GUIDELINE FOR ENVIRONMENTAL ASPECTS ASSESSMENT IN ISO 14001 ELECTRONICS INDUSTRIAL SECTOR CERTIFIED IN THAILAND

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Presently, the electronics sector has the highest export value in Thailand. Therefore, the constituent companies in this sector are directly concerned with the international trade standards. One of the most important aspects of international trade standards is Environmental Management System ISO 14001:1996.

The results from Thai Environmental Institute and Department of Industrial Works survey show that the major problem for implementing ISO 14001 is the identification of the environmental aspects involving the ISO 14001 standards stipulated by 4.3.1 clause that requires companies to follow certain procedures in order to comply with ISO 14001 standards. However, although the requirements are clearly stated, the procedure to comply with them remains unclear.

This thesis aims at establishing guidelines for identifying and evaluating the environmental aspects. The study was based on interview and questionnaire directed to the management and representatives of EMR. Moreover, data were collected from procedures used by 38 (ISO 14001) certified companies in the electronics sector. Data was analyzed using percentile and frequency distribution.

The outcome of this study, it is hoped will provide both certified and uncertified companies with guidelines for implementing ISO 14001 standards according to those stipulated by clause 4.3.1 aimed at modifying and improving their procedures concerning environmental safety. The guidelines are easy to understand and to follow. Moreover, they are flexible while being strictly in compliance with ISO 14001 standard requirements.

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แก้วตา นันทจิวากรชัย : แนวทางในการระบุและประเมินปัญหาสิ่งแวดล้อมในสาขาอุตสาหกรรมอิเล็กทรอนิกส์ที่ได้รับการรับรอง ISO 14001 ในประเทศไทย (GUIDLINE FOR ENVIRONMENTAL ASPECTS ASSESSMENT IN ISO 14001 ELECTRONICS INDUSTRIAL SECTOR CERTIFIED IN THAILAND). คณะกรรมการควบคุมวิทยานิพนธ์: สยาม อรุณศรีมรกต, วท.ม.,ชุมพร ยุวรี, วท.ม., ศิริลักษณ์ สุวรรณวงศ์, พบ.ม. 123 หน้า.
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ปัจจุบันสาขาอุตสาหกรรมอิเล็กทรอนิกส์มีมูลค่าการส่งออกสูงที่สุดในประเทศ ดังนั้นจึงมีส่วนเกี่ยวข้องโดยตรงกับการค้าโลกและมาตรฐานระดับสากล มาตรฐานหนึ่งที่มีความสำคัญมากที่สุด คือ มาตรฐานการจัดการสิ่งแวดล้อม ISO 14001:1996 จากผลการสำรวจโดยสถาบันสิ่งแวดล้อมไทยร่วมกับกรมโรงงานอุตสาหกรรมพบว่า ปัญหาที่สำคัญอย่างยิ่งในการจัดทำระบบ ISO 14001 คือ การบ่งชี้ประเด็นด้านสิ่งแวดล้อม ซึ่งประเด็นด้านสิ่งแวดล้อมนี้ถูกระบุในข้อกำหนดที่ 4.3.1 ของมาตรฐาน ISO 14001:1996 ซึ่งทุกองค์กรต้องปฏิบัติตาม ข้อกำหนดนี้ระบุว่าต้องปฏิบัติอะไรบ้างแต่ไม่ได้ระบุว่าปฏิบัติอย่างไร

วิทยานิพนธ์ฉบับนี้ได้ศึกษาแนวทางในการระบุและประเมินประเด็นด้านสิ่งแวดล้อม โดยการสัมภาษณ์ (ด้วยแบบสัมภาษณ์ที่สร้างขึ้น) ผู้แทนฝ่ายบริหารจัดการสิ่งแวดล้อมหรือตัวแทนที่ได้รับมอบหมายและเก็บรวบรวมเอกสารระเบียบวิธีปฏิบัติ สำหรับสาขาอุตสาหกรรมอิเล็กทรอนิกส์ที่ได้รับการรับรอง ISO 14001 จำนวน 38 แห่ง เพื่อเป็นแนวทางสำหรับองค์กรที่ยังไม่ได้รับการรับรองหรือองค์กรที่ได้รับการรับรองแล้ว เพื่อใช้ในการแก้ไขและปรับปรุงระบบการจัดการสิ่งแวดล้อมตามข้อกำหนดที่ 4.3.1 แนวทางนี้จัดทำขึ้นเพื่อให้ง่ายต่อการเข้าใจ, สะดวกในการนำไปใช้, ปรับเปลี่ยนได้และเป็นไปตามข้อกำหนดของ ISO 14001

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LIST OF ABBREVIATIONS

Electronics:
Radio, Television, Communications equipment
Environment:
surroundings in which an organization operates, including air, water, land, natural resources, flora, fauna, humans, and their interrelation
Note-Surroundings in this context extend from within an organization to the global system.
Environmental aspect:
Element of an organization's activities, products or services that can interact with the environment
Note-A significant environmental aspect is an environmental aspect that has or can have a significant environmental impact
Environmental impact:
any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's activities, products or services
EMS:
Environmental management system
EMR:
Environmental management representative(s)
IER:
Initial environmental review
ISO:
The International Organization for Standardization
MSDS:
Material Safety Data Sheet
TC 207:
Technical Committee 207

CHAPTER I

Introduction

1.1 Background and Rationale

Organizations are becoming increasingly concerned with the potential impact of their activities, processes, products and services on the environment. They face increasing pressure, both internal and external, to alter their business management plans to give environmental protection greater priority. Organizations' efforts to address environmental concerns can be given more order and consistency through the implementation of an environmental management system (EMS). The view of having the final publication of the ISO 14000 standards in 1996. There was also general consensus that the ISO EMS standard should be used as the "single world-wide EMS standard for self-declaration and specification purpose."

ISO 14001:1996 is a specification with guidance for use of an Environmental Management System in an organization. This Standard is accepted as appropriate for managing an Environmental System in all organizations. There are currently 245 ISO 14001 certified organizations in Thailand (5/4/2000)(1).

A summary (2) of ISO 14001 certified companies survey results in Thailand as of December 1998 found that the benefits obtained from ISO 14001 implementation to be better corporate image and also other reasons. According to these surveys the benefits obtainable increased the interest for organization to implement ISO 14001.

Table 1.1 Benefits obtained from ISO 14001 Implementation as follows:

Benefits of ISO 14001 Implementation	Percentage of Respondents
Better corporate image	98%
Improved working environment	78%
Cost saving	76%
Decrease in environmental problems	73%
Increase in working efficiency	69%
Increase in working potential	49%
Reduced complaints	40%
Others, such as social contributions, etc	11%

Source: Summary of ISO 14001 Survey Results by Thailand Environment Institute, 1999.(2)

Greater pressure on organizations in developing countries to comply with environmental requirements originates from foreign customers or international organizations rather than from local stakeholder. Therefore ISO 14001 certification is likely to become a means to meet overseas customer demand and to participate in competitive advantage on the domestic market. For exporters, the certification could be a tool to achieve a competitive advantage in comparison to other local exporters.

ISO 14000 is voluntary (3) but under committee of the WTO (World Trade Organization) concerned with environmental conservation. Especially, MEAs (Multilateral Environment Agreements) are very significant for considering trading and international environment. This standard impacts to industrial sectors that are relevant to international trading.

Now, In Thailand the electronics industrial sector is the highest exporting value, so this sector is concerned very closely with word trading and environmental standards, therefore, organizations in this sector must to be the highest ISO 14001 certified in Thailand.

Table 1.2 Exports important to Thailand

No.	Goods	1998 (Jan.-Jul.) Million Bath	1999 (Jan.-Jul.) Million Bath
1	Computers and parts	185,332	167,302
2	Clothes	75,914	59,556
3	Printed Circuit Boards	55,950	56,275
4	Motor vehicles and parts	36,898	46,441
5	Rice	53,621	37,588

Source: Department of Business Economics (21,September 1999)

Table 1.3 ISO 14001 certified companies by sector (as of 5/4/2000)

No.	Industrial sector	Number of companies certified
1	Electronics	59
2	Electrical machinery	26
3	Chemicals	23
4	Education	21
5	Cement/ Concrete	13
6	Leather/Foot wear	12
7	Others	75
Total		245

Source: Thai Industrial Standards Institute (TISI), ISO 14000 Certification (1)

In a plan for SME (Small & Medium Enterprises)(4) in the 5 years from 1998 -2002 by the Department of Industrial Promotion, it was identified that the electronics industrial sector is 1 of 5 sectors that was the most important needing urgent support. It showed that many companies in this sector are planning or already implementing ISO 14001 for a competitive advantage in world trading. According to those reasons this sector is a very interesting sector to study for guidelines to implement ISO 14001.

To be certified to ISO 14001 they must comply with legal and every requirement of ISO 14001. However, the requirements in ISO 14001 are very clear about what to do but have no details about how to do it. The organizations must find their own appropriate methods. They found a lot of problems during the implementation of ISO 14001.

According to this data it show that the Indication of Environment Aspects is the most serious problem. This is within the planning process (requirement 4.3)(5) and is a very important process that dominates other processes that follow. Like the saying "If you fail to plan, you plan to fail".

In this process, the most important requirement is clause 4.3.1, because goals must be set for specific process where significant aspects are identified and objectives and targets must be defined to meet these goals, also the correct actions and controls must be in place for the environmental management system.

Table 1.4 Problems and Barriers encountered in implementing and achieving ISO 14001 certification

Problems and Barriers	Percentage of severity		
	Minor	Moderate	Major
Indication of Environment Aspects	18	49	33
Raising staff awareness of environmental impacts	24	53	22
Defining objective and targets	29	58	13
Modifying procedures and processes	31	58	11
Auditing and corrective action	31	60	9
Defining staff roles and responsibilities	53	42	4
Certification fee	58	36	4
Amount of time required to achieve certification	44	53	-
Defining the environmental policy	73	27	-

Source: : Summary of ISO 14001 Survey Results by Thailand Environment Institute, 1999.(2)

The ISO 14001 non-certified organization (especially SMEs) must pass through the same process. Because of the importance of this process it depended on correct data, teamwork and expertise. This process may have a lot of problems for example making the same mistakes, delay, duplication, non-completeness or confusion from lack of experience, data, and applicable guideline for work not available.

Those problems will cause damage to the organization because if they cannot be fully identified or there is misevaluation of significant aspects, it will impact on them because they will not be following the correct method for control in the future. Not only can the organizations not receive ISO 14001 certification but it will also damage their image, opportunity in world trading and affect the local community and environment too. According to these problems, organizations suggested there should be government support for ISO 14001 implementation as follows:

Table 1.5 Suggested form of government support

Suggested	Percentage of Respondents	
	Necessary	Unnecessary
Tax incentives for certified organizations	98	-
Training and seminars for non-certified organizations	91	2
Guidelines/manual on implementing ISO 14001	91	2
Promotion of green label by offering benefits (such as tax incentives)	89	2
Soft loans for implementing ISO 14001 and achieving certification	64	24
Establish a national institute to provide consultation on ISO 14001 implementation	62	31
Others	9	-

Source: Summary of ISO 14001 Survey Results by Thailand Environment Institute, 1999.(2)

It was found that Training and seminars for non-certified organizations and Guidelines/manuals on implementing ISO 14001 was the important support suggested. The other important problem is implementation cost as follow:

Table 1.6 Implementation cost

Cost by Category	Amount (bath)
New equipment	1,400,000 – 10,000,000
Infrastructure improvement	55,000 – 10,400,000
Equipment/process modification	50,000 – 1,750,000
New technologies	Max 1,653,000
Consultants' fees	22,000 – 900,000
Assessment fees over 3 years	20,000 – 1,960,000
Training	9,000 – 800,000
Additional staff	9,000 – 540,000
Raw material substitution	-

Source: Summary of ISO 14001 Survey Results by Thailand Environment Institute, 1999.(2)

If companies get applicable guidelines in aspects identification and evaluation, it will help to implement the correct planning. It can make sure available spending is for the implementation system and can protect against spending in incorrect areas.

In the aspects identification and evaluation process there should be a reliable tool to find out aspects. This tool is created from factors concerned to the environmental and organizations status. These factors came from consultants, training, text and brainstorming from relevant staff up to high management level. Those methods passed many problems, trial and error, filtering, selecting, improving and correcting many times until concluded to be applicable tools in theirs organizations.

From usage by ISO 14001 certified organizations, it was felt a pity that methods are available but are controlled in only each of the organizations.

Studying, collecting, concluding and suggestions for guidelines for aspect identification and evaluation will be useful for non-certified and certified companies in ISO 14001 for implementing, modifying or improving their system. This guideline should be easy to understand, friendly for use and flexible for different organizations and compliance with ISO 14001 requirements. From more usage, it will improve this guideline to be more complete, correct and applicable.

Help and cooperation by ISO 14001 certified organizations to non-certified organizations proved that they have a strong attention to protect the environment, very high responsibility and sincerity towards the community. It is good for the electronics industrial sector image and for sustainable development in Thailand.

1.2 Objective

1.To establish guidelines for identification and evaluation of environmental aspects according to clause 4.3.1 in ISO 14001 for the electronics industrial sector.

2.To find out problems for implementation of environmental aspects identification and evaluation.

1.3 Scope of Thesis Study

Study the method of environmental aspect identification and evaluation from interviews, the opinions of Environmental Management Representative(s) or their representative(s) in the electronics industrial sector for 38 ISO 14001 certified organizations.

1.4 Conceptual Frame Work

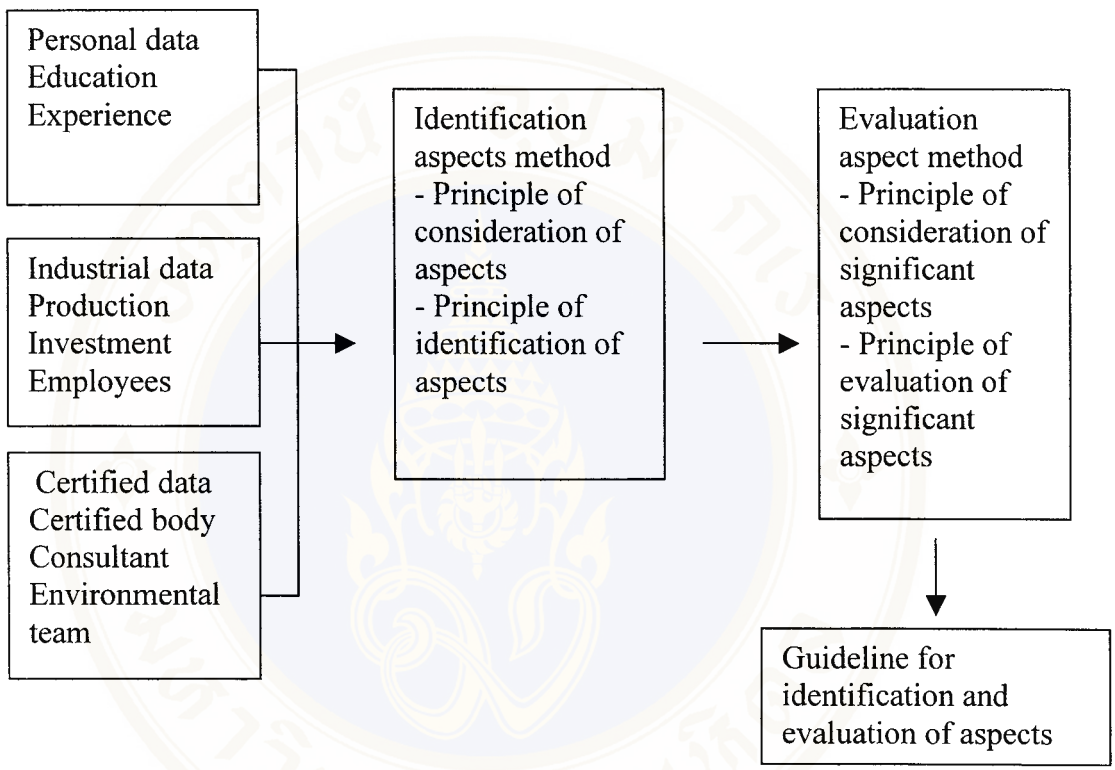

Figure 1.1 Conceptual Frame Work

1.5 Expected Result

Receive a guideline for identification and evaluation of environmental significant aspects according to clause 4.3.1 in ISO 14001 for the electronics industrial sector.

Receive problems for implementation of environmental aspects identification and evaluation.

CHAPTER II

LITERATURE REVIEW

The Identification and evaluation in Environmental Management System ISO 14001 are systemic processing. This process requires effective decision making for identifying and evaluating environmental significant aspect. Those topics are relevant with this process as follows:

2.1 System and environmental problems system approach
2.2 Environmental Management Systems ISO 14000
2.3 Environmental Aspect Identification method
2.4 Environmental Aspect Evaluation and Classification method
2.5 Environmental Risk Assessment
2.6 Classification Analysis

2.1 System and environmental problems system approach

The system dynamics is a method of analyzing problems in which time is an important factor, and which involve the study of how a system can be defended.

2.1.1 Definition of Systems

A system (6) can be defined as a network of interrelated procedures that are joined together to perform an activity or to accomplish a specific objective. It is, in effect, all the ingredients, which make up the whole. And a procedure is a precise series of step-by-step instructions that explain

1.What is to be done.
2.Who will do it.
3.When it will be done.
4.How it will be done.

The procedures tell how the ingredients are made into the whole. Systems are often classified into the following two categories.

- An Open System (7) is one characterized by outputs that respond to inputs but where the outputs are isolated from and have no influence on the inputs. An open system is not aware of its own performance. In an open system, past action does not control future action. An open system is a watch, taken by itself, does not observe its own inaccuracy and adjust itself.
- Close System is a feedback system. It is influenced by its own past behavior. A feedback system controls action based on the results from previous action.

2.1.2 Systems Analysis

The system analysis approach to a problem differs from a trial-and-error approach. The trial-and-error approach involves identifying a number of potential solutions to the problem and testing each randomly until one alternative appears to provide an acceptable solution.

In the systems analysis approach,(6) all influences and constraints are identified and evaluated in terms of their impact on the various decision points in the system. A decision point is that point in a system at which some person or automatic mechanism must react to input data and make a decision. The system itself conveys the information or material between the different decision points and it determines the criteria with which to make the decision.

The system analyst is a methods person who can start with a complex problem, break it down logically, and identify the reasonable solutions. The analyst can study an ailing system and come up with supervisor alternatives. Or given some number of objectives, the analyst can devise systematic means of attaining them. The systems analyst views a systems situation in terms of its scope, objectives, and the organizational framework.

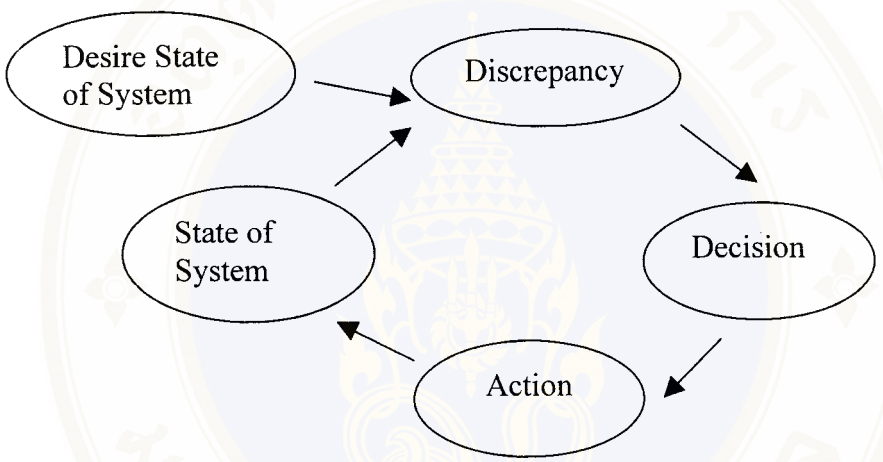

Figure 2.1 Casual Loop Diagram (8)

2.1.3 Problems Structures in Management Systems

The system conceptualization starts from: (8)

1.Problems Identification and definition

2.System boundary

3.System representation of feedback structure

The key variable of problem identification and definition is the integration or System State (9). This latter term is literally accurate; it is by looking at the present state of affairs that we decide what, if any thing to do. The System State may be the current value, an average over some period of time, a forecast value, or an old value. Many current states are actually out of date to some degree, and the state system is almost certainly inaccurately, either because it is old information or because of errors in counting, transmission, forecasting or interpretation. It is often more appropriate to refer to apparent or perceived system state.

The System State is compared to a required state, which may also be a forecast value, and this comparison leads to a positive, negative, or zero discrepancy. The sign of discrepancy is usually found by taking (Desire Value-Actual Value)

A decision rule or policy specifies the action to be taken for a discrepancy of a given sign and magnitude. This gives the magnitude (and possibly sign) of the flow

variable which will lead to a change in the system state. Definition of policy is a rule for regulating a flow in the hope of achieving a target level.

In Environmental Management Systems it considers legal and other requirements to be the minimum need of the desired state of the system.

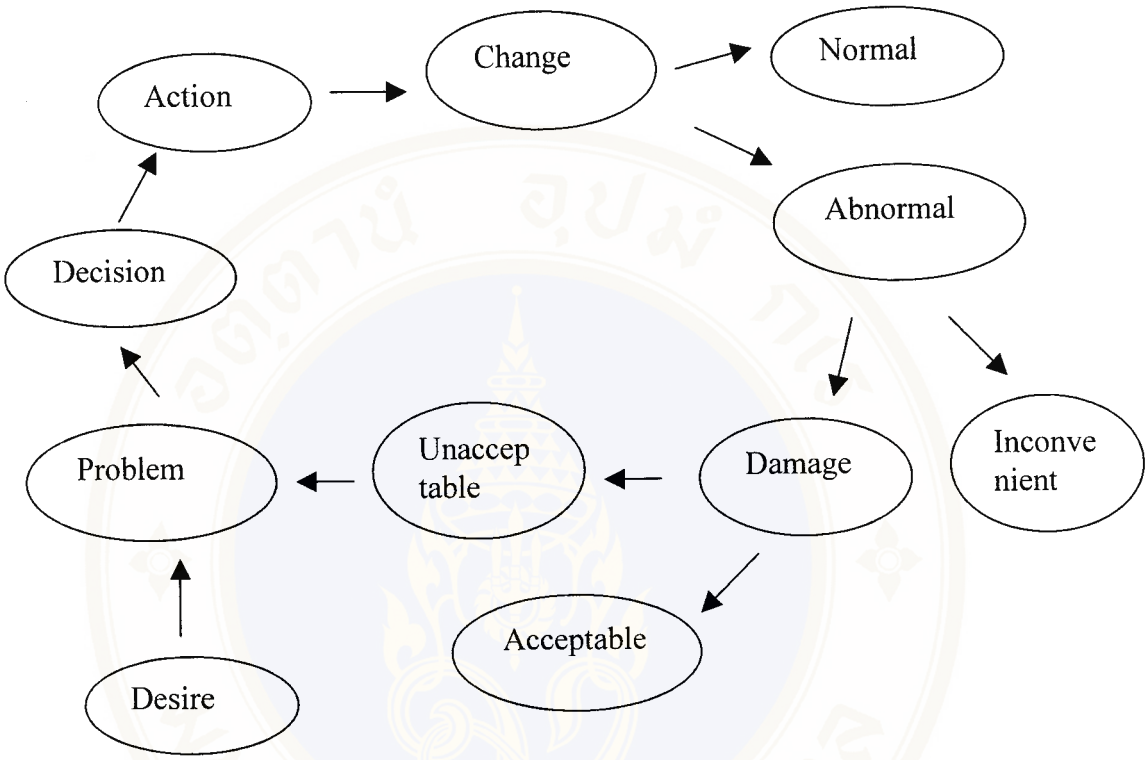

Figure 2.2 Problems Structures in Management Systems (8)

2.2 Environmental Management Systems ISO 14000

2.2.1 Background and developments

Development in the area of Environmental Management System (EMS) (2) started in the early 1990s. In 1992, the British Standard BS 7750 was introduced. This standard was subsequently revised in 1994. While the British Standard was being developed, work on the European Commission's environmental standard for companies began. This work eventually led to the launch of the Eco-Management and Audit Scheme (EMAS) in 1993. Revision to these two standards has made them very similar in their requirements.

The International Organization for Standardization (ISO) established a Technical Committee (TC 207) to develop and produce a set of unified, voluntary standards for environmental management. This action was based on the advice of the Strategic Advisory Group on the Environmental (SAGE), which was set up to examine the need for standardization of environmental management practices. After the last TC 207 meeting, with the view of having the final publication of the ISO 14000 standard in 1996. There was also general consensus that the ISO EMS standard should be used as the "single world-wide EMS standard for self-declaration and specification purposes."

The aims of this new initiative are:

- To provide a basis for the harmonization of existing standards as well as future endeavor in this field, in order to facilitate international trade; and
- To support " environmental protection in balance with socio-economic needs" by providing organizations with a tool to achieve and measure improvement in environmental performance.

