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Evaluation and Ranking of Success Factors and Benefits of ISO 14001- Based EMS Implementation Using the TOPSIS Method

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ABSTRACT

In this study, the important factors and sub-factors to the successful implementation of ISO 14001-based environmental management system (EMS) and benefits that can be gained from the implementation were recognized and in our study we used the TOPSIS method, to find out the ranking of critical factors and benefits of successful implementation of ISO 1400-based environmental management system (EMS) and the study was accomplished in Iran by experts in EMS systems. The results of this study suggest that the most important sub-factors are as follows: top management commitment and support, cost of maintenance and improvement, environmental policies and objectives, and cost of initial set up. The results of the study also indicate that the most important benefits that can be achieved by the implementation of ISO 14001 are as follows: improvement in quality of products and services, reduction of energy consumption and pollution reduction, and improvement in the company's image and reputation.
KEY WORDS: ISO 14001, environmental management system (EMS), Sustainability, TOPSIS

1. INTRODUCTION

The industrial globalization that has taken place in recent years is having significant effects on the environment (Gonza´lez *et al.*, 2008) and the ability of companies to handle their environmental performance is emerging as a strategic issue for many companies in all over the world (Ann *et al.*, 2006). There has been important awareness of global environmental problems (Chavan, 2005) and companies have begun recently to face increasing stakeholder concerns respecting the operational impact of the company on the environment and society as individuals become more aware of the fact that each operational process has the potential of producing a negative impact on ecological and societal systems (Setthasakko, 2010). So, environmental management issues have become more and more significant in both public and private companies in recent years (La¨nsiluoto and Ja¨rvenpa¨a¨,2010) and businesses have progressively tended to develop and implement management practices and tools directed at improving their environmental performance by merging environmental considerations in their management decision-making processes (Ribeiro and Aibar-Guzman, 2010) and this phenomenon infers that companies are now starting to identify that environmental awareness can be a source of competitive advantage (Hu and Hsu, 2010) and each organization should formulate environmental protection related policies or plan "product environment quality assurance" and regulation restricted product environment quality objectives (Lin and Juang, 2008). Thus, Companies who achieve environmental management system (EMS) certification, such as ISO14001, suggests that organization has installed a management system that documents all the environmental aspects and impacts, and recognizes a pollution prevention process that organization can be continuously improved over time (Hsu and Hu, 2009). In This study we have used TOPSIS method to study the influence of implementation and benefits of ISO 14001and ranking benefits of them. This paper is organized as follows: Section 2 discusses the basics of sustainability, ISO 14001 and EMS systems, Section 3 discusses the important success factors and benefits of ISO 14001 implementation, Section 4 discusses the methodology, Section 5 analyzes the results, and Section 6 concludes and discuses the study.

2. Basics of sustainability, EMS and ISO 14001

2.1 Sustainability

Sustainability is explained as those activities of corporations presenting the incorporation of social and environmental worries in business operations, (La¨nsiluoto and Ja¨rvenpa¨a¨, 2008) and the thought of sustainable

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development is based on the idea of meeting the needs of the present without compromising the ability of future generations to meet their own needs (Moneva and Ortas, 2010) and sustainability is forcing companies to find ways to improve environmental performance in parallel with economic growth (Setthasakko, 2010) .The environment protection and sustainable development is a complex process and sustainable development needs innovation that is necessary in each Process and everybody is included in innovation (Kralj, 2008).

2.2 What is an EMS?

The word "environment" is often observed as something green and relates to nature. In relation to business operations, it indicates the idea of correctly managed activities that do not damage the environment that encircles a corporation (Yusoff and Lehman, 2009) and environmental management attempts to insert the concept of sustainable development in the processes of production of products and services (Da Silva and De Medeiros, 2004). An EMS is a tool for managing the influence of an organization's activities on the environment. (Chavan, 2005) and environmental management systems based on ISO 14001 were developed to evaluate and improve the environmental behavior of corporations (Beltra´n *et al.,* 2010). Therefore, implementation of an EMS permits continuous reassessment of the production process, looking for procedures, mechanisms and behavior standards that are less harmful to the environment (Perotto *et al.,* 2009).

