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Development of an Expert System Tool for Environmental Impact Assessment

Raed Mohamed M. Al Marzouqi

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**United Arab Emirates University
Deanship of Graduate Studies**

**Development of an Expert System Tool for
Environmental Impact Assessment**

By

Raed Mohamed M. M. Al Marzouqi

**B. Sc. In Chemical Engineering
Ohio State University-USA (1998)**

**A Thesis
Submitted to
United Arab Emirates University
in Partial Fulfillment of the Requirements for the
Degree of Master of Science in Environmental Sciences**

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Supervised by

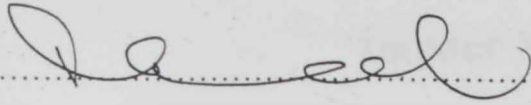
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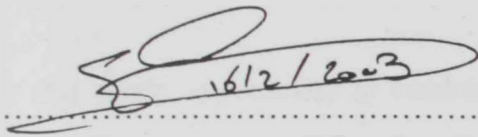
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(February, 2003)

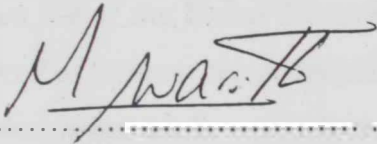
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Development of an Expert System Tool for Environmental Impact Assessment

Abstract

In this study, approaches to environmental impact assessment are reviewed and discussed. An expert system tool has been developed via the use of Microsoft Access tool for data management and Visual Basic programming for decision-making. Policies and regulations included in the program are based on the Technical Guidelines # 4 of the Dubai Municipality. The salient features of the program can be summarized as follows: the program allows the EIA applicant to input all the necessary information about his/her company and its activities. All discharges to air, water and land are compared with TG # 4 and status report is issued indicating whether or not the application is in compliance with the current policies and regulations. Also, suggested measures are outlined to mitigate the anticipated adverse impact.

The Program is documented and an example is given to highlight its use. It is anticipated that such program could be adapted by Federal Environmental Agency for EIA s throughout the UAE.

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CHAPTER I

Introduction

1.1 Introduction

It took the earth more than millions of years to reach the equilibrium state, however, since the emergence of industrial revolution (1760-1830) mankind still abusing the natural resources of the earth and the environment without considering future consequences.

In the last century, the pollution introduced by the man was much more than the sum of whatever generated before. At the beginning of the century, the industrial activities totally neglected the environmental issues and conservation of natural resources. As a result, several consequences took place such as death of more than several thousands of people in London and US due to the deadly fogs, and several rivers turned black.

After witnessing the extent of pollution caused by industries and machines, and experiencing catastrophic incidents, people began to act toward environment protection legislations. For example, in 1947, the Los Angeles Air Pollution Control District was the first air pollution control Bureau in the United State of America being formed.

On the same trend, the world experienced more pollution caused to the rivers and lakes. The history shows that most of the industries nearby the water bodies used to dump most of their liquid and solid waste to rivers or lakes causing noticeable damage to the environment. As a result of such pollution and damage to the environment, several positive changes took place in the last century (**Kovarrik, 1996**) in Europe, and mostly United State of America such as passing Clean Air Act (1960), Water Quality Act (1965), Wild and Scenic River Act (1968)...etc.

On the international scale, several positive steps were taken such as foundation of World Wilderness Funds in 1961, United Nations Conference on the Human Environment in 1972; Convention on International Trade in Endangered Species signed by eight Nations in 1973...etc.

In the last 2 decades, environmental concerns become polarized all over the globe and excessive researches were done by scientists to evaluate the magnitude of damage and pollution done by mankind. Studies show that the air quality of the world has been changed, for example, since pre Industrial Revolution in the early 18th century the concentration of Carbon Dioxide (**Exploring the Environmental, 2002**) has increased

from 275 to 360 ppm. This in turn contributes to the green house effect that led to the global warming and excess of some unexpected natural disasters. On the other hand, studies show that emission of sulfur and nitrogen gases from the burning of fossil fuels and coals plays key roles in formation of acid rains which harms fish, trees... etc.

As we are well aware, the marine environment is and ever will be the victim of mankind non-environmentally safe acts. The studies show that a lot of coral reefs in several parts of the world nearby the beaches are dead. The reason of the death varies either due to the discharge industries of water of contaminated form, or high temperature (**Buchheim, 2002**) from process water discharge.

Since the last decades, the world's population has doubled and the demand over services and goods began to uprise causing series of non-environmentally safe activities leading to exploitation of natural (non-renewable) resources and polluting the environment. The world community became worried whether the earth capacity will be able to sustain the human needs or withstand tolerating human pollution.

Today the World witnessed and realized a clear picture of what non-environmentally planned acts (ex. (**United State Chemical Safety and Hazardous Investigation Board, 1999**) Bhopal Disaster, Chernobyl explosion, Exxon Valdez oil leakage, (**Christian Science Monitor**) Kuwait war "Depleted Uranium") can impact the safety of the environment. As a result of these findings the international community began to act seriously through several international meetings and agreements such as:

Montreal Protocol 1987, International Treaty bans ocean dumping of waste 1988, UN Antarctica treaty prohibits mining...protect animal species 1991, (UN, 1997) Earth Summit in Rio 1992, and Kyoto Protocol 1997(Geller, 1999), and Johannesburg Earth summit in 2002.

Thinking of Environmental damages caused by industries and human activities in the past, one will find out that there is a lack of Environmental Awareness, Environment Management, Environmental Planning, Risk Assessment, and Environmental Impact Assessment; all of which are key factors in causing environmental damages and disasters.

In recent years, the world began to focus on achievement of sustainable development. The benefits of successful developments are (Mohamed and Antia, 1998, Mohamed, 1999, a, b): (1) cultivate general integration among all factors (environmental, social, economical, technical...) of consideration and concern from the early stage of the proposed project or activity; (2) encourage multi-disciplinary cooperation among interested parties; (3) build up credible background reference information and findings to make "Informed Decision"; and (4) leave to the decision makers responsibilities of all societal decision and choice.

Sustainable development considers the development and the environment as inseparable parts of each other and both are dealt with as a one issue. Several organizations have defined the Sustainable Development as (Mohamed and Antia, 1998, Mohamed, 1999a,b): - *"The right to development must be fulfilled so as to equitably*

meet developmental and environmental needs of present and future generations."

(Principle # 3 of Rio Conference 1992).

"In order to achieve sustainable development, environment, environmental protection shall constitute an integral part of the development process and cannot be considered in isolation from it." (Principle # 4 of Rio Conference 1992)

The basic elements of sustainable development are (Muschett, 1997): (1) population control; (2) technology sharing and transfer; (3) wise and environmentally planned use of natural resources; (4) prevention of pollution; (5) waste minimization or termination; (6) identify environmental limits and assimilation capacity; (7) perfecting market economy; (8) education & illiteracy minimization or termination; (9) change in perception and attitude; and (10) changes in social and cultural levels. The main challenge in sustainable development is how it can be made fairly practical.

Sustainable development can be approached through maintaining environmental, social, and economical sustainability. *"Sustainable development accrues only when management goals and actions are simultaneously ecologically viable, economically feasible, and socially desirable"*. (Mohamed and Antia, 1998, Mohamed, 1999)

Part of the sustainable development is to foresee and evaluate environmental impacts for any development. Today, countries in the process of evaluating environmental impact of old exist sites to find out any chance of existence of intolerable contaminants. However, to avoid or easily control unwanted environmental consequences

of new projects, prior to the beginning of the activity, an Environmental Impact Assessment (EIA) chosen to be the best solution.

1.2 Environmental Impact Assessment (EIA)

The EIA is an environmental management tool, and multi-disciplinary approach in nature. It is generally conducted for identifying, predicting, evaluating, and mitigating the biophysical, social, economical, and other relevant and concerned effects of the proposed development. Various issues of concerns should be integrated effectively in the development process at early stage before making any commitments and taking main decisions.

While defining the objectives for environmental impact assessment, the objectives should cover social objectives and economical objectives along with environmental objectives as main keys for assurance of sustainable development. (**Mohamed and Antia, 1998**). Part of assuring sustainable development, in approaches to be used for input collection from concerned parties and technique of options evaluations, is the implementation of (1) group interdisciplinary work: the specialist of same field work together to share information and feedback to each other; (2) “modelling workshop”: meetings among specialist, decision-makers and methodologists; and (3) “study task”: consultancy principle in date and reports collections from all parties involved in EIA.

1.2.1 Risk Assessment Part of EIA for Sustainable Development

In EIA, the regulatory criteria related to risk management of polluted sites or environmental nature must be considered and used. Regulation can be identified as location specific, pollutant specific, or action/technology specific. Those regulations related to site where pollution and remediation took place called location specific; however, regulations related to type, quantity, and quality of pollutant (waste) called pollutant specific. Regulations related to methods, means, and techniques of risk management called action/ technology specific.

In risk management there are two types of criteria (numerical criteria, and risk assessment criteria) applied. Numerical Criteria (used by most of European Countries) is easy to be used and managed, it enhances the communications among interested parties and minimizes confusion and miss-understanding as well. In broad application, Numerical Criteria becomes unresponsive (useless) to site-specific conditions with limited level of confidentiality; therefore, risk assessment criteria (used by US) will become a good approach to consider site-specific factors. Risk assessment criterion is a challenging tool that enforces all interacting parties to apply procedures clearly and analyze the result confidentially. Moreover, in case of modeling, uncertainty in interpretations of results must be highlighted.

1.2.1a Risk-Based Mitigation Criteria

In risk-based mitigation criteria (site specific risk assessment) for health evaluation, the following steps selected in setting remediation goals: -

1. Selection of indicator compound for the site of interest.
2. Estimation of short-term and long-term concentration (STC & LTC respectively) at point of maximum exposure.
3. Comparing the STC & LTC with the existing or relevant adequate standards.
4. Estimation of both sub-chronic and chronic daily intake (SDI & CDI).
5. Computation of hazardous indices for both SDI & CDI as (HIS & HIC).

The remediation target levels for indicator compounds with standards and those without standards are different. For those with standards the upper limit is the target. However, for those without standards the compound classified in two categories: (1) chemical compound with non-carcinogenic effects and (2) chemical compound with carcinogenic effects.

The daily intake for the first category must be maintained at acceptable level; however, for multiple substances the total must be maintained at one. On the other hand, for carcinogenic compound the remediation target goal is to maintain the cancer risk at 10^{-6} average.

1.2.1b Numerical-Based Mitigation Criteria

In numerical based criteria, several factors can be considered depending on the subject (air quality clean up, soil remediation, water quality maintenance) criteria. These criteria have been changed in terms of numbers considered and relative importance assigned for each factor. The main factors were background quality, and analytical detection limits.

In building up numerically based mitigation criteria, considerations are given to the following factors: (1) background (ambient) concentration of pollutant, (2) environmental mobility of pollutant, (3) relationship among the subject remediation factor and the surroundings, (4) Health of terrestrial plants and animals, (5) Human Health, (6) esthetics, (7) limits of analytical capabilities (detection limits), and (8) subject material use.

1.2.2 Status of EIA

Since 1969, the United State of America is the leading country in implementation of EIS along with Canada, and Western Europe. It has been indicated that more than one million applications of impact assessments were conducted in US.

In practice, most of the world countries (Developing Countries) started to implement the EIA since 1992. After several catastrophic environmental crises, most of the world countries began to appreciate the EIA as key requirement for establishment any

development of projects especially those of industrial nature. On the other hand, some of the poor and undeveloped countries still neglect the EIA.

Most of the developing Asian Countries (similarly Arab World) began to build up perception of the EIA; however, applicability still considered difficult in some parts of it due to several factors, such as economical situations, required knowledge base, and technology limitation. (Lohani, 1997)

Since 1991, as per Local Order 61 (1991), Emirate of Dubai has enforced the use of EIA and requested all industries to obtain Environmental and Safety Clearance. It also enforced the existing industries to comply with all Environmental rules & regulations and to submit a complete Waste Audit Report if required as per Technical guidelines provided, that is assuring full commitment to Environmental Rules and Regulations.

The United Arab Emirates Federal Environmental Law # 24/1999 for the protection and development of the environment in its Article # 4 has required that EIA is compulsory for any project to be established in UAE. It also ensures that no project can start activity unless an EIA is submitted and approved by the Federal Environmental Agency (FEA).

On the same steps, after the establishment of the FEA in 1999, other Emirates began to build their own system of Environment Protection in accordance with the FEA Regulations.

The existing EIAs techniques vary but all are based on the one or more of the following methods or tools such as overlay techniques, checklist, matrices, networks and system diagram, consultations and questionnaires, expert opinions, modeling, carrying capacity (threshold)...etc. Each technique has some characters and specifications that make it work for covering certain aspects of EIA. In fact, several key factors that can be used are environmental laws, law enforcements, economical conditions of the country, availability of expertise, type of activity, size of activity, location of activity, environmental conditions...etc. Most of advanced countries (ex. W. Europe, US, and Japan) have their own methods and techniques due to the enhanced environmental rules and regulations, and availability of environmental expertise and data. Some of these techniques are developed models, expert models, and other PC- linked models that are rarely found in the Arab world.

In the Arab World, rarely we can see any type of software being applied in environmental impact assessment. Considering UAE as one of the regional leading countries in application of Environmental Impact Assessment, we will focus on Environmental rules and regulations of Dubai Emirate, to develop an Expert System for Environmental Impact Assessment, and Waste Audit Report. There are several factors that motivate developing such a system of EIA in the Dubai Emirate such as aim of Dubai Emirate to achieve Free-Paperwork Departments, Quality Performance, Distinct Performance, and Fast Service Satisfaction as well as Electronic Government. The population composition, multi language environment, and trends toward PC learning,

usage, and dependency, and aims towards increase in level of environmental awareness all are key factors behind the importance of developing an Expert System for EIA in the UAE.

In addition, the detailed rules and procedures of the environmental regulation as well as the transparency of application processing system of the Environment Department at Dubai Municipality (DM) are the key factors behind the development of an Expert System tools for EIA and Waste Audit.

The policies and regulations adapted in the developed Expert System program are those being used by Dubai Municipality and represented in the Technical Guidelines (TG) # 4.

1.3 Objectives

The main objective of this study is to develop an expert system tool to help the planner of a new project to identify and recognize the environmental impacts of his/her activity as per existing rules and regulations.

In Expert System tool developments, the following items were kept in mind.

- 1- To help the basic PC user apply it easily;
- 2- To clarify to the user all data required as per TG # 4 to process their application;
- 3- To educate the project owner about the environmental condition of his project;

- 4- To guide the user to the expected non-environmental by accepted conditions;
- 5- To clarify the requirement in order to comply with environmental conditions;
- 6- To guide the user to know which Technical Guidelines to follow;
- 7- To save the applicant time, and excess consultation fees;
- 8- To help the applicants to get a full picture of the environmental and safety requirements for his project in stepwise;
- 9- To minimize back and forth meetings with statutory and non-statutory authorities and assure inclusion of all necessary project's details;
- 10- To help environmentally unaware users learn about the environmental requirement easily and fast;
- 11- To minimize the chance of misleading of environmentally unaware entrepreneurs by identifying requirements to process EIA report; and
- 12- To insure a full document submission at once and to avoid any miscommunications at any stage.

By inclusion of environmental and safety guidelines and use of specified discharge standards in the developed expert system program, application process will be straight forward procedures

1.4 Tasks

In an attempt to approach the goal of developing the software, first of all rules and regulations relating to the subject was searched for. These rules based on the existing Technical Guidelines, Information Bulletins, Code of practices, and Discharge Standards

in the emirate of Dubai. Literature review was conducted on EIA over Europe (especially United Kingdom) and United States of America.

Initially, new structure software, by the application of Microsoft Access tools, was developed and programmed by the use of functional commands. The developed Access program was not expertly behaving; therefore, the need for the use of visual basic was mandatory to provide summary reports for the expected conditions and suggested corrective actions; all of which are discussed in Chapter III.

1.5 Study Approach

An initial attempt was done by using the old version (dose) of Expert System Software, and due to non-availability of the window version and limitations of the commercial software, it was decided to use Microsoft Access **XP** to develop the expert system tools for EIA. The developed system is basically based on the Technical Guidelines # 4 (*Guidelines for Preparation of Environmental Impact Statements for New Industrial Premises*) and discharge standards certified by the Department of Environment, Dubai Municipality.

In reality it will be too lengthy and detailed to develop an EIA system based on specific industry and it requires a huge expertise, time and efforts. However the developed system is simple in a sense that it highlights and verifies all points of concern to the project owner as per **TG # 4** in order to give a full view of all environmental and

safety concerns of any project to be established in the Emirate of Dubai and inform the applicers in a summary report for what action to be taken in order to comply with policies and regulations.

Moreover, it conducts a waste audit for the activity's discharge quality and informs the software user if certain discharge parameters have exceeded the limit and what corrective measures to be taken. Finally, the developed system can be used and accessed from all over the world if it gets linked to the net and due to the access confidentiality and system format it will update the EIA reviewer with a direct statement from the project owner.

1.6 Thesis Organization

The Thesis is organized as follows: -

Chapter 1: Covers the introduction to the problem, objectives, tasks, and study approach.

Chapter 2: Covers literature review.

Chapter 3: Covers the methodology of the developed system.

Chapter 4: Covers the application Procedures of the Expert System Program summary,

Chapter 5: Covers the summary, conclusion and recommendations

CHAPTER II

Literature Review

2.1 Introduction

Environmental Impact Assessment (EIA) is a planned pre-evaluation and predictions of environmental concerns of any actions and to be used as judgmental feedback system tools in any decision-makings plan. The EIAs that exists today are unified in terms of concept and understanding. The EIA should be conducted at early stage of the proposed activity and should be done for any development that might have significant effects. EIA should be comprehensive in a way of considering interest of all concerned parties, and cover all factors of interest that will encourage the notion of sustainable development.

2.2 The Objectives of EIA

1. To secure that all environmental concerns are recognized precisely, and embodied in decision-making process.
2. To foresee and avoid, minimize or even eliminate the significant biophysical, social, economical and other concerned adverse effects.
3. To maintain the natural environmental quality by protecting the productivity and capacity of natural systems and the ecological process that maintain their functions.
4. To encourage sustainable development and optimize resource use and management opportunities.

2.3 EIA Principle (Attributes)

The International Association of Impact Assessment (**IAIA, 2001**) has defined EIA principle precisely into two types of principles; basic principles and operating principles.

The **Basic Principles** are: -

1. **Purposive:** inform the decision-maker of the findings in environmental and human well-being context.
2. **Rigorous:** application of the best relevant and practical science, technology, and methodologies for problem studies.

3. **Practical:** the process finding and information used in assessment should be acceptable and applicable by proponents.
4. **Relevant:** information provided should be sufficient, subject related, and reliable.
5. **Cost effective:** the process should achieve the target within the information, time, resources, and techniques available.
6. **Efficient:** the process should guarantee proper and adequate time, cost, and coordination for meetings with concerned parties.
7. **Focused:** the process should cover the prominent environmental issues and main concerns.
8. **Adaptive:** the process should be fitted to the realities, factual issues and situations to make it iterative, incorporate, and valuable.
9. **Participative:** the process should involve in and document the concerns of all interested parties to be presented in decision making.
10. **Interdisciplinary:** the process should guarantee the use of suitable tools and expertise in impact assessment steps.
11. **Credible:** the process should be done fairly, professionally, and right in all aspect of assessment and steps.
12. **Integrated:** the process should emphasize all cross-relationships among assessed aspects.
13. **Transparent:** the process should contain all aspects of EIA clearly, clarify all factors of concern and existing difficulties, and accessible to public review.

According to the IAIA (2001), the EIA process should go through the following

Operational Stages: -

1. **Screening:** the process through which it will identify if the project requires EIA or not, and if so, to what extent.
2. **Scoping:** the process of indicating which impacts and issues needed to be assessed.
3. **Examination of Alternatives:** proposing the best environmentally safe alternatives and choices to proposed actions.
4. **Impact Analysis:** the process of identifying and foreseeing all types of impacts of each alternative.
5. **Mitigation and Impact Management:** to take corrective measures in order to minimize, evade, or eliminate adverse impacts, and if relevant, considered in management plan or system.
6. **Evaluation of Significance:** to figure out the significance of each impact and degree of tolerability.
7. **Preparation of Environmental Impact Statement (EIS) or report:** to transparently include impact of alternatives of choice, proposed mitigation methods, impact significance, and concerns of interested parties.
8. **Review of EIS:** to identify whether the report complies with the basic principles in terms of reference, satisfactory, and full clear information for proper decision making.

9. **Decision-making:** to identify the acceptance or rejection of the proposal, and what constraints and conditions to comply with in case of implementation.
10. **Follow-up:** to insure a full compliance with commitment, and monitor the impact of development and effectiveness of mitigation measures applied.

2.4 EIA Methods and Techniques

The EIA methods or techniques that are being used today vary and they are function of resources availability, time limitation, criteria of assessment, assessors, law and regulations...etc. (Canter, 1996). The methods are based on the basis of approaches and constituting principle. Some of these methods are Ad-Hoc procedures; overlay techniques, checklist, matrices, networks and system diagram; questionnaires & consultancy...etc.

