

# **The Effect of ISO 14001 Standards Adoption on Manufacturing Firms’ “Return on Investment”: Using PSM and Probit Regression Model**

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## **Abstract**

It is necessary to be aware of both the costs and the advantages associated with the adoption of ISO 14000 certification in an organisation in order to conduct an accurate evaluation of the investment with regard to the state of the financial performance. On the other hand, as we will see, calculating these figures can be challenging, mostly because there is a dearth of reference data or particular evaluation criteria. This paper investigates the effect of iso 14001 certification on firm performance using Indian public listed manufacturing firms financial data from CMIE prowess data base using the propensity score matching techniques followed by regression analysis. The result indicates that effect of iso 14001 certification on firm performance is significant. The further investigation reveals that sales coefficient is higher than cost for iso 14001 certified firms. This study provides empirical support for policy-makers promoting environmental practices that may lead to sustainable economic growth.

## **Keywords**

Iso 14001, Financial performance, PSM, Manufacturing, Return on asset

## **1. Introduction**

Increasing emphasis on environmental protection and the increasing importance of sustainable development have been an important stimulus in the development of the ISO 14000 series of environmental management standards. ISO 14001 has been widely adopted across the world as the standard environmental management system certified by the ISO (International Organization for Standardization) (Ambec & Lanoie, 2008). ISO 14001 certification can be used as an active tool for promoting comprehensive organizational changes leading to SD (Sebhatu et al., 2007). However, Iso 14001 certification or adoption is a strategic investment decision taken by an organisation to improve operational efficiency, environmental concern and unlock valuable insights to minimize wastage.

Implementing ISO 14000 certification in a business involves a number of expenses and benefits that must be understood in order to evaluate the investment objectively. when it comes to environmental quality investment may appear to be costly at times, but there are returns that are often economically significant quantifiable. Such benefits are dependent on the selection and pursuit of goals, the observance of rules (e.g., no omissions), and environmental efficiency (e.g., no waste), and can only be determined after an in-depth investigation (Alberti et al., 2000). It has been determined that major organisational motives for the adoption of EMS include the following: meeting the demands of customers, complying with the requirements of regulatory agencies, seeking cost reduction and efficiency improvement, and searching for competitive advantages (Prajogo et al., 2012; Teng et al., 2018; Treacy et al, 2019).

However, the fact that the existing literature has investigated the influence of ISO 14001 adoption on firm performance, the conclusions are inconclusive. According to several studies, adopting the ISO 14001 standard will increase a company's environmental performance. Others have discovered neutral performance in terms of return on assets (ROA) and return on capital (ROCE) (Ali et. al., 2010; Wenlong et al, 2015; Jacobs et al., 2010; Nishitani, 2011).ISO 14001 implementation can have positive or negative effects on a company's performance (Erauskin-Tolosa et al., 2020; Hazudin et al., 2015; Heras-Saizarbitoria et al, 2011; King & Lenox, 2001). Firms that embrace the ISO 14001 standard, in particular, are recognised as environmentally friendly; as a result, they might enjoy differential

benefits in their product sales, potentially leading to increased higher profitability (Nishitani, 2011). Furthermore, companies that embrace the ISO 14001 standard may establish more effective production processes, lowering operational and waste disposal expenses leading to reduce cost and operational efficiency (Fryxell & Szeto, 2002). However, adopting the ISO 14001 standard may not raise business sales or improve operational efficiency; in such cases, the advantages would fail to cover the additional expenses of initial adoption and recurring maintenance fees, particularly in the short run (Lee et al., 2017). As a result, it is still uncertain if ISO 14001 adoption improves corporate financial performance or is primarily a placebo for firm managers seeking membership in the 'green club.'

The difficulty in getting consistent findings about the impacts of ISO 14001 certification on company performance may be caused by shifts in the overall institutional environment of a country and the progression of its economy (Hazudin et al., 2015). It is also observed that devolved countries have positive significant result with firm performance. Moreover Yang et al., 2011 stated this case is not applicable to developing countries. Thus India is one of the top developing country and has the highest growth in adoption of Iso 14001 certification in south Asian countries from past 10 years.

