

Research on the Operational Performance of ISO 14000-Certified Taiwan's Manufacturers

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Abstract

This research topic evaluates the effectiveness and importance of environmental protection in the 21st century in light of the increasing demand on the earth's natural resources and the pressures on economic and industrial development to provide dynamic power. As the world and our fellow citizens become more conscious of environmental protection, companies are under greater pressure whilst pursuing economic growth. Therefore, domestic manufacturers have been devoting efforts to promote environmental management. This research conducts survey using questionnaires on the operational performance of the manufacturers who have ISO 14000 series accreditation and certification. The survey considers five dimensions/functions within a manufacturer, financial management, human resources management, production management, and marketing management. A total of 35 indices are used for analysis of the effects that the location, history, industry, number of employees, amount of capital, and revenue may have on the performance. This research targets the manufacturers approved of ISO 14000 series certification by Environment Administration Association. The statistical methods deployed are descriptive statistics, T-test, and single factor analysis of variance used for analysis. The conclusions reveal that a certain level of performance has been achieved in every dimension. After T-test, all the indices have reached a significant level. The indications are that ISO 14001 benefits all manufacturers the level of benefits however varies from company to company.

Key Words: ISO 14000, Operational Performance

1. Introduction

As Environmental protection has become an important topic in the 21st century, environmental management has become an integral part of corporate perpetual growth, and ISO 14000 is just the instrument of environmental management. Following the successful implementation of ISO 9000 series, ISO 14000 series become another success as the International Environmental Management Standard; the standard differs from ISO 9000 [which applies particularly to products quality and customers' satisfaction], in that, ISO 14000 focuses on regulating the impact on the environment during product manufacturing and service processes. It aims to ensure the system undertaken not only meet customers' needs, but also complies with Government's Environmental Protection Organization Policy, local social and economic requirements of the people, Public Environmental Protection Organisations, and International Environmental Protection Regulations. Particularly as the attitude of International Government and large enterprises, hold the view that environmental protection is very important. Accordingly, ISO 14000 become more important than ever. In order to ensure both economic development and environmental protection, manufacturers should pay more attention to their own environmental management, using ISO 14000 and adapting it to achieve their ultimate goals of perpetual growth. However, at present, there are still many manufacturers who treat environmental management as an extra burden, they think implementing ISO 14000 cannot benefit business, and it does not contribute to the overall turnover, but instead decreases profit. This is because businesses see an underlying cost of implementation of the ISO 14000 standard, which is not recovered in the short term. Naturally they think investing in environmental management is an extra burden. However, we discovered many practical examples that show if business manufacturers invest in environmental management, they will not only save resources, and decrease productivity waste, but also create many business opportunities and increased profits [3].

Sadgrove states in the 'Green Management Handbook' that by implementing ISO 14000, manufacturers can obtain 18 benefits which include increasing turnover, decreasing costs, enhancing competition and improving corporate image, etc. Lu Wenxian agrees and points out that implementing environmental management will not only help manufacturers increase profit, but also help them save costs, improve efficiency, enhance competition, increase market share, enhance the corporate image. Furthermore attaining the relevant regulatory standard also benefits the manufacturers as sanctions for non compliance and fines for producing pollution, etc are avoided [1]. Therefore, when a manufacturer implements

environmental management standards, consideration should be given to the long-term return, and thus the goal of perpetual growth [3]. Despite the positive benefits to a manufacturer using ISO 14000 there are still some manufacturers reluctant to adopt ISO 14000 as they feel it is difficult and problematic to implement and control. Therefore the aim of this research is to analyze the effectiveness of implementation of ISO 14000. The reason manufacturers implement environmental management is to obtain more benefits. Therefore, in order to assess the current position on implementation of ISO 14000, this research employs questionnaire methodology to obtain the present status of manufacturers implementing ISO 14000 and the benefits they have gained. Thus the purpose of the research is: (1) To examine the current situation of Taiwan manufacturers implementation of ISO 14000; (2) To analyze the benefits from Taiwan manufacturers implement ISO 14000; (3) To examine if the benefits gained solely from implement ISO 14000 or are influenced by other factors.

