Veidekke Anläggning Öst AB
Planning of an Environmental Management system according to ISO 14001 standards

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Master of Science Thesis
Stockholm 2007
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PLANNING OF AN ENVIRONMENTAL MANAGEMENT SYSTEM
ACCORDING TO ISO 14001 STANDARDS

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Master of Science Thesis
STOCKHOLM 2007

PRESENTED AT
INDUSTRIAL ECOLOGY
ROYAL INSTITUTE OF TECHNOLOGY
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Abstract

This thesis project is a continuation of a project that was previously done at KTH environmental management course during Fall 2006 semester at Veidekke to identify the deficit and the flaws of the current way of dealing with the environmental matters. The purpose of this thesis project is to plan the environmental management system according to ISO 14001 standards specifically for Veidekke Anläggning Öst AB.

The first part of the work was to identify the environmental aspects that relate to the activities and the processes at Veidekke Anläggning’s projects. From these aspects, the significant environmental aspects would be identified, in order to act upon them, and minimize the environmental risks as much as possible.

An environmental management system is mainly a combination of an environmental policy, environmental requirements, environmental goals, and an emergency response plan. So in order for the environmental goals to be set, an accurate identification of the aspects needs to occur before the process of building an environmental management system starts. Then proper solutions and recommendations will be provided in order to motivate the employees at Veidekke Anläggning Öst to increase their environmental awareness and to take responsibility for their actions.

All employees need to undergo a series of educational courses in order to, change their behaviour towards the environment, and to take environmental responsibility for the company. The basic foundation to start building an environmental management system is to
provide the employees with the necessary environmental knowledge, and the motivation to do the best they can. The most important factor is the willingness of the top management to change.

Acknowledgements

This report is a 20 points thesis project for the Master of "Sustainable Technology" at the Royal Institute of Technology in Stockholm. The thesis project is written at Veidekke Anläggning Öst AB during the Fall 2006 semester. The project’s purpose is to create an Environmental management system that fulfil the ISO 14001 standards, through identifying the company’s significant environmental aspects and influences, recommending solutions to their environmental problems, and setting future environmental goals for them to attain.

I would like to thank my advisor, Carina Andersson-Nordin, KMA, for her never ending engagement, enthusiasm, and support. Fredrik Gröndahl, the Institute for Industrial Ecology, KTH for his support, and good ideas and advice. From Veidekke Anläggning Öst., I would specifically like to thank, Berg L., Berglund H., Dahlstedt A., Hamberg P., Lindberg S., Lindfors R., Lindholm A., Lundin A., Lundman E., Nilsson L., Olsson M., Sandström H., Spinos K., Wilson L., and Wistedt G. for taking the time to discuss with me the environmental questions that I had for them about VAÖ.
I also want to thank everyone at Veidekke who made the office feel like my second Home!
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1. Introduction

1.1. Background

Veidekke Anläggning Öst AB (VAÖ) is part of Veidekke Sverige, which is a construction and infrastructure company that has its headquarters in Norway. Veidekke has evolved over the years to become one of the competitive construction companies in the Nordic countries except for Finland. Since Veidekke Anläggning Öst always strives for the best, its next step was to create its environmental management system according to ISO 14001 standards. Its concern for the environment, and the safety of its employees and the public health, motivated Veidekke Anläggning Öst to start this project to build its Environmental Management System (EMS).

The environmental issues are being considered and prioritized to a growing extent, in the government, the business world, and the public in Sweden and around the world. The
construction industry however, is responsible for one of the biggest parts of the total resource exploitation and consumption, using raw materials like mountain rocks, cement, plastic products, asphalt, PVC, PC, PVH, isolation products, iron, water, oil products, electricity, steel, and more. This therefore implies that the construction industry stands for a significant part of the environmental problems. That’s why it’s very important for the construction companies to increase their awareness towards their environmental work and always strive to improve, and have the insight and be in control of their activities that can affect the environment.

For example, China now accounts for half of all new building area in the world. Increases in building stocks of all types have occurred during an extended period of accelerated growth of the national economy. This expansion promises to continue through 2030. As a result, the rapid conversion of land from low-density agricultural and light manufacturing to new urban zones of high density and material-intensive commercial and residential buildings has consumed enormous quantities of domestic and imported resources and has irreversibly altered the Chinese landscape. Therefore the consumption of material resources dedicated to Chinese building construction has doubled and is still increasing. With this as the starting point, the field of industrial ecology in China needs to work toward formulating strategies for a circular economy that include a resource-efficient urban China. (Fernández, 2007)

Most of the activities in a company are considered as environmental aspects, which mean that most of these activities has or can have an environmental impact. The activities that are identified to have the most critical and strongest environmental impact are called the significant environmental aspects. In order to identify these significant environmental aspects, a lot of research should be done to evaluate the aspects with the highest risks and effects. The ISO 14001 handbook doesn’t state specific ways to identify these aspects, so this research is totally up to the researcher. The handbook only states guidelines about the steps that are needed to be taken in order to adopt the ISO standards to your company. (ISO 14001 standards handbook, 2004)

This process is a never ending one, and the aspects and the solutions that are being identified in this thesis projects are for the ones that are currently present. In the future years, totally different aspects and solutions might be discovered. The evolution of the environment is still uncertain, so we can only work with what we have now.

2 Methods

2.1 General

Veidekke Anläggning Öst, just like all the other construction companies in Sweden are project based. They receive a project proposal from their clients e.g. Banverket, Vägverket, and private clients, then they start working on these projects. The process of beginning with a new project varies a little bit from one project to the other depending on whether the client has already mapped out the project plan steps for VAÖ, or if the company needs to come up with a project plan. The same process is still followed in both scenarios, only few beginning steps are skipped in cases that the client has a created their own project plan. The rest of the processes in the projects are common for all projects. For example, the project may start at the project development phase, the planning phase, or directly in the production phase.

The full project steps can be described as follows in the order of the beginning of the project till its end. A new project usually starts with project development, planning, production
preparation, production control, and ends with delivering the project with a guarantee that it was done with the quality expected from the client.

The environmental actions that relate to each step in the process should be done at the beginning of each stage before we move on to the next one. For the project development stage, an environmental feasibility study and environmental planning are part of this step. For the planning stage, looking into risk assessment, local environmental demands, VAÖ’s environmental demands, chemicals, machines and equipments, waste management plan, emergency response plan, purchasing, management, and the organization’s responsibility are the environmental steps to be taken in this planning stage of the project’s process.

It’s very important to note here that the project development and the planning stage are of the same importance if not more important in some cases than the production case. Making the efforts in planning the project is what VAÖ will eventually get as a reward at the end of the project.

In the production phase, the environmental steps to be taken are security and environmental protection, handling of chemicals, UE control, revisions, control program, information and finally documentation. This is a critical stage of the project that requires the employees to follow through with the environmental plan, and not overlook it due to time constraints.

In the final stages of the project, when the project is delivered to the customer, it’s important that the working place is restored, and that the lessons learned from this project are documented.

**Figure 1:** Check the figure below for an overview of the processes at VAÖ.
2.2 Interviews and Questionnaires

Veidekke Anläggning will adopt the ISO 14001 standards to its environmental management system. This will be done by following the environmental policy, which is written by the VAÖ’s top management, then by defining the environmental aspects and impacts of the activities that occur in the company, and finally by providing a guideline on how to handle and prevent such impacts from happening by being as environmentally friendly as possible.

VAÖ will do so by observing certain projects that belong to the different types of constructions, like underground, houses, roads, bridges, infrastructure, and others. It has been noticed in a similar project between KTH and Veidekke, that Veidekke Skåne has an excellent environmental management system that is very similar to the one applied by ISO 14001 standards, which VAÖ can benefit from greatly, so a contribution between the two branches of Veidekke will be very useful to both parties. EMS ISO 14001 handbooks will be used to guide the way through the planning of the project. (Ledezma, Ahmed, Rasoul, 2006)

Communication is very important in the project, many interviews and discussions will be held with many employees at Veidekke, especially the ones concerned in the project. The laws of the company and its culture were definitely taken into consideration, and making sure that the regulations and legislations are compatible with the Swedish laws.

A questionnaire was designed and distributed to the employees working on the projects from all levels of management and positions in order to test the people’s knowledge on environmental work and, to know more about the significant environmental aspects, and to create a better image on the real situation of the environmental issues and how they are dealing with them in real time at the projects. All of this information benefited the thesis project in creating an Environmental management system that is created exactly for VAÖ, and that will sure fulfil its needs and solve its environmental problems.
The questions for the interviews were developed in a way that made it possible to collect information about the current situation, the managers and employees’ ways of thinking and understanding of the environment. Twenty five questions were written in simplified Swedish and English to make it easier for the interviewees to understand and grasp the meaning of the questions, and give a feedback that answers the questions clearly with as much attention to detail as possible. The questions revolved around all important environmentally related subjects, for example the current environmental problems, and their problem-solving methods. The issues of chemicals, waste policy, and emergency response plan were also considered. To take it one step further, the issues of employees’ safety and risk taking was also of mutual interest in the interviews. The choice of these questions was specifically made for the sake of knowing about their current environmental management system, and what needs to be changed to give a solution that is appropriate for VAÖ.