This article investigates the empirical influence of ISO 14001 certification on the financial performance using financial data of Indian public enterprises listed on the BSE. To locate related firms, the analysis used propensity score matching algorithms. We initially evaluated the influence of ISO 14001 certification on firm financial performance using regression analysis on return on asset and return on capital. The findings revealed that ISO 14001 certification has a considerable impact on firm financial metrics. The significant result suggested that enterprises with ISO 14001 certification have a higher return on investment than firms that have not decided to adopt 14001 certifications; the substantial difference can be attributed to two factors such as Sales and cost. Sales can be raised if a company's product is recognised as environmentally friendly (Nishitani, 2011). Second, because it is cost effective due to lower operational and waste disposal expenses (Fryxell & Szeto, 2002). We investigate the impact of ISO 14001 certification on firm sales and costs. The results showed that ISO 14001 certification increased the firm's revenues and costs with varying potential. Increases in sales and costs do not correspond, which has a substantial impact on financial performance.

This paper is organised as follows: in Section 2, we provide a brief overview of the data and empirical methods; in Section 4, we present the primary results and robustness tests; and in Section 4, we conclude.

### **1.1. Objective**

The present study has been conducted with the objective of providing scientific evidence to an organization, to consider whether ISO 14001 adoption would provide any competitive advantage. Second, it compares any actual difference in return on investment (ROI) between organizations that have adopted ISO 14001 and have not adopted ISO 14001.

## **2. Data And Research Methods**

To determine the impact of ISO 14001 adoption or certification on the performance of manufacturing firms, we utilise Indian census data published annually by the Centre for Monitoring Indian Economy Pvt. Ltd (CMIE). For the fiscal year 2018-2019, the Prowess database contains 4754 BSE-listed companies, of which 2754 have comprehensive data for all needed variables used in this analysis. The manufacturing firm selected for this study was one of 1357. The variables utilised in this investigation are described in Table 1 along with their definitions and sources. The samples for the fiscal years 2018-2019, 2019-2020, and 2020-21 reflect 1357, 1322, and 1284 manufacturing companies, respectively. In each sample fiscal year, the ratio of Iso 14001 standard certifications is roughly 50 percent. The selection of these three is based on the fact that the financial year 2018-19 to 2020-21 demonstrates the greatest increase in Iso 14001 certification adoption from 2013 to 2018 and depicts the appropriate treatment difference in manufacturing enterprises' economic outcomes. Several previous research (de Jong et al., 2014; Hazudin et al., 2015) revealed that Iso 14001 certifications require time to realise the economic benefit. The difference will assist organisations make strategic decisions regarding Iso 14001 adoption and how it affects firm financial performance.

Propensity score matching (PSM) enables the pairing of businesses that have ISO 14001 certification with those that do not. The purpose of the matching is to determine whether or not the company is balanced between these two categories. In our sample, two groups have identical percentages, which corresponds to one treatment and one control.

Which does not successfully reflect the characteristics of the organisation or balance both groups. We have matched 255 random samples from the untreated group with the treated group three times more frequently for each fiscal year.

## **2.1. Propensity Score matching Method**

The propensity score matching method (Heckman and Robb, 1986; Heckman, Ichimura, and Todd, 1998) is used in this study to determine the causal association between ISO 14001 certification and return on investment. Because a firm's Iso 14001 certification is endogenous, its financial state might have an impact on both Iso 14001 certification and return on investment.

We begin by categorising our sample into two groups: treatment and control. Firms with ISO 14001 certification requirements comprise the treatment group, whereas non-certified counterparts comprise the control group. By measuring the average effect of treatment in three steps, we assess the firm's probability to adopt ISO 14001 on 255 randomly selected BSE-listed manufacturing enterprises. First, the likelihood of ISO 14001 certification is determined, and each firm is assigned a balancing score. Rosenbaum and Rubin describe the propensity score as "the conditional chance of obtaining a therapy given pre-treatment characteristics" (1983). Second, the generated balance scores are utilised to identify a perfect comparison group of non-certified enterprises that did not implement ISO 14001. The mean difference in return on investment between ISO 14001 certified and non-certified enterprises was discovered. Finally, the treatment impact of a matched sample is determined by regressing the return on investment on variables.