2.3 International environmental standards – ISO 14001

The International Organization for Standardization (ISO) is a universal federation of national standards bodies. It was established in the 1970s in Geneva, Switzerland, to improve the development of safety standardization and related activities (Fisher, 2003). ISO certification has been proposed to be a strategic tool in establishing a reputable corporate image and garnering of long-term competitive advantage (Delmas, 2001) and the standards, asserted to be less conflicting and user-friendly, may provide a potentially innovative supplement to current environmental regulations (Murray, 1999). The ISO 14001 standard was published in September 1996 (Casadesu´s *et al.,* 2008) and ISO 14001 is a general and international standard for assessing environmental management process (Hillary, 2000) and the implementation of these standards motivates organizations to invest in environmental improvements (Da Silva and De Medeiros, 2004) and this standards will help companies merge environmental considerations into company decision-making in a more organized and systematic mode (Ann *et al.,* 2006)

3. The important success factors and benefits of ISO 14000 implementation

3.1 The important success factors

In this section we will explain the important success factors of ISO 14000 implementation. The choice of critical success factors is based on the main clauses of ISO 14001 and some researches that for effective design and implementation of ISO 14000-based EMS any organization must pay attention to them. Five main factors in this research are as follows: (1) Management approach, (2) Organizational change, (3) Technical aspects, (4) External and social aspects, and (5) costs. On this basis, 17 sub-factors were determined and classified in 5 main groups (see table 1).

3.1.1 Management approach: The sub-factors that come under management approach are as follows: top management commitment and support (M_1), environmental policies and objectives (M_2), and management reviews (M_3).

Top management commitment and support (M_1): For effective design and implementation of an ISO 14001-based EMS in any organization (Sambasivan and Fei, 2008) and top management commitment is necessary for implementing all types of management systems (Chin *et al.,* 1999) and without the total participation of top management, all quality attempts might fail and top management commitment plays a critical role in the implementation of ISO 14001 (Padma *et al.,* 2008).

Environmental policies and objectives (M_2): Environmental policy is a statement of what an organization implies to obtain from an EMS. It ensures all environmental activities are coherent with the organization's objectives. An organization can find benefits in adopting more stringent longer term objectives to encourage organization to improve its performance and for continuous improvement, targets should be regularly reviewed (Chavan, 2005).

Management reviews (M_3): The top management must review ceaselessly the company's EMS to ensure that the system is appropriate, sufficient, and effective (Sambasivan and Fei, 2008) and the review should include the development of environmental management practice within the construction industry, the response or complaints from customers or other third-parties (Liyin *et al.,* 2006).

3.1.2 External and social aspects: The effective development and implementation of ISO 14001-based EMS is certainly influenced to a great extent by external and social aspects that include: market pressure (S_1), environmental legislation (S_2), customer requirements (S_3), and employee relations (S_4).

Market pressure (S_1): globalization has resulted in pressure on multinational companies to improve environmental performance and as a result of this pressure, environmental management problems have become related to operations management (lee, 2008) and the manufacturing and service sector companies feel the strong

market pressure to implement such environmental quality standards (ISO 14001) in order to do business in international markets (Sambasivan and Fei, 2008).

Environmental legislation (S_2): Governments worldwide have established different policies and regulations for controlling the impacts (Liyin *et al.*, 2006) and the expanding trend of environmental legislation is found not only in developed countries but also in developing countries (Chin *et al.*, 1999) like Iran and many countries, including developing countries have legislated strict environmental laws to prevent environmental damage and to penalize the offenders (Sambasivan and Fei, 2008).

Customer requirements (S_3): Many multinational firms are adopting EMS in response to pressure from their customers. Companies have already started to guide their suppliers to conform to the ISO 14001 standard. Moreover, the international standard can aid companies simplify and integrate their environmental protection programs into a more consistent framework (Sambasivan and Fei, 2008).

Employee relations (S_4): Central to the effective operation of the EMS is employee involvement (Ann *et al.*, 2006) and Implementation of ISO 14001-based EMS is a good exhibition of such a commitment. High quality employees and their constancy are likely to improve the employee relations within the organization and this makes the implementation of EMS much easier (Sambasivan and Fei, 2008).

