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ISO 14001 and solid waste generation rates in US manufacturing organizations: an analysis of relationship

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ABSTRACT

The purpose of this paper is to study the impact of ISO 14001 and other significant factors on solid waste generation rates of organizations. The research is based on a survey conducted on a random sample of industrial companies that operate in United States. The paper reveals that companies' solid waste generation rates are significantly reduced by certification and identifies several factors of ISO 14001 that are most significant in terms of solid waste reduction. The paper also reveals that solid waste disposal costs are also significant and influence the solid waste generation of industrial companies.

1. Introduction

In 1996, International Organization for Standardization (ISO) based in Geneva, developed the ISO 14000 series which describe the requirements to be fulfilled by organizations to implement an effective environmental management system (EMS). The ISO 14000 series consists of 21 standards and guidance documents. These environmental standards are divided into six categories: 1) environmental management system; 2) environmental auditing; 3) environmental performance evaluation; 4) environmental labeling; 5) life-cycle assessment; and 6) environmental aspects in product standards (Resale, 2000).

ISO 14001 is considered the only standard designed for the purpose of audit and certification in the ISO 14000 series. The core elements of the ISO 14001 standard are environmental policy, planning, implementation and operation, checking and corrective action, review, and improvement. General Motors, Daimler-Chrysler, Ford, Toyota, and other automobile manufacturers have adopted ISO 14001 certification and they are requiring their suppliers worldwide to adopt the certification as a condition for continuing to do business (Morrow and Rondinelli, 2002). Although ISO 14001 certification has been demanded by customers and stakeholders, companies still have no clear understanding of the benefits of implementing ISO 14001 (Babakri et al., 2004). It is often assumed that ISO 14001 certification leads to a better performance, including reduced waste generation, for organizations. Some environmental management system (EMS) authors claim that the effective implementation of ISO 14001 elements will reduce or eliminate negative environmental impact and move a company toward better environmental performance (Rondinelli and Vastag, 2000). However, few studies discuss the quantitative effects of implementing ISO 14001 on improving the environmental performance, including solid waste generation.

This paper presents an empirical examination of the impact of ISO 14001 certification and other significant factors on the solid waste generation rates of organizations. This research was conducted in the United States, and includes 121 industrial organizations. The aim of this research is to investigative the reduction of solid waste generation rates for the organizations as result of adopting ISO 14001 certification versus similar organizations that are not certified. The main questions for this paper can be described as follows: "Does ISO 14001 certification lead to a lower solid waste generation rates for organizations and what other factors influence the solid waste generation rates of manufacturing companies?". Both quantitative regression analyses and qualitative data analysis are studied.

2. Literature review

Numerous research articles have been published on the effects of ISO 14001 certification from a qualitative and quantitative standpoint. Nawrocka and Parker (2009) performed a meta-study

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that analyzed a pool of 23 studies connecting environmental performance and its measurement. This study was very informative, but as described by the authors, the results were inconclusive and suggested a case by case approach and the need for additional research in the field. In addition, few studies have had solid waste reduction as the focal point in regards to the benefits of ISO 14001 certification. Many studies have been conducted linking other aspects of environmental performance to ISO 14001 certification. Concerns have also been raised whether the correlation between ISO 14001 and improved environmental performance can show causality (Coglianese and Nash, 2001).

Several studies that have been conducted related ISO 14001 and waste reduction include a study by Rondinelli and Vastag (2000). In their study of Alcoa's Mt. Holly plant, they found that ISO 14001 certification led to more ideas among the employees for materials recycling and increased their commitment to recycle. Additionally, during the period following the achievement of ISO 14001, the amount of waste that had to be sent to landfills was reduced from 7608 tons in 1995 to 4960 tons in 1998 and the waste cost of production per ton of aluminum dropped from $8.33 in 1995 to $6.50 in 1998. Parry (2000) used a combination of interviews and case studies to investigate the role of ISO 14001 in minimizing waste. According to the author, improvement in recycling is one of the more quantifiable business benefits of ISO 14001 and some companies have captured the cost savings associated with reducing waste. Parry did not provide quantitative analyses related to solid reduction achievements as a result of certification.

Most of the ISO 14001 studies do not focus on solid waste reduction, but comprehensive environmental performance improvement or other aspects. For example, as case study was presented from Malaysia that analyzed the impact of environmental management system (EMS) certification and organizations' performance (2006). This study concluded that EMS certification positively impacts economic performance and customer satisfaction. In addition to this study, Mohammed (2000) conducted a survey by sending questionnaires to 106 ISO 14001 certified firms in Japan in 1997. The results of the survey showed that about 69% of the respondent reduced paper purchases due to the implementation of ISO 14001. The survey also showed that more than 60% of the respondents have given special consideration to the reuse and recycling of their packing and final products. In addition, 41% of the respondents used recycled materials inside the firms. Tan (2005), completed a comprehensive literature review that summarized the benefits of obtaining ISO 14000 registration. This study identified four articles that are related to the minimization or elimination of waste and none of them provided quantified solid waste reduction rates derived from ISO 14000 certification (Melnyk et al., 2003; Hong Kong Department of Industry, 1998; Pun et al., 1998; Fussler, 1996.). In addition, many recent studies have not focused on solid waste, but focus on hazardous waste, waste water, and air emissions (Russo, 2009; Barla, 2007; Curkovic et al., 2005; Zutshi and Sohal, 2004; Welch et al., 2003; Raines, 2002; Hamschmidt and Dyllick, 2002).

3. Methodology

3.1. Description of the sample and collection methods

The data used in this study was collected from a questionnaire survey. In January 2008, the questionnaire was mailed to 440 manufacturing companies in the United States using a stratified sampling method. From the 440 surveys, 55 surveys were mailed to each of the eight common business groups that commonly pursue ISO 14000 certification (Babakri et al., 2004). These eight common groups were determined from literature reviews and based on Standard Industry Classification (SIC) Codes and included the following manufacturing industries:

- Wood and Lumber
- Metal
- Food Processing
- Chemical and Rubber
- Paper
- Transportation Equipment
- Textile and Fabric
- Electronic

The time span of the data collection was five months. A total of 121 sets of usable questionnaire data were successfully collected, yielding a response rate of 27.5%. Company profile information is presented in Table 1.

3.2. Variables considered and assumptions

In order to test the impact of IS0 14001 certification on waste generation rates for organizations, the following nine potential recycling performance indicators were developed from the literature review:

- Business activity (based on SIC code)
- Number of employees at the facility
- U.S. State of Operation
- Working Days at the facility per year
- Tons of solid waste generated per year
- Overall Recycling Percentage for the facility
- Landfill Disposal Cost Per Ton
- ISO 9000 Registration
- ISO 14000 Registration

The survey was designed to examine the solid waste generation rates of the company based on several indicator variables discussed in the preceding list. In terms of assumptions, the study did not

Table 1
Company profile information.

Manufacturing industry category	SIC code	Number of companies analyzed	Average solid waste per company per year (tons)	Average number of employees per company	Average solid waste per employee per year (tons)
Wood and Lumber	24–25	14	1528.6	84.3	18.13
Metal	33–34	10	1313.6	123.8	10.61
Food Processing	20	8	784.8	68.8	11.41
Chemical and Rubber	28–30	16	749.8	84.5	8.87
Paper	26–27	14	726.0	84.8	8.56
Transportation Equipment	37	14	653.5	120.1	5.44
Textile and Fabric	22–23	13	584.7	97.0	6.03
Electronic	35–39	32	194.5	59.3	3.28