2. Research Methodology

A variety of research studies have provided different opinions concerning the benefits of implementation of environmental management, shown in Table 1. The main benefits are increasing profit rate, decreasing producing costs, improving corporate image, and enhance customers' confidence on the products, etc. Hence, implementing environmental management will not only improve corporate image, but also help manufacturers obtain more profits. The researchers used questionnaires to collect the information. The source data of this research are collected from ISO 14000 certified manufacturers registered with Republic of China Commodities Inspection Bureau from January 1994 to end of February 2004. The questionnaire has three main parts:

1. **Basic data of manufacturers in study:** Include manufacturers' location, number of years in operation, industry category, employee number, turnover and average revenue for the past three years.
 2. **The outline of manufacturers' implementation of ISO 14001:** include the difficulties and barrier factors which effected implementation ISO 14001 and the key factors to the success in implementation.
 3. **The benefits obtained by ISO 14001:** According to some previous academics' research on this topic, the benefits of ISO 14001 can be concluded in five dimensions: overall company, financial management, human resources management, production management
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and marketing management. These five dimensions further divided to 35 topics targeting the manufacturers certified by ISO 14000 series of quality control system, in order to scale manufacturers' operational performance index. The data analysis methods adopted in this research mainly include 'Excel' and 'SPSS' software descriptive statistics, Chi-square test and single-factor analysis of variance. Firstly, descriptive statistics is used to collect manufacturers' basic data and status of ISO 14001 implementation and explore its number of times and distribution; secondly, T-test is used to compare the performance of these five dimensions in implementation of ISO 14000, also identify well performed items in each dimensions; finally, 'single-factor analysis of variance' is adopted to analyze the correlation between basic data, motivations for implementation and average implementation performance in different phases. Furthermore, 'Least-Significant Difference, LSD' is employed to examine the significant difference.

Table 1. The Benefits of Manufacturers Implementing ISO 14001

Item	Sally [11]	Geisler [12]	Gu [7]	Lu [1]	Yang [4]	Weng [2]
Increase in Sales			⊙			
Increase in Purchase Order			⊙			
Increase in Profit Rate	⊙			⊙		
Decrease in Manufacturing Costs	⊙	⊙		⊙	⊙	
Decrease in Risk	⊙					
Improvement in Produce Ability	⊙			⊙		
Improvement in Products Liability	⊙			⊙		
Improvement in Firm's Goodwill and Image	⊙			⊙	⊙	⊙
Increase in Market Share				⊙		⊙
Increase in Customer's Trust on Products	⊙	⊙	⊙			⊙
Decrease in Customer's Complaints Number			⊙			⊙
Improvement in Correlation between Firms and Society					⊙	⊙
Products Competitive Ability Compare with Similar Industry' Products	⊙			⊙		
Increase in Operation Effectiveness Rate		⊙				
Promote Sale's Strategies		⊙	⊙			
Easy to obtain funding		⊙			⊙	

3. Questionnaire Results

Questionnaires were mailed to 295 manufacturers on August 2004. A total of 84 questionnaires were returned by October, of which, 73 were valid excluding the remaining 1 that is either incomplete or unclear, 10 were returned back without answer.