Having interviews with the managers and employees who worked in the offices at VAÖ was definitely not enough to have the bigger picture of how things really are; so a questionnaire of 14 questions was designed. The questions were designed in a way that would help me gather information about how much do the employees know about the environmental management system, the environmental problems and impacts that occur in their projects. Most of the questions in the questionnaire are multiple choice questions making it easier for the employees to give more accurate answers, and easier for me to analyse the information collected.

3 Results

3.1 Manufacturing and storing in the Projects

Like all construction projects, the materials that are used cannot be ordered or delivered on a daily basis. That’s why storing the necessary amounts of material needed is a crucial step for saving time, money, and labour at the projects of VAÖ.

The projects that are taken by VAÖ involve the manufacturing of tunnels, railways, concrete constructions, bridges, and foundations of houses.

The amount of material stored at a project varies from one project to the other. Yet the materials are almost the same. Chemicals are usually stored in a small box; diesel and gasoline are stored in tanks. During the process time, products like cement, diesel, and explosives are stored in small amounts, since there are certain rules for storing them especially explosives; hence the amount to be stored varies in different locations. For example if the project is in the centre of the city, then they cannot store any explosives.

Other materials stored are rocks, granite, and concrete. These materials are stored in the workplace. For example, they store gravel (naturgrus produkten) which could be an environmental aspect due to its affect on the environment.

Aerosol tubes, color spray, and very little toxic material are also stored. Chemicals like glue foam, hydraulic oil for machines, gasoline are also stored. During the project, a lot of spray cans are used for marking things. These spray cans are not recycled. Glue, paint remove solution, and gas (svetsar) are also stored in the work place.
There’s no list of the material that can be stored at the work place, or which material can or can’t be stored at Veidekke Anläggning Öst. Water is usually the only material that is processed since it needs treatment afterwards.

3.2 Resources and Raw material used at Veidekke Anläggning Öst

Naturally, in order for a construction company to exist, it needs resources, chemicals, and raw materials to work with. It’s very important for a company to have a list of its chemicals that are most used. Veidekke Anläggning Öst does not have its own chemical database; therefore it uses the Vägverket (vv.se), Banverket (banverket.se), and kemikalierinspektionen’s databases (kemi.se) to evaluate the chemicals that they shall use. The chemicals used are very commonly used in almost all projects. Of course, a private chemical database would be very useful to VAÖ, and time saving to the project leaders and the employees who work at the projects. This would allow them to make wiser choices when choosing more environmentally friendly chemicals.

3.3 Most used chemicals at Veidekke Anläggning Öst AB

The types of the most used chemicals at Veidekke Anläggning Öst vary in their amounts and kinds from one project to the other. In some cases, the clients are willing to pay more to use better environmentally friendly chemicals, and other clients want to use the usual chemicals. According to the interviews that were done at VAÖ, the following are the most used chemicals:

1) Underground blasting chemicals, and explosives. These chemicals are similar to bomb chemicals. Ex: nitro-glycerine is the old type of this chemical used.
2) Diesel, ammonium (was used before), nitrate (not used so often), cement (the chemicals found in the cement like chrome), and glue chemicals (in small amounts).
3) Benzene, asphalt, oil products (betonen).
4) Chemicals for grouting, after exploding, this grouting material is used to ceil the rocks, yet it’s not used so much.
5) Hydraulic oils for equipments, and SSC (a type of explosive, looks like a glue). The explosives are Oreca’s products.
6) Some additives called “tillsats ämnen för injektering”, and “sprutbetong”.
7) Membrane hardening (a material used on the surface of concrete to harden it), concrete additives, and different kinds of injecting material like tuptax.
8) Material that is like grease to put the pipes together, oils (formolja) when using concrete, and finally epoxy that is used very rarely.

The most chemicals at VAÖ can be seen more clearly in the table below:

<table>
<thead>
<tr>
<th>Blasting chemicals</th>
<th>Explosives</th>
<th>Diesel</th>
<th>Ammonium</th>
<th>Cement</th>
<th>Benzene</th>
<th>Asphalt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil products</td>
<td>Grouting chemicals</td>
<td>Hydraulic oils</td>
<td>SSC</td>
<td>Additives chemicals</td>
<td>Spruting concrete</td>
<td>Membranes hardening</td>
</tr>
<tr>
<td>Concrete Additives</td>
<td>Injecting materials</td>
<td>Tuptax</td>
<td>Oils</td>
<td>Epoxi</td>
<td>Greasy material</td>
<td>Other additives</td>
</tr>
</tbody>
</table>
3.4 Raw materials

Raw materials are any substances that are in their natural unprocessed state that serve as the starting point for a production or manufacturing process.

The raw materials that are commonly used at Veidekke Anläggning Öst are the following:

1) Plastic, concrete, PVC, PC, PVH (These materials have negative environmental effects), and asphalt coatings.
2) Rock, isolation (in some parts), and plastic pipes.
3) Iron, wood, water, oil products.
4) Water and electricity.
5) Crushed rocks, and natural gravel. Steel for reinforcement, and “bitumen” which is an oil based material used with Asphalt.
6) Wood, and steel pipe lines.
7) Iron for reinforcement, and plastic cells.

They can be seen more clearly in the table below:

<table>
<thead>
<tr>
<th>Water</th>
<th>Electricity</th>
<th>Steel</th>
<th>Wood</th>
<th>Plastic</th>
<th>Rocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVC</td>
<td>PC</td>
<td>PVH</td>
<td>Concrete</td>
<td>Isolation material</td>
<td>Plastic pipes</td>
</tr>
<tr>
<td>Iron</td>
<td>Oil products</td>
<td>Gravel</td>
<td>Plastic cells</td>
<td>Wood</td>
<td>Crushed rocks</td>
</tr>
</tbody>
</table>

3.5 Environmentally friendly chemicals?

According to the Underground construction Department at VAÖ, the construction industry in Sweden follows the Swedish governmental rules and standards, and therefore the chemicals that are available in the market follow the standards that are put by the Swedish law. This does not mean that all the chemicals that are available are environmentally friendly, but the quality of these chemicals is better than other chemicals of the same type.

For example, cement is not the most environmentally friendly product, but the more environmentally friendly replacement of cement is not as efficient, and is much more expensive, so there is no real alternative for cement, yet there’s development in the cement industry to reduce the chrome in the cement. Chrome is naturally found in cement from the stones that cement is made from. Regarding explosive materials, experts still don’t agree which is more environmentally friendly, but Veidekke Anläggning Öst is using the ones that are said to be friendly, for example, nitro-glycerine.

The explosives that are currently being used in the construction industry are either in bulk form or in cartridge form. Bulk explosives are manufactured on-site by a licensed explosives manufacturer for use on the same day. Cartridge explosives are either emulsion or water-gel types. They are imported and stored in Government Explosives Depots before being delivered to blasting sites by staff of the Mines Division. (Geotechnical Engineering Office, 2004)

At VAÖ, there’s bad control on these chemicals. They follow the rules but their no research about a better way of using chemicals. For example, the diesel and benzene used are the most
environmentally friendly ones present, but still they are not very friendly in general. The chemicals used in pipes and oil for concrete are environmentally friendly, yet some types of glues and oils can cause environmental problems, that’s why more research is definitely needed at VAÖ.

3.6 Environmental Management System.

An EMS is a management approach which enables an organization to identify, monitor and control its environmental aspects. An EMS is part of the overall management system that includes organizational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy.

The reasons to introduce an environmental management system to a company can be many, but according to the answers that were gathered from the questionnaire that was distributed to VAÖ’s employees in the projects, were summarized as follows:

A functioning environmental management system can help prevent and control the pollution that is caused by the construction work. An EMS can also improve Veidekke Anläggning’s relations with regulatory authorities. It creates differentiation in their products and services that they provide. It improves the company’s image and reputation; it creates cost savings in terms of use of inputs and waste management, and finally an EMS can improve information flow and documentation about Veidekke Anläggning’s operations. All these reasons seem to improve the performance of the company, and reflect a good image and reputation. (Wellford R., 1996)

3.7 Regulations for an environmental impact assessment

There are many requirements to be followed in order to do an environmental impact assessment to find out the environmental aspects of Veidekke Anläggning Öst, since for example each client has demands; the Swedish environmental agency has other demands. Other demands like Stockholm community, Sweden, European Union, and finally the company’s requirements also need to be followed and investigated.

Currently and according to the ground construction department at Veidekke Anläggning Öst, there are no follow ups and no one is reading these demands and requirements. Veidekke Anläggning does not have environmental investigation, to know what’s good, and what’s bad.

The regulations are found in the laws and they must be a part of the environmental plan for each part of Veidekke Anläggning Öst and in the projects under the title of Environmental laws. What needs to be done is proper planning, as in going down to the bottom level of the processes even for the environmental levels and finding out how each process can be a more environmentally friendly one.

Knowing the environmental requirements is a basic step, and then going backwards to see what is Veidekke Anläggning doing in its projects and then checking if they are following these requirements, and then providing more practical information that everyone can work with in all the levels of employees at Veidekke Anläggning.
The contractors that work with Veidekke Anläggning Öst also have obligations connected to the laws to do environmental investigations, for example, MKB (miljökonsekvensbeskrivning), vattendom, and miljödomstolen.