We employ a logit model as defined by Dehejia and Wahba (2002) and Becker and Ichino (2002) to construct propensity scores. Where X is a multidimensional vector of control group characteristics and A is an indicator of ISO 14001 acceptance. As a function of the control variable, we control numerous dimensions that may influence enterprises' proclivity to adopt ISO 14001, including firm demographics and industry-level characteristics (Xi).

$$P(A = 1/Xi) = 1/(1 + e^{-(\beta_0 + \beta_i X_i)})$$

Covariates for the balance score model are chosen based on previous research. ISO 14001 accreditation is found to be highly related to business size, financial leverage, and firm export (Wenlong et al., 2015). However, because investing in ISO 14001 certification is related with long-term investment decisions, we have included the financial investment requirement payout ratio below. It has costs for implementation, system maintenance, credentials, and auditing (Alberti et al., 2010).

The payout ratio, in particular, is an important consideration in the investing decision. According to Husna and Satria (2019), the payout ratio has a negative correlation with investment, suggesting that the higher the payout ratio, the lower the investment. The bigger the investment, the lower the payout ratio. Companies with a lower payout ratio are more inclined to invest in ISO 14001 certification since it is a strategic investment decision.

With the help of the derived propensity score, we apply the closest neighbour matching technique to close the match for the treated and control samples. Using the nearest adjacent approach of Propensity score matching, there were 255 random matches (control-treated), that is, 255 firms without ISO 14001 certification (control) and 255 firms with certification (treated firm). As a result, we had 510 firms matched from the total number of firms examined for the study each year. To examine the relationship between return on investment and tendency to adopt ISO 14001 certification, the sample is free of selection bias (Table 1).

Table 1. Variable name and definitions

<b>Variable Name</b>	<b>Definitions</b>
ROA	Return on Asset: Net income divided by total assets
ROCE	Return On Capital Employed: Net income divided by total capital
Sales	Log Of Income
Cost	Log of Expenditure
Iso 14001 certification	Dummy Variable With 1 and 0. 1- Iso 14001 Certified, 0- Otherwise
Investment Criteria	Payout Ratio: yearly dividend per share divided by the earnings per share (EPS)
Financial Leverage	Debt to Equity Ratio

AUR	Assert Utilization Ration: revenue by the average total assets
EUR	Employee Utilization Ratio: the number of billable hours divided by the total number of available hours
Export Ratio	Export to Sales
Firm Size	Log of total no. of employee
Gross profit	difference between revenue and cost of goods sold, divided by revenue
Source: CMIE prowestiq Indian Firm financial census	

Finally, a robust variance for the average treatment effect on treated ATT was calculated using multiple regression analysis. ATT determined the potential difference between firms that have ISO 14001 certification and those who do not, which is calculated as

$$R_i = \alpha + \beta A_i + \gamma X_i + \varepsilon_i$$

The dependent variable,  $R_i$ , refers to the firm's return on investment as measured by two indicators: return on assets (roa) and return on capital employed (roce) (roce). The treatment variable of ISO 14001 certification is  $A_i$ .  $X_i$  is also a vector of company-level control variables, such as the log number of employees (size), debt-equity ratio (der), firm age (age), firm age squared (ages), assert utilisation (aur), and gross profit (gp).  $I$  is a mean-zero error term with a normally distributed distribution.

### 3. Result Estimation

This section initially gives comprehensive sample descriptive data used to determine the influence of ISO 14001 certification on financial performance, sales, and costs in a firm. And shows the difference in outcome and control variable means before and after matching the propensity score with statistical significance. Finally, the regression findings investigate the influence of ISO 14001 certification on return on investment.