Table 1- The important success criteria and sub criteria

criteria	sub criteria	references
Management approach	Top management commitment and support (M_1)	(Hu and Hsu,2010), (Sambasivan and Fei,2008), (Padma *et al.*,2008), (Ann *et al.*,2006), (Chavan,2005), (Arvidsson,2004), (Chin *et al.*,1999), (Pearson *et al.*,1993)
	Environmental policies and objectives (M_2)	(Hu and Hsu,2010), (Oliveira *et al.*, 2010), (Sambasivan and Fei,2008), (Ann *et al.*,2006), (Liyin *et al.*,2006), (Chavan,2005), (Chin *et al.*,1999)
	Management reviews (M_3)	(Sambasivan and Fei,2008), (Ann *et al.*,2006), (Chan and Ho,2006), (Chin *et al.*,1999)
External and social aspects	Market pressure (S_1)	(Hu and Hsu,2009), (lee,2008), (Sambasivan and Fei,2008), (Chin *et al.*,1999)
	Environmental legislation (S_2)	(Sambasivan and Fei,2008), (Chan and Ho,2006), (Liyin *et al.*,2006), (Chin *et al.*,1999)
	Customer requirements (S_3)	(Sambasivan and Fei,2008), (Padma *et al.*,2008), (Morrison *et al.*, 2000),
	Employee relations (S_4)	(Sambasivan and Fei,2008), (Ann *et al.*,2006), (Chin *et al.*,1999)
Organizational change	Training and awareness (O_1)	(Jain and Pant, 2010), (Hu and Hsu,2010), (Sambasivan and Fei,2008), (Pe´rez *et al.*,2007), (Chan and Ho,2006), (Liyin *et al.*,2006), (Chavan,2005), (Arvidsson,2004), (Chin *et al.*,1999), (Clements, 1996),
	Documentation control (O_2)	(Sambasivan and Fei,2008), (Padma *et al.*,2008), (Chan and Ho,2006), (Liyin *et al.*,2006), (Chavan,2005), (Chin *et al.*,1999),
	Emergency response and preparedness (O_3)	(Sambasivan and Fei, 2008), (Chan and Ho, 2006), (Chavan, 2005), (Liyin *et al.*, 2006), (Chin *et al.*, 1999), (Clements, 1996),
	Communication (O_4)	(Jain and Pant, 2010), (Sambasivan and Fei,2008), (ISO 14001,2008), (Chan and Ho,2006), (Liyin *et al.*,2006), (Chin *et al.*,1999)
	Preventive actions (O_5)	(ISO 14001,2008), (Sambasivan and Fei,2008), (Chan and Ho,2006)
Technical aspects	Production process enhancement (T_1)	(Sambasivan and Fei,2008), (Padma *et al.*,2008), (Chin *et al.*,1999),
	Monitoring and measuring equipment (T_2)	(Beltra´*n et al.*, 2010), (Sambasivan and Fei,2008), (Padma *et al.*,2008), (Chin *et al.*,1999)
	Environmental specialist assistance (T_3)	(Sambasivan and Fei,2008), (Chavan,2005), (Chin et al.,1999)
Costs	Costs of initial set up (C_1)	(Chin *et al.*,1999)
	Costs of maintenance and improvement (C_2)	(Chin *et al.*,1999)

3.1.3 Organizational change: Implementation of ISO 14001-based EMS requires significant changes in an organization and the top management should ensure that the changes are obviously understood and supported by all employees in the organization (Chin *et al.*, 1999). The changes include: training and awareness (O_1), documentation control (O_2), emergency response and preparedness (O_3), communication (O_4), and preventive actions (O_5).

Training and awareness (O_1): Employees should be supplied with awareness and knowledge about the environmental effects from their operations and their actions (Liyin *et al.*, 2006) and firms must also identify education and training needs (Sambasivan and Fei, 2008) and various education and training in green issues need to be launched for improving the environmental awareness of their employees (Hu and Hsu, 2010).

Documentation control (O_2): Controlling should be available for ensuring that environmental documentation is most updated, and that the current versions of the documents are communicated across the whole organization as

early as possible (Liyin *et al.*,2006) and the procedures for controlling all EMS documents must be established and correctly maintained by the organization (Sambasivan and Fei, 2008).