3.8 Procedures to be followed for the assessments

According to the Underground and Ground construction departments at VAÖ, there are many procedures that need to be done when one wants to start an environmental assessment. One of these procedures is risk assessments. Asking the producers, the clients, the employees, and maybe some consultants if needed on how to solve the current environmental problems is a very important step to gather information about the situation.

When the employees’ environmental knowledge is increased, they are then allowed not only to sort the materials and do their environmental routines, but they would understand why they are sorting, and how does the EMS work. To reach this step, a lot of education and training is needed.

Resarching the kind of chemicals that VAÖ is buying and trying to find a better way of using the chemicals or by replacing some of them by better ones is also a part of this environmental assessment. Even though there isn’t so much that could be replaced, but taking the motive to do so will motivate others around as well.

Involving all levels of the management is very essential in a successful and realistic environmental assessment, if the top management is not concerned then the lower management wont question or care about the issue. Plus the employees of the company, who are working and in the projects where the environmental problems are being caused would have a more realistic view on what is really happening. Yet these employees can not be aware of their actions unless they receive the proper environmental education. (Wellford R., 1996)

Looking into the contract text about the environmental requirement for the projects and the Swedish environmental agency’s (naturvårdsverket) website also gives an insight on what is needed to be done to have such an assessment.

Many questions need to be asked while assessing the environmental situation of the company. These questions could be:

- How do we see the environment?
- What do we need to improve?
- What’s the way to reach this improvement and our goals?
- Who does what?
- How does the environmental work function?
- How can we improve our selves?

3.9 Model for identifying the environmental aspects: ISO 14001

One of the main functions of an environmental management system is the identification of the environmental aspects, which will be the cause for the continuous environmental improvements. That’s why environmental investigation is an essential step in this process. To do so, one of the best methods for identifying these aspects and creating an environmental management system is chosen, that is the ISO 14001 standards.
The ISO 14001 standards does not describe a certain way for identifying environmental aspects but it provides general guidelines for example, doing interviews, checklists, documentation, measures, and using revisions from previous measurements.

So according to ISO 14001 standards, identifying of the environmental aspects, and the evaluation of the environmental impacts is a process that can be divided into 4 steps:

**Step 1: Choose an activity or process.**
These activities are to be researched in a meaningful way using the relevant tools.

**Step 2: Identify the environmental aspect from the activity, process, or service.**
Identify as many as possible from the environmental aspects that are connected to every activity, process or service.

**Step 3: Identify the environmental impact.**
Identify as many as possible from the actual and potential, positive or negative environmental impacts for every environmental aspect.

**Step 4: Evaluate the environmental aspects.** (Miljöledningsguiden, 2004)

### 3.10 Current Situation at Veidekke Anläggning Öst AB

Through the interviews that we done with the project leaders and the managers at VAÖ, and through the collection of the results from the Questionnaire that was distributed at 5 different VAÖ’s projects, these information were obtained, summarized and organized in a well understandable manner. This is an overview of the real situation, and the concerns and ambitions of the employees of VAÖ.

#### 3.10.1 Environmental Policy problem

An environmental policy plays a role of showing that a company is aware of its environmental impacts caused by their activities, and also shows the company’s commitment to continuous improvement towards their environmental work. The environmental policy reflects the commitment of the top management to follow through with the environmental legislations and goals.

At Veidekke Anläggning Öst, the environmental policy seems to be unclear, and the top management has mixed the quality and the environmental policy together. This form of environmental policy lacks the ISO 14001 structure.

The main points that should be included in an environmental policy can easily be found in the ISO 14001 standards or other environmental management books. This will be further discussed in the proposal for the environmental policy.

#### 3.10.2 Environmental problems and their causes at Veidekke Anläggning Öst AB

Since the work at VAÖ is project based, the study of their environmental problems at the projects was divided into underground and ground construction. The underground
construction being the tunnels projects, and the ground construction projects are all the other projects that are built above the ground level. For example, houses, roads, bridges, etc.

3.10.2.1 Underground construction

The company is always trying and striving to fulfil the demands of its customers which are Banverket, Vägverket, and other private clients. The demands from these companies on the environmental aspects could sometimes be harsh, and tough to fulfil, yet Veidekke Anläggning tries with whatever knowledge and expertise they’ve got, to reach the desired outcome.

The environmental problems that VAÖ faces are relatively minor problems. According to the underground construction department at VAÖ, they are currently using 99% from the approved chemicals available in the market, and about 1% of those that are not approved, but are used everywhere because there’s no replacement to them. There is no organised supervision by the government on the chemicals used on the projects, so this responsibility falls on the companies’ level of awareness and environmental reputation.

When researching and evaluating the status of the chemicals used, VAÖ usually refers to the chemical database of Banverket (BV) and Vägverket (VV). VAÖ does not have its own chemical database. The chemicals in the Banverket and Vägverket websites are evaluated and ranked according to their risks, and usability. VAÖ also refers to BV and VV for their list of forbidden chemicals.

Yet for example Diesel and Cement are some of the most used material in the construction industry, and at the same time, they are not environmentally friendly, but they are the “must have” in order to be able to start building. If you are using cement for a long time, you should wear protection gloves, yet the laws are not very well enforced regarding to safety issues, so the employees tend to overlook them.

According to the underground construction department at VAÖ, there are other none environmentally friendly compounds that are used are usually sealed so that no water can go in, ex. Plastic chemicals. In the tunnel building, two chemicals are used to seal the water leakage, these chemicals are similar to glue. They can cause environmental effects if they react with water, and turn to glue. It has a bad smell, and it can affect the employees working with it. It could also affect the air, water, and ground, just to a certain extent.

3.10.2.2 Ground construction

According to the ground construction department of VAÖ, air pollution from trucks is one of the most important aspects. The gases that are released from the trucks, like carbon dioxide and carbon monoxide (greenhouse gases), are very harmful to the environment and the public and employees’ health. Also, when they’re digging, old things could be found in the ground for example, an old gas station, or other pollutants, so ground water pollution is a consequence of their work. It happens that ground water is polluted quite often and sometimes the pollutants go to the streams nearby.

Soil can get mixed up with chemicals and oils and heavy metals, creating soil pollution, which is another expense on the treatment list, and another aspect on the environment.
Since there’s different kind of requirements for each project, for example, Vägverket or Banverket has different demands than others, so economical costs could be a potential problem as well. Regarding the machines, since VAÖ rents its machines and equipment from special construction companies, and in some cases, the clients require more environmentally friendly machines on their projects, this is sometimes economically impossible to fulfil these demands at Veidekke Anläggning Öst because of the higher cost of renting more environmentally friendly machines. The challenge is to fulfil the demands of the clients, and to show them that VAÖ is able to handle it within a specific time period, as they expect VAÖ to handle the responsibility and their risks in the Environmental area.

Water leaching is another problem as well. Water pollution, especially when they are digging is a major aspect to be considered. Yet, when they need to test and know what kind of pollution it is, and what kind of metals or ions are present in the polluted water, people tend to ignore these environmental aspects because the time limits and the lack of knowledge in these fields, and when the projects becomes delayed, and need to be finished, the first things that are overlooked are the environmental issues. The environmental issues at the projects are not given the importance that they deserve. It has not come to the awareness of the employees how much impact can environmental accidents have on the environment. One accident might not look significant, but these accidents accumulate, and their sum is definitely significant on many levels of the environment and public health.

The ground water pollution is a very significant aspect due to the nature of the ground water system in Stockholm that is connected together, so pollution in ground water could possibly affect the inhabitants of Stockholm city.

There are two kinds of projects. The first is when Veidekke Anläggning Öst designs and decides how to handle the projects. The second type is already done by the client, and the calculations and the decisions are already taken, so VAÖ only implements the projects, so in case a problem with the land that the client provides happens, then it’s the clients’ responsibility.

VAÖ suffers from minor environmental problems, yet the consequences of ignoring them, could be significant. For example, when the purchasing department buys the chemicals from the suppliers and uses them, though they have certain restrictions on using them, yet some material are used where they shouldn’t be used, yet this happens very rarely.

According to the ground and concrete department at Veidekke Anläggning Öst, the purchasing department buys raw materials from other countries because it is more expensive to buy them in Sweden. The handling of these raw materials in the countries follows the countries’ laws and regulations.

Sometimes, the employees’ working conditions at their job in the outsourced countries is investigated by Veidekke Anläggning due to the clients’ demands or on the behalf of Veidekke itself. Veidekke Anläggning Öst puts certain demands on these outsourced companies before they buy the raw materials from them since it affects their reputation. For example in China, Veidekke Anläggning puts certain conditions on the companies to improve the employees’ working conditions, or else they would take their work elsewhere. According to the ground construction department at VAÖ, if the major construction companies in Sweden or internationally are dealing with these suppliers, then VAÖ can be sure that these products are more environmentally friendly than others, since the major
companies have reached a higher level of environmental awareness in their work, and are more concerned with their reputation.