3.1 Descriptive Statistics

Table 2 shows that manufacturers from the North occupied high percentage (total 40 manufacturers, there are 50.8%). It should be noted the high technological development recently, in the electric industry. Recently, there are many people pay more attention on environmental protection, which puts pressure on manufacturers to pay more attention on environmental protection. The Electric industry main problem is in the release wastes; therefore, it is imperative that they must be certified by ISO 14000, in order to obtain customer's trust. However, the number of replies from the East is much less, maybe because there are fewer ISO 14000 certified manufacturers there. At present, most ISO 14000 certified manufacturers have been in operation for 11-40 years. These manufacturers have operated for many years, without the need for their equipment and machinery to meet environmental protection standards. In recent years, because of the increasing pressure of environmental protection, they have to obtain ISO 14000. Therefore they can get customers' contract easily and get customers' trust, etc. In addition, most ISO 14000 certified manufacturers through environmental management association are in electronic and electric appliance industry (200-250) [10]. Therefore, currently, in Taiwan, the ISO 14001 certified manufacturers mainly are in technology industry. The size of manufacturers, are determined in this study by the number of employees, the number of ISO 14000 certified manufacturers is similar in each industry. However, in the respect of capital and turnover, ISO 14000 certified manufacturers mainly are larger scale manufacturers; because these have more capital and turnover and are more likely to invest in promote environmental management. The study revealed that in respect of the barriers to implementation of environmental management, there is 41.1% lack of relevant professionals and technology, 35.6% lack good communication and understanding, 31.5% of objectives can not be decided easily, and 30.1% of employees could not co-operate well. All these factors cause ISO 14000 manufacturers to suffer difficulties, here it is worth noting that no enterprise chose a consultancy company, thus it is clear that the current problems are inside enterprises themselves. On another hand, the main factors contributing to success are senior managers' support which revealed 89%,

continually manage and examine the Standard are 64.4%, total implement and requirement 63%, other factors are about 20-30%. It is acknowledged that decision maker's highly support contributes to high quality results. The Senior managers should release some of the 'decision making' to grass-roots managers, if not implementation will be a difficult process and will cause many difficult factors, resulting in poor communication and employee's lack of co-operation, thus putting enterprises into difficulties and stopping development. Furthermore, continually improvement also is very important.

3.2 Performance Measurement Index Analyses

In part 3 of questionnaire (Benefits from implementing ISO 14001), through 'T test', 'single-factor analysis of variance' of statistic analysis, analyze the degree of benefit manufacturers obtained. The research divided in five dimensions, and detail analyze the performance of each dimensions, where if achieve basic manufacturers' benefits, if it is relevant with manufactures' location, operation years, number of employees, industry categories, capital and turnover.

(1) T-Test

The research use $\mu=3$ as hypotheses in order to detect if the performance in each dimension to illustrate any significant difference. Table 3 indicates that the average score of performance measurement in each dimensions are all above 3.45, the Standard Deviation all under 0.77, only the 'obtain government award and allowance', 'easy to gain fund' and 'obtain benefits from exploiting new products or patent' in financial management these three items did not reach the significant level. Thus, enterprises have not felt the governments' influence of encouraging environmental management. However, environmental management is not influenced with the amount of capital, research and development. Moreover, other items all achieved a significant level, which show manufacturers have positive attitude in most of performance.

(2) Single-factor analysis of variance

The research uses 'single-factor analysis of variance' in order to detect the correlation between basic data and five dimensions. Table 4 shows that these five dimensions and basic data mostly have no differences. The only difference is between industry category, financial management and marketing management in operational years. In other words, firms' basic data have no significant impact on five dimensions' performance.

