

# Safety Culture: A Catalyst for Sustainable Development

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**Abstract** The present paper investigates the potential benefits of a strong safety culture (SC). Specifically, we build on the organizational support theory to explore the direct and indirect effects of SC on firm performance. Partial least squares method is used to analyze the data collected from a survey among 251 Canadian plants. The results show that SC is associated with several performance indicators all linked to sustainable development (i.e., environmental, financial, and safety performance). Importantly, our findings also suggest that the relationships between SC and environmental/safety performance are mediated by the actual level of implemented environmental/safety practices within plants. We conclude the paper by highlighting the study's limitations and contributions as well as theoretical and managerial implications.

**Keywords** Sustainable development · Workplace safety · Environmental management · Safety culture · Organizational support theory · Survey research

## Introduction

During the past three decades, sustainability has become an important strategic objective for businesses. Based on this concept, companies should operate in ways that secure their long-term economic performance by avoiding short-term behaviors which are socially detrimental or environmentally

wasteful (Porter and Kramer 2006). The organizations' growing interest in sustainability can be attributed to the increasing internal and external pressures (Sarkis et al. 2010) and to the risk of losing sales and even jeopardizing their survival (Ehrenfeld 2005). In addition, organizations have realized that they can enjoy cost savings and gain long-term competitive advantage by being concerned about the future of people and planet and through the creation of unique sustainability-oriented processes (Hart 1995).

This paper focuses on the internal dimension of “sustainable operations management” as defined by Kleindorfer et al. (2005), and how it affects the financial, environmental, and social performance of the organization. This dimension consists of (i) the management of human resources, health and safety at work, and adaptation to change, and (ii) the management of environmental impacts and natural resources. Specifically, the emphasis is on environmental management and workplace safety. Although both of them became important social responsibility issues during the 1970s, the green movement seems to have gained much more scholarly attention and despite their similarities, to date, there has been a lack of research to establish a link between the two (Cantor 2008). The number of occupational safety research publications in top operations management journals has also remained extremely low (Das et al. 2008; De Koster et al. 2011). There are limited evidences in the operations management literature to show that managerial attention to employees' safety actually leads to improved performance (Das et al. 2008). Yet the need for improving workplace safety is pressing. Each year, millions of people suffer disabling injuries and thousands are killed at the workplaces throughout the world. In the United States, nearly 4,690 work-related fatalities and 3.1 million nonfatal occupational injuries and illnesses have been reported in 2010 (Bureau of Labor Statistics 2010). The Occupational

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Safety and Health Administration (OSHA) estimates that organizations pay almost \$1 billion per week to injured employees and their medical care providers (Cantor 2008).

In order to fill the gap in the current literature regarding the conjunction of occupational safety and ecological sustainability, this study attempts to address two major research questions: “Are the organizations promoting occupational safety for their employees more likely to join the green movement?” And, “Does an organization’s safety culture (SC) have a spillover effect on its environmental endeavors and financial performance?” In doing so, we draw on the SC literature and organizational support theory (Eisenberger et al. 1997) to explain how the employees motivated by organization’s SC and their management commitment in improving workplace safety, help the organization enhance its financial performance and effectively adopt environmental practices (EPR) and improve its environmental performance. Similar to McFadden et al.’s (2009) proposed culture–initiative–outcome model for patient safety in the healthcare industry, we also suggest that a positive workplace SC encompassing two critical components, that is, management commitment and employees’ participation/empowerment, positively affects its safety performance both directly and indirectly through implementation of safety practices (SPR). We examine these issues by applying a survey methodology and collecting primary data from a sample of 251 Canadian manufacturing plants.

This paper contributes to the operations management literature in many ways. First, by linking workplace safety and financial performance, this study provides a foundation for future research on making a business case for safety management. Second, a theoretical model is developed linking SC to safety and environmental management practices and performance. More specifically, the model suggests that a positive SC can improve organization’s safety and environmental performance both directly and indirectly through the adoption of related processes and practices. Third, it highlights the important role of individuals, both managers and employees, in achieving all three sustainability objectives, that is, improving social, environmental, and financial performance. Finally, unlike other sustainable operations management studies which focus on the environmental sustainability as the entry point for operationalizing sustainability, this paper introduces the commitment to safety and establishing a positive SC as the starting point toward achieving sustainable development.

In the next section, we integrate two streams of literature on environmental and safety management and define the six constructs of interest. We then propose nine hypotheses building on the organizational support theory, SC literature, and prior empirical studies in sustainability domain. After presenting the research methodology and data

analysis results, we discuss our findings and their theoretical and managerial implications.

## Literature Review

### Safety Culture

The concept of SC was first coined in the International Nuclear Safety Advisory Group’s (INSAG) summary report on the Chernobyl accident, published by the International Atomic Energy Agency (IAEA) in 1986. Although it has been widely used since then, there is no clear cut definition of the term SC and numerous definitions have been developed in the academic literature for it (Choudhry et al. 2007). It is used to describe an organizational culture in which safety is understood to be, and accepted as, the top priority (Cooper 2002). Cooper (2000) refers to it as the observable degree of effort by which all organizational members direct their attention and actions toward improving safety on a daily basis, while Richter and Koch (2004) describe it as the shared and learned meanings, experiences, and interpretations of work and safety which guide people’s actions toward risk, accidents, and prevention. In a nutshell, a strong SC is formed when the values espoused by management are consistent with the behavior of the employees (Vredenburg 2002) and when safety is regarded by everyone as being an issue that concerns everyone (Choudhry et al. 2007).

Researchers have carried out empirical studies to determine the indicators which reflect SC (Mearns et al. 2003; Ostrom et al. 1993). Despite several inconsistencies in the idiosyncratic labeling of SC indicators, two factors—employees’ participation and management commitment to safety—appear to be replicated across several studies (Cox and Cheyne 2000; Fernández-Muñiz et al. 2007; McFadden et al. 2009; Vecchio-Sadus and Griffiths 2004). Hence, in this study, a positive SC is defined as the one in which managers are committed to and reinforce safety as an organizational priority and employees adhere to the safety rules and guidelines and participate in their establishment and improvement.

### Safety Practices

Safety practices are the policies, procedures, and activities implemented or followed by the management of an organization targeting safety of their employees (Kirwan 1998). They are the essential elements permitting an effective management of safety in the organizations and are designed to comply with the existing applicable legislations. Numerous studies have attempted to identify specific safety management practices that improve safety

performance in terms of accident and incident rates (DePasquale and Geller 1999; McFadden et al. 2009; Shannon et al. 1997). They have revealed that organizations with lower accident rates are characterized by a few of the following factors: management active involvement in safety initiatives; frequent safety training for employees; hazard identification and assessment; horizontal and vertical communication about safety issues; frequent safety inspections; safety-oriented reward systems; thorough investigation and statistical analysis of accidents and incidents; and empowerment of the workforce. These practices can be categorized into two mutually exclusive groups of control and prevention. The former includes safety-related initiatives which are aimed at reducing the adverse impacts of accidents/incidents after their occurrence. Emergency response plans and actions are among these practices. The second group, however, includes the activities that are intended to prevent incidents/accidents occurrence, such as hazard identification and assessment, safety training, reporting incidents/accidents and statistical analysis of the collected data, and system redesign for improving the workplace safety. The latter type of practices is of interest in this study. Therefore, we define SPR as the set of procedures/activities which aim at preventing incidents/accidents occurrence.

Environmental Practices

Upon the enactment of various environmental regulations in the 1970s, organizations have allocated significant capital and operating budgets to control the adverse environmental impact of their products and processes. Environmental practices encompass the techniques to reduce, minimize, or eliminate the negative impacts of organization’s operations, products or services on the natural environment (Rao and Holt 2005; Shrivastava 1995a).

These practices are classified into three categories of pollution prevention, pollution control, and management systems (Klassen and Whybark 1999a). While all three categories aim at improving environmental performance, practices which address pollution at the source are generally recognized to generate other benefits (Hart 1995). This type of practices is of interest in this paper. Therefore, we define EPR as the techniques and procedures that lead to pollution reduction at the source (Thoumy and Vachon 2012). They include efforts to analyze product life-cycle, prevent pollution, reduce wastes, or recycle materials.

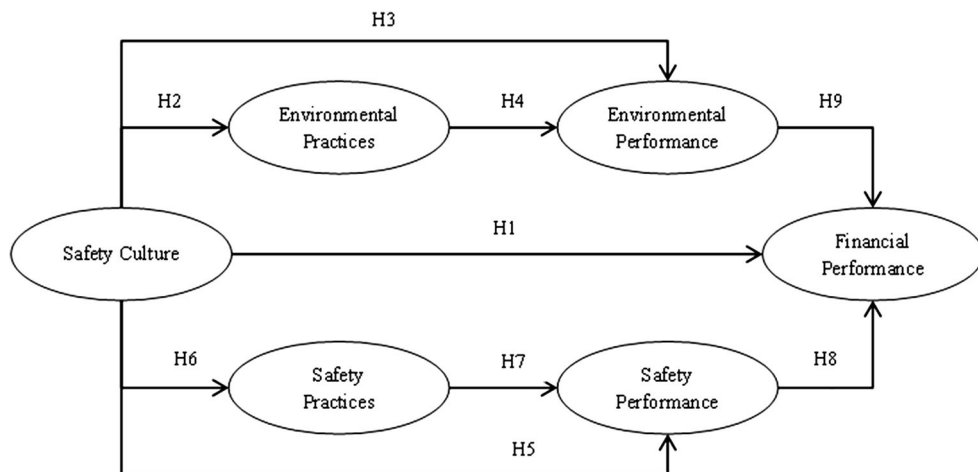
Organization’s Performance

In line with sustainable development perspective, we define the organization’s performance along three dimensions: environmental performance (EPE), safety performance (SPE), and financial performance (FPE). The concept of safety performance refers to the extent to which organizations are able to prevent accidents and incidents or decrease their adverse impacts (De Koster et al. 2011). Environmental performance is defined as the extent to which an organization improves its performance in respect to its environmental responsibilities (Kleindorfer et al. 2005). Financial performance refers to the degree to which an organization achieves profit-oriented outcomes and reduces its overall costs.

Conceptual Model and Hypotheses Development

In this section, drawing from safety and sustainability literatures and organizational support theory, we present our hypotheses on the interrelationships among six constructs of interest (see Fig. 1).

Fig. 1 Conceptual model



## Safety Culture and Financial Performance

Organizational support theory (Eisenberger et al. 1997), derived from social exchange theory (Blau 1964), assumes that employees form general beliefs about how much their organization values their contributions and cares about their well-being. Central to this theory is the norm of reciprocity: when one person treats another well, the norm of reciprocity obliges the return of favorable treatment (Gouldner 1960). Hence, the employees' perceived organizational support increases their willingness to further contribute to the organization's success and helping the organization reach its objectives (Eisenberger et al. 2001).