Water, air, vibration, noise pollutions are all potential environmental aspects for the work at Veidekke Anläggning Öst. The vibration and noise problem in the surrounding neighbourhood from the drilling sounds under houses is a major problem as well. The houses shake when they blast, and some concrete could fall off the ceilings of the houses on the ground injuring some of the residents of the houses. Other problems can be when they drill for tunnels; the ground water falls down deeper in the ground, so you can get movements in the houses’ foundations. Even though there are restrictions for drilling under inhabited areas, yet they are sometimes ignored.

The drilling water is pumped out, and then sent to Henriksdal or Käppala, the local water treatment sites, to be cleaned from oil and slag. There are certain demands on how to deal with leakages to ground water which they follow at Veidekke Anläggning Öst.

When explosions takes place in the tunnels, the Nitrate and Sulfate gases (NOx and SOx) are not necessary a problem because the gases spread out easily. Yet it is a problem sometimes if the gases stay in the tunnels, so depending on the ventilation system that have been installed, the quality of the air in the projects varies.

Another environmental aspect labelled under “Ground pollution” could be the PHA asphalt, and leftovers from the industries. For example, when they have a project that has something already built on it, and they need to remove the current structure in order to build over it, so the material present might have chemicals or toxins that are sometimes unknown or confusing to Veidekke Anläggning Öst.

3.10.3 Current Problem-solving methods

Veidekke Anläggning Öst AB usually has a programme or actions to take when facing environmental problems, which are ready given to them from their clients to follow. This is the case when the client is environmentally aware, and well established like Vägverket and Banverket. On other occasions, Veidekke Anläggning Öst has to act from its own knowledge and conscience.

If they know that the material or chemicals are not approved and there are alternatives, then they don’t use it. A project in the north of Sweden had a problem with air pollution. They usually solve air problems in the tunnels by pumping fresh air to the tunnels, for the employees to breath. The underground areas are usually polluted because of the use of machines.

It’s not a problem when the air goes up to the atmosphere, because the concentration of the pollutants is minimal when they are diluted in the open atmosphere, but it’s a problem for the employees if the air stays in. As a solution, they install bigger fans to pump more air into the tunnel. This description is not necessary an environmental problem, but it’s more related to employees working conditions (arbetsmiljö AFS 2003:2)

Having fewer machines is probably a better solution, but the productivity would be less. The health problems on the short term are headaches, yet on the long term, it’s still unknown or studied. Employees complain about having headaches.
According to the construction department at VAÖ, a lot of the problems are not solved because VAÖ want to earn more money. They would rather sell the material that they removed from the projects than reuse them in other projects. There’s no real control from the government. If there’s a certain law, then they follow it regarding the environmental issues at least, but if there are no laws, then profitability comes first.

VAÖ is now dealing with companies that are aware of environmental thinking, and that are on the same terms. When there’s an environmental risk, they ship this risk and pay to protect the environment.
They always follow the demands of the contract with the suppliers. When VAÖ needs waste treatment at its projects, they outsource them to SITA, or SWECO, which VAÖ have agreements with.
They have restrictions in the contract that they follow most of the time for the ground water, vibrations and noise. The requirements on the water that they pump out from tunnels are to be treated using small treatment plants. For gases, they have ventilation.
For every project, they have an environmental plan that comes from the supplier, or from Veidekke itself.
Wastes from older machines that release coal dioxides (greenhouse gases) are just ventilated. Pumped water goes to sedimentation, also depending on the size of the work place, so they clean the water by sedimentation, or put the water in containers. They use pumps to keep the water out of the holes when they dig before it gets polluted.

Sedimentation is the most common used method for waste water treatment. The water treated is not used again. It’s then pumped to a bigger communal plant, used to separate oils from water, and sedimentation of clay and sand from water are also used.

3.10.4 EMS costs

According to the Underground and Ground Construction departments at VAÖ, it costs more to have an EMS in the short run. The sooner the EMS is installed, the better. It gives the company a very good reputation. If you don’t have an EMS, and an accident happens, then the cost of dealing with it could be higher, depending on the type of accident, and if you have an EMS, you can take earlier preventive actions before the problems grow, and the organization can be more effective.

There are no documented data of how much money is VAÖ loosing because of environmental problems. This is also due to the unawareness to the type of environmental problems that are occurring due to the lack of knowledge in the field. Yet if you have a good environmental education, it sets a good example for customers and other companies to follow. Yet education of personal also costs money, but it is seen as an investment.

3.10.5 Emergency response plan

VAÖ has a virtual ERP, as in there’s no documented information on how to deal with environmental accidents, and there’s no data about previous accidents, and lessons learned from these accidents. Yet VAÖ has a “to do” list in case of an accident, including all the telephone numbers to the places or people who can handle such accidents. Ex for oil leakage, they use a powder to pour over the leakage. They also have other ones for Fire, and pollution cases.
There are certain routines that they follow, depending on the kind of project and the requirements of the clients. Ex: if the project is near ground water or near houses, then it costs more in order to be precautious.

The response plan is unique for each project, yet there’s a common part that is all the telephone numbers and contacts and the maps to the places and people that can handle their problem. Ex: in cases of oil leakages to water or fire breaks.

There’s no real environmental emergency plan, yet they have materials and absorbers in case of leakages or accidents.

3.10.6 Environmental problems loss runs

According to the Underground and Ground construction departments, VAÖ is currently not loosing money directly because of the environmental problems that it faces, yet it would be more profitable if the company had an EMS. The loss is more of an indirect loss runs, because the company is not always aware of the environmental problems, for example when VAÖ has slow production in one of its projects, and the managers or the employees do not know that some activities are taking longer time to finish than usual. For example, when they find confusing material or when they don’t have enough knowledge about the chemicals that they are using. The production would be more efficient if the problems were simply solved by giving the employees more education, documenting the things that are happening on the projects that are delaying these projects, and writing the lessons learned from these experiences.

There’s a lot more costs now because of the regulations that should be followed regarding the environmental status of the projects, more than it was in the past years. For example, there are certain precautions that are taken especially if they’re near water, so that there would be no leakage. It also costs a lot when they have to check all of their products because they don’t have an Environmental management system to ease their work.

Sometimes the company faces losses mostly because of the weather condition especially when it rains a lot or it snows, because of the ground water level, since there’s no plan for this kind of situation because they don’t know what to expect from the ground water levels.

3.10.7 Employees education and training

As part of the Working conditions (arbetsmiljö) at VAÖ, the employees are sent to a basic environmental course in most projects. This course is not enough to be given once in order to change the behaviour of the employees towards the environment.

All employees at Veidekke are gradually taking these basic environmental courses starting the top management and going down to the workers. Special courses are given to some employees who are dealing with hazardous or toxic material in order to know how to handle it and its effects on the environment. This is only the case when the client is environmentally aware, like project for Vägverket, and Banverket. The employees go for training at their offices or at the clients’ offices, yet these courses are mostly designed to teach them how to deal with their machines and equipment.

The training that the employees at Veidekke Anläggning have undergone is very basic environmental education, and the employees definitely need continuous follow ups with deeper environmental education until they reach the appropriate level of awareness to be able
to take action of their own behalf by shifting their thinking to prioritising environmental thinking and behaviour.

3.10.8 Are the workers at the projects taking risks?

There’s always a risk in the construction industry whether it’s in operations, dealing with chemicals, or daily construction routines. There’s more risk in operations, and less risk with using the substances. According to the underground construction department at VAÖ, a lot of the risk lies on the workers who lift heavy things, and breathe polluted air and dust from exploding the ground, chemicals, and pollutants. The dust is a major problem.

The employees do take risks especially with dust which might cause them healthy problems especially when they don’t use their protection safety glasses, or ear plugs, because the employees are not aware or they think that “It wont happen to me”, and Veidekke Anläggning is not strict in enforcing their demands regarding such employees safety issues.

It’s a risky job and the employees are aware of it even when dealing with toxic material. So it comes as a natural part of their job. Yet they don’t follow the safety regulations all the time, but they are aware of the risks that they are taking. Though sometimes the employees say it’s too risky, but they get used to their work eventually. VAÖ needs to play a better role in enforcing their safety regulations to all employees, since this gives a better reputation to VAÖ, and decreases the costs of hiring more employees when other ones get sick.

3.10.9 Confusing material

Some material could be confusing for the employees at VAÖ, but most of the cases, the material are very well explained and understood. For example, PCB was confusing but VAÖ does not use that material in their pipes anymore, they use PP instead. If there’s something confusing, they usually look at the material manual (materialvarordeclaration) which comes with the product.

The materials from the suppliers are clear, but some materials that are found in old lands that they buy might be confusing.

VAÖ looks at the chemical database from Banverket and Vägverket, and evaluate the risks if present. Sometimes they do research themselves, but that’s a rare case.

Substances that they don’t use a lot, like special kinds of glues could be confusing. The confusing material could be cement, or concrete. Batteries are a bit confusing, because they don’t know how to handle them. Epoxy is bad for the health but there’s no alternative, so it’s still used.