#### 3.1. Propensity score Estimation

In this section, we first computed the propensity score, as shown in Figure 1. For each fiscal year, show the kernel density estimate graph for the treated and control groups before and after matching. The discrepancy after the matches has been minimised, and both groups are now evenly comparable.

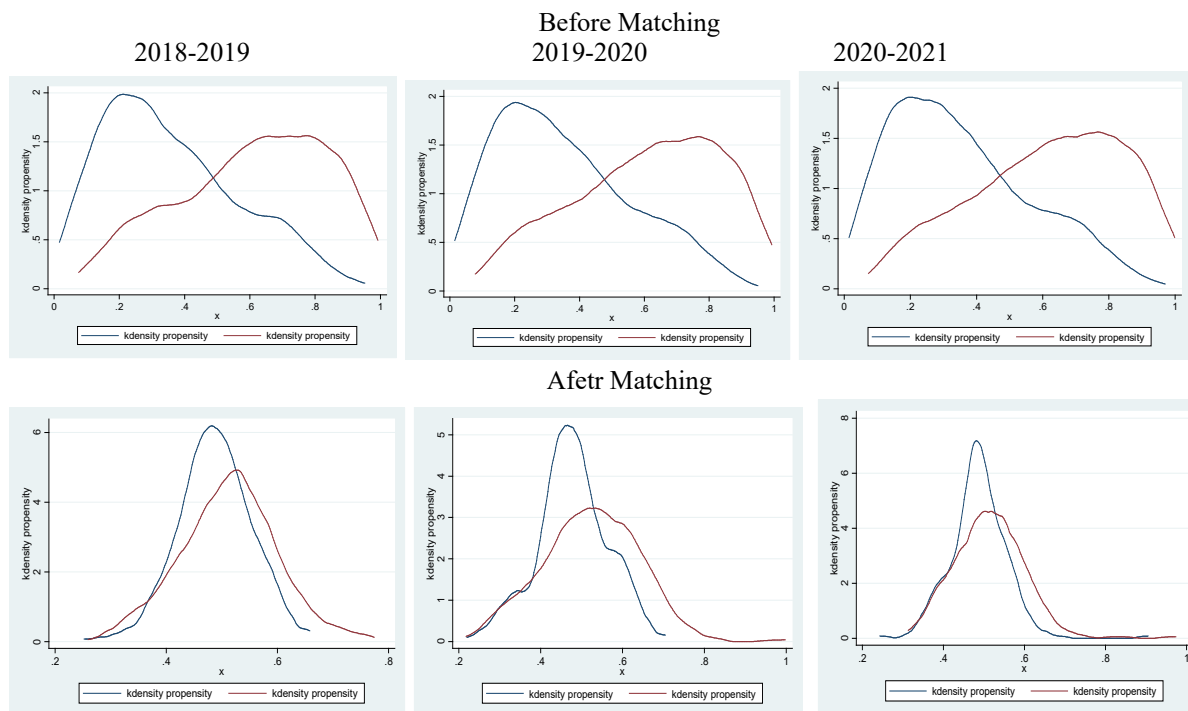


Figure 1. Kernel Density Graph

Second, Table 2 shows the results of the balancing test for propensity score matching for each fiscal year. We represented the mean difference with a statistical significance level for the selected variables, and we discovered that, with the exception of the outcome variable, the difference between groups was significant before matching and insignificant after matching.