Applying this theory to the safety context, it can be posited that a positive SC stemmed from management commitment has the potential to create a positive exchange relationship between the organization and its employees. When employees believe that top management cares about their personal safety and well-being, they will choose to reciprocate by developing affective commitment to the organization (Rhoades et al. 2001), putting forth discretionary effort on behalf of the firm (Piercy et al. 2006), and involving in more pro-social behaviors like aiding fellow employees, offering constructive suggestions, and gaining knowledge and skills that are beneficial to the organization (Meyer and Herscovitch 2001). They will be more willing to pursue organizational goals and to remain with the organization (Meyer et al. 1990) which leads to decreased absenteeism and turnover rates (Harrison et al. 2006) and increased productivity and customer satisfaction (Mathieu et al. 2006; Patterson et al. 2004). They will also feel more satisfied with their jobs (Rhoades and Eisenberger 2002). Such employees' reactions to their perceived organizational support improve their job performance, which in turn positively influences the organizational profitability and financial performance (Ostroff 1992; Podsakoff and MacKenzie 1997; Subramony 2009; Sun et al. 2007).

**H1** The level of an organization's safety culture is positively associated with its financial performance.

## Safety Culture, Environmental Practices, and Environmental Performance

The similarities between workplace safety and environmental management are significant enough that they have been thought of as major components of the overall concept of sustainability in the operations management literature (Kleindorfer et al. 2005). Activist groups interested in both environmental and occupational health issues have recognized the similarities between the two and formed labor-environmental alliances across the United States

known as "blue-green coalitions" (Mayer 2009). However, to date, there has been a lack of research to establish a direct link between environmental management and workplace safety.

In this paper, we argue that organizations with a positive SC are more likely to adopt an environmental sustainability perspective, implement ecologically friendly practices, and improve their environmental performance due to a number of factors. First, a prime component of SC relates to management commitment to safety and how it is demonstrated to the employees. The motives and drivers behind management commitment to safety are quite similar to the ones for seeking improvements in environmental performance (Taubitz 2010). As a result, managers who are motivated to enhance their organizations' workplace safety will also be willing to invest in EPR (Caprar and Neville 2012). According to Corbett and Kleindorfer (2001), these drivers include enhancing corporate image and reputation (Vastag 2004), increasing revenue and market share (Delmas 2001), seeking regulatory compliance (Snir 2001), avoiding liability and negligence (Kleindorfer and Saad 2005; Wolf 2001), and improving company's relations with local communities and other stakeholders (Rothenberg et al. 2001). Moreover, by encouraging and committing to a positive SC, top management can serve as champion of change and alter the culture of the organization to be more flexible and responsive to changes (Daily and Huang 2001), hence increasing the chances of EPR success, that is, improved environmental performance.

Second, it is frequently argued in the environmental management literature that motivated and empowered individuals can bring the critical ideas and deliver the efforts necessary to improve their organizations' environmental performance (Starik and Rands 1995; Zwetsloot and Marrewijk 2004). One of the critical components of a positive SC is employees' active involvement and participation in safety-related activities, which results in their empowerment. Therefore, it is possible to conclude that an organization with a positive SC will be able to implement EPR more effectively and improve its environmental performance due to employees' motivation and active participation.

Third, workplace accidents are sometimes associated with environmental problems. For example, air pollution due to the release of chemicals into the air is not only undesirable from an environmental point of view, but it also has an adverse impact on the working conditions of employees and their safety and well-being (Chandrashekar et al. 1999). Hence, being committed in eliminating workplace hazards and risks sometimes requires the organizations to implement environmental practices to prevent waste and pollution, which in turn results in improvements in their environmental performance.

Finally, both environmental and safety management domains require large-scale behavior change for a meaningful impact to be realized. For example, the same mindset that underlies practices to prevent workplace injuries can be applied in efforts to reduce energy consumption (Cunningham et al. 2010). The organizations with positive SC are the ones who have successfully managed to change their managers' and employees' attitudes and behaviors to be safety-oriented. Hence, they do not need to reinvent the wheel to develop successful interventions for aligning the employees' behaviors with environmental sustainability objectives. They can harness the momentum of the SC and adapt successful behavioral interventions from the safety domain to achieve improvements in environmental sustainability.

**H2** The level of an organization's safety culture is positively associated with the degree of investments in environmental practices within that organization.

**H3** The level of an organization's safety culture is positively associated with its environmental performance.

Further, it is expected that adopting the techniques and procedures which take into account the environmental considerations, namely EPR, reduce the organization's negative impacts on the natural environment (Melnik et al. 2003; Sroufe 2003). For example, organizations participating in emission and energy consumption reduction programs will reduce their carbon footprint by introducing energy conserving operation processes, installing energy efficient lighting fixtures and conservation-oriented maintenance. Moreover, with proactive EPR organizations can eliminate environmentally hazardous production processes, redesign their existing product systems to reduce life cycle impacts, and develop new products with lower life cycle costs (Hart 1995). Likewise, they can analyze and understand the impacts of their products and processes on the environment and improve their environmental performance by conducting life-cycle analysis (Matos and Hall 2007). Several studies, to date, have provided empirical evidences to support the positive relationship between EPR and environmental performance in organizations (Klassen and Whybark 1999b; Pullman et al. 2009; Russo and Fouts 1997).

**H4** The degree of investments in environmental practices within an organization is positively associated with its environmental performance.

#### Safety Culture, Safety Practices, and Safety Performance

Developing and maintaining a positive SC is an effective tool for improving safety-related outcomes at work, such as decreasing accidents and injuries and increasing safety

compliance and safety knowledge of employees (Hofmann and Stetzer 1996; Neal et al. 2000; Vecchio-Sadus and Griffiths 2004). Organization's SC considerably affects the employees' involvement in unsafe behaviors which, based on the Domino Model of Accident Causation (Heinrich 1931), is one of the major root causes of workplace accidents in different industries (Brown et al. 2000; Mearns et al. 2003; Oliver et al. 2002). Sulzer-Azaroff (1978) suggests that employees are "naturally" reinforced to engage in unsafe practices by taking shortcuts to achieve immediate positive results (e.g., completing the tasks in shorter time). Positive SC counteracts this "natural" reinforcement by increasing employees' motivation to comply with safety rules and also by increasing their awareness of rules and the importance of following them (safety knowledge). In their survey study of 551 workers from two steel plants located in the southeastern US, Brown et al. (2000) demonstrate that a weak SC increases the presence of unsafe work behaviors through employees' perceived work pressure and perceived barriers to safety. Similar findings have been reported by other studies such as Thompson et al. (1998) and Seo (2005).

A few empirical studies in operations management literature have demonstrated that several aspects of a positive SC such as the creation of a blame-free environment, a commitment to be safety-centered, an openness about errors, and a safety-over-productivity attitude lead to exceptionally good safety outcomes (De Koster et al. 2011; McFadden et al. 2009; McFadden and Hosmane 2001). The frequency and severity of occupational accidents and incidents are reduced through improved SC in terms of management commitment and employee participation and empowerment. Top management commitment has a dual effect on safety performance (Krause and Weekley 2005). On the one hand, committed leaders allocate adequate resources to implement safety initiatives and safety enhancing systems. On the other hand, they influence employees' behaviors simply by demonstrating support for improving workplace safety. When employees observe their management commitment, they will be more willing to co-operate to improve safety performance (Hofmann et al. 2003). They will try to comply with regulations, to take the proper safety measures, and to actively participate in activities designed to promote improvements in their workplace safety. Therefore, management commitment enhances employees' commitment and decreases occupational injuries (Zacharatos et al. 2005). In addition, employees' participation and commitment to safety is likely to increase not only their personal safety consciousness (De Koster et al. 2011), but also the safety of the work environment, through actions on safety suggestions and the encouragement of safe behavior among coworkers (Michael et al. 2005).



**H5** The level of an organization's safety culture is positively associated with its safety performance.

A culture which encourages shared vision of a strategy usually results in an internal drive and passion to develop new innovation and embrace change (Hamel and Prahalad 2005). According to Shrivastava (1995b), an organization's sustainability initiatives and its strategy must be closely interwoven, rather than being separate programs that are managed independently of one another. Top management's verbal commitment must be supported by their actions to effectively influence the workplace safety performance. To be perceived as credible, their words should be supported by establishing safety-related practices in the organization and allocating money for safety supplies and initiatives.

**H6** The level of an organization's safety culture is positively associated with the level of implemented safety practices within that organization.

The preventive safety programs and practices are regarded in several studies as the antecedent of the employees' perceptions about the importance of safety in their organization and hence contribute to performing tasks in a safe manner (DeJoy et al. 2004). Companies that have better safety initiatives in place and invest more money in safety management are expected to have better safety outcomes (Hoonakker et al. 2005). The extent to which these practices are implemented in an organization affects the probability, frequency, and severity of the accidents and incidents. For example, communication of safety information through either formal training or informal on-the-job discussions enhances employees' safety awareness and consciousness, decreases their involvement in unsafe behaviors and hence, improves organization's safety performance (De Koster et al. 2011). It also helps them to identify the hazards in the workplace, and the procedures available to prevent, correct or minimize their risks (Fernández-Muñiz et al. 2007). Employees' involvement in the hazard identification and risk analysis process is another behavioral-oriented technique that provides them with authority, responsibility, and accountability for required decisions which in turn reduce their involvement in unsafe acts and consequently, the accidents rate (Cox and Cheyne 2000; Rundmo 2000; Vredenburg 2002).

**H7** The level of implemented safety practices within an organization is positively associated with its safety performance.

#### Safety, Environmental, and Financial Performance

It is widely believed that there is a trade-off between efforts in safety and profitability/production, that is, safety preventive measures require expenses that are not in line with

production objectives, and consequently have negative impacts on organization's profitability and competitiveness (Carrillo 2005). Conversely, researchers have suggested that accidents have adverse effects in terms of decreases in productivity and quality and deterioration of the firm's public image or employee morale, all of which lead to decreased financial performance (Brown 1996; Rechenthin 2004). Evidences of both arguments have largely been anecdotal in nature. Therefore, to make a business case for safety, the level of invested resources in safety management should be compared to its impact on the organization's profitability.