Emergency response and preparedness (O_3): Emergent environmental problems are possible on site (Liyin *et al.*, 2006) and companies might face different environmental dangers which have dire result. Therefore, it is necessary that they plan for emergencies and provide suitable facilities to react to possible environmental accidents (Padma *et al.*, 2008).

Communication (O_4): Communication is believed the key indicator for successful implementation of an EMS (Jain and Pant, 2010) and organizations shall establish, implement and maintain a procedure for internal communication among the various levels and relevant communication from external interested parties (ISO 14001, 2008).

Preventive actions (O_5): ISO 14001 certification simulates the development of preventive environmental actions preventing unexpected costs and it improves quality of product and services (Sambasivan and Fei, 2008).

3.1.4 Technical aspects: The effective implementation of ISO 14001-based EMS in manufacturing and service industries certainly depends on integrating it with technical aspects (Chin *et al.*, 1999). These include: production process enhancement (T_1), monitoring and measuring equipment (T_2), and environmental specialist assistance (T_3).

Production process enhancement (T_1): Generally operational performance is an indicator of a firm's capability to use its resources effectively in order to meet its objectives (Padma *et al.*, 2008) and controlling mechanisms can be used to enhance production processes (Sambasivan and Fei, 2008).

Monitoring and measuring equipment (T_2): All firms with a certified EMS must have completed the implementation process of all the metrological requisites contained in the ISO 14001 standard (Beltra´n *et al.*, 2010) and the equipment used must make possible the organization to record information to track performance, perform relevant operational controls and evaluate adaptation with the organization's objectives and targets (Sambasivan and Fei, 2008).

Environmental specialist assistance (T_3): Specialist's assistance should develop and implement parallel response actions to improve the organization's environmental performance in a applicable way leading to compliance with environmental legislation (Chin *et al.*, 1999) and they also aid to improve the company (Chavan, 2005).

3.1.5 Costs: The sub-factors that come under costs are as follows: costs of initial set up (C_1), and costs of maintenance and improvement (C_2).

Costs of initial set up (C_1) and Costs of maintenance and improvement (C_2): The typical costs of implementation of ISO 14001 are the initial set-up cost and long-term maintenance and improvement costs (Chin *et al.*, 1999) and Businesses by nature are profit-driven. Usually, any activity makes extra cost will not attract businesses' real interests (Liyin *et al.*, 2006). Decisions with respect to costs made at the designed and engineering and implementation phases have an important impact on service costs. Increasing costs of cleaning materials and process technology are now driving some companies to raise emphasis on environmental problems (lee, 2008).

3.2 Benefits of implementation

By developing and implementing an effective EMS, companies can achieve tangible and intangible profit and rewards (Sambasivan and Fei, 2008). The following benefits have been considered in this study: improved company reputation and image for media and society (A_1), increased staff morale and motivation (A_2), earning growth, performance, and opportunity (A_3), customer constancy and trust (A_4), reduction energy consumption of electric power, water, gas, fuel oil, etc. and pollution reduction (A_5), improved quality of products and services (A_6).

3.2.1 Improved company reputation and image for media and society (A_1): ISO 14000 improves corporate image (Fisher, 2003) and this certification can exhibit a good corporate image (Chavan, 2005) and competitiveness can be increased by improved company public image as a result of ISO 14000 implementation (Chin *et al.*, 1999; La¨nsiluoto and Ja¨rvenpa¨a¨, 2010; Saizarbitoria *et al.*, 2011) and the certification aids the company to establish legitimacy of its activities and also the company becomes more interesting to investors after ISO 14001 certification (Sambasivan and Fei, 2008).

3.2.2 Increased staff morale and motivation (A_2): An appropriate work environment is essential for the effectiveness of employees who are one of the assets of an organization (Padma *et al.*, 2008) and employees resistant in relation to the internal/external audit process according to ISO 14001 certification has a positive impact on employee morale and employee relations (Oliveira *et al.*, 2010) and employees can be motivated by communicating the objectives and significance of EMS standards and a thorough match between the organizational and employees' values can be reached (Sambasivan and Fei, 2008).