Table 2. T-Test Before and After Propensity Score Matching

Outcome Variable	2018-2019			2019-2020			2020-2021		
	Mean Difference			Mean Difference			Mean Difference		
	Sample Mean	Pre	Post	Sample Mean	Pre	Post	Sample Mean	Pre	Post
ROA	0.0465	0.0242***	0.0158**	0.0445	0.0352***	0.0291***	0.0342	0.0284***	0.0215***
ROCE	0.0652	0.0396***	0.0244**	0.0632	0.0474***	0.0442***	0.0463	0.0445***	0.0316***
Sales	27525.7	47419***	372.1	31810.5	55574***	888.61	30578.2	52480***	2097.5
Cost	20419.5	34954***	759.2	24107.5	42056***	872.68	23288.1	39888***	1791.8
<b>Control Variables</b>									
Firm Size	3.515	0.794***	0.179	3.544	0.806***	0.225	3.577	0.807***	0.17
DER	0.957	0.130***	0.0428	1.382	0.703*	0.0877	1.322	0.504	0.044
ER	0.0931	0.0251**	0.0118	0.0892	0.0203*	0.0119	0.0848	0.0216*	0.003
AUR	1.907	0.891*	0.0525	1.199	0.719**	0.0623	1.18	0.976**	0.0829
DP	0.138	0.0955***	0.0047	0.217	0.0429*	0.0274	0.264	0.0224***	0.0271
GP	0.166	0.063*	0.0024	0.167	0.110**	0.0617	0.175	0.0734***	0.059
AGE	38.965	6.846***	0.749	39.908	6.821***	1.643	40.8777	6.865***	1.149
Statistically significant difference *** p<0.01, ** p<0.05, * p<0.1 (Firm with and without Iso 14001 certification before and after Propensity Score Match)									

The balancing test score indicates that the matched sample has commonalities between ISO 14001 certified and non-ISO 14001 certified enterprises. The balancing test takes into account all of the variables used to calculate the propensity score (payout ratio, number of employees, debt-equity ratio, and export ratio) as well as a few more (Asset utilisation ratio, Gross profit Ratio, and Firm age). Return on investment indicators differ significantly across firms in the treated and control groups, while all control variables attain balance with a statistically insignificant difference. As a result, the chosen control group appears to be appropriate. This finding demonstrates that the average treatment effect on treated (ATT) estimates give a reliable measure of the causal effect of ISO 14001 certification on investment return.

### 3.2 Causal Relationship Evidence

#### 3.2.1 ISO 14001 And Financial performance

The average treatment effect (ATT) of ISO 14001 certification on firm performance is determined using regression analysis with a matched sample. The terms return on asset (ROA) and return on capital employed (ROCE) refer to various aspects of a company's financial performance. These profitability statistics are most useful when comparing companies in the same industry (Aanu et al., 2014; Cherian et al., 2019). Because of their individual characteristics, ISO 14001 certification can have an impact on both financial performance measurements. ROA focuses on asset efficiency, whereas ROCE focuses on making the best use of available capital. Because ISO 14001 certification helps organisations decrease waste and boost work efficiency, it may have an effect on ROA and ROCE via the "kaizen theory of continuous improvement" or "plan-do-act-check." To evaluate the effect of ISO 14001 certification on firm performance, we included two financial performance measures. The findings point to a link between HR analytics adoption and return on investment. Table 3 shows how ISO14001 certification affects ROA and ROCE. The coefficient is statistically significant, indicating that ISO 14001 certification has an impact on corporate financial performance.

Table 3. ATT on ROA and ROCE

	2018-2019		2019-2020		2020-2021	
	ROA	ROCE	ROA	ROCE	ROA	ROCE
Iso 14001 certification	0.0125*	0.0200*	0.0209***	0.0339***	0.0146*	0.0231*
	(2.15)	(2.36)	(3.33)	(3.36)	(2.19)	(2.51)
Firm Size	0.0159***	0.0224**	0.0170**	0.0220*	0.0223***	0.0274***
	(3.33)	(3.23)	(3.00)	(2.42)	(4.02)	(3.58)
DER	-0.00872***	-0.0128***	-0.00199***	-0.00314***	-0.00358**	-0.00497**
	(-6.14)	(-6.16)	(-3.91)	(-3.84)	(-3.05)	(-3.07)
AUR	0.0211***	0.0306***	0.0259***	0.0324***	0.0181***	0.0289***
	(5.97)	(5.95)	(5.72)	(4.46)	(3.63)	(4.22)
GP	0.00223	0.00268	0.0334***	0.0435***	0.0608***	0.0861***
	(1.83)	(1.51)	(4.54)	(3.68)	(7.03)	(7.21)
ER	0.0212	0.0291	0.0352*	0.0422	0.0542***	0.0654**
	(1.42)	(1.34)	(2.46)	(1.84)	(3.54)	(3.10)
Age	-0.0000974	-0.000184	0.000237	0.000204	-0.000383	-0.000707
	(-0.23)	(-0.30)	(0.52)	(0.28)	(-0.75)	(-1.00)
Ages	-0.00000209	-0.00000256	-0.00000442	-0.00000570	0.00000158	0.00000338
	(-0.62)	(-0.52)	(-1.21)	(-0.97)	(0.37)	(0.58)
_cons	-0.0294	-0.0448	-0.0648**	-0.0789*	-0.0708**	-0.0911**
	(-1.52)	(-1.59)	(-3.08)	(-2.33)	(-3.17)	(-2.96)
N	510	510	510	510	510	510
R <sup>2</sup>	0.179	0.176	0.202	0.156	0.212	0.217