Limitation in methods application might arise due to the notion that things (environment, economy, society, technology) are always subjected to change (Barrow, 1997); therefore, the methods that are applied at one country or point in time might not be applicable or sufficient to another country or at different point of time. Most of the existing methods were originally developed for specific situations and tasks, and some were re-modified by others. Methods and techniques should be standardized, adaptable, duplicable, consistent, cheap, economically affordable, fast, accurate, transparent... etc.

2.4.1 Ad-Hoc Method

The AD-Hoc method is the first simple method being used in the assessment. It is characterized by simplicity, minimum guidelines, limitation in identification of possible impacts, and impact parameter investigation. They are easy to use and there is a possibility to joint them to the specific circumstances of a given assessment situation without the restrictions on formality. Ad-Hoc method defines broad area of impact (such as water, land, forest, populations...etc.) rather than specific one. It is fast, conducted with minimum efforts, expertise, and experience. (Lohani, 1997). However, they do not include any assurance for comprehensiveness or completeness. They do not include any secondary impacts, and may lack consistency in the analysis due to lack of guidance and specific formalization. Ad-Hoc method is of limited value for scoping. Therefore, they depend strongly on the background information and other tools such as expertise, and experienced people in conducting the EIA. Characteristic nature of Ad-Hoc technique is shown in **Figure 2.1**.

The characters of Ad-Hoc technique as per **Figure 2.1** show that Ad-Hoc cannot identify neither indirect impact nor cumulative impact or impact interactions; Also, Ad-Hoc method does not provide choice for evaluation.

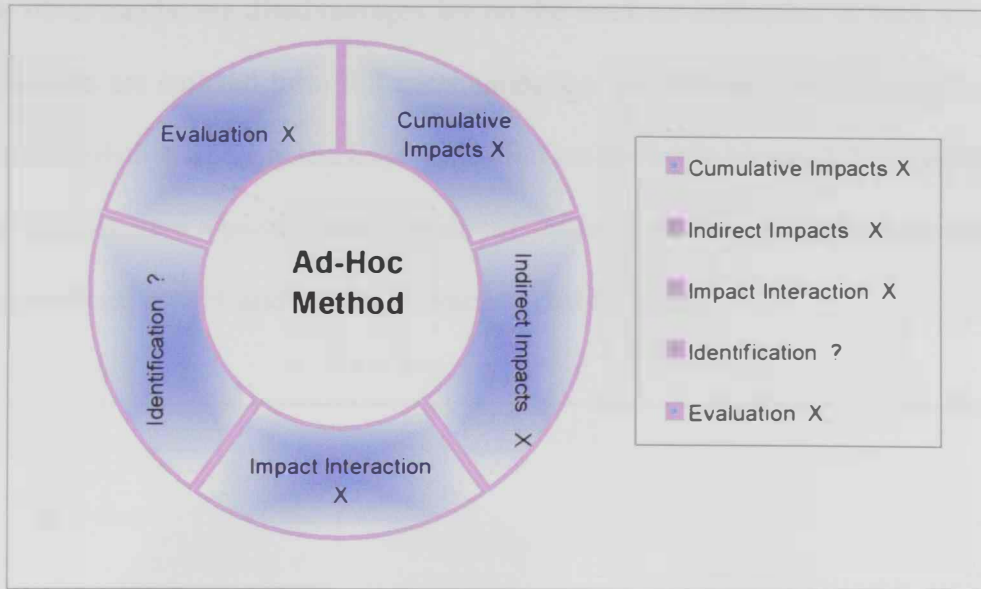


Figure 2.1. Summary of Ad-Hoc Method Characterizations

2.4.2 Expert Opinion

Expert opinion is an intrinsic mean of conducting any method of impact assessment, although Expert Opinion is not exactly a method, it is an important means for assessment of indirect and cumulative impact as well as impact interaction. Because the technical inputs of the expert are important part of impact assessment, it is important to choose an appropriate expert team with a talented co-ordinator, (Walker, 1999). The task of the co-ordinator is to prepare a clear and cooperative interaction networks among the experts to insure integrated and productive expertise input to the core of impact identification and assessment. The advantages of Expert Opinion lays on the fact that regular meetings will lead to the fact that all types of impact will be identified and will become inseparable part of Environmental Impact Assessment process.

On the other hands, the disadvantages lay on the weak co-ordination in such a way that some experts are isolated form full communication and sharing with other team expert. The characteristic natures of the Expert Opinion are shown in **Figure 2.2**. It is shown that Expert Opinions are a good choice for identification & evaluation as well as cumulative impact, indirect impact, and impact interaction clarification.

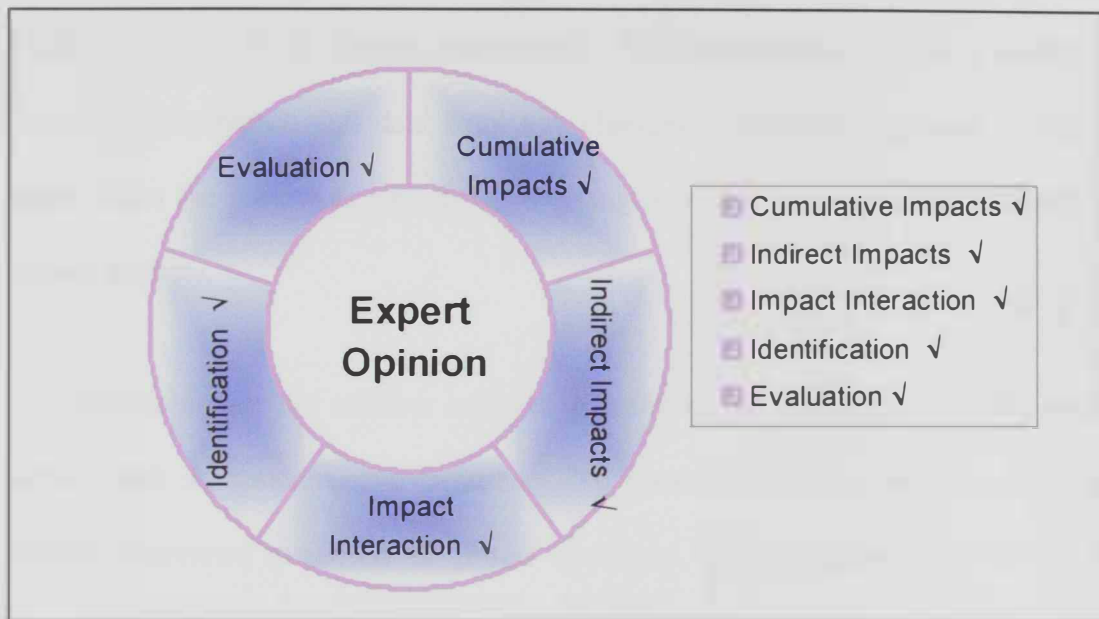


Figure 2.2. Summary of Expert Opinion Method Characterizations

2.4.3 Consultations and Questionnaires

Consultations and Questionnaires are methods of gathering information useful in identifying the core of assessment and all types of impacts including impact interaction. Both methods ensure clear understanding of parties and resources that might be affected,

and they help identify the basic data and information needed to conduct the environmental assessment and potential impacts.

Consultation is a mean of data gathering for assessment and is usually conducted through meetings or correspondences. Consultation identifies the main concern and views of consulted parties with regard to the project to be established. Typical consulted parties can be concerned both un/lawful authorities, local community, businesses in the area, and experts in the field of impact assessment. The consultation can be a useful tool in obtaining information and data from any changes or actions in present or future that might affect the project as well as highlighting opinions, concerns, and resources on the project impacts.

Questionnaires are another method of information collection from the concerned parties such as resident, and business. The questionnaire can be conducted through normal interviews questions or postal questions. Questionnaires can help providing specific information that cannot be easily available or thought of; therefore, questionnaire considered as complementary to consultation.

The advantages are earlier consideration of potential impacts' aspects in the assessment process. Disadvantages of consultation could be due to the fact that relevant important data sometimes may not be available. Consultation can be costly and time consuming. Confidentiality issues may block data obtaining from old projects, and adequate consulting group or specialist might be difficult to get.

Questionnaire can also be time consuming and costly. Weak response or cooperation to the questionnaires will impose other difficulties in collecting relevant information related to impact assessment scope. It is always recommended to approach relevant concerned party in order to ensure adequate and sufficient reply to the questionnaires. Characteristic nature of Consultations and Questionnaires are shown in **Figure 2.3**, which shows that Consultations and Questionnaires are a good choice for identification as well as cumulative impact, indirect impact, and impact interaction clarification; however, it cannot work for evaluation.

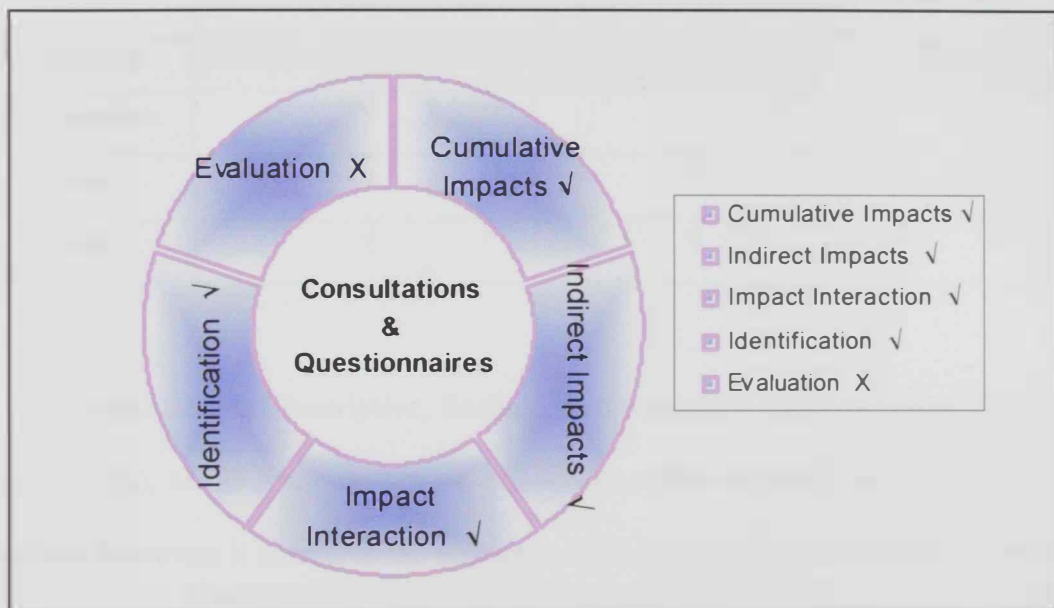


Figure 2.3. Summary of Consultations & Questionnaires Method Characterizations

2.4.4 Checklist Methods

Checklist methods consist of a list of environmental parameters to be investigated for potential impacts. They are divided in simple checklists and sophisticated checklist.

Simple checklists consist of hierarchical list of factors previously selected for assessment.

In simple checklist a blank space left to indicate there is no impact.

The purpose of checklist is to identify the impact list and if needed, the nature and character (adverse, Significant...etc.) as well. The benefits of checklists lay in aiding information gathering, restrict overlook on possible impacts by assessor, organize the thought, and aid in screening and impact focusing.

Table 2.1. An example of Simple Checklist identifying Impacts from Building Demolishing

	Potential Impact from Building Demolishing in Cities		
Resources	Building Demolishing	Materials Removals	Excavation
Air Pollution	√		
Noise	√	√	√
Traffic	√	√	

The sophisticated (Descriptive, Scaling, questionnaires, Environmental Evaluation System (EES), Multi Attribute Utility Theory) checklist methods are same as simple checklists however; it measures the impact or indicates usefulness function by applying weighing or scaling techniques. They are also applied for different phases of the project including planning. Advantages of well structured checklist are avoidance of potential impact overlooking, easy comparison of alternatives at early stage, modification as standard project and site details base, and consideration of past, present and future activities.

Table 2.2. An example of Descriptive Checklist in Impact Identification

Potential descriptive Impacts of Shifting new industries to the City Creek areas					
Resources	Past Activities	Present Activities	Project Impact	Future Impacts	Cumulative Impacts
Air Quality	No impact No emissions	A Slight emission from the existing activities	Additional Emissions	Emission from all sources within standards	Pollutants in Air will not remain within admired limits
Ground-water	Limited use of ground water	Average use of Ground water	Additional use of G. Water	Consumption of G. water of each industry within average	Total Usage of G. water will exceed threshold limits

The considered factors in checklists can result in unclear assessment result. On the other hand, the disadvantages of checklist lie on the fact that checklist does not show interaction between impacts and sometimes an impact may be double counted. Other disadvantages of checklist are due to the possibilities of incomplete or inadequate impact issues. Furthermore, checklist could become lengthy without prioritizing the impact; and may not clarify more important impacts, or likelihood impacts. Therefore checklists of critical environmental coverage are recommended.

Checklists can be used almost for all types of impacts, and they are most useful for scoping stages, and comparing options. They can be adapted to the assessment of particular environmental parameters or receptors and it has been characterized as shown in **Figure 2.4**. The **Figure** summarizes the fact that Checklist Methods are a good choice

for identification as well as cumulative impact, and indirect impact clarification; however, it is not a good choice for evaluation, and impact interaction clarification.

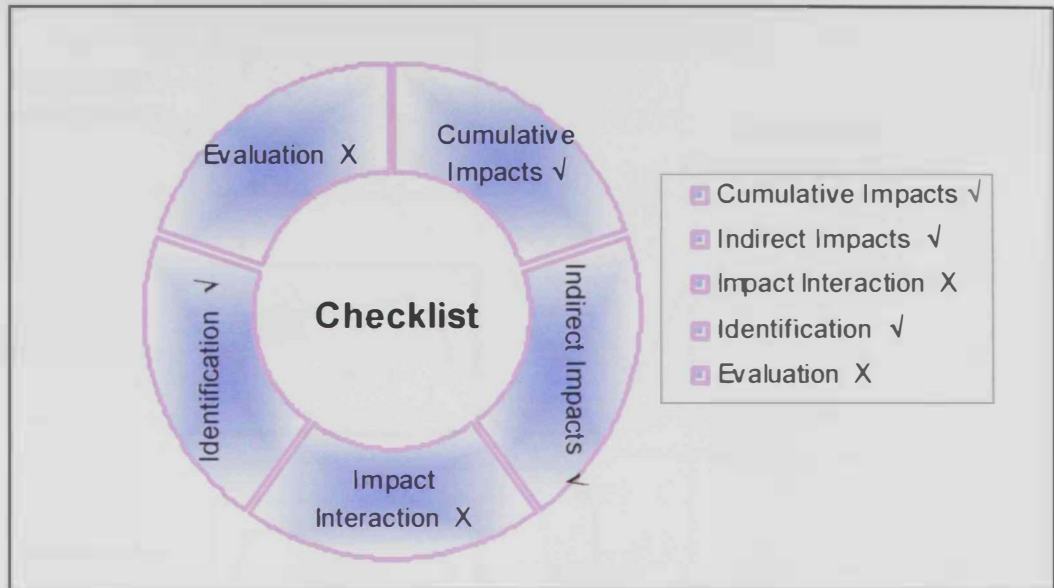


Figure 2.4. Summary of Checklist Method Characterizations

2.4.5 Overlay Mapping Methods

Overlay methods are widely used by landscape architecture, planning, and capacity assessment to identify special distributions of impacts.

Overlay methods consist of set of maps called 'sieve maps' for proposed development; each map represents different issues relating to the subject-studies such as economical, physical, social, biological...etc. When overlapping two or more maps on each other combined pictures will result. The combined pictures chosen as a helpful means of impact identification during screening stage. Overlay maps are in the form of

transparent map sheets; however, when the number of sheets increases it become difficult to identify the impacts.

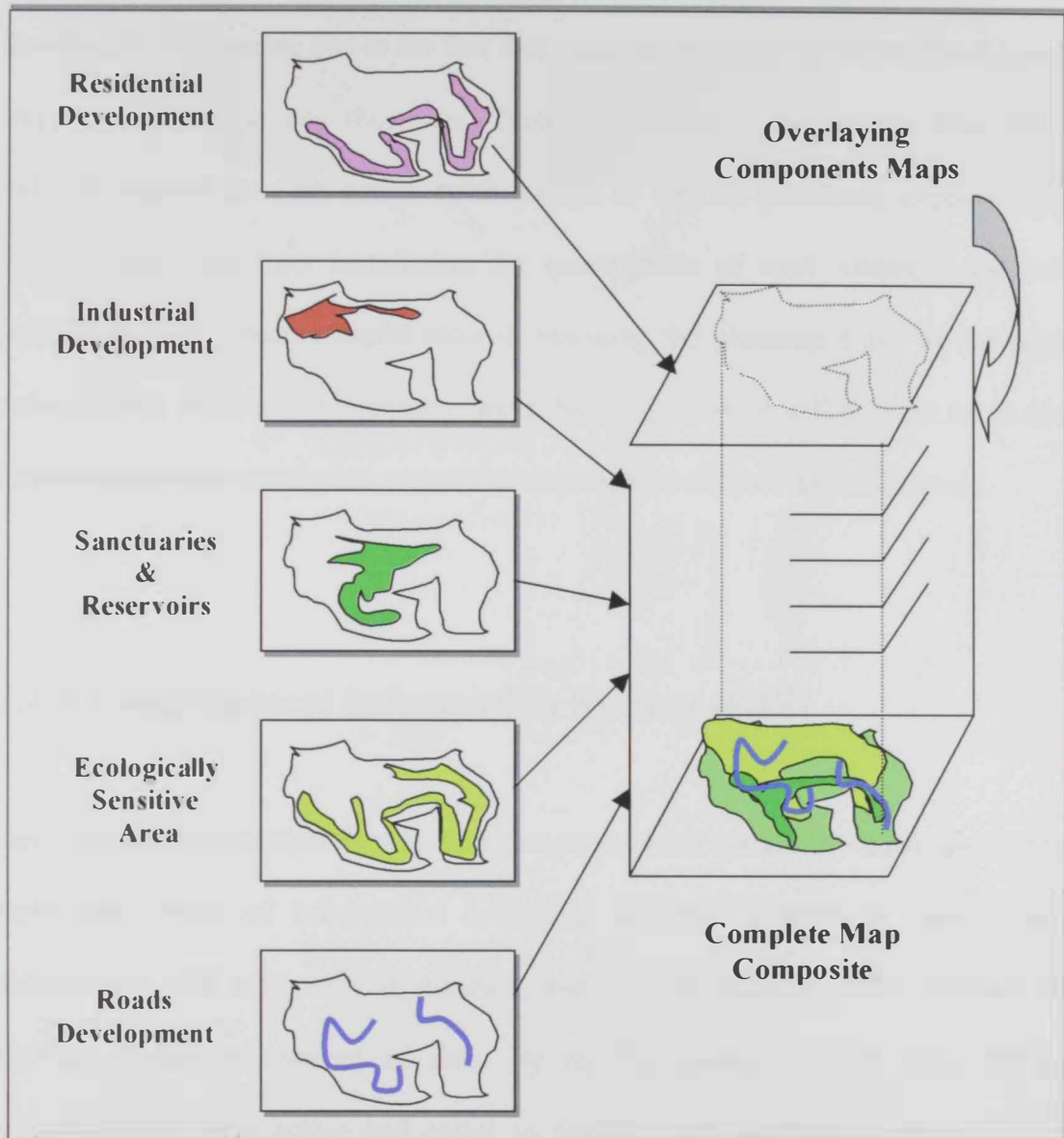


Figure 2.5 Overlay Map being compiled from Several Component Map

The overlay mapping method does help to identify both cumulative impacts and impact interactions. For example, we can map the impact from several projects on the receptors of concern to identify cumulative impacts and impact interactions.

The problem of overlaying maps lies on the fact that it is difficult to define real boundaries for the map because the nature by itself lacks defined boundaries. Another disadvantage of overlay lies in the fact that maps are not static and therefore it is difficult and expensive to update the maps. Therefore, overlay maps do not give direct and indirect impacts, or even causal relationships as well as predicting expected impacts. When considering liner installation for construction of road, channel, and railroad, overlay methods become useful tools in assessing the planning phase of the project in economically risk-less, and cohesion ways. By utilizing PC it will become much easier to handle much more overlaying maps (electronic maps) without any difficulties.

2.4.6 Geographical Information System (GIS)

Geographical Information System is a computer-based system in which data entered as input and layers of information indicating different sources of impacts and its distributions. GIS helps regular, constant, and on time updating of the gathered data as well as explicit adjustment of data. By regular updating of the data, the impact assessment becomes active and easier to predict. Data updating nature of GIS helps assessment of cumulative impacts on local and regional levels, and it can be used in developing predictive modeling as well. Both cumulative impacts and impact interactions can easily be identified by use of GIS.

