



EVALUATION OF CRITICAL SUCCESS FACTOR IN IMPLEMENTING ISO 14001 USING ANALYTICAL HIERARCHY PROCESS (AHP) IN PULAU PINANG

by

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DECLARATION

I declare that this thesis entitled 'Evaluation of Critical Success Factor in Implementing ISO 14001 using Analytical Hierarchy Process in Pulau Pinang' and is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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Evaluation of Critical Success Factor in Implementing ISO 14001 using Analytical Hierarchy Process (AHP) in Pulau Pinang

ABSTRACT

ISO 14001 has engaged with all industries, international firms and governments around the world and outlines to assist the organizations to reduce the impact of operation towards environment as well as to construct a systematic managing process to improve environmental performance. The main objectives that can be derived from this study is to identify the challenges in implementing ISO 14001 and to identify the benefits of ISO 14001 standards implementation as well as to analyse the critical success factors of ISO 14001 execution in Pulau Pinang using analytic hierarchy process (AHP). Besides that, increase in bureaucracy and demand for more and unneeded certification has made the organization to consider about the EMS execution. The sampling method used in this research was a purposive sampling which based on objective of study. The survey was conducted by distributing the questionnaire to all the 13 companies that certify with the ISO 14001 standards in Pulau Pinang. An empirical study using the analytic hierarchy process (AHP) was carried out to find the relative weights and priorities of these critical success factors and benefits. The findings of the study indicate that the critical success factors in the order of importance are as follows management approach (0.2694), organizational change (0.2477), external and social aspects (0.2457) and technical aspects (0.2373). The findings of this empirical study specify which elements an organization should ponder for effective execution of ISO 14001. The research model proposed in this study offers methodology to analyse and recognize the critical success factor and the advantages due to ISO 14001 execution. Even though the study was done in manufacturing and electronics sector in Pulau Pinang but the proposed research model can be utilized in other sector as well.

Penilaian Faktor Kritikal Kejayaan dalam Pelaksanaan ISO 14001 dengan Menggunakan Proses Hierarki Analitik (AHP) di Pulau Pinang

ABSTRAK

ISO 14001 melibatkan semua industri, firma dan kerajaan antarabangsa di seluruh dunia dan menggariskan untuk membantu organisasi untuk mengurangkan kesan operasi terhadap alam sekitar serta membentuk proses pengurusan yang sistematik untuk meningkatkan prestasi alam sekitar. Objektif utama yang boleh diperolehi daripada kajian ini adalah untuk mengenal pasti cabaran-cabaran dalam melaksanakan ISO 14001 dan untuk mengenal pasti kebaikan pelaksanaan standard ISO 14001 serta untuk menganalisis faktor-faktor kejayaan kritikal pelaksanaan ISO 14001 di Pulau Pinang menggunakan proses hierarki analisis (AHP). Selain itu, peningkatan dalam birokrasi dan permintaan untuk pensijilan yang lebih dan tidak penting telah membuat organisasi mempertimbangkan tentang pelaksanaan EMS. Kaedah sampel yang digunakan adalah berdasarkan objektif daripada penyelidikan yang dijalankan. Kaji selidik ini dijalankan dengan mengagihkan soal selidik kepada semua 13 syarikat yang mengesahkan piawaian ISO 14001 di Pulau Pinang. Kajian empirikal yang menggunakan proses hierarki analitik (AHP) telah dijalankan untuk mencari berat dan prioriti faktor-faktor kritikal kejayaan serta manfaatnya. Hasil kajian menunjukkan bahawa faktor kritikal kejayaan dalam susunan kepentingan adalah seperti pendekatan pengurusan (0.2694), perubahan organisasi (0.2477), aspek luaran dan sosial (0.2457) dan aspek teknikal (0.2373). Penemuan kajian empirikal ini menentukan unsur-unsur yang perlu ditinjau oleh organisasi untuk pelaksanaan ISO 14001 yang berkesan. Model penyelidikan yang dicadangkan dalam kajian ini menawarkan metodologi untuk menganalisis dan mengenali faktor kejayaan kritikal dan kelebihan yang dapat diperolehi daripada pelaksanaan ISO 14001. Walaupun kajian ini dijalankan dalam sektor perkilangan dan elektronik di Pulau Pinang tetapi model penyelidikan yang dicadangkan boleh digunakan dalam sektor lain juga.

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LIST OF ABBREVIATIONS

ACI	average consistency index
AHP	analytic hierarchy process
CI	consistency index
CR	consistency ratio
EMS	environmental management system
ISO	International Organization of Standardization
PDCA	plan-do-check-act
EEA	environmental aspect assessment

LIST OF SYMBOLS

$>$	Greater than
$<$	Less than
\geq	Greater than or equal to
$\%$	Percentage
F	Frequency

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CHAPTER 1

INTRODUCTION

ISO 14001 is the global standard level that define necessitate for an efficient environmental management system (EMS). It gives a structure for organization to comply, instead of building environmental performance condition (Da Fonseca, 2015). From ISO 14000 standards family, the organization can register under ISO 14001 standard since it is a willing standard that applicable to all types of business regardless their size. Integration of ISO 14001 helps to boost assistance in executing firm's objectives. Owing to the enlarged request concerning environmental law in developed countries, firms at the present time are compulsory to extremely take into thought not only environmental features related to the production chain however also focus into the life cycle of their products. They are enforced to execute appropriate EMS to minimize waste and to protect the environment (Santos & Silva, 2016).

ISO 14001 has engaged with all industries, international firms and governments around the world and outlines to assist the organizations to reduce the impact of operation towards environment as well as to construct a systematic managing process to improve environmental performance (Sambasivan & Fei, 2008). ISO 14001 holds a vital position on environmental management system thus the firms that want to gain a competitive advantage cannot neglect this standard. The particular cause that influence the companies to come after ISO 14001 certification are huge public demand from the customer who concern about environment, to gain access through global market, to remain competitive in global market, to modify company's appearance, and to alter company's

operations (Tan, 2005).

Many organization are facing difficulties in implementing the ISO 14001 standard due to some primary reasons such as high initial set up costs, more time is required for EMS implementation, huge training processes and complications in documentation process (Anna & John, 2018). Certification process at the early execution stage is quite expensive. There are proper expenditures are involved to work out new procedures, perform some tests, procurement of new amenities and instruments (mainly for monitoring and measuring purposes) and to review the outcomes (Anna & John, 2018).

The critical success factor in implementation of ISO 14001 helps to determine the effectiveness of ISO 14001 standards towards the organizations as well as to improve the environmental performance of the organizations. The management approach helps to enhance the cooperation and teamwork between management team and staff while the organizational change ensure that the responsibilities are clearly define and communicate to all the levels (Sambasivan & Fei,2008). Besides that, the external and social aspects assists the organization to comply with the environmental laws and regulations whereas technical aspects helps to observe and keep record of operation that contribute to negative effect towards environment.

1.1 Background of Study

After the establishment of the ISO 9000 series of quality standards, the International Standards Organization (ISO) issued an inclusive criteria to manage the environment quality. ISO 14001 is a family of standards related to environmental management that exists to help organizations to minimize the operations that negatively affect the environment and comply with applicable laws, regulations and other environmentally oriented requirements (Sambasivan & Fei, 2008). ISO 14001 has evolved in the early of nineties and was introduced in 1996 by the International Organization for Standardization. ISO 14001 is a worldwide voluntary standards that serve common framework to manage environmental problems. This flexible standard consists of leading rule on better environmental management and applicable to all nations (Pun & Hui, 2001). ISO 14001 is product and process oriented and not a performance standard which helps to determine the environmental impact of product and service.

The ISO 14001 imply five aspects as follow (1) environmental management system, (2) environmental auditing and related investigations, (3) environmental labels and declarations, (4) environmental performance evaluation and (5) life cycle analysis (Sambasivan & Fei, 2008). The series also consider ISO 14006 (guidelines for incorporating eco design), ISO 14010 series (guidelines and general principal for environmental auditing) and others. ISO 14001 is a worldwide consent standard that seek the necessitate for environmental management system. It helps firms to improve their environmental performance through more efficient use of resources and reduction of waste, gaining a competitive advantage and enhance the trust of all stakeholders. The norm is focused on management system, not on technical requirements (Sambasivan & Fei, 2008). ISO 14001 is based on model of continual

improvement and it is recognized by an international certification system. The system help to provide commercial and economical benefits as well as the standard is suitable for all types of organizations regardless the sizes (Pun & Hui, 2001). The system require an organization to consider all environmental issues relevant to its operation such as pollution, waste management, resource use and efficiency.

The alternative elements that drive to success is rely on clauses of ISO 14001 and extrinsic aspects that influence a firm to conduct the management system. The five leading parts of ISO 14001 are as follow environmental plan, design, execution and process, inspection and management review (Clements, 1996). The management approach serve as main point to analyze the dedication and reinforcement from top management, develop a suitable environmental policy and conduct the constant management reviews. Execution of ISO 14001 require the involvement of all employees and emphasize role of organization so it is crucial to obtain full commitment and support from top management to execute an EMS with efficient.

The second point is the organizational change that adopt the third clause which is the implementation and operation. Some necessary alteration inside the firm are expected in the execution of ISO 14001 (Clements, 1996). The third point is the external and social aspects which emphasize the government laws, market force and customer demand that prompt a firm to execute ISO 14001. The last point is the technical aspects which consists of part that encounter with inspection. The accomplishment of the execution of ISO 14001 rely on correct tracking performance.

Organization can gather gains and benefits by executing EMS with efficient. There are many advantages can be looking forward after the execution of ISO 14001 based EMS such as improve company image, improve employee morale, gain profit and opportunity as well as enhance customer trust (Pun & Hui, 2001). The first reward from execution of ISO 14001 is to improve the reputation of firm. Conformity with ISO 14001 standard will assist to modify value of products and services, execute environmental friendly process that helps to modify efficiency of performance as well as to reduce the risk of harm on environment. As a results, this helps to improve the firm's image as well as gain a competitive advantage.

The second reward is to improve in employee morale display an essential role in execution of ISO 14001 standards. Employee should involve themselves from the starting of certification process and increase their commitment and awareness level towards environment. Execution of EMS standards can promote a healthy relationship and teamwork among the management group and employee (Petroni, 2001).