Proactive safety engenders an increase in the organization's costs through areas such as salaries paid for safety professionals, employees' training, and protective equipment purchase. On the other hand, investing in safety can make changes in the organization's processes and production technologies, which in turn can offer benefits in terms of savings in materials or energy, and hence cutting the real costs of such investment (Ashford 1997). Lack of safety, however, can result in direct and indirect costs when accidents and incidents occur. The direct costs include such things as medical expenses, disability payments, attorney fees, and property damage repair costs. The larger indirect costs with a long-term negative impact on the organization's financial performance include increased insurance costs, increased operational costs due to disruptions to work progress, loss or injury of trained and experienced workers, and loss of production quality due to a non-experienced employee performing work normally handled by an experienced employee who has been injured and is away from work (Brown et al. 2000; Manuele 2011). In addition, accidents also undermine the organization's internal relationships, workers' morale and motivation or harm its public image and cause a severe deterioration in its public relations (Smallman and John 2001). They can also cause organizations to miss delivery dates causing financial losses due to the delay itself and due to deterioration in the customers' perception of the firm (Fernández-Muñiz et al. 2009). Finally, strong safety reputation helps companies attract and retain higher-quality employees and reduce the costs of recruiting and training of new employees (Howard-Grenville et al. 2003).

**H8** An organization's safety performance is positively associated with its financial performance.

Similarly, many organizations perceive trade-offs between environmental performance and economic performance. Researchers and practitioners have tried for a long time to find out whether it "pays" to be green. A large number of studies have demonstrated that environmental management efforts and improved environmental performance can increase firms' revenues and lower their overall

costs (Ambec and Lanoie 2008; Angell and Klassen 1999; King and Lenox 2002; Melnyk et al. 2003). Improved environmental performance reduces the amount of waste, the consumption of various production inputs including energy and materials, and the number of components in products (Rothenberg et al. 2001). Elimination of spills and other environmental damages prevents expenses associated with lawsuits and legal settlements (Karpoff et al. 2005). Pollution prevention can also allow a firm to avoid the cost of installing and operating pollution control devices and to reuse materials through recycling (Hart 1997; Quazi et al. 2001). Waste reduction, another aspect of improved environmental performance, leads to better utilization of natural resources, improved efficiency and higher productivity and reduces operation costs. Finally, an organization's strong environmental reputation, similar to safety reputation, results in lower costs for recruiting and training of new employees (Howard-Grenville et al. 2003).

In addition to its effects on costs, environmental performance can impact revenues either through gains in existing markets or access to new markets. Firms can benefit from their improved environmental performance as a powerful marketing tool which brings about increased revenue, market share, and new market opportunities (Klassen and McLaughlin 1996; Rao and Holt 2005). Examples of new environmentally conscious markets range from clothing produced with organic materials to hybrid vehicles. Hence, we expect that improved environmental performance in terms of lower levels of air emissions, waste water generation, solid waste disposal, and energy consumption contributes to better financial performance.

**H9** An organization's environmental performance is positively associated with its financial performance.

## Methodology

### Data Collection

Data from a sample of 1,001 Canadian manufacturing plants located in Ontario and Quebec provinces was collected through a mail survey distributed in April–May 2011, following a procedure inspired by Dillman (2000). We chose the plant as the level of analysis because it is generally where many safety and environmental issues are evaluated and operational decisions are implemented. The sample was randomly selected utilizing the Canadian Scott's Directory and included the plants with more than 100 employees (as it was reported by this database) from the industries included in the North American Industrial Classification Systems (NAICS) codes 315–337, excluding process-based industries such as paper, petroleum, and chemical products. These codes include leather goods,

textile products, clothing, wood products, furniture, plastic and rubber products, machinery, transport equipment, electrical equipment, and fabricated metal industries. A follow-up phone call was made a couple of weeks after the mailing to confirm the reception of the questionnaire and to encourage participation. A total of 251 usable responses mostly from plant managers were collected from that effort, that is, a response rate of 25 %.

### Survey Questionnaire and Measures

The survey instrument used for this research includes total of 32 items measured on a seven-point likert-type scale for the six main constructs (listed in Appendix 1). As noted earlier, SC construct represents management commitment to reinforcing safety as organizational priority and employees' adherence to the established safety rules and guidelines and their participation in workplace safety activities. In this study, SC was measured by seven items adapted from a previously published safety climate survey (Sexton et al. 2003). Similar to McFadden et al.'s approach (2009), we only included seven of the original 19 items which measured SC at the organizational level and were most closely aligned with our definition of SC in "Safety Culture" section. A seven-item scale captured the degree and level of implementation of seven activities that aim to improve workplace safety, such as taking input from all stakeholders on hazard identification/assessment and incident/accident reduction methods, reporting incidents/accidents without blame, open-ended discussion groups, safety training for employees, statistical analysis of incidents/accidents data, and system redesign for safety. These items were taken from McFadden et al.'s scale (2009) for patient safety initiatives and modified based on OHSAS 18001 (British Standards Institution 2007) principles of a workplace safety management system. Safety performance was also measured by a five-item scale taken from McFadden et al.'s scale (2009) for safety outcomes. These items were modified to assess the changes in the workplace safety performance of the plant over a 2-year period on five different dimensions, that is, severity, frequency, and impact of incidents/accidents as well as increased awareness and understanding of incidents/accidents and their root causes.

The extent of EPR was assessed using a five-item scale which captured the extent to which resources have been invested in five programs related to environmental management over the previous 2 years: ISO 14001 certification, pollution prevention, recycling of materials, life cycle analysis, and waste reduction. Environmental performance was measured by a five-item scale, in terms of improvements in the amount of air emissions, waste water generation, solid waste disposal, consumption of hazardous/harmful/toxic materials, and energy consumption over a 2-year period.

Lastly, financial performance was measured by a three-item scale, in terms of the level of plant's average returns on investment, average profit, and profit growth compared to the industry average over a 2-year period.

In addition to the variables presented above, we also examined three control variables to avoid any unjustifiable influence of alternative factors, other than those included in our model, on the plant's performance. First, we controlled for plant size because the safety, financial and environmental performance gains or failures we observe may be explained by this factor as opposed to the mechanisms we model. On one hand, larger firms may have greater adverse environmental impacts or larger number of accidents/incidents and consequently be under more external pressure to improve their performance; on the other hand, they might have larger resource pools to invest in environmental technologies or SPR and consequently higher levels of environmental/safety improvement (Vachon and Klassen 2006a). In our study, plant size is measured as the number of employees (logarithmized). The second possible confounding effect relates to the complexity of plant's internal processes. Plants with a higher level of complexity could be prone to lower levels of performance. The number of plant's product lines is taken as a proxy for the level of plant complexity. Finally, we controlled for the percentage of unionized shop floor workers, as it can affect plant's safety performance.

#### Post Hoc Tests of Data Appropriateness

We assessed nonresponse bias using *t* tests to compare the early and late waves of responses (Armstrong and Overton 1977; Lambert and Harrington 1990). Two groups of 63 surveys were chosen from the first and last waves of surveys received (i.e., the upper and lower quartiles of the returned surveys), and *t* tests were performed on the responses of the two groups on four demographic-related as well as ten randomly-selected items in the dataset. The *t* tests yielded no statistically significant differences, suggesting that nonresponse may not be a problem to the extent that late respondents represent the opinions of non-respondents.

To minimize key-informant bias, we contacted each plant by phone prior to sending the survey to identify the manager most knowledgeable about the financial, environmental and safety issues (Kumar et al. 1993). Although responses from multiple informants may have been preferred, we believe that our informants were positioned to make the assessment asked of them. In addition, we checked for common method bias to assure that the observed relationships between variables are not confounded by the respondents' social desirability, leniency, acquiescence, and other social, psychological, and

measurement factors. To reduce the likelihood of common method bias, the dependent variables were placed after the independent variables in the survey to diminish, if not avoid, the effects of consistency artifacts (Podsakoff et al. 2003). In addition to this precaution taken during the survey design, Harman's single factor post hoc test (Harman 1976) was performed. The exploratory factor analysis revealed seven factors with eigenvalues greater than 1.0 that accounted for 63.67 % of the total variance. The first factor only accounted for 29.4 % of the variance. These results suggested that common method bias was not a serious problem in our study (Podsakoff et al. 2003).

Finally, in order to establish the validity of the answers provided by the single respondents and to enhance the rigor of research, the survey data on environmental performance were compared to the objective data which is publicly available from National Pollutant Release Inventory (NPRI) provided by the federal government of Canada (Environment Canada 2010). This database contains information on more than 300 pollutants released and transferred from individual plants across Canada (air, water, land, and injected underground and transferred off-site to disposal, treatment, sewage, energy recovery, and recycling). Of the 251 plants in our sample, we were able to identify 56 of them in the NPRI database. In line with our definition of environmental performance in the survey data to be the improvement of plant's environmental impacts over a 2-year period (i.e., 2008–2010), we took three different measures of change in pollutant release over the same period from NPRI data of the 56 plants in our sample (Henri and Journeault 2010). These measures include changes in onsite air emissions, changes in total onsite emissions, and changes in total onsite and offsite emissions. Nonparametric Spearman Rank Correlation test shows positive and significant correlations between the mean score of environmental performance as provided by the respondents and each of the abovementioned measures (correlations of 0.436, 0.406, 0.385;  $p < 0.01$ ). Hence, the self-rated improvement in environmental performance is positively correlated with the improvement in the level of pollutants released from 2008 to 2010. These results are in line with Dixon-Fowler et al.'s (2013) meta-analysis findings which indicate that the use of self-report measures of environmental performance does not result in different outcomes than the use of archival data.

Given that the majority of the firms in our sample were privately owned and also because the unit of analysis was the plant, unfortunately, a meaningful validation of financial performance data with a third party secondary data source was not possible. Moreover, manufacturing plants' accident/incident records were not publicly available and hence, we could not validate the safety performance data.



## Data Analysis

Partial least squares (PLS) method and more specifically SmartPLS 2.0 (beta) software (Ringle et al. 2005) was selected as the modeling technique for testing the proposed conceptual model in this study for a number of reasons (Peng and Lai 2012). The environmental management and safety management concepts have seldom been examined in one single study, and there are no well-established theories that can directly serve as the theoretical foundation of their hypothesized relationships, making PLS an appropriate analysis tool for the exploratory nature of this study. Second, PLS performs better relative to covariance-based structural equation modeling (CBSEM) techniques in testing complex models with small sample sizes. To test the hypothesized relationships using CBSEM techniques, the minimum required sample size would be 350 cases, while the minimum sample size of 60 cases is enough for PLS analysis (Chin and Newsted 1999; Tanaka 1987). Finally, unlike CBSEM, PLS does not assume multivariate normality in the data, making it useful where observations do not fit with this restriction. Kolmogorov–Smirnov and Shapiro–Wilk tests show that the variables in this study are not normally distributed (statistics: 0.113–0.354 and 0.711–0.941;  $p < 0.01$ ). Multivariate kurtosis of 136.803 with critical ratio value of 23.231 further confirms the data's departure from multivariate normality requirement for using CBSEM techniques (Byrne 2010).

