Green Supply Chain Management in Thailand
An Investigation of the Use in the Electrical and Electronics Industry

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Abstract

The objective with this thesis is to clarify the advantages - both economic and environmental - that companies in the Thai electronic manufacturing industry can draw from managing their supply chain and adding a green aspect to it. This through investigations of the concept known as Green Supply Chain Management (GSCM). The research will assist companies with scarce knowledge of green supply chain management in making decisions and priorities in that area.

Semi-structured interviews were performed on sight in Bangkok, Thailand and surrounding region. These provided insight and knowledge of the situation and today-state regarding environmental awareness and GSCM implementation within the Thai Electrical and Electronics Industries. Interviews were performed with representatives and experts from different sectors – from universities, industry and supporting agencies and serve as the foundation for the research.

A model has been developed out of previous research and findings that could suit the Thai industry. This model can be seen as guidelines in the work towards becoming green and aims at continuous improvement of the organizations environmental performance.

In Thailand today companies do not see the benefits of themselves review their organizations environmental impact or developing in this area. Environmental awareness among the public is low and the lack of demand for green products result in few drivers for companies to become green. Also the lack of proper legislation and compliance audits are part of the problem. Missing environmental education and knowledge are extensive and improvements needed. The concept of GSCM is not widespread but popularity is increasing steadily. Some environmental initiatives are though performed in the industry but not under the name of the concept. Customer demands, legislation and education should be the main focus areas for developing the industry.

From the today state at a very basic low much is to be done. Fear of large investments, cost and the lack of knowledge are obstacles to the development. This research shows that these concerns are to be avoided. And by following the model in this thesis companies can find proper knowledge in the area of GSCM. Concluded is that with understanding of the concept and proper implementation from the right knowledge Thai companies can gain great advantages in the future - both economical and environmental.
## Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>5S-GSCM Model</td>
<td>The 5 Step Green Supply Chain Management Model</td>
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<tr>
<td>ASEAN</td>
<td>Association of South East Asian Countries</td>
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<tr>
<td>CC</td>
<td>Customer Cooperation</td>
</tr>
<tr>
<td>ECO</td>
<td>ECO-design</td>
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<tr>
<td>EEE</td>
<td>Electrical and Electronic Equipment</td>
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<td>EEI</td>
<td>Electrical and Electronics Industries</td>
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<tr>
<td>EoL</td>
<td>End-of-Life</td>
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<tr>
<td>EuP</td>
<td>Energy-using Products</td>
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<tr>
<td>GP</td>
<td>Green Purchasing</td>
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<tr>
<td>GSCM</td>
<td>Green Supply Chain Management</td>
</tr>
<tr>
<td>IEM</td>
<td>Internal Environmental Management</td>
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<tr>
<td>IR</td>
<td>Investment Recovery</td>
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<tr>
<td>LCA</td>
<td>Life Cycle Analysis</td>
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<tr>
<td>NGO</td>
<td>Non-Governmental Organizations</td>
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<tr>
<td>QCD</td>
<td>Quality, Cost and Deliverance</td>
</tr>
<tr>
<td>RoHS</td>
<td>Restriction of Hazardous Substances</td>
</tr>
<tr>
<td>SCM</td>
<td>Supply Chain Management</td>
</tr>
<tr>
<td>SME</td>
<td>Small and Medium-size Enterprises</td>
</tr>
<tr>
<td>SEEI</td>
<td>Swedish Electrical and Electronics Industries</td>
</tr>
<tr>
<td>TEEI</td>
<td>Thai Electrical and Electronics Industries</td>
</tr>
<tr>
<td>WEEE</td>
<td>The Waste Electrical and Electronic Equipment directive</td>
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1 Introduction

1.1 Background
Companies in all industry sectors are experiencing increased pressure to reduce costs, increase innovation rate, “time to market”, outsourcing and collaborative product development (Baumann, 2004). Through optimization of the supply chain and the development and increased interest of supply chain management (SCM), many of these pressures are handled to a certain extent. It can be defined as: “Supply chain management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners ... supply chain management integrates supply and demand management within and across companies” (CSCMP). This has made the companies to change the focus from full scale development to their core competencies and outsource as much as possible to other reliable suppliers (Cohen & Roussel, 2004). Within the procurement an increased number of actors are involved in the development process of a product and this also increases the demands on the supply chain and management of the different activities within this. This also causes greater environmental impact and presents new issues to handle. The development implies further actions towards becoming environmental friendly through all supply chain tiers. There is a growing need for greening\textsuperscript{1} enterprises, from both customer and management point of view, which implies an overall review of the activities performed and affecting the environmental performance. The traditional performance dimensions of cost, quality, delivery and technology has far from disappeared but with the new dimension of environmental performance the impact of the decisions most often change. New ways and initiatives must be brought to life for the possibility to get these dimensions to symbiotically exist.