Third reward for organizations to look upon ISO 14001 as a mode to maintain a good relationship with consumer, societies and investors that aware about environmental issue. ISO 14001 standard enlarge the company aspect by emphasizing on inputs based on extraction of raw materials and resources reduction as well as focusing on output based on waste production and their associated negative impact on environment. Conformity with 14001 standards can give more environmental advantage such as reduce harmful discharge, minimize the generation of waste and decrease the risk of mishap related to environment (Sambasivan & Fei,2008). These advantages can be further explain more into less input utilization, minimize the waste removal charges and increase the manufacture of output. Execution of ISO 14001 standards helps to improve environmental act in firm, gain profits and contribute to an innovative commercial opportunity as more countries are coming after ISO 14001 certification to enhance their environmental performance. Organizations adopt ISO 14001 so as to reestablish their legitimacy and status in foreign markets and encourage their competitiveness and strong inspirations cover the way for companies to motivate their competitiveness by improving the efficiency, as some firms might reinforce their position in the local market by executing ISO 14001 practically (Iatridis & Kesidou, 2018).

The fourth reward relates that the company to have a great environment related evidence documentation to enhance their community social relation within the society and strengthen the trust of consumer. Environmental conscious consumer wish to buy the product from the suppliers that have a great environmental records (Pun & Hui, 2001). Execution of ISO 14001 standards helps to channel a powerful content to all the consumer regarding their commitment towards environmental protection and this will enhance customer trust towards the organization.

1.2 Problem Statement

The firm that applied ISO 14001 standards faced problems such as frustration among the staff that argue on more responsibilities as well as hesitancy by management to give more time and resources that necessary to execute EMS. Besides that, increase in bureaucracy and demand for more and unneeded certification has made the organization to consider about the EMS execution. (Psomas & Kafetopoulos, 2011). This is one of the main reason why not all the firms accept the certification process despite the fact that ISO 14001 gives more environmental advantages. Even, some firms have make the decision to slow down the certification process (Bansal & Bogner ,2002) and the primary reason why the firms took this decision is due to they have problem in deciding the advantages and have to suffer from unbearable costs from the negative impacts towards environment.

Some of the firms that execute ISO 14001 standards with success can question the strength about total environmental operation. The elements that drive to success of execution ISO 14001 standards are deviate according to the different states and may consider elements like administrative law and economical issues as well as culture.

According to the Zutshi and Sohal (2004), organization endure to involve in conflict once executing and sustaining the system whether in quality, occupational health and safety or environmental field. Despite the fact ISO 14001 was formed to assist firms, there are some issues that may avoid a firm from effectively executing an EMS such as annoyance from workforce who may face the upsurge in their everyday jobs, unwillingness from organization to provide the period and capitals required to execute the EMS and the faith that after EMS is in place, it does not need to be regularly revised and enhanced (Chavan, 2005).

The space in the study is occupy by distinguishing the element that drive to success and some advantages of ISO 14001 standards execution (Sambasivan & Fei, 2008). Despite this survey is view in Pulau Pinang but the systematic structure cover can be relevant to different states as well. ISO 14001 is assembled with fundamental components from established ISO 9000 series and is a willing action that entail no legal requirements are needed to prove it. It basically control on management process instead of focus on particular environmental outcomes and does not hold any performance standard (Bansal & Bogner, 2002). Subsequently this has lead to the major factor why companies are going against ISO 14001 standard. In spite of that, several firms do accept that ISO 14001 supply them with a platform to enhance their environmental

performance and lessen the harmful effect on environment.

1.3 Research Questions

- 1) What are the challenges faced in implementing ISO 14001 standards?
- 2) What are the benefits gained from ISO 14001 implementation?
- 3) What is the critical success factor of ISO 14001 implementation in Pulau Pinang?

1.4 Objectives

- 1) To identify the challenges in implementing ISO 14001 standards.
- 2) To identify the benefits of ISO 14001 standards implementation.
- 3) To analyse the critical success factors of ISO 14001 execution in Pulau Pinang using Analytical Hierarchy Process (AHP).

1.5 Scope of Study

The main limitation of this study is the data collection that comprise smaller size sample of industries that certified with ISO 14001 standards in Pulau Pinang. The industries that studied are belong to medium and large sized companies in total (Psomas & Kafetzopoulos, 2011). The industries studied in Pulau Pinang are from manufacturing or electronics background in total. Some organization state the primary reason why the companies does not took part in this study is due to the lack of knowledge and less exposure about ISO 14001 standards.

The critical success factor that is control in this review are classify into four major elements such as management approach (MA) , organizational change (OC), external and social aspects (ENSA) as well as technical aspects (TA) (Sambasivan & Fei , 2008). Moreover, the advantages that can be gained

from execution of ISO 14001 are as follow (1) improve company image (ICRI), (2) improve employee morale (IEM), (3)gain profit and opportunity (GPO) as well as enhance customer trust (ETC) .

1.6 Significant of Study

This study helps to discover the some of the challenges faced during the implementation of ISO 14001 standard. Apart from that, this study mention about the critical success factor that help to determine the effectiveness of ISO 14001 implementation and benefits that gained from the ISO 14001 execution. Thus the organization can picture themselves clearly about why they need to implement this standard and what they can get from this execution. Since the benefits of ISO 14001 execution outweigh the challenges in ISO 14001 implementation, the organization can consider this as proactive tool to enhance the environmental performance of their organization and as well as reduce the negative impact of the operation towards environment.

CHAPTER 2

LITERATURE REVIEW

2.1 ISO 14001 Implementation

International Organization of Standardization (ISO) describe the environmental management system as a system utilized to control environmental impacts, comply with laws and regulations and reduce negative impact towards environmental (Da Fonseca, 2015). The structure of ISO 14001 standard can be applied by using a plan-do-check- act (PDCA) model to enhance the environmental performance. On the other hand, an organization's compliance to requirements of ISO 14001 to notify the EMS that not only can enhance environmental performance (Chowdhury & Jayaram,2018) but also economic and market performance has been stated as the fundamental mode of execution.

PDCA model is a constant response circle to classify and alter process to lessen difference. The goal of PDCA model is plan to prepare something, manufacture them, verify them to meet the necessities, and correct the procedure to sustain the performance output (Gupta, 2006). PDCA model is define as follow:

- 1) Plan: develop the goals and procedures required to obtain outcomes in compliance with customer demand and the firm's policies.
- 2) Do: execute the procedure.
- 3) Check: monitor and measure procedures contrary to policies, goals and desires for the product, and report the outcomes.
- 4) Act: Take actions to constantly enhance the procedure.

2.2 Ineffective Implementation of ISO 14001

Some element forbid the organization from executing ISO 14001 such as dissatisfaction of staff that argue on more responsibilities, hesitation by management to give time and resources that needed to execute EMS. Besides that, increase bureaucracy and demand for more and unneeded certification (Psomas & Kafetopoulos, 2011). High cost and high consumption in time and resources to execute environmental management system has prevent many organization from execute this standards. Many organization states that leading obstacle in execution of ISO 14001 is increase in set up cost as well as maintenance and improvement cost for long term. Turk (2009) stated that difficulties in acquiring ISO 14001 certifications are such as the increase in set up and operation costs, deficiency of skilled staffs and shortage of appropriate information about the certifications. Furthermore, the emphasis on certification and reinforcement has compulsory some supervisors to outlook ISO 14001 as nothing more than additional certification driven process for administrators to approve (Curkovic & Melnyk, 2005).

High costs were the most significant barrier to EMS execution in Australian organizations and for small and medium sized firms in the UK (Waxin,2019). Besides that, many of these firms were unclear about the market advantage of becoming certified. Previous literature revealed that obstacles to EMS approval for small and medium firms are deficiency of human resources for effective execution and maintenance of the EMS compared to the shortage of monetary capitals (Waxin,2019). Moreover, it was found that an opposed company values, comprising unreliable support from top management delayed effective execution.

EMS execution and improvements was a difficult procedure that offer several practical encounters. Studies showed that Estonian corporations fought with practical encounters throughout the planning stage of ISO 14001, particularly with the environmental aspect assessment condition (EAA). This assessment was the most essential fragment of the ISO 14001 planning stage as firms must recognize origins of the organization's events, products and services that contribute to the negative impact of environment (Waxin,2019). ISO 14001 provides only common values for EAA application which are imprecise and insufficient as well as cannot be scientifically improved. The utmost struggle originated throughout the planning stage in defining the environmental performance matter which involved the formulating of quantifiable goals.

2.3 Impact from Ineffective Implementation of ISO 14001

Many organizations have contribute to negative impact towards environment due to ineffective implementation of ISO 14001. As a result, the organization produce more waste and pollution in environment. Without proper guidance from ISO 14001, the organization also indirectly involve in high risks of causing environmental accidents because there is no emergency preparedness training is provided. Moreover, ineffective implementation of ISO 14001 can lead to high consumption of raw material and energy which propagate towards depletion of natural resources in environment. The efficiency of operation will be reduced thus affect the yield of production of the organization.

2.4 Critical Success Factor of ISO 14001 Implementation

The main point to design and implement an ISO 14001 with efficient is

the management approach (MA) which can be interpreted by analyze the commitment from top management, suitable environmental policy and constant management reviews (Petroni, 2001). Execution of ISO 14001 require the involvement of all employees and emphasize on the role of organization and this is not possible without the guidance from top management. The sub elements that derived from management approach (MA) are as follows top management commitment and support (TMC), environmental policies and objectives (EPO), and management reviews (MR). The environmental policy provide a foundation for the organization to fix the objectives and targets (Sambasivan & Fei, 2008). The senior management enthusiastically take part in the policy formulation and ensure that it is conveyed to everyone in the firm. The senior management need to evaluate EMS constantly to make sure that the structure is appropriate, sufficient, and efficient.

The second point is the organizational change (OC) that adopt the third clause which is the implementation and operation. Some necessary alteration inside the firm are expected in the execution of ISO 14001 (Clements, 1996). The sub-elements derive from organizational change (OC) are as follows (1) training and awareness (TNA), (2) documentation and control (DC), (3) emergency response and preparedness (ERP), and (4) communication (CM). Effective execution of ISO 14001 entails the environmental responsibilities must be visibly well-defined and communicated (Sambasivan & Fei, 2008). Education and training are necessary to boost the capabilities of workforce while organizations executing ISO 14001 need to develop as well as sustain processes during the exchange of information related to ISO 14001. Process to

control the necessary documentation are developed as well as appropriately sustained in firm to recognize and react to emergency circumstances as well as to prevent the environmental effects that linked with emergency conditions.

The third point is the external and social aspects (ENSA) which emphasize the government laws, market force and customer demand that prompt an organization to execute ISO 14001. The sub elements derived from external and social aspects (ENSA) are as follows (1) market force (MF), (2) government regulations (GR), (3) customer demand (CD), and (4) relations between employee (RBE). ISO 14001 helps firm to comply with the rules placed under the legislation. Emergent stress from legislation has compel firms to embrace an inclusive EMS to increase self-assurance of all stakeholders and managers. ISO 14001 execution has surge the capacity of firm to draw high skilled workforce and their faithfulness that indirectly helps to enhance the worker relationships inside the firm which can contribute to effective implementation of EMS (Sayre,2014). Several international firms are implementing EMS due to demand from customers that aware and concern about the environmental issues.