The number of countries participating in TC 207 was constantly growing until its first meeting and reached by June 1995, a total of 64 countries-almost 60% of all ISO members.

2.2.2 The Content of ISO 14000 Standard Series

The ISO 14000 Standard Series will, according to current planting, consist of over twenty individual standards. The ISO 14000 Series are as follow in this table:

Table 2.1 The ISO 14000 family of standards and ongoing work

Designation	Publication	Title
ISO 14001:1996	1996	Environmental Management Systems-Specification with guidance for use
ISO 14004:1996	1996	EMS-General Guidelines on Principles, Systems and Supporting Techniques
ISO 14010:1996	1996	Guidelines for Environmental Auditing – General principles
ISO 14011:1996	1996	Guidelines for EA – Audit procedures Part 1:– Auditing of EMS
ISO 14012:1996	1996	Guidelines for EA –Qualification criteria for environmental auditors
ISO/WD 14015	To be determined	Environmental assessment of sites and entitles
14020:1998	1998	Environmental labels and declarations-General principles
ISO/DIS 14021	1999	EL and declarations-Self-declared environmental claims
ISO/FDIS 14024	1998	EL and declarations – Type I environmental labeling – Principles and procedures
ISO/WD/TR 14025	To be determined	EL and declarations – Type III environmental declarations – Guiding principles and procedures
ISO/DIS 14031	1999	Environmental management-Environmental performance evaluation-Guidelines
ISO/TR 14032	1999	Environmental management-Environmental performance evaluation-Case studies illustrating the use of ISO 14031
ISO 14040:1997	1997	Environmental management-Life cycle assessment-Principles and framework
ISO 14041:1998	1998	Environmental management-Life assessment-Goal and scope definition and inventory analysis
ISO/CD 14042	1999	Environmental management-Life cycle assessment-Life cycle impact assessment
ISO/DIS 14043	1999	Environmental management-Life cycle assessment-Life cycle interpretation

Table 2.1 The ISO 14000 family of standards and ongoing work (continuous)

Designation	Publication	Title
ISO/TR 14048	1999	Environmental management-Life cycle assessment-Life cycle interpretation
ISO/TR 14049	1999	Environmental management-Life cycle assessment-Examples for the application of ISO 14041
ISO 14050:1998	1998	Environmental management-Vocabulary
ISO/TR 14061	1998	Information to assist forestry organizations in the use of the EMS ISO 14001 and 14004
ISO Guide 64:1997	1997	Guide for the inclusion of environmental aspects in product standards

Note: CD = Committee Draft/ DIS = Draft International Standard/ FDIS = Final Draft International Standard/ TR= Technical Report
Source: http://www.iso.ch/9000e/iso14000.pdf (last update 1999/11/25)

Thematically (11) TC 207 is divided into 6 subcommittees (SC) each responsible for a specific aspect of environment:

SC1: Environmental Management System
SC2: Environmental Auditing
SC3: Environmental Labeling
SC4: Environmental Performance Evaluation
SC5: Life Cycle Assessment
SC6: Terms and Definitions

The SC is responsible for formally deciding to give a Working Draft (WD) a Committee Draft (CD) status. The CD is circulated for comments and voting to participate members in order to register it as a Draft International Standard (DIS). Eighty percent affirmative voting are needed for a document to proceed to the next step. Each participated member's country gets one vote. Once it is agreed that a standard is an ISO standard, it is distributed to member countries for acceptance as theirs national standard.

2.2.3 Environmental Management System ISO 14001

An Environmental Management System (EMS)(11) interpreted as the organizational structure, including practices, processes, resources and responsibilities for implementing environmental management. Such a system should enable organizations to achieve and demonstrate ongoing compliance with regulations. It should allow organizations to control the environmental impact of all activities, products and services taking into account a self-determined environmental policy and objectives. These objectives need to include those environmental aspects, which organizations can control and over which they can be expected to have an influence. The standards are based on the concept that organizations will periodically review and evaluate systems in order to improve environmental performance.

The EMS specification document, CD 14001, defines the core elements of EMS , which should be audited by a third-party for certification/ registration purposes. A separate guidance document provides additional information for interpretation of CD 14001 and is not intended for certification.

Beyond the requirement of compliance with applicable legislation and continual improvement of performance criteria. In consequence, two organizations engaged in similar activities but having different environmental performance may both comply with its requirements as long as both commit themselves to comply with legislation. The reason for ISO not providing concrete thresholds for performance is to allow the standards to be applicable in different countries with different regulations and environmental conditions.

CD 14001 defines the following core elements of an EMS:

1.Policy definition
Definition of an environmental policy set by top management. This policy constitutes the organization's objectives in relation to environmental performance. It has to be documented, communicated to all employees and made available to the public.

2.Planning phase:
- Identification of environmental aspects and legal requirements with respect to the company's activities, products and services.
- Development and documentation of environmental objectives and targets at each relevant organization level. Technological options and views of interested parties have to be taken into account.
- Establishment of an environmental management program to achieve the objectives. Designation of responsibilities at each organization level; documentation and communication of these responsibilities.
- Detailing of the means and the timeframe by which the objectives are to be achieved.

3.Implementation phase:
- Provision of technology, financial and human resources necessary for the EMS; appointment of a specific management representative.
- Training and awareness-raising procedures for employees
- Documentation and document control
- Operation control

4.Control phase:
- Monitoring and evaluating operational processes as well as establishing of an EMS audit program to determine conformity with objectives and standard requirements and to provide information for the management review.
- Preventive and corrective action in the case of non-conformity and documentation of those actions.
- Maintenance of environmental records, including training records, audit and review results.

5.Management Review:

The management has to review the EMS to ensure its continuing efficiency, based on the audit results, changing circumstances and the commitment to improvement. Changes have to be documented.

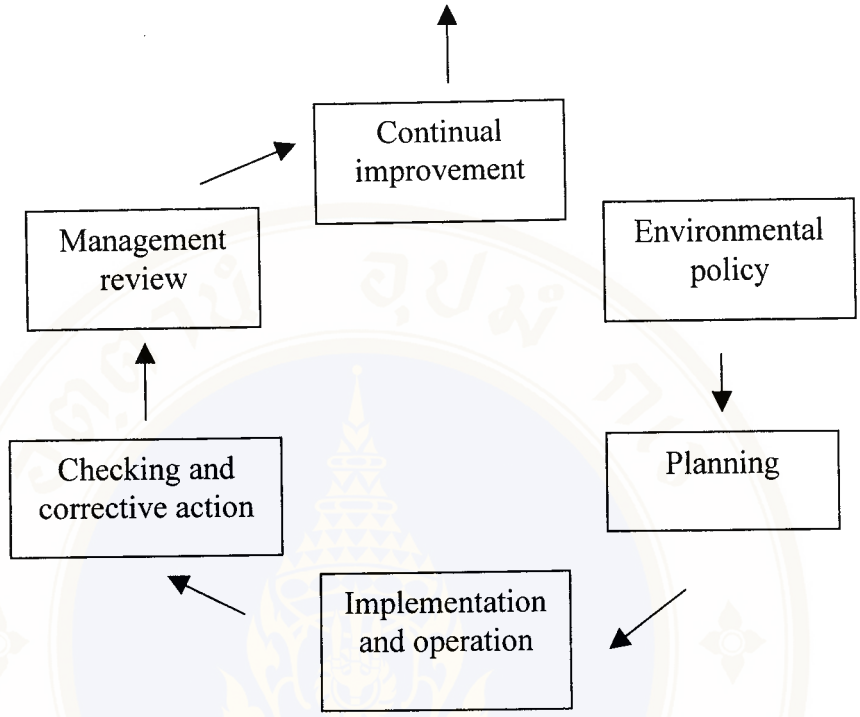

Figure 2.3 Environmental management system model for ISO 14001 International Standard (5)

2.3 Aspect Identification Method

2.3.1 Introduction

The purpose of the EMS; as designed against ISO 14001; is to ensure appropriate levels of control and improvement of environmental aspects are practiced and achieved. The majority of sites and companies undertaking Environmental Management will discover that they are responsible for a large number of Sources of Pollution from Products, Processes, Activities and Services carried out.

From our basic understanding of the chain of events that make up overall environmental aspects, Source, Pathway, Target, Impact, it is obvious that some pollution's will be more important to control than others. How can a company decide this prioritization? ISO 14001 requires a company to do so but gives no real guidance on how this can be achieved. The company must decide on "Significant" and decide on whether or not they are: (12)

- Appropriate
- Logical
- Repeatable

The most important factors to remember when reviewing a company's listing and methodologies for significant aspects are;

- Appreciate it is the most challenging section of ISO 14001

- Judgements should be objective but can be, will be supported or qualified by subjective opinions
- It will probably be a multidisciplinary task
- It is one of the single most important elements of an EMS because, if not considered in detail, realistic objectives and management control may not be achieved

2.3.2 The starting Point

The guidance in ISO 14001 is not very specific when it comes to assessing significance, particularly for people who are not familiar with the assessment of environmental aspects. Before a company can manage a series of problems it must understand what those problems are. The methods that a company can use to determine the "Starting Point" are many but the most common ones are: (12)

- The Preparatory Environmental Review (PEW); or
- The Initial Environmental Review (IER)

Essentially the same these "Environmental Audit" disciplines are most commonly conducted by external experts – primarily because the "average" company has little or no concept of "the environment". They will examine such things as:

- The site history – looking for "inherited" problems
- The site activities – identifying migration pathways and potential targets for the pollution
- Site Pressure – identifying some of the external "arbiters" of impact considerations
- Existing Management Practices – identifying what present attributes can be used and incorporated into the future EMS

The intention of a PER/IER is to provide the company with a "baseline" from which the company can understand the need to and types of Operation Controls that will be require; as well as the areas of improvement that will have to be considered. All of these will be based on the relative Significance of the "list" of environmental issues identified for the site.

2.3.3 Environmental aspects

Sub-clause 4.3.1(5) is intended to provide a process for an organization to identify environmental aspects that should be addressed as a priority by the organization's environmental management system. This process should take into account the cost and time of undertaking the analysis and the availability of reliable data. Information already developed for regulatory or other purposes may be used in this process. Organizations may also take into account the degree of practical control they may have over the environmental aspects being considered. Organizations should determine what their environmental aspects are, taking into account the inputs and outputs associated with their current and relevant past activities, products and/or services.

An organization with no existing environmental management system should, initially, establish its current position with regard to the environmental by means of a review. The aim should be to consider all environmental aspects of the organization as a basis for establishing the environmental management system.

Those organizations with operating environmental management systems do not have to undertake such a review.

The review should cover four key areas:

a) legislative and regulatory requirements;
b) an identification of significant environmental aspects;
c) an examination of all existing environmental management practices and procedure;
d) an evaluation of feedback from the investigation of previous incidents.

In all cases, consideration should be given to normal and abnormal operations within the organization, and to potential emergency conditions.

A suitable approach to the review may include checklists, interviews, direct inspection and measurement, result of previous audits or other reviews depending on the nature of the activities.

2.3.4 Identification of environmental aspects

An organization's policy, objectives and targets should be based on knowledge about the environmental aspects and significant environmental impacts associated with its activities, products or services. This can ensure that the significant environmental impacts associated with these aspects are taken into account in setting the environmental objectives.

The identification of the environmental aspects is an ongoing process that determines past, current and potential impact (positive or negative) of an organization's activities on the environment. This process also includes the identification of the potential regulatory, legal and business exposure affecting the organization. It can also include identification of health and safety impacts, and environmental risk assessment.

Some issues to be considered in identification of environmental aspects and evaluation of environmental impacts (13)

1.What are the environmental aspects of the organization's activities, products and services?

2.Do the organization's activities, products or services create any significant adverse environmental impact?

3.Does the organization have a procedure for evaluating the environmental impacts of new projects?

4.Does the location of the organization require special environmental consideration, for example sensitive environmental area?

5.How will any intended changes or additions to activities, products or services affect the environmental aspects and their associated impacts?

6.How significant or severe are the potential environmental impacts should a process failure occur?

7.How frequently will the situation arise that could lead to the impact?

8.What are the significant environmental aspects; considering impacts, likelihood, severity and frequency?

9.Are the significant environmental impacts local, regional or global in scope?

The identification of environmental aspects and the evaluation of associated environmental impacts is a process that can be dealt with in four steps.

Step-1 Select an activity, a product or service

The selected activity, product or service should be large enough for meaningful examination and small enough to be sufficiently understood.

Step-2 Identify environmental aspects of the activity, product or service

Identify as many environmental aspects as possible associated with the selected activity, product or service.

Step3- Identify environmental impacts

Identify as many actual and potential, positive and negative, environmental impacts as possible associated with each identified aspect.

Tables 2.2 Example from the three steps above are shown as follows:

Activity, product or service	Aspect	Impact
Activity-Handling of hazardous materials	Potential for accidental spillage	Contamination of soil or water
Product-Product refinement	Reformation of the production to reduce its volume	Conservation of natural resources
Service-Vehicle maintenance	Exhaust emissions	Reduction of air emissions

Source: ISO14004:1996: Environmental management systems: general guidelines on principles, systems and supporting techniques.(13)

Step 4- Evaluate significance of impacts

The significance of each of the identified environmental impacts can be different for each organization. Quantification can aid judgement.

Considering the following can facilitate evaluation

Environmental concerns:

- the scale of the impact;
- the severity of the impact;
- probability of occurrence;
- duration of impact.

Business concern:

- potential regulatory and legal exposure;
- difficulty of changing the impact;
- effect of change on other activities and processes;
- concerns of interested parties;
- effect on the public image of the organization

2.3.5 Process of Aspect Identification

The following are process of aspect identification analysis (14)

1.Scope of aspect identification

- Direct, Indirect
- Past incident, Current, Future
- Normal, Abnormal, Emergency

2.Aspect identify and analysis

- Collecting data
- Survey source and pathway of pollution
- Flow diagram analysis
- Mass Balance analysis
- Site Inspection
- Cause analysis
- Analysis of significant aspects
- Determine objective and target

3. Aspect identification methods

The following demonstrated are some examples (not mandatory) that could be followed:

1.Stakeholder and Interested Party Analysis

Analysis by Stakeholders, customers, Business, Neighbors, Employee, Government, others criteria request.

2.Site-base Analysis

Analysis by potential impacts to around site

3.Process-base Analysis

Analysis by input-output in 3 step

- Company Flow Diagram
- Department Flow Diagram
- Process Flow Diagram

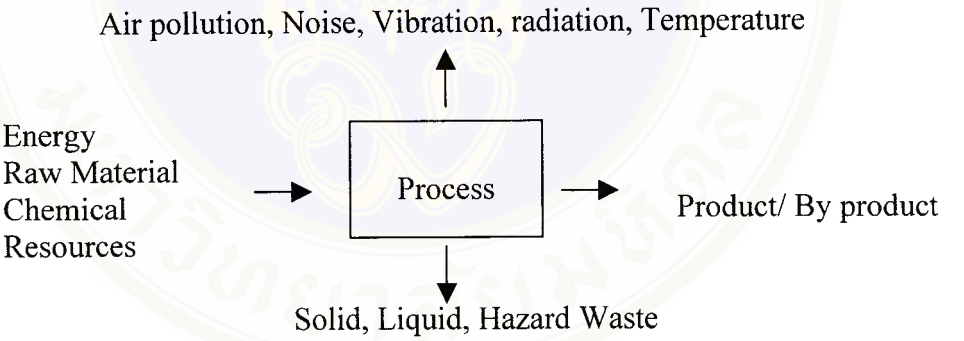

Figure 2.4 Process base Analysis

4.Combination Methods

Each method has strong and week points, then a combined method may be appropriate for difference organizations.

2.3.6 Initial Environmental Review

The current position of an organization with regard to the environment can be established by means of an initial environmental review. The initial review can cover the following (13):

- identification of legislative and regulatory requirement;
- identification of environmental aspects of its activities, products or services so to determine those that have or can have significant environmental impacts and liabilities;

- evaluation of performance compared with relevant internal criteria, external standards, regulations, codes of practice and sets of principles and guidelines;
- existing environmental management practices and procedure;
- identification of the existing policies and procedures dealing with procurement and contracting activities;
- feedback from the investigation of previous incidents or non-compliance;
- opportunities for competitive advantage;
- the reviews of interested parties;
- functions or activities of other organizational systems that can enable or impede environmental performance.

In all case, consideration should be given to the full range of operating conditions, including possible incidents and emergency situations. The process and results of the initial environmental review should be documented and opportunities for EMS development should be identified.

Practical help- Initial environmental review

An important first step is to develop the list of area to be reviewed. This can include organization activities, specific operations or a specific site.

Some common techniques for conducting a review include

- questionnaires,
- interviews,
- checklist,
- direct inspection and measurement,
- record review,
- benchmarking

Organizations, including SMEs, can consult a number of outside sources such as:

- government agencies in relation to law and permits;
- local or regional libraries or databases;
- other organizations for exchange of information;
- industrial associations;
- larger customer organizations;
- manufacturers of equipment in use;
- business relation (e.g. with those who transport and disposal of waste);
- professional help.

2.4 Aspect Evaluation and Classification Method

2.4.1 Significance Aspects

The process to identify the significant environmental aspects associated with the activities at operating units should, where relevant, consider, (5)

a) emission to air
b) release to water
c) waste management
d) contamination to land
e) use of raw materials and natural resources
f) other local environmental and natural resources

This process should consider normal operating conditions, shut-down and start-up conditions, as well as the realistic potential significant impacts associated with reasonably foreseeable or emergency situations.

The process is intended to identify significant environmental aspects associated with activities, products or services, and is not intended to require a detailed life cycle assessment. Organizations do not have to evaluate each product, component or raw material input. They may select categories of activities, products or services to identify those aspects most likely have a significant impact.

The control and influence over the environmental aspects of products vary significantly, depending on the market situation of the organization. A contractor or supplier to the organization may have comparatively little control, while the organization responsible for product design can alter the aspects significantly by changing, for example, a single input material. Whilst recognizing that organizations may have limited control over the use and disposal of their products, they should consider, where practical, proper handling and disposal mechanisms. This provision is not intended to change or increase an organization's legal obligations.

2.4.2 Evaluating Significance

2.4.2.1 External Pressures

There are a number of external pressures or factors associated with an environmental aspects that will indicate when it may be significant.(12)

- If there is environmental legislation against it then it is obviously important to the company and the environment
- Industry Association Codes of Practice exists to which the company subscribes then the company subscribes then the company's partners and competitors have decided this is important
- Scientific evidence exists to indicate known or suspected risks-particularly for fairly complex issues like Ozone Layer Depletion and CFC's
- Public pressure and awareness is high on locally sensitive issues-Noise, Nuisance and Odor particularly
- Regulatory requirements govern company actions- License restrictions for groundwater extraction or storage of hazardous chemical etc.
- Financial institutions (Banks) require environmental reporting to maintain loans and project financing.

It may be the case that one of these factors on its own (in particular the existence of law; as one of the fundamental concepts of ISO 14001 is "Legal Compliance") implies an effect is significant. Indeed it should be recognized that the existence of a consistent or repeated legal non-compliance should automatically make the contravention of a basic ISO 14001 principle and puts the organization at risk. alternatively a combination of factors will give an aspects its significance.

Clearly a variety of factors can cause an environmental aspect to be significant. When assessing significance it is important to bear in mind the subjectivity of the management, or team, who are deciding what effects are.

It may be appropriate to have a range of people to give their view on what aspect are significant as this could reduce the influence that individual personal opinion could otherwise have on the overall.

2.4.2.2 Quantitative Decisions

Two further factors that should be considered when assessing significance are:

- The scale of the aspects/ pollution (i.e. the larger the scale/amount of the aspect/pollution the more likely it is to be significant)
- Is an aspect likely to result in an emergency (e.g. following a leak or spill)- an emergency can be treated as a large scale accident with immediate and dangerous hazards attached to it.

2.4.2.3 Objective Methods of Evaluation of Significance

Having established, what is meant by the different levels and terms of Significance and having appreciated that certain external factors can influence decisions; the company should then be looking to establish a logical and repeatable method of initially estimating the actual level of Significance to be applied to individual issues identified

2.4.3 Significant Aspects Assessment

After identification there will be several aspects in different levels of severity. So methods of evaluation and classification are very important to guide decision making in setting objectives & targets and operation controls.

The following are some examples (not mandatory) that could be followed:

2.4.3.1 The easy method

Evaluation = High or Medium level

To arrange in order of important level: 1-2-3 or A-B-C, that method does not complicate and can describe primary data of activity. But the weak point of this is that method is that it cannot indicate the cause of aspects.

Table 2.3 The easy method

Type	Level of Significant	Criteria
1 or A	High	- exceeded legal - high quantity impact/ harmful in normal situation - exceeded level of company/policy - cause of emergency situation
2 or B	Medium	- harmful in abnormal situation - potential will exceed legal in abnormal situation - trend to increase high quantity - have complaint in past incident
3 or C	Low	- low impact - low potential to occur

Source: Sutep Terasart, Environmental Management System ISO 14000. (14)

2.4.3.2 The same weight scoring method

Evaluation = (A+B+C)

To set criteria of evaluation and scoring by Yes or No in each aspect in the same weight scoring method 1 as follow:

Table 2.4 The same weight scoring -method 1

No.	Criteria	Aspect		
		Normal	Abnormal	Emergency
1	Legal and other requirements relevant			
2	Environmental impact			
3	Health & Safety			
4	Business concern			
5	Neighbor			
6	Customer requirement			
7	Decrease cost			
8	Does it have operation control?			
9	Is it easy to detect?			
10	What frequency of occurrence?			
11	Does it have protection?			
12	Does it have applicable work instruction?			

Source: Sutep Terasart, Environmental Management System ISO 14000. (14)

To set criteria of evaluation by the same weight scoring method 2 as follows: (In this sample significant score is ≥ 10)

Table 2.5 The same weight scoring -method 2

Aspect	Worker H&S	Toxicity	Impact Nat. & Res.	Potential for NC	Wasted Material $	Disposal $	Total	Signifi-cant
Material in waste water	4	3	4	5	3	4	23	Y
VOC emission	2	3	1	1	1	0	8	N
Generation of scrap boards	3	2	1	2	5	3	16	Y
Generation of solid waste	1	0	2	0	4	3	10	Y
Water use	0	0	5	0	3	2	10	Y
Electricity use	0	0	4	0	3	0	7	N

Source: EPA's National Center for Environmental Assessment.1998. Design for the Environment.(15)

2.4.3.3 The different weigh scoring method

Evaluation = A x B

To set criteria of evaluation but with different weight of importance and different scoring in each aspect

Table 2.6 The different weight scoring method

Aspect No1		Normal		Abnormal		Emergency	
Criteria	Weigh (A)	Score (B)	Total (AxB)	Score (B)	Total (AxB)	Score (B)	Total (AxB)
1.Exceeded legal (3 = often, 0 = not happen)							
2.Exeeded level of company/policy (3 = often, 0 = not happen)							
3.Toxic to human/environment (3 = high, 0 = no toxic)							
4.Duration of impact (3 = > 5 y, 2= < 5 y-1y, 1 = < 1y-1m, 0= < 1m)							
5.Impact of environment (3 = high, 0= no impact)							
6.Scope of impact (1= local, 2= region, 3 = global)							

Source: Sutep Terasart, Environmental Management System ISO 14000. (14)

2.4.3.4 Failure Mode and Effects Analysis (method 4)

Failure Mode and Effects Analysis (FMEA)(16) is one of the first systematic techniques for failure analysis. It was introduced as an aid in designing and documenting military systems in the late 1950's.

The principle of the method is to examine every component in a system and ask the question:

- How can this component fail?
- What will happen if this component fail?

The success of failure mode and effects analysis depends on the analysis having a good conception of what failure mode can occur within a process plant, and what modes it is necessary to distinguish to ensure a reasonably complete analysis.

Environmental aspect identification by FEMA (Failure Mode and Effects Analysis) system by following:

Table 2.7 Likelihood of occurrence -method 4

Score				
5 100% Continually happens	4 75% Happens by changing situation	3 50% Happens in half of the times	2 25% Sometimes happen	1 0 % Rarely happens

Source: Sutep Terasart, Environmental Management System ISO 14000. (14)

Table 2.8 Severity - method 4

Score				
5	4	3	2	1
Exceeded legal	Nearly Exceed legal	Compliance with legal	Compliance with lowest of legal	No legal
Very high cost of operation control	High cost of operation control	Medium cost of operation control	Low cost of operation control	Very low cost of operation control
Exceeded customer requirement	Impact with customer requirement	No impact with customer requirement but exceeded company level	Impact compliance with company level	No impact with customer and company
High impact with neighbor	Unacceptable with neighbor	No impact with neighbor	Good benefit with neighbor	Very good benefit with neighbor
Very high toxic or harmful	High toxic or harmful	Medium toxic or harmful	Low toxic or harmful	Very low toxic or harmful
Very widely impact	Widely impact	Medium impact	Low impact	Very low impact
Very high impact with cost or working-times	High impact with cost or working-times	Medium impact with cost or working-times	Low impact with cost or working-times	Very low impact with cost or working-times

Source: Sutep Terasart, Environmental Management System ISO 14000. (14)

Table 2.9 Detection - method 4

Score				
5	4	3	2	1
Hard to detect	25% detection of problem duration	50% detection of problem duration	75% detection of problem duration	100% detection of problem duration

Source: Sutep Terasart, Environmental Management System ISO 14000. (14)

Table 2.10 Operation control after detection - method 4

Score				
5	4	3	2	1
Cannot set appropriate control at all	Cannot set appropriate control at this time	May have some appropriate control	May have some effective and appropriate control	Have effective and appropriate control

Source: Sutep Terasart, Environmental Management System ISO 14000. (14)

2.4.3.5 Preliminary hazards analysis (16)

The basic idea of preliminary hazards analysis is to select an object to study, and to identify which problems might arise. It can be used as a team method, with a very free structure allowing a wide range of problems to be raised. It is easiest to apply to plant types for which experience already exists.