As stated earlier, the items related to SC, practices, and performance constructs were adopted from McFadden et al.'s (2009) study with a healthcare context and applied to a manufacturing context in this study. Therefore, constructs' unidimensionality was tested prior to PLS data analysis to purify the measurement scales. The sample of 251 cases was randomly split in half for unidimensionality pre-test (Sample 1) and data analysis (Sample 2) to avoid the problem of capitalization on chance due to specification searches and model modifications aiming at improving the measurement models (MacCallum et al. 1992).

### Unidimensionality of Constructs

Unidimensionality refers to existence of a single concept underlying a group of measures (Gerbing and Anderson 1988). Following Kim et al. (2012), unidimensionality of the six constructs was assessed through confirmatory factor analysis (CFA) employing IBM SPSS Amos 19 (Arbuckle 2010) software.

The measurement model for each construct was estimated first. Then, the constructs were combined into pairs and each pair was estimated separately. The measurement model including all constructs was estimated last. At each step, we assessed whether or not the model fit the data, by

examining the  $t$  values, standardized residuals, modification indices, and a number of goodness-of-fit indices. These indices are reported for pair-wise and total measurement models in Table 1.

During this stage, six items were dropped due to their low loadings or high cross-loadings to establish unidimensionality of all six constructs (SPR-3, SC-5,6, EPR-1,2 and EPE-3). A comparison of the goodness-of-fit statistics to the recommended values of these fit indices reveals an adequate fit of the modified measurement models to the data.

### Estimation of Measurement Model

After establishing the unidimensionality of the constructs and identifying their measurement models' structure, the next step is to test the measurement models in PLS and assess reliability, convergent, and discriminant validity of the constructs (Fornell and Larcker 1981). The reliability study indicates the degree of internal consistency between the multiple variables that make up the scale, in other words, the extent to which the indicators or items of the scale are measuring the same concepts. In PLS, alternative ways of judging multiple-item consistency, rather than Cronbach's  $\alpha$ , are used. The methods look at (1) the reliability of the individual items that make up the measure, and (2) the composite reliability of the items as a group (comparable to Cronbach's  $\alpha$ ). Individual item reliability is assessed using the item's loading on the construct. A common rule of thumb is to accept items with more explanatory power than error variance (Carmines and Zeller 1979), that is, with loadings greater than 0.7 (Fornell and Larcker 1981). Of the 26 items in the various scales, four of them were below this threshold with minimum loading of 0.57, which were kept in the measurement model to retain the content validity of their underlying constructs. All factor loadings were also statistically significant ( $p < 0.01$ ). Further, composite reliability assesses the inter-item consistency, which should also have a minimum value of 0.7. All of the scales demonstrated acceptable performance on this basis (see Table 2).

The standard for acceptable convergent validity is that the construct's average variance extracted (AVE) should exceed 0.5, indicating that the items share at least half of their variance with the construct (on average). Again, as depicted in Table 2, all scales performed acceptably on this basis.

Discriminant validity addresses the potential problem of having measures for one construct overlap the conceptual territory of another construct. To test the discriminant validity, we ran a series of nested measurement model comparisons in which we constrained the covariance between each pair of constructs to one (Bagozzi and Yi 1988) employing IBM SPSS Amos 19 software. The  $\chi^2$

**Table 1** Fit indices for pair-wise and total measurement models (CFA)

Model	$\chi^2$ (df)	$\chi^2/df$	GFI	CFI	NFI	RMR	RMSEA
(1) SC and SPR	56.618 (42)	1.348	0.925	0.983	0.938	0.066	0.054
(2) SC and SPE	43.869 (33)	1.329	0.935	0.984	0.939	0.044	0.052
(3) SC and EPR	20.844 (29)	1.097	0.959	0.995	0.950	0.083	0.028
(4) SC and EPE	31.474 (26)	1.211	0.945	0.984	0.918	0.072	0.042
(5) SC and FPE	18.421 (19)	0.970	0.965	1.000	0.967	0.055	0.000
(6) SPR and SPE	56.943 (41)	1.389	0.918	0.983	0.942	0.062	0.057
(7) SPR and EPR	32.988 (24)	1.374	0.946	0.986	0.951	0.077	0.056
(8) SPR and EPE	59.466 (33)	1.802	0.916	0.956	0.908	0.105	0.081
(9) SPR and FPE	31.588 (25)	1.264	0.947	0.992	0.961	0.081	0.047
(10) SPE and EPR	13.584 (18)	0.755	0.973	1.000	0.972	0.060	0.000
(11) SPE and EPE	45.638 (25)	1.826	0.924	0.955	0.907	0.055	0.083
(12) SPE and FPE	16.733 (18)	0.930	0.967	1.000	0.974	0.035	0.000
(13) EPR and EPE	13.632 (12)	1.136	0.970	0.991	0.933	0.067	0.034
(14) EPR and FPE	15.995 (8)	1.999	0.959	0.979	0.960	0.105	0.091
(15) EPE and FPE	18.380 (13)	1.414	0.957	0.984	0.950	0.051	0.058
Measurement Model	310.697 (280)	1.110	0.844	0.983	0.852	0.092	0.030
Recommended value		<3.0	>0.9	>0.9	>0.9	<0.07	<0.08

**Table 2** Reliability and convergent validity

Items	Loadings	Composite reliability	AVE	Items	Loadings	Composite reliability	AVE
SPR		0.89	0.57	SC		0.89	0.61
SPR-1	0.81			SC-1	0.86		
SPR-2	0.78			SC-2	0.86		
SPR-4	0.71			SC-3	0.83		
SPR-5	0.78			SC-4	0.75		
SPR-6	0.66			SC-7	0.57		
SPR-7	0.79						
SPE		0.91	0.68	EPE		0.80	0.50
SPE-1	0.79			EPE-1	0.71		
SPE-2	0.76			EPE-2	0.72		
SPE-3	0.90			EPE-4	0.73		
SPE-4	0.84			EPE-5	0.67		
SPE-5	0.83						
EPR		0.85	0.65	FPE		0.93	0.81
EPR-3	0.68			FPE-1	0.88		
EPR-4	0.87			FPE-2	0.92		
EPR-5	0.86			FPE-3	0.90		

difference tests for all pairs of constructs were statistically significant at  $p$  value of 0.05 (Table 3). In addition, the square roots of the AVE for all constructs were greater than all of the inter-construct correlations (Table 4), which is the evidence of sufficient discriminant validity (Chin 1998). Lastly, the examination of items' cross-loadings table revealed that each item loading in the table was higher on its assigned construct than on the other constructs, supporting adequate convergent and discriminant validity (Table 5).

In conclusion, analysis of measurement models shows that the underlying items have sound measurement properties.

#### Estimation of Structural Model

The PLS structural model was assessed using bootstrapping procedure (Efron and Tibshirani 1993) with 250, 500 and 1,000 times of resampling. The magnitude and statistical significance of the structural paths were consistent across

**Table 3** Discriminant validity

Constructs	SC	SPR	SPE	EPR	EPE
Safety practices	8.2 <sup>a</sup>				
Safety performance	22.3	10.9			
Environmental practices	11.5	6.0	13.7		
Environmental performance	45.4	39.7	44.7	23.3	
Financial performance	40.9	29.6	37.2	24.2	30.3

<sup>a</sup>  $\chi^2$  differences between each constrained model and unconstrained model. Difference in degree of freedom = 1. All of the differences on pair-wise comparisons of the scales were significant at *p* value of 0.05

the three rounds of bootstrapping. Figure 2 and Table 6 show the path coefficients and the explained construct variances.

The *R*<sup>2</sup> values of 0.25, 0.21, and 0.06 indicate that the model explains a fair amount of variance for environmental, safety, and financial performance, respectively. As demonstrated in Fig. 2, the links between SC and financial performance, EPR, and SPR are significant (*t* values equal to 2.03, 4.12, and 12.68, respectively) offering evidence for hypotheses H1, H2, and H6. Environmental practices are also significantly related to environmental performance (*t* = 4.57), providing statistical support for H4. The significant SC-safety performance and SPR-safety performance paths provide support for hypotheses H5 and H7 (*t* = 1.77 and *t* = 2.32). Sobel test (Preacher and Hayes 2004) further demonstrates that the former relationship is partially mediated by SPR (Sobel = 2.28; *p* < 0.05). Similarly, the significant SC-environmental performance path provides support for hypothesis H3 (*t* = 2.04) and Sobel test confirms that this relationship is partially mediated by EPR (Sobel = 3.06; *p* < 0.01). As to hypotheses H8 and H9, Fig. 2 and Table 6 show that the safety and

environmental performance do not significantly relate to financial performance. With regards to the three control variables included in the model, only plant size can significantly affect environmental performance.

Overall, the conceptual model that we originally proposed gained adequate support from the data. The SC proved to be related to the environmental, safety, and financial performance through direct and indirect paths defined in the model.