The fourth point is the technical aspects (TA) which consists of clause that encounter with checking. The accomplishment of the execution of ISO 14001 rely on the correct monitoring performance. The sub elements derived from technical aspects (TA) are as follows (1) improve production (IP), (2) monitoring and measuring equipment (MME), and (3) environmental expert aid (EEA). Firms require aid from the experts to identify and tackle with technical issues of operations that cause significant environmental effects (Sambasivan & Fei, 2008). The experts helps the firm to enhance the environmental performance and comply with environmental law. Execution of ISO 14001 entails dependable monitoring and measuring equipment to monitor frequently and measure all activities that contribute significant bearing on the environment. The monitoring tools can be utilized to boost production process and become more ecofriendly.

2.4.1 Management Approach (MA)

For productive ISO 14001 execution, the management approach can be assumed by evaluating the top management commitment and support, suitable environmental plan and constant management reviews. The ISO 14001 execution is a long-term process including the involvement of staffs from all stages within an organization (Chin,1999). Hence, full commitment and support from the top management is needed to induce the progress of environmental management system. An environmental plan signifies a serious dedication on behalf of the firm in which every term and expression will be wisely thought through and its impact are fully understood. The strategy provide the source on which the organization develop the environmental goals

and targets. The top management must enthusiastically take part in policy development and ensure that it is communicated efficiently to all stages inside the organization. The top management should review environmental management system regularly to ensure the continuous improvement in environmental act.

2.4.2 Organizational Change (OC)

Execution of ISO 14001 demand significant changes in organization in terms of structure and accountability, training and awareness, communication and documentation as well as mishap alertness. The top management should make sure that the changes are obviously implicit and reinforced by every staffs in the organization. Environmental accountabilities should not be perceived as limited to the environmental purpose, but also comprise other parts of an organization such as operative management or staff roles (Chin, 1999). The organization must recognize training and awareness needs which entail all staffs to create a substantial effect on the environment. The organization should create and preserve processes for both internal and external communication as well as to control all EMS documents appropriately. Besides, the organization should ascertain the possibility for mishap to occur as well as to respond to emergency conditions.

2.4.3 External and Social Aspects (ENSA)

The execution of ISO 14001 is certainly determined to a great magnitude by external and social aspect comprising environmental regulation, market demand, and staff relation. Emergent stress from different ways are also driving some firms to apply the ISO 14000 trend. International and local firms

predominantly the high-profile ones, are likely to be developers in embracing EMS to boost the public appearance (Chin, 1999). Likewise, an organization dedicated to the environment is more expected to reinforce team spirit and create loyalty thus increase the organization's capability to invite high quality staff. Execution of ISO 14001 will be the best demo of such dedication.

2.4.4 Technical Aspects (TA)

The efficient execution of ISO 14001 in manufacturing and electronic sectors undoubtedly incorporating with technical aspects such as environmental expert aid, accessibility of monitoring and measuring tools, and the improved production method. There is a mutual difficulties in all the firms including lack of knowledge about pollution prevention, risk assessment and management (Chin, 1999). Therefore, there is a necessity for environmental expert aid to recognize and evaluating the technical matters from organization's process that may lead to substantial environmental effects. Specialists should improve and execute the proper actions to develop the environmental act in a practical manner as well as to comply with environmental regulation. In executing ISO 14001, organizations entail some consistent monitoring and measuring tools to track and record the operation that cause major effect on the environment.

2.5 Using AHP to Identify Critical Success Factor of ISO 14001 Implementation

AHP is utilize to find out the respective significance of certain projects. By applying a procedure to measure the weights of elements in each stage of the hierarchy that correspond to element on higher stage, an array based on project that are compare pairwise are build, to identify that one element which

influence other element corresponds to standard. The measurement are converted into standardize weights for each stage of hierarchy to produce variable of weights for whole hierarchy (Saaty, 1977). The variable estimate correspond priorities in lowest stage in order to achieve the goal of hierarchy. The respective priorities weights ensure the resources are equally distribute in lower stage of hierarchy.

Al Khalil (2002) utilized AHP to choose the best and suitable project delivery system as main project success element. Byun (2001) utilized the expanded form of AHP in choosing the choice of cars. The report engrossed on two matters as follow one integrate the pairwise comparison with a spreadsheet technique using a five point rating scale whereas the other put on group weights to consistency ratio. Tam and Tummala (2001) have utilized AHP in choosing the vendor of a telecommunication system which is composite and multi criteria decision making. They discover AHP as a very beneficial method that comprising some decision making with diverse contradictory purposes to reach at consent conclusion. The outcome of process is efficient and lessen the time to choose the vendor. For choosing quality programs, Noci and Toletti (2000) have applied AHP together with fuzzy method. Dong and Yu (2010) has choose the individual numerical scale and prioritization technique using the AHP and fuzzy linguistic method.

2.6 Benefits Gained from the ISO 14001 Implementation

The first benefits gained from ISO 14001 implementation is help to improve the company's image and reputation (ICRI). Compliance to the principles fixed by ISO 14001 has assist the firm to develop feature of

products and services by emphasizing on environmental friendly process and enhance efficiency of performance by minimize harm to the environment. These elements help to increase the status and appearance of organization as well as to gain a competitive advantage (Sambasivan & Fei, 2008).

Second benefit gained from ISO 14001 implementation is able to increase employee morale (IEM) which make the implementation much more easier to execute. From the starting of certification process, the workforce must involve in decision making process by increase their commitment and awareness level about environmental issues. This process can achieve through sharing the goals and prominence of standards as well as to encourage a good teamwork and gain confidence among the senior management and the workforces relations with full of dedication and worker liberation (Petroni, 2001).

Thirdly, the ISO implementation also helps the firms to gain profits and opportunity (GPO) to do with business with other corporations that certify with same standard. Some prominent corporations are using environmental force to enhance their operational productivity by inventing new products which are more eco- friendly and hence gain a competitive advantage in business world (Sambasivan & Fei, 2008). ISO 14001 can contribute to many environmental advantages such as reduce the input utilization, less waste removal charges, and enhancement in manufacture outcomes. Thus, the execution of ISO 14001 helps to increases the environmental efficiency in firm, gain interest as well as affords an innovative commercial chances as more states entail ISO 14001 standard as prerequisites to engage in the business world.

Lastly, benefits gained from ISO 14001 implementation has enhance the trust of customer (ETC) by providing eco- friendly products to the customer that environmental conscious. Execution of ISO 14001 delivers a powerful contents to consumer regarding the obligation of firm towards environmental protection practices as well as cleaner and safer production (Sambasivan & Fei, 2008). This without doubt will develop trustworthiness of consumer and boost confidence to the firm.

2.7 Effectiveness of ISO 14001 Implementation

Firms identify optimistic influence of the standard in nurturing environmental awareness, recognizing significant environmental aspects, and enhancing the compliance with legal requirements (Pesce & Marcomini, 2018). ISO 14001 can inspire the application of new sustainable commercial models and utilization of green technologies, develop environmental communication, decrease the emissions, saving more energy, and designing more environmental friendly products. Simultaneously, ISO 14001 can help to divert public attention towards environmental issues, develop a good quality of life for society and as well as lead to a cleaner environment (Pesce & Marcomini, 2018). The ISO 14001 is a proactive tool to improve the management of resources in the company. It also help firms to gain new opportunities such as new customers, decrease the legitimate risks and associated costs (overall costs of execution, and environmental taxation). The standard helps to provide the access to external financial sources and gain supports from government sector.

The standard leads to a better management of environmental problems and to better improvement in environmental performance of organization. Other strong point that relate are as follow (1) applicable to all industries, (2) the need to adopt a suitable indicators to improve the environmental performance, and (3) the existence of a third-party assessment to get the certification (Pesce & Marcomini, 2018). The ISO 14001 helps business in terms of technology advancement and enhance the resource management in firms, therefore allowing them to invest more in R&D fields.

Take part in the certification process leads to increase in sustainable act of companies and gain a competitive advantages as they helps to identify stakeholder concerns on triple-bottom-line questions. Finally, ISO 14001 is renowned by customers at national and international level (Pesce & Marcomini, 2018). The standard helps to foster strong relationships with customers and suppliers as well as increases the partnership and contribution among staffs. Besides, it helps to recover the reputation of the company and its social permit to operate. ISO 14001 also consider the interests of a company's stakeholders and encourage suppliers to adopt the environmental management processes along the supply chain.

CHAPTER 3

METHODOLOGY

3.1 Study Area

Malaysia's 'Pearl of the Orient' conveys a natural beauty and cultural splendor like no other place. The name comes from the Malay translation of betel nut which means 'pinang'. Every year, thousands of tourists come here to experience the unique cultural heritage and the beautiful scenery. It is also a very multiethnic city, and the second eventful state after Kuala Lumpur. Penang consists of a 285 square kilometres where the island connected via a 13 km bridge to an additional 760 square kilometre of mainland, known as Seberang Perai. Commercial and administrative activity is focused in the capital of Georgetown which is located on the northeast tip of the island. Whereas the temples and other historical sites are distributed in many places and the northern areas hides some attractive beaches. The study was conducted in Bayan Lepas area at Penang island and covered all companies along the Bayan Lepas Free Industrial Zone that certify with the ISO 14001 standards since the research help to evaluate about the elements that drive to success of ISO 14001 standards execution and its associated advantages in Pulau Pinang.



Figure 3.1: The study area showed the Pulau Pinang state map.
(Source: <https://www.google.com.my>).

RESEARCH FLOW

In the preliminary study, the issues and the problem was identified as well as the problem statement and research question was developed. The research objective was developed based on the research question. For data collection, a set of questionnaire was prepared where it divided into three parts such as respondent background, pairwise comparison between critical success factor and advantages. It also include the challenges faced during the ISO 14001 implementation. The data analysis was carried out using the analytical hierarchy process (AHP). AHP method comprise few stages where the first stage is the goal of ISO 14001 implementation and the second stage was belongs to critical success factor. The third stage contributed to sub element critical success factor whereas the fourth and fifth stage directed to advantages and effectiveness of implementation respectively. Lastly, report writing was done based on the result obtained from the AHP method.