The GIS provides more sophisticated analysis and can handle a large amount of data easily. Since the data is stored in digital form, modeling and analysis would be possible to encounter. In GIS, the data should be in specified format in order to ensure correct interpretation. GIS is an expensive tool and requires skilled staff to operate, The GIS cannot identify impact interaction or ensure complete evaluations. Therefore both statistical information and expert opinion are key roles in assigning integrated weighting to the system to ensure accuracy.

Today, GIS is a large science in itself with many applications. GIS is widely used in various aspects of research area such as city directory mapping, environmental monitoring, weather and climate monitoring. The characteristic nature of GIS and overlay technique are shown in **Figure 2.6**, which summarizes the fact that Spatial Analysis Methods are a good choice for identification as well as cumulative impact, and impact interaction clarification; however, it is not a good choice for evaluation, and indirect impact clarification.

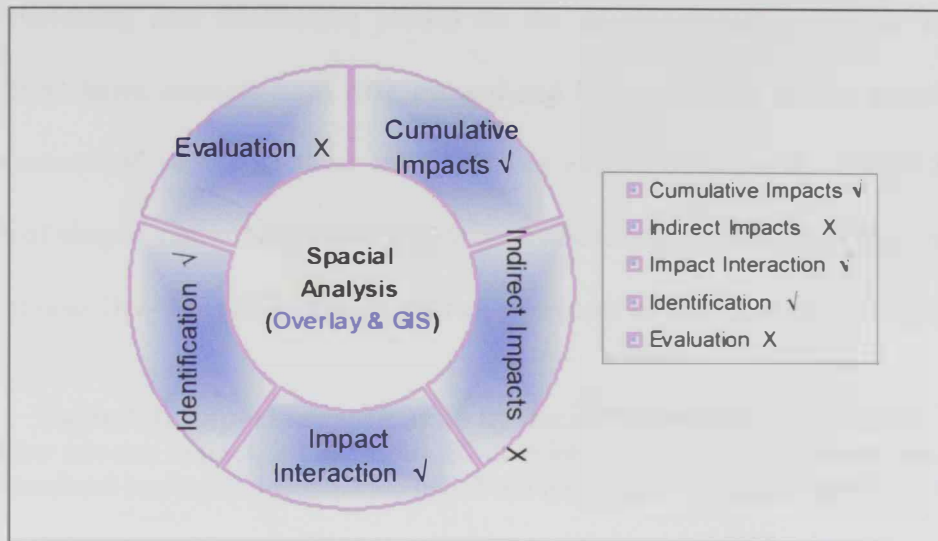


Figure 2.6 Summaries of GIS Method Characterizations

2.4.7 Matrix Methods

A matrix is a combination of two checklists one represents expected impact of proposed action (column) and the other (row) represents the considered development features showing causal relationships. They are two-dimensional checklist in tabular format. Matrix is a good choice in screening and (cumulative, indirect, and interactive) impact identification. Depending on type of matrix, one can identify the impact and its rank.

2.4.7.1 Simple Matrix

Simple matrix can give little clarification on characters of impact (long-term or short-term, constant, delayed or instantaneous, or unpredicted). It is used to evaluate the effect of various phases of projects or actions (e.g., construction, installation, operation,

decommissioning and finalization phase) on the environmental receptors. In simple matrix, cumulative impacts from past, present and future impacts can be highlighted as well as numerical values to show magnitude or extend of impacts. **Table 2.3** is an example of simple matrix of a proposed impact evaluation for Cleanup of Polluted Creek Sediment near Dry-Dock Ship Repair after enforcement of Environmental Regulations.

Table 2.3. Impact Identification by use of Simple Matrix Method
 (-) low adverse impact, (--) moderate adverse impact, (---) severe adverse impact
 (+) low beneficial impact, (++) moderate beneficial impact, (+++) severe beneficial impact

Potential Impacts	Removal of Creek Heavy Metal-Contaminated Sediment				Past Actions	Present Actions	Cumulative Impacts
	Equipment Installation	Sedimentation Removal	Sediment Dewatering	Sediment Treatment			
Water Quality	-	--	+	++	--	++	+++
Sediment Quality		++		+++	--	+++	+++
Habitats	--	-	-	-	-	+	+++
Health		+++		+++	--	+++	+++
Cultural		++		++	--	+++	+++

2.4.7.2 Weighted Matrices

Weighted (quantitative) matrices allow ranking of impacts by introducing the weight effect of each impact.

Table 2.4. Impacts Identification for Highway Construction using Weighted Matrix
R = Relative Assigned Weight for element of Environment (Total of 120)
S = Score of Impact

Impact Evaluation of new Highway Construction near Marine Sanctuary Areas					
Environmental Elements of Concern	R Relative Weighing (120 Total)	Construction	R x S Action Specific Impact	Operation	R x S Action Specific Impact
		S Score of Impact		S Score of Impact	
Noise	60	5	300	7	420
Dewatering	10	3	30	0	0
Air	10	2	20	3	30
Ecology	40	4	160	6	200
Total Impact (Cumulative)			510		700

In these matrices, after assigning weight-showing importance to each environmental component, the impacts are assessed and scored. Assigning weight to the impact is subjective therefore; justified assumptions and criteria used must be clarified. After assigning relative weight to each component of the environment indicating importance of each, then assessment of project on each component is done and scored. The scoring and weighting will help to calculate overall assessed value of project or project alternatives or mitigation measures. For construction of new highway near the sanctuary area, one could easily develop a weight matrix as shown in **Table 2.4**. During the construction phase, action specific total impact is **510** while during the operation phase it is **700**.

2.4.7.3 Leopold Matrix

Leopold Matrix, one of the best-known types of matrices, is an open-cell interaction matrix and was developed by US Geological Survey (**Barrow, 1997**). The Leopold matrix relates the environmental aspects to the development process, in such away that no potential impacts being overlooked. Leopold matrix considers both importance (significance) and Magnitude (impact). As an example, score of **0, 5, 10** can be used to indicate the degree of importance, which is based upon judgment of experts. Leopold matrix, in general, depends on the expert for subject evaluation, and less chance for public involvement. Disadvantages of Leopold matrix lies on the chance of less or non-clear coverage of public, double account the impact, might be individual's view point, lengthy, or small group assessment point, distinct culture or age judgment. **Table 2.5** shows an example of a proposed Leopold Matrix impact evaluation (Magnitude and Importance) for Enlargement, Modification and Clean up of lightly polluted Creek in Arabian Gulf regions.

2.4.7.4 Other Types of Matrix

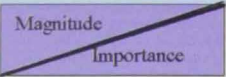
Due to the lack of the previous matrices in considering indirect impacts and larger views of impact in their assessment and inability to support total score, to compare ranking score, and to identify secondary of territory impacts, different types of matrices were developed. Some names (depending on association or developer) of these matrices are

Table 2.5. Impacts identification for proposed enlargement, modification, and clean up of polluted creek in Arabian Gulf by use of Leopold Matrix Method.

Row = Impacts
Cell: Left = Magnitude (1-10)

Column = Development Actions
Right = Importance (1-10)

Proposed Actions →

Apparent Characteristics and Conditions of Environment	Instruction: - 1. Identify & list all Proposed Actions on the right (top of matrix). 2. Place Diagonal line (slash) if Impact is possible as shown. 3. Left side of diagonal place Magnitude (1-10) and Right side Importance (1-10) and (+) if Beneficial Impact no impact empty. 4. Text discussing the impacts must be accompanied the Matrix 		Enlargement, Modification & Clean up of Creek						
			1	2	3	4			
	1	3 7	5 6						
	2	8 9	3 5			4 6			
								1. Dredging	
								2. Expansion of Creek	
								3. Alteration of Flora & Fauna	
								4. Sediment Removal	
								5. Sound & Noise Generation	
								6. Dewatering of some spots	
							7. Plantation on two sides of creek		
Environmental Characteristics(Factors)	Water	1. Turbidity							
		2. Visibility							
		3. BOD Level							
		4. Faecal Coliform							
	Earth	1. Sediment Quality							
		2. Quantity Reduction							
		3. Removed Materials							
		4. Creek Forms							
	Aquatic Ecology	1. Habitats							
		2. Irrigation Chem. leaching							
		3. Rare & endangered species							
		4. Species Diversity							
		5. Food Web Index							
		6. ETC. XXXXXXXXXXXXXXXX							

Sphere Impact matrix, Optimum-Pathway matrix, Saratoga Associates matrix, Component Interaction matrices, Minimum-link matrix, Disruption Matrix, Moore Impact matrix, Goal Achievement matrix, Steeped matrix...etc.

The following four matrices (Saratoga Associate Matrix, Component interaction Matrix, and Steeped Matrix and Sorenson Matrix) will be discussed.

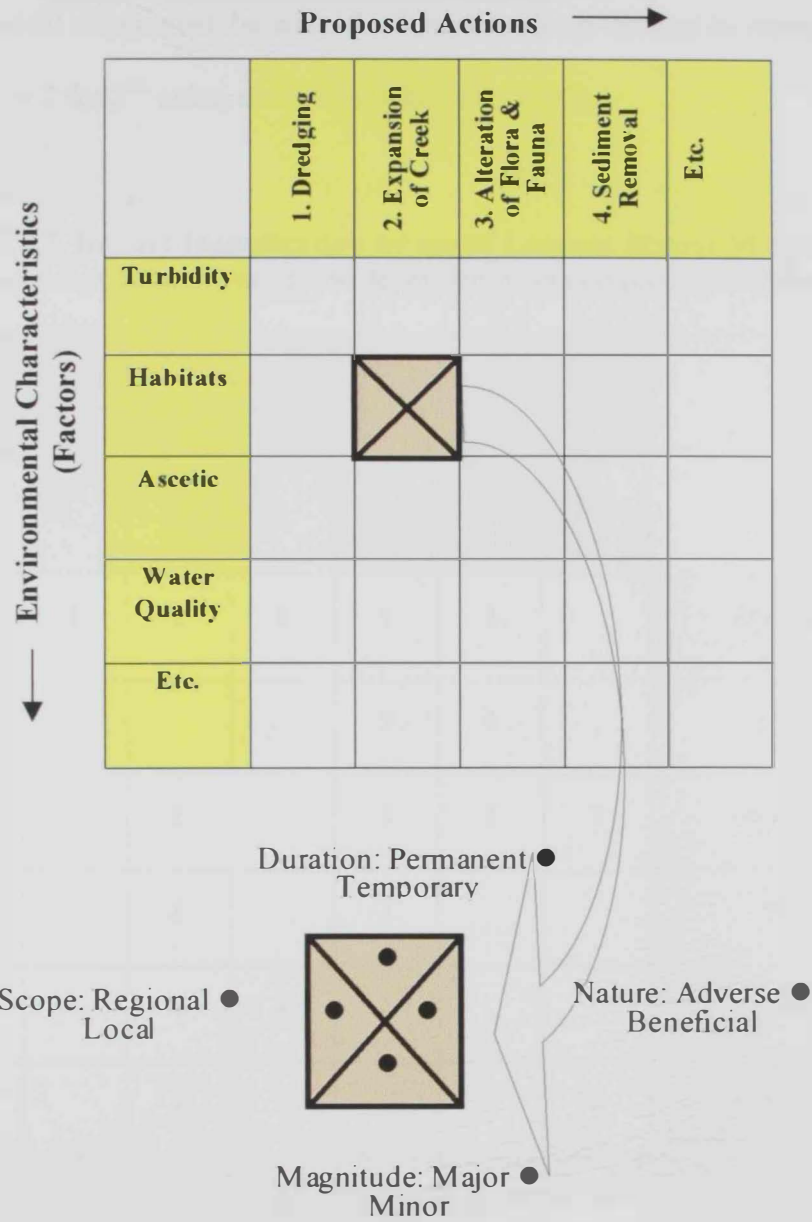
2.4.7.4.1 Saratoga Associates Matrix

Saratoga associates matrix is same as Leopold matrix except that each cell is divided into four areas through the two diagonal. As shown in **Table 2.6**, each area of the four used to represent different types of impacts (by dot) such as duration (permanent or temporary), nature (adverse or beneficial), scope (regional or local) and magnitude (major or minor) (**Barrow, 1997**).

2.4.7.4.2 Component Interaction Matrix

Component interaction matrix has been developed by Environment Canada in 1974 and can identify the indirect impacts by use of matrix algebra.

Table 2.6. Impact Identification by use of Saratoga Associates Matrix Method



In this matrix the same ecosystem components are listed vertically and horizontally in a tabular format as shown in **Table 2.7**. The direct dependency, horizontal component depends on vertical component, between the components are defined by marking the cell (1 for 1st order, or 2 for 2nd order, and so on) (**Barrow, 1997**).

Table 2.7. Impact Identification by use of Leopold Matrix Method
A (1) represent component of row dependency on component of column

Plantation	Fertilizer	Irrigation	Birds	Animal	Soil	Air	Ground Water	
1	1	1	1	1	1	1		Plantation
1					1	1		Fertilizer
1			1		1	1	1	irrigation
1	1		1		1			Birds
1	1		1	1	1			Animal
1	1		1				1	Soil
1		1	1	1	1			Air
1		1						Ground Water

2.4.7.4.3 Steeped Matrix

Steeped Matrix is a more developed and advanced format of a matrix that shows relationship of project activities to environmental receptors, parameters or resources (Walker, 1999).

An example of the use of Steeped matrix application for construction of new island and marine development is shown on proposed **Table 2.8**. Activity of sand & rock filling during island construction can affect other sensitive environmental receptors such as Coral reef, and habitat function as well as other receptors and activities such as water quality, marine biology, navigation...etc.

2.4.7.4.4 Sorenson Matrix (or Advance Network Matrix)

Sorenson matrix is an advance form of matrix (sometimes classified as network matrix) has been developed in USA in 1970s (Barrow, 1997). This type of matrix shows what interactions (change) occur and how they are generated, and dependency relations. Through the network it will show how the impact of one change can be a cause of another change; that is second and higher order. **Table 2.9** is an example of the developed Sorenson Matrix application, for city development. It can be seen that some aspect of city development (Column A.) leads to other changes (Column B), which in turn depend on other changes (Column C) and so on as a network.

Table 2.8. Impact Identification by use of Steeped Matrix Method

- Major Adverse Impact ○ Minor Adverse Impact
 ■ Major Beneficial Impact □ Minor Beneficial Impact

Construction Phase							
Sand Filling	○	●	●		○		○
Dredging	○	●	●			○	●
Sea Ground Level Disturbance		●	●		○		●
Weave Brake Installation		□	□	□	□	□	□
Building Marina		○	○	■			
Operation							
Lighting	□			■		○	
Noise							
Accident Risk	○						
Leisure Activities	■			■			
Plantation	■		□	■		■	
Sensitive Environmental Receptor							
	Residential Use	Coral Reef	Habitat Function	Tourist Attraction	Ecosystem Function	Marine birds	Fish Growth
Receptor Types							
Human	■			■		■	■
Marine Birds & Animals		□	□			□	□
Water	■	○			□	□	■
Navigation		●	○	○		○	

Table 2.9. Impact Identification by use of Sorenson Matrix Method
 ● = Indicates dependency &/ or interaction

City Development

(A)					Possible Impacts									
					(B)					(D) 2 nd Conditions				
Residential Growth					●	●	●	●	●	●	●	●	●	●
Farming														
Commercial Growth					●	●	●	●	●	●	●	●	●	●
Industrial Growth					●	●	●	●	●	●	●	●	●	●
Etc.					●	●	●	●	●	●	●	●	●	●
					(C) Initial Conditions					(E) 3 rd Conditions (Effect)				
					Increase in Water Usage					Air pollution				
					Sewage Water Treatment					Water Shortage				
					Increase in Solid Waste									
					Etc.									
										(F) 4 th Conditions				
					Parks					Corrective Actions				
					Utilities					Control Mechanisms				
					Roads & Parking					Regulation Amendment				
					Drainage									
					Irrigation									
					Air port Expansion									
					Etc.									
					Etc. →									
										(G) 5 th Cond.				
					Etc.					Monitoring				
										Enforcement				

Stepped matrix defines the direct and indirect linkage including the relationships but it does not evaluate the associated impacts (Walker, 1999). It is best applied in ecological

impact assessment but, it is difficult to apply to socio-economic impacts. Like Leopold matrix, steeped matrix lacks public input, chance of individual's viewpoint, lengthy, complex, or small group assessment point.

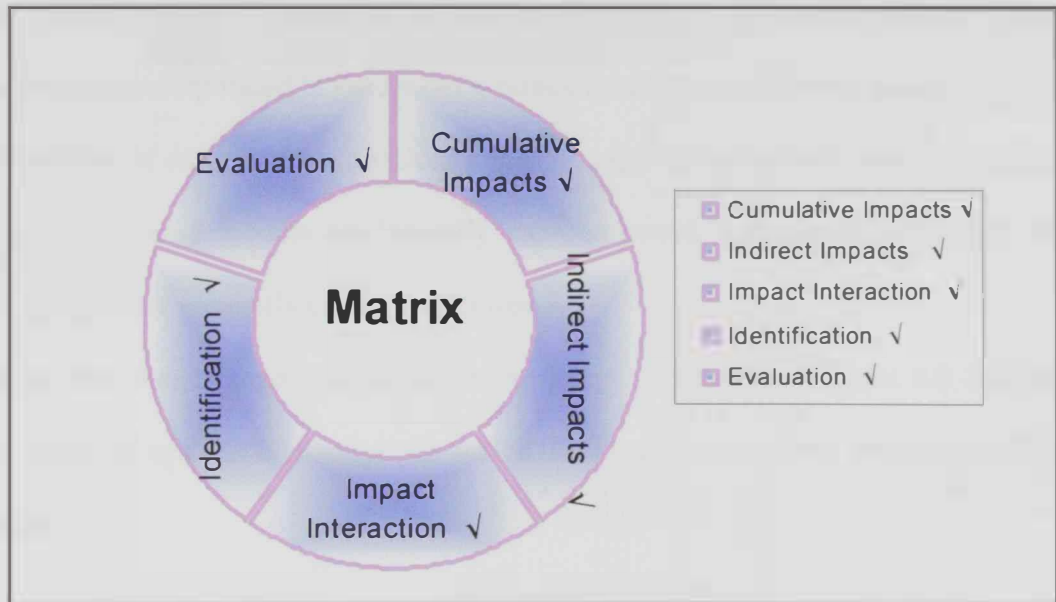


Figure 2.7 Summary of Matrix Method Characterizations

Characteristic nature of Matrix Method is shown in **Figure 2.7**, which indicates that Matrices are not only a good choice for identification and evaluation but also good tools for indirect impact, cumulative impact, and impact interaction clarification as well.

2.4.8 Network and System Analysis

Network and system analysis are cause and effect relationship, they identify the routes of impacts using a series of chains (network) or webs (system diagrams) between proposed project and the receptor (environmental element) of the impact through the impact chains. That is, there are links and interactions between elements of environment and the affected

elements that in turn affect those elements interacting with (Lohani, 1997). This in turn allows consideration of indirect impact, and the relationship between actions of proposed development, and the impacts themselves. Through this analysis it will be easy to identify the cumulative impacts on the same environmental receptor or element. When the feedback is incorporated in the model it builds up a loop or **network analysis**. These models are set of equations for predicting the behavior of variables in specific subject, however when these models are logically interconnected, it becomes a **system**. The network graphs are generally called impact tree.

There are also direct graphs that represent variation of networks. **Figure 2.8** shows a simple form of system interaction in which full cause and effect relations are not identified.

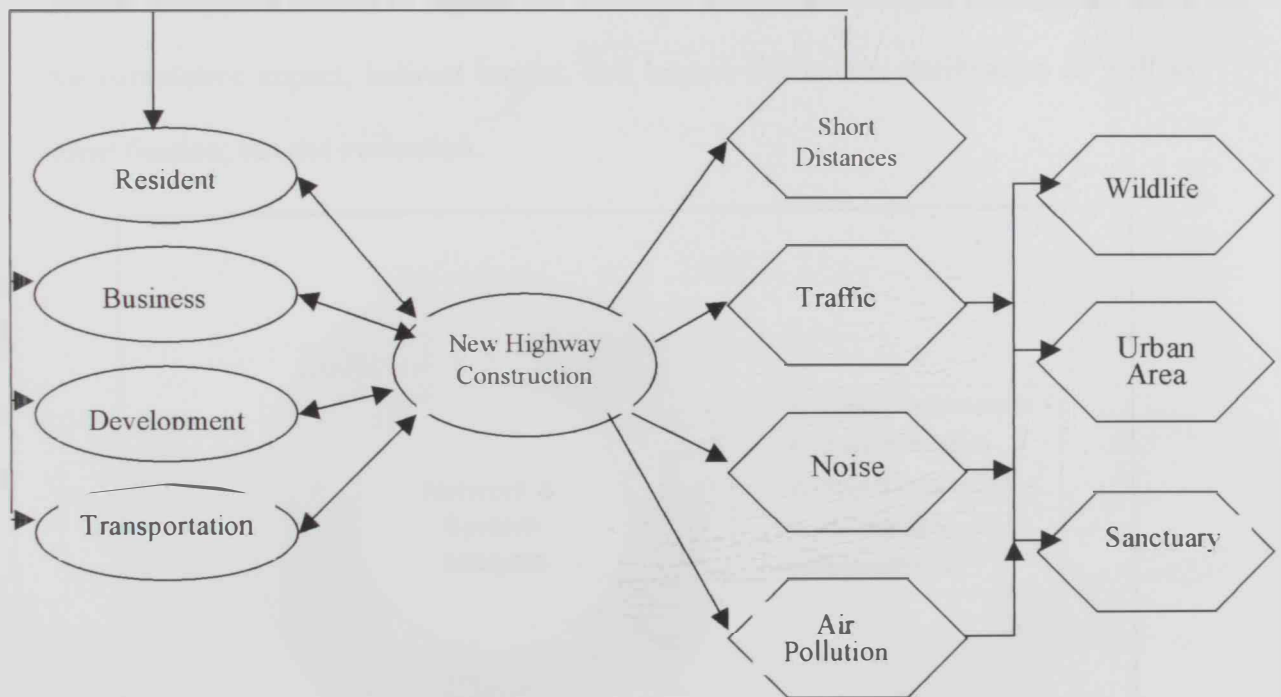


Figure 2.8. System Analysis (Interaction) clarifies Impact of Highway Construction

It shows also some of the proposed expected impact from construction of a new Highway in the urban areas in order to shift a traffic load from the old roads and maintain future traffic needs.

