



Research article

Analysis of the Environmental Management System based on ISO 14001 on the American continent



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ABSTRACT

The American continent is in broad economic and industrial development. Consequently, a more detailed discussion of the impacts generated by such development is needed. Moreover, there is an increase in the number of ISO 14001 certificates issued to this continent. Given the above, no studies were found that bridge the gap to identify the influence of different factors on ISO 14001 in the Americas. Thus, this article has as its main aim to check which economic, environmental and cultural factors have influence on ISO 14001 Certification in the American Continent. The data were collected in the ISO Survey, World Bank, United Nations Development Programme and International Energy Agency. Among the countries of that continent, thirteen were analyzed and only two did not show the economic factors as the influence factor in the multiple regression models fitted with Brazil and the United State. In these models, all presented environmental factors as influencing factors. Only in Brazil the index HDI presented as cultural factor in multiple regression model fitted. The economic factors: Gross Domestic Product and exports of goods and services and environmental: Carbon Dioxide (CO₂) and fossil fuel consumption were the most influential in ISO 14001 certification. Venezuela, Uruguay, Colombia and the United States were countries that had factors dependent on each other, featuring the environmental marketing. Briefly, this study brings up several implications: to the academy, with the proposal of new concepts and guidance on the factors that assist in ISO 14001 certification in the American Continent. Additionally, taking into account the industry, the factors serve as efficiency parameters for the implementation of ISO 14001 standard, and for the Government to improve through factors that do not fit in multiple regression models.

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1. Introduction

A growing number of companies emit pollutants into the environment and consequently stimulate the degradation process. These companies, driven by continuous consumption, become major environmental risks. As a result, they contribute for instance to global warming and the depletion of the ozone layer (Gomez and Rodriguez, 2011). In this context, various models, methods and tools are being developed to minimize the emission of different types of pollutants, one of them is the Environmental Management System Certification based on ISO 14001. This international standard is part of a series, a standard designed to meet these needs through an efficient system of environmental management (Nishitani, 2009; Gomez and Rodriguez, 2011).

Given the importance of this standard, several studies have been

conducted in order to understand its contribution to the environment and present the growth in the number of certificates around the world. Among these studies, it is mentioned: Prakash and Potoski (2013); Salgado and Neves (2014); Testa et al. (2014); Zhang et al. (2014) and Nguyen and Hens (2013). These studies report that ISO 14001 has the ability to manage the reduction of emissions of various pollutants. For example, Salgado and Neves (2014) found that ISO 14001 has a positive influence on the reduction of air pollutants in São Paulo. In addition, Prakash and Potoski (2013) reported that certification reduced the amount of SO₂ in approximately 160 countries. Additionally, Zhang et al. (2014) have shown that the implementation of certification significantly decreased the amount of pollutants emitted by coating industries. Likewise, Testa et al. (2014) found that, in Italy, the implementation of the Environmental Management System (EMS) based on ISO 14001, has a clear positive impact on CO₂ emissions in the short and long term. In turn, Nguyen and Hens (2013) found a reduction of environmental impacts, such as reduced SO₂ and NO₂

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List of acronyms

AIC	Akaike Information Criteria
ANOVA	Analysis of variance
BB	Biogas and Biofuels
CH ₄	Methane
CO ₂	Carbon Dioxide
E	Electricity
EE (β)	Error Estimation
EGS	Export of Goods and Services
EMS	Environmental Management System
EP	Economic Performance
FFC	Fossil Fuel Consumption
FI	Foreign Investment
GDP _{exp}	Gross Domestic Product per export
GDPG	Gross Domestic Product Growth

GDP _{ind}	Industrial Gross Domestic Product
GNI	Gross National Income
HDI	Human Development Index
HFC	Hydrofluorocarbons
ICI	Industrial Competitiveness Indicator
ISO	International Organization for Standardization
IW	Industrial Waste
NG	Natural Gas
NH ₃	Ammonia
NO ₂	Nitrous Oxide
PD	Petroleum and Derivatives
PDCA	Plan, Do, Check and Act
PFC	Perfluorocarbons
QMS	Quality Management System
SF ₆	Hexa Sulfur Fluorocarbons
TR	Total Reserves

dust discharged during the manufacturing process and organizational improvement resulting from the ISO 14001 certification.