3.10.10 Corrective actions

The corrective actions that have been taken so far started with employing a Quality, environment and work-environment (Kvalitet, Miljö och Arbetsmiljö) expert to the company that has a great experience in this field, and can truly help Veidekke Anläggning reach their goals. Yet very few other steps have been taken so far to improve the condition at the company. There are meeting being held with the employees, to tell them about the substances used. They are using a method to describe each task and how to use them, including operations in case of hazards or accidents.
Educations, talking about environmental issues in the meetings and spreading the awareness is also one of the basic steps that Veidekke Anläggning is trying to accomplish, especially now in the tendering phase of the work, they have a lot of environmental issues to deal with, so they are calculating in more detail the costs, and they ask the clients to clarify their intentions regarding their demands for the environmental aspects of the project. They are taking risk management in the early stages of the projects. For example, on one of the projects, they switched to another kind of glue that is more environmentally and health friendly because it was dangerous to the health and the environment.

According to the construction department, in some projects at VAÖ, the machines that are used are safer for the environment, and release less toxins to the atmosphere. This is only the case in certain projects that clients have put conditions on Veidekke Anläggning to fulfil. Veidekke Anläggning cannot afford to rent all new and environmentally friendly machines for all its projects.

Planning the Environmental management system that is common for all Veidekke Anläggning is also an important and basic step on the right path that needs the commitment and the responsibility of the top management.

3.10.11 Average number of accidents

There is no record of statistics kept about the environmental accidents that take place at the projects that Veidekke Anläggning handles. On a general basis, and in certain projects 1-2 accident per year are occurring like leakage of hydraulic oil about 1-5 litres on the surface of the ground.

In other projects, the discharge problems like hydraulic oil leakages, pumped water accidents, and asphalt that contains stones happen at least 1 time varying between once week to once a month. These hydraulic oil leakage and pumped water accidents also happen depending on the machines that are being used as well. The leakage of hydraulic oil each time is around half a litre to one litre. Sometimes the leakage is being treated by using absorbers, and sometimes they are ignored due to time constraints.

According to the working conditions statistics (arbetsmiljö) of VAÖ that are obtained from the Ground construction department, the usual employee accidents are 28 accidents/ 1 million working hour, which is about 7 accidents per year resulting that the employee has to be away from work for at least one full day.

3.10.12 Waste handling policy

According to the ground construction department at Veidekke Anläggning, there exists a contract with the waste handling company SITA to help them with their waste. For soil, they ask companies like SKANSKA or Ragnsells on how to deal with them. VAÖ doesn’t have any personal waste handling treatment, so they give them to the experts.

Trees, reinforcement materials (skrotjärn), plastics and other material are sorted and sent to SITA to be treated. It’s cheaper to sort these waste materials than put everything together in a landfill due to the Swedish laws that charge more money on waste that goes to landfills.
Yet at VAÖ there’s no written policy other than what is known as sorting of materials. When VAÖ buys materials, they try to have minimum packaging material to have least amount of wastes. Examples of sorted material can be PVC ( ) that is sorted and sold back to the company that they bought them from. Batteries, and spray cans are all sorted and sent to the recycling site with SITA.

3.10.13 Absences due to specific illnesses

According to the employees’ working conditions (arbetsmiljö), back problems, headaches, shoulders, hearing and sight problems are some of the common problems that some of the workers complain about. There are no absences documented due to environmental accidents or reasons, yet they do have absences especially those working in tunnels as they are paid more than others as well on the basis that their work has more health risk.

VAÖ usually created and follows diagrams like the H-value diagram, that has information about the number of injuries that lead to absences at the work site per million working hour.

The diagrams are almost constant, and it could be influenced when the employees have fever. Yet these documentations correspond to the working conditions part of the work, and not to the environmental part.

3.10.14 Suspicion of environmental problems

There’s always an influence in all areas, for example, transportation has a big influence on the environment. When you work near big roads, employees suffer from the car gases, and the noises; so noise and air pollution are big influences.

When the project is near water, it is ground water and stream pollution aspects. The ground water sinking under the city is a major aspect, yet the requirements that come with such projects could be too much to handle.

The use of chemicals is also of important concern. The CO2 increases because of the use of a lot of diesel running machines, and high use of energy.

The working conditions are of high risk as well because the employees don’t follow the safety rules. Plus there’s stress and pressure on them since there’s a specific way to handle the material that they are using. Working in the mountains, and tunnels, especially when they blast create a problem with noise and with stone in the exploded area.

3.11 Evolution

Many factors that have been occurring over the past years that have led us to the situation of increased environmental awareness that we have reached today. The clients have more demands on the environmental aspects than ever before. The Swedish people have raised their level of awareness, they think more about the environment, and they don’t want the problems any more.
Recycling became a trend in the Swedish house hold, and an essential part of any company’s work who wants to have a good reputation.
For example, in a project like Norra länken, the project leader looks at the environmental requirements and then put them in a programme, so that they know who does this and why and the risk with their activities. There could be a delay in the project because they don’t understand the environmental requirements and the environmental work, so more awareness is definitely needed for all employees. There’s a great potential to improve, since they don’t have statistics on the environmental effects or aspects of accidents, so a better foundation is definitely a must.

3.11.1 What needs to be changed?

As long as the governmental laws about being more environmentally friendly are not properly enforced by the government, then not much is going to happen, because of the economical values, and the desire to make more profits. Everyone is affecting the environment in a small way, but when you put them together, they become a big problem.

Thinking in a more environmentally friendly way is maybe the first step towards the change and at the same time is the most difficult step. Changing people’s behaviour towards something is probably one of the most challenging actions that a company can do to its employees or the public. None of the employees care enough to ask about how to be better on the environmental level, yet they like the idea that they are trying to stay environmentally friendly. This proves that there’s a big chance for change, only if VAÖ tries harder. Several construction companies have succeeded in reaching the level of awareness and education that allows them to have a competitive advantage when it comes to being environmentally friendly. For example, Veidekke Skåne, and SKANSKA are companies that achieved a good level of success.

More education and training are definitely needed, as well as technology development in order to have more silent machines that create fewer vibrations. New types of explosive materials are also of desperate need in order to have a safer environment. More education about the material used, from an environmental perspective can also help, yet the education needs to be continuous and concurrent. One environmental course for four hours is definitely not enough to change the employees’ behaviour. The courses need to be practical, and showing the employees what harm are they doing, not only to the environment but to themselves as well.

More awareness for employees is a must. Explaining the rules until the employees understand the effects of their actions is also a challenging job due to people’s resistance to change.

Finding other ways to explode the tunnels, and doing research about the subject is a major benefit for Veidekke Anläggning. For example, some of the new machines called Tunnel Boring Machines (TBM) that are available now in Sweden are used to scale and smooth the surfaces of the tunnels that are dug.

3.11.2 Delays and concerns about EMS at VAÖ

According to the Ground and Underground Construction departments, there’s not much knowledge about the area of environmental management systems. Environmental problems are hard to grab and to know to what degree to deal with them, man can’t always be right, but they strive to be as good as possible.
Lack of resources especially human resources and time, and being too busy with other things are the main reasons of the delay of having an EMS. There’s no priority for it either. It also takes time and money to teach the employees in the projects to use the EMS in the right way.

There’s a lack of knowledge about what is an EMS, and knowledge about environmental aspects and effects that Veidekke Anläggning has on the environment, which are the basis of having an EMS.

The concerns on having an EMS are that VAÖ wants the EMS to apply to the project’s reality, and be helping the system instead of complicating it. The production people have to feel that they are using it as a helping tool that makes things easier for them instead of being a burden to use it.

There are certainly money concerns at VAÖ; hence no one sees the potential of saving money or making money out of an EMS. The top management needs to believe and understand the potential behind having an EMS, and the credibility that comes with the reputation that reflects on VAÖ. They need to see the EMS as an investment instead of an expense, an investment that will bring profits back to VAÖ. This profit may not be noticeable at the beginning, but it accumulates with time especially with the cost saving and efficiency that comes with having a good EMS. Companies like SKANSKA who started implementing their EMS in 2001, have recently started noticing the income profit of their EMS. The actual figures of the profit were kept confidential, but the presence of the profit was assured by the KMA (Kvalitet, miljö och Arbetsmiljöchef) at SKANSKA.

3.11.3 Symptoms due to poor environmental management

According to the interviews that were done at VAÖ in all different departments, and the questionnaires that were filled by the employees of VAÖ at 5 different projects, the conclusions that were deduced are that employees are mostly just not interested in the environmental aspects of the work. This is, of course, changeable as the employees receive the proper environmental education. The little knowledge that the employees had about the environmental problems and their solutions, were a definite indicator to poor environmental management at VAÖ. Yet VAÖ has taken the initiation to educate its employees properly with courses that are in collaboration with excellent KTH (Kungliga Tekniska Högskolan) professors.

Other symptoms could be when some employees had allergies to concrete and created illnesses like eczema. They wear gloves, as a solution now. Most of these symptoms can be avoided using protection methods.

Other symptoms can be that the employees always have to find the environmental requirements again in order to apply them, because they’re not done and managed properly. Many incidents (not accidents) are not reported due to poor documentation. There’s also bad quality of the grouting results, and in most of the times, too high vibrations.