Finally, the advantages of network and system analysis are: (1) explaining the multiple and complicated nature of impacts (indirect impact, impact interactions...etc.) resulting from any projects; (2) identifying the interaction pathway (cause and effect) between elements of environment; and (3) identifying which process must be looked at or quantified or modeled in further details. The disadvantage of network analysis is that it is becoming too sophisticated, and time demanding including cost input. Also, network analysis alone cannot guarantee accurate evaluation; therefore, other methods (expert opinions...) need to be applied along with. The characteristic nature of Network and system analysis is shown in **Figure 2.9**. Network and system analysis are a good choice for cumulative impact, indirect impact, and impact interaction clarification as well as identification; but not evaluation.

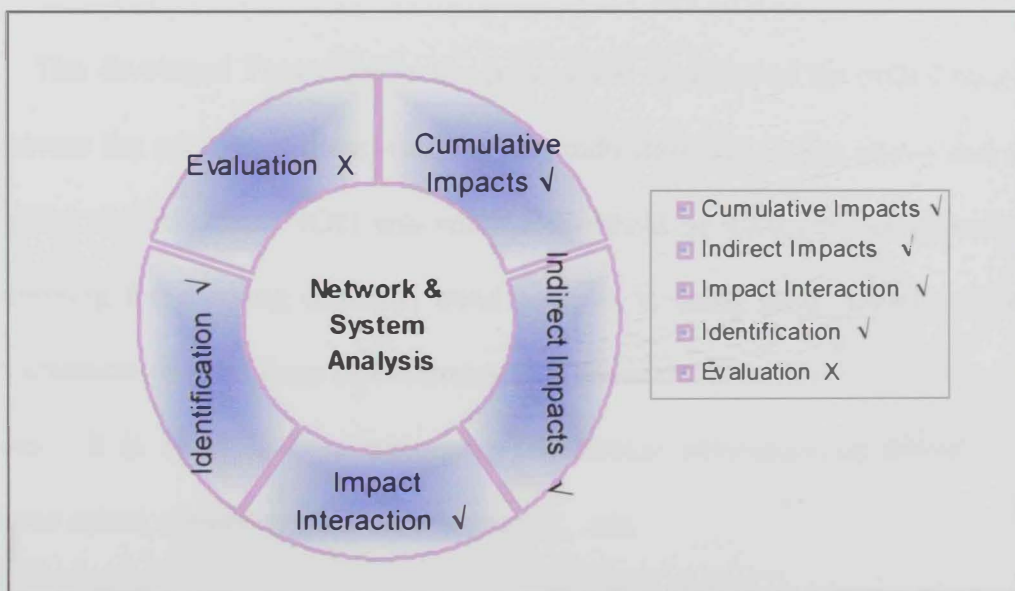


Figure 2.9. Summary of Network & System Analysis Method Characterizations

2.4.9 Carrying Capacity or Threshold Capacity

It is the maximum level of environmental strain that the system (human or ecosystem) can withstand without causing permanent damage to the system. In fact, it is based on the notion that natural threshold exists in most natural and man-made systems (Morris, 1995). This tool is of vital importance in assessing cumulative impacts. Threshold could be found from direct relationships or from expert opinion or surveys, and should be regulated (standardized) by legal authority; as example, discharge standard to sea, land, and air... wildlife population... etc. Trend analysis can be well described and measured as factor of time on the receptors from the affecting sources. **Figure 2.10** shows the proposed change in the Average Nitrogen Concentration with respect to the increase in the number of industries using diesel as burning Fuel. The trend analysis indicates that at 22 industries the concentration of NO_2 is reaching the maximum threshold level after which the ambient air quality will be unhealthy.

The developed Figure shows the polynomial equation of the NO_2 Concentrations (Y) versus the number of diesel-fuel burning industries (X). It also shows that above 20 industries the pollutant (NO_2) will reach a threshold of maximum acceptable level. In determining the carrying capacity, trend analysis is being used. Trend analysis is the representation of conditions of environmental resources over time; that is, result of past actions. It is being used to encounter the critical environmental threshold such as resource status, ecosystem, human community... etc.

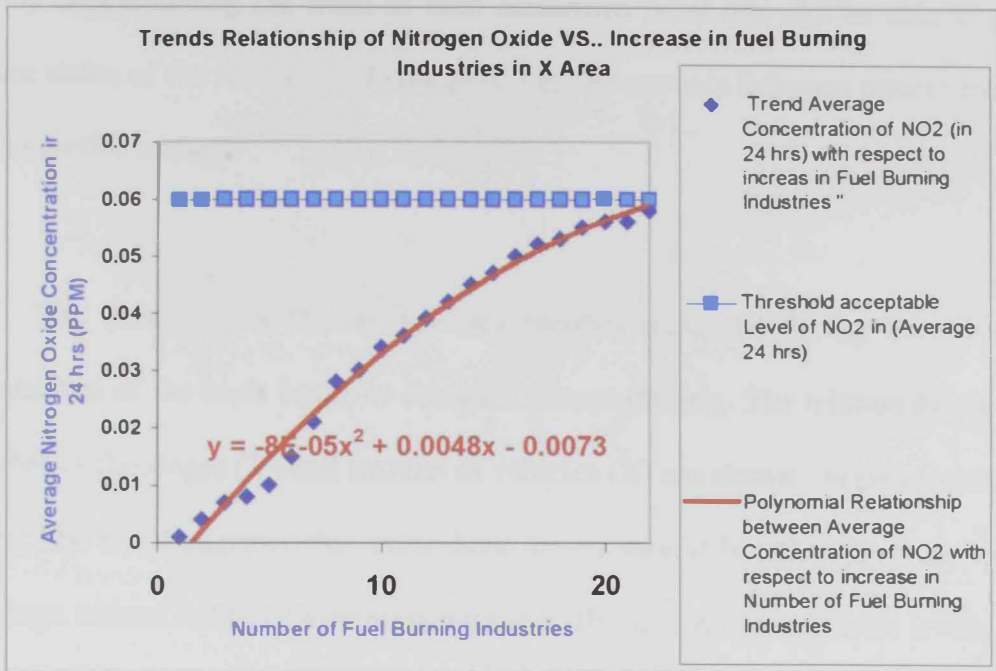


Figure 2.10. Case Study shows NO₂ concentration trends as per air quality data monitoring in X area V.S. increase in number of industries.

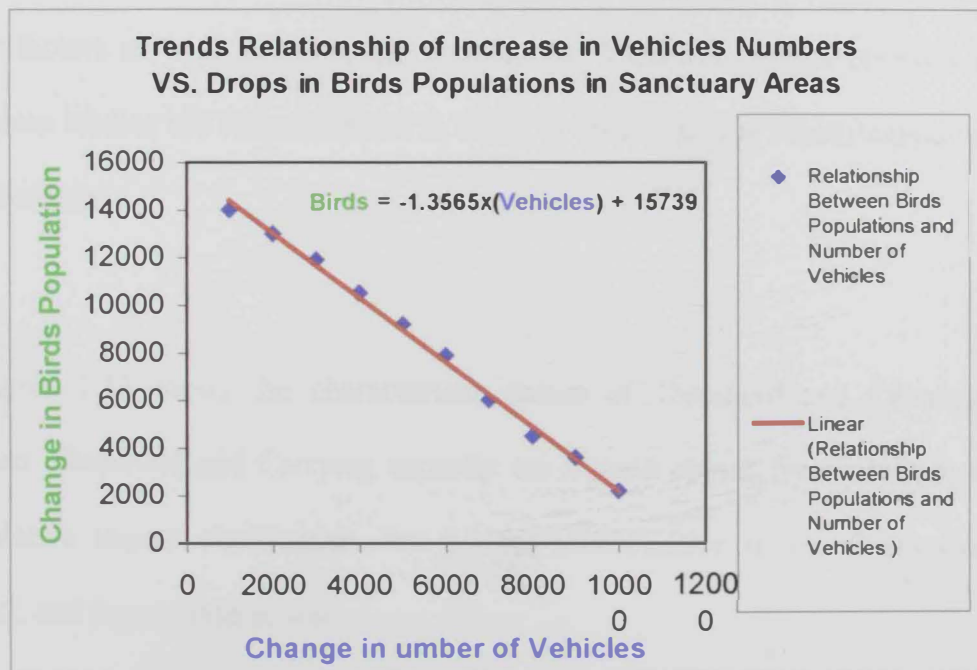


Figure 2.11. Case Study shows trends relationship of increase in vehicles populations versus drops in birds' populations in Sanctuary Area (Inverse Relationship).

By understanding the trend of each concerned point one will be able to predict the future status of the resources of concerns; i.e. “Resource’s behavior pattern that can help commutative impacts”.

The trend shows that as vehicles number increased during last 30 years, the populations of the birds began to decrease almost linearly. The relationship between the number of flamingos (Y) and number of vehicles (X) are shown in polynomial equation form. The trend suggests that immediate action should be taken in order to save the flamingo natural wildlife by minimizing the traffic and in turn the noise levels. Some of the proposed solutions could be buildup of trees boundaries, as sound barriers, along the highway. Another option is building of a new highway far away from the Sanctuary area, and minimizing the vehicles movement on the existing highway. Also there might be other factors as well affecting the populations. Therefore, expert opinions as well as adequate studies are recommended in order to ensure proper identification, evaluation, and decision.

Figure 2.12 shows the characteristic nature of Threshold and Carrying capacity method. Threshold and Carrying capacity are a good choice for evaluation as well as cumulative impact clarification; but not for identification or clarification of indirect impact, and impact interaction.

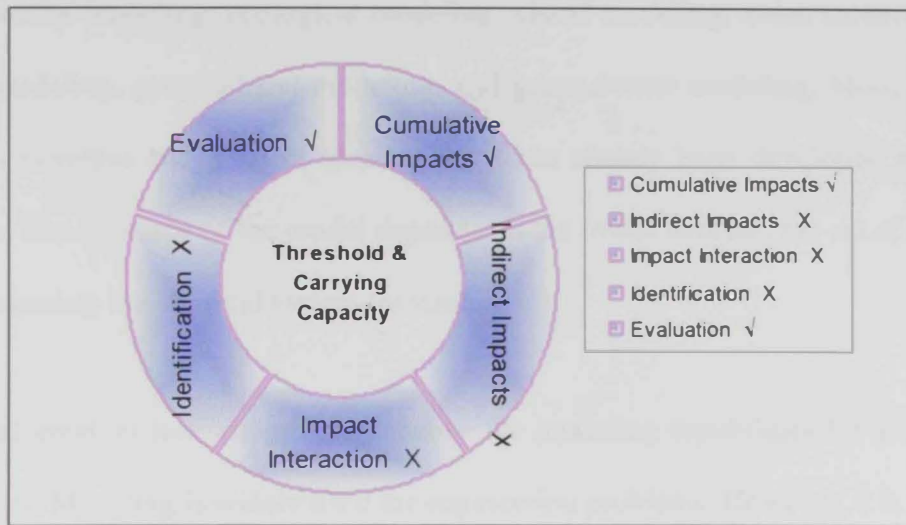


Figure 2.12. Summary of Threshold & Carrying Capacity Method Characterizations

2.4.10 Modeling

Modeling, to certain levels, resembles the real world situation and can be used along with other models (e.g., Overlay) to assess different options and gain insight into the expected behavior of the real system, and they are useful tools for impact simulation over time and the real system (Walker, 1999).

Modeling is a tool that enables quantification of impact by simulating environmental conditions. In modeling, sets of equations or conceptual judgment criteria are used to predict the behavior of variables that describes the development process (Lohani, 1997).

Models are either conceptual model (formulate, check, and organized thoughts, ideas, and hypotheses...) or simulation models. Models can be simple considering one aspect of environment or complex considering behaviors of natural system. Some of these models

are air quality modeling, ecological modeling, visual modeling, noise modeling, water quality modeling, geographical modeling, and groundwater modeling. Modeling often demands expertise and a lot of time unless it has already been developed for similar situation. The accuracy of the model depends on the initial data and the set of equations used to simulate the physical system (environment).

Use of information technology will enhance the modeling capabilities for analysis and assessment. Modeling is widely used for engineering problems. However, it is of limited use in environmental impact assessment. Complexity of natural system, high cost, long time requirement, lack of expertise, and data are relevant primary reasons to look for other computer-based methods such as expert system, interactive modeling, and dynamic computer graphics or even previously used model for EIA evaluation. The characteristic nature of Modeling is shown in **Figure 2.13**.

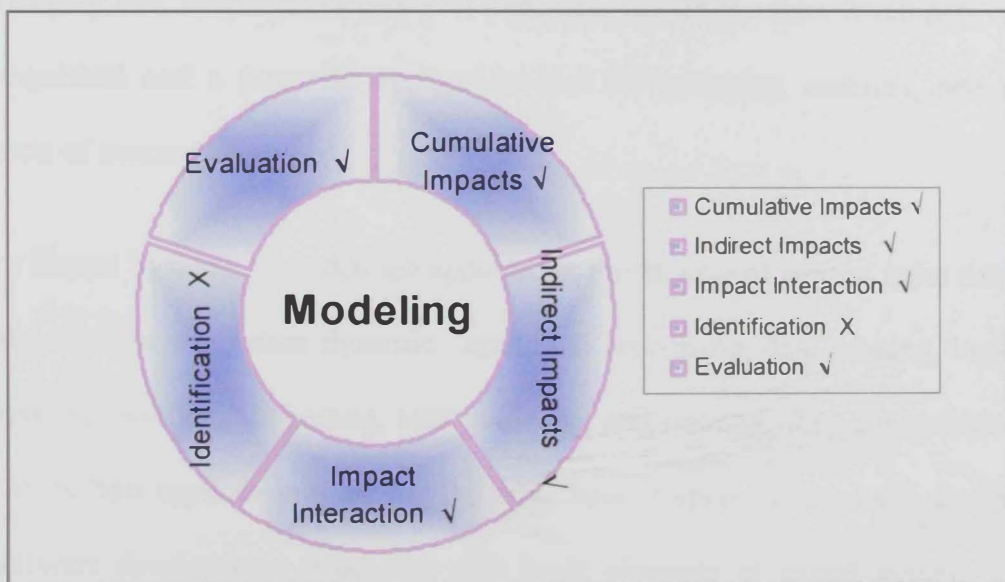


Figure 2.13. Summary of Modeling Method Characterizations

The proposed Figure shows that Modeling is a good choice for clarification of cumulative impact, indirect impact, and impact interaction as well as evaluation, however; not a good choice for identification.

2.4.11 Expert Systems

Expert systems, derived from Artificial Intelligence (AI), are "knowledge based system" software in processing information, problem solving, and proper decision support used in various applications. Expert systems and the "man-machine systems" that achieve problem-solving tasks that based on expert knowledge in specific application. Expert system (Fedra, 1991) use rules, heuristics, and techniques, such as first order logic or semantic network, including questionnaires to represent knowledge, together with interference mechanisms, in order to device or deduce conclusion stored and user-supplied information. Developing an expert system for specific application is a challenging task, and requires plenty of expertise. However, when developed, it will be a distinguished and a powerful application tool for assessing, auditing, and managing projects of concerns.

Since Expert Systems have defined application limits, known type of input data needed, fixed parameter evaluation dynamic, input data processing, data running, logical result interpreting, solution suggesting, user guidance, and training, they are considered to be one of the best application tools. On the other hand, Expert System tools are open fields of software development structured with basic elements of expert system. The basic elements of expert system tools, shown in **Figure 2.14** below, are knowledge base, reasoning engine, knowledge gaining subsystem, clarification subsystem, and user

interface (WTEC, 2003). However, both “reasoning engine” and “knowledge base” are considered to be the main elements of the expert system tools.

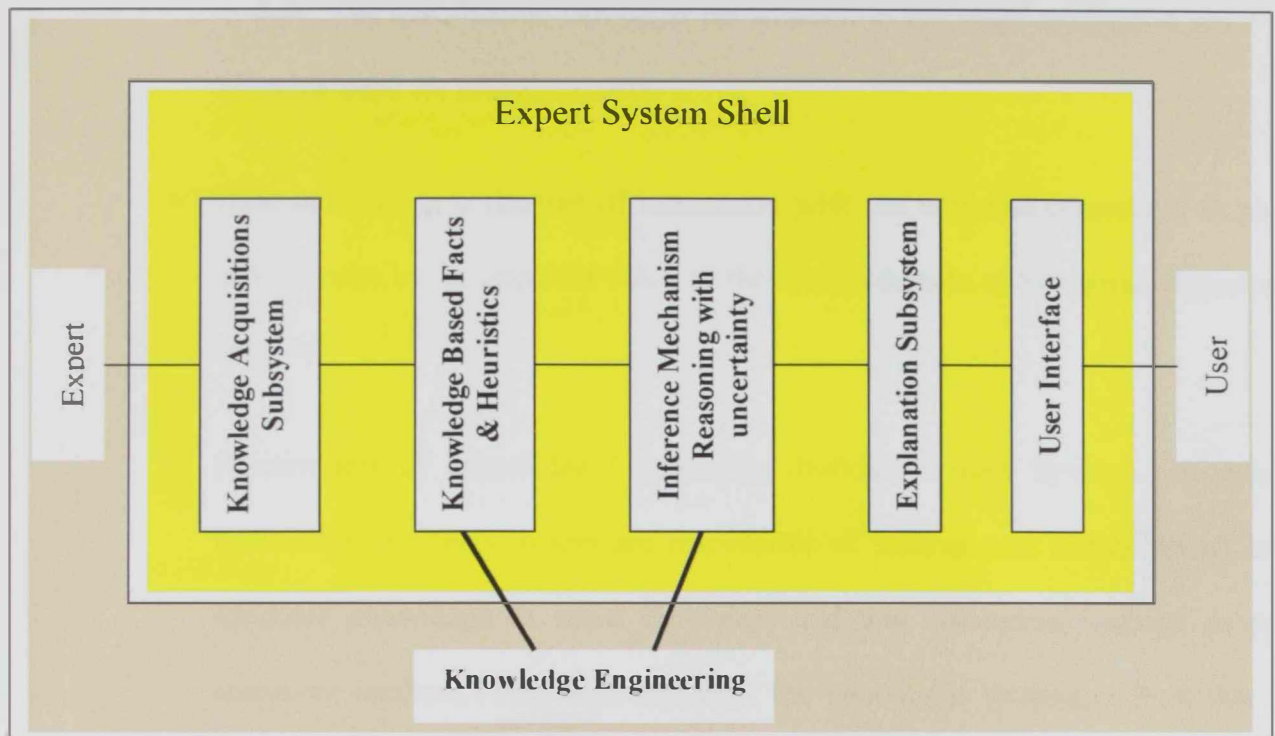


Figure 2.14. Basic Working-Mechanism of Expert System Tools

Source (JTEC, 1993)

- Knowledge acquisition subsystem is a field where experts build bases of know-how –data.
- Knowledge base is bank of realistic and hibernated (more experimental & judgmental) know-how-expertise; expert system tool does have schemes of how to input (represent) the required knowledge in the related type of application. The expert system tools rules are IF THEN (condition and action) and FRAMES.
- Reasoning engine is deduction functioning means of manipulating representative information and know-how-data in the Knowledge base building a system of

reasoning for solving a problem. The deduction (inference) functioning-means can varies from IF THEN rule to situation base reasoning.

- Explanation subsystem is a subsystem that clarifies the functional behavior of the system. The clarification can be to the solution at any stage reached in order to align the need for additional data.
- User interface is a channel of interaction with the user and considered to play critical rules in the apparent value of the system despite of the system's quality-acts.
- Practitioners of knowledge Engineering (building Expert System) are called knowledge engineers, whom are responsible of making sure that computer has adequate knowledge to solve the cases, and that computers function as per reasoning methods. They also represent the knowledge in symbol form that is selection of knowledge representation.
- Task Domain is the area of human-intellectual behavior apparent in Expert system. Task refers to some target- adjusted, situation-solving projects, and Domain means the area where the task is accomplished.