Not referring only to environmental issues but also to economic and market issues, ISO 14001 is also influenced by these factors, as in the environmental marketing (Nishitani, 2009; Gomez and Rodriguez, 2011). Thus, it is clear that companies put international regulations into practice as a way to succeed in the market access (Nishitani, 2009). This is proven in the study by Vries et al. (2012), who found an improvement in the environmental management and in the financial and market performance of the companies studied, due to the ISO 14001 certification. Adding to the factors mentioned before, there is a significant increase in the diffusion of international management standards in a wide range of economic activities. Among these international standards, in particular, it is mentioned the Quality Management System based on ISO 9001 (ISO, 2015). This is due to structural and cultural issues, where most companies get certified first with ISO 9001 and then with ISO 14001 (ISO, 2015).

Thus, it is necessary to verify which environmental, economic and socio-cultural aspects influence the issuance of certificates, because according to data from ISO Survey (2015), between 2001 and 2013, the standard increased from 36464 to 301647 in its totalization. In addition, the continents present the following evolution in the numbers of certificates issued for the same period: Asian 14637-157761; European 17941-119107; American 3381-18807; Middle East 194-3434 and African 311-2538. This evolution is portrayed by the research of To and Lee (2014). In addition, the same authors identify factors that imply in the issuance in several world regions. However, no research found coverage of that growth in the certifications issued in the American continent. One of the alternatives to analyze certificate issuance and the aspects that influence its issuance is through the modelling technique. Several researchers conducted modelling studies for ISO 9001, among them: Franceschini et al., 2004, 2010; Sampaio et al., 2011a,b; Llach et al., 2011. It is worth mentioning that Salgado et al. (2015) verified the influence of economic factors on ISO 9001 with focus on the American continent. ISO 14001 follows the same implementation pattern of ISO 9001, however there are no articles in the literature that verify the influence of factors on the certifications issued of ISO 14001, as the article by Salgado et al. (2015). However, some researches on the American continent are mentioned in the ISO 14001 standard: Oliveira et al. (2010) in a survey in Brazil bring the main benefits and difficulties of implementing ISO 14001; Barla (2007) found the influence of ISO 14001 on cellulose companies

in Quebec (Canada), resulting in a large reduction in waste arising from that material; Newbold (2006) shows the environmental dynamics of the Chilean mining industry and Franchetti (2011) verifies the effectiveness of ISO 14001 in companies that emit solid waste in the United States. For the other countries, no researches were found in journals globally.

The diffusion of ISO 14001 in the American countries does not follow the same dynamics of other places highlighted in other researches (e.g. Boiral and Henri, 2012; Zeng and Eastin, 2012). Boiral and Henri (2012) developed a mathematical model to demonstrate the influence of certification on some environmental indicators and verified that their effect is not significant. In addition to these studies, Hikichi et al. (2016) verified the evolution of ISO 14001 in the American continent by focusing on the sectors, and Hikichi et al. (2017) verified the forecast of this standard in the American continent in 2016 and 2017 considering time as the only factor. Given the above, no studies were found that bridge the gap to identify the influence of different factors on the ISO 14001 for this continent, such as environmental, economic and socio-cultural factors.

According to what it was mentioned before, this article proposes to present through multiple regression models, the environmental, economic and socio-cultural factors influencing the Environmental Management System based on ISO 14001. Thus, some gaps related to the ISO 14001 certification in the Americas must be clarified. The questions that served as motivation for this study are:

- What are the features of the evolution of ISO 14001 certificates issued?
- Is it possible to identify clusters of countries according to their ISO 14001 evolution patterns?
- What economic, environmental and socio-cultural factors influence the number of certifications issued?
- What is the best fitted multiple regression models for each cluster studied? and;
- What are the effects of environmental, socio-cultural and economic factors on the ISO 14001 standard?

General purposes: The analysis of the environmental management system based on ISO 14001 in the Americas, in addition to the socio-cultural, environmental and economic factors that influence the issue of ISO 14001 certificates in this continent. The scope of this study is quantitative. Through cluster analysis and multiple regression models, it was possible to meet the overall objective and

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