Give this background material, the analyst, or the team, considers the possible hazards, first freely, then with a checklist of hazard types (table 2.11 gives a suggestion). For each hazard, the relative frequency and consequences are considered, and potential problems are identified.

Table 2.11 Hazard Checklist for preliminary hazards analysis

Situation.	Normal Holiday Strikes Shift change Sickness	Places	Plant unit Pipe bridges and trenches Storage Water supply Drains Control room
Operations	Startup Shutdown Normal operation Unusual operation Maintenance Overhaul Transport New construction	Hazards	Release Fire Explosion Missiles Toxics Product contamination Plant damage Shutdown
External causes	Storm Flood Snow Freezing Earthquake Landslide Vehicle crash Crane crash Fire	Causes	Technical failure Operator error Maintenance error Power supply Services Sabotage Raw material Other causes

Source: J.R.Taylor. Risk analysis for process plant, pipelines and transport.1994.(16)

The assessment is intended to be a very rough one. For this reason frequencies and consequences are classified only into ranges, for example using the table given below (table 2.12). Note that the scales are essentially logarithmic, so that high numbers represent serious hazards.

Table 2.12 Preliminary hazards assessment

Criteria	Score
Frequency	
Not possible	0
Rarer than 1 per 1000 years	1
Between 1 per 100 and 1 per 1000 years	2
Between 1 per 10 and 1 per 100 years	3
Between 1 per 1 and 1 per 10 years	4
More frequent than 1 per year	5
Harm to people	
No injuries	0
Serious injuries	2
Fatality	3
Several fatality	5

Source: J.R.Taylor. Risk analysis for process plant, pipelines and transport.1994.(16)

A risk index may then be calculated as follows:

$$R = F + H$$

The risk index indicates seriousness, and is quite rough, science the various consequence classes are only roughly comparable. The risk index is used to establish which hazards require special effort, and to set the scope for detailed analyses. It is useful too, at this point, to consider risk reduction measures and inherent safety.

2.5 Environmental Risk Assessment

2.5.1 Environmental Assessment

There are various established methods of assessing the significance of environmental aspects. There are various, traditionally established methods available and the method used on the evaluation of significance is up to the company. Methods include: (12)

- Risk Assessment
- Process Assessment
- Product Based Assessment
- Environmental Assessment

For no other reason than it is the most commonly adopted and also the most easily operated method this course will now concentrate on Risk Assessment as the a recommenced methodology.

Risk Assessment is a very useful tool in assessing the significance of environmental aspects. (It is also currently favored as a method of prioritizing and decision making on environmental and other matters by the British government.)

Certain operations a company undertakes are liable to create environmental risks. Risk assessment of operations is a well-established approach in some countries, for example in the field of Health and Safety. Part of the Health and Safety approach involves the assessments of materials; where information on materials used on the site, their characteristics and hazards to health are often collated on safety data sheets, providing a risk assessment of the material.

The assessment of environmental risks can also utilize a similar approach, and in many cases address risks noted by similar hazards or situations. For example, CFC's are a health and safety concern, and also an environmental hazard. One of the principal differences with a risk-based approach over the methods of significance evaluation is that a company is addressing the size and extent of a risk as well as the actual risk itself.

2.5.2 Environmental Risk

Before calculate significance based upon risk must understand what mean by the term "Risk" and it is necessary to define terms used on environmental risk before proceeding: (12)

- Harm- damage to the environment or person.
- Hazardous- something with the potential to cause harm, this could be a characteristic of a material, a particular incident or process. An Environmental Hazard is thus going to be a set of circumstances, which could lead to the direct or indirect degradation of the environment.
- Risk- the probability of the harm from a particular hazard being released, and its severity of any damage or changed resulting.

2.5.3 Risk Evaluation

In such an assessment it would be necessary to consider the following factors;

- likelihood of occurrence – the more likely it is to occur the higher the risk factor
- likelihood of detection – the less likely a company is to be able to detect and emission the less likely they are to be able to control it- particularly in abnormal circumstances- and therefore the higher the level of risk
- severity of consequence – the more severe the damage resulting from the pollution the higher the risk

Each of these factors could then be evaluated against a numerical system – as below – to determine the level of "Significance". The following is one example (not mandatory) that could be followed:

Table 2.13 Determination of risk

Likelihood of Occurrence (A)		Likelihood of Detection (B)		Severity of Consequence (C)	
Significance	Rank	Significance	Rank	Significance	Rank
Very High	5	Very High	1	Very Low	2
High	4	High	2	Low	4
Moderate	3	Moderate	3	Moderate	6
Low	2	Low	4	High	8
Very Low	1	Very Low	5	Very High	10

Source: AJA EQS (Thailand). ISO 14001 EMS Lead auditor/ assessor training course. ; 1998. (12)

A combination of the three scores indicates the risk (12)

(A+B) x C = Total

The higher the score the more significant an aspect could be. This technique will allow comparison of risks and hence allow determination of the significance of aspects. Question that should be asked when using such a criteria would include:

Occurrence
- Is it a normal part of process activities?
- Will it automatically occur in breakdown or start-up situation?
- Is their record of accidents happening previously?

Detection
- Is there a program for regular inspections or checks?
- Are there automatic detection systems in place?
- Is the type of pollution "obvious" immediately on occurrence?
- Are the pathways "controlled" or "Uncontrolled"? (Design or Random)

Severity
- What is the nature of the pollution?
- How much would be/is produced?
- What are the Targets and how sensitive are they?
- What are the possible impacts on the Targets?

As a guideline to the assessment of significance such a numerical system is invaluable provided that, as a minimum, the elements of legal compliance and lack of information are always remembered. The issue of lack of data should be considered in initial evaluations of significance because; without data a company cannot accurately:
- Decide how much pollution is produced
- Decide on whether or not compliance is being achieved
- Decide upon the actual or possible severity

2.5.4 Environmental and Health Risk Assessment

Environmental and Health Risk assessment (17) has been defined as "the characterization of the potential adverse health effects of human exposures to environmental hazards". In a risk assessment, the extent to which a group of people has been or may be exposed to a certain chemical is determined, and the extent of exposure is then considered in relation to the kind and degree of hazard posed by the chemical, thereby permitting an estimate to be made of the present or potential health risk to the group of people involved.

Risk assessment information is used in the risk management process in deciding how to protect public health. Examples of risk management action include deciding follow as:
- how much of a chemical a company may discharge into a river
- deciding which substances may be stored at a hazardous waste disposal facility
- deciding to what extent a hazard waste site must be cleaned up
- setting permit levels for discharge
- storage or transport
- establishing levels for air emissions
- determining allow levels of contamination drinking water

Essentially, risk assessment provides information on the health risk, and risk assessment is the action taken based on that information. A complete risk assessment consists of the following four step:

1. Hazard identification;
2. Dose-response assessment;
3. Exposure assessment; and
4. Risk characterization

2.6.Classification Analysis

2.6.1 Statistic and Decision Making

All of the questions in environmental significant aspects require that decisions be made under uncertainly. The required choices must be based on incomplete information. (18) Nevertheless, choices must be made. Even a failure to make a decision constitutes a choice-one that may have not benefits far less or far more desirable than those that flow from an explicit decision. In the modern interpretation, statistics is a body of theory and methodology for drawing inferences and making decision under conditions of uncertainly. From this interpretation, it would seem that the field of statistics has much to contribute toward answering some of the questions posed earlier, and indeed it does.

The raw material of statistics is statistical data or numbers that represent counts and measurements of events or objects. The theory and methodology of statistics aid in determining what data should be complied and how they should be collected, analyzed, interpreted, and presented to make the best inferences and decisions.

For some decisions, a careful scientific approach based on quantitative data does not seem very appropriate. Many decisions require a substantial component of intuitive judgment. Nonetheless, in many areas of human activity, statistical analysis provides a solid foundation for decision making. They are not meant to replace intuition and commonsense judgments. On the contrary, they assist in structuring a problem and in bringing the application of judgment to it. In many of these matters, such quantitative analysis has been found to be not only applicable but also extremely helpful.

2.6.2 Frequency Distributions

When we are confronted with masses of ungrouped data, it is difficult to generalize about the information the masses contain. A frequency distribution or frequency table records the number of cases that fall in each class of the data. The numbers in each class are referred to as frequencies; hence the term frequency distribution in each class, the table is usually referred to as a relative frequency distribution or a percentage distribution.

How the classes of a frequency distribution are described depends on the nature of the data. In all cases, data are obtained either by counting or by measuring. When large numbers of measurement are made, it is convenient to use intervals or groupings of values and to list the number of cases in each class. With this procedure,

a few problems have to be resolved concerning the number of class intervals, the size of these intervals, and the manner in which class limits should be stated.

2.6.3 Construction of a frequency distribution

The decisions about the number and size of the classes in a frequency distribution are essentially arbitrary. However, these two choices are clearly interrelated.

Selecting size and number of class, The smaller the intervals chosen, the more intervals will be needed to cover the range of the scores. Frequency distributions generally are constructed with from 5 to 20 classes. When class intervals are of equal size, comparisons of classes are easier and subsequent calculations from the distribution are simplified. However not always a practical procedure. There is no single perfect frequency distribution for a given set of data. Several alternative distributions which different class interval sizes and difference highest and lowest value may be equally appropriate.

Let us assume that we would like to set up a frequency distribution with 5 classes and that we want the classes to be equal size. A simple formula to obtain an estimate of the appropriate to be of equal size. A simple formula to obtain an estimate of the appropriate interval size is (19)

$$i = \frac{H - L}{k}$$

where

i = The size of the class intervals
H = The value of the highest item
L = The value of the lowest item
k = The number of classes

This formula for class interval size simply divides the total range of the data (that is, the difference between the values of the highest and lowest observations) by the number of classes.

2.6.4 Standard Score

It is convenient to use the term normally distributed for variables that have normal probability distribution. Any normally distributed variable can be transformed into a form applicable to a single table of areas under the normal curve, regardless of the units of the original data. The transformation used for this purpose is of the units of the original data. The transformation used for this purpose is that of the standard unit or, as it is often called in the case of a normal distribution, the standard score.

Let us state these notions in general form. The standard score, that is, the number of standard unit z for an observation x from a probability distribution is defined by (19)

$$Z = \frac{\text{Value} - \text{Mean}}{\text{Standard deviation}} = \frac{x - \bar{x}}{S.D.}$$

Where x = The value of the observation
$\bar{x}$ = The mean of the distribution
$S.D.$ = The Standard deviation of the distribution

The mean value of a sample $x_1, x_2, \ldots\ldots, x_n$ or, briefly, sample mean, is denoted by $\bar{x}$ and is defined by the formula

$$\bar{x} = \frac{1}{n}\sum_{j=1}^{n} x_j = \frac{1}{n}(x_1 + x_2 + \ldots.. + x_n)$$

The variance of a sample $x_1, x_2, \ldots\ldots, x_n$ or, briefly, sample variance , is denoted by $S.D.$ and is defined by the formula

$$S.D. = \frac{1}{n-1}\sum_{j=1}^{n}(x_j - x)^2 = \frac{1}{n-1}\left[(x_1 - x)^2 + \ldots. + (x_n - x)^2\right]$$

The T-Score formula is defined by

$$T = 10Z + 50$$

$$T = 10\frac{(x - \bar{x})}{S.D.} + 50$$

If k (the number of class) = 3

$$Range = \frac{T_{max} - T_{min}}{3}$$

$$Low = T_{min} + Range$$

$$Medium = T_{min} + 2Range$$

$$High = T_{min} + 3Range$$

CHAPTER III

MATERIALS AND METHODS

This research is for collecting and concluding a guideline for the identification and evaluation of significant aspects in the electronics industrial sector for ISO 14001 certified organizations in Thailand. That method should be available and easy for adjustment during usage.

3.1 Study Design

Survey research by collecting data from procedures and interviews of Environmental Management Representative(s) or their representatives in the electronics industrial sector for ISO 14001 certified organizations in Thailand.

3.2 Subjects

All of the electronics industrial sector of 38 ISO 14001 certified companies and group of companies (e.g. National group, Minebea group) in Thailand.

3.3 Instruments

3.3.1 Personal Computer and related equipment

3.3.2 Using questionnaire made by researcher and studying environmental identification and evaluation aspect procedures in each company.

3.3.3 Test consistencies of content in the questionnaire being proved and adjusted from 3 professionals as follows:

- Mrs.Sunaree Veerasawadrak, Scientist level 8, Bureau of industrial Environmental Technology, Department of Industrial Works, Ministry of Industry
- Ms.Pornpan Parinyatanakun, Chief of ISO 14001 consultant, Thailand Productivity Institute
- Ms.Wadsana Unarun, ISO 14001 auditor, Management System Certificatation Institute

3.4 Data Collection

3.4.1 Interview Environmental Management Representative(s) or their representatives in the electronics industrial sector for ISO 14001 certified companies in Thailand and recording in questionnaire.

3.4.2 Studying Aspect Identification and Evaluation procedures in each company.

3.5 Data Analysis

Analysis data with descriptive analysis as follows:

3.5.1 Analysis content is in there parts i.e. personal data, database of organization, ISO 14001 certification by percentile and frequency.

3.5.2 Collecting and grouping data from procedure and in-depth interview for making aspect identification and evaluation guideline. Analysis by concluding distribution frequency of criteria and discussion from those companies for each criteria meaning.

3.5.3 Proving and discussing meaning of contents and criteria by 3 professionals and advisors as follows:

- Mr.Panthep Bhandhufalck, ISO 14001 Lead auditor, Anglo Japanese America :AJA EQS (Thailand) Ltd.
- Mr.Udomdej Kongtaveelert, ISO 14001 Lead auditor, Bureau Veritas Quality International: BVQI
- Mr.Kamjorn Kuichoon, ISO 14001 Lead auditor, Bureau Veritas Quality International: BVQI

3.5.4 Establishing a guideline that must be complete and available to identify and evaluate significant environmental aspect shall consider the criteria as follows:

- Compliance with requirement clause 4.3.1 of ISO 14001:1996
- Compliance with guidance clause A.3.1 in annex of ISO 14001:1996 and clause 4.2.2 in ISO 14004:1996 guideline
- The most usage method
- High frequency of usage criteria
- Meaning of criteria is clear and easy to understand. Decision making about available meaning depend on discussion with professional and subjects.
- Effective to identify and evaluate different aspects of pollution and resource usage.
- Classification of significant aspect should come from statistical or logical methods.

CHAPTER IV

RESULTS

Data of results consists of 2 main part.

4.1 General results of content analysis in part of personal data of the subjects. database of organization, ISO 14001 certification data in percentile and frequency.

4.2 Aspects assessment guideline results of Collecting and grouping data from procedure and in-depth interview for making aspect identification and evaluation guidelines. Analysis by concluding distribution frequency and percentile of criteria.

4.1 General results

4.1.1 Personal data of the subjects

Table 4.1 Sex

Sex	Count	Percents
Male	20	52.6
Female	18	47.4
Total	38	100.0

The personal data shows that 52.6 % are male.

Table 4.2 Experience in Environmental field

Experience in Environmental	Count	Percents
Below 5 years	32	84.2
5-10 years	3	7.9
11-15 years	3	7.9
16-20 years	-	-
More than 20 years	-	-
Total	38	100.0

84.2 % have environmental experiences below 5 years and 7.9% are between 5-15 years.

Table 4.3 History of experience in the electronic industrial sector

History experience	Count	Percents
Below 5 years	20	52.6
5-10 years	7	18.4
11-15 years	9	23.7
16-20 years	2	5.3
More than 20 years	-	-
Total	38	100.0

52.6 % have electronic experience history below 5 years, in 23.7 % between 11-15 years, and in 18.4% between 5-10 years.

Table 4.4 Duration of working times in this company

Duration of working times	Count	Percents
Below 5 years	23	60.5
5-10 years	10	26.3
11-15 years	5	13.2
16-20 years	-	-
More than 20 years	-	-
Total	38	100.0

60.5% have been working in their companies below 5 years, in 26.3% between 5-10 years, and in 13.2% between 11-15 years.

Table 4.5 Education Level

Education Level	Count	Percents
Below Bachelor	1	2.6
Bachelor degree	29	76.3
Master degree	8	21.0
More than Master degree	-	-
Total	38	100.0

Most of them have received a Bachelor degree in 76.3%, in 21% have graduated to Master degree.

Table 4.6 Field of education

Field of education	Count	Percents
Environmental Health & Safety Science	12	31.5
Management or Business	9	23.6
Engineering	8	21.0
Others Science	5	13.2
Others	4	10.5
Total	38	100.0

31.5% graduated from Environmental Health & Safety fields, in 23.6% from Management or Business field, and 21.0% from Engineering field.

Table 4.7 ISO 14001 Starting Team until certified.

ISO 14001 starting team	Count	Percents
Yes	33	86.9
No	5	13.2
Total	38	100.0

Most of the subjects are part of ISO 14001 Starting Team in 86.9 %.

Table 4.8 Kind enough to be ISO 14001 advisors for interested parties.(Appendix B)

ISO 14001 advisor	Count	Percents
Yes	35	92.1
No	3	7.8
Total	38	100.0

Most of them, 92.6% are kind enough to be ISO 14001 advisors for interested parties.

Table 4.9 Section of Responsibility in company

Section	Count	Percents
Environmental Health & Safety	20	52.6
ISO, TQM, QMS	9	23.7
Administrative	5	13.2
Others	4	10.5
Total	38	100.0

52.6% have responsibility in Environmental Health & Safety section, 23.7% are in ISO, TQM, QMS section, and 13.2% are in administrative section.

Table 4.10 Level of position in company

Level of position	Count	Percents
Manager	16	42.1
Supervisor	11	28.9
Officer	7	18.4
Assist Manager	3	7.9
Director	1	2.6
Total	38	100.0

There are 42.1% in Manager positions, 28.9% in Supervisor positions, and 18.4% in Officer positions.

Table 4.11 Environmental Management Representative(s) position

Environmental Management Representative position	Count	Percents
Yes	21	55.3
No	17	44.7
Total	38	100.0

There are 55.3 % in Environmental Management Representative(s) position but 44.7 % are not.

4.1.2 The results database of organization

Table 4.12 Class of industry

Class 3	Count	Percents
Yes	38	100.0
No	-	-
Total	38	100.0

All of them are in industrial class 3, which means that their employees are more than 51 persons or equipment is more than 50 HP.

Table 4.13 Production

Production	Count	Percents
Integrated Circuit (IC)	11	28.9
Hard Disk Drive, Floppy Disk Drive (HDD,FDD)	9	23.6
Monitor, Audio	7	18.4
Others	7	18.4
Printed Circuit Board (PCB)	4	10.5
Total	38	100.0

Their products are Integrated Circuit for 28.9%, in 23.6% are Hard Disk Drive, Floppy Disk Drive, and 18.4% are Monitor and/or Audio and others.

Table 4.14 Amount of employees

Employees (persons)	Count	Percents
Less than 1,000	2	5.3
1,001-1,500	11	28.9
1,501-2,500	7	18.4
2,501-3,000	3	7.9
More than 3,000	15	39.5
Total	38	100.0

39.5% have employees more than 3,000 persons, 28.9% between 1,001-1,500 persons, and 18.4% between 1,501-2,500 persons.

Table 4.15 Duration of their business

Duration of business	Count	Percents
Below 5 years	4	10.5
5-10 years	13	34.2
11-15 years	13	34.2
16-20 years	4	10.5
21-25 years	-	-
More than 25 years	4	10.5
Total	38	100.0

Duration of theirs business are between 5-15 years in 68.4%. The same 10.5% are below 5 years, between 16-20 years and more than 25 years too.

Table 4.16 Investment

Investment	Count	Percents
Japan	16	42.1
USA	11	28.9
Thailand	6	15.8
Taiwan	3	7.9
Europe	2	5.3
Total	38	100.0

The highest investment in Japan is 42.1%, USA with 28.9%, and Thailand with 15.8%.

Table 4.17 Capital cost

Capital cost (million baht)	Count	Percents
Below 100	10	26.3
101-500	10	26.3
501-1,000	7	18.4
1,001-1,500	5	13.2
1,501-2,000	1	2.6
More than 2,000	5	13.2
Total	38	100.0

Capital cost of them is between below 100 – 500 million baht in 52.6%, 18.4% between 501-1,000 million baht, and 13.2% are between 1,001-1,500 and more than 2,000 million baht.

4.1.3 The results of ISO 14001 certification

Table 4.18 Other certificates in company (can answer more than 1 choice)

Certificate	Count	Percents
ISO 9001 or ISO 9002	37	97.4
QS 9000	9	23.7
QSR	1	2.6
BS 8800	1	2.6

The Most certificates are ISO 9001 or ISO 9002 in 97.4%, 23.7% of them received QS 9000.

Table 4.19 Scope of Certification

All areas in company	Count	Percents
Yes	38	100.0
No	-	-
Total	38	100.0

All of them set scope of certification for all areas in their companies.

Table 4.20 Certification Bodies

Certified Bodies	Count	Percents
AJA	10	26.3
SGS	8	21.0
Others	8	21.0
BVQI	5	13.2
TISI	4	10.5
TUV Rhailand	3	7.9
Total	38	100.0

AJA is the first in the list of Certification bodies with 26.3%, SGS and others are the second with 21.0% and BVQI is the third with 13.2%.

Table 4.21 Professional consultation undertaken regarding the ISO 14001 Project

Consultant	Count	Percents
None	17	44.7
All of the project	12	31.6
Some part of the project	9	23.7
Total	38	100.0

For 44.7% they did not use consultants in their ISO 14001 project, for 31.6% they used consultants for all of the project, and 23.7% used consultants for some parts of the project.

Table 4.22 Amount of persons having direct responsibility for the environment

Environmental Responsibility (persons)	Count	Percents
0-2	21	55.3
3-5	8	21.0
6-10	4	10.5
10-15	1	2.6
More than 15 persons	4	10.5
Total	38	100.0

For most companies, 55.3% have only 0-2 environmental responsibility persons, 21.0% have 3-5 persons, and 10.5% have 6-10 and more than 15 persons.

4.2 Aspects assessment guideline results of collecting and grouping data

4.2.1 Results of environmental aspect identification method

Table 4.23 Method of environmental aspect identification

Method of aspect identification	Count	Percents
Method 1+2+3	34	89.5
Method 1+2+3+Others	4	10.5
Total	38	100.0

Method 1 is Process base analysis (process flow analysis)
Method 2 is Site tour
Method 3 is Initial Assessment Environmental Review
Others mean Site impacts method, interested party impact method

In 89.5% used method 1+2+3, 10.5% combined others method for identification environmental aspect.

4.2.2 Results of consideration of criteria

Table 4.24 Consideration of situations in environmental aspect identification

Situation	Count	Percents
Normal, abnormal, emergency	27	71.0
None	11	29.0
Total	38	100.0

The situations are considered normal, abnormal, emergency in 71.0% and 29.0% are not considered as this situation.

Table 4.25 Consideration of statuses in environmental aspect identification

Status	Count	Percents
Direct, indirect	25	65.8
None	13	34.2
Total	38	100.0

The statuses are considered direct, indirect in 71.0% and 29.0% are not considered as this status.

Table 4.26 Separate impact of resource use from pollution in aspect identification

Separate	Count	Percents
Separate Resource use/pollution	15	39.5
Not separate	23	60.5
Total	38	100.0

In 60.5% they did not separate impact of Resource use from Pollution for identifying environmental aspects, only 39.5% separate.

Table 4.27 Consideration of all areas in aspect identification

Consider all area	Count	Percents
Manufacturing/Supportive/ Sub-contractor	14	36.8
Consider not cover area	24	63.2
Total	38	100.0

In 63.2% they did not consider all areas of impact in Manufacturing, Supportive and Sub-contractor for identifying environmental aspect, only 36.8% considered cover all areas.

Table 4.28 Consideration of all tenses of aspect identification

Tenses	Count	Percents
Past/Current/Future	11	28.9
Not consider	27	71.1
Total	38	100.0

In 71.1% of they did not consider all of tenses in Past/Current/Future for identifying environmental aspects, only 28.9% considered cover.