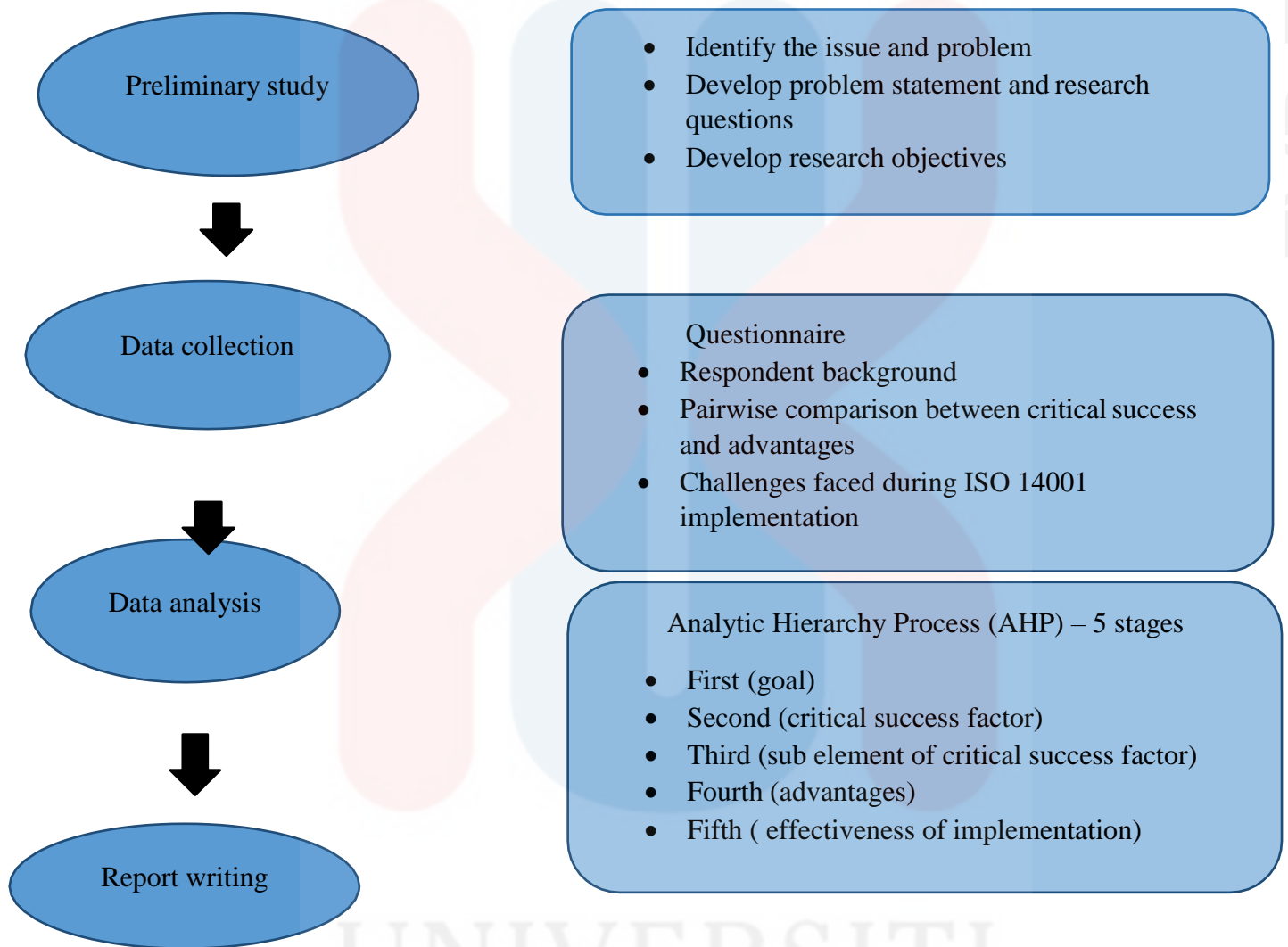


Figure 3.2 : The Research Flow

3.2 Data Collection

3.2.1 Sampling Method

The sampling technique used in this study is purposive sampling where non-probability sample are selected based on the objective of the study. The database of ISO 14001 certified industries in Pulau Pinang state is the sampling frame of the study. The main dominant industries in Penang state are from manufacturing and electronics background. There are total of 13 companies from both industries that is registered under certification body. The survey is conducted by distributing the questionnaire to all the employees of the respective industries that have knowledge and experience about EMS. Frequent calls are made to each industries to smoothen the process.

3.2.2 Research Instrument

The research tool utilized in this study is a questionnaire that contain details regarding respondent background and the pairwise comparison in individual hierarchy stage in AHP structure. The questionnaire is prepared by referring to previous research done by Pui and Hui (2001). The respondent background segment consists of two sections where the first section includes about the demographic features of respondent while the second section is about organization size, the time period after certification, different applicable system, consultant utilization in execution of ISO 14001, leading activity of firm and position. The pairwise comparison segments consist of respective significance of elements that drive to success and advantages.

Respondent are required to do pairwise comparison among four major elements that drive to success such as management approach , organizational change, external and social aspects and technical aspects and 14 sub elements such as top management commitment, environmental policy and objectives, management review, training and awareness, document control, emergency preparedness and response, market force, government regulations, customer demand, relationship between employee ,improve production, monitoring and measuring instruments and environmental aid expert as well as four advantages from ISO 14001 execution such as improve company image and reputation, improve employee morale, gain profit and opportunity and enhance customer trust. These response is converted into figures by applying the nine rating scale. Verbal communication is utilized while conducting the pairwise comparison. The last part of questionnaire consist of challenges that faced by the companies during the ISO 14001 implementation. These challenges is transformed into likert questions to evaluate the degree which respondents agree to specific challenges more.

3.3 Data Analysis

The AHP framework structure comprise of five stages and the model is identical with the structure project (Pun & Hui, 2001). The primary stage is the main objective of hierarchy which is the execution of ISO 14001. The secondary and tertiary stage involve elements that drive to success for ISO 14001 execution. Based on the prior framework, the elements that drive achievement to embrace ISO 14001 present in secondary and tertiary stages (Pun & Hui, 2001). The quaternary stage involves advantages from execution

of ISO 14001 while the last stage emphasize on the outcome either the execution is efficient or not. All the critical success factor are determined using the analytic hierarchy process method (AHP) to analyze the effectiveness of ISO 14001 implementation among the industries in Pulau Pinang. AHP method is used in this study because of the practical nature of technique which is appropriate to solve complex and intangible decision problem.

AHP comprise of four leading steps such as :

- 1) Construct the issue and design a model structure
- 2) Gather data based on pair wise comparison and quantified them
- 3) Estimate standardize priorities weights of each elements
- 4) Examine the priorities weights and problem solving.

In stage 1, the utmost significant part of AHP is where the analysis divide the problem of decision into hierarchy stage of interconnected decision factor (Saaty,1990). At the upper level of hierarchy situated the macro goal of the model such as ISO 14001 implementation. The lower level of hierarchy stage comprise features which reflect the quality of decision making (Zahedi,1986). The particulars of features will increase as going down the lower levels of the hierarchy. The ultimate level of hierarchy cover choices of decision such as effectiveness of ISO 14001 implementation among industries in Pulau Pinang.

In stage 2, the informations for the decision problem involves matrices of pairwise comparison of factors from third level that reflect to accomplish the goals of the second level. Pairwise comparison provide the evaluator a foundation to make choice by comparing two factors (Zahedi,1986). One practices hierarchy method to emphasis decision individually on each of some characteristics crucial to construct a comprehensive decision. The most efficient method to focus decision is by taking a pair of factors and compare them on particular characteristics without worry for other features or other factors. This explain why paired comparison with combination of hierarchical structure is beneficial in obtaining the measurement (Saaty,1990). The evaluator have the choice to utter selection between the two factors as equally preferred, weakly preferred, strongly preferred or absolutely preferred which would interpreted into pairwise weights of 1,3,5,7 and 9 respectively with 2,4,6 and 8 as intermediate values (Wind & Saaty,1980). The nine point scale was used in typical analytic hierarchy process are such as mentioned in the table below.

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Table 3.3: Nine point scale used in analytic hierarchy process with respective intensity of importance

Intensity of importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective.
3	Weak importance of one over another	Experience and judgment slightly favor one activity over another
5	Essential or strong importance	Experience and judgment strongly favor activity over another
7	Demonstrated importance	An activity is strongly favored and its dominance is demonstrated in practice
9	Absolute importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2,4,6,8	Intermediate values between two adjacent judgments	When compromise is needed

(Source : Wind & Saaty, 1980)

In stage 3, the key method of AHP consider the pairwise comparison to produce the relative weights of each factors at respective stage as output.

$$A = \begin{matrix} & \begin{matrix} 1 & 2 & \dots & n \end{matrix} \\ \begin{matrix} 1 \\ 2 \\ \vdots \\ n \end{matrix} & \begin{vmatrix} w_1/w_1 & w_1/w_2 & \dots & w_1/w_n \\ w_2/w_1 & w_2/w_2 & \dots & w_2/w_n \\ \vdots & \vdots & \ddots & \vdots \\ w_n/w_1 & w_n/w_2 & \dots & w_n/w_n \end{vmatrix} \end{matrix}$$

Matrix A have embraces the equation as follow $A \bullet W = n \bullet W$ where the $W = (w_1, w_2, \dots, w_n)$ is the vector of definite relative weights and n is the number of factors. In matrix algebra, n and W are termed as the eigenvalue and right eigenvector of matrix A . AHP suggests that the evaluator does not recognize W and hence is not able to do pairwise relative weights of matrix A with accurate. Therefore the matrix A have discrepancies (Zahedi, 1986). The approximation of W (denoted as \hat{W}) could be achieved from equation $\hat{A} \bullet \hat{W} = \lambda_{\max} \bullet \hat{W}$ where \hat{A} is the matrix of pairwise comparison and λ_{\max} is the main eigenvalue of \hat{A} and \hat{W} is the right eigenvector. The λ_{\max} is always larger than or equal to n . The closer the value of calculated λ_{\max} is to n , the more consistent are the values of \hat{A} . This characteristics has led to production of consistency index (CI) as $CI = (\lambda_{\max} - n) / (n - 1)$ and the consistency ratio (CR) as $CR = (CI / ACI) * 100$, where ACI is the average index of casually produced weights. According to the rule of thumb, a CR value of 10 percent or less is measured as acceptable value.

Stage 4 sums all relative weights of several stage level acquired from stage 3 to produce a vector of composite weights which denoted as rankings for decision choices to attain the main goal of decision problem (Zahedi,1986). The composite weight vector of elements at final stage (denoted as k) with respect to that first stage may calculated from $C [1,k] = \prod_{i=2}^k B_i$, $i = 2$ where $C[1.k]$ is the vector of composite weights of factors at level k with respect to factors on first level and B is the n_{i-1} by n_i matrix with rows comprising of estimated \hat{W} vectors. The n_i denote the number of factors at level i and is the similar as n but to display that it refers to level i. The combination of relative weights of factors at the lower stage of hierarchy with respect to main goal of decision on first level are termed as decision choices to form base for choosing an alternative choice.