### Discussion

The significant results for the direct and indirect relationships between SC and all three dimensions of organizational performance (i.e., financial, environmental, and safety performance) lend support for the concept of reciprocity norm and organizational support theory in workplace safety context. Organizational support theory (Eisenberger et al. 1997) is built upon the underlying concept that employees’ perceived organizational support stimulates their felt obligation to return the profitable treatment they receive from their organization by caring about the organization’s success and helping the organization reach its objectives. Our results suggest that organizations with a positive SC, where (i) top management is concerned about employees’ safety and well-being and (ii) employees are empowered and actively involve and participate in safety-related activities, are more likely to gain better financial, environmental, and safety outcomes as a result of their increased employees’ commitment in pursuing organization goals and objectives. These results are also in accord with total quality management literature (Curkovic et al. 2000; Kaynak 2003; Nair 2006; Samson and Terziovski 1999) as well as human resource management literature (Huselid et al. 1997; Jayaram et al. 1999;

**Table 4** Correlation matrix

	SC	SPR	SPE	EPR	EPE	FPE	PS	PC	PU
Safety culture	<b>0.782</b>								
Safety practices	0.644	<b>0.760</b>							
Safety performance	0.375	0.421	<b>0.826</b>						
Environmental practices	0.327	0.355	0.291	<b>0.806</b>					
Environmental performance	0.270	0.267	0.333	0.405	<b>0.709</b>				
Financial performance	0.223	0.0926	0.131	0.062	0.053	<b>0.900</b>			
Plant size (PS)	0.143	0.208	0.146	0.010	0.253	-0.018	-		
Plant complexity (PC)	0.064	0.126	0.104	0.083	0.106	0.041	0.035	-	
Plant unionization (PU)	-0.179	-0.010	0.059	-0.114	0.082	-0.118	0.257	-0.016	-

The diagonal elements are the square roots of the average variance extracted (AVEs); the off-diagonal elements are the inter-construct correlations

**Table 5** Items' loadings and cross loadings

	SC	SPR	SPE	EPR	EPE	FPE
SC-1	<b>0.86</b>	0.57	0.33	0.20	0.19	0.23
SC-2	<b>0.86</b>	0.64	0.40	0.30	0.26	0.19
SC-3	<b>0.83</b>	0.52	0.27	0.37	0.18	0.21
SC-4	<b>0.75</b>	0.40	0.25	0.19	0.26	0.09
SC-7	<b>0.57</b>	0.30	0.14	0.19	0.15	0.11
SPR-1	0.50	<b>0.81</b>	0.41	0.30	0.28	0.11
SPR-2	0.47	<b>0.78</b>	0.37	0.29	0.32	0.02
SPR-4	0.43	<b>0.71</b>	0.33	0.30	0.25	0.05
SPR-5	0.58	<b>0.78</b>	0.28	0.28	0.12	0.11
SPR-6	0.35	<b>0.66</b>	0.18	0.25	0.14	0.07
SPR-7	0.55	<b>0.79</b>	0.30	0.20	0.10	0.05
SPE-1	0.25	0.28	<b>0.79</b>	0.15	0.27	0.07
SPE-2	0.23	0.27	<b>0.76</b>	0.23	0.17	0.01
SPE-3	0.35	0.39	<b>0.90</b>	0.29	0.29	0.10
SPE-4	0.40	0.42	<b>0.84</b>	0.32	0.35	0.19
SPE-5	0.28	0.34	<b>0.83</b>	0.19	0.25	0.12
EPR-3	0.01	0.04	0.06	<b>0.68</b>	0.25	-0.03
EPR-4	0.36	0.36	0.28	<b>0.87</b>	0.38	0.09
EPR-5	0.28	0.33	0.28	<b>0.85</b>	0.32	0.04
EPE-1	0.23	0.24	0.22	0.22	<b>0.71</b>	-0.01
EPE-2	0.24	0.13	0.21	0.32	<b>0.72</b>	-0.03
EPE-4	0.18	0.17	0.28	0.31	<b>0.73</b>	0.06
EPE-5	0.12	0.22	0.22	0.30	<b>0.67</b>	0.13
FPE-1	0.20	0.12	0.14	0.05	0.02	<b>0.88</b>
FPE-2	0.18	0.03	0.10	0.02	0.01	<b>0.92</b>
FPE-3	0.22	0.09	0.11	0.09	0.10	<b>0.90</b>

The values in bold font highlight the items' loadings on their intended constructs

Subramony 2009) pointing out the beneficial effects of management commitment and employee empowerment on organizational performance.

Our results also contribute to the workplace safety, sustainability, and operations management research in several ways. This is the first study to provide empirical evidence for the relationship between safety, environmental, and financial dimensions of sustainable development in one model. Prior research and managerial practices regarding sustainability in operations management emphasize on the environmental issues as the entry point for operationalizing sustainability. Our results, however, suggest that commitment to safety and establishing a positive SC as the starting point toward achieving a sustainable business can yield great benefits not only in terms of improved safety performance, but also with regards to improvements in firm's environmental and financial outcomes.

Our results also reaffirm the proposed safety chain concept put forth by McFadden et al. (2009) for patient safety in healthcare industry as we provide empirical evidence for their SC-initiative-outcome model in a

manufacturing context. More specifically, this study demonstrates that a culture of safety within the workplace is tied to the successful implementation of SPR, and ultimately to improved safety performance in terms of reduction in the frequency, severity, and impact of incidents/accidents as well as heightened awareness and understanding of incidents/accidents and their root causes. We have also extended their model and explored the connections among safety chain variables with financial performance and ecological sustainability. More specifically, given the similarities between a safety-oriented and an environmental-friendly culture, our theoretical model and empirical results suggest that McFadden et al.'s model can be extended to the environmental management domain. In other words, a strong SC directly relates to the successful implementation of green practices and improved green performance of the firm.

Our study is also consistent with a recent stream of studies in corporate social responsibility (CSR) domain which focuses on the details of CSR activities and on how firms can maximize the beneficial effects of CSR on their financial outcomes (Basu and Palazzo 2008; Houghton



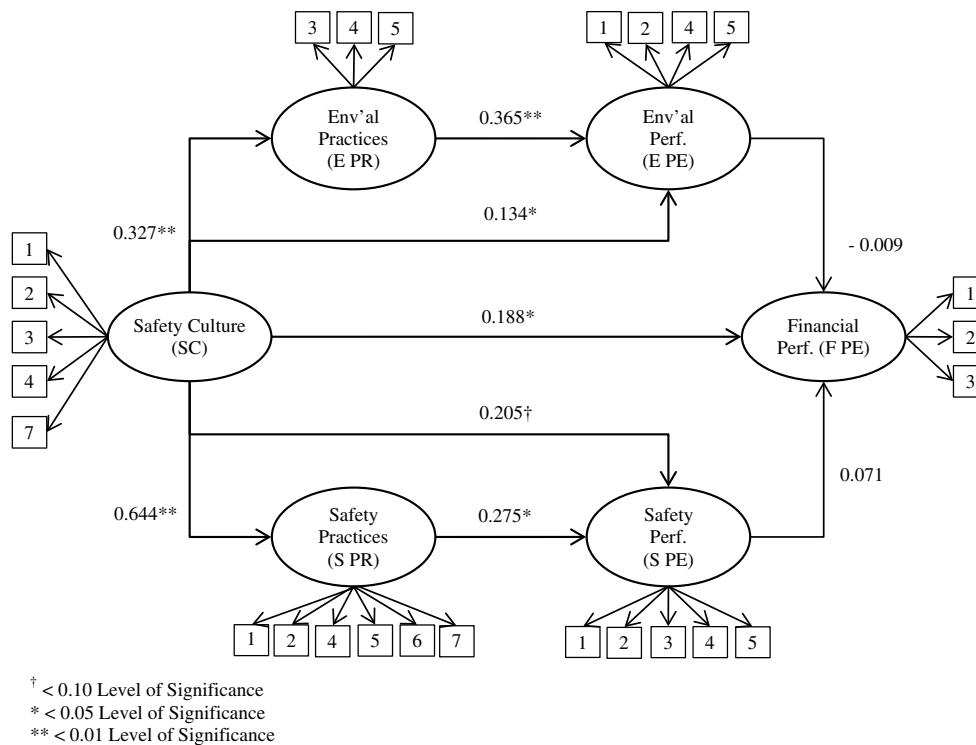


Fig. 2 Operational model with path coefficients

Table 6 PLS structural model results

	Standardized Coefficient	t value
Safety culture → Financial performance	0.188	2.028*
Safety performance → Financial performance	0.071	0.071
Environmental performance → Financial performance	-0.009	0.086
Plant size → Financial performance	-0.034	0.385
Plant complexity → Financial performance	0.022	0.183
Plant unionization → Financial performance	-0.078	0.815
Safety culture → Safety performance	0.205	1.770†
Safety practices → Safety performance	0.275	2.317*
Plant size → Safety performance	0.036	0.439
Plant complexity → Safety performance	0.056	0.858
Plant unionization → Safety performance	0.087	0.974
Safety culture → Environmental performance	0.134	2.039*
Environmental practices → Environmental Performance	0.365	4.571**
Plant size → Environmental performance	0.203	2.218*
Plant complexity → Environmental performance	0.062	0.978
Plant unionization → Environmental performance	-0.096	1.048
Safety culture → Safety practices	0.644	12.684**
Safety culture → Environmental practices	0.327	4.119**
Variance explained in the endogenous variables		
Financial performance	$R^2 = 0.061$	Safety practices $R^2 = 0.415$
Safety performance	$R^2 = 0.209$	Environmental Practices $R^2 = 0.107$
Environmental performance	$R^2 = 0.250$	

\*\*  $p < 0.01$ ; \*  $p < 0.05$ ; †  $p < 0.10$

et al. 2009; Kim et al. 2010; Margolis and Walsh 2003; Tang et al. 2012). Specifically, our findings provide partial support for Tang et al.'s (2012) study, suggesting that two "CSR engagement strategies" can increase the overall CSR benefits to the firm: (i) pursuing an "internal CSR" activity (in our case, SC) as the entry point of CSR engagement rather than an "external CSR" activity, and (ii) engaging in other "related" CSR dimensions with similar resources, skills, and knowledge requirements (in our case, environmental management) at the next steps.

Unfortunately, the research reported here is of a purely cross-sectional snapshot and we are unable to test and account for the lags between the development of the SC and the existence of practices and performance changes, which is a limitation of all such studies. Therefore, we suggest that two further streams of field research are needed. The first is to conduct in-depth case studies to detail the impact of SC and improvement initiatives on the performance dimensions internally used by the firms, to determine the rich fabric of how the culture and these initiatives lead to performance changes. Secondly, to increase the rigor of the study, a set of longitudinal studies are required to measure the extent of safety-oriented culture and the implementation level of SPR and EPR and their impact on organizational performance across a 3-to-5-year period, examining the relationships and their development through time. These studies can collect secondary panel data for companies whose CSR and performance information are available on databases such as Compustat and Environmental, Social and Governance factors (ESG) in addition to gathering primary survey data from the same companies regarding their organizational culture and specific practices.

Lastly, the surprising findings of no significant relationship between safety/environmental performance and financial performance merit some discussion. One reason for the lack of such effects could well lie in a possible lagged relationship between these performance constructs, as suggested by Hart and Ahuja (1996). Their results provide some evidence that it may pay firms to be green, but only after a time lag. Specifically, they found that it takes up to 2 years for improved environmental performance in terms of emission reduction to improve accounting profitability measures such as return on sales (ROS), return on assets (ROA), and return on equity (ROE). Therefore, our somewhat-puzzling findings might not be surprising after all. Moreover, this lagged effect could be due to reputation considerations. For example, a firm that is sued in time period  $t$  may experience an immediate stock price reaction (Klassen and McLaughlin 1996; Konar and Cohen 2001), but the accounting returns may only be affected several years later if the litigation results in substantial legal or compliance costs. Similarly, although a firm may emit

toxic chemicals, this information is only released to the public with at least a 1-year lag, which in turn takes one more year for it to affect the firm's revenue and profit. Unfortunately, as we did not perform a longitudinal study and cannot empirically investigate this suggestion and have to leave it for subsequent research.