Table 4.29 Consideration of all possibilities in aspect identification

Tenses	Count	Percents
Actual/Potential	10	26.3
Not consider	28	73.7
Total	38	100.0

73.7% of the subjects did not consider all possibilities of impact in Actual, Potential for identify environmental aspect, only 26.3% considered.

Table 4.30 Consideration of all nature in aspect identification

Nature	Count	Percents
Source/Pathway/Target	8	21.0
Not consider	30	79.0
Total	38	100.0

79.0% did not consider all nature of impact in Source, Pathway, Target for identifying environmental aspect, only 21.0% considered.

Table 4.31 Consideration electricity and other energy input in aspect identification

Criteria	Count	Percents
Electricity and Other Energy	34	89.5
Not consider	4	10.5
Total	38	100.0

89.5% considered electricity and other energy of input identification as environmental aspect, only 10.5% did not consider.

Table 4.32 Consideration of raw material input in aspect identification

Criteria	Count	Percents
Raw Material	38	100.0
Not consider	-	-
Total	38	100.0

100% considered raw material of input identification as environmental aspect.

Table 4.33 Consideration of water consumption input in aspect identification

Criteria	Count	Percents
Water Consumption	35	92.1
Not consider	3	7.9
Total	38	100.0

92.1% considered water consumption of input identification as environmental aspect, only 7.9% did not consider.

Table 4.34 Consideration of chemical usage input in aspect identification

Criteria	Count	Percents
Chemical usage	20	52.6
Not consider	18	47.2
Total	38	100.0

52.6% considered water consumption of input identification as environmental aspect, 47.2% did not consider.

Table 4.35 Criteria of output consideration in environmental aspect identification

Criteria	Count	Percents
Emission to air	38	100.0
Release to water	38	100.0
Waste management	38	100.0
Land contaminated	38	100.0
Others local environmental and Community issues	38	100.0

100% considered output environmental aspect identification in Emission to air, Release to water, Waste management, Land contaminated, and Others local environmental and Community issues

4.2.3 Results of environmental aspect evaluation method

Table 4.36 Method of environmental aspect evaluation

Method No.	Method	Count	Percents
1	Total Score = (Likelihood of Occurrence + Likelihood of Detection) x Severity of Consequence	9	23.7
2	Total Score = Sum of rating criteria	8	21.0
3	Others method	6	15.8
4	Total Score = (Likelihood of Occurrence x Likelihood of Consequence) Combine with other criteria	6	15.8
5	Total Score = (Likelihood of Probability) x (Severity of Consequence)	5	13.1
6	Total Score = Score of Yes/No	4	10.5
Total		38	100.0

There are 23.7% of the subjects that used method 1, 21.0% used method 2, the same in 15.8% used method 3,4.

Example: Method 1

Table 4.37 Aspect evaluation method1

Aspect	Likelihood of Occurrence (A)	Likelihood of Detection (B)	Severity of Consequence (C)	Total	Significant

Total mark shall be calculated as follow

$$\text{Total score} = (A+B) \times C$$

Where
A = Likelihood of Occurrence
B = Likelihood of Detection
C = Severity of Consequence

Risk Assessment will be used in accessing the significant of environmental effect. The higher the score the higher significant and effect could be.

Table 4.38 Evaluation score-method 1

Likelihood of Occurrence (A)		Likelihood of Detection (B)		Severity of Consequence (C)	
Criteria	Rank	Criteria	Rank	Criteria	Rank
Very high	5	Very high	1	None	2
High	4	High	2	Minor	4
Medium	3	Medium	3	Low	6
Low	2	Low	4	Moderate	8
Very low	1	Very low	5	High	10

Table 4.39 Classification score-method 1

Score	Level	Transfer for registration significant
0-20	Low	N
21-40	Medium	Y
41-70	High	Y
71-100	Very High	Y
Legislation relevant	Very high	Y

Example: Method 2.1

Table 4.40 Aspect evaluation method 2

Aspect	1	2	¾	5	Total	Significant

Total rating = (1) + (2)+(3 or4) +(5)

Where

1.Likelyhood of occurrence

10 = Every minute or normal process (Daily)
8 = Every scheduled occur with frequent repetition (Weekly/Monthly)
6 = Every scheduled occur with infrequent (6 monthly/Annually)
4 = In brake down situations
2 = Emergency/ Major Accident

2.Severity of consequence

10 = Very high severity
8 = High severity
6 = Medium
4 = Low
2 = Very low

3.Law exists

30 = Any legal requirement
0 = No legal requirement

4.Previous complaint or legal non-compliance

50 = Previous complaint or legal noncompliance
0 = No

5.Lack of data

50 = Lack of data

0 = Data available

Table 4.41 Classification score-Method 2.1

Level	Score
High	60 < X <100
Medium	20 < X < 60
Low	10 < X <20
Very low	0< X < 10

Example: Method 2.2

Table 4.42 Aspect evaluation method 2.2

Aspect	Legal (15)	Impact (10)	Cost (6)	Procedure (8)	Recycle (4)	Total	Sig.

Evaluation Total = ∑(Rating x Weigh)

Table 4.43 Rating score-method 2.2

Rating	Legal & Other Requirement (Weigh 15)	Impact on the environment (Weigh 10)	Cost effect (weigh 6)	Procedure (Weigh 8)	Recycle/ Reuse able Waste (Weigh 4)
1	No legal or other requirements	No (hardly any) impact	No (hardly any)	Procedures existing is completed and controlled	76-100% recyclable or reusable
2	Legal requirements expected within 3 year	Insignificant impact	< 100,000 /year	Procedure exist but need some adjustment	51-75% recyclable or reusable
3	Legal requirements expected within 1 year	Serious impact	100,000 to 500,000 /year	Procedure exist but need major changes	26-50% recyclable or reusable
4	Other requirements are already in place	High impact	500,000 to 200,000 /year	Procedure don't exist and should be made in 1 y	1-25% recyclable or reusable
5	Legal requirements are already in place	Very high impact	2000,000 up/year	Procedure don't exist and should be made directly	0% recyclable or reusable

2.Classification

2.1 Group 1 is to be fully managed in 1 year after evaluation.

- Every environmental aspect which is within the Thailand Legislation.
- All the identified and evaluated environmental aspects higher than 100 points.

2.2 Group 2 is to be fully managed in 2 years after evaluation.

- All aspects higher than 40 points

2.3 Group 3 score below 40 points considered non-significant aspect.

Example: Method 3

Table 4.44 Aspect evaluation method 3

Aspect	A1	A2	A3	A4	A5	O	Q	Total	Sig.

Risk Priority Number = (A1+A2+A3+A4+A5) x O x Q

Table 4.45 Criteria A-method 3

Criteria A	Score	
A1.Legal requirements	Comply = 1	Violate = 5
A2.Business/ Customer requirements	Meet = 1	Not meet = 3
A3.Cost of management	Low budget (x < 20,000) = 1	High budget (x > 20,000) = 3
A4.Natural of pollutant	Solid = 1 Liquid = 2 Gas = 3	
A5.Standard Control/ procedure	Available = 1	Not available = 3

Table 4.46 Criteria O-method 3

Occurrence	Score
1.Always :more frequency than once / week	3
2.Sometimes : occur once per week to once per quarter	2
3.Very Seldom : occur less than once per quarter	1

Table 4.47.Criteria Q-method 3

Occurrence	Score
1.High quantity : (Solid > 700 kg/d, Liquid > 500 Lit/d)	3
2.Medium quantity : (Solid = 100-700 Kg/d, Liquid = 100-500 Lit/d)	2
3.Low quantity : (Solid < 100 Kg/d, Liquid < 100 Lit/d)	1

2.Process Condition

- Normal: Process parameters run within specification limit.
- Abnormal: Process parameters run out of specification limit/ Process shut down.
- Emergency: Leakage or out of control of hazardous materials/ Plant shut down.

3.Classification

Not Matter

Example: Method 4

Table 4.48 Aspect evaluation method 4

Aspect	Law	Risk			Res.			Emer	Nui	Total	Sig.
		Prob	Con	T	Qua	Opp	T				

1.Legal and other requirements if have any relevant =Y

2.Risk to environment (Likelihood of occurrence X likelihood of consequence)
2.1.Probability of incidents

1 = likely to occur in extreme condition

2 = likely to occur only in abnormal condition, such as loss of power, incapacitated operator; any normally controlled condition being out of control, malicious damage, or in emergency condition (i.e. fire, flood etc.)

3 = May occur if operator is untrained, inattentive, or if equipment is not maintained

4 = Occurs in normal conditions

2.2.Consequence of Incidents

0 = No measurable impact to the environment, and human.

1 = Minimal and immediately remediable environmental impact

2 = Limited and/or short term impacts to the environment.

3 = Damaging impact to the environment or risk of danger to health or safety of people.

Significant if Probability x Consequence is 4 or more than = Y

3 Resource Usage and management
3.1 Quantity of environmental impact or aspect

1 = low

2 = Medium

3 = High

3.2 The opportunities and/or need for improvement of management of the current utilization or resources.

1 = low

2 = Medium

3 = High

Significant if Quantity x Opportunity is 6 or more than = Y

4.Emergency Preparedness, if require = Y
5.Actual and potential nuisance and community issues, if have any = Y
6.Classification

Total Rating if have any Y = Significant; if all of them are N =Non-significant

Example: Method 5

Table 4.49 Aspect evaluation in Direct Pollution -method 5

Aspect	Freq	Quan	Reg	Check	Total	Sig

Table 4.50 Aspect evaluation in Indirect Pollution -method 5

Aspect	Reg	Check	Total	Sig

Table 4.51 Aspect evaluation in Direct Resource usage- method 5

Aspect	Scale	Impact	Freq	Total	Sig

Table 4.52 Aspect evaluation in Indirect Resource usage -method 5

Aspect	Cor	Legal	Emer	Cont. Env.	Dest. Res.	Quan	Comp	Total	Sig

The Evaluation = (occurrence X Consequence)

Assessment of pollution Impact/Resource Use Impact and Direct/Indirect

1. Direct Pollution / Indirect Pollution.

1.1 The Direct pollution is considered under five criterions as below.

Table 4.53 Frequency of occurrence-method 5

Score	Frequency
1	Hardly occur
2	Occur occasionally, on average, less than or equal once a month
3	Occur often, once a month or more
4	Occur daily or in continuous operation

Table 4.54 Quantity of released pollutant to the concerned area-method 5

Score	Quantity of released pollutants
1	No identification of legal requirement
2	Release is under legal limit or standard
3	Release nearly exceeds or equal to legal limit or standard
4	Release exceeds legal limit or standard

Table 4.55 Regulation and training-method 5

Score	Regulation and training
1	All regulations, training and control are complete.
2	Have regulations, training and control but not complete.
3	Have some regulations and training.
4	Regulations and training are not available.

Table 4.56 Checking and maintenance-method 5

Score	Impact Scale
1	Inside organization
2	Local
3	Region
4	Global

The level of significance would be the multiplication of all the above.

1.2 Indirect pollution

1.Regulation and Training

2.Checking and Maintenance

Table 4.57 Subcontractor, vender and forwarder control ability-method 5

Score	Subcontractor, vender and forwarder control ability
1	Can be controlled easily and also enforceable by contact
2	Can be controlled easily but without the contact
3	Difficult to control

The level of significance would be the multiplication of all the above.

2.Assessment of resource usage impact

2.1 The direct resource usage is considered under three criterions.

Table 4.58 Scale of resource use-method 5

Score	Scale of resource use
1	Usage less than standard
2	Usage comply with standard
3	Consume over standard at operation level

Table 4.59 Impact of resource usage-method 5

Score	Type of resource use
1	Renewable/Recycle able/Reduce able/Reuse able
2	Non-renewable/ Non-Recycle able/ Non-Reduce able/ Non-Reuse able
3	Legal relevant

Table 4.60 Frequency of occurrence-method 5

Score	Frequency
1	Hardly occur
2	Occur occasionally, on average, less than or equal once a month
3	Occur often, once a month or more
4	Occur daily or in continuous operation

The level of significance would be the multiplication of all the above.

2.2 The indirect resource usage is considered under three criterions as below.

1.Scale of resource use

2.The Subcontractor, vender and forwarder control ability

The level of significance would be the multiplication of all the above.

3.Classification of the environmental aspects are shown as below:

Table 4.61 Classification score-method 5

Direct Pollution		Indirect Pollution	
High	xxx-xxxx	High	xx-xx
Medium	xxx-xxx	Medium	x-xx
Low	x-xxx	Low	x-x
Direct Resource Usage		Indirect Resource Usage	
High	xx-xx	High	x-x
Medium	x-xx	Medium	x-x
Low	x-x	Low	x-x

Example: Method 6

Table 4.62 Aspect evaluation -method 6

Aspect	1	2	3	4	5	6	7	Sig.

Significant if it fulfills YES in any one of 7 conditions list below

1.Corporate requirement

Do the environmental aspects consist of Corporate requirement, Environmental, Health and Safety and Microelectronics Group Environmental & Safety Assurance Plan and Environmental, Health and Safety Worldwide Standard?

2.Legal

Do the environmental aspect comply with all applicable Thai and other relevant law, regulation and other requirement to which we subscribe such as IE requirement?

3.Emergency Preparedness

Are the environmental aspect associated risk and potential liabilities? The emergency preparedness program, which is need to support each aspect. The Emergency Preparedness Procedure will be referred.

4.Contaminated Environment

Are the environmental aspect contaminated to local environment, the waste of environmental aspect that can contaminate the environment?

5.Destructive natural resource

The Environmental aspect is produced from the natural resource. The information will be come from MSDS, and from material specification etc.

6.Quantitative

The consumption per year of each environmental aspect is selected as ABC analysis

7.Community Complaint

Any letter containing complaint from neighbor community or other.

Table 4.63 Recommendation from professionals in all methods

Method No.	Very Good	Good	Fair/Poor
1			√√√
2	√	√√	
3	√	√√	
4	√√	√	
5		√√√	
6	√√√		

Because the subjects may have some bias in their own method this data shows only recommendation from 3 professionals that method 6 is the highest accepted to be available for evaluation of aspects, method 4 is the second, method 3,2 is the third. Method 1 is the lowest accepted because of its meaning are not clear.

4.2.4 Results of environmental aspect evaluation criteria

Table 4.64 Criteria usage of environmental aspect evaluation (can answer more than 1 choice)

Criteria	Count	Percents
1.Legal and other requirements/ Corporate policy	38	100.0
2.Likelihood of Occurrence	27	71.0
3.Severity of Consequence	19	50.0
4.Protection/Prevention/Control/Maintenance	19	50.0
5.Community complaint, Image of Company	16	42.1
6.Amount or quantity	15	39.5
7.Resource usage impact	15	39.5
8.Procedure/Work Instruction existing	13	34.2
9.Likelihood of Detection	12	31.6
10.Toxicity	11	28.9
11.Target Sensitivity/ Enhance effects	11	28.9
12.Past incident/Emergency prepare	11	28.9
13.Nuisance	8	21.0
14.Lack of data	8	21.0
15.Training	6	15.8
16.Adhered with the subjective decision making	6	15.8
17.Cost of loss	5	13.2
18.Resuscitate/Treated	4	10.5

There are 100% that considered legal and other requirements/ Corporate policy usage of environmental aspect evaluation, 86.8% also considered severity of consequence, 71.0% also considered likelihood of Occurrence too.

4.2.5 Results of meaning of criteria

Table 4.65 Meaning of Legal and other requirements, Corporate policy considered in environmental aspect evaluation

Criteria	Count	Percents
Legal compliance, applicable legislation	15	39.5
There are any legal and other requirements relevant.	11	28.9
Legal and other requirements and corporate policy compliance	8	21.0
Legal and other requirements compliance	4	10.5
Total	38	100.0

39.5% considered only criteria of legal compliance, 28.9% considered any legal and other requirements relevant, 21.0% considered legal and other requirements and corporate policy compliance.

The meaning of Legal and other requirements, corporate policy:

- Legal imposes a requirement from government authority for environmental compliance and/or control.
- Other requirements are environmental requirements generated by non-government sources such as business requirements, customers, industry codes of practice, agreements with public authority.
- Corporate policy is the requirement from the corporate organization.

Table 4.66 Meaning of Likelihood of Occurrence considered in environmental aspect evaluation

No.	Meaning of Criteria	Count	Percents
1	1 = likely to occur in extreme condition 2 = likely to occur only in abnormal condition, such as loss of power, incapacitated operator; any normally controlled condition being out of control, malicious damage, or in emergency condition (i.e. fire, flood etc.) 3 = May occur if operator is untrained, inattentive, or if equipment is not maintained 4 = Occurs in normal conditions	5	18.5
2	5 = Very high 4 = High 3 = Medium 2 = Low 1 = Very low	5	18.5
3	Pollution :Frequency, Complaint, Maintenance, Training, Procedure, Indirect Add :Sub-contractor Control Resource Usage Add :Quantity of Resource Usage	4	14.8

Table 4.66 Meaning of Likelihood of Occurrence considered in environmental aspect evaluation. (Continuous)

No.	Meaning of Criteria	Count	Percents
4	1 = Hardly occurs 2 = Occurs occasionally, on average, less than or equal to once a month 3 = Occurs often, once a month or more 4 = Occurs daily or in continuous operation	4	14.8
5	5 = Every minute or normal process (Daily) 4 = Every scheduled occur with frequent repetition (Weekly/Monthly) 3 = Every scheduled occur with infrequent (6 monthly/Annually) 2 = In brake down situations 1 = Emergency/ Major Accident	4	14.8
6	Others	5	18.5
Total		27	100.0

There are 18.5% of 27 subjects that used criteria No.1, No.2, 14.8% used No.3, No.4, No.5.and 18.5% used others meanings.

Table 4.67 Meaning of Severity of consequence considered in environmental aspect evaluation.

No.	Meaning of Criteria	Count	Percents
1	0 = No measurable impact to the environment, and human. 1 = Minimal and immediately remediable environmental impact 2 = Limited and/or short term reversible effects that warrant controls to minimize the potential and likelihood of their occurrence 3 = Damaging impact to the environment or risk of danger to health or safety of people.	6	31.9
2	10 = Very high, 8 = High, 6 = Medium, 4 = Low 2 = Very low	5	26.3
3	2 = No impact on health or environment 4 = Less impact to health of employee 6 = More impact to health or environment 8 = Much impact to health or environment 10 = Severe impact to health or environment	2	10.5
4	Numerical score in impact to Air, Water, Land, Natural Resource, Waste, Human	2	10.5
5	1 = No (hardly any) impact 2 = Insignificant impact 3 = Serious impact 4 = High impact 5 = Very high impact	2	10.5
6.	Others	2	10.5
Total		19	100.0

There are 31.9% of 19 subjects that used criteria No.1, 26.3% used No.2, 10.5% used No.3, No.4, No.5 and others.

Table 4.68 Meaning of Protection, Prevention, Control, Maintenance considered in environmental aspect evaluation

No.	Meaning of Criteria	Count	Percents
1	Environmental Management System Status	5	26.3
2	Existing Control, Operation Control, Maintenance 1 = Existing control available 2 = Have Control but not regular 3 = No control	4	21.0
3	Subcontractor, vender and forwarder control ability 1 = Can be controlled easily and also enforceable by contact 2 = Can be controlled easily but without the contact 3 = Difficult to control	4	21.0
4	Efficiency of Protection, Percentage of Protection Failure	3	15.8
5	Others	3	15.8
Total		19	100.0

There are 26.3 % of 19 subjects that used criteria No.1, 21.0% used No.2, No.3, 15.8% used No.4 and others.

Table 4.69 Meaning of Community complaint, Image of Company considered in environmental aspect evaluation

No.	Meaning of Criteria	Count	Percents
1	Community Complaint Any letter containing complaint from neighboring community and the others.	7	43.8
2	Image of Company, Concern by interested party 3 =High impact by in house, out side, emergency, legal exceeded 2 = low impact 1 = no impact	4	25.0
3	5 = Claims from most of member/people, mass media 4 = Not being brought out to mass media 3 = Claims from some of member/people, mass media 2 = Time by time claims ,but being knowledge 1 = Very few people complain	2	12.5
4	Complaint 1 = Not more than 1 times/year 2 = More than 1 but below 5 times/year 3 = More than 5 times/year	2	12.5
5	Others	1	6.3
Total		16	100.0

There are 43.8 % of 16 subjects that used criteria No.1, 25.0 % used No.2, 12.5 % used No.3, No.4, 6.5% used others.

Table 4.70 Meaning of Amount or quantity/quality considered in environmental aspect evaluation

No.	Meaning of Criteria	Count	Percents
1	Standard Quantity by Legal or normal usage (Quantity/month or year) Normal usage = 3,high usage = 5, low usage = 1 a) Chemical Storage b) Air emission from scrubber i.e. Lead, Solvent c) CFC d) Waste water e) UST (Under ground storage tank) f) Waste i.e. General waste, Chemical waste, Medical waste g) Energy/Resource use i.e. Water, Electricity, Site cleanliness/ Facilities operation i) Other aspects	6	40
2	Resource Usage and management Quantity of environmental impact or aspect 1 = low 2 = Medium 3 = High	4	26.7
3	Standard Quantity by Legal (Quantity/month or year)	2	13.4
4	Others	3	20.0
	Total	15	100.0

There are 40 % of 15 subjects that used criteria No.1, 26.7 % use No.2, 13.4 % used No.3, 20% used others.

Table 4.71 Meaning of Resource usage impact considered in environmental aspect evaluation.

No.	Meaning of Criteria	Count	Percents
1	Renewable Sustainable Recycle-able	7	46.7
2	Destructive natural resource Natural Consumption	4	26.7
3	Recycle-able Reuse-able Reduce-able	2	13.4
4	Others	2	13.4
	Total	15	100.0

There are 46.7 % of 15 subjects that used criteria No.1, 26.7 % used No.2, 13.4 % used No.3, others.

Table 4.72 Meaning of Procedure/Work Instruction existing considered in environmental aspect evaluation

No.	Meaning of Criteria	Count	Percents
1	Procedure/ Standard Control/ Work Instruction Existing	6	46.2
2	Procedure/ Work Instruction 1 = Complete 2 = Non-Complete 3 = None	5	38.5
3	1 = Procedures existing is completed and controlled 2 = Procedure exist but need some adjustment 3 = Procedure exist but need major changes 4 = Procedure does not exist and should be made in 1 year 5 = Procedure does not exist and should be made directly	2	15.4
Total		13	100.0

There are 46.2 % of 13 subjects that use criteria No.1, 38.5 % use No.2, 15.4 % use No.3.

Table 4.73 Meaning of Likelihood of Detection considered in environmental aspect evaluation.

No.	Meaning of Criteria	Count	Percents
1	1 =Very high, 2 =High, 3 =Medium, 4 =Low, 5 =Very low	6	50.0
2	Routine Inspection	2	16.7
3	Detection 1 = Always detection and checking 2 = Some detection and checking 3 = No detection and checking	2	16.7
4	1= Control system or continuous monitoring 2= Control and sampling check 3= Can be monitored by 4 sense 4 = No current monitoring and need measuring tools or equipment 5= No current monitoring and need higher analysis technology	1	8.4
5	5= No monitoring possible and no physical indicators 4= No monitoring possible but has physical indicators. 3= Periodic infrequent monitoring performed (annual) but physical indicators difficult to assess 2= Regular frequent monitoring or with obvious physical indicators 1 = Daily/weekly monitoring or automatic alarm systems	1	8.4
Total		12	100.0

There are 50 % of 12 subjects that used criteria No.1, 16.7 % used No.2, No.3, 8.4 % used No.4 and No.5.

Table 4.74 Meaning of Toxicity considered in environmental aspect evaluation.

No.	Meaning of Criteria	Count	Percents
1	Human Impact 1 = No impact 2 = Irritant, long term period, discomfort 3 = Severe, Chronic, Trauma , short term period 4 = May cause death	4	36.4
2	Impact to human 3 = High toxicity, Resuscitate period more than 1 month 2 = Medium toxicity, Resuscitate period less than 1 month or stop working 1= Low toxicity, Not stop working	3	27.3
3	Toxicity (reference from MSDS or other international standard) 3 = High Toxicity 2 = Moderate Toxicity 1 = Low Toxicity, No Toxicity	2	18.2
4	Toxicity reference from MSDS or other international standard 5= Highly toxic/ hazardous 4= Toxic in normal circumstances 3 =Toxic in abnormal circumstances 2= Low toxicity 1= Very low toxicity	1	9.0
5	Casualties to human lives up to health or life lameness. Loss of part of body Up to hospitalized for ≥ 1 mo. Up to hospitalized for ≥ 1 wk. Up to few hospitalized First aid	1	9.0
Total		11	100.0

There are 36.4 % of 11 subjects that used criteria No.1, 27.3 % used No.2, 18.2 % used No.3, 9% used No.4 and No.5.

Table 4.75 Meaning of Target Sensitivity/ Enhanced effects considered in environmental aspect evaluation.