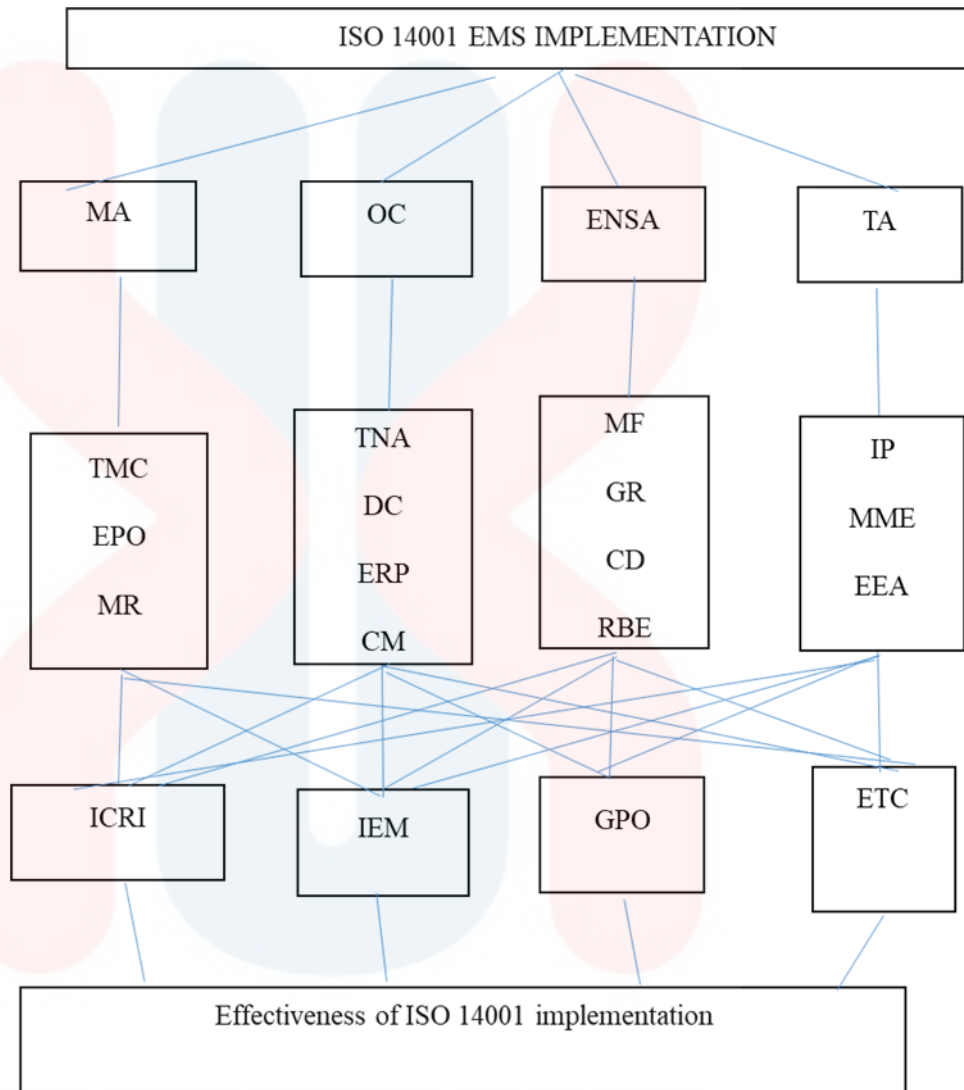


Figure 3.3 : Proposed critical success factor and benefits model of ISO 14001 implementation.

(Sambasivan & Fei, 2008).

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Profile of the Respondents

From the questionnaires distributed, about 85% of respondent has replied to questionnaires all from manufacturing and electronic sector. 19% and 15% from the total respondents who responds the questionnaire are male and female respectively. The range for age group of total respondents who respond the questionnaire divide into 3 categories such as 20-30 years (41%), 31-40 years (21%) and 41-60 years (91%) respectively. The educational level falls into four categories such as high secondary schools (9%), diploma (12%), degree (74%) and others such as primary schools (6%) respectively. The questionnaires were filled in by 'manager'(21%) or 'assistant manager'(12%) or 'supervisor'(18%) or 'engineer'(50%). About 94% of the respondent have been certified for more than five years. The companies also reported that they practiced other quality system such as OHSAS 18001 (32%) and MS 9001 (26%) besides ISO 14001 and about 85% of the companies applied for ISO 14001 from international certified body.

Table 4.1 : The Profile of Respondent

Demographic Features	F (%)
Types of industries 1) Food & beverages 2) Manufacturing 3) Cottage & crafts 4) Others	0 (0) 31 (91) 0 (0) 3 (9)
Gender 1) Male 2) Female	19 (56) 15 (44)
Age group (years) 1) 20-30 2) 31-40 3) 41-60 4) > 60 years	14 (41) 7 (21) 13 (91) 0 (0)
Educational level 1) High secondary schools 2) Diploma 3) Degree 4) Others	3 (9) 4 (12) 25 (74) 2 (6)
Position 1) Manager 2) Assistant manager 3) Supervisor 4) Others	7 (21) 4 (12) 6 (18) 17 (50)
Quality system applied 1) MS 9001 2) ISO 14001 3) MS 9001 & ISO 14001 4) MS 9001 & ISO 14001 & others	0 (0) 14 (41) 9 (26) 11 (32)
Number of years since ISO 14001 certification 1) < 5 years 2) > 5 years	2 (6) 32 (94)
Types of certified body applied for ISO 14001 (EMS) 1) National certified body 2) International certified body	5 (15) 29 (85)

4.2 Challenges from ISO 14001 Implementation

About 85% of respondents was agreed with the statement that more time and resource consumption is needed to execute the standard and about 21% of respondent was agreed with the statement lack of appropriate information about the certification has further delayed the process. While only 32% of respondent was disagreed about the statement that it is just an additional certification driven process for authority to approve the ISO 14001 implementation and about 3% of respondent was disagreed with the statement more time and resource consumption is needed to execute the standard. Approximately 50% of respondent being neutral with the statement that lack of appropriate information about the certification has further delayed the process while only about 12% of respondent being neutral with statement that more time and resource consumption is needed to execute the standard.

Table 4.2: The challenges faced during ISO 14001 implementation

<div>Ranking</div> <div>Challenges</div>	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	F (%)	F (%)	F (%)	F (%)	F (%)
Dissatisfaction of staff on more responsibilities	0(0)	10 (29)	8 (24)	14 (41)	2 (6)
Hesitation to give time and resource by management	0(0)	7 (21)	9 (26)	14 (41)	4(12)
Increase bureaucracy and demand for more Certification	0(0)	3 (9)	10 (29)	19 (56)	2(6)
High set up cost and operation cost	0(0)	0(0)	12(35)	17(50)	5(15)

More time and resource consumption	0(0)	1(3)	4(12)	17(50)	12 (35)
High maintenance and improvement cost for long Term	0(0)	2(6)	7(21)	19(56)	6(18)
Deficiency of skilled staffs	0(0)	5(15)	8(24)	17(50)	4(12)
Lack of appropriate information about the Certification	1(3)	9(26)	17(50)	5(15)	2(6)
Additional certification driven process for authority to Approve	0(0)	11(32)	12(35)	9(26)	2(6)

4.3 Benefits from ISO 14001 Implementation

The standardised marks at stage three specify the relative significance of advantages in ISO 14001 implementation. The order of rank of advantages is as follows: ICRI (0.2602), ECT (0.2546), GPO (0.245) and IEM (0.2402). The standardised marks at stage four show the relation for effectiveness of ISO 14001 implementation in terms of several advantages. The order for effectiveness is the same as the order of rank for advantages as well. Based on these marks and priority weights at other stages, the overall effectiveness of ISO 14001 implementation is 0.25.

Table 4.3: The benefits gained from ISO 14001 implementation

	ICRI	IEM	GPO	ECT	PW
ICRI	0.2256	0.2883	0.27	0.2567	0.26015
IEM	0.2672	0.2434	0.2094	0.2408	0.2402
GPO	0.2555	0.2137	0.2385	0.2723	0.245
ECT	0.2516	0.2546	0.2821	0.2302	0.254625

4.4 Critical Success Factors from ISO 14001 Implementation

The significant stage in AHP is constructing multiple pairwise comparison for normalization. The main concern in this comparison method is the consistency of pairwise decision delivered by the respondent. AHP offers a measure of consistency for the pairwise comparison by computing the consistency ratio. The consistency ratio of different element are specified in Table 4.4. Therefore it is clear that the consistency ratio for total elements are within the acceptable limits which is less than 0.10 so the matrices are reasonably consistent and can continue with process of decision making using AHP method. If the value of consistency ratio is 10% or less then the consistency can be accepted.

Based on the normalized priority weight at stage one, MA (priority weight = 0.2694) is found to be the most critical success element while the least important is TA (priority weight = 0.2373). The priority weights of the critical success elements show their relative prominence in the ISO 14001 implementation. The order of rank for critical success elements is as follow: MA (0.2694), OC (0.2477), ENSA (0.2457) and TA (0.2373).

The standardised marks at stage two show the relative importance of sub elements under the critical success element at stage one. Under MA, the order of rank for sub elements is as follow: EPO (0.0803), TMC (0.076) and MR (0.0725). Under OC, the order of rank of sub elements is as follows: TNA (0.0712), CM (0.0682), ERP (0.0674) and DC (0.0653). Under ENSA, the order of rank of sub elements is as follow: MF (0.0736), RBE (0.0735), CD (0.0714) and GR (0.0672). Under TA, the order of rank of sub elements is as follow: EEA (0.0724), IP (0.0718) and MME (0.0693). The global priority weights for each of the elements are specified in Table 4.4.2 where it can be seen evidently that the top most five elements comparative to the goal are as follow: EPO (0.0057), TMC (0.0054), MF (0.0053), RBE (0.0053) and MR (0.0052).