3.2.3 Earnings growth, performance, and opportunity(A_3): An EMS can be an effective tool for organizations to improve enhances their business efficiency (Chavan, 2005). Obviously, the benefits of ISO 14000 certification is many: earning market place and shareholder advantages, reduced costs, (Ann *et al.*, 2006) and attaining higher productivity (Ann *et al.*, 2006; Baharum and Pitt, 2009). ISO 14001 will help increase a firm's economic

performance and at the same time improve its environmental performance (Chavan, 2005; Ann *et al.*, 2006) and it maximizes the efficient use of resources (Chavan, 2005). Therefore, it improves profitability (La¨nsiluoto and Ja¨rvenpa¨a¨, 2010) and ISO 14001 certifications increased the demand for goods and services produced by the firms (Oliveira *et al.*, 2010).

3.2.4 Customer constancy and trust (A_4): Implementation of ISO 14001 by an organization sends a strong message to all the stakeholders and customers about the organization's commitment to environmental protection, cleaner and safer production practices and this will definitely increase customer constancy and trust towards the organization (Sambasivan and Fei, 2008) and customers expect good environmental performance from suppliers and companies (Padma *et al.*, 2008).

3.2.5 Reduction energy consumption of electric power, water, gas, fuel oil, etc. in the production and pollution reduction (A_5): Reducing pollution may also result in increased demand from environmentally sensitive consumers, (Saizarbitoria *et al.*, 2011) and Implementing ISO 14001 reduces hazardous waste, water usage (Ann *et al.*, 2006) and it Also helps reductions in environment impacts of construction such as land use, air, ground and water pollution, and pollution to plants and wildlife. Implementing ISO 14001 reduces the use of non-renewable and non-sustainable natural resources such as oil and fuels and usage of natural minerals in construction materials and components (Griffith and Bhutto, 2009). So, ISO 14001 certifications contributes a reduction in the consumption of electric power, water, gas, fuel oil, etc. in the production process (Oliveira *et al.*, 2010).

3.2.6 Improved quality of products and services (A_6): ISO 14001 certification simulates the development of preventive environmental actions preventing unexpected costs and it improves quality of product and services. Furthermore, ISO 14001 implementing aids to improve quality of products and services, practice ''green'' operations and thereby, improve quality of operations (Sambasivan and Fei, 2008).

4. METHODOLOGY

4.1 The TOPSIS method

Multi criteria optimization is the process of determining the best feasible solution according to the established criteria (Opricovic and Tzeng, 2004) and TOPSIS (technique for order preference by similarity to an ideal solution) was developed by Hwang and Yoon (Hwang and Yoon, 1981; Jadidi *et al.*, 2008). The basic principle of TOPSIS is that the chosen alternative should have the shortest distance from the ideal solution and the farthest distance from the negative-ideal solution (Opricovic and Tzeng, 2004). Indeed, TOPSIS is a multiple criteria method to recognize solutions from a set of alternatives based upon simultaneous minimization of distance from an ideal point and maximization of distance from a nadir point (Olson, 2004) and based on the concept that the chosen alternative should have the shortest distance from the positive ideal solution (PIS) and the farthest from the negative ideal solution (NIS) for solving a multiple criteria decision making problem. Briefly, the PIS is made up of all best values attainable of criteria, whereas the NIS is composed of all worst values attainable of criteria (Jadidi *et al.*, 2008).

The TOPSIS procedure consists of the following steps:

(1) Calculate the normalized decision matrix. The normalized value r_{ij} is calculated as:

$$r_{ij} = \frac{f_{ij}}{\sqrt{\sum_{j=1}^{J} f_{ij}^2}} \quad , \quad j = 1, \dots, J; i = 1, \dots, n, \quad (1)$$

(2) Calculate the weighted normalized decision matrix. The weighted normalized value v_{ij} is calculated as:

$$v_{ij} = w_i r_{ij} \quad j = 1, \dots, J; i = 1, \dots, n, \quad (2)$$

where w_i is the weight of the ith attribute or criterion, and $\sum_{i=1}^{n} w_i = 1$.

(3) Determine the ideal and negative-ideal solution.

$$A^* = \{v_1^*, \dots, v_n^*\} = \{(max\ v_{ij} | i \in I'), (min\ v_{ij} | i \in I'')\}, \quad (3)$$

$$A^- = \{v_1^-, \dots, v_n^-\} = \{(min\ v_{ij} | i \in I'), (max\ v_{ij} | i \in I'')\}, \quad (4)$$

Where I' is associated with benefit criteria, and I'' is associated with cost criteria.