No.	Meaning of Criteria	Count	Percents
1	Enhanced effects in abnormal situation	4	23.4
2	In house / local / Global	3	27.3
3	Local / Regional/ Global	2	18.2
4	Little impact/ Factory/ Company / Public	1	9.0
5	Narrow/ Wider	1	9.0
Total		11	100.0

There are 23.4 % of 11 subjects that used criteria No.1, 27.3 % used No.2, 18.2 % used No.3, 9% used No.4 and No.5.

Table 4.76 Meaning of Past incident/Emergency preparedness considered in environmental aspect evaluation.

No.	Meaning of Criteria	Count	Percents
1	Past incident or poor performance	5	45.5
2	Needs to establish and maintain performance response emergency preparedness.	3	27.3
3	Condition or situation for past year	2	18.2
4	Past incident 0= No past incident 1= Original Severity 2= Extent to which remedial action taken 3 = Whether problem has re-occurred 4 = Demonstrated effectiveness of corrective action	1	9.0
Total		11	100.0

There are 45.5 % of 11 subjects that used criteria No.1, 27.3 % used No.2, 18.2 % used No.3, 9% use No.4.

Table 4.77 Meaning of Nuisance considered in environmental aspect evaluation.

No.	Meaning of Criteria	Count	Percents
1	Nuisance	4	50.0
2	Actual and potential nuisance and community issues	3	37.5
3	Nuisance/Amenity 0 = no nuisance 1 = Occasional minor disturbance-non routine 2 = Ongoing minor disturbance but not seriously affecting neighbor amenity 3 = Routine disturbance affecting local of life 4 = Serious local disturbance	1	12.5
Total		8	100.0

There are 50 % of 8 subjects that used criteria No.1, 37.5 % used No.2, 12.5 % used No.3.

Table 4.78 Meaning of Lack of data considered in environmental aspect evaluation.

No.	Meaning of Criteria	Count	Percents
1	Lack of information/ Data /Insufficient information	5	62.5
2	No test data	2	25.0
3	No detail	1	12.5
Total		8	100.0

There are 62.5 % of 8 subjects that used criteria No.1, 25 % used No.2, 12.5 % used No.3.

Table 4.79 Meaning of Training considered in environmental aspect evaluation.

No.	Meaning of Criteria	Count	Percents
1	Training	3	50.0
2	Training 1= Complete 2= Incomplete 3= Not received	2	33.3
3	Regulation and Training 1=There are regulations, training and implementation are complete. 2=There are regulations, training and implementation are not complete. 3=There are some regulations and training. 4= No regulations and training	1	16.7
Total		6	100.0

There are 50 % of 6 subjects that used criteria No.1, 33.3 % used No.2, 16.7 % used No.3.

Table 4.80 Meaning of Adhered with the subjective decision making considered in environmental aspect evaluation.

No.	Meaning of Criteria	Count	Percents
1	Adhered with the subjective decision making	3	50.0
2	Subject decision	2	33.3
3	Discussion of aspects	1	16.7
Total		6	100.0

There are 50 % of 6 subjects that used criteria No.1, 33.3 % used No.2, 16.7 % used No.3.

Table 4.81 Meaning of Cost of losses considered in environmental aspect evaluation.

No.	Meaning of Criteria	Count	Percents
1	Cost effect 1= No (hardly any) 2= < 100,000 Baht/year 3 = 100,000 to 500,000 Baht/year 4 = 500,000 to 200,000 Baht/year 5 = More than 2000,000 Baht/year	2	40.0
2	Cost of loss 10= More than 500,000 Baht/year 5= Less than 500,000 Baht/year 0= No loss	1	20.0
3	Cost of loss 1 = Low (Less than 500,000 Baht/year) 2 = Medium (500,001 – 100,000 Baht/year) 3 = High (More than 100,000 Baht/year)	1	20.0
4	Cost of management 1 = High budget (>20,000 Baht) 3 = Low budget (< 20,000 Baht)	1	20.0
Total		5	100.0

There are 40 % of 5 subjects that used criteria No.1, 20 % used No.2, No.3, No.4.

Table 4.82 Meaning of Resuscitate/Treated considered in environmental aspect evaluation.

No.	Meaning of Criteria	Count	Percents
1	1 = No impact 2 = Fast recover 3 = Long times	2	50.0
2	Times of Self Recovery 1 = Less than 1 week 2 = between 1-3 month 3 = More than 3 month	1	25.0
3	Land Contaminated 1 = Treatable 2 = Non-treatable	1	25.0
Total		4	100.0

There are 50 % of 4 subjects that used criteria No.1, 25 % used No.2, No.3.

4.2.6 Results of implementation problems from subjects

The problems of environmental aspect identification and evaluation from subjects discussion as follows:

Table 4.83 The problems of environmental aspect identification from subjects discussion

No.	Problems	Count	Percents
1	Lack of quantity data in each of area	10	18.5
2	Lack of proficiency staff	9	16.7
3	Do not understand between aspects and impact	7	12.9
4	Lack of cooperate from other employee	6	11.1
5	Do not understand clearly between abnormal and emergency	5	9.3
6	Do not understand clearly between actual and potential	4	7.4
7	Can not make decision between pollution and resource usage	4	7.4
8	Can not define sensitive area	3	5.6
9	Lack of past incident data	2	3.7
10	Did not identify pollution control area	2	3.7
11	Confuse in meaning of some impacts such as waste water and water discharge	2	3.7
Total		54	100.0

Lack of quantity data in each of area is the highest problem in 18.5% of the subjects, Lack of proficiency staff is the second in 16.7%, Do not understand between aspects and impact is the third in 12.9%.

Table 4.84 The problems of environmental aspect evaluation from subjects discussion

Method	Problems	Count	Percents
1	- Because of the meaning of criteria is not clear, it make them loss consistency and confuse to make decision point in evaluation process.	7	77.8
2	-	-	0
3	- Some of the methods are complicate because it come from corporate company and very hard to understand.	4	66.7
4	-	-	
5	-	-	
6	-	-	

Method 1 is the highest problem in 77.8% of the user, Method 3 is the second in 66.7% of the user, the other Methods have not suggested from the user.

CHAPTER V

Discussion

Presently, the electronics industrial sector has the highest exporting value in Thailand. Therefore, they are directly concerned with the international trade standards. One of the most important aspects of international trade standards is the Environmental Management System ISO 14001:1996.

The results from the Thai Environmental Institute and Department of Industrial Works survey (2) show that the most major problem for implementing ISO 14001 is identification of environmental aspects. Environmental Aspect is the requirement clause 4.3.1 in ISO 14001 that every organization must follow. In this requirement it explains about what to do but does not describe how to do it.

This thesis study is for implementing guidelines for environmental aspect identification and evaluation. The study by interviews (follows as questionnaire) of Environmental Management Representative(s) (EMR) or their representatives in the electronics industrial sector from 38 ISO 14001 certified companies and collecting data from procedures.

It will be a guideline for non-certified and certified companies in ISO 14001-implementation for clause 4.3.1 to modify and improve their system. This guideline should be easy to understand, friendly for use, flexible and comply with ISO 14001 requirements.

The discussion chapter consists of 2 main part

5.1 Discussion of study results

5.2 Discussion of study design

5.1 Discussion of study results

Discussion of study results consists of 2 main parts.

5.1.1 Discussion results of personal data, database of organizations and ISO 14001 certification data

5.1.2 Discussion results of data from procedures and in-depth interviews for implementing aspect identification and evaluation guidelines

5.1.1 Discussion results in general data

Consists of 3 parts.

5.1.1.1 Personal data

Personal data of the subjects is very important for reliability in results of discussion from them. The personal data shows that 52.6 % are male. In 84.2 % they have environmental experience below 5 years, in 52.6 % they have electronic industrial experience below 5 years and in 60.5% they have been working in their companies for less than 5 years also.

The data shows that most of the subjects have low experience with regards to the environment, history and the current electronics industrial sector.

Most of them have received a Bachelors degree, 76.3% of the subjects, and in 21.0% have graduated to Masters degree. There are 31.5% of the subjects that graduated from the Environmental Health & Safety field, 23.6% from Management or Business and 21.0% from Engineering. In 52.6% they have been working in the Environmental Health & Safety section. This data shows that most of the subjects received a high level of education. They graduated from Environmental Health & Safety, Management or Business and Engineering. Half of them have been working in the Environmental Health & Safety section. However, they have experience below 5 years, they have a good background and direct responsibility relevant to ISO 14001.

For 86.9 % they were members of the ISO 14001 Starting Team. Most of them, 92.6% are kind enough to be ISO 14001 advisors for interested parties. The data shows that most of them have passed the aspects identification and evaluation process (because this is early in the process). They are very confident and understand much, enough to be advisors for interested parties.

There are 42.1% in manager positions and 28.9% in supervisor positions. In 55.3% they are the Environmental Management Representative(s) (EMR). The data shows that they are at management and chief responsibility levels. They must pass the discussion and decision making process regarding aspects identification and evaluation by themselves.

5.1.1.2 Database of organization

The results database of organization show that all of them are in the medium to large company sector because they are within industrial class 3, l.e. their employees are more than 51 persons or equipment is more than 50 HP.

Their products are Integrated Circuit for 28.9%, 23.6% produce Hard Disk Drives, Floppy Disk Drives, and 18.4% produce Monitor, Audio or others. The data shows that they are very different products and processes. They may have differences regarding available aspect identification and evaluation methods from their complicated organizations.

There are 39.5% that have employees of more than 3,000 persons, 28.9% have between 1,001-1,500 persons, and 18.4% have between 1,501-2,500 persons. The data shows that they are large organizations.

Duration of their businesses are between 5-15 years for 68.4%. The data shows that they are recognized as long life businesses. Therefore, the image or reputation of the organization is very important to them.

The highest investment is Japan with 42.1%, USA with 28.9%, and Thailand with 15.8%. The data shows that most of the electronic industrial investments is Japanese. The tradition or corporate policy of Japanese and USA organizations is to fully implement ISO 14001 at all locations.

The capital cost is between less than 100 to 500 million baht for 52.6%. The data shows that they are large organization and because of their large size and also because of their world trade their organizations will be directly effected with the implementation of ISO 14001.

5.1.1.3 ISO 14001 certification data

Most of the other certificates received are for ISO 9001 or 9002 for 97.4%. The data shows that they already have supporting documentation and management systems to implement ISO 14001.

All of them set the scope for certification of all areas within their companies. AJA is the first in the list of Certification bodies with 26.3%, SGS and others are the second with 21.0% and BVQI is the third with 13.2%. The data shows that they received certification from reputable certification bodies.

For 44.7% they did not use consultants in their ISO 14001 project, for 31.6% they used consultants for all of the project, and 23.7% used consultants for some parts of the project. The data shows that most of them have used consultant. If they used the same consultant, their aspect identification and evaluation method will be very similar.

Most of the companies 55.3 % have 0-2 persons with direct environmental responsibility. The data shows that they have already succeeded in implement ISO 14001 with or without persons with direct environmental responsibility.

5.1.2 Discussion results of data from procedure and in-depth interview

For implementing aspect identification and evaluation guidelines

The guidelines for environmental aspect identification and evaluation method are considered by important criteria as follows:

- Compliance with the requirements of clause 4.3.1 of ISO 14001:1996
- Compliance with guidance clause A.3.1 in annex of ISO 14001:1996 and clause 4.2.2 in ISO 14004:1996.
- The most usage method
- High frequency of usage criteria
- Meaning of criteria is clear and easy to understand. Decision making about available meaning depends on discussion with professionals and subjects.
- Effectively identify and evaluate different impacts between pollution and resource usage.
- Classification of significant aspects should come from statistic or logic methods.

ISO 14001 Requirement Clause 4.3.1

The organization shall establish and maintain (a) procedure(s) to identify the environmental aspects of its activities, products or services that it can control and over which it can be expected to have an influence, in order to determine those which have or can have significant impacts on the environment. The organization shall ensure that the aspects related to these significant impacts are considered in setting its environment objectives.

The organization shall keep this information up-to-date

Discussion of guideline results consists of 2 parts.

1.Guidelines for environmental aspects identification

2.Guidelines for environmental aspects evaluation and classification

Guidelines for environmental aspects identification

1.0 Purpose

To identify the organization's relevant environmental aspects causing significant impact on the environment for all productions, processes, services and supporting activities.

2.0 Scope

These guidelines are applicable to all production processes and supporting activities in organizations associated with electronics manufacturing.

3.0 Applicable Documents:

ISO 14001:1996
Environmental Management Systems: Specification with guidance for use
ISO 14004: 1996
Environmental Management Systems: General Guidelines on Principles, Systems and Supporting Techniques

4.0 Responsibility

4.1 It is the responsibility of the organization's EMS committee to initiate and coordinate the overall environmental aspects review of the organization and oversee the implementation and effectiveness of the organization's Environmental Management System.

4.2 It is the responsibility of the representative in each area for the preparation and the head of each section for reviewing the aspect identification and evaluation.

4.3 The Environmental Health and Safety Manager (EMR) is responsible for approving the identification of environmental aspects and evaluation of associated environmental impact.

4.4 It is the responsibility of the Environmental Health and Safety Manager for establishing and implementing this procedure.

Discussion: Responsibility depends on the structure of the organization.

5.0 Definitions

For the purposes of these guidelines, the following definitions apply.

5.1 A Significant environmental aspect
: is an environmental aspect that has or can have a significant environmental impact.

5.2 Environment
: surroundings in which an organization operates including air, water, land, natural resources, flora, fauna, humans, and their interrelation.
Note – Surroundings in this context extend from within an organization to the global system.

5.3 Environmental aspect
: element of an organization's activities, products or services that can interact with the environment.

5.4 Environmental impact
: any change to the environment, whether adverse beneficial, wholly or partially resulting from an organization's activities, products or services.

5.5 EMS committee
: Environmental Management System committee
Discussion: Should identify qualification of EMS committee members.

5.6 EMR
: Environmental Management Representative (s); The Environmental Health and Safety Manager

5.7 Interested party
: individual or group concerned with or affected by the environmental performance of an organization

5.8 IER
: Initial Environmental Review

5.9 Organization
: A company, corporation, firm, enterprise, authority or institution, or part or combination thereof, incorporated or not incorporated, public or private, that has its own functions and administration.

Discussion: Definition of other specific technical terms depends on processes of the organizations.

6.0 Form (see Appendix C)
Environmental Process Flow Analysis form
Environmental Aspect Identification form
Changing request form

7.0 Guidelines

7.1 up-to-date

This aspect identification is reviewed at least one time per year after management review activity or carried out under the following circumstances;

- Sources and nature of the pollution according to the new or modified product, project, raw material, machine, equipment and/or process were changed.
- Quantity or types of pollution were changed.
- Legislation, complaints, policy and pressure from interested parties were changed.

If there are any changes, The head of each department must complete the Changing request form and send it to the EMS committee within 1 month for approval/review.

7.2 Steps for identifying environmental aspects

Steps to start identifying environmental aspects

7.2.1 Site tour at operating section and desk study

7.2.2 Process analysis/ Process flow analysis (Process line)

7.2.3 Initial Environmental Review based on process flow analysis and site tour data (not mandatory)

7.2.4 Identification of environmental aspects based on Initial Environmental Review (IER) data.

The aim should to be considered all environmental aspects of the organization as a basis for establishing the environmental management system

The review should cover four key areas:

a) legislative and regulatory requirements;
b) an identification of significant environmental aspects;
c) an examination of all existing environmental management practices and procedure;
d) an evaluation of feedback from the investigation of previous incidents.

The review may include checklist, interviews, direct inspection and measurement, results of previous audits or other reviews depending on the nature of the activities.

At the start of environmental aspects identification, The Initial Environmental Review (IER) is created by a qualified EMS committee that shall be used as a base line for implementation.

7.3 Select an activity, a product or service (Identify scope)

7.3.1 Manufacturing Scope

The activities to be identified should be large enough for meaningful examination and small enough to be sufficiently understood. These activities can be categorized into the following 3 categories

Category 1: Manufacturing activities, such as

1.1 Process line

- Receiving
- Expansion
- Die bonding
- Wire bonding
- Moldering
- Soldering & Washing
- Cutting (Pin form)
- Marking & Testing
- Packing

1.2 Supporting Process line

- Facility and Maintenance
- Air Treatment

- Air polluted treatment
- Water treatment
- Waste water treatment plant
- Cooling Tower/ Boiler
- Gas Tank
- Chemical Storage room
- Suppliers and Products Storage room
- Waste room
- Generator

Category 2: Supporting activity, such as

- Administration, Office Department
- Medical Room
- Canteen
- Car park
- Rest room, Janitorial Activities
- Gardening

Category 3: A contractor or supplier activities, such as

- Bus Transportation for employee
- Supplier Container for goods or raw material
- Shipping
- Construction

7.3.2 Processing Scope

Representatives of each area will have to identify their own processes or activities, products and services. In order to understand environmental aspects related to each category in the organization. If it is very complicated they should be identified in sub-processes. In another way, some processes can be included together, because they will have the same controls.

Organizations do not have to evaluate each product, component or raw material input. They may select categories of activities, products or services to identify those aspects most likely to have a significant impact.

Representatives of each area will have to identify the aspects of their activities. Which can (or are likely to) interact with the environment for significant impacts that the organization can control and be expected to have an influence.

Identify activities relevant in each processes system in Environmental Process Flow Analysis form.

- Process flow diagram (overall)
- Process Flow Analysis (fill form)
- Sub-process Flow Analysis (If any)
- Identify a contractor or supplier activities analysis
- Identify special or sensitive environmental consideration activity or area (If any)

7.3.3 Identify input in process

For each activity identify its type of product, raw material, natural resources used and equipment.

- Energy

Such as electric, fuel, gas
- Water consumption
  Such as DI water, city water, Others
- Chemical consumption (all acids, base, solvents in process)
  Such as Cl_2, flux, NaCl
- Raw material
  Such as lead frame, bonding wire
- suppliers consumption
  Such as paper, packing material
- Equipment/Tooling/Maintenance item
  Such as solder, wet scrubber

For each area, An Environmental Aspect Identification form should be completed. Refer to paragraph 7.4.4 for guidance in filling in the form.

7.3.4 Identify output and impact in process
- Product
- By-Product (If any)
- Environmental impact

The process to identify the significant environmental aspects associated with the activities at operating units should, where relevant, consider,

a) emissions to air;
Scrubber exhaust
General exhaust
Chemical fume
b) release to water;
Waste water in process
Domestic waste water
c) waste management;
Hazard waste
General waste
d) contamination of land;
Chemical spill
Floor drain
e) use of raw materials and natural resources;
IC unit
Shipping material
f) others local environmental and community issues;
Odor, Noise, Health & Safety risk

For each area, An Environmental Aspect Identification form should be completed. Refer to paragraph 7.4.4 for guidance in filling in the form.

Discussion
: This is only some examples for guidance.
: This analysis method aids in to guidance towards the next step and finds out the source, pathway, target and impact of environmental problems. These analyses are useful for deciding control in the organization.

7.4 Identification of environmental aspects

To identify the environmental aspects of organization's process or activities that can control and over which it can be expected to have an influence
This process should consider:

Organizations put further details from each Environmental Process Flow Analysis form into the Environmental Identification aspect form. This information is developed for environmental aspect evaluation in the next process. The following paragraphs will explain the items mentioned in the Environmental Aspect Identification form

7.4.1 General data

Name of the activity
: the name of the activity for which the environmental aspects are identified
Area/Department name
: is the name of the area where this identification is conducted.
Responsibility
: the name of the responsible person (s) in this area.
Prepared by
: the name of the person who conducted this identification.
Approved by
: the name of the person who approved this identification.
Date
: the date when the form was finished.
Aspect No.
: code reference for the aspect for traceability to the source of area as follow:
_____ Department_____ Activity/Area_____ Number
such as F WR 01 means Facility Department, Waste room, aspect number 01

Discussion: The organization should identify meaning of department and activity abbreviation elsewhere in this procedure.

7.4.2 Identify Condition

In all cases, consideration should be given to normal and abnormal operations within the organization, and to potential emergency conditions.(5)
Normal (N)
: The organizations activities that proceed under regulations, supervision and operational control systems, such as production processes, material consumption, and other regular activities.
Abnormal (A)
: The abnormal condition occurs during the organization's regular activities and affecting the production processes or operation control systems, such as machines or equipment malfunction, shut-down and start-up, small chemical spill or leakage, over usage of raw materials in operation, that may create pollution near to or over the regulatory limit.
Emergency (E)
: The situations, which may accidentally occur at any time during the organization's regular activities, that may cause a shut down of any or all the organization's

operations as well as creating severe pollution that will have an impact on the environment, human, and community such as fire, explosion, harmful air emission, large chemical spill, flood.

Discussion: Emergency is identified for preparing different specific control from normal and abnormal conditions.

7.4.3 Identify Situation

Actual (A)
: This situation is in normal operation.
Potential (P)
: The associated realistic potential significant environmental impacts, which are reasonably foreseeable. The potential regulatory, legal and business exposure affecting the organization.
Past (P)
: Since 1998- 1/01/2000
Current (C)
: Since 1/01/2000-now
Future (F)
: Has not yet occurred.
Direct Control (D)
: Possible to design an operating control system, resource consumption system or appropriate control equipment in the plant such as sewage plant for domestic treatment, wet scrubber for air emission from solder plating, saving energy.
Indirect Control (I)
: Not possible to design an operating control system, resource consumption system or appropriate control equipment in the plant such as chemical supplier, raw material supplier, oil transportation.

Discussion
: Definition of Past and Current depends on the organization.

7.4.4 Identify Control situation

Organizations may also take into account the degree of practical control they may have over the environmental aspects being considered.(5)
Control level 1
: Maintain completely the monitoring, work instructions, and operational controls in the area.
Control level 2
: Lack of one or two of the monitoring, work instructions, or operational controls in the area.
Control level 3
: All not available for the monitoring, work instructions, and operational controls in the area.

7.4.5 Identify environmental aspect

Identify the aspect from details of each activity in the Environmental Aspect

Identification form as follows:

7.4.5.1 Under the "Input"

Each aspect item shall have an individual technique to find out the quantity.

- Energy
  Total quantity by rate per year
  The consumption by Kilowatt per Hour of each equipment and calculate time of usage per month/year
  For the calculation of oil to the Kilowatt per Hour (fuel 100 liter = 200 Kilowatt) or the quantity from Facility consumption record and/or finance.
- Water consumption
  The quantity rate per year from facility consumption record and/or finance
- Chemical consumption (all acids, base, solvents in process)
  The quantity rate per year/month from Material Control Department reports, which give total use and average usage per day to calculate the consumption.
- suppliers consumption
  The quantity rate per year from Material Control Department reports, which give total use and average usage per day to calculate the consumption.
- Use of raw materials and natural resources
  Product/Packing/Shipping material: The quantity of product is form the Shipping section or finance and the materials are from Material Control Department reports, Which gives total use and average usage per day to calculate the consumption.
  The quantity rate per year from Material Control Department reports, which give total use and average usage per day to calculate the consumption.

- Equipment/Tooling/Maintenance items

Discussion: Quantity of electricity and water consumption should identify sensitive area that can be controlled and reduced. After that the organization should set up measurement and monitoring activities to analyze the next available target.

7.4.5.2 Under the "Output"

Each aspect item shall have an individual technique to find out the quantity or quality.

a) emissions to air;
   - Specify any kind of pollution to the air, for example the air may be polluted with chemical fumes, dust, heat.
   - Quality data are from air monitoring results in working areas and stationary sources.

b) release to water
   - Specify any kind of pollution of the water stream, For example, the water may contain chemicals, heavy metals, silica.

- Quality data are from water monitoring results at each point after release to outside organization.
- The conclusion of indirect discharge and direct discharge to drain lines is the quantity from facility records.

c) waste management
- Specify any from of waste, which this activity is producing.
The example for non hazardous waste: paper, plastics, foam, rails, non-radio active, tubes, boxes, construction steel, finger-cots, face masks all items that are not contaminated with hazardous substances.
The example for hazardous waste: sludge, waste oil, waste chemicals (acids, base, plating solution, solvents, flux) from the process.
- The data is from the sales waste list, which is provided from the Purchasing Section.

d) contamination of land
- Specify any possibility to pollute the land, for example spillage of hazardous substances.
- The quantity is calculated by the area space (in square meter: m^2) and data is from each facility.

e) others local environmental and community issues
- The most common issues related to nuisance (problems) are odor, noise, visual and vibrations. If there is a nuisance impact to the environment in the activity then specify it.
- Any letter containing a complaint from employees, neighboring, community and others.

g) Description
- If there is any relevant information that can contribute to this identification, please specify it. For example: any past incidents, complaints from employees, neighbor etc.
- Specify source and brief description of the aspects including pathway to the targets of those aspects.

Discussion
: Source of available data depends on the organization.
: Data in the same rate or unit is easy to be evaluated in the next step.