Table 4.4: The consistency ratios for various factors

Factors	Success factor	Consistency ratio
Main critical success	MA OC ENSA TA	0.1068
MA	TMC EPO MR	0.0647
OC	TNA DC ERP CM	0.0618
ENSA	MF GR CD RBE	0.0934
TA	IP MME EEA	0.0852

Table 4.4.1 : The priority weights for main critical success factor

MA	OC	ENSA	TA	PRIORITY		
WEIGHTS						
MA		0.2177	0.3102	0.2883	0.2614	0.2694
OC		0.2873	0.2351	0.2297	0.2385	0.2477
ENSA		0.2642	0.2273	0.2376	0.2536	0.2457
TA		0.2308	0.2274	0.2444	0.2465	0.2373

Table 4.4.2 : The global priority weights of sub factors relative to the goal

<i>Ranking</i>	<i>Success factor</i>	<i>Priority weights</i>	<i>global priority weights</i>
1	EPO	0.0803	0.0057
2	TMC	0.076	0.0054
3	MF	0.0736	0.0053
4	RBE	0.0735	0.0053
5	MR	0.0725	0.0052
6	EEA	0.0724	0.0052
7	TNA	0.0712	0.0051
8	CD	0.0712	0.0051
9	IP	0.0718	0.0051
10	MME	0.0693	0.005
11	CM	0.0682	0.0049
12	ERP	0.0674	0.0048
13	GR	0.0672	0.0048
14	DC	0.0653	0.0047

DISCUSSION

About the 32% of respondent disagree with the statement that ISO 14001 standard was just an additional certification driven process for authority to approve. This was due to most companies were aware of the importance and benefits that gained from execution of standard. Execution of ISO 14001 enable them to improve their company image as well as enhance the production level. Certification drives a clear hint to consumers and government that the certified firm was dedicated to improve the environmental performance (Waxin,2019). Previous studies initiated that primary adopters of ISO 14001 in the USA became certified to develop firm appearance and strengthen their current environmental policies instead of increase their environmental act (Waxin,2019).

50% of respondent being neutral with the statement that lack of appropriate information about the certification can delay the execution process. This was due to not many research were done about the certification process as well as some companies that executed the standard questions the effectiveness of the standard. Besides, the benefits gained from implementation were not clearly defined by the prior studies. ISO 14001 offers only common values for environmental aspect assessment (EEA) while the assessment norms generally was imprecise and insufficient hence cannot be thoroughly improved (Waxin,2019).

Almost 56% of respondent agree with the statement that increase bureaucracy and demand for more certification can prevent the implementation of ISO 14001 standard. These was because ISO 14001 certification urge the companies that applied this standard to follow the proper procedures to improve the environmental performance. Moreover, the high maintenance and improvement cost for long term has trigger the companies to reconsider the implementation of standard. The big companies who have a lot of money have no problem to implement the standard but some companies that not financially stable have to think twice before take the action as they have to pay large amount at last. Great costs of certification comprise the period and

costs related with documentation preparation and training of staffs as well as the prices for internal and external auditors (Waxin,2019).

From the weights attained at stage three, it can be summarized that the most important advantages from ISO 14001 execution is to develop the reputation and image of company. The dedication of firm to environmental protection boost the image of firm in the eyes of consumers and suppliers (Sambasivan,2008). The stress to recover image of firm helps to modify the operations, increase the efficiency and product feature.

The second most important advantage from ISO 14001 execution is to improve the consumer faithfulness and trust. Consumers are becoming gradually aware about the environmental protection and choose the suppliers with good environmental track record (Sambasivan,2008). The ISO 14001 standard helps to develop the trust in consumer as well as maintain the faithfulness of consumer towards the firm.

The third most important advantage is to gain profit and new business opportunities with other firms. The modification in operations helps to reduce harmful discharge, decrease waste generation and prevent the occurrence of environmental mishaps (Sambasivan,2008). These helps to reduce the expenses and gain profit through less raw material and energy consumption as well as lower waste disposal charges.

The last of the most important advantages in ISO 14001 execution is improve the staff morale and motivation. Awareness and dedication about environmental matters helps to enhance the morale of workforces and encourage them to be more accountable towards environment (Sambasivan,2008). A highly motivated worker is expected to work together with management and this develops the manager and worker relation. Overall effectiveness mark showed companies in Pulau Pinang implemented the ISO 14001 certification because they want to enhance the firm 's image , increase business opportunities as well as to increase the morale and motivation of workforce which in turn will boost the consumer loyalty towards the firms.

From the priority weights achieved at stage one and two, it can be summarised that the most important of the critical success element is the management approach. ISO 14001 standard put much pressure on the dedication and support from top management for effective implementation of these quality standard (Sambasivan,2008). The dedication of management begin from the design of environmental plan and the act of conveying the message to all staffs.

The second most critical success element is organizational change. An effective execution of ISO 14001 demand alterations within an organization with clearly defined tasks and the capability of organization to react to emergency condition such as environmental mishaps (Sambasivan,2008). These involve proper training and an increase in the consciousness level of workforces about the environment.

The third most important critical success elements is external and social aspects that encourage the ISO 14001 execution (Sambasivan,2008). The growing stress from consumers and other stakeholders to firms to prove their dedication towards environment and ISO 14001 certification is simply the best answer for the question arise as indication for such dedication. The standard also assists the firm to do business in the global market.

The last critical success element is technical aspects in ISO 14001 execution. The manufacturing procedure must be improved with suitable equipment and techniques so that the whole process become more environmental friendly (Sambasivan,2008). Nevertheless, regular monitoring needs to be done by using suitable monitoring and measuring equipment. Several firms do not have the knowledge to design and implement the EMS so the support from an environmental expert is necessary in ISO 14001 execution.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

A multi attribute estimation technique, AHP has been offered to help one to recognize the elements and sub elements that critical to the effective execution of ISO 14001 and advantages that reaped from the execution. The research model recommended in this study offers a methodology to analyse and recognize the critical success element and advantages due to ISO 14001 execution. Even though the study was done in manufacturing and electronics sector in Pulau Pinang but the proposed research model can be utilized in other sector as well.

The findings of this empirical study specify which elements an organization should ponder for effective execution of ISO 14001. All worker must be provided with proper training and increase the awareness level about the environmental issues. Suitable equipment to monitor the standard and technical skills must be offered within the organization to certify the continuous improvement in environmental management. The advantages gained from the execution are enhancement in company image and reputation, upgrading the efficiency of process, improvement in consumer faithfulness and trust as well as increase the staff morale and relation between the management team and the workforce.

5.2 Recommendations for the Research

This research has limitation of study due to the small sample size. Since there is less companies that certified under ISO 14001 standard in targeted location at the time of data collection, the data collection was limited with only 34 respondent which is fewer than recommended minimum for data analysis. Future studies with large number of sample will allow better generalization of results.

Another limitation of study is the research focused only one type of quality system such as ISO 14001 standard. The research scope was limited to the companies that certified under ISO 14001 standard only. Despite the advantage gained can be surveyed with questionnaire but it raise the questions regarding the management system. Future research could address this problem by designing a questionnaire about effectiveness with and without ISO 14001 certification. This would help to understand the strategies under different approach to environmental management system.

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APPENDIX A

Step 1: calculating the sum of values for each column.

Main Critical Success Factor

	MA	OC	ENSA	TA
MA	1	1.3195	1.2136	1.0604
OC	1.3195	1	0.9669	0.9674
ENSA	1.2136	0.9669	1	1.029
TA	1.0604	0.9674	1.029	1
Sum	4.5935	4.2538	4.2095	4.0568

Sub Critical Success Factor

	TMC	EPO	MR	TNA	DC	ERP	CM	MF	GR	CD	RBE	IP	MME	EEA
TMC	1	1.2114	1.1721	1.3756	1.0965	1.0666	1.1166	1.0415	1.1841	1.1805	1.0158	0.9536	0.9577	1.0122
EPO	1.2114	1	1.1894	1.3761	1.1589	1.1326	1.3974	1.0619	1.1924	1.2552	1.0918	1.1619	0.945	1.0447
MR	1.1721	1.1894	1	1.1092	0.9498	1.0686	1.0062	1.0852	0.9257	1.0966	0.9352	1.0486	1.0214	1.1002
TNA	1.3756	1.3761	1.1092	1	0.9198	1.0557	0.9295	0.9213	0.9908	0.8929	0.8634	1.0426	0.9423	1.0545
DC	1.0965	1.1589	0.9498	0.9198	1	0.8928	0.9274	0.9964	0.8527	0.8636	0.9018	0.8878	0.8423	0.9624
ERP	1.0666	1.1326	1.0686	1.0557	0.8928	1	0.9327	0.9178	0.9085	0.959	0.9423	0.9559	0.9026	0.9346
CM	1.1166	1.3974	1.0062	0.9295	0.9274	0.9327	1	0.9539	0.8542	0.8835	0.928	0.9559	0.9223	1.0689
MF	1.0415	1.0619	1.0852	0.9213	0.9964	0.9178	0.9539	1	0.9189	1.1602	1.4597	1.0463	1.2134	1.1429
GR	1.1841	1.1924	0.9257	0.9908	0.8527	0.9085	0.8542	0.9189	1	0.9694	0.9356	0.9671	0.9359	1.009
CD	1.1805	1.2552	1.0966	0.8929	0.8636	0.959	0.8835	1.1602	0.9694	1	1.0501	1.081	1.0807	1.0315
RBE	1.0158	1.0918	0.9352	0.8634	0.9018	0.9423	0.928	1.4597	0.9356	1.0501	1	1.2903	1.1373	1.3709
IP	0.9536	1.1619	1.0486	1.0426	0.8878	0.9559	0.9559	1.0463	0.9671	1.081	1.2903	1	1.194	0.9855
MME	0.9577	0.945	1.0214	0.9423	0.8423	0.9026	0.9223	1.2134	0.9359	1.0807	1.1373	1.194	1	0.9662
EEA	1.0122	1.0447	1.1002	1.0545	0.9624	0.9346	1.0689	1.1429	1.009	1.0315	1.3709	0.9855	0.9662	1
Sum	15.3842	16.2187	14.7082	14.4737	13.2522	13.6697	13.8765	14.9194	13.6443	14.5042	14.9222	14.5705	14.0611	14.6835

Benefits

	ICRI	IEM	GPO	ECT
ICRI	1	1.1844	1.1324	1.1151
IEM	1.1844	1	0.878	1.046
GPO	1.1324	0.878	1	1.1831
ECT	1.1151	1.046	1.1831	1
Sum	4.4319	4.1084	4.1935	4.3442

Step 2 : All the elements in column are divided by the sum of the column. Priority weights are calculated by averaging all the elements in the row and divided with the number of the criteria.