(4) Calculate the separation measures, using the dimensional Euclidean distance. The separation of each alternative from the ideal solution is given as:

$$D_j^* = \sqrt{\sum_{i=1}^{n} (v_{ij} - v_i^*)^2} \quad , \quad j = 1, \dots, J \quad (5)$$

Similarly, the separation from the negative ideal solution is given as:

$$D_j^- = \sqrt{\sum_{i=1}^{n} (v_{ij} - v_i^-)^2}, \quad j = 1, \dots, J \quad (6)$$

(5) Calculate the relative closeness to the ideal solution. The relative closeness of the alternative a_j with respect to A^* is defined as:

$$C_j^* = \frac{D_j^-}{(D_j^* + D_j^-)} \quad , \quad j = 1, \dots, J \quad (7)$$

(6) Ranking (Opricovic and Tzeng, 2004).

5. RESULTS

5.1 The TOPSIS model of research:

In this study we used the TOPSIS method, to find out the ranking of critical factors and benefits of successful implementation of ISO 14001-based environmental management system (EMS). The goal is to ranking benefits and the most important sub-factors of implementing the ISO 14001-based EMS. Based on this goal, the relevant critical success factors (decision criteria) were recognized and then the relevant attributes (sub-criteria) that defined each of the critical factors were identified. Similarly, the benefits of implementing an ISO 14001 based EMS were recognized and defined. In table 2 we observe decision making matrix that completed by 8 questionnaires were responded from experts.

Table2- Decision making matrix

Criteria benefits	M_1	M_2	M_3	S_1	S_2	S_3	S_4	O_1	O_2	O_3	O_4	O_5	T_1	T_2	T_3	C_1	C_2
A_1	7.19	5.99	6.61	6.03	5.88	4.39	4.72	5.82	4.42	5.17	5.42	5.92	6.38	5.07	5.99	4.46	5.38
A_2	7.01	5.35	5.75	4.59	5.69	4.3	6.21	7.13	5.25	5.48	5.23	5.79	4.36	4.33	5.44	4.43	3.98
A_3	6.69	5.68	5.99	6.18	5.12	6.21	6.54	5.91	5.21	4.29	4.59	5.49	6.12	5.08	5.43	4.72	4.4
A_4	6.59	6.26	6.81	4.11	4.5	5.36	5.86	5.53	5.77	4.94	5.87	4.44	4.76	3.39	6.02	4.98	4.13
A_5	5.94	6.94	5.44	6.83	6.52	4.28	4.32	5.93	5.84	4.42	4.91	6.13	3.83	7.13	6.99	5.25	6.95
A_6	6.23	5.24	6.75	5.63	6.65	5.61	5.25	6.03	6.83	4.3	6.36	6.48	5.77	6.61	5.31	4.97	5.46

The relevant data was collected by questionnaire and for this research a questionnaire was designed that included a section for general data of experts and a section for decision making matrix. All these experts were senior consultants, auditors of ISO 14001 and teachers of universities, that they were experienced in ISO 14001- based EMS implementing. 12 questionnaires were specifically sent to the experts of EMS systems. From 12 questionnaires, 8 questionnaires were responded and completed and since we are using TOPSIS to analyze the data, the results are not influenced by small sample size and in MCDM methods we collect the data in expert population and knowledge of experts is more important than the number of experts.

5.2 calculations of weights of sub-criteria

Based on completed questionnaires, we calculated the weighs of sub-factors that are shown in table 3 and the weights arranged and ranked in table 4. So, we can see that the top five criteria are as follows: top management commitment and support (**0.075**), costs of maintenance and improvement (**0.068**), environmental policies and objectives (**0.067**), costs of initial set up (**0.067**), and environmental specialist assistance (**0.066**).