7.4.6 Identify environmental impact and environmental class

Table 5.1 Identification for impact and aspect class

Impact	Aspect Class
Air emission	Air emission
Release to water	Water discharge
waste management	General waste, Hazardous waste, Reuse/recycle, IC Scrap, Hard decompose waste
Contamination of land	Land use, Land contaminated
Use of raw material and natural resources	Energy, Water, Chemical, Raw material, Supplies, Product/ Packaging/ Shipping material
Others local environmental and community issues	Community complaint, Employee complaint, Noise, Odor, Vibration, Visual, Health & Safety

Each completed form shall be reviewed together by the Head of the section, the owner who coordinated the aspect identification and the representative from the EMS team for adequacy and correctness. After reviewing the completed forms, perform the next Guideline as defined in "Environmental aspects evaluation"

Guidelines for environmental aspects Evaluation and classification

1.0 Purpose

To evaluate the organization's relevant environmental aspects causing significant impact on the environment for all production processes and supporting activities.

2.0 Scope

These guidelines are applicable to all production processes and supporting activities in organization associated with manufacturing.

3.0 Applicable Documents:

ISO 14001:1996
Environmental Management Systems: Specification with guidance for use
ISO 14004: 1996
Environmental Management Systems: General Guidelines on Principles, Systems and Supporting Techniques
Thailand Legislation and Others Standard

4.0 Responsibility

4.1 It is the responsibility of the EMS committee for setting the criteria for evaluation and approval by top management

4.2 It is the responsibility of the EMS Committee and Head of section to cooperate in the evaluation of environmental aspects of each section in the organization.

4.3 It is the responsibility of the Environmental Health and Safety Manager for establishing and implementing this procedure.

4.4 The Environmental Health and Safety Manager is responsible for reviewing and approving the evaluation of associated environmental significant aspect list.

Discussion: Responsibility depends on the situation of the organization.

5.0 Definitions

For the purposes of this guideline, the following definitions apply.

5.1 Hazardous substance
: are substances which can be explosive, flammable and inflammable, oxidizing, toxic, pathogenic, radioactive, genetic transforming, corrosive, irritating, or other substances whether chemicals or not, which may cause danger to human being, animal, property or environment.

5.2 MSDS
: Material Safety Data Sheet

5.3 Pollution
Waste water discharge
Air pollution

Waste and hazardous waste
Contamination to land
Chemical handling and storage

5.4 Natural resource depletion
Water consumption
Electricity or energy consumption
Raw material consumption
Supporting material consumption

5.5 Corporate policy
The main policy from corporate company.

Discussion: Definition of other specific technical terms depends on the organization processes.

6.0 Form (see Appendix C)
Environmental Aspect Evaluation form
Significant Aspects List

7.0Guideline

7.1 up-to-date

- The evaluation of environmental aspects shall be set when the aspects identified were changed under the circumstances; (see clause 7.1 in Guidelines for environmental aspects identification)
- Re-evaluation of environmental aspects results from the changes and/or after the corrective action has been taken to reduce impact to the environment shall be done with in 1 months after the date of changes or actions is recognized.

7.2 Steps of environmental aspects evaluation
Steps to start evaluation of environmental aspects

- Setting criteria for evaluation by the EMS committee and approval by top management
- Setting or finding out standards for making decisions about significant environmental aspects in each of criteria.
- Grouping environmental aspect by class. (see 7.5.2)
- Evaluate every aspect in each group.
- Design Classification method.

7.3 Setting Criteria

For an appropriate guideline to the evaluation of environmental significant aspect, criteria from study results can be facilitated by considering the following

Table 5.2 Criteria setting guideline for evaluating of environmental aspect significance.

ISO 14004:1996	Study Result
Other criteria concern	
-	- Protection/Prevention/Control/Maintenance
-	- Lack of data (over all)
-	- Past incident/Emergency preparedness
-	- Adhered with the subjective decision making
Environmental concern:	
The scale of the impact	- Target Sensitivity/ Enhanced effects
The severity of the impact	- Severity of Consequence (over all) - Amount or quantity/quality - Toxicity - Resource usage impact
Probability of occurrence	- Likelihood of Occurrence (over all) - Procedure/Work Instruction existing - Training
Duration of impact	- Resuscitate/Treated
	- Likelihood of Detection
Business concern:	
ISO 14004:1996	Study Result
Potential regulatory and legal exposure	- Legal and Other requirements/ Corporate policy
Difficulty of changing the impact	-
Cost of changing the impact	- Cost of loss
Effect of change on other activities and processes	-
Concerns of interested parties	- Community complaint, Image of Company (combined) - Nuisance
Effect on the image of the organization.	

Source: ISO14004:1996: Environmental management systems: general guidelines on principles, systems and supporting techniques. (13)

Discussion
: Organization should select only the suitable criteria for each of company
: Some of the criteria are not chosen because it's difficult to set a decision making point, depending on finance, nature of organization and this situation such as effect of change on other activities and processes, difficulty of changing the impact, Resuscitate/Treated, adhered with the subjective decision making.

7.4 Setting or finding standards for decision making in each of criteria setting as follows:

Yes = Significant aspect
No = Non-Significant aspect

7.4.1 Business concerns:

7.4.1.1 Legal and other requirements/ Corporate policy
Yes = If any legal and other requirements/ Corporate policy relevant
No = Not any legal and other requirements/ Corporate policy relevant

Discussion: The most important section in ISO 14001:1996 is Legal and Other requirements/ Corporate policy relevant, that must be considered in all aspects.

7.4.1.2 Cost of loss
Yes = More than 500,000 baht/year
No = Less than 500,000 baht/year

Discussion: Cost of loss depends on suitability of the organization.

7.4.1.3 Community complaint, Image of Company (combined), Nuisance: will be evaluated based on complaints from the employees and neighbors, and can be divided in the following main items : noise, vibrations, visual, odor
Yes = If any community or employee complaint, impact to image of company, Nuisance by letter or other means.
No = No community or employee complaint, impact to image of company, Nuisance by letter, or other means.

Discussion: Most of the companies in electronics industrial sector are international, and therefore, the image of the company is very important.

7.4.2 Environmental concerns:

Total Score = (Likelihood of Occurrence + Likelihood of Detection) x Severity of Consequence

In setting the standard score they have the same rating as follows:
1 = Low impact
2 = Medium impact
3 = High impact

7.4.2.1 Likelihood of Occurrence (A)
Likelihood of Occurrence = (Probability of Occurrence) + (Procedure/Work Instruction existing) + (Training)

- Probability of Occurrence (P_1)

1 = Hardly occurs, once a year or less
2 = Occurs often, at least once a month or more
3 = Occurs daily or in continuous operation

Discussion: Probability should be easy to make a decision or may be adjusted at any time.

- Procedure/Work Instruction existing (P_2)

1 = Procedure/ Work Instruction or Standard Control exists
3 = Procedure/ Work Instruction or Standard Control does not exist

Discussion: This means the Environmental Procedure/Work Instruction or Standard Control exists in the requested area and is up-to-date.

- Training (Tr)

1 = Completely Trained
3 = Incompletely Trained

Discussion: Meaning of completely trained is having received environmental training in awareness and competence for all relevant persons, all courses or target from training needs are approved, and have passed the examination or tests (if any).

7.4.2.2 Likelihood of Detection (B)

1 = Daily/weekly monitoring or automatic alarm systems (Routine Inspection) / known quantity of usage
2 = Periodic infrequent monitoring performed (annual) but physical indicators difficult to assess/ Easy to predict quantity
3 = No monitoring possible and cannot indicate by physical indicators/ hard or cannot predict quantity

Discussion: Detection is very important for feedback control in the environmental system but not mandatory in all areas. The organization should identify critical areas for receiving suitable detection that can make deviation from legal or severity environmental impact.

7.4.2.3 Severity of Consequence (C)

Severity of Consequence of pollution = (Amount or quantity/quality) + (Toxicity)
Severity of Consequence of resource use = (Amount or quantity) + (Resource usage impact)

Discussion: Organization should identify what is the meaning of resource use and pollution such as all consumption of paper use, raw material use, electricity and resource usage. Because the severity of their meanings are very different.

- Amount or quantity/quality (Q)

Standard Quantity/Quality by Legal or normal usage (Quantity/month or year)

1 = Lower than or equal to normal usage/ Legal compliance
3 = Higher than normal usage/ Exceeded legal limitation

Table 5.3 Example for Standard quantity/quality by legal or normal usage

Topic	Quantity	Quality
Chemical Storage - HCL	- 1,500-2,000 lit/month	-
Air emission from scrubber - Lead	-	- Lead 30 mg/m^3
Waste water discharge - point 1 after release to outside	- 2,000 – 5,000 m^3/month	- BOD 20 mg/m^3 - pH 5.5-9
Waste - Chemical waste	- 50 kg/month	-
Energy consumption - Electricity in production 1	- 450 kWh /month	-

Discussion: Some aspects in pollution cannot be decided only by quantity but should also use quality to make a decision on this. Firstly, organizations may lack data for water consumption or electricity usage of each area and should analyze sensitive areas and set a monitoring plan for there.

- Severity of consequence (C_1)

Reference from MSDS: Material Safety Data Sheet

Table 5.4 Severity of consequence

Classification	Hazard Identification	Toxicity	Ecological
1 = Low severity	Not being a hazardous substance	Not toxic, Irritant	Level 0
2 = Moderate Severity	Being a hazardous substance	Not toxic, Irritant, Corrosive	Level 1 or more
3 = High Severity	Being a hazardous substance	Harmful, Poisonous, Toxic, Radioactive, Infectious	Level 1 or more

Discussion: For standards that are easy to use for reference in making decisions the organization must choose 1 or more of this standard for reference to its severity (see Appendix D) such as:

- MSDS Hazards identification, Toxicology information, Ecological information
- Legislation Identified as hazardous substance in legislation or not.
- NFPA Identification number of reactivity, flammability, toxicity to human, and special data

- Resource usage impact (C_2)

1 = Renewable, Recycle-able, Reuse-able, or Reduce-able

3 = Non-renewable, Non-Recycle able, Non-Reuse able, or Non-Reduce able

Discussion: Score of 1 assigned if organizations have existing controls in this resource use aspect.

7.4.2.4 Calculation

Solving the environmental concern significance gives:

Total Score = (Likelihood of Occurrence + Likelihood of Detection) x Severity of Consequence

Where:

Likelihood of Occurrence = (Probability of Occurrence) + (Procedure existing) + (Training)

Where:

Likelihood of Detection refer to clause 7.4.2.2

Where:

1.Severity of Consequence of pollution = (Amount or quantity/quality) + (Toxicity)

2.Severity of Consequence of resource use = (Amount or quantity) + (Resource usage impact)

Classification

Highest = (9 + 3) x 6 = 72

Lowest = (3 + 1) x 2 = 8

If the number of classes = 3

A simple formula to obtain an estimate of the appropriate interval size is:

$i = (H-L) / k$

where i = The size of the class intervals

H = The value of the highest item

L = The value of the lowest item

k = The number of classes

$21 = (72 - 8) / 3$

Discussion: If it is a very complicated score then the T-Score Standard (19) should be used.

Significant level setting

Table 5.5 Classification Score

Class	Score	Significant level
Low	8-29	Non-significant
Medium	30-51	Significant (M)
High	52-72	Significant (H)

- If score is Medium or High it will be a significant aspect.

Table 5.6 Objective of Significance level

Significance level	Objective
Non-significant	Maintain any existing current controls, improvement implementation considered not yet required.
Significant (M)	Maintain any existing current controls and/or implement improvement program, as resources permit.
Significant (H)	Implement controls or improvement program for the management of this significant issue.

Discussion
: Organizations must identify what is to be the significant score.
: If organization set significant levels they should set objectives for each level too.

7.4.3 Others criteria concerns as follows:
Yes = Significant aspect
No = Non- Significant aspect

- Protection/Prevention/Control/Maintenance

No = Existing Protection/Prevention/Control/Maintenance available
Yes = No Protection/Prevention/Control/Maintenance

Discussion: Meaning is establishing and maintained for all items of Protection/Prevention/Control/Maintenance for environmental issues.

- Lack of data (over all)

No = Complete information/ Data / Sufficient information
Yes = Lack of information/ Data /Insufficient information

Discussion: Meaning that there is insufficient information provided to make a decision regarding environmental controls such as monitoring data, past incident data, business data, severity data.

- Past incident/Emergency preparedness

No = No past incident/ Complete Emergency preparedness for the last 2 years in case of have potential in emergency situation
Yes = Have past incident or poor performance/ Non-complete Emergency preparedness for the last 2 years and have potential in emergency situation

Discussion: According to ISO 14001 clause 4.4.7: emergency preparedness and response is the reason for identification of all potential emergency situations as significant aspects.

7.5 Evaluate environmental aspect

To evaluate the overall environmental aspects related to the different production, process and supporting activities in the organization, representatives of each area who identified the aspects of their activities have to refer to the previously filled in Environmental Aspect Identification form. In the first instance of environmental aspects evaluation, the Initial Environmental Review (IER) created by the EMS committee shall be used as a base line for implementation.

The following paragraphs will explain the items mentioned in the Environmental Aspect Evaluation form.

7.5.1 General data

Name of the activity
: the name of the activity over which the environmental aspects are evaluated.
Area/Department name

: is the name of the area where this evaluation is conducted.
Responsibility
: the name of the responsible person (s) in this area.
Prepared by
: the name of the person who conducted this evaluation.
Approved by
: the name of the person who approved this evaluation.
Date
: the date when the form was finished.

7.5.2 The evaluation will be a group discussion between the representative of each area who identified the environmental aspects of their activities and the EMS committee. Identify and evaluate the activities based on the aspect classes defined below:

1.Air Emission
2.Water Discharge
3.Waste management
- General waste
- Hazardous waste
- IC scrap
- Reuse/Recycle
- Hard decompose

4.Land
- Land use
- Land contaminate

5.Raw material & Natural resources
5.1.Energy Consumption
- Electricity
- Fuel
- Gas

5.2 Water Consumption such as DI water, City water, Deep-well water
5.3 Chemical Consumption
5.4 Raw material Consumption
5.5 Supplies Consumption
5.6 Production/ Packaging/ Shipping Material

6. Others
Others will be defined for any environmental aspects that is not previously mentioned such as Community complaint, Nuisance, Employee complaint, Noise, Odor, Vibration, Health & Safety

Discussion
: Class of identification and evaluation depends on the structure of the organization.

7.5.3 For every aspect class, fill in a separate class. For every aspect,

determine the points to be given, for evaluation and calculation of the organization's overall environmental aspects (see clause 7.4).

7.5.4 All "YES" instances for business concern and other criteria concern from the Environmental Aspect Evaluation Form are to be counted and the quantity to be placed in the corresponding column in the Environmental Significant Aspect List. The Significant level "H/M" from the Environmental Aspect Evaluation Form is to be placed in the corresponding column of the Environmental Significant Aspect List. Any instance of "YES" or "H/M" will make the aspect significant.

Discussion: Significant Aspect List Form is useful for management reviews for making decisions and therefore should present only the important data.

7.5.5 Significant Aspect Evaluation Forms are reviewed/revised by the EMS committee by checking and discussion with the representative of each area that identified and/or evaluated the information. The Significant Aspect Evaluation Form and Significant Aspect List Form will be approved by the EMR.

Environmental Aspects Analysis Process

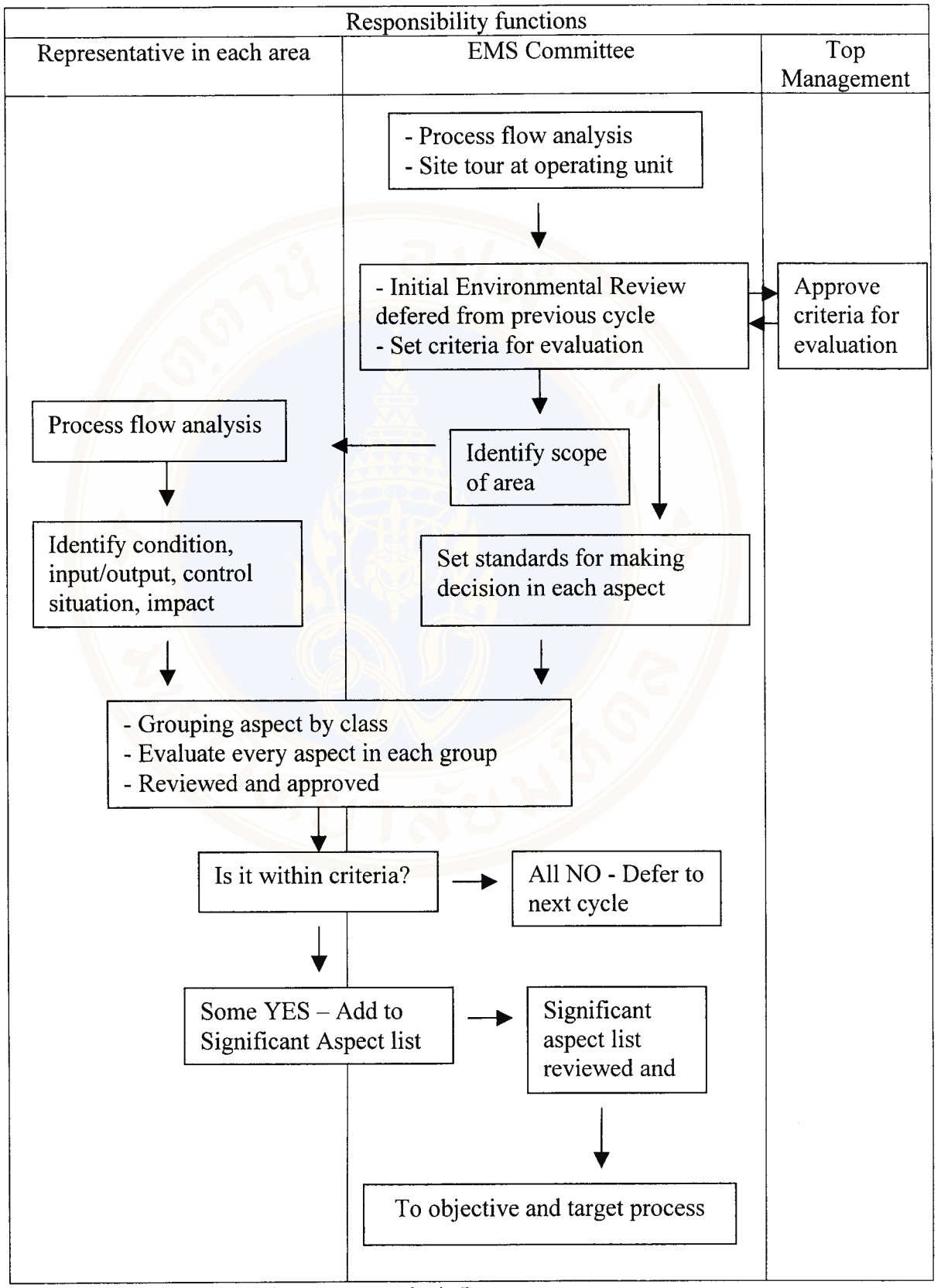

Figure 5.1 Environmental Aspects Analysis Process

5.2 Discussion of study design

5.2.1 Limitation

There are some limitations in these studies as follows:

5.2.1.1 Because the data in organizations is confidential and private, it cannot be distributed or copied. The guideline must be adjusted to available criteria and meaning for use. It is difficult to describe or reference this data in quantitative or meaningful terms to the original method.

5.2.1.2 There are some criteria that may be important for organizations but they are not identified here because of difficulty setting a decision point such as treatable depends on the financial authority of each company.

5.2.1.3 Two companies did not allow interviews because:

- Procedures were being modified
- Top management did not give permission

5.2.1.4 Because some companies were part of a group of companies under single registration, the target number of 47 companies will not be reached.

5.2.1.5 Because of bias by the subjects towards their own systems, analysis of data from their opinions was not possible. Therefore the analysis of data was made only from the opinions of the three professionals.

5.2.2 Comparative

Because all of identification methods are similar, then discussion only in evaluation method.

Table 5.7 Comparative of all evaluation and classification methods

Method	Strength	Weakness
1	- Easy to understand and calculate	- Meaning of each criteria are not clear, it should be lack of consistency for scoring. - Not defined action for each level of classification.
2.1	- Appoint high weighs score at legal, which will filter all aspects concerns. - Easy to calculate	- Meaning of severity of consequence is not clear - Not defined significant point after classification
2.2	- Identify group of management after classification. - Procedure concerns. - Clearly defined value of cost effect	- Some aspects concern only impact on the environmental, it cannot evaluate in recycle waste criteria. - Meaning of impact on the environmental is not clear.
3	- Easy to calculate and understand - Decision point in each criteria are clear.	- Not defined severity impact of environmental criteria - Not defined quantity of gas. - Not defined significant point

Table 5.7 Comparative of all evaluation and classification methods (continuous)

Method	Strength	Weakness
4	- If any YES will be significant aspect. - Define other criteria concerns such as emergency. - Separate environmental risk and resources use	- Difficult to understand - Consequence of incident = 0, if multiply any score will be 0 too. - Meaning of Quantity and Opportunities of resource usage are not clear.
5	- Meaning of each criteria are clearly - Separate pollution and resource usage - Easy to calculate	- Pollution direct and indirect does not define severity of impact criteria. - Not defined significant point
6	- If any YES will be significant aspect. - Easy to determine. - Cover pollution, resource usage and quantity criteria	- Quantitative is hard to understand as ABC analysis.
Guideline	- If any YES will be significant aspect. - Meaning of each criteria are easy to determine. - Defined other criteria concern. - Cover pollution, resource usage and quantity criteria - Classification by statistic and defined action for each level.	- Complicate for calculating.

Discussion: Appropriate method for the organization in Thailand is 4, 6 and Guideline by their hardness reasons.

5.2.3 Benefit obtain

5.2.3.1 To submit in partial fulfillment of the requirements for the degree of Master of Science in Appropriate Technology for Resources Development faculty, Mahidol university

5.2.3.2 To establish guidelines for the identification and evaluation of environmental significant aspects for implementation according to clause 4.3.1 in ISO 14001 for electronic industrial sector.

The guideline is complete and available to identify and evaluate significant environmental aspect because of:

- Compliance with the requirements of clause 4.3.1 of ISO 14001:1996
- Compliance with guidance clause A.3.1 in annex of ISO 14001:1996 and clause 4.2.2 in ISO 14004:1996 guideline
- Compliance with legislation
- The guideline is established for reliability, traceability and consistency data.

- Meaning of criteria and decision making points are clear and easy to understand.
- This guideline considered environmental concerns, businesses concerns and other criteria concerns.
- The guideline is suitable not only for proficiency but also operational staff.
- Effective to identify and evaluate differences in aspects of pollution and resource usage.
- If identification and evaluation are clear, it will be easy to set objectives and targets or available controls in the next step.
- Classification of significant aspects should come from statistic or logic methods.

Most importantly, organizations should provide the essential quality and quantity data to make decisions in each criteria.

In fact, There is no single method available that is suitable for every organization, the organizations should apply according to its own nature that is dependent on corporate policy and proficiency of staff.

CHAPTER VI

CONCLUSION

6.1 Conclusion

The conclusion of this guideline consists of 2 main parts.

6.1.1 This Environmental Aspect Identification guideline uses a process flow analysis method to identify environmental aspects. In this the processes are identified as follow:

6.1.1.1 Scope of area:
Manufacturing, Supporting, A contractor or supplier
6.1.1.2 Process scope
Process flow Analysis, Identify a contractor or supplier, Identify special or sensitive environmental consideration area
6.1.1.3 Type and quantity/quality of input and output in each process
Input: Energy, Water consumption, Chemical consumption, Raw material, Suppliers consumption, Equipment
Output: Product, By-Product (If any), Environmental impact
6.1.1.4 Identify Condition
6.1.1.5 Identify Control situation
6.1.1.6 Environmental impact
Emissions to air, Release to water, Waste management, Contamination of land, Use of raw materials and natural resources, Others local environmental and community issues

For guidance all information should be reviewed from each areas aspect controls before performing the objective and target process.

6.1.2 This Environmental Aspect Evaluation guideline is combined with environmental risk assessment and others criteria concerned to evaluate significant aspects. In this process evaluation is as follow:

6.1.2.1 Business concern
Legal and Other requirements/ Corporate policy, Cost of loss, Community complaint, Image of Company, Nuisance
6.1.2.2 Environmental concern
- Likelihood of Occurrence consists of Probability of Occurrence, Procedure existing, Training
- Likelihood of Detection
- Severity of Consequence consists of Amount or quantity/quality and/or Severity, Resource usage impact

6.1.2.3 Other criteria concern
Protection/Control, Lack of data, Past incident/Emergency preparedness
If there is any concerns in any of these criteria, it will be a significant aspect.

6.2 Recommendation for study in the future

For studying in the future the following should be studied.

6.2.1 To study the aspect identification and evaluation method in other industrial sectors for ISO 14001 certified organizations in Thailand.

6.2.2 To study the effectiveness and consistency of this guideline by testing at operational level in the electronic industrial sector to identify and evaluate examples of significant aspects.

