. EM–OM integration

Few studies have investigated the integration of environmental management in the manufacturing area (Gupta, 1995; Matias and Coelho, 2002; Handfield et al., 2005; Vachon and Klassen, 2007; Johansson et al., 2007). For example, Gupta (1995) suggests that EM provides competitive results when it is fully integrated with OM. Moreover, Johansson et al. (2007) investigate the design/environment integration by focusing on mechanisms, such as the use of technological tools and inter-functional teams, to facilitate eco-design in new product development projects. However, none of these studies, to the best of our knowledge, focus on how environmental issues are integrated into production processes, which is an important topic of discussion (Angell and Klassen, 1999). Indeed, the integration of EM–OM decision areas influences the decision-making processes pertaining the implementation of environmental and operational practices.

The definition of integration underlies a multi-dimensional construct, and collaboration and interaction are the most prominent dimensions (Kahn, 1996; Kahn and McDonough, 1997; Kahn and Mentzer, 1998; Kahn, 2001; Pagell, 2004; Garrett et al., 2006). As Kahn and McDonough (1997) maintain, collaboration refers to the "willingness of departments to work together, having mutual understanding, having a common vision, sharing resources, and achieving collective goals" (p. 56) and interaction refers to "the communication and information exchange activities between departments" (p. 56). Similarly, O'Leary-Kelly and Flores (2002) conceptualize integration as "the extent to which separate parties work together in a cooperative manner to arrive at mutually acceptable outcomes" (p.226). Therefore, we define EM–OM integration as the extent to which individuals collaborate and interact together to pursue objectives that are mutually agreed upon.

Integration is often described as a continuum from low to high (Kahn and Mentzer, 1998; Pagell, 2004; Mollenkopf et al., 2011). Several studies have demonstrated that high internal integration is normally associated with positive operational and financial performance (Kahn and Mentzer, 1998; Hausman et al., 2002; Vandevelde and Van Dierdonck, 2003; Swink and Nair, 2007; Swink and Song, 2007; Swink et al., 2007; Furlan et al., 2011a, 2011b; de Menezes et al., 2010; Paiva, 2010; Turkulainen and Ketokivi, 2012). Despite this strong evidence, only a few studies have explored how firms can achieve tight levels of integration (Kahn and McDonough, 1997; O'Leary-Kelly and Flores, 2002; Pagell, 2004; Johansson et al., 2007; Wong and Boon-itt, 2008; Wong et al., 2011). From these studies, it emerges that collaboration and interaction among different decision areas is achieved by developing effective information systems and inter-functional teams and relying on top managers' support and trust throughout the organization (O'Leary-Kelly and Flores, 2002; Hausman et al., 2002; Pagell, 2004; Oliva and Watson, 2011).

We explore these studies to address the issues of integration among environmental and operational decision areas. Specifically, we draw on operations management literature to define the construct of integration and on the contingency approach to project management literature to explore the contextual factors affecting such integration.

2.3. Contingency approach to project management

According to the contingency approach, no action, strategy, or organization can be effective if it does not fit its business environment (Burns and Stalker, 1961; Lawrence and Lorsch, 1967; Thompson, 1967). Business environment is characterized by factors that are out of managerial control and that shape the constraints under which structures and processes can be designed (Swamidass and Newell, 1987; Ward et al., 1995, 2007; Ward and Duray, 2000; Sousa and Voss, 2008). Inconsistencies between the structure and processes of an organization and its context often hinder optimal performance (Miller, 1992; Anand and Ward, 2004; Nair et al., 2011). The contingency approach seeks to identify those relevant contingency variables (also called contextual factors) that are behind the achievement of successful results at any level of organization and affect structural and process-related decisions and actions.

Recently, the contingency approach has been applied to project management literature (Shenhar, 2001; Shenhar and Dvir, 2007; van Donk and Molloy, 2008; Sauser et al., 2009; Howell et al., 2010). Scholars have investigated the congruence between contextual factors and project characteristics, highlighting that the "one size fits all" approach is not an effective solution (Shenhar, 2001). Pich et al. (2002) propose a model of project management strategies that effectively responds to the ambiguity of information: as project complexity increases, project members adopt a flexible managerial approach that allows them to deal with new information. Shenhar and Dvir (2007) present the NTCP diamond

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