Many questions have been asked especially to know the company’s environmental responsibility. For example, How far should our responsibility for the environment go? Within the sight or outside as well? And what kind of help they need on the projects?
It’s very important to have a management that understands the system in order to avoid problems, so it would be easier to diagnose and correct the system. The project leaders’ responsibility varies from one project to the other, depending on the type of project, to whether the environmental responsibility lies mostly on the client or on VAÖ.

The purchase department must be more aware which products have less environmental problem, and buy the most suitable chemicals and products.

3.12 Criteria used for the assessment of the environmental impacts

There are many criteria that are needed to be looked at in order to assess the environmental impacts of the aspects that were identified. These environmental criteria are in one way or the other very similar to the environmental demands and requirements that are put on each project to follow. These criteria can be measured by comparing their potential to the actual reality of applying and implementing them. The environmental demands that are proposed by Vägverket and Banverket are the most ideal ones, and therefore can be used as criteria to assess the environmental impacts.

Other criteria that could be used include “The 15 environmental quality goals for Sweden”, “Naturvårdsverkets 14 environmental points”, “The ICC 16 principles”, and others (Naturvårdsverket). The criteria can be used as a checklist to measure the environmental impacts, by putting values next to the environmental criteria that relate to the environmental impacts, the more significant the impact, the higher the value next to the criteria. The environmental impacts with the highest value are then called the significant environmental impacts that relate to their significant environmental aspects. (Ministry of environment, 2006)

In other words, we can say that an environmental aspect can become significant if:
- It requires a lot of natural resources
- Its discharge to water or air is significant
- It has a risk of discharge of hazardous material
- Does not fulfil the Naturvårdverket’s 14 environmental points (Naturvårdverket, 2006)

The environmental aspects of a company’s activities can cause short term and long term impacts. The environmental aspects that are identified belong to these following categories:

- Raw materials
- Chemicals
- Energy
- Discharge till air, water and ground
- Noise and vibrations
- Transportation
- Machines and equipment
- Products
- Waste and remaining products
- Purchasing and suppliers’ relations

It’s important that the environmental aspects be thoroughly described so that they can be clearly identified when noticed in the projects.
The environmental impacts that were identified belong to the following categories:

**Direct Environmental impacts**
- Water consumption
- Energy consumption
  - Diesel
  - Benzene
  - Hydraulic oils
  - Electricity
  - Gasoline
- Raw material consumption
  - Construction material
  - Helping material (used during the construction time)
  - Chemical products
- Air discharge
  - Transportation
  - Equipment and machines
- Ground and water discharge
- Noises and vibrations
- Remaining products
- Environmental impacts due to accidents
- Prescribed chemical

**Indirect Environmental impacts**
- Engagement and resources
- Education/information
- Purchasing of material

**4 Discussion**

In order to organize the environmental work at Veidekke Anläggning Öst, many aids and tools are needed. An environmental management system is one of the certain and secure ways that can contribute to promoting and controlling the efforts for a better environment. Through this way, the company can decrease its environmental load effectively within its activities. An environmental management system should always be a tool that will make the work of the employees easier regarding their environmental work. That’s why the management needs to understand and grasp the resolution of the environmental policy and the environmental goals, and take part in the follow ups. At the same time, the management needs to decide about which improvement steps to be taken next, and show the employees that environmental work has a high priority. The employees must feel involved and constantly informed about the environmental work.

When we say to take responsibility for their actions, we don’t mean blaming the employees for the environmental problems, but having the ability to respond in case an environmental accident happens. There definitely could also be resistance to forward thinking, for example, the employees might say, it was working before so why change it now? That’s why putting the right people in the right jobs is very important, because nothing would change if we have an EMS that is not applied, and if there’s still no documentation. Steven Convey, the author of “The 7 habits of highly effective people” said, “Seek first to understand, and then to be understood”. This implies that VAÖ needs to understand the employees’ behaviour and their
points of views in case they are resisting change, and then seek to educate them and help them understand the importance of this positive change for themselves as well as for the company and the environment.

One of the environmental management system’s benefits to Veidekke Anläggning Öst, is that it helps it measure how much the company is contributing to the environmental impacts, as in VAÖ can build a better reputation for itself based on facts and figures that support their environmental goals. The difficulty in identifying these significant environmental aspects is that this research is based on a few projects that were done at VAÖ taken from different types of projects. It has been noticed that in some projects, it’s very difficult to identify these aspects due to bad documentation, and lack of environmental knowledge of the staff. So even if these aspects were present, yet they are not yet realized by the staff working on the projects, or they are overlooked due to time or financial strains. In other projects, the environmental aspects seem to be more obvious to point out due to their repetitive pattern, and difficulty to handle.

For example, when they explode in the tunnel, the NOx and SOx gases are not necessary a problem because the gases spread out easily. Yet it is a problem sometimes if the gases stay in the tunnel. So depending on the ventilation system they have installed, the quality of the air in the projects varies. For instance, one of the projects that I have personally visited had a thick layer of unhealthy air during the tearing down phase of the old structure before beginning the building phase, due to bad ventilation.

From the information that were gathered from the questionnaires that were distributed on the managers and employees at the project that were visited, it is very clear that the employees are striving for any environmental help whether its in the form of knowledge or training. About 80% of the employees like the fact that they are causing less harm to the planet because of their work. It is also very obvious from the questionnaire that more than 60% of the answers were answered by “I don’t know”. This is a clear indication of the poor environmental education that the employees had. This problem has been under study, and the managers at VAÖ has paid good attention to, hence, by the time, this thesis project’s time was done at VAÖ, all employees including managers and project workers have undergone basic environmental education. This doesn’t mean that they have all the environmental knowledge to allow them to handle any environmental problem, but now they understand that these problems exist and are important. This gives them more priority and more attention.

According to the ground construction department of Veidekke Anläggnings Öst, maybe putting more fines on the environmental laws can be a motive for companies to be more environmentally friendly, of course on the condition of providing the needed environmental information that should be applied. Yet, there’s not much knowledge about the area of environmental management systems. Environmental problems are hard to grasp and to know to what degree to deal with them, man can’t always be right, but they strive to be as good as possible, and this is the case with VAÖ.

5 Proposal for an Environmental Management System

This thesis project has been a milestone for the beginning of building an EMS that is formed according to the ISO 14001 standards at VAÖ. A proposal for this EMS must cover all its aspects starting with the environmental policy, and environmental aspects reaching all the way to the employees training and education. There is no step more important than the other,
and therefore, no step is to be left behind or skipped. Creating an environmental vision for VAÖ is as important as identifying its significant environmental aspects.

5.1 Recommendations and Solutions

5.1.1 General Recommendations

At this place and time of the project, the current situation of VAÖ is known and understood. It is known that VAÖ has an environmental policy, environmental goals, emergency plan, and are following the demands that the Swedish law and the clients are putting. Yet what needs to be done is proper planning, as in going down to the bottom level of the processes even for the environmental levels and finding out how each process can be a more environmentally friendly process. Knowing the environmental requirements is also a basic step, and then going backwards to see what is Veidekke Anläggning doing in its projects and then checking if they are following these requirements, and then providing more practical information that everyone can work with in all the levels of employees at Veidekke Anläggning.

When the employees environmental knowledge is increased, they are then allowed, not only to just sort and recycle the material, but they would understand why they are doing this environmental work, and how does the EMS work. To reach this step, a lot of education and training is needed.

Researching the kind of chemicals that you are buying and trying to find a better way of using the chemicals or by replacing some of them by better ones is also part of this environmental assessment. Even though there isn’t so much that could be replaced, but taking the motive to do so will motivate others around as well.

Involving all levels of the management is very essential in a successful and realistic environmental assessment, if the top management is not concerned then the lower management won’t question or care about the issue. Plus the employees and workers at the company, who are working and in the projects where the environmental problems are being caused would have a more realistic view on what is really happening. Yet these employees cannot be aware of their actions unless they receive the proper environmental education.

Looking into the contract text about the environmental requirement for the projects and the Naturvårdsverket’s website also gives an insight on what is needed to be done to have such an assessment.

How does VAÖ come to change?

Everyone is affecting the environment in a small way, but when you put them together, they become a big problem. Yet a shift in the public’s and the employees’ awareness is slightly increasing, which might make the job of the educators at VAÖ a bit easier.

Thinking in a more environmentally friendly way is maybe the first step towards the change and at the same time is the most difficult step. Changing people’s behaviour towards something is probably one of the most challenging actions that a company can do to its employees or the public.
More education and training are definitely fundamental. More education about the material used, from an environmental perspective can also help, yet the education needs to be continuous and empowering. The courses need to be practical, and showing the employees what harm are they doing, not only to the environment but to themselves as well.

More awareness for employees is a must. Explaining the rules until the employees understand the effects of their actions is also a challenging job due to people’s resistance to change.

5.1.2 Environmental Policy

An environmental policy plays a role of showing that a company is aware of its environmental impacts caused by their activities, and also shows the company’s commitment to continuous improvement towards their environmental work. The environmental policy should also comprise of the company’s promises and obligations that they will follow through in their work, and also shows their commitment to follow the environmental legislations.