We must also acknowledge some other limitations of our study. First, reliance on single-respondent perceptual data is a potential shortcoming of survey methodology, creating grounds for bias. While any potential bias of this kind cannot be explicitly ruled out, earlier research suggests no major concerns (Ellis et al. 2010; Gadenne et al. 2009; Hajmohammad et al. 2013; Jiang 2009; Sarkis et al. 2010; Vachon and Klassen 2006b). Moreover, studies suggest that self-reported data are highly consistent with more objective measures, especially when the respondents are at the appropriate level within the organization (Ketokivi and Schroeder 2004; Miller and Roth 1994). Besides, validation of our survey data on environmental performance with NPRI objective measure confirms that there is no major bias in the single respondent self-reported data in this study.

Second, the plants included in this study were selected from a limited range of industries with moderate levels of safety and environmental risks. Indeed, our findings might not be completely applicable to industries with lower levels of workplace hazards/adverse environmental impacts. Exploring the effect of industry type—with regards to safety and environmental concerns—on our proposed model is a fruitful avenue for future research (Baird et al. 2012).

In addition, the findings of this paper suggest other areas for future research. For example, it would be interesting to explore the connections between our proposed model and firm's competitive advantage. Given that SC is shown here to be an important driver of sustainability, additional longitudinal research should examine whether it leads to or is associated with emergence of an environmental-friendly culture within the organizations.

## Conclusions

This paper addresses Brown (1996) and Cantor's (2008) almost-unanswered calls for workplace safety research in operations and logistics management, and puts the anecdotal trade-off between safety and productivity/profitability into question. The arguments advanced in this paper illuminated how two aspects of SC, that is, management commitment and employee participation could directly enhance the three dimensions of the organization's performance, i.e., safety, environmental, and financial performance. Specifically, we demonstrated that SC influences

safety performance indirectly through the mediating effect of SPR. We also showed that organizations with a safety-oriented culture were more likely to join the green movement, adopt green technologies and successfully implement green practices, and subsequently, improve their environmental performance.

This study is distinct from previous works in the CSR and sustainability fields in that it looks into the inter-relationships between safety and environmental management constructs, and suggests using safety as an entry point for operationalizing sustainability for an organization. Further, it emphasizes on both the human benefits (safety performance) and the business case (environmental and financial performance) of achieving this broader conceptualization of sustainability. It also uses survey data from validated and reliable scales specifically designed to measure the defined constructs rather than the standard MSCI ESG (also known as KLD) data which is often the source of proxy variables for CSR-related constructs in CSR literature.

On the practical level, the proposed model provides the organizations' managers a path for designing or rethinking their approaches toward sustainability and a guideline for making the best out of their established environmental and safety management systems. To keep up with the worldwide quest for sustainability in various industries, many organizations have sought to become environment-oriented and establish environmental management systems such as ISO 14001, after becoming customer-oriented and implementation of quality management systems such as ISO 9001 during late twentieth and early twenty-first centuries. This study provides empirical support that both financial and environmental outcomes are tied to the SC, suggesting that organizations desiring to make environmental and financial improvements need to focus their attention to this infrastructural issue as the first step and emphasize on the important role of the individuals' commitment, empowerment, and participation. Our results suggest that managers interested in improving environmental and safety performance of their plants in parallel to their financial gains should follow a systematic approach in creating a culture of safety prior to pursuing ecological sustainability. Once employees' safety becomes a priority and employees participate in building a safe workplace environment, organizations can transfer the gained momentum to successfully adopt environmental technologies and implement SPR and ultimately improve their safety/environmental performance.

## Appendix 1: Survey Items

See Table 7.

**Table 7** Survey items

Constructs and their scale items <sup>a</sup>	Mean	SD
<b>Safety culture (SC)</b>		
To what extent does your plant exhibit each of the following organizational characteristics? (1 = not at all, 7 = great extent)		
SC-1: Senior management listens to and cares about employees' safety concerns	6.24	0.89
SC-2: The plant's management is driving the workforce to be a safety-centered organization	6.16	0.88
SC-3: The plant's management acts upon the employees' suggestions regarding safety matters	5.93	0.99
SC-4: The plant's employees encourage each other to report any safety concerns they might have	5.19	1.33
SC-5: <i>Employees' safety is constantly reinforced as a priority</i>	Dropped	
SC-6: <i>The plant's management knowingly compromise safety concerns for productivity</i>	Dropped	
SC-7: The plant's employees adhere to the established safety rules and guidelines	5.26	0.99
<b>Safety practices (SPR)</b>		
To what extent has your plant implemented the following practices as a means to reducing safety incidents/accidents? (1 = not at all, 7 = great extent)		
SPR-1: Taking input from all stakeholders on hazard identification and assessment	5.59	1.12
SPR-2: Taking input from all stakeholders on incident/accident reduction methods	5.52	1.16
SPR-3: <i>Reporting incidents/accidents without blame</i>	Dropped	
SPR-4: Open-ended discussion groups (discuss openly about incidents/accidents)	5.39	1.33
SPR-5: Safety training for employees	5.75	1.11
SPR-6: Statistical analysis of incidents/accidents data	5.18	1.59
SPR-7: System redesign for safety (restructuring the functioning of equipment, technology, procedures, etc.)	5.71	1.12
<b>Environmental practices (EPR)</b>		
Over the last 2 years, to what extent has your plant invested resources (money, time, and people) in programs in the following areas? (1 = not at all, 7 = great extent)		
EPR-1: <i>ISO 14001 certification</i>	Dropped	
EPR-2: <i>Pollution prevention</i>	Dropped	
EPR-3: Recycling of materials	4.88	1.55
EPR-4: Life cycle analysis	2.68	1.64
EPR-5: Waste reduction	4.57	1.59
<b>Safety performance (SPE)</b>		
Over the last 2 years, to what extent have the following safety performance indicators changed? (1 = much worse, 7 = much better)		
SPE-1: Frequency of incidents/accidents	5.21	1.08
SPE-2: Severity of incidents/accidents	5.26	1.15
SPE-3: Understanding of incidents/accidents	5.39	0.98
SPE-4: Awareness of possible incidents/accidents	5.56	0.90
SPE-5: Impact of incidents/accidents	5.27	1.05
<b>Environmental performance (EPE)</b>		
Over the last 2 years, to what extent has your plant's environmental performance changed in the following areas? (1 = much worse, 7 = much better)		
EPE-1: Air emissions	4.63	0.89
EPE-2: Waste water generation	4.65	1.01
EPE-3: <i>Solid waste disposal</i>	Dropped	

**Table 7** continued

Constructs and their scale items <sup>a</sup>	Mean	SD
EPE-4: Consumption of hazardous/harmful/toxic material	4.78	1.04
EPE-5: Energy consumption	5.04	1.07
Financial performance (FPE)		
Rate the following plant's performance over the last 2 years against the industry average (1 = well below, 7 = well above)		
FPE-1: Average returns on investments	4.57	1.15
FPE-2: Average profits	4.39	1.33
FPE-3: Profit growth	4.40	1.25

<sup>a</sup> The items in italic font have been dropped during confirmatory factor analysis (CFA)

## References

- Ambec, S., & Lanoie, P. (2008). Does it pay to be green? A systematic overview. *Academy of Management Perspectives*, 22(4), 45–62.
- Angell, L. C., & Klassen, R. D. (1999). Integrating environmental issues into the mainstream: An agenda for research in operations management. *Journal of Operations Management*, 17(5), 575–598.
- Arbuckle, J. L. (2010). *IBM SPSS Amos*. Chicago, IL: IBM SPSS Inc. Retrieved from <http://www.01.ibm.com/software/analytics/spss/products/statistics/amos/>.
- Armstrong, J. S., & Overton, T. S. (1977). Estimating nonresponse bias in mail surveys. *Journal of Marketing Research*, 14(3), 396–402.
- Ashford, N. (1997). Policies for the promotion of inherent safety. *New Solutions*, 7(4), 46–52.
- Bagozzi, R. P., & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science*, 16(1), 74–94.
- Baird, P. L., Geylani, P. C., & Roberts, J. A. (2012). Corporate social and financial performance re-examined: Industry effects in a linear mixed model analysis. *Journal of Business Ethics*, 109(3), 367–388.
- Basu, K., & Palazzo, G. (2008). Corporate social responsibility: A process model of sensemaking. *Academy of Management Review*, 33(1), 122–136.
- Blau, P. (1964). *Exchange and social power in social life*. New York: Wiley.
- British Standards Institution. (2007). *BS OHSAS 18001:2007: Occupational health and safety management systems—Requirements*. London: BSI.
- Brown, K. A. (1996). Workplace safety: A call for research. *Journal of Operations Management*, 14(2), 157–171.
- Brown, K. A., Willis, P. G., & Prussia, G. E. (2000). Predicting safe employee behavior in the steel industry: Development and test of a sociotechnical model. *Journal of Operations Management*, 18(4), 445–465.
- Bureau of Labor Statistics. (2010). The Injuries, Illnesses, and Fatalities (IIF) Program. Retrieved August 5, 2012, from United States Department of Labor, <http://www.bls.gov/iif/>.
- Byrne, B. M. (2010). *Structural equation modeling with AMOS: Basic concepts, applications, and programming* (2nd ed.). New York, NY: Taylor and Francis Group.
- Cantor, D. E. (2008). Workplace safety in the supply chain: A review of the literature and call for research. *International Journal of Logistics Management*, 19(1), 65–83.
- Caprar, D. V., & Neville, B. A. (2012). “Norming” and “conforming”: Integrating cultural and institutional explanations for sustainability adoption in business. *Journal of Business Ethics*, 110(2), 231–245.
- Carmines, E. G., & Zeller, R. A. (1979). *Reliability and validity assessment*. Newbury Park, CA: Sage.
- Carrillo, R. A. (2005). Safety leadership: Managing the paradox. *Professional Safety*, 50(7), 31–34.
- Chandrashekar, A., Dougless, T., & Avery, G. C. (1999). The environment is free: The quality analogy. *Journal of Quality Management*, 4(1), 123–143.
- Chin, W. W. (1998). The partial least squares approach to structural equation modeling. In G. A. Marcoulides (Ed.), *Modern methods for business research* (pp. 295–336). Hillsdale, NJ: Lawrence Erlbaum Associates.
- Chin, W. W., & Newsted, P. R. (1999). Structural equation modeling analysis with small samples using partial least squares. In R. Hoyle (Ed.), *Statistical strategies for small sample research* (Vol. 2, pp. 307–342). Thousand Oaks, CA: Sage.
- Choudhry, R. M., Fang, D., & Mohamed, S. (2007). The nature of safety culture: A survey of the state-of-the-art. *Safety Science*, 45(10), 993–1012.
- Cooper, M. D. (2000). Towards a model of safety culture. *Safety Science*, 36(2), 111–136.
- Cooper, M. D. (2002). Safety culture. *Professional Safety*, 47(6), 30–36.
- Corbett, C. J., & Kleindorfer, P. R. (2001). Environmental management and operations management: Introduction to part 1 (manufacturing and ecologistics). *Production and Operations Management*, 10(2), 107–111.
- Cox, S., & Cheyne, A. (2000). Assessing safety culture in offshore environments. *Safety Science*, 34(1–3), 111–129.
- Cunningham, T. R., Galloway-Williams, N., & Geller, E. S. (2010). Protecting the planet and its people: How do interventions to promote environmental sustainability and occupational safety and health overlap? *Journal of Safety Research*, 41(5), 407–416.
- Curkovic, S., Vickery, S., & Dröge, C. (2000). Quality-related action programs: Their impact on quality performance and firm performance. *Decision Sciences*, 31(4), 885–902.
- Daily, B. F., & Huang, S. (2001). Achieving sustainability through attention to human resource factors in environmental management. *International Journal of Operations & Production Management*, 21(12), 1539–1552.
- Das, A., Pagell, M., Behm, M., & Veltri, A. (2008). Toward a theory of the linkages between safety and quality. *Journal of Operations Management*, 26(4), 521–535.
- De Koster, R. B. M., Stam, D., & Balk, B. M. (2011). Accidents happen: The influence of safety-specific transformational leadership, safety consciousness, and hazard reducing systems on warehouse accidents. *Journal of Operations Management*, 29(7–8), 753–765.
- DeJoy, D. M., Schaffer, B. S., Wilson, M. G., Vandenberg, R. J., & Butts, M. M. (2004). Creating safer workplaces: Assessing the determinants and role of safety climate. *Journal of Safety Research*, 35(1), 81–90.
- Delmas, M. (2001). Stakeholders and competitive advantage: The case of ISO 14001. *Production and Operations Management*, 10(3), 343–358.
- DePasquale, J. P., & Geller, E. S. (1999). Critical success factors for behavior-based safety: A study of twenty industry-wide applications. *Journal of Safety Research*, 30(4), 237–249.
- Dillman, D. A. (2000). *Mail and Internet survey: The tailored design method* (2nd ed.). New York: Wiley.
- Dixon-Fowler, H. R., Slater, D. J., Johnson, J. L., Ellstrand, A. E., & Romi, A. M. (2013). Beyond “does it pay to be green?” A meta-