In reference to Expert system building tools in the market, traditionally, the Expert system tools were classified by the base of their hardware such as PC or Workstation-based, Macintosh based, or mainframe based (**Harmon, 1992**). However, the new types of tools in the market are classified according to the tasks (planning, surveying,

diagnosis...etc.) and problem-solving methods (case-based reasoning or model based reasoning). These second new tools are made for different area of application and made by application of traditional (first generation) tools. The earlier well-known (Simple & flexible) research programming language for Expert system was LISP (LISt Processing). PROLOG (PROgramming in LOGic), invented in early 1970s in France, (*JTEC, 1993*) is a first-order predicate calculus and consists of statements (facts), rules, and questions. On the other hand, Expert system building tools are classified according to general purpose (e.g. ES/KERNEL), mission-specific, result-specific, and development methodology tools. The four most popular ES tools in the Japan are Hitachi, Fujitsu, and NEC, and the most popular tools are those works are for general purpose and run on multiple platforms. The market indicates that the Expert systems trends are specializations of tools, workstation tools, and Embedded systems and system integration.

If Expert System was supported with rules that deal with uncertainty (confidence factor, or weight), then the method of reasoning models with uncertain knowledge is Fuzzy Logic (uncertainty-based reasoning).

2.4.11.1 Applications of Expert Systems

Applications of Expert systems are very broad and vary from diagnosis, planning, configuration, knowledge publishing, financial decision-making ...etc.

Applications of Expert system in diagnosing and troubleshooting consist of the system that figure out the faults and recommend the corrective actions such as programs used in computer diagnosis (test) equipments for checking faults in fully computerized vehicles,

and the programs used for medical diagnosis (**Shortliffe, 1976**) and troubleshooting such as program (multi-function body behavior diagnosing equipments with suggestion mechanisms of predicting problems and recommending solutions). This type of expert system application can be seen in control of treated wastewater distribution (**STG, 2003**). Plymouth District Council applies expert system in optimizing the distribution of the treated water from treatment plant to reservoirs by interpolation of the stream-levels data with history data and treatment plant production rate in order to maintain the water level in the stream within the minimum safe level.

Application of Expert system in Planning and scheduling consist of system that integrates all expected difficulties and related solution for each single goal to achieve the final targeted goals, the applications of this type can be seen in airlines' flight, gates, and personal scheduling. This type of Expert system application in planning and prediction can be seen in agriculture. The past expertise of scientist and data accumulated in agriculture field can be reflected in Expert system based program to help the farmers in making the best decision practice that will ensure useful productivities. For example, expert system is used as decision support system in wheat yield prediction under different soil conditions (**Tripathi, et. al. (2003)**). This system consist 25 qualifiers and 34 rules, and the selected qualifiers are based on considerations of several conditions such as climate field history, and soil as well as management factors (pesticide, fertilizer, disease control...etc). The data used are obtained from reports collected by districts and rules are based on known problem faced by the farmers, and the system highlights the predicted productivity from given data.

Application of Expert system in configuration of manufactured (designed) objects from given parts (conditions) is another type of application. In this type of application all constraints with regards to configuration are defined and the system will integrate the best (optimum) configuration possible. Building of tech-size computer system (**McDermott, 1981**), or designing integrated building structure, and estimating the best costs of project are some type of this application. In support of power supply circuit designer more than 60 applications of Expert system are found (**Foutz, 2001**). Expert System is applied in electrical circuit designs to estimate cost based on the work methods of the plan. That is, by encapsulating the expert knowledge in if then rules, the expert system will assemble work plan sub-elements to ensure the best-cost estimations for labor hours, circuit path schedule, and material and time cost.

Application of Expert system in financial field helps the user to take the best decisions in verifying and approving the applications. This type of application is seen in the insurance price estimation system, banks loan approval system, credit cards application approval system... etc. Expert system application in assessment of credit cards application is based on scoring the credit and for simulating similar to human way of decision taking profiling methods being used (**MRI, 2003**). The system does save applicant times and ensure the process of maximum number of applications. It also ensures uniform decision-making (without human uncertainty or mistake factor) in evaluating the application, and fast service as well as cost saving in long run. The evaluation of developed program for credit cards application assessment is based on statistical analysis of former data combined with experiences collection of experts.

Application of expert system in design and manufacturing is a broad field; in this application the best design of the process is analyzed and predicate. For example in water management application the system developed for mines rehabilitation decision making (Davis and Sharp, 2003), the task was to encounter all interacting factors in designing and developing the decision support expert tools to be applied for decision making prospective suggestions about mains rehabilitation.

Moreover application of expert system extend from control and monitoring of processes (predicting trends and controlling the reply to reach target state) to Knowledge Publishing (advising user to best acts (knowledge supplier) based on specified condition entered.

The characteristic nature of Expert systems is shown in **Figure 2.15**. Expert systems are a good choice for cumulative impact, indirect impact, and impact interaction clarification as well as identification and evaluation.

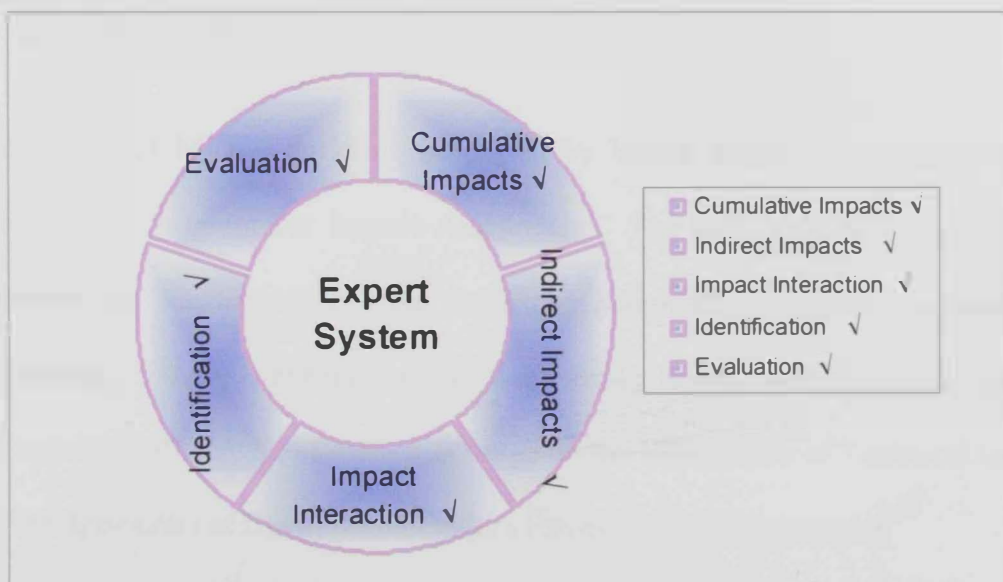


Figure 2.15. Summary of Expert System Method Characterizations

CHAPTER III

Developed Program Tools for EIA

3.1 Methodology

Access tools of Microsoft Office supported by Visual Basic are used to develop the expert system program for Impact Assessment. The first version of this program is functional for identifying: (1) the industrial activities; (2) details submission and confirmation, (3) case evaluation, (4) final status report, and (5) report update for environmental officer. The Program is based on the information of Technical Guidelines # 4 (*See Appendix*) of Dubai Municipality's Environmental Department.

The Technical Guidelines # 4 (*Guidelines for Preparation of Environmental Impact Statements for New Industrial Premises*) is a short form of Environmental Impact Assessment details requirement for every new industrial facilities to be established in Dubai. That is, compliance with Environmental Protection Regulations, Local Order 61/1991. Technical Guidelines # 4 (TG # 4) is a start up with background information and then guidelines for the points to be covered by small projects. Then, the kind of information to be clarified (highlighted under 8 topics), and the Application form for the Environmental and Safety Approval are followed.

The required information to be clarified by the applicant as per TG # 4 are (1) General Requirements, (2) Air Emissions, (3) Waste Discharge, (4) Solid Waste Discharge, (5) Chemicals and Dangerous Goods, (6) Safety and Health, (7) Construction Issues, and (8) Emergency contingency Planning.

The basis of this program is to ensure that all environmental issues of concern as per TG # 4 have been included in the submission in a step wise by the project owner or consultant. The program further requested the project owner for data entry to verify whether the discharge quality level of wastewater, solid waste, and air emission are in compliance with standards.

The Program also highlights the environmental requirements as per existing Guidelines in order to help the project owner to: (1) learn and be aware of environmental issues; (2) submit full report; (3) ensure a well planned processes; (4) prevent any delays

in project due to lack of knowledge about environmental concerns; (5) reduce paper works' times; and (6) identify compliance status.

3.2 Program Development

The Developed Program structured on the following seven issues, as per Technical Guidelines # 4, **(1) General Requirements Construction, (2) Issues of Safety and Health, (3) Emergency and Contingency Plan, (4) Air Emission, (5) Water Discharge (6) Solid Waste Discharge, (7) Chemical and Dangerous Goods as well as Assessed Company details.** The Developed Expert Program is divided into two window screens one is Data Entry and the other is Report details. The Data Entry Screen is divided into four screens under the following categorical topics: General Information, Air Emission, Solid Waste Discharge, and Waste Water Discharge.

General Information is combined of four requirements, which are: General Requirements, Construction, Safety and Health, Commercial and Dangerous Goods that are to be submitted and identified first.

Air Emission is combined of three requirements, which are: Air Emission-General Information, Air Emission-Ground level Concentration Identification, Air Emission-Stationary Sources.

Like Air Emission, Solid Waste Discharge is combined of three requirements, which are: Solid Waste Discharge-General Information, Solid Waste-Process Sludge Discharge

Flow Chart for the Application of Developed Expert Tools



Figure 3.1 Flow Chart of the Application of Developed Expert Tool

Parameters, and Solid Waste-Contaminated Soil/Sand Discharge Parameters.

Finally, Waste Water Discharge is combined of five requirements, which are: Waste Water General Information, Waste Water-Land Drip Irrigation Parameters, Waste Water-Land Spray Irrigation Parameters, Waste Water Marine Discharge Parameters, and Waste Water Sewer Discharge Parameters.

The other report screen is classified in the same manner as that of Data Entry Screen.

3.3 Program Front Page Screen

The front page of the developed program identifies the title of the program and the names of the developers as shown in **Figure 3.2**.

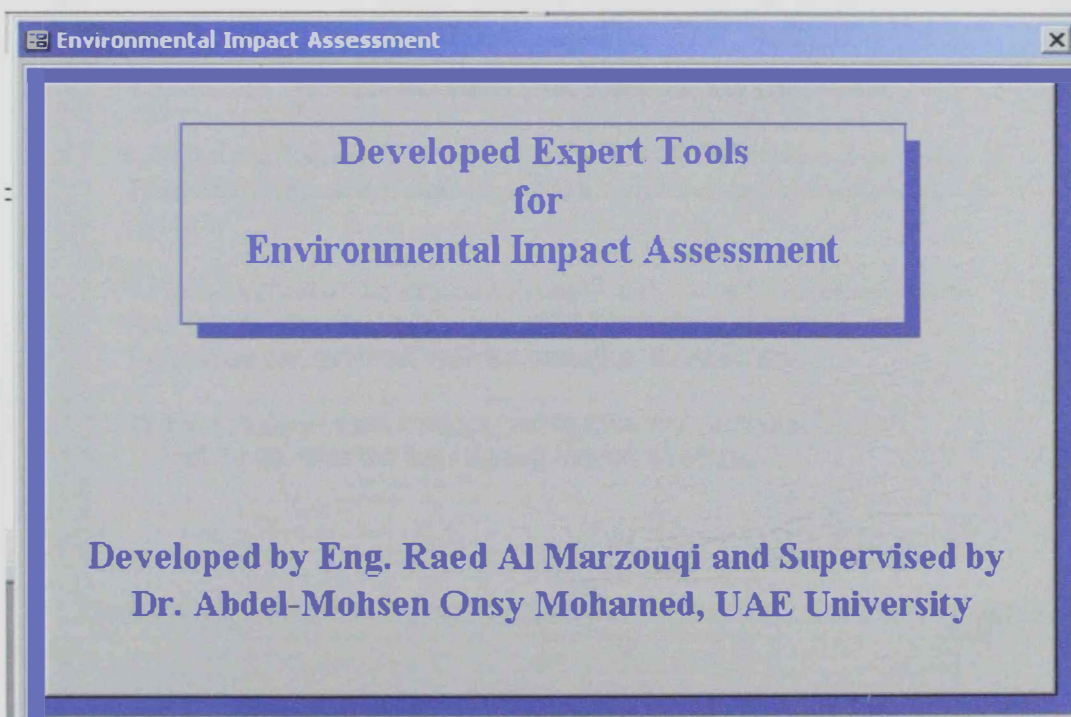


Figure 3.2 Front Start Page of the Developed EIA Software

3.4 Program Application Guides

In the program application guide, a list of informational items is highlighted as shown in **Figure 3.3**.

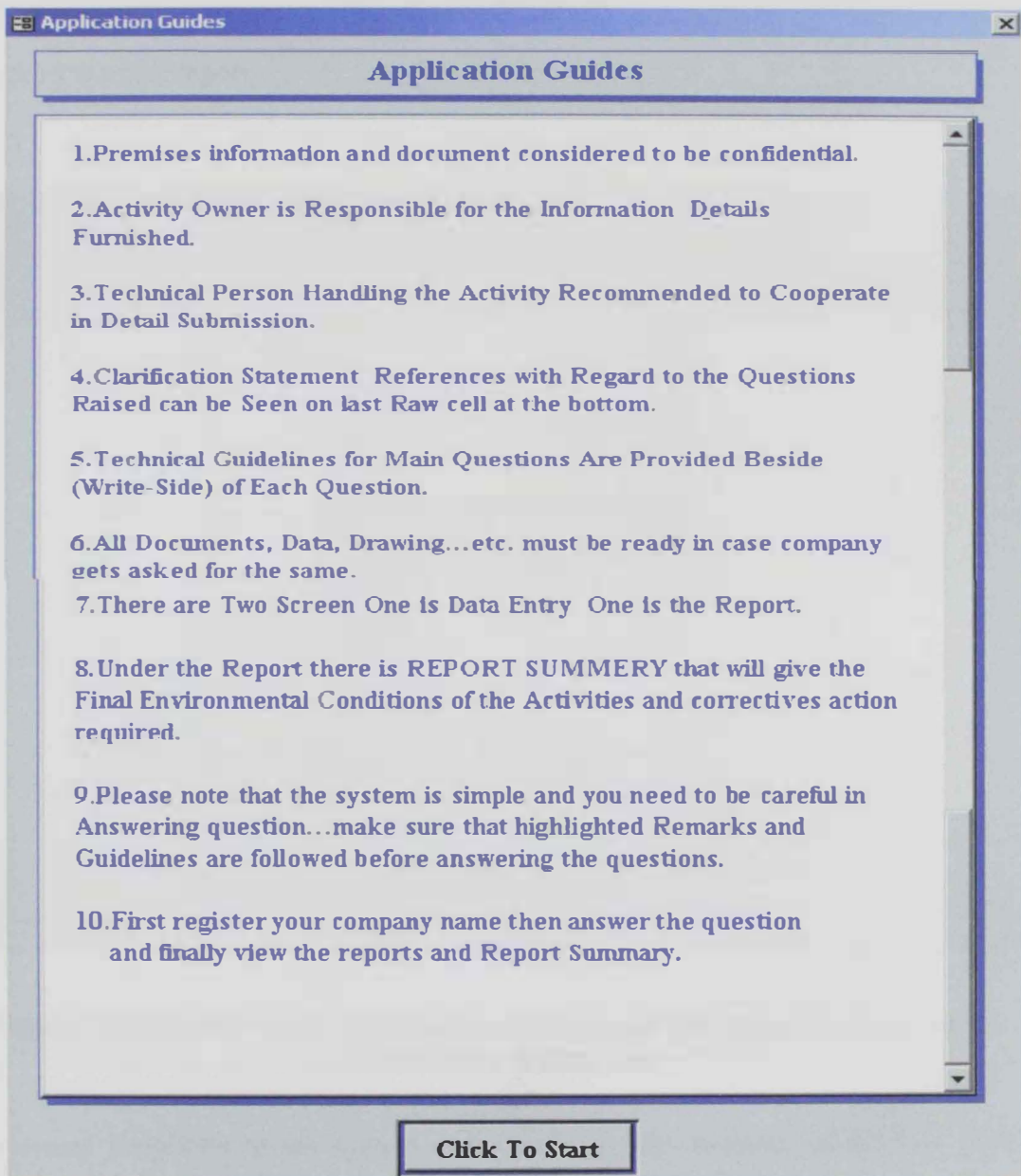


Figure 3.3 Guidelines, Application Procedures, and Responsibilities of all Applicants.

3.5 Program Main Page

The program main page identifies three choices for the applicant. The first is whether or not one uses the existing company or adds a new one, while the second is data entry and the third is status report

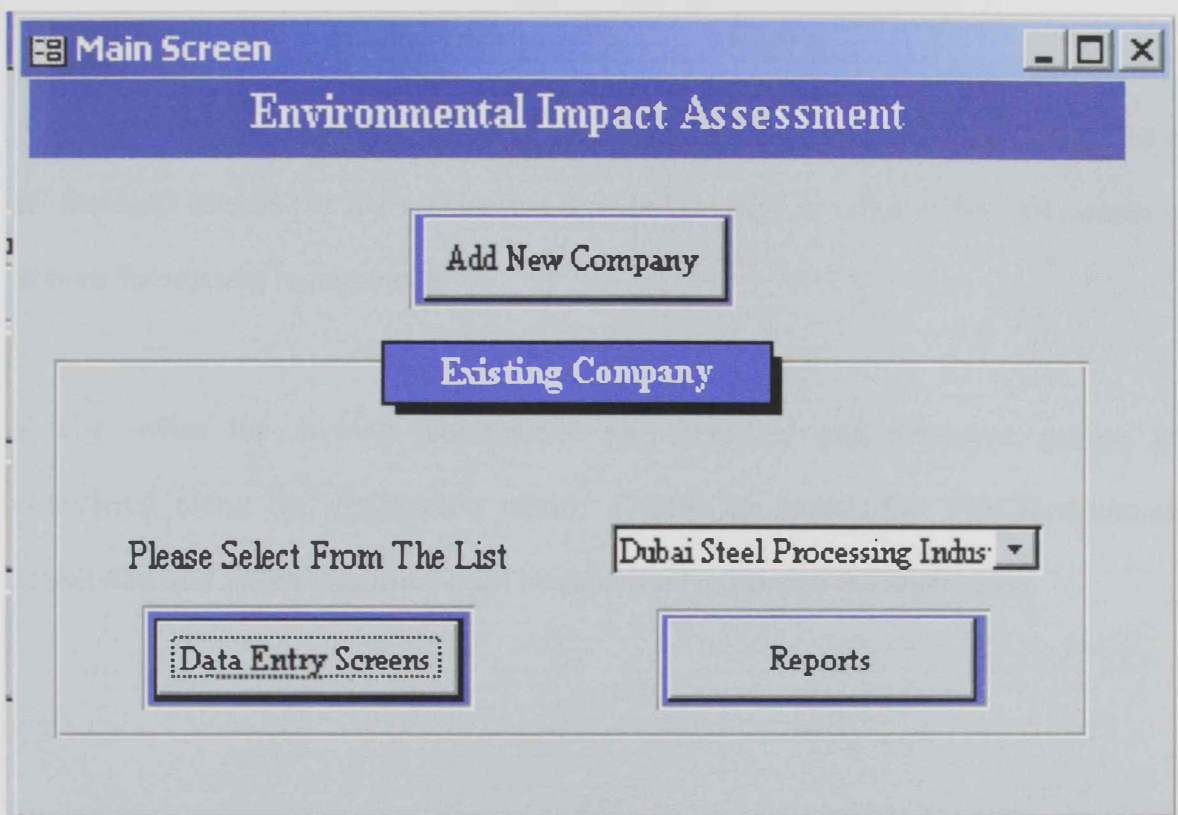


Figure 3.4 EIA main page of Build Expert Program shows the two Screen Cells, Data Entry & Reports.

To ensure simplicity of the system and follow up, the structure of required general information is based on the YES and NO answering. On the other hand, discharge or

emission quality verification (auditing) is based on data entry for levels of parameters of concerns.

To ensure clarification of questions being raised, some modification such as explanation and hints on each question (get highlighted by pointing cursor to question of concern) as well as related Regulations (as Technical Guidelines, Code of Practice...etc.). By clicking on any of the related regulation (labeled cell) the information will appear on the Microsoft Word Document format.

Moreover, the final reporting part of the program helps the project owner to have list of all assessed data as per his verification reported (handy) in order to take all corrective actions for missing requirements.