Table 2. Basic data of manufacturers in study

Basic data item		Times (%)	Basic data item		Times (%)	
Location	North	40(54.8%)	Amount of capital (NT\$)	Less than 60 million	6(8.2%)	
	Mid land	12(16.4%)		60~300 million	11(15.1%)	
	South	21(28.8%)		300~500 million	4(5.5%)	
	East	0		500 million~1 billion	6(8.2%)	
Operation Years	Below 10 years	7(9.6%)		1~3 billion	19(26%)	
	11~20 years	22(30.1%)		3~5 billion	10(13.7%)	
	21~30 years	20(27.4%)		5~10 billion	9(12.3%)	
	31~40 years	17(23.3%)		Above 10 billion	8(11%)	
	41~50 years	4(5.5%)		Average Revenue for the past three years (NT\$)	Less than 60 million	1(1.4%)
	Above 50 years	2(2.7%)			60~300 million	6(8.2%)
Industry Category	Electric Machinery	12.5%	300~500 million		9(12.3%)	
	Electronic	15.21%	500 million~1 billion		6(8.2%)	
	Machinery	21.88%	1~3 billion		14(19.2%)	
	Chemistry	40.39%	3~5 billion		8(12.3%)	
	Other (Note)	65.63%	5~10 billion	13(16.4%)		
Number of Employees	Below 100	11(15.1%)	Above 10 billion	15(20.5%)		
	301~500	10(13.7%)	The main factors of difficulties and barriers	Lack of professionals and technology	30(41.1%)	
	501~1,000	13(17.8%)		Poor communication	26(35.6%)	
	1,001~2,000	11(15.1%)		Poor employee cooperation	22(30.1%)	
	Above 2,000	7(9.6%)		Difficulty in collecting relevant data	10(13.7%)	
Key Success Factors	Choice of excellent consultancy company	20(27.4%)		Poor consultant service from consultancy Company	0	
	Highly support from senior management	65(89%)	Difficult to reach pollution standards	17(23.3%)		
	Completed Environmental Management System	29(39.7%)	Difficult to join the system	3(4%)		
	Totally implement requirements	46(63%)	Difficult to decide target and objectives	23(31.5%)		
	High concern through whole company	25(34.2%)	Note: Other industry category includes 3 from plastics industry, 3 from electric machinery industry, 2 from automobile industry, 2 from steel industry, 1 from aluminium industry, 1 from stationary, 1 from leather manufacturing, and 8 from others.			
	Have existed good base	17(23.3%)				
	Effective encourage system	10(13.7%)				
	Continued management and examination	47(64.4%)				

4. Conclusions and Recommendations

4.1 Conclusions

- (1) Because the trend of environmental protection, non compliance is an important topic for concerned manufacturers and customers, furthermore, non compliance is of greater concern should manufacturers not be encouraged to join ISO 14000. According to this research's results, after implement ISO 14000, manufacturers have obtained improvement in both tangible benefits and goodwill. However, they must not rush into ISO 14000 certification without really implementing it. Otherwise, there is a risk this will result in not only no benefits but also increased costs.
- (2) The analysis results indicate that ISO 14000 can be implemented in different industry category, and the average performance is more than 3 in whole, therefore, every industry categories can implement it.
- (3) Implementing ISO 14000 series needs not only manufacturers' senior management's support, but also the employee's positive devotion. Implementation cannot be a one sided affair, if so, the result will be in failure. Therefore, ISO 14000 is an entire and whole project for the whole of the manufacturers.
- (4) Manufacturers should consider ISO 14000 series as basic requirement. As people have an increasing sense of environmental protection, which will be reflected against manufacturers as soon as they find pollution have been produced, thus manufacturers' image and goodwill would decrease heavily. Because ISO 14000 series is an international certification, it has many advantages for manufacturers, customers, nearby residents and society.

4.2 Recommendations for following researchers

- (1) Because some outside factors may effect a manufacturers' operational performance, inflation, economic decline, resurgence of traditional industry, industry's relocation, and Government's policies and regulations, etc. Therefore, it is recommended that subsequent researchers take those outside factors in further study.
 - (2) This research does not assess manpower, material resources and costs which manufacturers invested, such as certification fee, consultant fee, and labor costs. Therefore, it is recommended that subsequent researchers can focus on the costs and benefits of implementing ISO 14000 for further research.
 - (3) This research embarked from 1996 where ISO 14000 started promotion. In the future, there should be more firms pass ISO 14000 qualification. Therefore, there should be more research on similar topics. Moreover, the research can be advanced in more dimensions, and obtain more representative results.
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Table 3. Performance effectiveness in each dimension