According to Table 3, ISO 14001 certification allows a company to boost return on investment by an average of 1.57% on assets and 2.56% on capital employed. It should be noted that these increases are in relation to ISO 14001 certification rather than without. The ISO 14001 coefficient has been strong year after year, indicating that enterprises with Iso 14001 certification schemes such as "kaizen theory of continuous improvement" or "plan-do-act-check" help to minimise operating costs and effective waste disposal, and it is growing more efficient each year.

### 3.2.2 Sales and costs after Iso 14001 certification

Despite the fact that ISO 14001 adoption has a major impact on firm financial performance, we are driven to delve deeper into the underlying causes for significance. As a result, we chose two financial indicators: sales and cost. Firm sales are generated by the selling of the firm's primary products or services. The costs of producing or providing these products or services include raw materials, labour, and depreciation. According to Table 4, the coefficient of ISO 14001 certifications is considerably positively associated with sales and cost, which is consistent with previous studies (Ye, et al., 2020, Wenlong et al., 2015, Yang, et al., 2011). The sales coefficient is greater than the cost coefficient, demonstrating that cutting costs through ISO 14001 certification is consistent with the previous study (Fryxell & Szeto, 2002).

Table 4. ATT on Sales and Costs

	2018-2019		2019-2020		2020-2021	
	sales	costs	Sales	costs	sales	costs
Iso 14001	0.229***	0.200***	0.253***	0.222***	0.200***	0.188***
Certification	(4.04)	(3.94)	(4.86)	(4.83)	(3.62)	(3.58)
DER	0.0118	0.0170	0.00410	0.00478	-0.0135	-0.0119
	(0.83)	(1.22)	(0.95)	(1.11)	(-1.37)	(-1.21)
AUR	0.195***	0.204***	0.306***	0.305***	0.308***	0.319***
	(5.62)	(5.94)	(8.02)	(8.00)	(7.41)	(7.68)
GP	0.0766***	0.0407***	0.403***	0.211***	0.259***	0.0530
	(6.40)	(3.44)	(6.49)	(3.41)	(3.58)	(0.73)
DP	1.008***	0.950***	0.00963	0.00946	0.000538	0.000530
	(4.21)	(4.02)	(1.12)	(1.10)	(1.32)	(1.30)
Age	-0.00586	-0.00602	0.00494	0.00466	0.00373	0.00369
	(-1.43)	(-1.49)	(1.28)	(1.21)	(0.87)	(0.86)
Ages	0.0000721*	0.0000735*	-0.00000133	0.000000513	0.00000186	0.00000390
	(2.18)	(2.25)	(-0.04)	(0.02)	(0.05)	(0.11)
_cons	2.888***	2.784***	2.424***	2.370***	2.625***	2.548***
	(24.67)	(24.06)	(21.96)	(21.48)	(21.68)	(21.07)
N	510	510	510	510	510	510
R <sup>2</sup>	0.174	0.134	0.236	0.192	0.164	0.140

Overall, the regression results show that ISO 14001 adoption certification has equal size but varied potential beneficial effects on sales and expenses. As a result, sales growth may not be offset by comparable costs. This is why the discovery explains the substantial effects of ISO 14001 adoption on financial performance.