Finally, when the missing requirements are furnished and corrective actions are considered along the verification report, a form of *Application For Environment Protection and Safety Approval* must be submitted to process the application

CHAPTER IV

Application Procedures of the Expert Program

4.1 Company Registration and Details Identification

First, one must identify and register the name and address details of the company to be assessed including other information in order to have all information required for submission of Application for Environment Protection and Safety Approval furnished.

The list of all required information as per format prepared is shown in **Figure 4.1**.

4.2 Application for Environment Protection and Safety Approval

After company data entry, Application for Environment Protection and Safety Approval will be ready by clicking on the report cell see **Figure 4.2**

Company

Companies

Applicant Name:	Hamad Al Marsoori
Address:	Jebel Ali Industrial Area
Postal Code	38885 Dubai
Phone Number	8823101
Fax Number	8823102
License #:	Pending
Site Location:	un-known
Manager:	Dr.Salem Abdullah
Company Name	Dubai Steel Processing Industry
Activity:	Steel Fabrications
Capital Cost:	8,000,000
Reason for Application:	Environment Approval, and Application for Land
Country/Region	UAE, Dubai
ContactName	Saeed Salem (PRO)
Email Address	Dubaisteel@hotmail.com
Date:	22/09/2002




 [Add a Company](#)   [Close](#) [Report](#)

Figure 4.1 First Data Entry page for adding new company details



**APPLICATION FOR ENVIRONMENT PROTECTION AND
SAFETY APPROVAL**

Instructions:

This form is to be completed and submitted along with all relevant plans and the information contained in EPSS Technical Guideline Number 4, to obtain approval for a new or substantially modified industrial premises. For guidance on whether a plant modification is covered by these requirements consult the Environmental Protection and Safety Section Tel.: 206-4244/206-4241 Fax: 2270160

Applicant Name:	Hamad Al Mansoori
Postal Code:	38885 Dubai
License #:	Pending
Phone Number:	8823101
Fax Number:	8823102
Country/Region:	UAE, Dubai
ContactName:	Saeed Salem (PRO)
Site Location:	un-known
Manager:	Dr. Salem Abdullah
Reason for Application:	Environment Approval, and Application for Land
Company Name:	Dubai Steel Processing Industry
Activity:	Steel Fabrications
Capital Cost:	8,000,000
Address:	Jebel Ali Industrial Area
Date:	22/09/2002
Email Address:	Dubaisteel@hotmail.com

Figure 4.2 Application form for Environment Protection and Safety Approval

4.3 Data Entry Screen for General Information.

Data Entry Screen is combined of four sub-screens as mentioned before and on right side of each sub-screen part, there is an open key as shown for General information in **Figure 4.3**.

The screenshot displays the 'Environmental Impact Assessment' software interface. At the top, a blue header bar contains the title. Below the header, a text box labeled 'Company Name' contains the text 'Dubai Steel Processing Industry'. A horizontal menu below this contains four tabs: 'General Information', 'Air Emission', 'Solid Wastes Discharge', and 'Waste Water Discharge'. The 'General Information' tab is selected and highlighted. Underneath this tab, there is a list of four sub-screen categories, each with an 'Open' button to its right:

- General Requirements
- Construction
- Safety & Health
- Chemical & Dangerous Goods

In the bottom right corner of the main window, there is a small icon representing a folder with a plus sign.

Figure 4.3. Start Data Entry Screen showing the sub-screens (General Information)

4.3.1 Data Entry for General Information

(a) General Requirements Data Entry Screen.

Please Notice the comments and references to Guidelines which are highlighted in the last row on the bottom for better understanding of the question raised. Make sure to read every single guide provided

Activity of Company	Steel Fabrications, P.	Guides
Size of Industry	LARGE	Guides
Is the Nature of the activity conducted by the company or project clarified?	YES	Guides
Is detailed process description provided?	YES	Guides
Are all materials used in the process clarified?	NO	Guides
Is the process flow diagrams clarified and submitted?	NO	Guides
Is the proposed production rate clarified and submitted?	YES	Guides
Is the site plan showing all building and drains clearly?	YES	Guides
Is the site plan showing all discharge points clearly?	NO	Guides
Is the site plan showing all storage areas for Dangerous Goods?	YES	Guides
Is the storage areas for Dangerous Goods as per code of practice?	NO	Guides
Are the engineering drawings of plant or process submitted?	YES	Guides
Are the engineering drawings of pollution control equipment if any included?	YES	Guides

Detailed engineering drawings of the plant or process equipment including pollution control equipment if any must be submitted

Report Print

Figure 4.3.1 Data Entry page for General Requirements

(b) View General Requirements Data Entered Report

When clicking on the Report cell at the bottom a detailed report of data entered will be presented.

Table 4.3.1a Report Details of General Requirements Data Entered

General Requirements	
Company Name : Dubai Steel Processing Industry	
Activity of Company	Steel Fabrications; P
Size of Industry	LARGE
Is the Nature of the activity conducted by the company or project clarified?	YES
Is detailed process description provided?	YES
Are all materials used in the process clarified?	NO
Is the process flow diagrams clarified and submitted?	NO
Is the proposed production rate clarified and submitted?	YES
Is the site plan showing all building and drains clearly?	YES
Is the site plan showing all discharge points clearly?	NO
Is the site plan showing all storage areas for Dangerous Goods?	YES
Is the storage areas for Dangerous Goods as per code of practice?	NO
Are the engineering drawings of plant or process submitted?	YES
Are the engineering drawings of pollution control equipment if any included?	YES

(c) View Evaluation and Assessment Feedback Report for General Requirements

The report indicated in **Table 4.3.1b** shows incomplete information and expected decision based on the data furnished by the applicant.

Table 4.3.1b Evaluation and Assessment Report for General Requirements Data

Company Name: **Dubai Steel Processing Industry**

The requirements of **General Requirements** were not completed, so please follow the instructions below :

- ★ All materials used in the process must be clarified
- ★ The process flow diagrams must be clarified, explanatory, and submitted for review and verifications
- ★ Site plan must show all discharge points clearly
- ★ The storage areas for Dangerous Goods must be as per Code of Practice of Dangerous Good

Non-Compliance with the above requirements makes Application incomplete and therefore application can not be processed

4.3.2 Data Entry for Construction

(a) Construction Data Entry Screen.


Construction		
Company Name	Dubai Steel Processing Industry	
Are details of proposed constructions schedule submitted?	YES	Guides
Details of major operations to be undertaken during construction explained	YES	Guides
All aspects of environmental concerns for major operations considered	NO	Guides
Proposed safety and health plan for construction phase explained	YES	Guides
Proposed safety and health adequate and as per DM regulations	YES	Guides
Are onsite waste management and disposal plan properly maintained?	NO	Guides
Expected Construction time period	Within half Year	Guides
List of activities which may cause environmental concerns modified	YES	Guides
Is modified list of activities submitted?	YES	Guides
Are risk minimization strategies and precautions considered?	YES	Guides
Is outline of risk minimization strategies submitted?	YES	Guides
Are contingency plans in the event of environmental incidents considered?	YES	Guides
Is outline of contingency plans submitted?	NO	Guides
Contingency plan in the event of Environmental Incidents such as leakage, spills, explosion, cracks... etc. should be considered and be handy to workers... view TG # 61.		
		Report 
Form View		

Figure 4.3.2 Construction Data Entry Page

(b) View Construction Data Entered Report.**Table 4.3.2a Report Details of Construction Data Entered**

Construction	
Company Name :	Dubai Steel Processing Industry
Are details of proposed constructions schedule submitted?	YES
Details of major operations to be undertaken during construction explained	YES
All aspects of environmental concerns for major operations considered	NO
Proposed safety and health plan for construction phase explained	YES
Proposed safety and health adequate and as per DM regulations	YES
Are onsite waste management and disposal plan properly maintained?	NO
Expected Construction time period	Within half Year
List of activities which may cause environmental concerns modified	YES
Is modified list of activities submitted?	YES
Are risk minimization strategies and precautions considered?	YES
Is outline of risk minimization strategies submitted?	YES
Are contingency plans in the event of environmental incidents considered?	YES
Is outline of contingency plans submitted?	NO

(c) View Evaluation and Assessment Feedback Report for Construction

Table 4.3.2h Evaluation and Assessment Report for Construction Data

Company Name: Dubai Steel Processing Industry

The requirements of **Construction**

were not completed, so please follow the instructions below :

- * All aspects of environmental concerns as well as corrective measures for major operations must be considered

- * Onsite waste management and disposal plan must be maintained properly

- * Outline of contingency plans must be submitted for review and verification

Non-Compliance with the above requirements makes Application incomplete and therefore application can not be processed

4.3.3 Data Entry for Safety and Health.

(a) Safety and Health Data Entry Screen

Safety & Health		
Company Name	Dubai Steel Processing Industry	
Identify the proposed number of workers at the site	65	Guides
Details of ventilation and safety as per EPSS Requirements	YES	Guides
Proposed methods for handling Hazardous materials provided	YES	Guides
Proposed methods in handling of hazardous materials as per DG code	NO	Guides
Details of jobs which require use of hazardous materials provided	NO	Guides
Details of jobs which require working 3m above ground provided	YES	Guides
Details of jobs which require lifting more than 40 kg provided	YES	Guides
Details of jobs which require use of welding or cutting provided	YES	Guides
Details of jobs which require working in confined space provided	NO	Guides
Details of proposed personal protective equipment provided	YES	Guides
Are proposed personal protective equipment adequate?	YES	Guides
Details of expected internal factory noise levels provided	YES	Guides
Details of expected factory noise level as per TG 44	YES	Guides

As examples view TG # 14, 15, 16, 17, 18, 19, 20, 21, and 38 for main List of personal protective equipment

Report

Figure 4.3.3 Safety and Health Data Entry Screen

(b) View Safety and Health Data Entered Report.**Table 4.3.3a Report Details of Safety and Health Data Entered**

Safety & Health	
Company Name :	Dubai Steel Processing Industry
Identify the proposed number of workers at the site	65
Details of First Aid as per TG 25	YES
Details of fire fighting as per Civil Defense Requirements	YES
Details of ventilation and safety as per EPSS Requirements	YES
Proposed methods for handling Hazardous materials provided	YES
Proposed methods in handling of hazardous materials as per DG code	NO
Details of jobs which require use of hazardous materials provided	NO
Details of jobs which require working 3m above ground provided	YES
Details of jobs which require lifting more than 40 kg provided	YES
Details of jobs which require use of welding or cutting provided	YES
Details of jobs which require working in confined space provided	NO
Details of proposed personal protective equipment provided	YES
Are proposed personal protective equipment adequate?	YES
Details of expected internal factory noise levels provided	YES
Details of expected factory noise level as per TG 44	YES

(c) View Evaluation and Assessment Feedback Report for Safety and Health

Table 4.3.3b Evaluation and Assessment Report for Safety and Health

Company Name: Dubai Steel Processing Industry

The requirements of **Safety & Health**

were not completed, so please follow the instructions below :

- * Proposed methods in handling of Hazardous Materials must be as per Code of Practice of Dangerous Good

- * Details of jobs which may require use of hazardous materials must be provided

- * Details of jobs which require working in confined space must be provided

Non-Compliance with the above requirements makes Application incomplete and therefore application can not be processed

4.3.4 Data Entry for Chemical and Dangerous Goods

(a) Chemical and Dangerous Goods Data Entry Screen

Chemical & Dangerous Goods		
Company Name	Dubai Steel Processing Industry	
Are there any chemicals and D G used at the premise?	YES	Guides
Is list of chemicals and D G provided?	YES	Guides
Are MSDS for each material provided?	YES	Guides
Are details of D G storage area, transportation and labeling clarified?	NO	Guides
Are details clarified are per D G Code of Practice?	YES	Guides
Are fire safety precautions for storages fully considered?	YES	Guides
Bunding details for tanks, cylinders and bulk storage provided	NO	Guides

View Code of Practice of Management of Dangerous Good

[Report](#)

Figure 4.3.4 Data Entry Screen for Chemical & Dangerous Goods

(b) View Chemical and Dangerous Goods Data Entered Report.

Table 4.3.4a Report Details of Chemical and Dangerous Goods Data Entered

Chemical & Dangerous Goods	
Company Name:	Dubai Steel Processing Industry
Are there any chemicals and D G used at the premise?	YES
Is list of chemicals and D G provided?	YES
Are MSDS for each material provided?	YES
Are details of D G storage area, transportation and labeling clarified?	NO
Are details clarified are per D G Code of Practice?	YES
Are fire safety precautions for storages fully considered?	YES
Bundling details for tanks, cylinders and bulk storage provided	NO

(c) View Evaluation and Assessment Feedback Report for Chemical & Dangerous Goods

Table 4.3.4b Evaluation and Assessment Report for Chemical and Dangerous
Goods

Company Name: Dubai Steel Processing Industry

The requirements of **Chemical & Dangerous Goods**

were not completed, so please follow the instructions below :

* Details of Dangerous Goods Storage Area, Transportation, and labeling must be clarified

* Bunding details for tanks, cylinders, and bulk storage must be clarified in order to assure full awareness of safety requirements

Non-Compliance with the above requirements makes Application incomplete and therefore application can not be processed

4.4 Data Entry Screen for Air Emission.

The screenshot displays a software window titled "Environmental Impact Assessment". The main title bar also reads "Environmental Impact Assessment". Below the title bar, there is a field for "Company Name" with the value "Dubai Steel Processing Industry". A tabbed interface is visible with four tabs: "General Information", "Air Emission", "Solid Wastes Discharge", and "Waste Water Discharge". The "Air Emission" tab is active. Inside this tab, there are three sub-screen options, each with an "Open" button:

- Air Emission - General Information
- Air Emission - Ground Level Concentration Identification
- Air Emission - Stationary Source (Parameters Identification)

At the bottom right of the window, there is a small icon with a plus sign.

Figure 4.4 Start Data Entry Screen showing the sub-screens (Air Emission)

4.4.1 Data Entry for Air Emission-General Information

(a) Air Emission-General Information Data Entry Screen.


Air Emission - General Information		
Company Name	Dubai Steel Processing Industry	
Is emission rate from each discharge clarified?	YES	Guides
Is rate of fuel used in all fuel fired equipment clarified?	YES	Guides
Is the type of fuel used in all fuel fired equip clarified?	YES	Guides
Is the type of fuel used of lowest pollutant contents?	NO	Guides
The height of all chimneys clarified	YES	Guides
The height of all chimneys adequate	YES	Guides
Are diameters of all chimneys defined?	YES	Guides
Is diameter and discharge velocity of chimneys integrated?	YES	Guides
Is discharge velocity of all chimneys defined?	YES	Guides
Are Exposure Limits (PEL & STEL & TWA) for Chemicals Contaminant Permissible as	YES	Guides
Are Ground Level concentrations of significant emissions verified and within standards?	NO	Guides
Are details of proposed emission control devices clarified?	NO	Guides
Are proposed emission control devices maintaining quality within the limits?	YES	Guides
Examples of emission control devices View TG # 42, TG # 55, and TG # 58		
		Report 
Form View		

Figure 4.4.1 Data Entry page for Air Emission

(b) View Air Emission-General Information Data Entered Report.

Table 4.4.1a Report Details of Air Emission-General Information Data Entered

Air Emission - General Information	
Company Name:	Dubai Steel Processing Industry
Any sources of Air Emission?	YES
Is description of types of wastes clarified?	YES
Is emission rate from each discharge clarified?	YES
Is rate of fuel used in all fuel fired equipment clarified?	YES
Is the type of fuel used in all fuel fired equip clarified?	YES
Is the type of fuel used of lowest pollutant contents?	NO
The height of all chimneys clarified	YES
The height of all chimneys adequate	YES
Are diameters of all chimneys defined?	YES
Is diameter and discharge velocity of chimneys integrated?	YES
Is discharge velocity of all chimneys defined?	YES
Are Exposure Limits (PEL & STEL & TWA) for Chemicals Contaminant Permissible as per Limits?	YES
Are Ground Level concentrations of significant emissions verified and within standards?	NO
Are details of proposed emission control devices clarified?	NO
Are proposed emission control devices maintaining quality within the limits?	YES

(c) View Evaluation and Assessment Feedback Report for Air Emission-General Information

Table 4.4.1b Evaluation & Assessment Report for Air Emission-General Information

Company Name: Dubai Steel Processing Industry

The requirements of **Air Emission - General Information** were not completed, so please follow the instructions below :

- * The Type of fuel used in all equipments must be of lowest pollutants contents to ensure the minimization of pollutants content in the emission quality otherwise your application is incomplete and therefore application can not be processed

- * Ground Level Concentrations of significant emissions must be verified and within standards

- * Details of proposed emission Control devices or corrective measures must be clarified

Non-Compliance with the above requirements makes Application incomplete and therefore application can not be processed

4.4.2 Air Emission-Ground level Concentration

(a) Air Emission-Ground level Concentration Data Entry Screen


Air Emission - Ground Level Concentration Identification		
Company Name	Dubai Steel Processing Industry	
Carbon Monoxide (1 hr)	9	Guides
Nitrogen Dioxide (1hr)	0.14	Guides
Nitrogen Dioxide (24hr)	0.04	Guides
Oxidants (Ozone) (1 hr)	0.02	Guides
Suspended Particulates (PM-10 - 1hr - ug/Nm3)	350	Guides
Suspended Particulates (PM-10 - 24hr - ug/Nm3)	140	Guides
Sulfur Dioxide (1hr)	0.11	Guides
Sulfur Dioxide (12hr)	0.01	Guides
Benzene (1 hr)	0.02	Guides
Lead (3 hr)	0.04	Guides
Fluoride as HF (24 hr)	2	Guides
Fluoride as HF (3 hr)	0.1	Guides
		Report 
ppm		

Figure 4.4.2 Data Entry page for Air Emission-Ground level Concentration

(b) View Air Emission- Ground level Concentration Data Entered Report.

Table 4.4.2a Report Details of Air Emission- Ground Level Concentration Data Entered

Air Emission - Ground Level Concentration Identification	
Company Name :	Dubai Steel Processing Industry
Carbon Monoxide (1 hr)	19
Nitrogen Dioxide (1hr)	0.14
Nitrogen Dioxide (24hr)	0.04
Oxidant (Ozone) (1 hr)	0.02
Suspended Particulates (PM-10 - 1hr - ug/Nm ³)	350
Suspended Particulates (PM-10 - 24hr - ug/Nm ³)	140
Sulfur Dioxide (1hr)	0.11
Sulfur Dioxide (12hr)	0.01
Benzene (1 hr)	0.02
Lead (3 hr)	0.04
Fluoride as HF (24 hr)	2
Fluoride as HF (3 hr)	0.1

(c) **View Evaluation and Assessment Feedback Report for Air Emission- Ground level Concentration**

Table 4.4.2b Evaluation & Assessment Report for Ground Level Concentration

Company Name: Dubai Steel Processing Industry

The requirements of **Air Emission - Ground Level Concentration Identification** were not completed, so please follow the instructions below :

- * Ground Level Concentration for Suspended Particulates (PM-10 - 1hr - ug/Nm³) exceeding Maximum prescribed standards limits of 300 ug/Nm³
-

Maintain Ground Level Concentration within the Limits by Proper Corrective Measures (Ex. Change in Fuel Quality, Process Technology Upgrade, Installation of Pollution Control Facilities... etc.); Otherwise Application is incomplete and can not be processed

4.4.3 Air Emission-Stationary Sources

(a) Air Emission-Stationary Sources Data Entry Screen


Air Emission - Stationary Source (Parameters Identification)		
Company Name	Dubai Steel Processing Industry	
Is there any visible Emission excluding emission of water vapor?	YES	Guides
There is no any Visible Emissions (except combustion sources)	YES	Guides
Any Aluminum Smelter?	NO	Guides
What is Visible Emission in Randerman?	1	Guides
What is Total Particulate Matter (g/Nm ³) from all Combustion sources?	0.25	Guides
What is the Total Particulate Matter from Large Sources?	0.5	Guides
Enter Sulfuric Acid and Sulfur Trioxide (as SO ₃) Concentration in g/Nm ³ .	0.005	Guides
Enter Sulfur Dioxide concentration in g/Nm ³ from all fuel burning source.	0.13	Guides
Enter Hydrogen Sulfide concentration in mg/Nm ³ from all sources (mg).	1.6	Guides
Enter Concentration of Oxides of N ₂ at 7% O ₂ in g/Nm ³ (gas).	0.13	Guides
Enter concentration of Oxides of N ₂ at 7% O ₂ in g/Nm ³ (Liquid fuel).	03	Guides
Enter Concentrations of Oxides of N ₂ at 15% O ₂ in g/Nm ³ from Turbines.	0	Guides
Enter Concentrations of Oxides of N ₂ at 15% O ₂ in g/Nm ³ for other fuels.	0	Guides
Enter Carbon Monoxide concentration from all stationary sources g/Nm ³ .	2	Guides
Does not apply to emissions of water vapor and a reasonable period for cold startup, shutdown or emergency operation		
		Report 
Form View		

Figure 4.4.3 Data Entry page for Air Emission-Stationary Sources

(b) View Air Emission-Stationary Sources Concentration Data Entered Report.