Main Critical Success Factor

	MA	OC	ENSA	TA	PW
MA	0.2177	0.3102	0.2883	0.2614	0.2694
OC	0.2873	0.2351	0.2297	0.2385	0.2477
ENSA	0.2642	0.2273	0.2376	0.2536	0.2457
TA	0.2308	0.2274	0.2444	0.2465	0.2373

Sub Critical Success Factor

	TMC	EPO	MR	TNA	DC	ERP	CM	MF	GR	CD	RBE	IP	MME	EEA	PW
TMC	0.065	0.0747	0.0797	0.095	0.0827	0.078	0.0805	0.0698	0.0868	0.0814	0.0681	0.0654	0.0681	0.0689	0.076007
EPO	0.0787	0.0617	0.0809	0.0951	0.0874	0.0829	0.1007	0.0712	0.0874	0.0865	0.0732	0.0797	0.0672	0.0711	0.080264
MR	0.0762	0.0733	0.068	0.0766	0.0717	0.0782	0.0725	0.0727	0.0678	0.0756	0.0627	0.072	0.0726	0.0749	0.072486
TNA	0.0894	0.0848	0.0754	0.0691	0.0694	0.0772	0.067	0.0618	0.0726	0.0616	0.0579	0.0716	0.067	0.0718	0.071186
DC	0.0713	0.0715	0.0646	0.0635	0.0755	0.0653	0.0668	0.0668	0.0625	0.0595	0.0604	0.0609	0.0599	0.0655	0.065286
ERP	0.0693	0.07	0.0727	0.0729	0.0674	0.0732	0.0672	0.0615	0.0666	0.0661	0.0631	0.0656	0.0642	0.0636	0.067386
CM	0.0726	0.0862	0.0684	0.0642	0.07	0.0682	0.0721	0.0639	0.0626	0.0609	0.0622	0.0656	0.0656	0.0728	0.068236
MF	0.0677	0.0655	0.0738	0.0637	0.0752	0.0671	0.0687	0.067	0.0674	0.08	0.0978	0.0718	0.0863	0.0778	0.073557
GR	0.077	0.0735	0.0629	0.0685	0.0643	0.0665	0.0616	0.0616	0.0733	0.0668	0.0627	0.0664	0.0666	0.0687	0.067171
CD	0.0767	0.0774	0.0746	0.0617	0.0652	0.0702	0.0637	0.0778	0.071	0.0689	0.0704	0.0742	0.0769	0.0702	0.07135
RBE	0.066	0.0673	0.0636	0.0597	0.068	0.069	0.0669	0.0978	0.0686	0.0724	0.067	0.0886	0.0809	0.0934	0.073514
IP	0.062	0.0716	0.0713	0.072	0.067	0.07	0.0689	0.0701	0.0709	0.0745	0.0865	0.0686	0.0849	0.0671	0.071814
MME	0.0623	0.0583	0.0694	0.0651	0.0636	0.066	0.0665	0.0813	0.0686	0.0745	0.0762	0.0819	0.0711	0.0658	0.069329
EEA	0.0658	0.0644	0.0748	0.0729	0.0726	0.0684	0.077	0.0767	0.074	0.0711	0.0919	0.0676	0.0687	0.0681	0.072429

Benefits

	ICRI	IEM	GPO	ECT	PW
ICRI	0.2256	0.2883	0.27	0.2567	0.26015
IEM	0.2672	0.2434	0.2094	0.2408	0.2402
GPO	0.2555	0.2137	0.2385	0.2723	0.245
ECT	0.2516	0.2546	0.2821	0.2302	0.254625

Step 3: calculating the consistency ratio by multiply the each value in the column with priority weights. The weighted sum value is calculated by taking sum of each value in a row. The ratio is calculated by dividing the weighted sum value with priority weights. λ max is calculated by taking the average each ratio values.

The consistency index are calculated based on the formula given below.

$$\text{Consistency Index (C.I.)} = \frac{\lambda \text{ max} - n}{n - 1}$$

Consistency ratio is calculated by dividing the consistency index with random index. The value for the random index can be refer by using the table below.

Number of elements (n)	R.I.
3	0.52
4	0.89
5	1.11
6	1.25
7	1.35
8	1.40
9	1.45
10	1.49
11	1.51
12	1.54
13	1.56
14	1.57
15	1.58

Main Critical Success Factor

	MA	OC	ENSA	TA	WSV	PW	λ_{\max}	C.I	C.R
MA	0.2694	0.3268	0.2982	0.2516	1.146	0.2694	4.2539	0.0961	0.1068
OC	0.3555	0.2477	0.2376	0.2296	1.0704	0.2477	4.3214		
ENSA	0.3269	0.2395	0.2457	0.2442	1.0563	0.2457	4.2991		
TA	0.2857	0.2396	0.2528	0.2373	1.0154	0.2373	4.279		
							4.2884		

Sub Critical Success Factor

	TMC	EPO	MR	TNA	DC	ERP	CM	MF	GR	CD	RBE	IP	MME	EEA	WSV	PW	λ_{max}	C.I	C.R
TMC	0.076	0.0973	0.085	0.0979	0.0716	0.0719	0.0762	0.0767	0.0796	0.0843	0.0747	0.0685	0.0664	0.0733	1.0994	0.076	14.4658	0.0411	0.0262
EPO	0.0921	0.0803	0.0862	0.098	0.0757	0.0763	0.0953	0.0782	0.0801	0.0896	0.0802	0.0834	0.0655	0.0756	1.1565	0.0803	14.4022		
MR	0.0891	0.0955	0.0725	0.079	0.062	0.072	0.0686	0.0799	0.0622	0.0783	0.0687	0.0753	0.0708	0.0797	1.0536	0.0725	14.5324		
TNA	0.1045	0.1105	0.0804	0.0712	0.0601	0.0712	0.0634	0.0678	0.0666	0.0638	0.0635	0.0749	0.0653	0.0763	1.0395	0.0712	14.5997		
DC	0.0833	0.0931	0.0689	0.0655	0.0653	0.0602	0.0632	0.0733	0.0573	0.0617	0.0663	0.0637	0.0584	0.0697	0.9499	0.0653	14.5467		
ERP	0.0811	0.0909	0.0775	0.0752	0.0583	0.0674	0.0636	0.0676	0.0611	0.0685	0.0693	0.0686	0.0626	0.0677	0.9794	0.0674	14.5312		
CM	0.0849	0.1122	0.0729	0.0662	0.0606	0.0629	0.0682	0.0702	0.0574	0.0631	0.0682	0.0686	0.0639	0.0774	0.9967	0.0682	14.6144		
MF	0.0792	0.0853	0.0787	0.0656	0.0651	0.0619	0.0651	0.0736	0.0618	0.0828	0.1073	0.0751	0.0841	0.0827	1.0683	0.0736	14.5149		
GR	0.09	0.0957	0.0671	0.0705	0.0557	0.0612	0.0583	0.0676	0.0672	0.0692	0.0688	0.0694	0.0649	0.0731	0.9787	0.0672	14.564		
CD	0.0897	0.1008	0.0795	0.0636	0.0564	0.0646	0.0603	0.0854	0.0651	0.0714	0.0772	0.0776	0.0749	0.0747	1.0412	0.0714	14.5826		
RBE	0.0772	0.0877	0.0678	0.0615	0.0589	0.0635	0.0633	0.1074	0.0629	0.075	0.0735	0.0926	0.0788	0.0993	1.0694	0.0735	14.5497		
IP	0.0725	0.0933	0.076	0.0742	0.058	0.0644	0.0652	0.077	0.065	0.0772	0.0948	0.0718	0.0827	0.0714	1.0435	0.0718	14.5334		
MME	0.0728	0.0759	0.0741	0.0671	0.055	0.0608	0.0629	0.0893	0.0629	0.0772	0.0836	0.0857	0.0693	0.07	1.0066	0.0693	14.5253		
EEA	0.077	0.0839	0.0798	0.0751	0.0628	0.063	0.0729	0.0841	0.0678	0.0736	0.1008	0.0708	0.067	0.0724	1.051	0.0724	14.5166		
																	14.53421		

Benefits

	ICRI	IEM	GPO	ECT	WSV	PW	λ_{max}	C.I	C.R
ICRI	0.2602	0.2845	0.2774	0.2839	1.106	0.2602	4.2506	0.0913	0.1014
IEM	0.3082	0.2402	0.2151	0.2663	1.0298	0.2402	4.2873		
GPO	0.2947	0.2109	0.245	0.3012	1.0518	0.245	4.2931		
ECT	0.2901	0.2512	0.2899	0.2546	1.0858	0.2546	4.2647		
							4.273925		



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EVALUATION OF CRITICAL SUCCESS FACTOR IN ISO 14001 IMPLEMENTATION AMONG INDUSTRIES IN PULAU PINANG

Please provide the following demographic information for analysis purposes. **(Place an √ on the squares to give your answers).**

- 1) Type of industries : ☐ Food & Beverages ☐ Cottage & Crafts
☐ Manufacturing ☐ Others : _____
- 2) Gender : ☐ male ☐ female
- 3) Age group : ☐ 20-30 years ☐ 31-40 years ☐ 41-60 years ☐ > 60 years
- 4) Educational level : ☐ High secondary schools
☐ Diploma
☐ Degree
☐ Others : _____
- 5) Position : ☐ Manager ☐ Asst. Manager ☐ Supervisor ☐ Others : _____

(For this question, you may tick (√) more than one)

- 6) Quality system applied : ☐ MS 9001 ☐ ISO 14001 ☐ Others : _____
- 7) Number of years since ISO 14001 certification : ☐ < 5 years ☐ > 5 years
- 8) Types of certified body applied for ISO 14001 (EMS):
☐ National certified body ☐ International certified body

Please rank the following in order of importance from 1 to 9 where 1 is equal importance and 9 is extreme importance to you. Please circle your answer.

Intensity of importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective.
3	Weak importance of one over another	Experience and judgment slightly favor one activity over another
5	Essential or strong importance	Experience and judgment strongly favor activity over another
7	Demonstrated importance	An activity is strongly favored and its dominance is demonstrated in practice
9	Absolute importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2,4,6,8	Intermediate values between two adjacent judgments	When compromise is needed

PAIRWISE COMPARISON BETWEEN MAIN CRITICAL SUCCESS FACTOR IN ISO 14001 IMPLEMENTATION

Main critical success factor	Intensity of importance																		Main critical success factor
Management approach (MA) -actively participate in development of policy	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Organizational change (OC) - restructuring the organization	
Management approach (MA)- actively participate in development of policy	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	External and social aspects (ENSA)- consist of environmental legislation, customer demand and market force	
Management approach (MA)- actively participate in development of policy	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Technical aspects (TA)- consist of monitoring and measuring equipment and improvement in production	
Organizational change (OC) -restructuring the organization	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	External and social aspects (ENSA)- consist of environmental legislation, customer demand and market force	
Organizational change (OC) -restructuring the organization	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Technical aspects (TA)- consist of monitoring and measuring equipment and improvement in production	
External and social aspects (ENSA)-consist of environmental legislation, customer demand and market force	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Technical aspects (TA)- consist of monitoring and measuring equipment and improvement in production	