- analysis of moderators of the CEP–CFP relationship. *Journal of Business Ethics*, 112(2), 353–366.
- Efron, B., & Tibshirani, R. (1993). *An introduction to the bootstrap*. New York: Chapman & Hall.
- Ehrenfeld, J. R. (2005). The roots of sustainability. *MIT Sloan Management Review*, 46(2), 23–25.
- Eisenberger, R., Armeli, S., Rexwinkel, B., Lynch, P. D., & Rhoades, L. (2001). Reciprocation of perceived organizational support. *Journal of Applied Psychology*, 86(1), 42.
- Eisenberger, R., Cummings, J., Armeli, S., & Lynch, P. (1997). Perceived organizational support, discretionary treatment, and job satisfaction. *Journal of Applied Psychology*, 82(5), 812.
- Ellis, S. C., Henry, R. M., & Shockley, J. (2010). Buyer perceptions of supply disruption risk: A behavioral view and empirical assessment. *Journal of Operations Management*, 28(1), 34–46.
- Environment Canada. (2010). National pollutant release inventory. Retrieved July 15, 2012, from <http://www.ec.gc.ca/inrp-npri/>
- Fernández-Muñiz, B., Montes-Peón, J. M., & Vázquez-Ordás, C. J. (2007). Safety culture: Analysis of the causal relationships between its key dimensions. *Journal of Safety Research*, 38(6), 627–641.
- Fernández-Muñiz, B., Montes-Peón, J. M., & Vázquez-Ordás, C. J. (2009). Relation between occupational safety management and firm performance. *Safety Science*, 47(7), 980–991.
- Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18(1), 39–50.
- Gadanne, D. L., Kennedy, J., & McKeiver, C. (2009). An empirical study of environmental awareness and practices in SMEs. *Journal of Business Ethics*, 84(1), 45–63.
- Gerbing, D. W., & Anderson, J. C. (1988). An updated paradigm for scale development incorporating unidimensionality and its assessment. *Journal of Marketing Research*, 25(2), 186–192.
- Gouldner, A. W. (1960). The norm of reciprocity: A preliminary statement. *American Sociological Review*, 25(2), 161–178.
- Hajmohammad, S., Vachon, S., Klassen, R. D., & Gavronski, I. (2013). Lean management and supply management: Their role in green practices and performance. *Journal of Cleaner Production*, 39(1), 312–320.
- Hamel, G., & Prahalad, C. K. (2005). Strategic intent. *Harvard Business Review*, 83(7), 148.
- Harman, H. H. (1976). *Modern factor analysis*. Chicago, IL: University of Chicago Press.
- Harrison, D. A., Newman, D. A., & Roth, P. L. (2006). How important are job attitudes? Meta-analytic comparisons of integrative behavioral outcomes and time sequences. *Academy of Management Journal*, 49(2), 305–325.
- Hart, S. L. (1995). A natural-resource-based view of the firm. *Academy of Management Review*, 20(4), 986–1014.
- Hart, S. L. (1997). Beyond greening: Strategies for a sustainable world. *Harvard Business Review*, 75(1), 66–76.
- Hart, S. L., & Ahuja, G. (1996). Does it pay to be green? An empirical examination of the relationship between emission reduction and firm performance. *Business Strategy and the Environment*, 5(1), 30–37.
- Heinrich, H. (1931). *Industrial accident prevention: A scientific approach*. New York: McGraw-Hill.
- Henri, J. F., & Journeault, M. (2010). Eco-control: The influence of management control systems on environmental and economic performance. *Accounting, Organizations and Society*, 35(1), 63–80.
- Hofmann, D. A., Morgeson, F. P., & Gerras, S. J. (2003). Climate as a moderator of the relationship between leader–member exchange and content specific citizenship: Safety climate as an exemplar. *Journal of Applied Psychology*, 88(1), 170.
- Hofmann, D. A., & Stetzer, A. (1996). A cross-level investigation of factors influencing unsafe behaviors and accidents. *Personnel Psychology*, 49(2), 307–339.
- Hoonakker, P., Loushine, T., Carayon, P., Kallman, J., Kapp, A., & Smith, M. J. (2005). The effect of safety initiatives on safety performance: A longitudinal study. *Applied Ergonomics*, 36(4), 461–469.
- Houghton, S. M., Gabel, J. T., & Williams, D. W. (2009). Connecting the two faces of CSR: Does employee volunteerism improve compliance? *Journal of Business Ethics*, 87(4), 477–494.
- Howard-Grenville, J. A., Hoffman, A. J., & Wirtenberg, J. (2003). The importance of cultural framing to the success of social initiatives in business. *Academy of Management Executive*, 17(2), 70–86.
- Huselid, M. A., Jackson, S. E., & Schuler, R. S. (1997). Technical and strategic human resource management effectiveness as determinants of firm performance. *Academy of Management Journal*, 40(1), 171–188.
- Jayaram, J., Droge, C., & Vickery, S. K. (1999). The impact of human resource management practices on manufacturing performance. *Journal of Operations Management*, 18(1), 1–20.
- Jiang, B. (2009). Implementing supplier codes of conduct in global supply chains: Process explanations from theoretic and empirical perspectives. *Journal of Business Ethics*, 85(1), 77–92.
- Karpoﬀ, J. M., Lott, J. R., Jr., & Wehrly, E. W. (2005). The reputational penalties for environmental violations: Empirical evidence. *Journal of Law and Economics*, 48(2), 653–675.
- Kaynak, H. (2003). The relationship between total quality management practices and their effects on firm performance. *Journal of Operations Management*, 21(4), 405–435.
- Ketokivi, M., & Schroeder, R. (2004). Manufacturing practices, strategic fit and performance: A routine-based view. *International Journal of Operations & Production Management*, 24(2), 171–191.
- Kim, D. Y., Kumar, V., & Kumar, U. (2012). Relationship between quality management practices and innovation. *Journal of Operations Management*, 30(4), 295–315.
- Kim, H. R., Lee, M., Lee, H. T., & Kim, N. M. (2010). Corporate social responsibility and employee–company identification. *Journal of Business Ethics*, 95(4), 557–569.
- King, A., & Lenox, M. (2002). Exploring the locus of profitable pollution reduction. *Management Science*, 48(2), 289–299.
- Kirwan, B. (1998). Safety management assessment and task analysis—A missing link. In A. B. M. Hale (Ed.), *Safety management: The challenge of change* (pp. 67–92). Oxford: Elsevier.
- Klassen, R. D., & McLaughlin, C. P. (1996). The impact of environmental management on firm performance. *Management Science*, 42(8), 1199–1214.
- Klassen, R. D., & Whybark, D. C. (1999a). Environmental management in operations: The selection of environmental technologies. *Decision Sciences*, 30(3), 601–631.
- Klassen, R. D., & Whybark, D. C. (1999b). The impact of environmental technologies on manufacturing performance. *Academy of Management Journal*, 42(6), 599–615.
- Kleindorfer, P. R., & Saad, G. H. (2005). Managing disruption risks in supply chains. *Production and Operations Management*, 14(1), 53–68.
- Kleindorfer, P. R., Singhal, K., & Van Wassenhove, L. N. (2005). Sustainable operations management. *Production and Operations Management*, 14(4), 482–492.
- Konar, S., & Cohen, M. A. (2001). Does the market value environmental performance? *Review of Economics and Statistics*, 83(2), 281–289.
- Krause, T. R., & Weekley, T. (2005). Safety leadership. *Professional Safety*, 50(11), 34–40.