Table 4.4.3a Report Details of Air Emission-Air Emission-Stationary Sources
Air Emission - Stationary Source (Parameters Identification)

Company Name : Dubai Steel Processing Industry	
Is there any visible Emission excluding emission of water vapor?	YES
What is Visible Emission in Randleman?	1
There is no any Visible Emissions (except combustion sources)	YES
What is Total Particulate Matter (g/Nm ³) from all Combustion sources?	0.25
What is the Total Particulate Matter from Large Sources?	0.5
Enter Sulfuric Acid and Sulfur Trioxide (as SO ₃) Concentration in g/Nm ³ .	0.005
Enter Sulfur Dioxide concentration in g/Nm ³ from all fuel burning source.	0.13
Enter Hydrogen Sulfide concentration in mg/Nm ³ from all sources (mg).	1.6
Enter Concentration of Oxides of N ₂ at 7% O ₂ in g/Nm ³ (gas).	0.13
Enter concentration of Oxides of N ₂ at 7% O ₂ in g/Nm ³ (Liquid fuel).	03
Enter Concentrations of Oxides of N ₂ at 15% O ₂ in g/Nm ³ from Turbines.	0
Enter Concentrations of Oxides of N ₂ at 15% O ₂ in g/Nm ³ for other fuels.	0
Enter Carbon Monoxide concentration from all stationary sources g/Nm ³ .	2
Enter higher concentration of Lead and its compounds as Pb (mg/Nm ³).	2.4
Any Aluminum Smelter?	NO
Enter Fluorine compounds concentration from Aluminum Smelters g/Nm ³ .	0
Enter Fluorine compounds Concentration from all other sources g/Nm ³ .	0
Enter Concentration of Chlorine and Chloride compounds (Cl ₂).	0
Enter higher concentration of Metals fumes (excluding iron oxide fumes).	7
Enter higher concentrations of Iron Oxide fume from Iron and Steel foundries .	0.03

(c) View Evaluation and Assessment Feedback Report for Air Emission-Stationary Sources.

Table 4.4.3b Evaluation & Assessment Report for Air Emission-Stationary Sources

Company Name: Dubai Steel Processing Industry

The requirements of **Air Emission - Stationary Source (Parameters Identification)** were not completed, so please follow the instructions below :

- * Emission Quality of Concentration of Oxides of N₂ at 7% O₂ (Liquid fuel) from Stationery Sources (Stack) is exceeding the limits of 0.5 g/Nm³

*

Maintain above Emission Concentration within the Limits by Proper Corrective Measures (Ex. Change in Fuel Quality, Process Technology Upgrade, Installation of Pollution Control Facilities... etc.); Otherwise Application is incomplete and can not be processed

4.5 Data Entry Screen for Solid Waste Discharge

The screenshot shows a software interface for an Environmental Impact Assessment. At the top, a blue header bar contains the text "Environmental Impact Assessment". Below this, a "Company Name" field is populated with "Dubai Steel Processing Industry". A horizontal menu bar contains four tabs: "General Information", "Air Emission", "Solid Wastes Discharge", and "Waste Water Discharge". The "Solid Wastes Discharge" tab is currently selected. Within this tab, there is a list of three sub-screens, each with an "Open" button to its right:

- Solid Waste Discharge
- Solid Waste - Process Sludge Discharge Parameters
- Solid Wastes - Contaminated Sand/Soil Discharge Parameters

In the bottom right corner of the main window, there is a small icon of a printer with a plus sign.

Figure 4.5 Start Data Entry Screen showing the sub-screens (Solid Waste Discharge)

4.5.1 Data Entry for Solid Waste Discharge.

(a) Solid Waste Discharge-General Information Data Entry Screen.


Solid Waste Discharge		
Company Name	Dubai Steel Processing Industry	
Any sources of Solid Wastes?	YES	Guides
Are the types of wastes requiring offsite disposal defined?	NO	Guides
Are quantities of any wastes requiring disposal defined?	NO	Guides
Is description of any solid hazardous waste defined?	YES	Guides
Is the analysis of any solid hazardous waste provided?	YES	Guides
Is there any treatment for the waste before being disposed?	YES	Guides
Are details of treatment for waste provided?	YES	Guides
Does waste treatment ensure all safety measures?	YES	Guides
Is there proper separate collection facility of wastes?	YES	Guides
Any details of steps taken to minimize generation of wastes?	NO	Guides
The proposed final disposal route of solid waste	General Waste	Guides
<p>Proper separate collection facilities must be provided for collection of waste (treated or not) Different collection facilities to ensure waste segregation. Examples TG # 12, TG # 27, and TG # 69</p>		
		Report 
Form View		

Figure 4.5.1 Data Entry page for Solid Waste Discharge- General Information

(b) View Solid Waste Discharge-General Information Data Entered Report.

Table 4.5.1a Report Details of Solid Waste Discharge-General Information Data Entered

Solid Waste Discharge	
Company Name:	Dubai Steel Processing Industry
Any sources of Solid Wastes?	YES
Are the types of wastes requiring offsite disposal defined?	NO
Are quantities of anywastes requiring disposal defined?	NO
Is description of anysolid hazardous waste defined?	YES
Is the analysis of anysolid hazardous waste provided?	YES
Is there any treatment for the waste before being disposed?	YES
Are details of treatment forwaste provided?	YES
Does waste treatment ensure all safety measures?	YES
Is there proper separate collection facility ofwastes?	YES
Any details of steps taken to minimize generation of wastes?	NO
The proposed final disposal route of solid waste	General Waste

(c) View Evaluation and Assessment Feedback Report for Solid Waste Discharge-General Information.

Table 4.5.1b Evaluation and Assessment Report for Solid Waste Discharge-General Information

Company Name: Dubai Steel Processing Industry

The requirements of **Solid Waste Discharge** were not completed, so please follow the instructions below :

- * All types of wastes requiring offsite disposal must be defined

- * Quantities of any wastes in any unit or forms requiring disposal must be defined


- * Details of steps taken to minimize generation of wastes if any must be defined

Non-Compliance with the above requirements makes Application incomplete and therefore application can not be processed

4.5.2 Solid Waste - Process Sludge Discharge

(a) Solid Waste - Process Sludge Discharge Data Entry Screen.

Solid Waste - Process Sludge Discharge Parameters		
Company Name	Dubai Steel Processing Industry	
Cadmium (sludge)	12	Guides
Chromium (sludge)	900	Guides
Cobalt (sludge)	23	Guides
Copper (sludge)	967	Guides
Lead (sludge)	235	Guides
Mercury (sludge)	0.5	Guides
Molybdenum (sludge)	3	Guides
Nickel (sludge)	272	Guides
Zinc (sludge)	520	Guides

[Report](#) 

Form View

Figure 4.5.2 Data Entry page for Solid Waste-Process Sludge Discharge

(b) View Solid Waste–Process Sludge Discharge Data Entered Report.

Table 4.5.2a Report Details of Solid Waste-Process Sludge Discharge Data Entered

Solid Waste - Process Sludge Discharge Parameters	
Company Name :	Dubai Steel Processing Industry
Cadmium (sludge)	12
Chromium (sludge)	900
Cobalt (sludge)	23
Copper (sludge)	967
Lead (sludge)	235
Mercury (sludge)	0.5
Molybdenum (sludge)	3
Nickel (sludge)	272
Zinc (sludge)	520

(c) **View Evaluation and Assessment Feedback Report for Solid Waste–Process Sludge Discharge.**

Table 4.5.2b Evaluation and Assessment Report for Solid Waste-Process Sludge Discharge

Company Name: Dubai Steel Processing Industry

The requirements of **Solid Waste - Process Sludge Discharge Parameters** were not completed, so please follow the instructions below :

- * Process Sludge Quality for Nickel (sludge) is exceeding the Land Discharge Limits of 200 mg/Kg
-

Process Sludge can not be disposed to land and it must be maintained within the limits otherwise Application is incomplete and therefore application can not be processed unless Hazardous Waste Disposal Considered

4.5.3 Solid Waste - Contaminated Soil/Sand Discharge

(a) Solid Waste - Contaminated Soil/Sand Discharge Data Entry Screen.

Solid Wastes - Contaminated Sand/Soil Discharge Parameters		
Company Name	Dubai Steel Processing Industry	
Arsenic (SS)	20	Guides
Barium (SS)	240	Guides
Cadmium (SS)	0	Guides
Chromium (SS)	120	Guides
Copper (SS)	830	Guides
Lead (SS)	40	Guides
Manganese (SS)		Guides
Mercury (SS)	0	Guides
Selenium (SS)	0	Guides
Zinc (SS)	730	Guides
Cyanide (SS)	0	Guides
Fluoride (SS)	0	Guides
Phenol (SS)	0	Guides
Benzene (SS)	0	Guides

Form View

Figure 4.5.3 Data Entry page for Solid Waste-Contaminated Soil/Sand Discharge

(b) View Solid Waste–Contaminated Soil/Sand Discharge Data Entered Report.

Table 4.5.3a Report Details of Solid Waste- Contaminated Soil/Sand Discharge Data Entered

Solid Wastes - Contaminated Sand/Soil Discharge Parameters	
Company Name :	Dubai Steel Processing Industry
Arsenic (SS)	20
Barium (SS)	240
Cadmium (SS)	0
Chromium (SS)	120
Copper (SS)	830
Lead (SS)	40
Manganese (SS)	0
Mercury (SS)	0
Selenium (SS)	0
Zinc (SS)	730
Cyanide (SS)	0
Fluoride (SS)	0
Phenol (SS)	0
Benzene (SS)	0
Chlorinated Hydrocarbons (SS)	0
Pesticides (total) (SS)	0
Polychlorinated Biphenyls (SS)	0
Petroleum Hydrocarbons C <9 (SS)	500
Petroleum Hydrocarbons C >9 (SS)	34.50

(c) **View Evaluation and Assessment Feedback Report for
Solid Waste– Contaminated Soil/Sand Discharge.**

**Table 4.5.3b Evaluation and Assessment Report for Solid Waste–Contaminated
Soil/Sand Discharge**

Company Name: Dubai Steel Processing Industry

The requirements of **Solid Wastes - Contaminated Sand/Soil Discharge Parameters**
were not completed, so please follow the instructions below :

* Sand or Soil Quality for Copper (SS) is exceeding the Land Discharge Limits 100 mg/Kg

* Sand or Soil Quality for Zinc (SS) is exceeding the Land Discharge Limits 500 mg/Kg

*Contaminated Sand/Soil must be removed to be disposed as Hazardous Waste and area quality
must be maintained within the limits otherwise Application is incomplete and therefore application can
not be processed unless Compliance Assured*

4.6 Data Entry Screen for Waste Water Discharge

The screenshot displays a software window titled "Environmental Impact Assessment". At the top, there is a blue header bar with the same title. Below the header, a text field labeled "Company Name" contains the text "Dubai Steel Processing Industry". A navigation bar below this contains four tabs: "General Information", "Air Emission", "Solid Wastes Discharge", and "Waste Water Discharge". The "Waste Water Discharge" tab is currently selected. The main content area is a table with five rows, each representing a different type of waste water discharge. Each row has a text field on the left and an "Open" button on the right. The rows are: "Waste Water Discharge", "Waste Water - Land Drip Irrigation", "Waste Water - Land Spray Irrigation", "Waste Water - Marine Discharge", and "Waste Water - Sewer Discharge Parameters". A small icon with a plus sign is located in the bottom right corner of the window.

Discharge Type	Action
Waste Water Discharge	Open
Waste Water - Land Drip Irrigation	Open
Waste Water - Land Spray Irrigation	Open
Waste Water - Marine Discharge	Open
Waste Water - Sewer Discharge Parameters	Open

Figure 4.6 Start Data Entry Screen showing the sub-screens (Waste Water Discharge)

4.6.1 Data Entry for Waste Water Discharge.

(a) Waste Water Discharge-General Information Data Entry Screen.


Waste Water Discharge		
Company Name	Dubai Steel Processing Industry	
What is the intended disposal root of the wastewater?	Sewer	Guides
Is any treatment processes needed for wastewater?	YES	Guides
Is the proposed treatment processes for wastewater defined?	YES	Guides
Are proposed treatment processes for wastewater sufficient?	YES	Guides
Are design details and drawings of treatment plants submitted?	NO	Guides
Are design details and drawings of treatment plants clear?	YES	Guides
Any land areas or facilities provided for storage or disposal of wastewater	YES	Guides
Are Wastewater Storage and Land area details for Wastewater intended for disposal defu	YES	Guides
Is storage facilities of adequate size?	NO	Guides
Are Storage facilities safe and not impose any effect on quality of ground water?	YES	Guides
Is storage facilities managed properly?	YES	Guides
Are storage facilities complying with Environment and safety measures?	YES	Guides
Is quality of Wastewater within the intended disposal limits?	YES	Guides
<p>The storage facilities must not impose any effect on quality of ground water & it must be properly modified and impermeable to prevent such an effect ... No Soakaway permitted</p>		
		Report 
Calculating . . .		

Figure 4.6.1 Data Entry page for Waste Water Discharge General Information

(b) Waste Water Discharge-General Information Data Entered Report.

Table 4.6.1a Report Details of Waste Water Discharge-General Information Data Entered

Waste Water Discharge	
Company Name :	Dubai Steel Processin Industry
Any source of Wastewater?	YES
Is proposed means of disposal defined?	YES
Is full analysis of expected quality of wastewater submitted?	YES
What is the intended disposal route of the wastewater?	Sewer
Is any treatment processes needed for wastewater?	YES
Is the proposed treatment processes for wastewater defined?	YES
Are proposed treatment processes for wastewater sufficient?	YES
Are design details and drawings of treatment plants submitted?	NO
Are design details and drawings of treatment plants clear?	YES
Any land areas or facilities provided for storage or disposal of wastewater	YES
Are Wastewater Storage and Land area details for Wastewater intended for disposal defined and submit	YES
Is storage facilities of adequate size?	NO
Are Storage facilities safe and not impose any effect on quality of ground water?	YES
Is storage facilities managed properly?	YES
Are storage facilities complying with Environment and safety measures?	YES
Is quality of Wastewater within the intended disposal limits?	YES

(c) **View Evaluation and Assessment Feedback Report for
Waste Water Discharge-General Information**

**Table 4.6.1b Evaluation & Assessment Report for Waste Water Discharge-General
Information**

Company Name: **Dubai Steel Processing Industry**

The requirements of **Waste Water Discharge**
were not completed, so please follow the instructions below :

* Design details and drawings of treatment plants must be submitted

* Storage facilities must be of adequate size

*Non-Compliance with the above requirements makes Application incomplete and therefore application
can not be processed*

4.6.2 Waste Water Discharge-Land Drip Irrigation

(a) Waste Water Discharge-Land Drip Irrigation Data Entry Screen.

Waste Water - Land Drip Irrigation		
Company Name	Dubai Steel Processing Industry	
PH (LDI)	6.5	Guides ▲
TDS (LDI)	850	Guides
SS (LDI)	20	Guides
BOD (LDI)	50	Guides
COD (LDI)	70	Guides
Oil & Grease (LDI)	3	Guides
Phenols (LDI)	0	Guides
Ammonia as N (LDI)	1	Guides
Total N (LDI)	25	Guides
Org N- Kjeldhal (LDI)	0	Guides
Total Sulphates (LDI)	45	Guides
Sulphides as S (LDI)	0	Guides
Cyanides as CN (LDI)	0	Guides
Fluorides (LDI)	0	Guides ▼
		Report

Figure 4.6.2 Data Entry page for Waste Water Discharge Land Drip Irrigation

(b) Waste Water Discharge-Land Drip Irrigation Data Entered Report.

Table 4.6.2a Report Details of Waste Water Discharge-Land Drip Irrigation Data Entered.

Waste Water - Land Drip Irrigation	
Company Name :	Dubai Steel Processing Industry
PH (LDI)	6.5
TDS (LDI)	850
SS (LDI)	20
BOD (LDI)	50
COD (LDI)	70
Oil & Grease (LDI)	3
Phenols (LDI)	0
Ammonia as N (LDI)	1
Total N (LDI)	25
Org N- Kjeldhal (LDI)	0
Total Sulphates (LDI)	45
Sulphides as S (LDI)	0
Cyanides as CN (LDI)	0
Fluorides (LDI)	0
Chlorides (LDI)	150
Phosphorous (P) (LDI)	5
Aluminium (Al) (LDI)	1
Arsenic (As) (LDI)	0
Barium (Ba) (LDI)	0
Beryllium (Be) (LDI)	0
Boron (B) (LDI)	0
Cadmium (Cd) (LDI)	0
Chromium (Cr) (LDI)	0
Cobalt (Co) (LDI)	0

(c) **View Evaluation and Assessment Feedback Report for
Waste Water Discharge-Land Drip Irrigation**

**Table 4.6.2b Evaluation and Assessment Report for Waste Water Discharge-
Land Drip Irrigation**

Company Name : Dubai Steel Processing Industry

The requirements of **Waste Water - Land Drip Irrigation**
were not completed, so please follow the instructions below :

- * BOD Concentration for Land Drip Irrigation is exceeding the Limits of 20 ppm
-

Maintain Wastewater Quality-Land Drip Irrigation within Limits by Proper Corrective Measures (Ex. Technology Upgrade/ Change, Treatment Facilities... etc.); or Other Disposal must be Considered; Otherwise Application is incomplete and can not be processed

4.6.3 Waste Water Discharge-Land Spray Irrigation

(a) Waste Water Discharge-Land Spray Irrigation Data Entry Screen.


Waste Water - Land Spray Irrigation		
Company Name	Dubai Steel Processing Industry	
Chromium (Cr) (LSI)	0	Guides
Cobalt (LSI)	0	Guides
Copper (Cu) (LSI)	0.05	Guides
Iron (Fe) (LSI)	0.02	Guides
Lead (Pb) (LSI)	0	Guides
Magnesium (mg) (LSI)	0	Guides
Manganese (Mn) (LSI)	0	Guides
Mercury (Hg) (LSI)	0	Guides
Molybdenum (Mo) (LSI)	0	Guides
Nickel (Ni) (LSI)	0.01	Guides
Selenium (Se) (LSI)	0	Guides
Sodium (Na) (LSI)	0	Guides
Zinc (Zn) (LSI)	0.2	Guides
Fecal Coliforms - MPN (100 ml (Land spray) (LSI)	15	Guides
		Report 
Form View		

Figure 4.6.3 Data Entry page for Waste Water Discharge Land Spray Irrigation

(b) Waste Water Discharge-Land Spray Irrigation Data Entered Report.

Table 4.6.3a Report Details of Waste Water Discharge- Spray Drip Irrigation Data Entered.

Waste Water - Land Spray Irrigation	
Company Name :	Dubai Steel Processing Industry
PH (LSI)	6.3
TDS (LSI)	730
SS (LSI)	5
BOD (LSI)	50
COD (LSI)	70
Oil & Grease (LSI)	4
Phenols (LSI)	0
Ammonia as N (LSI)	1
Total N (LSI)	21
Org N- Kjeldhal (LSI)	0
Total Sulphates (LSI)	30
Sulphides as S (LSI)	0
Cyanides as CN (LSI)	0
Fluorides (LSI)	0
Chlorides (LSI)	50
Phosphorous (P) (LSI)	0
Aluminium (Al) (LSI)	1
Arsenic (As) (LSI)	0
Barium (Ba) (LSI)	0
Beryllium (Be) (LSI)	0
Boron (B) (LSI)	0
Cadmium (Cd) (LSI)	0
Chromium (Cr) (LSI)	0
Cobalt (LSI)	0
Copper (Cu) (LSI)	0.05
Iron (Fe) (LSI)	0.02

**(b) View Evaluation and Assessment Feedback Report for
Waste Water Discharge- Land Spray Irrigation**

**Table 4.6.3b Evaluation & Assessment Report for Waste Water Discharge-
Land Spray Irrigation**

Company Name : Dubai Steel Processing Industry

The requirements of **Waste Water - Land Spray Irrigation**
were not completed, so please follow the instructions below :

* BOD Concentration for Land Spray Irrigation is exceeding the Limits of 10 ppm

* COD Concentration for Land Spray Irrigation is exceeding the Limits of 50 ppm

Maintain Wastewater Quality-Land Spray Irrigation within Limits by Proper Corrective Measures (Ex. Technology Upgrade/ Change, Treatment Facilities...etc.); or Other Disposal must be Considered; Otherwise Application is incomplete and can not be processed

4.6.4 Waste Water - Marine Discharge

(a) Waste Water - Marine Discharge Data Entry Screen.

Waste Water - Marine Discharge			
Company Name	Dubai Steel Processing Industry		
PH (MD)	6.8	Guides	▲
Temperature (MD)	4	Guides	
SS (MD)	24	Guides	
Turbidity (MD)	35	Guides	
BOD (MD)	50	Guides	
COD (MD)	70	Guides	
Oil & Grease (MD)	8	Guides	
Phenols (MD)	0	Guides	
Ammonia as N (MD)	0	Guides	
Total Organic Carbon (MD)	45	Guides	
Sulphides as S (MD)	0	Guides	
Cyanides as CN (MD)	0	Guides	
Chlorine residual (MD)	0	Guides	
Arsenic (As) (MD)	0.04	Guides	▼
		Report	+

Form View

Figure 4.6.4 Data Entry page for Waste Water-Marine Discharge

(b) Waste Water-Marine Discharge Data Entered Report.