#### 4. Conclusion and Implication

In the fast-paced and ever-changing world of modern business, an organization's primary focus should be on maximising its resource utilisation in order to get a strategic edge over its rivals. The ISO 14001 certification confers significant benefits on every company in terms of economic benefits. The findings of this research show that the advantages of adhering to the ISO 14001 standard go far beyond the improvements in corporate legitimacy that can be achieved by doing so. This was demonstrated by better operating performance in comparison to those who did not implement. In our result financial benefits due to operating performance, because sales and cost is directly corelated with same magnitude, however we found that iso 14001 certified firms has higher sales and cost but magnitude of cost is smaller than sales. Which indicates that Iso 14001 certifications helps firm to get operational efficient by reducing wastage or by improving operational process.

The management should be aware that there are performance benefits associated with ISO 14001 that go far beyond the benefits associated with marketing. More precisely, the results imply that standards such as ISO 14001 can enhance operating performance by applying operating procedures which promote a mindset of waste reduction and continual improvement. Because the findings presented here suggest that the integration and diffusion of ISO 14001 environmental practises can help build operating capabilities that lead to both cost efficiency gains and operating speed gains, management should incorporate ISO 14001 alongside a culture of cost control and collaboration amongst

business functions. This is because the findings suggest that the integration and diffusion of ISO 14001 environmental practises can help build operating capabilities.

In sum, our findings have consequences for spending decisions related to ISO 14001. The majority of publicly traded corporations (approximately half) have chosen to become ISO 14001 certified. According to our research, pursuing ISO 14001 certification is a good way to improve operational efficiency and get a competitive edge. Efforts in India to achieve ISO 14001 certification are, therefore, commendable.

This study found that ISO 14001 improves a firm intellectual aspect. ISO 14001 improved capital performance and operating procedures like cost control and operational coordination. Future research should examine the relationship between ISO 14001 procedures and intellectual capital, since it may have human, relational, process, and innovation benefits.