PAIRWISE COMPARISON BETWEEN SUB CRITICAL SUCCESS FACTOR IN ISO 14001 IMPLEMENTATION

Sub critical success factor	Intensity of importance																		Sub critical success factor
Top management commitment (TMC)-give full support and commitment to organization	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Environmental policy and objective (EPO)-help to organization to set environmental objective and targets	
Top management commitment (TMC)-give full support and commitment to organization	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Management review (MR)- to ensure the system is suitable, adequate and effective	
Top management commitment (TMC)-give full support and commitment to organization	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Training and awareness (TNA)-increase training and awareness	
Top management commitment (TMC)-give full support and commitment to organization	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Documentation and control (DC)-procedure to control all EMS documents	
Top management commitment (TMC)-give full support and commitment to organization	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Emergency response and preparedness (ERP)-procedure to responds to accidents and emergency situations	
Top management commitment (TMC)-give full support and commitment to organization	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Communication(CM)-procedure for both internal and external communication	
Top management commitment (TMC)-give full support and commitment to organization	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Market force (MF)-companies demand ISO 14001 to do business with them	
Top management commitment (TMC)-give full support and commitment to organization	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Government regulations (GR)-strict laws to punish offenders	
Top management commitment (TMC)-give full support and	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer demand (CD)-customer want	

commitment to organization																		eco-friendly products
Top management commitment (TMC)-give full support and commitment to organization	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Relations between employee (RBE)- help to encourage loyalty and motivation in staff
Top management commitment (TMC)-give full support and commitment to organization	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Improve production (IP)- implement action to improve environmental performance
Top management commitment (TMC)-give full support and commitment to organization	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Monitoring and measuring equipment (MME)- monitor and measure all activities that cause impact on environment
Top management commitment (TMC)-give full support and commitment to organization	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Environmental expert aid (EEA)-to assess technical issue in operation

Sub critical success factor	Intensity of importance																	Sub critical success factor
Environmental policy and objective (EPO)-help to organization to set environmental objective and targets	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Management review (MR)- to ensure the system is suitable, adequate and effective
Environmental policy and objective (EPO)-help to organization to set environmental objective and targets	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Training and awareness (TNA)-increase training and awareness
Environmental policy and objective (EPO)-help to organization to set environmental objective and targets	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Documentation and control (DC)-procedure to control all EMS documents
Environmental policy and objective (EPO)-help to organization to set environmental objective and targets	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Emergency response and preparedness (ERP)-procedure to responds to accidents and emergency situations

Environmental policy and objective (EPO)-help to organization to set environmental objective and targets	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Communication(CM)-procedure for both internal and external communication
Environmental policy and objective (EPO)-help to organization to set environmental objective and targets	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Market force (MF)-companies demand ISO 14001 to do business with them
Environmental policy and objective (EPO)-help to organization to set environmental objective and targets	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Government regulations (GR)-strict laws to punish offenders
Environmental policy and objective (EPO)-help to organization to set environmental objective and targets	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer demand (CD)-customer want eco-friendly products
Environmental policy and objective (EPO)-help to organization to set environmental objective and targets	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Relations between employee (RBE)- help to encourage loyalty and motivation in staff
Environmental policy and objective (EPO)-help to organization to set environmental objective and targets	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Improve production (IP)- implement action to improve environmental performance
Environmental policy and objective (EPO)-help to organization to set environmental objective and targets	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Monitoring and measuring equipment (MME)- monitor and measure all activities that cause impact on environment
Environmental policy and objective (EPO)-help to organization to set environmental objective and targets	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Environmental expert aid (EEA)-to assess technical issue in operation

Sub critical success factor	Intensity of importance																		Sub critical success factor
Management review (MR)- to ensure the system is suitable, adequate and effective	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Training and awareness (TNA)-increase training and awareness	
Management review (MR)- to ensure the system is suitable, adequate and effective	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Documentation and control (DC)-procedure to control all EMS documents	
Management review (MR)- to ensure the system is suitable, adequate and effective	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Emergency response and preparedness (ERP)-procedure to responds to accidents and emergency situations	
Management review (MR)- to ensure the system is suitable, adequate and effective	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Communication(CM)-procedure for both internal and external communication	
Management review (MR)- to ensure the system is suitable, adequate and effective	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Market force (MF)-companies demand ISO 14001 to do business with them	
Management review (MR)- to ensure the system is suitable, adequate and effective	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Government regulations (GR)-strict laws to punish offenders	
Management review (MR)- to ensure the system is suitable, adequate and effective	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer demand (CD)-customer want eco-friendly products	
Management review (MR)- to ensure the system is suitable, adequate and effective	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Relations between employee (RBE)- help to encourage loyalty and motivation in staff	
Management review (MR)- to ensure the system is suitable, adequate and effective	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Improve production (IP)- implement action to improve environmental performance	

Management review (MR)- to ensure the system is suitable, adequate and effective	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Monitoring and measuring equipment (MME)- monitor and measure all activities that cause impact on environment
Management review (MR)- to ensure the system is suitable, adequate and effective	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Environmental expert aid (EEA)-to assess technical issue in operation

[illegible]

awareness (TNA)- increase training and awareness	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	(IP)- implement action to improve environmental performance
Training and awareness (TNA)- increase training and awareness	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Monitoring and measuring equipment (MME)- monitor and measure all activities that cause impact on environment
Training and awareness (TNA)- increase training and awareness	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Environmental expert aid (EEA)-to assess technical issue in operation

Sub critical success factor	Intensity of importance																	Sub critical success factor
Documentation and control (DC)- procedure to control all EMS documents	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Emergency response and preparedness (ERP)-procedure to responds to accidents and emergency situations
Documentation and control (DC)- procedure to control all EMS documents	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Communication(CM)- procedure for both internal and external communication
Documentation and control (DC)- procedure to control all EMS documents	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Market force (MF)- companies demand ISO 14001 to do business with them
Documentation and control (DC)- procedure to control all EMS documents	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Government regulations (GR)- strict laws to punish offenders
Documentation and control (DC)- procedure to control all EMS documents	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer demand (CD)-customer want eco-friendly products
Documentation and control (DC)- procedure to control all EMS documents	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Relations between employee (RBE)- help to encourage loyalty and motivation in staff

Documentation and control (DC)-procedure to control all EMS documents	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Improve production (IP)- implement action to improve environmental performance
Documentation and control (DC)-procedure to control all EMS documents	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Monitoring and measuring equipment (MME)- monitor and measure all activities that cause impact on environment
Documentation and control (DC)-procedure to control all EMS documents	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Environmental expert aid (EEA)-to assess technical issue in operation

Sub critical success factor	Intensity of importance																	Sub critical success factor
Emergency response and preparedness (ERP)-procedure to responds to accidents and emergency situations	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Communication(CM)-procedure for both internal and external communication
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Emergency response and preparedness (ERP)-procedure to responds to accidents and emergency situations	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer demand (CD)-customer want eco-friendly products
Emergency response and preparedness (ERP)-procedure to responds to accidents and emergency	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Relations between employee (RBE)- help to encourage loyalty and motivation in staff

procedure for both internal and external communication	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	measuring equipment (MME)-monitor and measure all activities that cause impact on environment
Communication(CM)-procedure for both internal and external communication	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Environmental expert aid (EEA)-to assess technical issue in operation

Sub critical success factor	Intensity of importance																	Sub critical success factor
Market force (MF)-companies demand ISO 14001 to do business with them	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Government regulations (GR)-strict laws to punish offenders
Market force (MF)-companies demand ISO 14001 to do business with them	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer demand (CD)-customer want eco-friendly products
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Market force (MF)-companies demand ISO 14001 to do business with them	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Environmental expert aid (EEA)-to assess technical issue in operation

Sub critical success factor	Intensity of importance																		Sub critical success factor
Government regulations (GR)-strict laws to punish offenders	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer demand (CD)-customer want eco-friendly products	
Government regulations (GR)-strict laws to punish offenders	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Relations between employee (RBE)-help to encourage loyalty and motivation in staff	
Government regulations (GR)-strict laws to punish offenders	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Improve production (IP)-implement action to improve environmental performance	
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Customer demand (CD)-customer want eco-friendly products	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Monitoring and measuring equipment (MME)- monitor and measure all activities that cause impact on environment	

Customer demand (CD)-customer want eco-friendly products	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Environmental expert aid (EEA)-to assess technical issue in operation
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Sub critical success factor	Intensity of importance																	Sub critical success factor
Relations between employee (RBE)- help to encourage loyalty and motivation in staff	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Improve production (IP)- implement action to improve environmental performance
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Relations between employee (RBE)- help to encourage loyalty and motivation in staff	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Environmental expert aid (EEA)-to assess technical issue in operation

Sub critical success factor	Intensity of importance																	Sub critical success factor
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Sub critical success factor	Intensity of importance																	Sub critical success factor
Monitoring and measuring equipment (MME)- monitor and measure all activities that cause impact on environment	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Environmental expert aid (EEA)-to assess technical issue in operation

PAIRWISE COMPARISON BETWEEN THE BENEFITS OF ISO 14001 IMPLEMENTATION

Benefits	Intensity of importance																		Benefits
Improve company reputation and image (ICRI)- improve quality of products and services, practice green operations	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Increase employee morale (IEM)-increase employee awareness and commitment to environmental issues	
Improve company reputation and image (ICRI)- improve quality of products and services, practice green operations	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Gain profit and opportunity (GPO)-companies develop new products and opportunity	
Improve company reputation and image (ICRI)- improve quality of products and services, practice green operations	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Enhance customer trust (ECT)-increase customer loyalty and trust towards organization	

Benefits		Intensity of importance																Benefits	
Increase employee morale (IEM)-increase employee awareness and commitment to environmental issues		9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Gain profit and opportunity (GPO)-companies develop new products and opportunity
Increase employee morale (IEM)-increase employee awareness and commitment to environmental issues		9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Enhance customer trust (ECT)-increase customer loyalty and trust towards organization

Benefits	Intensity of importance																		Benefits
Gain profit and opportunity (GPO)-companies develop new products and opportunity	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Enhance customer trust (ECT)-increase customer loyalty and trust towards organization	

CHALLENGES FACED DURING ISO 14001 IMPLEMENTATION

Please rank between 1 to 5 (strongly disagree to strongly agree) by circle the answer in each questions

1 = Strongly disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly agree

1. Dissatisfaction of staff on more responsibilities	1	2	3	4	5
2. Hesitation by management to give time and resources that required to execute ISO 14001 standard	1	2	3	4	5
3. Increase bureaucracy and demand for more certification	1	2	3	4	5
4. High set up cost and operation cost	1	2	3	4	5
5. More time and resource consumption to execute the standard	1	2	3	4	5
6. High maintenance and improvement cost for long term	1	2	3	4	5
7. Deficiency of skilled staffs	1	2	3	4	5
8. Lack of appropriate information about the certification	1	2	3	4	5
9. It is just an additional certification driven process for authority to approve	1	2	3	4	5