- Kumar, N., Stern, L. W., & Anderson, J. A. (1993). Conducting inter-organizational research using key informants. *Academy of Management Journal*, 36(6), 1633–1651.
- Lambert, D. M., & Harrington, T. C. (1990). Measuring nonresponse bias in customer service mail surveys. *Journal of Business Logistics*, 11(2), 5–25.
- MacCallum, R. C., Roznowski, M., & Necowitz, L. B. (1992). Model modifications in covariance structure analysis: The problem of capitalization on chance. *Psychological Bulletin*, 111(3), 490–504.
- Manuele, F. (2011). Accident costs: Rethinking ratios of indirect to direct costs. *Professional Safety*, 56(1), 39–47.
- Margolis, J. D., & Walsh, J. P. (2003). Misery loves companies: Rethinking social initiatives by business. *Administrative Science Quarterly*, 48(2), 268–305.
- Mathieu, J. E., Gilson, L. L., & Ruddy, T. M. (2006). Empowerment and team effectiveness: An empirical test of an integrated model. *Journal of Applied Psychology*, 91(1), 97–108.
- Matos, S., & Hall, J. (2007). Integrating sustainable development in the supply chain: The case of life cycle assessment in oil and gas and agricultural biotechnology. *Journal of Operations Management*, 25(6), 1083–1102.
- Mayer, B. (2009). Cross-movement coalition formation: Bridging the labor-environment divide. *Sociological Inquiry*, 79(2), 219–239.
- McFadden, K. L., Henagan, S. C., & Gowen, C. R., I. I. I. (2009). The patient safety chain: Transformational leadership's effect on patient safety culture, initiatives, and outcomes. *Journal of Operations Management*, 27(5), 390–404.
- McFadden, K. L., & Hosmane, B. S. (2001). Operations safety: An assessment of a commercial aviation safety program. *Journal of Operations Management*, 19(5), 579–591.
- Mearns, K., Whitaker, S. M., & Flin, R. (2003). Safety climate, safety management practice and safety performance in offshore environments. *Safety Science*, 41(8), 641–680.
- Melnyk, S. A., Sroufe, R. P., & Calantone, R. (2003). Assessing the impact of environmental management systems on corporate and environmental performance. *Journal of Operations Management*, 21(3), 329–351.
- Meyer, J. P., Allen, N. J., & Gellatly, I. R. (1990). Affective and continuance commitment to the organization: Evaluation of measures and analysis of concurrent and time-lagged relations. *Journal of Applied Psychology*, 75(6), 710.
- Meyer, J. P., & Herscovitch, L. (2001). Commitment in the workplace: Toward a general model. *Human Resource Management Review*, 11(3), 299–326.
- Michael, J. H., Evans, D. D., Jansen, K. J., & Haight, J. M. (2005). Management commitment to safety as organizational support: Relationships with non-safety outcomes in wood manufacturing employees. *Journal of Safety Research*, 36(2), 171–179.
- Miller, J. G., & Roth, A. V. (1994). A taxonomy of manufacturing strategies. *Management Science*, 40(3), 285–304.
- Nair, A. (2006). Meta-analysis of the relationship between quality management practices and firm performance—Implications for quality management theory development. *Journal of Operations Management*, 24(6), 948–975.
- Neal, A., Griffin, M. A., & Hart, P. M. (2000). The impact of organizational climate on safety climate and individual behavior. *Safety Science*, 34(1–3), 99–109.
- Oliver, A., Cheyne, A., Tomas, J. M., & Cox, S. (2002). The effects of organizational and individual factors on occupational accidents. *Journal of Occupational and Organizational psychology*, 75(4), 473–488.
- Ostroff, C. (1992). The relationship between satisfaction, attitudes, and performance: An organizational level analysis. *Journal of Applied Psychology*, 77(6), 963.
- Ostrom, L., Wilhelmsen, C., & Kaplan, B. (1993). Assessing safety culture. *Nuclear Safety*, 34(2), 163–172.
- Patterson, M. G., West, M. A., & Wall, T. D. (2004). Integrated manufacturing, empowerment, and company performance. *Journal of Organizational Behavior*, 25(5), 641–665.
- Peng, D. X., & Lai, F. (2012). Using partial least squares in operations management research: A practical guideline and summary of past research. *Journal of Operations Management*, 30(6), 467–480.
- Piercy, N. F., Cravens, D. W., Lane, N., & Vorhies, D. W. (2006). Driving organizational citizenship behaviors and salesperson in-role behavior performance: The role of management control and perceived organizational support. *Journal of the Academy of Marketing Science*, 34(2), 244–262.
- Podsakoff, P. M., & MacKenzie, S. B. (1997). Impact of organizational citizenship behavior on organizational performance: A review and suggestion for future research. *Human Performance*, 10(2), 133–151.
- Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88(5), 879.
- Porter, M. E., & Kramer, M. R. (2006). The link between competitive advantage and corporate social responsibility. *Harvard Business Review*, 84(12), 78–92.
- Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods*, 36(4), 717–731.
- Pullman, M. E., Maloni, M. J., & Carter, C. R. (2009). Food for thought: Social versus environmental sustainability practices and performance outcomes. *Journal of Supply Chain Management*, 44(4), 38–54.
- Quazi, H. A., Khoo, Y. K., Tan, C. M., & Wong, P. S. (2001). Motivation for ISO 14000 certification: Development of a predictive model. *Omega*, 29(6), 525–542.
- Rao, P., & Holt, D. (2005). Do green supply chains lead to competitiveness and economic performance? *International Journal of Operations & Production Management*, 25(9), 898–916.
- Rechenthin, D. (2004). Project safety as a sustainable competitive advantage. *Journal of Safety Research*, 35(3), 297–308.
- Rhoades, L., & Eisenberger, R. (2002). Perceived organizational support: A review of the literature. *Journal of Applied Psychology*, 87(4), 698.
- Rhoades, L., Eisenberger, R., & Armeli, S. (2001). Affective commitment to the organization: The contribution of perceived organizational support. *Journal of Applied Psychology*, 86(5), 825.
- Richter, A., & Koch, C. (2004). Integration, differentiation and ambiguity in safety cultures. *Safety Science*, 42(8), 703–722.
- Ringle, C. M., Wende, S., & Will, A. (2005). *SmartPLS Release: 2.0 (beta)*. Hamburg, Germany: SmartPLS. Retrieved from <http://www.smartpls.de>
- Rothenberg, S., Pil, F. K., & Maxwell, J. (2001). Lean, green, and the quest for superior environmental performance. *Production and Operations Management*, 10(3), 228–243.
- Rundmo, T. (2000). Safety climate, attitudes and risk perception in Norsk Hydro. *Safety Science*, 34(1–3), 47–59.
- Russo, M. V., & Fouts, P. A. (1997). A resource-based perspective on corporate environmental performance and profitability. *Academy of Management Journal*, 40(3), 534–559.
- Samson, D., & Terziovski, M. (1999). The relationship between total quality management practices and operational performance. *Journal of Operations Management*, 17(4), 393–409.
- Sarkis, J., Gonzalez-Torre, P., & Adenso-Diaz, B. (2010). Stakeholder pressure and the adoption of environmental practices: The mediating effect of training. *Journal of Operations Management*, 28(2), 163–176.
- Seo, D. C. (2005). An explicative model of unsafe work behavior. *Safety Science*, 43(3), 187–211. doi:10.1016/j.ssci.2005.05.001.

- Sexton, J. B., Helmreich, R., Pronovost, P., & Thomas, E. (2003). *Safety climate survey*. Boston: Institute for Healthcare Improvement.
- Shannon, H. S., Mayr, J., & Haines, T. (1997). Overview of the relationship between organizational and workplace factors and injury rates. *Safety Science*, 26(3), 201–217.
- Shrivastava, P. (1995a). Environmental technologies and competitive advantage. *Strategic Management Journal*, 16(3), 183–200.
- Shrivastava, P. (1995b). The role of corporations in achieving ecological sustainability. *Academy of Management Review*, 20(4), 936–960.
- Smallman, C., & John, G. (2001). British directors perspectives on the impact of health and safety on corporate performance. *Safety Science*, 38(3), 227–239.
- Snir, E. M. (2001). Liability as a catalyst for product stewardship. *Production and Operations Management*, 10(2), 190–206.
- Sroufe, R. (2003). Effects of environmental management systems on environmental management practices and operations. *Production and Operations Management*, 12(3), 416–431.
- Starik, M., & Rands, G. P. (1995). Weaving an integrated web: Multilevel and multisystem perspectives of ecologically sustainable organizations. *Academy of Management Journal*, 20(4), 908–935.
- Subramony, M. (2009). A meta-analytic investigation of the relationship between HRM bundles and firm performance. *Human Resource Management*, 48(5), 745–768.
- Sulzer-Azaroff, B. (1978). Behavioral ecology and accident prevention. *Journal of Organizational Behavior Management*, 2(1), 11–44.
- Sun, L. Y., Aryee, S., & Law, K. S. (2007). High-performance human resource practices, citizenship behavior, and organizational performance: A relational perspective. *Academy of Management Journal*, 50(3), 558–577.
- Tanaka, J. S. (1987). “How Big Is Big Enough?”: Sample size and goodness of fit in structural equation models with latent variables. *Child Development*, 58(1), 134–146.
- Tang, Z., Hull, C. E., & Rothenberg, S. (2012). How corporate social responsibility engagement strategy moderates the CSR–financial performance relationship. *Journal of Management Studies*, 49(7), 1274–1303.
- Taubitz, M. A. (2010). Lean, green, & safe: Integrating safety into lean, green and sustainability movement. *Professional Safety*, 55(5), 39–46.
- Thompson, R. C., Hilton, T. F., & Witt, L. A. (1998). Where the safety rubber meets the shop floor: A confirmatory model of management influence on workplace safety. *Journal of Safety Research*, 29(1), 15–24.
- Thoumy, M., & Vachon, S. (2012). Environmental projects and financial performance: Exploring the impact of project characteristics. *International Journal of Production Economics*, 140(1), 28–34.
- Vachon, S., & Klassen, R. D. (2006a). Extending green practices across the supply chain: The impact of upstream and downstream integration. *International Journal of Operations and Production Management*, 26(7), 795–821.
- Vachon, S., & Klassen, R. D. (2006b). Green project partnership in the supply chain: The case of the package printing industry. *Journal of Cleaner Production*, 14(6–7), 661–671.
- Vastag, G. (2004). Revisiting ISO 14000 diffusion: A new “look” at the drivers of certification. *Production and Operations Management*, 13(3), 260–267.
- Vecchio-Sadus, A. M., & Griffiths, S. (2004). Marketing strategies for enhancing safety culture. *Safety Science*, 42(7), 601–619.
- Vredenburg, A. G. (2002). Organizational safety: Which management practices are most effective in reducing employee injury rates? *Journal of Safety Research*, 33(2), 259–276.
- Wolf, F. G. (2001). Operationalizing and testing normal accident theory in petrochemical plants and refineries. *Production and Operations Management*, 10(3), 292–305.
- Zacharatos, A., Barling, J., & Iverson, R. D. (2005). High-performance work systems and occupational safety. *Journal of Applied Psychology*, 90(1), 77.
- Zwetsloot, G., & Marrewijk, M. (2004). From quality to sustainability. *Journal of Business Ethics*, 55(2), 79–82.