## References

- Aanu, O. S., Odianonsen, I. F., & Foyeke, O. I, Effectiveness of audit committee and firm financial performance in Nigeria: an empirical analysis. *Journal of Accounting and Auditing*, 2014, 1, 2014.
- Alberti, M., Caini, L., Calabrese, A., & Rossi, D. , Evaluation of the costs and benefits of an environmental management system. *International Journal of Production Research*, 38(17), 4455-4466, 2020.
- Ali, Q., Salman, A., Parveen, S., & Zaini, Z., Green behavior and financial performance: Impact on the Malaysian fashion industry. *SAGE Open*, 10(3), 2158244020953179, 2020.
- Ambec, S., & Lanoie, P. , Does it pay to be green? A systematic overview. *The Academy of Management Perspectives*, 45-62, 2018.
- Cherian, J., Umar, M., Thu, P. A., Nguyen-Trang, T., Sial, M. S., & Khuong, N. V, Does corporate social responsibility affect the financial performance of the manufacturing sector? Evidence from an emerging economy. *Sustainability*, 11(4), 1182., 2019.
- de Jong, P., Paulraj, A. & Blome, C. The Financial Impact of ISO 14001 Certification: Top-Line, Bottom-Line, or Both?. *J Bus Ethics* 119, 131–149 , 2014. <https://doi.org/10.1007/s10551-012-1604-z>
- Erauskin-Tolosa, A., Zubeltzu-Jaka, E., Heras-Saizarbitoria, I., & Boiral, O. , ISO 14001, EMAS and environmental performance: A meta-analysis. *Business Strategy and the Environment*, 29(3), 1145-1159, 2020.
- Fahmi, K., Mustofa, A., Rochmad, I., Sulastri, E., Wahyuni, I. S., & Irwansyah, I, Effect of ISO 9001: 2015, ISO 14001: 2015 and ISO 45001: 2018 on operational performance of automotive industries. *Journal of Industrial Engineering & Management Research*, 2(1), 13-25, 2021.
- Fryxell, G. E., & Szeto, A., The influence of motivations for seeking ISO 14001 certification: an empirical study of ISO 14001 certified facilities in Hong Kong. *Journal of Environmental Management*, 65(3), 223-238, 2020.
- Hazudin, S. F., Mohamad, S. A., Azer, I., Daud, R., & Paino, H. , ISO 14001 and financial performance: is the accreditation financially worth it for malaysian firms. *Procedia Economics and Finance*, 31, 56-61, 2015.
- He, W., Liu, C., Lu, J., & Cao, J., Impacts of ISO 14001 adoption on firm performance: Evidence from China. *China Economic Review*, 32, 43-56, 2015.
- Heckman, J. J., & Robb, R., Alternative methods for solving the problem of selection bias in evaluating the impact of treatments on outcomes. In *Drawing inferences from self-selected samples* (pp. 63-107), Springer, New York, NY.1986.
- Heckman, J. J., Ichimura, H., & Todd, P., Matching as an econometric evaluation estimator. *The review of economic studies*, 65(2), 261-294, 1998.
- Heras-Saizarbitoria, I., Molina-Azorín, J. F., & Dick, G. P., ISO 14001 certification and financial performance: selection-effect versus treatment-effect. *Journal of Cleaner Production*, 19(1), 1-12, 2011.
- Husna, A., & Satria, I., Effects of Return on Asset, Debt to Asset Ratio, Current Ratio, Firm Size, and Dividend Payout Ratio on Firm Value. *International Journal of Economics and Financial Issues*, 9(5), 50, 2019.
- Husna, A., & Satria, I., Effects of Return on Asset, Debt to Asset Ratio, Current Ratio, Firm Size, and Dividend Payout Ratio on Firm Value. *International Journal of Economics and Financial Issues*, 9(5), 50, 2019.
- Jacobs, B., Singhal, V., & Subramanian, R., An empirical investigation of environmental performance and the market value of the firm. *Journal of Operations Management*, 28, 430–441, 2020.
- King, A. A., & Lenox, M. J., Does it really pay to be green? An empirical study of firm environmental and financial performance: An empirical study of firm environmental and financial performance. *Journal of industrial ecology*, 5(1), 105-116.2001.



- Lee, S. M., Noh, Y., Choi, D., & Rha, J. S., Environmental policy performances for sustainable development: from the perspective of ISO 14001 certification. *Corporate Social Responsibility and Environmental Management*, 24(2), 108-120, 2017.
- Nishitani, K.. An empirical analysis of the effects on firms' economic performance of implementing environmental management systems. *Environmental & Resource Economics*, 48(4), 569–586, 2011.
- Prajogo, D., Tang, A. K., & Lai, K. H., Do firms get what they want from ISO 14001 adoption?: an Australian perspective. *Journal of Cleaner Production*, 33, 117-126, 2012.
- Sebhatu, S. P., & Enquist, B, ISO 14001 as a driving force for sustainable development and value creation. *The TQM Magazine*, 2007.
- Teng, M. J., & Wu, S. Y., Sustainable development and competitive advantages—utilizing matching to overcome sample selection bias. *Corporate Social Responsibility and Environmental Management*, 25(4), 313-326, 2018.
- Treacy, R., Humphreys, P., McIvor, R., & Lo, C., ISO14001 certification and operating performance: A practice-based view. *International Journal of Production Economics*, 208, 319-328, 2019.
- Yang, M. G. M., Hong, P., & Modi, S. B. Impact of lean manufacturing and environmental management on business performance: An empirical study of manufacturing firms. *International Journal of production economics*, 129(2), 251-261, 2011.
- Ye, Y., Yeung, A. C., & Huo, B., Maintaining stability while boosting growth? The long-term impact of environmental accreditations on firms' financial risk and sales growth. *International Journal of Operations & Production Management.*, 2020.