Because an environmental policy acts as guideline document for all the environmental activities at a company, so it’s very important that it is legible, clear, and easy to understand. It should also clearly state how a company will reach its environmental goals. It’s very important that the environmental policy be rooted in the company’s management, and that the top management follows through with it. This way the environmental policy earns its credibility which encourages all of Veidekke Anläggning Öst to support the policy on all levels, including the financial support, as in to be willing to pay the needed money and commit to the environmental policy in case of an accident. This also means planning a budget for environmental development.

5.1.3 Environmental Aspects

Almost all the activities that are done at Veidekke Anläggning Öst can be considered as potential environmental aspects due to their possibility to affect the environment in one way or the other. Whether it’s related to air, water, ground, energy, raw materials, noises, vibrations, or waste products, they are still worth looking at and trying to minimize their effects.

According the activities that are done at VAÖ’s projects, the following environmental aspects were noticed. In the underground construction projects, the potential environmental aspects that exist are basically the use of diesel for energy purposes and cement for the constructions knowing that these two materials are both not environmentally friendly, and they both have a significant impact on the environment. The use of chemicals is also another aspect, especially the plastic chemicals that are similar to glues. These chemicals can easily react with water and create a bad smell affecting not only the environment but also the employees’ health.

On the other hand, the aspects that can potentially affect the environment in the ground construction projects are more than those in the underground construction project, and very significant as well. Air pollution from the trucks like COx, NOx, and SOx, water and soil pollution with the chemicals or oils, the possibility of the underground water to fall deeper into the ground when digging, vibrations and noise, the friendliness of the machines, and polluted water leaching into the ground water or nearby streams are all environmental aspects that Veidekke Anläggning Öst needs to seriously take into consideration when starting any project.
In both the underground and the ground construction, the energy consumption was magnified as a very important aspect. The large consumption of diesel for machines and transportation creates a lot of unfriendly outcomes like greenhouse gases.

Like it was assumed before that environmental aspects are related to almost all the activities that are done at VAÖ, and so did the interviews and the questionnaire prove the theory. The projects at VAÖ are affecting the environment on all its levels, whether its water, ground, or air. The level of impact varies between one project to the other, and between the sizes of the projects, but one thing is for sure, and that is if these environmental aspects will be ignored, they will only grow larger.

5.1.3.1 Significant Environmental Aspects

By definition, a significant environmental aspect is an aspect that has a significant negative impact on the environment. Through the research done with the interviews and questionnaires, the identified significant environmental aspects were as follows:

1. Gases released from transportation
2. Ground water pollution
3. High energy consumption of machines
4. The use of none environmentally friendly chemicals.

One of the significant environmental aspects that don’t directly relate to the environment but it relates to the employees working conditions is the enforcement of the safety rules at the projects. The workers need to accept these safety precautions as part of their daily work, and be motivated to use them for their own benefit.

5.1.4 Laws and demands

The company should establish and introduce and maintain routines in order to be able to follow up with the increasing environmental demands of the clients, the state, or any other demands. Veidekke Anläggning Öst needs to identify and have access to the applicable laws and demands that are related to the company’s environmental aspects. This means that they also need to determine how these demands apply to these environmental aspects.

The Environmental requirements can easily be taken from the demands that are put by Vägverket projects, Banverket projects, and Naturvårdsverket. When Veidekke decides to build an environmental management system with a database, it’s an important step to include the basic environmental laws that are common for all VAÖ’s projects in this database. The environmental laws that apply to specific projects will be given by the client in the form of environmental requirements for this specific project.

5.1.5 Environmental goals

It’s very important that the environmental goals that will be determined are compatible with the environmental policy and therefore these goals should take into consideration the direct environmental aspects, the environmental requirements, the technical possibility, and other points of view that are of interest. In order to establish this, the environmental goals can be general and detailed. The environmental goals must be specific, measurable, result oriented, practicable, and limited within a time frame.
Veidekke Anläggning Öst wants to establish and maintain a program that would help her reach its overall and detailed environmental goals. This program should include:

1) An assignment of responsibilities in order to reach the overall and detailed environmental goals for every relevant function and level of the company
2) There should be resources and time plan that can fulfill these goals.

5.1.6 Education

All employees that work in activities that could lead to a risk in one of the significant environmental aspects need appropriate environmental education. The company needs to establish and maintain routines so that the employees and other authorities on every relevant level and function of the company could realize and understand the following:

1) The importance and the meaning of the environmental policy, and the routine used to follow and apply the environmental management system.
2) The significant environmental impacts, the real or potential ones, that their work might cause, and therefore provide ways to attain and improve their personal effort towards the environment.
3) Their roles and responsibility in order to reach an agreement and conformity with the environmental policy, the routines, and the requirements in the environmental management system including the emergency response plan demands.

5.1.7 Communication

The communication regarding the environmental aspects of the company and the environmental management system must be used in a routine form that is established and maintained. There should be continuous internal communication between the different levels and functions within the company. There also should be documentation and answering the relevant points of views from the external interested parties.

Documents about how the internal and external communication system functions are important to have in the company. According to ISO 14001, the documents must be localized, archived, and be accessible and identifiable. Continuous documentation and communication about the environmental aspects of the activities at the company is an essential step in maintaining a healthy flow of motivation to the employees, and in helping the suppliers fulfill their environmental requirements.

5.1.8 Emergency Response Plan

Veidekke Anläggning Öst must identify the risks of accidents in order to act in advance and mitigate the environmental impacts. At the same time, the company should plan regular emergency situation exercises to the employees to train them.

5.1.9 Supervise and measure

Veidekke Anläggning Öst needs to facilitate the documentation routines of the supervision and the measurement of the activities that are directly related to the environmental impacts. Information need to be gathered and compared from different periods of time in order to be
able to see clearly the positive changes that are occurring. At the same time, other routines need to be maintained and supported that will help identify deviations in environmental impacts, and therefore this can decrease the environmental impact within the measures that have causes the deviations.

5.1.10 Documentation

Documentation should be clear and contain duties that are carried out like education and results from the revisions and supervisions. It’s very important that the documentation correspond and represent the truth of the system and organization.

5.1.11 Revision of the Environmental Management System

Veidekke Anläggning Öst needs to guarantee that internal revisions of the environmental management system are carried out within the processes. Veidekke Anläggning Öst needs to decide if the environmental management system agrees with the planned measurements for the management system including the demands for this standard. This should be introduced and maintained in a proper way.

The organization needs to plan, introduce and maintain a revision program with consideration to the relevant activities that are related to the environment and the results from previous revisions. The issues that need to be handled are related to the responsibility and the demands that are related, in order to plan and carry out these revisions and report the results that will be documented, plus identifying of the revision’s criteria, its extent, frequency and methods.

The top management needs to evaluate the environmental management system with its planned intervals in order to guarantee that it is proper, sufficient and effective. The evaluation must include the assessment of the possible improvements and of the need of changes in the environmental management system including changes in the environmental policy, and the general and detailed environmental goals.

The basis for management revisions should include:
- Results from the internal revisions of the environmental management system and the evaluations of how the organization is fulfilling the environmental demands that are concerned.
- Information from external factors including complaints.
- The organization’s environmental performance.
- To which extent are the general and detailed goals reached.
- The status of corrective measures.
- The follow up of resolved measures in the management system.
- Changed conditions including development of laws and other demands that are related to the organization’s environmental aspects.

6 Conclusion

Planning an environmental management system according to ISO 14001 is an art, an art that demands a lot of engagement from the company’s management. This will hopefully create a platform of awareness for the environmental work which the employees can count on to create a sustainable society. VAÖ has already taken major steps towards becoming more environmentally friendly; they just need to continue all the way until they have all their processes functioning according to ISO 14001 standards.
The Swedish ministry of environment has decided on environmental goals. The generation goal, as it has come to be known by Swedish law, means reducing pressures on the environment by 2020 (for climate change by 2050) to levels that are sustainable in the long run. For this to be feasible, every sector of society must assume its share of responsibility. Public agencies, organizations, enterprises and individuals must devote more attention to environmental issues and sustainable development. Many small decisions affect the environment, and information, education and evaluation are therefore increasingly necessary (ministry of environment, 2006). When companies like VAÖ does its share for helping the environment, other companies will be motivated by its example. This will cause a domino effect, therefore spreading the awareness more and more with every project they do.

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Table 2: Raw Materials used at VAÖ: page 13
8 References

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Vägverket, www.vv.se


9 Index

Interview Questions

1) What are the Environmental problems that you are facing?
   Vad är miljöproblemet som ni ha nu?

2) How are you dealing with these problems?
   Hur handlar ni de problemen?

3) Does it cost more to deal with them in the current way or to have a certified EMS?
   Kostar det mer för att handla de med nuvarande sätt eller kosta det mindre att installera en miljöledningssystemet?

4) What are the most used chemicals in the construction part of Veidekke?
   Vad är de mesta användande kemikalien i anläggning del av Veidekke?

5) Are these chemicals the most environmentally friendly ones present?
   Är de här kemikalierna mesta miljö vänliga?

6) What is manufactured, refined, stored or processed through the facility?
   Vad är det som är tillverkade, förvarade, eller behandlade igenom faciliteten?

7) What raw materials are used?
   Vilka råvaror är användande?