Table 3- weights of sub-criteria

Criteria	M_1	M_2	M_3	S_1	S_2	S_3	S_4	O_1	O_2	O_3	O_4	O_5	T_1	T_2	T_3	C_1	C_2
Total	62	56	44	53	44	39	39	52	37	40	49	50	51	49	55	56	57
Weight	0.075	0.067	0.053	0.064	0.053	0.047	0.047	0.062	0.044	0.048	0.059	0.060	0.061	0.059	0.066	0.067	0.068

Table 4- ranked weights of sub-criteria

Criteria	M_1	C_2	M_2	C_1	T_3	S_1	O_1	T_1	O_5	O_4	T_2	M_3	S_2	O_3	S_3	S_4	O_2
Weight	0.075	0.068	0.067	0.067	0.066	0.064	0.062	0.061	0.060	0.059	0.059	0.053	0.053	0.048	0.047	0.047	0.044

From weights obtained, it can be concluded that the most important of the critical success sub-factors is the top management commitment and support (weight = **0.075**) and the least important is documentation control (weight = **0.044**). So, top management commitment and support is very important for successful implementation of ISO 14001-based environmental management system. The commitment of management starts from the formulation of the environmental policy and its communication to all the employees. The commitment of the management is also evident from frequent reviews of EMS to continuously improve the system (Sambasivan and Fei, 2008) and without the total participation of top management, all attempts might fail (Padma *et al.*, 2008).

5.3 Ranking the benefits

Based on the weights of sub-factors, and data were shown in table 2, the benefits are ranked, and this benefits were explained in this article. For this calculation and ranking, we used TOPSIS 2005 and finally From calculations were obtained, the ranking of benefits based on relative closeness to the ideal solution are as follows: improved quality of products and services (0.617), reduction energy consumption of electric power, water, gas, fuel oil, etc. and pollution reduction (0.564), improved company reputation and image for media and society (0.531), earning

growth, performance, and opportunity (0.515), increased staff morale and motivation (0.385), customer constancy and trust (0.332). So, we concluded:

Based on calculations were performed, it can be concluded that the most important of the benefits of implementation of ISO 14001 is the improved quality of products and services.

6. DISCUSSION

The purpose of the ISO 14001 standard is to guide environmental improvements worldwide through a systematic approach to environmental management and In this paper, we used the TOPSIS method, to find out the ranking of critical factors and benefits of successful implementation of ISO 14001 and usefulness of the technique are clear and TOPSIS has been applied to a number of applications and we have seen this approach flexible and useful for ranking of critical factors and benefits of successful implementation of ISO 14001-based environmental management system (EMS) and the literature review that conducted by different authors helped ensure the content validity and the this study is align with research of Beltra´*n et al.* (2010), Perotto *et al.* (2009), Sambasivan and Fei (2008), Ann *et al.* (2006), Da Silva and De Medeiros (2004), Delmas (2001), Chin *et al.*,(1999), and Murray (1999).

Despite the strengths of this research, we had some limitations in our research and as the main contributions of this study are to recognize the factors and benefits of ISO 14001, the identification of them is very important. One limitation was the variables of this study and other researchers can use more variables in their study. Other limitation was sample size of experts and since we are using TOPSIS method to analyze the data, the results are not influenced by small sample size but it is better other researchers use larger sample size of experts. This research suggests further studies in order to extend the scope of this study. For example: other criteria or benefits can be added or such research can boost more awareness of other green and environment issues. Other researchers can also use and develop our models and benefits for other studies and this study provides a significant step into further research in environmental management systems and our observations may be completed over time with the same case study and other researchers can also use fuzzy TOPSIS or other Multi criteria decision making methods in their future researches.

7. Conclusions

Sustainability, green and environmentally issues are significant which has been discussed in recent years and a large number of companies implement ISO 14001- based EMS to improve their businesses and ISO 14001 certification is becoming an essential requirement in companies worldwide in order to adopt sound environmental practices. In this paper, we used the TOPSIS method, to find out the ranking of critical factors and benefits of successful implementation of ISO 14001-based environmental management system (EMS) and based on our research, we concluded that the most important of the benefits of implementation of ISO 14001 is the improved quality of products and services. Also, we concluded that the top five sub-factors of successful implementation of ISO 14001-based environmental management system (EMS) are as follows: top management commitment and support, costs of maintenance and improvement, environmental policies and objectives, costs of initial set up, and environmental specialist assistance. So, the most important of the critical success sub-factors of successful implementation of ISO 14001-based environmental management system (EMS) is the top management commitment and support and ISO 14000 highlights on the commitment and support from top management for a successful implementation and without their support, failure of any EMS is probably.

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