6.2.3 To develop meaning of criteria and a calculation method for this guideline in a computer program that is easy to use and understandable at operational level. This program should be flexible to change criteria, translate the same unit of data and help to make decisions in significant aspects or control. If this program is available it should help in legal, objective and target, and environmental program processes too.

6.2.4 To do a comparative study of the usage of aspect identification and evaluation guidelines with other methods such as reliability, traceability, and consistency studies.

The identification guideline is not different from each other. Because process base analysis is being used in all of the companies.

The evaluation guideline is quite different from each other. Because it is combined with environmental risk assessment and other criteria concerning significant aspects. Although this guideline is more complicated than the original method, this guideline is still easy to understand and calculate.

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APPENDIX

APPENDIX A

QUESTIONNAIRE

GUIDELINE FOR ENVIRONMENTAL ASPECTS ASSESSMENT IN ISO 14001 ELECTRONICS INDUSTRIAL SECTOR CERTIFIED IN THAILAND

Name of subject_____
Subject must be Environmental Management Representative(s) (EMR) or representatives from the organization, who in part of ISO 14001 implementation.
Environmental Position_____
Responsibility Position_____
Name of Organization_____
Address_____
Tel._____
E-mail_____
Date_____

Description

1. General Data

1.1 Title: GUIDELINE FOR ENVIRONMENTAL ASPECTS ASSESSMENT IN ISO 14001 ELECTRONICS INDUSTRIAL SECTOR CERTIFIED IN THAILAND

1.2 Name of Student: Kaewta Nuntajivakornchai, Appropriate Technology for Resources Development, Faculty of Environmental and Resource Studies, Mahidol University

1.3 Address: Condo 12 Fl.Bldg., KMITL, Ladkrabang, Bangkok, 10520. Page 1144-9114530

2.Objective
To establish guideline for aspects identification and evaluation for electronic industrial sector.

3.Do you need the summary of this thesis?
☐ YES ☐ NO

SECTION A

Personal data of subjects

1.Sex
☐ Male ☐ Female

2. Experience in Environmental field
☐ Below 5 years ☐ 5-10 years ☐ 11-15 years
☐ 16-20 years ☐ More than 20 years

3. History experience in electronic industrial sector
☐ Below 5 years ☐ 5-10 years ☐ 11-15 years
☐ 16-20 years ☐ More than 20 years

4. Duration of working times in this company
☐ Below 5 years ☐ 5-10 years ☐ 11-15 years
☐ 16-20 years ☐ More than 20 years

5. Education Level
☐ Below Bachelor ☐ Bachelor degree ☐ Master degree
☐ More than Master degree
Field of Education (please identify)_____

6. Did you in part of ISO 14001 Starting Team until get certified?
☐ Yes ☐ No

7.Would you mind be ISO 14001 advisor for interested party?
(If you get "yes", your name will be placed in Appendix of this thesis)
☐ Yes ☐ No

SECTION B

The database of organization

8. Class of industry

☐ Class 1 : which means that their employees are less than 20 persons or equipment is less than 20 HP.

☐ Class 2 : which means that their employees are more than 20 persons or equipment is less than 50 HP.

☐ Class 3 : which means that their employees are more than 51 persons or equipment is more than 50 HP.

9. Production (please identify)_____

10. Amount of employees (persons)

☐ Less than 1,000 ☐ 1,001-1,500 ☐ 1,501-2,500
☐ 2,501-3,000 ☐ More than 3,000

11. Duration of yours business

☐ Below 5 years ☐ 5-10 years ☐ 11-15 years
☐ 16-20 years ☐ 21-25 years ☐ More than 25 years

12. Investment

☐ USA ☐ Europe ☐ Japan
☐ Taiwan ☐ Thailand ☐ Other

13. Capital cost (million baht)

☐ Below 100 ☐ 101-500 ☐ 501-1,000
☐ 1,001-1,500 ☐ 1,501-2,000 ☐ More than 2,000

SECTION C

The database of ISO 14001 certification

14. Other certificate in company
☐ ISO 9001 or ISO 9002 ☐ QS 9000 ☐ QSR
☐ BS 8800 ☐ Other

15. Scope of Certification
☐ All of areas ☐ Part of areas (please identify)_____

16. Name of Certification Body (please identify)_____

17. Did you have consultant in ISO 14001 Project?
☐ None ☐ All of the project
☐ Some part of the project

18. Amount of direct responsibility person in environment (persons)
☐ 0-2 ☐ 3-5 ☐ 6-10
☐ 10-15 ☐ More than 15 persons

SECTION D

The Environmental aspect identification data

19. What is the class of consideration in environmental aspect in your organizations? (Can answer more than 1 choice)

☐ Supplies
☐ by-product
☐ Solid waste
☐ Hazard waste
☐ Chemical consumption
☐ Air Emission
☐ Vision
☐ Water discharge
☐ Stakeholder
☐ Land Use
☐ Water consumption
☐ Raw material consumption
☐ Light, Noise, Radiation,
☐ Energy
☐ Other (please identify)_____

20.What are your environmental aspect analysis method?

☐ Stakeholder impact
☐ Site impact
☐ Process impact
☐ Production impact
☐ Life Cycle
☐ Mass Balance
☐ Risk Assessment
☐ Combined Method
☐ Other (please identify)_____

21.What is the process of Initial Environmental Review in your organization? (If have any) (Can answer more than 1 choice)

☐ Questionnaire
☐ Plant Tour
☐ Interview
☐ Checklist
☐ Direct Inspection
☐ Recording review
☐ Process flow study
☐ Life Cycle
☐ Bench Marking
☐ Other (please identify)_____

22.How to get your checklist for IER?

☐ By Organization
☐ By Corporate Organization
☐ Improving from Corporate Organization
☐ Improving from other organization
☐ From other organization
☐ By consultant
☐ Other (please identify)_____

23.Did your organization have ever chosen method of environmental aspect identification?

☐ Yes
☐ No

24.Who identify environmental aspect in your organization?

☐ By organization
☐ By consultant
☐ Combined

25.What is your major problem in aspect identification process and how to solve this problem in your opinion?

SECTION E

The Environmental aspect evaluation data

26.How to establish environmental significant aspect evaluation method in your organization?
□ Brainstorm □ Corporate Method □ Consultant Method
□ Consultant and Organization combined Method
□ Other (please identify)_____

27.If this method is established by consultant, do the organization can choose this method in the starting time?
□ Yes □ No

28.What are your criteria considered environmental significant aspect?
□ Legal and Corporate policy
□ Emergency Preparedness
□ Environmental Contaminated
□ Resource Destruction
□ Health and Safety of employees
□ Community Complaint
□ Other (please identify)_____

29.What are your problems in environmental significant aspect identification process?
□ Not sure about Legal and Corporate policy compliance.
□ Not confident in effective of Emergency Preparedness Plan
□ Lack of environmental quantitative data
□ Not sure about reliability of quantitative data
□ Insufficiency of employees health data
□ Delay of Community Complaint data feed back
□ Do not understand definition of aspects such as actual, potential, normal, abnormal, resource use, pollution
□ Other (please identify)_____

30.What is your Environmental aspect Evaluation Method?
31.What is your Environmental aspect Classification Method?
32. What is your major problem in aspect evaluation process and how to solve this problem in your opinion?

APPENDIX B

LIST OF SUBJECTS IN ELECTRONICS INDUSTRIAL SECTOR ISO 14001 CERTIFIED IN THAILAND

List name and addresses of subjects who kind enough to be ISO 14001 advisors for interested parties as follow:

1.ALPHATEC SEMICONDUCTOR PACKAGING CO., LTD

Name	Mr.Mongkol Buengsai
Position	Manager-Environmental Health & Safety
Name	Mr.Wicheen Kumkerd
Position	Engineering-Environmental Health & Safety
Address	17/2 Moo 18, Suwintawong Rd., T.Saladang, A.Bang-Num-Priew, Chachoengsao 24000
Contact	(038) 845530, 845540, 845550 ext.2706 Fax (038) 845598,593227,593229
E-mail	MongkolBu@alphatec.co.th
Certified	By SGS in October 1998

2.AMD (THAILAND) LTD.

Name	Mr.Litichart Insome
Position	Manager-Environmental Health & Safety
Address	229 Moo 4, Changwattana Rd., Pakkert, Nontaburi, 11120
Contact	9621180,5841591-9 ext. 30316
Certified	By TEI in 8 November, 1999

3.CAPTRONIC INTERNATIONAL (THAILAND) PUBLIC CO., LTD.

Name	Mrs.Puangpetch Phukerdpimpa
Position	ISO 9002 /14001 Section Manager
Address	105 Moo.3, Bangna-Trad Rd., Km.52, Thakham, Bangpakong, Chachoengsao 24130
Contact	(038) 573161 ext.1242, Fax (038) 573174
Certified	By AJA EQS in 17/02/1998

4.DELTA ELECTRONICS (THAILAND) PUBLIC CO., LTD

Name	Mr.Chatchawal Ngamyiem
Position	Safety Officer
Name	Songkhram Hranta (ext. 635)
Position	Sr.Supervisor Production Line/ SPS/ADP
Address	909 Soi 9,Moo 4,Bangpoo IE,Pattana Soi 1 Rd.,Samutprakarn 10280
Contact	7092800 ext. 541 Fax 7093204,7092842
E-mail	chatchawal@delta.th
Certified	By SGS Yarsley in October 8,1998

5.FUJIKURA (THAILAND) CO., LTD

Address	101/2 Moo 20 Navanakorn IE 1,Paholyothin Km.46, Klongluang District, Patumthani 12120
Contact	5293523-33 Fax 5290606, 5290525
Web site	http://www.fthai.fujikura.co.th
Certified	SGS in May 1998

6.FUJITSU (THAILAND) CO., LTD

Name	Mrs.Korakot Lotongkum
Position	Assistant Manager/ TQM Promotion Center/ Administration Division
Address	60/90 Moo 19 Navanakorn IE Zone 3,Paholyothin Km.46, Klongluang District, Patumthani 12120
Contact	5292630, 5292597, 9095411-26 ext.1710 Fax 9095431
E-mail	Korakot_adm@ftc.fujitsu.co.jp Korakot@tw.ftc.fujitsu.co.jp
Certified	By TISI in May 19,1998

7.HANA SEMICONDUCTOR (AYUTTHAYA) CO.,LTD

Name	Mr.Yuthana Smansin
Position	Material Sr. Manager
Address	100 Moo 1 Hi-tech IE, Bang Pa-In, Ayutthaya 13160
Contact	(035) 350803-4, 350970-972 ext.539 Fax (035) 350805-6
E-mail	yuthanas@hanabk.th.com
Web	www.hanagroup.com
Certified	By BVQI in October 1,1999

8.HANA MICROELECTRONICS PUBLIC CO., LTD (LAMPOON)

Name	Mr.Weerapon porpun
Position	Project Development Section Manager
Name	Mrs.Napassawan Namwongsa
Address	101/2 Moo 4, Northern Region IE, Lamphun 51000
Contact	(053) 581565-70 , 581287 ext 437 Fax (053) 581574,581573,581290
E-mail	weerapol@lpn.hanabk.th.com
Certified	By BVQI in 1999

9.IBM STORAGE PRODUCTS (THAILAND) LTD.

Name	Mrs.Amornrat Somklang
Position	Admin Specialist/ Environment Coordinator
Address	203,205 Moo 7, T.Tha-Tum, A.Srimahaphote, Prachinburi 25140
Contact	(037) 208696-715 ext.3174 Fax (037) 208720
E-mail	amornrat@th.ibm.com
Certified	By BVQI in May 1999

10.JVC MANUFACTURING (THAILAND) CO.,LTD

Name	Mr.Samark Songsawang
Position	Manager /Personnel Administration Dept.

Address Navanakorn IE Zone 3, 107 Moo8,T.Klong1, A. Klong Luang, Pathumthani 12120
Contact 529-2105-09,5292238-40,5292210 Fax 5292241-3
Certified By TISI in April 1999

11.KSS ELECTRONICS (THAILAND) CO.,LTD

Name Mrs.Parinya A-Karachinoret
Position Deputy Sec.Manager / Safety & Environment Section.
Name Mrs.Pranee Wiang-in
Position Deputy Supervisor / Safety & Environment Section /Factory Control Division
Address 89 Moo 4,Northern Region IE, Lamphun 51000
Contact (053) 581201 Fax (053) 581206
E-mail ksts&e@kinseki.co.jp
Certified By TEI & JACO in 20/12/99

12.LITE-ON ELECTRONICS (THAILAND) CO., LTD.

Name Mrs.Chiraporn Munusamy
Position TQM Manager, ISO 14001 EMR
Address 38/4 Moo1 ,Rangsit-Ongkarak Rd.,Bungyeetoh, Tanyaburi, Patumthani 12130
Contact 5331208-16, 5331681-3 ext.120 Fax 5331747
E-mail chiraporn@thaits.liteon.com.tw
Certified By AJA in 21 January 1999

13.LUCENT TECHNOLOGIES MICROELECTRONICS (THAI) LTD.

Name Mrs.Amornrat Damrongkiatdee
Position EH & S Officer
Address 101/32-33 Navanakorn IE ,Paholyothin Km.46, Klongluang , Patumthani 12120
Contact 9090250, 5290115 ext.2525 Fax 9090240
E-mail amorn@lucent.com
Certified By Lloyds Register Quality Assurance of London in Jan 1997

14.MATSUSHITA ELECTRIC WORKS, (AYUTTHAYA) LTD.

Name Mr.Natthawut Mahawilai
Position Assistant Manager/ Personnel Section/ Administration Division
Name Mrs.Paniti Intararat
Position ISO 14001 Coordinator/ Personnel Section
Address 1/69 Moo 5 Rojana IP, Rojana Rd., T.Kanham, A. Uthai, Ayutthaya 13210
Contact (035) 330846 Fax (035) 226369
E-mail natthawut@int.mew.co.jp
Certified By LRQA in November 5,1999

15.MELCO MANUFACTURING (THAILAND) CO.,LTD.

Name Mr.Komsan Phungdang
Position Production Technics, Chief Staff, Manufacturing Department
Name Mrs.Puttima Srihasiyasit
Position Quality Assurance Section Staff (7448288)
Address 86 Moo 4 Bangna-Trad Rd.(KM.23), Bangsaothong Sub-district, Samutprakarn 10540
Contact 3128350 ext.2242 Fax 3128353-4
E-mail Komsan@mmt.meap.com
WEB www.melco.co.jp
Certified By BVQI in Mar 1999

16.MINEBEA GROUP OF COMPANIES (THAILAND)

Company	Establishment	Capital Mil. Bath	Major Products	Employees	Plant
NMB THAI LTD.	Aug'80	2,600	Miniature Ball Bearings	2,585	Ayutthaya (035) 335309-16
PELMEC THAI LTD.	May'84	1,700	Small Sized Ball Bearings	14,268	Bang pa-in (035) 361439
MINEBEA THAI LTD.	May'84	8,382	Computer Keyboards, Stepping Motors, Precision machining Parts		
			Aluminum Die Casting Part Plating & Coating of metal	1,300	Rojana (035) 330506-9
NMB HI-TECH BEARINGS LTD.	Dec'88	1,000	High Performance Ball Bearings	-	-
NMB PRECISION BALLS LTD.	Dec'88	600	Steel Balls for Ball Bearings	-	-
MINEBEA ELECTRONICS (THAILAND) CO.,LTD.	Mar'88	1,563	Magnetic heads for FDDs, FDD Sub-Assemblies, PM Series Stepping Motors, Electronics Circuits, Spindle Motors for FDD	9,333	Lopburi (036) 413811,413 931-4
POWER ELECTRONICS OF MINEBEA CO.,LTD.	Jul'97	1,610	Switching Power Supplies, FR Inductors, Hi-brid IC Ferrite Magnet, Transformers & Adaptors		
Total		17,455	Total	27,486	

Name Mr.Ekachai Sumpunsirikul
Position Head of Environmental Management System Center/ Human Resources & Administration Division
Name Mrs.Bunjapat Prungwanichsiri
Position Staff Office/ Human Resources & Administration Division
Address 1 Moo 7, Phaholyothin Rd., Km.51, Chiang Rak-Noi, Bang pa-in, Ayutthaya 13180
Contact (035) 361439 ext.2337, 2338, (035) 237073 Fax (035) 361477, (035) 362148
Certified All plants from TUV Rheinland in October 27,1997

17.MURATA ELECTRONICS (THAILAND) CO.,LTD.

Name Mrs.Em-orn Chaichompu
Position Supervisor/ General Affair Section/ Administration Department
Address 63 Moo 4 Northern Region IE, A.Mung, Lamphun 51000
Contact (053) 581166 ext.142 Fax (053) 581076
Certified By SGS Yarsley on October 5, 1998

18.NATIONAL THAI GROUP OF COMPANIES

Company	Contact	Date of Incorporation	Product/Item
National Thai Co.,Ltd. (NTC)	Tel.708111 Fax 3381529	1961,December	
Matsushita Electronic Components (Thailand) Co., Ltd.(TCOM)	Tel.708111 Fax 7080885	1996,May	Printed Wiring Board, Tuner, Coil, Remote Control, Speaker, Switch, Transformer
Matsushita Communication Industrial (Thailand) Co., Ltd.(MCT)	Tel.7080871 Fax 7080874	1996,June	Car Audio
Matsushita Battery (Thailand) Co., Ltd.(TMB)	Tel.3841156,3847515 Fax 3842136	1996,December	Dry Battery, Storage Battery, Flashlight
Matsushita Seiko (Thailand) Co., Ltd.(THAMS)	Tel.7081111 Fax 7080853	1996,December	Electric Fan, Ventilation Fan, Air Moving
Kyushu Matsushita Electric (Thailand) Co., Ltd.(TKME)	Tel.7081111 Fax 3381564	1997, August	Flyback Transformer, Deflection Yoke
Matsushita Industrial Equipment (Thailand) Co., Ltd.(MIECOT)	Tel.7081111 Fax 3381523	1997,November	Capacitor
Matsushita Technology (Thailand) Co., Ltd. (TMTEC)	Tel.7081111 Fax 3381523	1998, January	Parts, Mould
Matsushita Electric AVC (Thailand) Co., Ltd.(TAVC)	Tel.7081111 Fax 3381057	1998,June	Colour Television, Home Stereo

Name Mrs Marisa Intawong
Position 1.EMS Coordinator
2.Supervisor of EMS
Address 101 Moo.2 Teparak Rd., Bangsaothong sub-district, Samutprakarn 10540
Contact 7080759,7080881-7 Fax 3381523
E-mail marisa131@yahoo.com
Certified AJA EQS (Thailand) Co., Ltd. on July 3,1998 for Bangplee Site
AJA EQS (Thailand) Co., Ltd. on July 10,1998 for Samrong Site

19.NEC TECHNOLOGIES (THAILAND) CO.,LTD.

Name Mr.Ram Thippharos
Position Supervisor Plant Engineering & Environment Control Department

Address 60/76 Moo 19 Navanakorn IE ,Paholyothin Km.46, Klongluang District, Patumthani 12120
Contact 5292470 ext.571 Fax 5292477
E-mail ram_thippharos@tha-ntet2.ccgw.nec.co.jp
Certified By JQA in September 1998

20.NS ELECTRONICS BANGKOK (1993)
Name Mr.Siripong Kamonchaiwanit
Position Senior Project Manager & Environmental Management Coordinator
Address 40/10 Soi Sukhumvit 105, Sukhumvit Rd.,Bangna, Bangkok 10260
Contact 7491680, 3933126 ext.411 Fax 3987157 Mobile 01-3061151
E-mail Siripongka@nseb.co.th
Certified By AJA EQS in May 1998

21.PHILIPS ELECTRONIC (THAILAND) CO., LTD
Name Mrs.Kasemsan Pathumarak
Position Sr.Safety, OH& Environment Officer/ Human Resource Dept.
Address 515 Moo 4 Soi 8D Patana 3 Rd., Praekasa, Muang, Samutprakarn 10280
Contact 7093300 ext.4227 Fax 3230732, 3230769
E-mail Kasemsan.pathumarak@philips.com
Certified SGS in June 17,1998

22.PHILIPS SEMICONDUCTOR (THAILAND) CO., LTD
Name Mrs.Panyarat Polprucksa ext.337
Position Senior Environmental Engineering/ Human Resources & Facilities
Name Kanit Kongritpittaya ext.324
Position Energy Engineer, Facilities/ Human Resources & Facilities
Address 303 Moo 3 Chaengwattana Rd., Laksi, Bangkok 10210
Contact 5511052-62, 5527623-29, 9732379-403 Fax 5511063-4
E-mail Kanit.Kongritpittaya@philips.com
Certified KEMA in September 1996

23.PIONEER MANUFACTURING (THAILAND) CO., LTD
Name Mrs.Junjira Methapitak
Position ISO 14001 officer/ QEC Dept.
Name Mrs.Rungnapa Nonting
Position ISO 9000,QS 9000 officer/ QEC Dept.
Address 1/31 Moo 5 Rojana IP, T.Kanham, A.U-Thai, Ayutthaya 13210
Contact (035) 226159-170 ext.211 Fax (035) 330808
Certified By TEI & JACO in October 30,1999

24.READ-RITE (THAILAND) CO.,LTD.
READ-RITE SMI (THAILAND) CO.,LTD.
Name Somnuck Wiroonpong
Position Senior Director/ Quality Assurance

Address 140 Moo 2 Bangpa-in IE, Ayutthaya 13160
Contact (035) 258100, 221700 Fax (035) 258111, 258115, 221711
E-mail Somnuck@readrite.com
Certified By AJA EQS 3 August 1996 (The first in Thailand)

25.SAHA-UNION PUBLIC CO., LTD.
SAHA-UNION PUBLIC CO., LTD. (HDD)
Name Mrs.Supattra Wamwongwanit
Position -
Name Pattaravadee Sriprasert
Position ISO Officer
Address 336 Moo 10 ,Sukhumvit Rd., Bangpra, Sriracha, Chonburi 20210
Contact (038) 341370-8 Fax (038) 341380-3
E-mail gay@hits.sahaunion.co.th
Certified By BVQI in September 1997

26.SANYO SEMICONDUCTOR (THAILAND) CO.,LTD
Name Mrs.Preeyanun Techajarentroj
Position Environmental Engineering
Name Mr.Saichol Punpo
Position Senior Environmental Engineering
Address 1/7 moo 5 Rojana IE, Thumboon Kanham, Ahumpor Utai, Ayutthaya 13210
Contact (035) 330116 Fax (035) 330115
E-mail psaichol@ssth.head.semic.sanyo.co.jp
Certified By SGS April 1998

27.SCI SYSTEMS (THAILAND) LTD
Name Mrs.Ratree Jindapant
Position Chief QMS
Address 90 Moo 1,Tiwanon Rd.,Banmai, Muang.,Pathumthani 12000
Contact 5012400 ext 229 Fax 5012848-9,9616715
E-mail Ratree.J@scismail.sci.com
Certified By AJA EQS in April 1997

28.SEAGATE TECHNOLOGY (THAILAND) LTD.(CHOKCHAI)
Name Mr.Thanakorn Yodsaeng
Position ISO Sr.Manager
Address 294 Vibhavadi Rangsit Rd., Lumlookka, Patumthanee 12130
Contact 5310321-35,9989966-79 Fax 5312002
Certified By AJA EQS in September 1997

29.SEAGATE TECHNOLOGY (THAILAND) LTD.(TEPARUK)
SEAGATE TECHNOLOGY (THAILAND) LTD (KORAT)
Name Mr.Somporn Deemad
Position Document Control & QSR Manager

Name Mr.Somchai Yingsom
Position Environmental, Health & Safety Manager
Address 1627 Moo 7, Teparak Rd., T. Teparak, A. Muang, Samutprakan 10270
Contact Mr. Somporn 7152999 ext.2132, 7152132, 01-6536498 Fax 7152278-9
Contact Mr. Somchai 7152999 ext.2941, 7152941, 01-6452228
E-mail Somporn_Deemad@notes.seagate.com
Certified By SGS in January 1997

30.SEAGATE TECHNOLOGY (THAILAND) LTD.(RANGSIT)

Name Mr.Suphol Vitvongwai
Position Maintenance Manager /Facility Department
Address 152/11-13 Thunyaburi-Lumlookka Rd., Klong 7, Rangsit, Thunyaburi, Patumthanee 12110
Contact 5774780-99 ext.5505 Fax 5772687
E-mail Suphol_Vitvongwai@notes.seagate.com
Certified By AJA EQS in September 1997

31.SEAGATE TECHNOLOGY (THAILAND) LTD.(WELLGROW)

Name Mrs.Nilvadee Liangsoontornsidhi
Position Environmental, Health & Safety Manager /Administration Department
Address 73 moo 5 Wellgrow Industrial Eatate, Bangna-Trad Highway Km.36, Bangsamak District, Bangpakong, Chachoengsao 24180
Contact (038) 570514-21,570611-30 ext.5905 Fax (038) 570544,570576,570640
E-mail Nilvadee_Liangsoontornsidhi@notes.seagate.com
Certified By AJA EQS in October 1997

32.SONY SEMICONDUCTOR (THAILAND) CO., LTD

Name Mr.Somjet Intagarn
Position Assistant Manager /Safety Department/ Facility Division
Address 140 moo 5, Bangkadi Industrial Park, Tiwanon Rd., T.Bangkadi, A.Mung, Pathumtani 12000
Contact 5011730-3 Fax 5011734,5011065
E-mail Somjet@sct.th.sony.com.sg
Certified By TISI in 17 July 1997

33.SONY SIAM INDUSTRIES (THAILAND) CO., LTD

Name Mr.Somsak Lertruangsupakul
Position Manager /Common Engineering Dept. & Environmental Management Representative
Address 92 Moo 1, Hi-Tech Industrial Estate, Asia-Nakornsawan Rd., Banlen, Bangpa-in, Ayuthaya 13160
Contact (035) 350721ext.3600 Fax (035) 350754
E-mail somsak@ssi.th.sony.com.sg
Certified By TUV Rheinland in Mar 1998

34.SONY MOBILE ELECTRONICS (THAILAND) CO., LTD

Name	Mrs.Sam-ang Phuyen
Position	Supervisor / Environmental Section
Address	700/402 Moo 7 Amata Nakorn IE, Mung, Chonburi 20000
Contact	(038) 214900-9 ext.2904 Fax (038) 214899
E-mail	samang@smet.th.sony.com.sg
Certified	By TUV Rheinland in 20 March 1998

35.SUMMIT ELECTRONIC COMPONENTS CO.,LTD

Address	99 Moo 5, Soi Watsrivareenoi, T.Srisajorakaeyai, Bangsaothong, Minor District Samutprakarn 10540
Contact	3371553 Fax 3371201-3
E-mail	summit4@ksc15.th.com
Certified	By SGS in December 1998

36.TATUNG (THAILAND) CO., LTD

Name	Mr.Taradon Wattanavanich
Position	Deputy Quality and Environmental Manager
Name	Mr.Wyndham George
Position	Senior Quality and Environmental Engineer
E-mail	Wyndhamg@yahoo.com
Address	700/50 moo 6,Bangpakong 2 IE., Bangna-Trad Rd., Nong Maidaeng, Mung, Chonburi 2000
Contact	(038) 213478, 213473-9
Certified	By AJA EQS in July 1998

37.THAI CRT CO.,LTD.