Table 4.6.4a Report Details of Waste Water-Marine Discharge Data Entered.

Waste Water - Marine Discharge	
Company Name :	Dubai Steel Processing Industry
PH (MD)	6.8
Temperature (MD)	4
SS (MD)	24
Turbidity(MD)	35
BOD (MD)	50
COD (MD)	70
Oil & Grease (MD)	8
Phenols (MD)	0
Ammonia as N (MD)	0
Total Organic Carbon (MD)	45
Sulphides as S (MD)	0
Cyanides as CN (MD)	0
Chlorine residual (MD)	0
Arsenic (As) (MD)	0.04
Cadmium(Cd) (MD)	0
Chromium (Cr) (MD)	0
Copper (Cu) (MD)	0.3
Iron (Fe) (MD)	1.2
Lead (Pb) (MD)	0
Mercury (Hg) (MD)	0

(c) View Evaluation and Assessment Feedback Report for Waste Water-Marine Discharge.

Table 4.6.4b Evaluation and Assessment Report for Waste Water-Marine Discharge

Company Name: Dubai Steel Processing Industry

The requirements of **Waste Water - Marine Discharge** were not completed, so please follow the instructions below :

- * BOD Concentration for Marine Discharge is exceeding the Limits of 20 ppm
-

Maintain Wastewater Quality-Marine Discharge within Limits by Proper Corrective Measures (Ex. Technology Upgrade/ Change, Treatment Facilities...etc.); or Other Disposal must be Considered; Otherwise Application is incomplete and can not be processed

4.6.5 Waste Water - Sewer Discharge

(a) Waste Water - Sewer Discharge Data Entry Screen.

Waste Water - Sewer Discharge Parameters			
Company Name	Dubai Steel Processing Industry		
TDS (SD)	1200	Guides	▲
SS (SD)	324	Guides	
BOD (SD)	550	Guides	
COD (SD)	1450	Guides	
Oil & Grease - Emulsified (SD)	57	Guides	
Oil & Grease - Free Oil (SD)	30	Guides	
Phenols (SD)	0	Guides	
Non-Chlor. Pesticides (SD)	0	Guides	
Ammonia as N (SD)	0	Guides	
Total Sulphates (SD)	200	Guides	
Sulphides as S (SD)	0	Guides	
Cyanides as CN (SD)	0	Guides	
Chlorine - Residual (SD)	0	Guides	
Phenolamine (P) (SD)	0	Guides	▼
		Report	
ppm			

Figure 4.6.5 Data Entry page for Waste Water-Sewer Discharge

(b) Waste Water-Sewer Discharge Data Entered Report.**Table 4.6.5a Report Details of Waste Water-Sewer Discharge Data Entered.**

Waste Water - Sewer Discharge Parameters	
Company Name :	Dubai Steel Processing Industry
PH (SD)	6
Temperature (SD)	40
TDS (SD)	1200
SS (SD)	324
BOD (SD)	550
COD (SD)	1450
Oil & Grease - Emulsified (SD)	57
Oil & Grease - Free Oil (SD)	30
Phenols (SD)	0
Non-Chlor. Pesticides (SD)	0
Ammonia as N (SD)	0
Total Sulphates (SD)	200
Sulphides as S (SD)	0
Cyanides as CN (SD)	0
Chlorine - Residual (SD)	0
Phosphorous (P) (SD)	0
Detergents (SD)	1
Total Metals (SD)	4
Arsenic (As) (SD)	0.7
Baron (B) (SD)	0

(c) View Evaluation and Assessment Feedback Report for
Waste Water-Sewer Discharge.

Table 4.6.5b Evaluation & Assessment Report for Waste Water-Sewer Discharge-

Company Name : **Dubai Steel Processing Industry**

The requirements of **Waste Water - Sewer Discharge Parameters**
were not completed, so please follow the instructions below :

- * Arsenic (As) Concentration for Sewer Discharge is exceeding the Limits of 0.5 ppm

- * Nickel (Ni) Concentration for Sewer Discharge is exceeding the Limits of 1 ppm

- * Silver (Ag) Concentration for Sewer Discharge is exceeding the Limits of 1 ppm

- * Zinc (Zn) Concentration for Sewer Discharge is exceeding the Limits of 2 ppm

Maintain Wastewater Quality-Sewer Discharge within Limits by Proper Corrective Measures (Ex. Technology Upgrade/ Change, Treatment Facilities... etc.); or Other Disposal must be Considered; Otherwise Application is incomplete and can not be processed

4.7 Final Summery Report for Environmental Impact Assessment

Table 4.7a Final Summary Report for Environmental Impact Assessment

<p>Expert Tools For Environmental Impact Assessment</p> <p>ETEIS Version 1.0 2002</p> <p>Eng. Raed M. Amarzouqi and Dr. Abdel-Mohsen O. Mohamed</p> <p>Summary Report</p>

Company Name : Dubai Steel Processing Industry

The following instructions are to be followed so that you can complete your requirements successfully :

General Requirements

- * All materials used in the process must be clarified

- * The process flow diagrams must be clarified, explanatroy, and submitted for review and verifications

- * Site plan must show all discharge points clearly

- * The storage areas for Dangerous Goods must be as per Code of Practice of Dangerous Good

Non-Compliance with the above requirements makes Application incomplete and therefore application can not be processed

Construction

- * All aspects of environmental concerns as well as corrective measures for major operations must be considered

- * Onsite waste management and disposal plan must be maintained properly

- * Outline of contingency plans must be submitted for review and verification

Non-Compliance with the above requirements makes Application incomplete and there fore application can not be processed

Safety & Health

- * Proposed methods in handling of Hazardous Matenals must be as per Code of Practice of Dangerous Good

- * Details of jobs which may require use of hazardous materials must be provided

- * Details of jobs which require working in confined space must be provided

Non-Compliance with the above requirements makes Application incomplete and therefore application can not be processed

Chemical & Dangerous Goods

- * Details of Dangerous Goods Storage Area, Transportation, and labeling must be clarified

- * Bunding details for tanks, cylinders, and bulk storage must be clarified in order to assure full awareness of safety requirements

Table 4.7b Final Summary Report for Environmental Impact Assessment

Expert Tools For Environmental Impact Assessment
ETEIS Version 1.0
2002
Eng. Raed M. Almarzouqi and
Dr. Abdel-Mohsen O. Mohamed
Summary Report

Company Name: **Dubai Steel Processing Industry**

The following instructions are to be followed so that you can complete your requirements successfully :

Chemical & Dangerous Goods

Non-Compliance with the above requirements makes Application incomplete and therefore application can not be processed

Air Emission - General Information

- * The Type of fuel used in all equipments must be of lowest pollutants contents to ensure the minimization of pollutants content in the emission quality otherwise your application is incomplete and therefore application can not be processed
- * Ground Level Concentrations of significant emissions must be verified and within standards
- * Details of proposed emission Control devices or corrective measures must be clarified

Non-Compliance with the above requirements makes Application incomplete and therefore application can not be processed

Air Emission - Ground Level Concentration Identification

- * Ground Level Concentration for Suspended Particulates (PM-10 - 1hr - ug/Nm³) exceeding Maximum prescribed standards limits of 300 ug/Nm³

Maintain Ground Level Concentration within the Limits by Proper Corrective Measures (Ex. Change in Fuel Quality, Process Technology Upgrade, Installation of Pollution Control Facilities... etc.); Otherwise Application is incomplete and can not be processed

Air Emission - Stationary Source (Parameters Identification)

- * Emission Quality of Total Particulate Matter (from Large Sources) from Stationery Sources (Stack) is exceeding the limits of 0.1 g/Nm³
- * Emission Quality of Concentration of Oxides of N₂ at 7% O₂ (Liquid fuel) from Stationery Sources (Stack) is exceeding the limits of 0.5 g/Nm³
- * Emission Quality of Concentration of Carbon Monoxide (from all stationary sources) from Stationery Sources (Stack) is exceeding the limits of 1.5 g/Nm³

*

Maintain above Emission Concentration within the Limits by Proper Corrective Measures (Ex. Change in Fuel Quality, Process Technology Upgrade, Installation of Pollution Control Facilities... etc.); Otherwise Application is incomplete and can not be processed

Table 4.7c Final Summary Report for Environmental Impact Assessment

Expert Tools For Environmental Impact Assessment

ETEIS Version 1.0

2002

Eng. Raed M. Almarzouqi and
Dr. Abdel-Mohsen O. Mohamed

Summary Report

Company Name: **Dubai Steel Processing Industry**

The following instructions are to be followed so that you can complete your requirements successfully :

Solid Waste Discharge

- * All types of wastes requiring offsite disposal must be defined
- * Quantities of any wastes in any unit or forms requiring disposal must be defined
- * Details of steps taken to minimize generation of wastes if any must be defined

Non-Compliance with the above requirements makes Application incomplete and therefore application can not be processed

Solid Waste - Process Sludge Discharge Parameters

- * Process Sludge Quality for Nickel (sludge) is exceeding the Land Discharge Limits of 200 mg/Kg

Process Sludge can not be disposed to land and it must be maintained within the limits otherwise Application is incomplete and therefore application can not be processed unless Hazardous Waste Disposal Considered

Solid Wastes - Contaminated Sand/Soil Discharge Parameters

- * Sand or Soil Quality for Copper (SS) is exceeding the Land Discharge Limits 100 mg/Kg
- * Sand or Soil Quality for Zinc (SS) is exceeding the Land Discharge Limits 500 mg/Kg

Contaminated Sand/Soil must be to be removed to be disposed as Hazardous Waste and area quality must be maintained within the limits otherwise Application is incomplete and therefore application can not be processed unless Compliance Assured

Waste Water Discharge

- * Design details and drawings of treatment plants must be submitted
- * Storage facilities must be of adequate size

Non-Compliance with the above requirements makes Application incomplete and therefore application can not be processed

Waste Water - Land Drip Irrigation

- * BOD Concentration for Land Drip Irrigation is exceeding the Limits of 20 ppm

Table 4.7d Final Summary Report for Environmental Impact Assessment

Expert Tools For Environmental Impact Assessment
ETEIS Version 1.0
2002
Eng. Raed M. Almarzouqi and
Dr. Abdel-Mohsen O. Mohamed
Summary Report

Company Name: **Dubai Steel Processing Industry**

The following instructions are to be followed so that you can complete your requirements successfully :

Waste Water - Land Drip Irrigation

Maintain Wastewater Quality-Land Drip Irrigation within Limits by Proper Corrective Measures (Ex. Technology Upgrade/ Change, Treatment Facilities...etc.); or Other Disposal must be Considered; Otherwise Application is incomplete and can not be processed

Waste Water - Land Spray Irrigation

- * BOD Concentration for Land Spray Irrigation is exceeding the Limits of 10 ppm
- * COD Concentration for Land Spray Irrigation is exceeding the Limits of 50 ppm

Maintain Wastewater Quality-Land Spray Irrigation within Limits by Proper Corrective Measures (Ex. Technology Upgrade/ Change, Treatment Facilities...etc.); or Other Disposal must be Considered; Otherwise Application is incomplete and can not be processed

Waste Water - Marine Discharge

- * BOD Concentration for Marine Discharge is exceeding the Limits of 20 ppm
- * Zinc (Zn) Concentration for Marine Discharge is exceeding the Limits of 0.1 ppm

Maintain Wastewater Quality-Marine Discharge within Limits by Proper Corrective Measures (Ex. Technology Upgrade/ Change, Treatment Facilities...etc.); or Other Disposal must be Considered; Otherwise Application is incomplete and can not be processed

Waste Water - Sewer Discharge Parameters

- * Arsenic (As) Concentration for Sewer Discharge is exceeding the Limits of 0.5 ppm
- * Nickel (Ni) Concentration for Sewer Discharge is exceeding the Limits of 1 ppm
- * Silver (Ag) Concentration for Sewer Discharge is exceeding the Limits of 1 ppm
- * Zinc (Zn) Concentration for Sewer Discharge is exceeding the Limits of 2 ppm

Maintain Wastewater Quality-Sewer Discharge within Limits by Proper Corrective Measures (Ex. Technology Upgrade/ Change, Treatment Facilities...etc.); or Other Disposal must be Considered; Otherwise Application is incomplete and can not be processed

CHAPTER V

Summary, Conclusions, and Recommendations

5.1 Summary

The Developed Expert Program is based on the Specified Rule and Regulations currently used by Dubai. This program is comprehensive and covers all aspects of environmental concerns as per Rules and Regulations. It clarifies to the project owner the major concerns with regards to environment and safety issues. The program covers vital aspects of environment and safety for any project to be established. These aspects range from general information about the project including each type of discharges to quality verification for each type of discharge.

5.2 Conclusions

In UAE and Specifically Emirate of Dubai the areas are divided as residential areas, sanctuary areas, commercial areas, Hotel areas, and Industrial areas. Therefore, there is

no need for mitigation for activities location and the industry must comply with rule and regulations established and being implemented by statutory environmental authorities.

The developed program helps the project establisher to understand, review and evaluate his EIA with a full awareness of environmental regulations requirements. The importance of this program lays on the fact that it can be linked through Internet to all over the world and the project owner can evaluate his project through the system directly and personally.

For environmentally unaware person, the program is developed to be used as educational and evaluation tool. Hence, making the user familiar with all environmental regulations and policies.

The Developed program is a very effective tool and can be applied in various environmental departments as long as there is a full system of environmental management and planning for every emirate interlinked to the Federal Environmental Agency.

It should be noted that the developed expert system should be updated periodically due to the following issues: -

1. Variation of Technology from time to time and place to place.
2. Changes in Environmental Regulations due to more restrictions on environmental quality.

3. Technology Variation and Development.
4. Economical Changes and Stresses.
5. Variation in environmental management standards, environmental and safety policies, and environmental commitments.

5.3 Recommendations

It is recommended to expand and integrate the contents of this program data with the Federal Environmental Agency (FEA) requirements as well as other emirates. Then the updated program could be utilized for the assessment of any new project to be established in the UAE. Moreover, the system can further be developed to automatically send a reply letter as an independent self-decision making system. The above-indicated system will require a lot of effort, time, and data gathering along with continuous needs for environmental specialists (i.e. safety and risk assessments, software programming, and environmental law) and process design engineers.

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APPENDIX

DUBAI MUNICIPALITY

ENVIRONMENT DEPARTMENT

ENVIRONMENT PROTECTION &
SAFETY SECTIONإرشادات فنية
Technical Guidelineبلدية دبي
إدارة البيئةقسم حماية البيئة و
السلامة*Number 4*

Guidelines for Preparation of Environmental Impact Statements for New Industrial Premises

Background: The design and construction of new industrial facilities plays a large part in their final environmental and safety program.

It is a requirement for all new industrial facilities to submit an Environmental impact Report before gaining municipality approval.

This will ensure that the requirements of Local Order 61/1991 The Environmental Protection regulations in the Emirate of Dubai are complied with.

Guidelines:

1. ***Small projects may submit only the information highlighted by ****
2. ***All major projects must submit an Environmental Impact Statement containing all information given below.***

2.1. General Requirements

- * a. Nature of the activity conducted by the Company or Person.
- * b. Detailed process description including all materials used in the process.
- * c. Site plan showing all buildings, drains, discharge points to air, water or land and storage areas for dangerous goods.
- d. Proposed production rate.
- e. Engineering drawings of the plant or process equipment including pollution control equipment.
- f. Process flow diagrams.

2.2. *Air Emissions*

- * a. A description of the types of waste produced from each point of discharge and their emission rate.
- * b. The rate and type of fuel used in all fuel fired equipment.
- * c. The height of all chimneys.
- * d. The diameter and discharge velocity of all chimneys.
- * e. Details of proposed emission control devices.
- f. Calculated ground level concentrations for significant emissions.

2.3. *Water Discharges*

- * a. Expected generation rate of waste water.
- * b. Proposed means of waste water disposal.
- * c. Full analysis of expected quality of the waste water.
- * d. Proposed treatment processes for waste water if needed.
- e. Design details and drawings of any treatment plants.
- f. Details of any land areas or ponds used for the storage disposal of waste water including size, location, soil type, depth to ground water, pond construction and location of surrounding residences.

2.4. *Solid Waste Discharges*

- * a. The quantities of any wastes requiring off-site disposal.
- * b. The analysis of any hazardous wastes in the above category.
- c. The proposed disposal/treatment sites of all wastes for off-site disposal.
- d. Details of steps taken by the occupier to minimize the generation of waste (i.e., hazardous waste).

2.5. *Chemicals and Dangerous Goods*

- * a. A list of all chemicals and dangerous goods used at the premises.
- b. Material Safety Data Sheets for each material mentioned above.
- c. Details of dangerous goods storage areas.
- d. Fire safety precautions for flammable goods stores.
- e. Bunding details for tanks and storages.

2.6. *Safety and Health*

- * a. Proposed number of workers at the site.
- * b. Details of first aid, fire fighting, ventilation and safety procedures to be employed.
- c. Proposed methods to be employed in the handling and use of any hazardous materials.
- d. Details of any jobs which require:
 - i. the use of hazardous materials.
 - ii. working more than 3 m above ground level.
 - iii. lifting more than 40 kg.
 - iv. the use of welding or cutting equipment
 - v. work in confined spaces.
- e. Proposed personal protective equipment
- f. Expected factory noise levels (internal).

2.7. *Construction Issues*

- a. Detail proposed constructions schedule.
- b. Detail major operations to be undertaken during construction.
- c. Detail proposed safety and health plan for construction phase.
- d. Indicate how waste disposal issues for workforce will be addressed.

2.8. *Emergency Contingency Planning*

- a. List activities which may cause significant environmental or safety concerns.
- b. Detail risk minimization strategies and precautions.
- c. Detail contingency plans in the event of environmental or safety incidents.

FURTHER INFORMATION IS AVAILABLE FROM:

ENVIRONMENT PROTECTION & SAFETY SECTION

% 2064244/2064245 FAX: 2270160



APPLICATION FOR ENVIRONMENT PROTECTION AND SAFETY APPROVAL

Instructions:

This form is to be completed and submitted along with all relevant plans and the information contained in EPSS Technical Guideline Number 4, to obtain approval for a new or substantially modified industrial premises. For guidance on whether a plant modification is covered by these requirements consult the Environmental Protection and Safety Section Tel.: 2064244/2064241 Fax.: 2270160.

Application details:

Applicant Name : _____

Address : P.O. Box: _____

Telephone / Fax : Tel.: _____ Fax: _____

Licence Number (if granted) : _____

Site Location : _____

Name of Manager/Occupier : _____

Name of Business/Company : _____

Nature of Business/Activity : _____

Capital Cost : _____

Reason for this Application : _____

Date : _____

Signed: _____ Occupier

ARABIC SUMMARY

تطوير نظام الخبير لتقييم الانعكاسات البيئية

الخلاصة

في هذه الدراسة، تمت مراجعة ومناقشة طرق التقييم البيئي، ومن ثم تطوير نظام أدائي باستخدام برنامج إدخال البيانات (ميكروسوفت أكسس) وبرنامج (فجوال بيسك) لإعطاء التقييم الملانم وفقاً للبيانات المدخلة.

إن الأنظمة والقوانين المتضمنة في البرنامج معتمدة على الإرشاد الفني رقم (4) الصادر عن بلدية دبي كما يمكن تلخيص الدور البارز للبرنامج فيما يلي:

يمكن البرنامج المتقدم للحصول على تقييم الانعكاسات البيئية من إدخال كل المعلومات والبيانات الضرورية الخاصة بشركته والأنشطة المرتبطة بها، وتتم مقارنة الانبعاثات من الهواء والماء والتربة بما جاء في الإرشاد الفني رقم (4) وعلى ضوء ذلك يتم إصدار تقرير بالحالة، يوضح ما إذا كان المتقدم بالطلب ملتزم بالقوانين والأنظمة البيئية الحالية، كما يتم إعطاء الاقتراحات التي قد تخفف من الآثار البيئية السلبية المتوقعة.

تم دعم البرنامج بالوثائق والأمثلة التي توضح كيفية استخدامه كما أنه من المتوقع أن يتم اختيار البرنامج من قبل الهيئة الاتحادية للبيئة لتقييم الآثار البيئية للصناعات المختلفة في دولة الإمارات.



جامعة الامارات العربية المتحدة
عمادة الدراسات العليا

تطوير نظام الخبر لتقييم الانعكاسات البيئية

رسالة مقدمة من الطالب

رائد محمد محمود محمد المرزوقي

بكلوريوس هندسة كيميائية - جامعة ولاية أومايو - الولايات المتحدة الأمريكية (1998)

استكمالاً لمتطلبات الحصول على درجة الماجستير في العلوم
(علوم البيئة)

2003-2002