8) What’s your emergency response plans? Environmental permits?
   Vad är din nödsituation respons plan?

9) Are you facing any loss runs due to environmental problems?
   Lider ni avbräck på grund av miljöproblemet?

10) Are the employees trained to do environmental work?
    Är anställarna tränade för att handla arbetsmiljö?

11) Ask workers at the sight if they feel they are taking risks, or if they believe that their jobs involve hazardous operations or substances?
    Fråga anställarna på sikten om de känner att de på risk, eller om de tro att deras jobb innehåller farliga operationen eller substanser?

12) What material was confusing or distracting?
    Vilka material kan vara förvirrar?

13) What corrective actions have been taken so far?
    Vilka korrigerande åtgärder har du tagit till nu?

14) What is the average number of accidents happening in one year?
    Hur många i genomsnitt olyckor händer i ett år?

15) What needs to be changed to be more environmentally friendly?
Vad behöver förändra för att bli mer miljö vänlig?

16) What is delaying the implementation of an EMS? Is there any concerns?
Vad fördröjer genomförande av en miljöledningssystemet? Finns där någon oroar.

17) What is the policy on waste handling?
Vad är policyn om avfall hantering?

18) What regulations require an environmental impact assessment to be carried out?
Vilka bestämmelser är behöv för att utföra en miljö verkan värdering?

19) What procedures have to be followed in respect of such assessments?
Vilka förfarande måste vi följa i hänsyn till sådan värdering?

20) What recommendations do you make?
Vad rekommenderar du?

21) What factors, in particular, can you identify which might have increased this level of concern?
Vilka faktorer kan du identifiera som kunde ha ökat den nivå av oroar?

22) What are the symptoms that show due to poor environmental management? On the employees as well?
Vad är symptomen som visa på grund av dålig miljöledning? På personal också?

23) Why are symptoms often difficult to diagnose?
Varför symptomen är ofta svårt att diagnos?

24) Have there been more absences for specific illnesses recently compared to other months or to the same season in other years?
Finns där mer frånvaro på grund av specifik sjukdom i jämförelse till andra säsonger?

25) Which areas would you suspect might have problems?
Vilka områden misstänka du att finns problem där?

Environmental Questionnaire

This questionnaire was distributed to some of the employees of 5 projects that we current during fall 2006/2007. The number of answers that were received stands next to each question. The total amount of answered questionnaires received back was 15.

**Miljö Enkät**

Namn: _____________________ Yrke: __________________

Alla frågor handlar om Miljöledningssystemet.

1.1. När man upphandlar transporter tar ditt projekt hänsyn till följande?

<table>
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<td>8</td>
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<td>11</td>
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<tr>
<td>Informerar köpare för att minska deras miljöpåverkan</td>
<td>4</td>
<td>2</td>
<td>10</td>
</tr>
</tbody>
</table>

Adrian Nour Al Jamal Final Degree Project 08/10/2007
1.2. Vad har gjorts i ditt projekt för att införa miljöledning? (var god kryssa för ett svar på varje rad.)

<table>
<thead>
<tr>
<th></th>
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<th>Nej</th>
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<td>Riktlinje för miljö- arbete</td>
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<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Miljö- rapporter</td>
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<td>6</td>
<td>3</td>
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<tr>
<td>Miljömål</td>
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<td>4</td>
<td>5</td>
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<tr>
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</table>

1.3. Var god bedömm vikten av följande påstående (var god kryssa för ett svar på varje rad.)

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<td>Den kan minska användningen av några lagar</td>
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<td>Göra oss annorlunda jämfört med våra konkurrenter</td>
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</tbody>
</table>

1.4. I vilken omfattning är miljö- aktiviteterna av ditt projekt integrerat med följande ledningsverksamhet? (var god kryssa för ett svar på varje rad.),

<table>
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<tr>
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</table>
2.1. Hur viktigt är varje av den följande potentiella negativmiljöpåverkan på ditt projekts produkter och produktion? (var god kryssa för ett svar på varje rad.)

<table>
<thead>
<tr>
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<td>Fast avfall produktion</td>
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<td>3 4 3 - 5</td>
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</table>

2.2. Ta i hänsyn negativ miljöpåverkan som påstås, vilket av följande miljöarbetsaspekter är kontrollerade? (var god kryssa för ett svar på varje rad.)

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<td>Spillvatten flöde</td>
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<td>Lokalt eller regionalt lufta föroreningar</td>
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<td>Riskera av olycka</td>
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<td>- - 6</td>
<td></td>
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</tbody>
</table>

2.3. Har ditt projekt gjort steg för att minska miljöpåverkan som är relaterad till följande? (var god kryssa för ett svar på varje rad.)

<table>
<thead>
<tr>
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<td>3 2 4 6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Global föroreningar (e.g. växthusgaser)</td>
<td>5 1 3 6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estetisk effekter (oväsen, luktar, landskap)</td>
<td>4 2 3 6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smutsa föröreningar</td>
<td>5</td>
<td>1 3 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Riskera av olycka</td>
<td>7</td>
<td>- - 7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.4. Om ditt projekt har gjort betydande ändringar relaterade till dess produktion, vilket av följande är mest nära till verksamheten?

- Ändringar i produktion som minskar utsläpp och/eller resursbruk (2)
- "End-of-Pipe" lösningar som minskar föröreningssutsläpp eller för resurs användning (1)
- Ingen Aning (12)
2.5. Om ditt projekt har gjort viktiga tekniska ändringar som minskar den miljö-
effekt relaterad till dess aktiviteter, vilket av följande är mest nära till verksamheten?

- Ändringar i produktionsteknologi (3)
- Ändringar i produktegenskap (3)
- Ingen aning (10)

2.6. Har ditt projekt genomgått en ändring i miljöpåverkan av dess produkter eller produktion
bearbetar i de sist tre åren med hänsyn till följande?

<table>
<thead>
<tr>
<th>Viktigt</th>
<th>ingen</th>
<th>Viktigt</th>
<th>Vet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minskning</td>
<td>Ändring</td>
<td>Förhöjning</td>
<td>Förhöjning</td>
</tr>
</tbody>
</table>

- Användning av naturliga resurser (energi,..) - 1 4 - 1 9
- Fast avfall produktion - 3 1 1 1 9
- Spillvatten flöde - 1 4 - - 10
- Lokalt eller regionalt lufta föroreningar - 1 5 - - 9
- Global föroreningar (e.g. växthusgaser) - 1 5 - - 9
- Estetiskt effekter (oväsen, luktar, landskap) - 1 5 - 1 9
- Smutsa förorenings 2 - 2 - 2 10
- Riskera av olycka 1 1 2 - 1 9

Annan effekt (specificera var god), ________________

3.1. Hur viktigt tycker du att påverkan av följande grupper eller organisationerna på miljö-
verksamheten av ditt projekt?

<table>
<thead>
<tr>
<th>Inte</th>
<th>Viktigt</th>
<th>Måttligt</th>
<th>Mycket</th>
<th>Vet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Publik myndighet (regeringen, statligt, kommunala)</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Företags huvudkontor</td>
<td>-</td>
<td>4</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Hushållkonsument</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Reklamfilmköpare</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Leverantörer av transporter</td>
<td>-</td>
<td>2</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Aktieägare och investeringsfond</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Banker</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Ledninganställda</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Ingen-ledning anställda</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Fackklubb</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Industri- eller handelanslutning</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>Miljö- grupper eller organisationer</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Grannskap/gemenskapgrupp- &amp; organisationer</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Andra grupper eller organisationer</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>10</td>
</tr>
</tbody>
</table>

(spacificera var god), ________________
3.2. Hur viktigt tycker du att följande påstående med hänsyn till miljö- verksamhet av ditt projekt är?

<table>
<thead>
<tr>
<th>Stoppa eller kontrollera miljö- olyckan</th>
<th>Inte Viktigt</th>
<th>Måttligt Viktigt</th>
<th>Mycket Viktigt</th>
<th>Vet Inte</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-</td>
<td>1</td>
<td>8</td>
<td>6</td>
</tr>
</tbody>
</table>

| Likhet av lagar                      | -            | 3                | 4              | 8        |

| Företagets profil                   | -            | 1                | 8              | 6        |

| Likhet av lagar                      | -            | 3                | 4              | 8        |

| Ekonomiska besparingene             | -            | -                | 8              | 7        |

| Utveckling för ny teknologi         | -            | 1                | 8              | 6        |

| Utveckling för ny produkt           | -            | 1                | 8              | 6        |

| Projekt som är liknande till vårt   | -            | 3                | 2              | 10       |

Annat orsakar (specifika var god) ______________

4.1 Har ditt projekt en budget för utveckling och omhändertagande relaterad till miljö- frågor?

- Ja (1)
- Nej (7)
- Vet Inte (7)

Om ja, vilken procent av din totala budget för forskning och utveckling har tilldelats till miljö- frågor i de sista tre åren? ______________

5.1. Hur dömer du dina projekts total- affärsarbete över de sista tre åren?
(Var god kryssa för endast ett svar.)

- Stor förlust (1)
- Mindre förlust
- +/- Noll (1)
- Litet vinst (4)
- Stor vinst
- Vet Inte (9)