Address	87/9 Moo 2 Laem Chabang IE., Sukhapiban 7 Rd., Tungsukla, Sriracha, Chonburi 20230
Contact	(038) 490220 ext.391,387 Fax (038) 490226
Certified	By RW TUV in August 24,1999

38.TOSHIBA SEMICONDUCTOR (THAILAND) CO., LTD

Name	Arissara Phumkacha
Position	Environmental Engineering/ Environmental Section/ Facility Department
Address	135 Moo 5,Bangkradi IP, Tivanon Rd., T.Bangkradi, A.muang, Pathumtanee 12000
Contact	5011030,5011632 ext.3532 Fax 5011637,5011644
Certified	By TISI September 25, 1998

APPENDIX C

Figure Appendix C.1 Environmental Process Base Analysis form

Area/Department name_____
Name of the activity _____
Prepared by _____Date_____
Reviewed by _____Date_____
Approved by _____Date_____

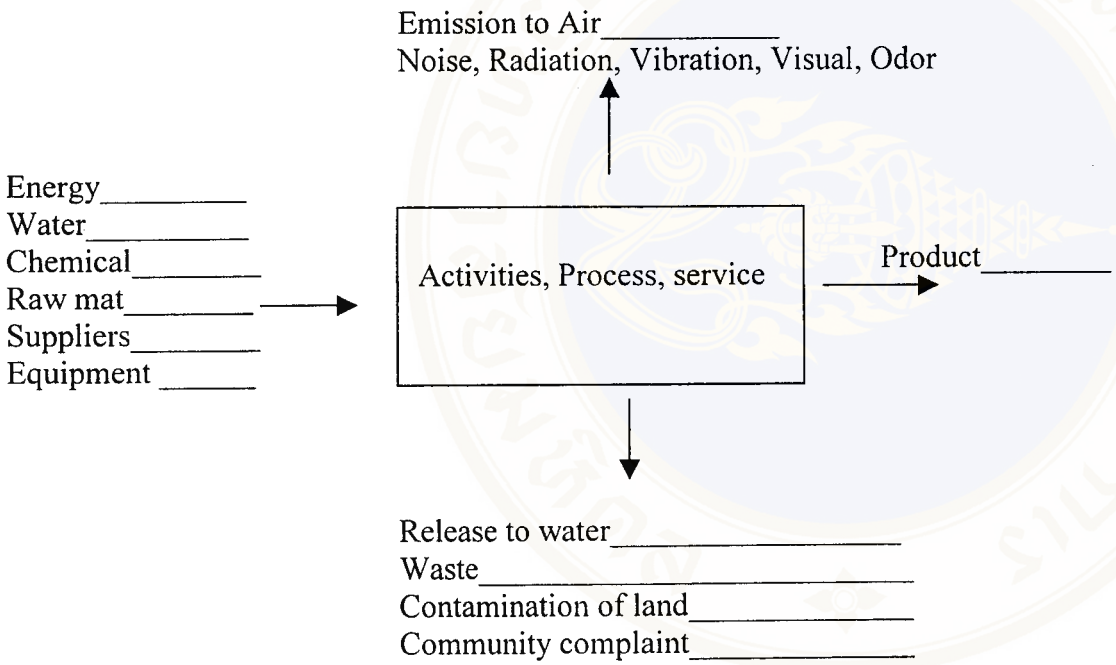


Table Appendix C.1 Environmental Aspect Identification form

Area/Department name_____
Name of the activity _____
Prepared by _____Date_____
Reviewed by _____Date_____
Approved by _____Date_____

Aspect detail /No.	Condition	Situation	Control level	Input	Out put	Impact	Aspect Class

Table Appendix C.2 Changing Request Form

Area/Department name _____
Prepare by _____ Date_____
Reviewed by_____ Date_____
Approved by_____ Date_____

Changing

☐ Building Expansion/Construction ☐ Administration Changes
☐ Process Change ☐ New Process
☐ New Chemical ☐ New Product
☐ New Material ☐ New Equipment
☐ Capacity Expansion
☐ Scrapped Equipment/ Tooling
☐ Transferred Process ☐ Transferred Equipment
☐ Services ☐ Other

Details of project

Detail of Change

Attached Document

Changed Date

Environmental aspects and impact that may occur

Table Appendix C.3 Environmental Aspect Evaluation Form

Area/Department name _____

Name of the activity _____

Prepared by _____ Date _____

Reviewed by _____ Date _____

Approved by _____ Date _____

Aspect Class	Aspect No.	Business Concern			Environmental Concern											Others criteria concern			**Significant Aspect**
		Legal/ Cor. policy	Cost	Com. Complaint	LH of Occurrence (A) (P_1+P_2+Tr)				LH of Detect (B)	Severity (C) (Q+C1 or Q+C2)				Total (A+B) xC	Sig. Level	Protect/ Control	Lack of data	Past/ Emer.	
					P_1	P_2	Tr	T		Q	C1	C2	T						
1.Energy Consumption																			
2.Water Consumption																			
3.Chemical Consumption																			
4.Raw material Consumption																			
5.Supplies consumption																			
6.Air Emission																			
7.Waste																			
8.Water Discharge																			
9.Production																			
10.Land contaminated																			
11.Community complaint																			
12.Others																			

Table Appendix C.4 Environmental Significant Aspect List

Prepared by _____Date_____
Review by _____Date_____
Approved by _____Date_____
Aspect Class _____

Sequence	Aspect No.	Business concern		Environmental concern	Others criteria concern
		Legal/ Corporate policy	Others		
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

Example for aspect identification
Step 1 Identified and Selected processes in company

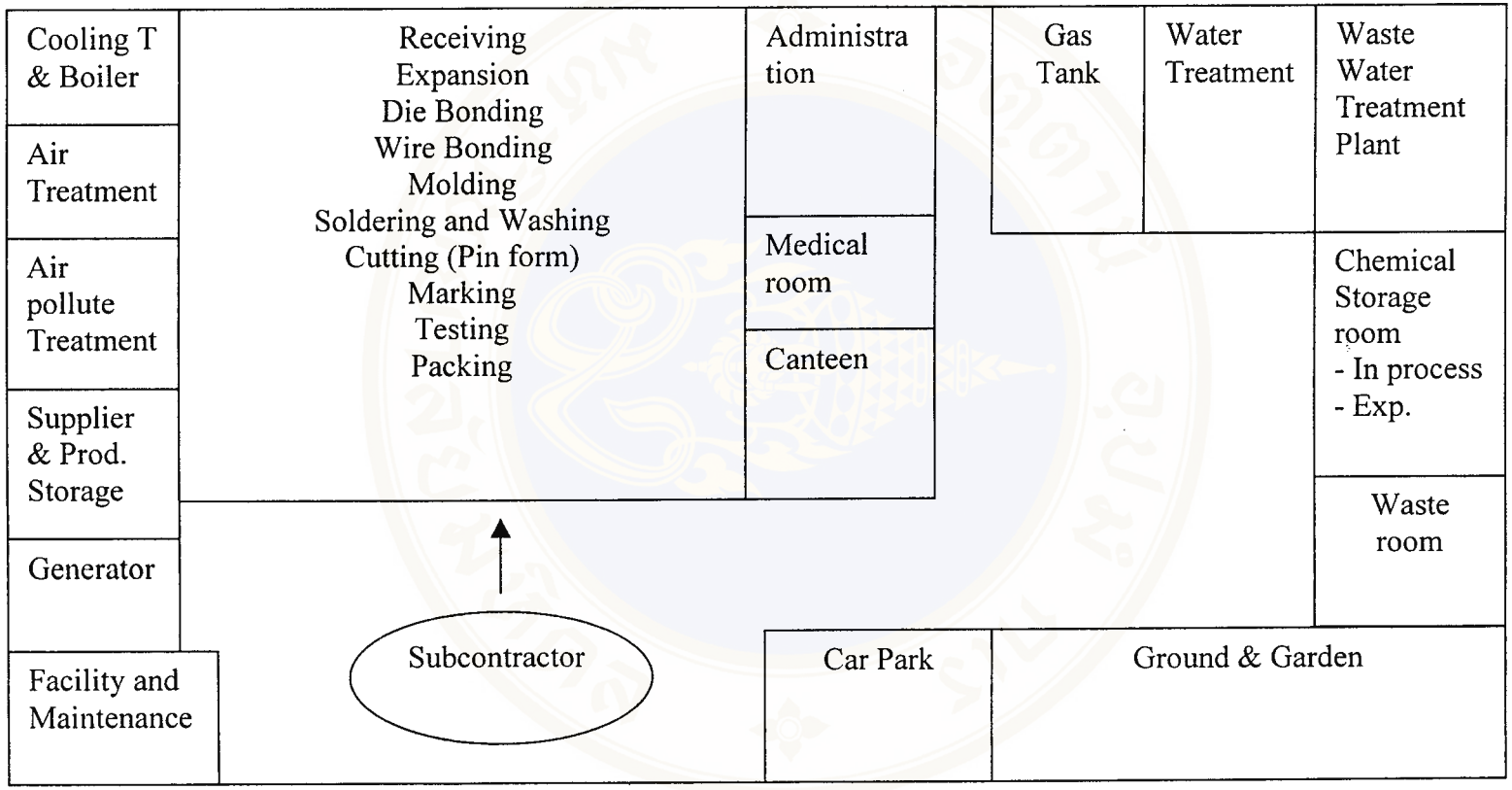


Figure Appendix C 2 Example for assembly processes identify in electronics industry

Step 2 Classify Process and Critical activity Scope

Table Appendix C 5 Classify process and critical activity scope in electronic industry

Category Scope	Process	Critical activity
1.Manufactering Scope	- Receiving	
- Process line	- Expansion	Dust/ Cleaning agents/ IC scrap
	- Die Bonding	Epoxy contaminated
	- Wire Bonding	IC scrap/ fume
	- Molding	Plastic scrap
	- Soldering and Washing	Soldering generated lead fume/ Solder Waste Acid and Base concentrated use for washing DI water contaminated discharge/ Cleaning agents
	- Cutting (Pin form)	Hazard IC scrap/ Hard decomposing waste
	- Marking	Ink contaminated
	- Testing	Energy/ IC scrap or waste
	- Packing	Packaging usage
- Supporting process line	- Air treatment	CFC leakage/ Water discharge from washing filter Filter / Chemical waste Electrical usage
	- Air pollute treatment	Air pollute monitoring Waste water from wet scrubber Bag filter/ Chemical filter waste
	- Water treatment	Resin/ Manganese/ Carbon/ Sand or membrane usage for treatment Injection water
	- Waste water treatment plant	Waste water monitoring/ Sludge/ Oil & Grease Concentrated chemical spillage
	- Cooling Tower/ Boiler	Energy management/ Chemical usage/ Explore/ Blow down

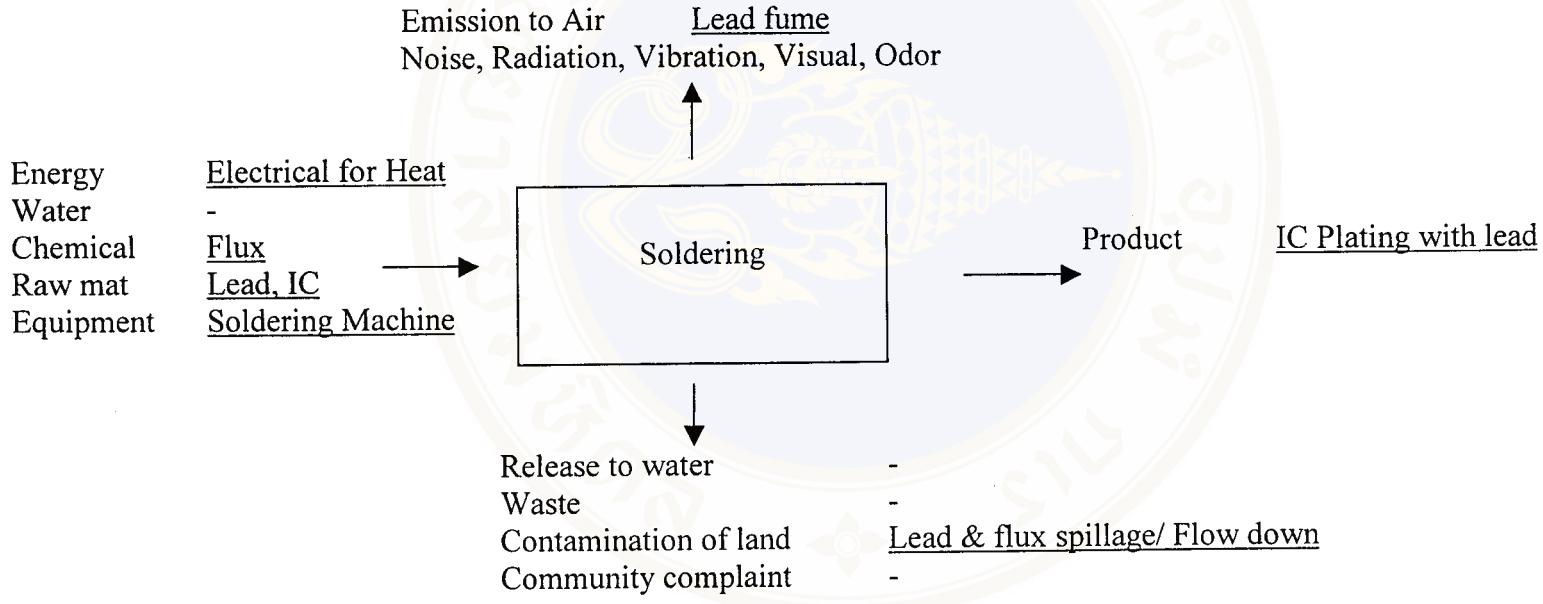
Table Appendix C 5 Classify process and critical activity scope in electronic industry (continuos)

Category Scope	Process	Critical activity
	- Gas Tank	Fire & explore/ Toxicity
	- Chemical Storage room	Usage and expire chemical Large chemical spill and explore
	- Suppliers and Products Storage room	Supplier consumption Fire protection
	- Waste room	Waste management Odor/ leach / fire/ land contaminated
	- Generator	Air pollution/ Noise/ oil usage
	- Facility & Maintenance	Oil/ lubricant/ Chemical usage
2.Supporting	- Administration	Paper usage/ Electrical usage/ Office waste
	- Medical room	Medical waste
	- Canteen	Oil & Grease generated/ Food waste/ Water usage/ Air pollute from cooking Fire protection
	- Car park	Air pollute from car/ Lubricant or oil spillage
	- Ground/Gardening	Pesticide usage/ water gardening usage
	- Rest room, Janitorial	Toilet/ Water consumption/ Cleaning chemical
3.Contractor or Supplier	- Bus Transport	Air & Noise pollution Lubricant or oil spillage Community complaint
	- Supplier Container for supplier & good - Shipping	Chemical transport Air & Noise pollution Lubricant or oil spillage Community complaint
	- Construction	Land & water contaminated from chemical spill Hazard & general waste generate Visual/ Noise/ Air pollute/ Fire

Step 3 Identify input/output in each process

Figure Appendix 3 Example for Environmental Process Base Analysis form

Area/Department name	Soldering / Production		
Name of the activity	Soldering lead to IC pin		
Prepared by	Kaewta N.	Date	7/5/00
Reviewed by	Wicheern K.	Date	10/5/00
Approved by	Mongkol B.	Date	15/5/00



Step 4 Filling in Environmental Aspect Identification form

Table Appendix C 6 Example for Environmental Aspect Identification form

Area/Department name Soldering / Production
Name of the activity Soldering lead to IC pin
Prepared by Kaewta N. Date 7/5/00
Reviewed by Wicheern K. Date 10/5/00
Approved by Mongkol B. Date 15/5/00

Aspect detail /No.	Condition	Situation	Control Level	Input	Out put	Impact	Aspect Class
Prod. S 01 Soldering generate lead fume	N	A/C/D	1	-	35 mg/m^3	Emission to air	Air Emission
Prod. S 02 Lead & Flux spillage	A	P/C/D	1	-	0.5 lit/d	Waste management	Hazardous Waste
Prod. S 03 Lead usage	N	A/C/D	2	30 lit/d	-	Raw material usage	Raw material Consumption
Prod. S 04 Flux usage	N	A/C/D	1	10 lit/d	-	Raw material usage	Chemical Consumption
Prod. S 05 Electrical consumption of soldering machine	N	A/C/D	1	10 Kw/h	-	Natural resources usage	Energy Consumption
Prod. S 06 Flow down lead tank	A	P/F/D	3	N/A	-	Waste management	Hazardous Waste

Step 5 Filling in Environmental Aspect Evaluation Form

Table Appendix C 7 Example for Environmental Aspect Evaluation Form

Area/Department name Soldering / Production
Name of the activity Soldering lead to IC pin
Prepared by Kaewta N. Date 7/5/00
Reviewed by Wicheern K. Date 10/5/00
Approved by Mongkol B. Date 15/5/00

Aspect Class	Aspect No.	Business Concern			Environmental Concern											Others criteria concern			Significant Aspect
		Legal/ Cor. Policy	Cost	Com. Complaint	LH of Occurrence (A) (P_1+P_2+Tr)				LH of Detect (B)	Severity (C) (Q+C1 or Q+C2)				Total (A+B) xC	Sig. Level	Protect/ Control	Lack of data	Past/ Emer.	
					P_1	P_2	Tr	T		Q	C1	C2	T						
1.Energy Consumption	Prod. S 05	✓	✓	✗	3	1	1	5	1	1	-	3	4	24	N	✗	✗	✗	Sig
2.Water Consumption																			
3.Chemical Consumption	Prod. S 04	✗	✗	✗	3	1	1	5	1	1	-	3	4	24	N	✗	✗	✗	N
4.Raw material Consumption	Prod. S 03	✗	✗	✗	3	3	1	7	1	1	-	3	4	32	M	✗	✗	✗	Sig
5.Supplies consumption																			
6.Air Emission	Prod. S 01	✓	✓	✗	3	1	1	5	2	3	3	-	6	42	M	✗	✗	✗	Sig
7.Waste	Prod. S 02	✓	✗	✗	2	1	3	6	2	1	3	-	4	32	M	✗	✗	✗	Sig
	Prod. S 06	✓	✓	✗	1	3	3	7	2	3	3	-	6	54	H	✓	✓	✗	Sig
8.Water Discharge																			
9.Product/ Packaging																			
10.Land Contaminated																			
11.Community complaint																			
12.Other																			

Step 6 Filling in Environmental Significant Aspect List
Table Appendix C 8 Example for Environmental Significant Aspect List

Prepared by Wicheern K Date 15/5/00
Review by Mongkol B Date 18/5/00
Approved by Sayam A. Date 20/5/00
Aspect Class Hazardous Waste

Sequence	Aspect No.	Business concern		Environmental concern	Others criteria concern
		Legal/ Corporate policy	Others		
1	Prod. S 06	✓	✓	H	✓✓
2	Prod. S 02	✓	✗	M	✗
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

APPENDIX D

Selected Resources of Environmental analysis implementation

Web site

- Electronic Reporting at EPA: Implementation Guideline for electronic reporting http://www.epa.gov/oppeedil/implement.htm
- Croner's Substances Hazardous to the Environment; Email: info @ croner.co.uk
- The Integrated Risk Information System (IRIS) available through U.S.EPA http://www.epa.gov/iris/intro.htm
- Material Safety Data Sheet (MSDS) available through http://www.merck.co.th/manual/si/eng/1240/124020.htm http://www.gis.diw.go.th
- EPA's National Center for Environmental Assessment.1999.EPA Risk Assessment Guidelines [online]. Available: http://www.epa.gov/ncea/raf/rafguid.htm
- Integrated Safety Management Program: http://tis-nt.eh.doe.gov/ism/
- EPA's home page from Earth 1, the official environmental information network for EPA www.epa.gov/envirosense
- EPA Federal Facilities Enforcement office for Environmental Management Reviews (EMRs) and the code of Environmental Management Principle www.epa.gov/envirosense/oeca/fedfac/fflex.html
- American Conference of Governmental Industrial Hygienists (ACGIH) http://www.acgih.org

Documented

- Dangerous Properties of Industrials Materials, 6 th ed. I.N.sax, 1984, Van Nostrand Reinhold
- NIOSH Pocket Guide of Chemical Hazards, U.S.Dept.of Health and Human Services, available by calling NIOSH (513) 533-8257
- Environmental Mutagen Information Center, Building 9224, P.O.Box Y, Oak Ridge, TN 34831 (615) 574-7871
- Hazardline available through Occupational Health Service, Inc. 400 Plaza Drive, P.O.Box 1505 Secaucus, NJ 07094 (800) 223-9878
- Dow chemical Company. 1987. Fire and Explosion Index Hazard Classification Guide. Sixth ed. New York : AICHE.
- American Petroleum Institute. 1990. Management of Process Hazards, Recommended Practice. First ed., Washington, DC : API.
- New Jersey Environmental Protection Agency. 1987. Toxic Catastrophe Prevention Act. Princeton, NJ
- Environmental Protection Agency. 1987. 40 CFR Part 355, "Extremely Hazardous Substances List."
- National Fire Protection Association 704. Identification of the Fire Hazards of Materials. 1989. Quincy, Mass. : NFPA.

- U.S. Environmental Protection Agency. April 1988. Superfund Exposure Assessment Manual.
- U.S. Environmental Protection Agency. November 1986. Superfund Risk Assessment Information Directory.
- U.S. Department of Health and Human Services. February 1987. NIOSH Pocket Guide to Chemical Hazards, p. 14.
- U.S. Environmental Protection Agency/Federal Emergency Management Agency/U.S. Department of Transportation. December 1987. Technical Guidance for Hazards Analysis : Emergency Planning for Extremely Hazardous Substances.
- Department of Labor—OSHA. February 1990. Process Safety Management of Highly Hazardous Chemicals, (Notice of Proposed Rulemaking).
- State of New Jersey Department of Environmental Protection, Proposed Rule N.J.A.C. Toxic Catastrophe Prevention Act Program
- Department of Labor—OSHA. August 24, 1987. Hazard Communication Act—Final Rule, Federal Register.: 31869-31881.
- Acute Hazards Data, available through the Office of Economics and Technology, U.S.EPA

BIOGRAPHY

NAME	Mrs. Kaewta Nuntajiwakornchai
DATE OF BIRTH	22 February 1970
PLACE OF BIRTH	Ubonratchatanee, Thailand
INSTITUTIONS ATTENDED	Police Nursing College, 1989-1993: Bachelor of Science (Nursing) Mahidol University, 1997-2000: Master of Science (Appropriate Technology for Resources Development)