	Performance effectiveness index item	Mean	Standard Deviation	T-value	P-value
Overall Company	1.Obtained manufactures, customers, etc. trust	4.068*	0.631	14.811	0.000
	2.Help to set up good relationship with residents nearby	3.548	0.765	5.866	0.000
	3.Complete enterprise and society's responsibility	4.288*	0.565	19.483	0.000
	4.Guarantee the enterprise's perpetual growth for shareholders	3.74	0.746	8.532	0.000
	5.Comply with shareholder's expects	3.562	0.645	7.437	0.000
	6.Imprcve international competitiveness	3.904	0.649	11.902	0.000
	7.Imprcve enterprise's image	4.247*	0.547	19.463	0.000
	8.Imprcve enterprise's quality and culture	4.055*	0.685	13.157	0.000
	9.Decrease enterprise's risk	3.904	0.557	12.395	0.000
	Average performance effectiveness	3.924	0.643		
Financial Management	1.Decrease wastes and storage, recourses costs	3.795	0.912	7.440	0.000
	2.Gain government award and allowance	3.082	0.997	0.942	0.349
	3.Easier to gain funds	2.849	0.844	-1.525	0.132
	4.Obtain benefits from exploiting new products or patent	3.014	0.842	0.276	0.784
	5.Investment return and decrease wastes	4.068*	0.536	17.044	0.000
	6.Decrease accidental society costs	3.89	0.756	10.066	0.000
		Average performance effectiveness	3.45	0.814	
Human Resources Management	1.More clear in orientation and separation of powers	3.753	0.795	8.130	0.000
	2.Enhance employees' sense of environmental protection and concept	4.082*	0.662	14.261	0.000
	3.Increase environment pollution disposal professionals	3.55	0.62	7.086	0.000
	4.Imprcve employees' work environment	4.123*	0.666	13.820	0.000
	5.Set up effective communication system	3.795	0.576	10.695	0.000
	6.Increase paper work, promote systematize	3.685	0.743	7.876	0.000
		Average performance effectiveness	3.831	0.678	
Production Management	1.Accord with environmental trends	4.384*	0.49	24.077	0.000
	2.Accord with relevant regulation requirement, decrease risk	4.301*	0.639	17.348	0.000
	3.Obtain standards system	3.973	0.645	13.150	0.000
	4.Decrease energy and resources wastes	4.082*	0.64	14.443	0.000
	5.Enhance produce rate and ability	3.438	0.833	4.496	0.000
	6.Decrease products defect rate	3.342	0.749	3.904	0.000
	7.Decrease repeated verification and costs	3.315	0.762	3.543	0.001
	8.Enhance the ability of pollution control	4.014*	0.514	16.886	0.000
	9.Enhance technology development and change	3.247	0.703	3.000	0.004
	10.Manufacture process optimization	3.425	0.815	4.451	0.000
	Average performance effectiveness	3.752	0.679		
Marketing Management	1.Attract professionals work in enterprises	3.411	0.879	3.929	0.000
	2.Enhance internal sales competitiveness	3.192	0.776	2.113	0.038
	3.Produce green products, catch business opportunities	3.781	0.692	9.639	0.000
	4.Enhance sales ability	3.452	0.708	5.456	0.000
	Average performance effectiveness	3.459	0.764		

Note: *p < 0.1; **p < 0.05; ***p < 0.01

Table 4. The correlations between each dimension and Manufactures' basic data

		Location	Operation years	Industry category	Number of employees	Amount of capital (NT\$)	Turnover
Overall Company	F-statistic	0.89	0.92	1.102	1.44	0.82	0.46
	F-statistic	0.417	0.475	0.408	0.215	0.574	0.858
Financial Management	F-statistic	0.55	1.24	3.17*	1.25	1.40	0.67
	F-statistic	0.578	0.301	0.019	0.291	0.220	0.694
Variance		-	-	-	-	-	-
Human resources Management	F-statistic	0.23	1.24	2.44	0.95	1.11	0.54
	F-statistic	0.797	0.301	0.055	0.465	0.369	0.798
Production Management	F-statistic	0.78	1.14	2.42	1.13	1.13	0.64
	F-statistic	0.464	0.349	0.057	0.356	0.356	0.719
Marketing Management	F-statistic	0.44	2.65*	0.58	0.69	0.97	0.27
	F-statistic	0.644	0.030	0.677	0.658	0.458	0.965
Variance		-	2,4,5 > 3	-	-	-	-

Note: 1. *p < 0.1; **p < 0.05; ***p < 0.01

2. 1 ~ 5 represents the industry category respectively: (1) Electric Machinery; (2) Electronic; (3) Machinery; (4) Chemistry; (5) Other.

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