Legislation and regulation have over the past years with growing concern for the environment been reviewed and revised to fit current environmental goals. This has put new demands on enterprises and their environmental performance. International standards and agreements also affect how and where in the supply chain or production process efforts are made. Although big national differences still exist.

The last decade the environmental awareness has rapidly increased in all tiers in the enterprises. Eco-design concepts and environmental management have already gained acknowledgement within most enterprises and industry sectors (Sarkis 2002, Shecterle et. al. 2008). Some years ago the environmental domains of SCM mostly aimed at avoiding operations that broke regulations. The

\textsuperscript{1} Green is a name used in general for products, services and activities that are environmental friendly. Urban Green Partnership (UGP) is defining it by “green is the design, commercialization, and use of processes & products that are feasible & economical while: reducing the generation of pollution at the source, and minimizing the risk to human health & the environment.” (http://urbangreenpartnership.org/what-is-green/retrieved 080110)
tactic was mainly to stay within the constituted limits regarding emissions, waste, hazardous materials etc. These regulations have during the years hardened considerably, and the awareness of other aspects of environmental effects from different processes has improved the focus on these areas. The managerial realization of that environmental risk are to be found in all layers and tiers of the enterprises supply chain, has changed the view of environmental performance and the actions to take (Walton 1998). This has led to awareness that every action taken by a supply chain participant has the potential to generate negative social or ecological impact and the need of environmental initiatives along the entire length of the supply chain. With a more proactive thinking the focus lies more on value creation through doing environmental favourable actions. There is a growing need for Green Supply Chain Management (GSCM) to handle these issues (Zhu et. al. 2007).

The innovation rate within the electrical and electronic products has to be high as for satisfying the demand from the customers. New technology should be developed rapidly with high quality and shortened lead times. This put high pressure on the supply chain in combination with the demands of satisfying environmental performance. With possession of more international experiences than many other industry sectors the Electrical and Electronic Industry (EEI) is more likely to easily adopt the green thinking at higher levels at the companies hierarchy and creating the foundation for GSCM (Zhu et al., 2007).

What companies can see is that environmental thinking and actions towards becoming green is not just for building a corporate image but also a competitive asset for increased benefits. Actions for becoming more environmental friendly lead to both economical as well as environmental gains. Despite the potential for significant financial gains, most supply chain managers currently do not focus on environmental concerns (USEPA, 2000). This is mainly because of the difficulty to see the direct impact and benefits of environmental initiatives.

Studies show (Rao, 2002) that a majority of the world’s manufacturing will, for several number of reasons, be carried out in Asia in the upcoming decades. This generates a need for a more GSCM-thinking for the companies concerned in order to uphold their competitiveness. The study by Rao (2002) show that GSCM has started to take root among the leading edge companies but it is far from fully spread out among regular manufacturers. Many of the actions are restrained by economic reasons wherefore the necessity of guidance and proof of economic benefits are important for a broader appliance of the concept. GSCM is a concept that is gaining popularity in the South East Asian region. For many organizations in this region it is a way to demonstrate their sincere commitment to sustainability (Bacallan, 2000). Still much work and development is needed.

With the global financial crises occurring in 2008 some might think that environmental concerns in companies are set aside and not as prioritized as they might be in good economic times. A Swedish study show however that the environmental work is intensified during hard economic times (Nutek, 2004). This is in many cases a deliberate strategy for strengthen the company’s competitiveness. Although the same study point out that a certain level of stability in the company is a condition for starting the work in the first place. But when already doing so, high profit does not automatically mean that the companies continue (and develop) or even invest more in environmental work. Therefore the information and numbers that show the actual gains with for instance GSCM, must be made more obvious for the management.
1.2 Objectives and Aim
The objective with this thesis is to clarify the advantages - both economic and environmental - that companies in the Thai electronic manufacturing industry can draw from managing their supply chain and adding a green aspect to it. The research will assist companies with scarce knowledge of green supply chain management in making decisions and priorities in that area. Also play a helpful role for others (eco-consultants etc.) by strengthen the arguments for, and facilitate progress towards, a more ecologically sustainable industrial development in Thailand. Environmental work is primarily not about increasing the income rather than cutting the expenses (Almgren et al., 2008), and this thesis will provide information on how to do so.

1.3 Research Questions
We have formulated specific research questions (RQ) with purpose to support our investigation of the objectives. With these questions we can identify the situation today for the business and to pinpoint what existing studies and theory gives as good practices for GSCM. Also give direction for the comparison and interviews with and between Swedish and Thai companies.

RQ1. In which extent is the Thai industry and market today ready for Green Supply Chain Management according to demands, awareness and cultural identity?  
The present situation in the industry with respect to maturity level and already implemented actions for a green supply will be investigated. Also in which extent management understand, and are ready to meet, demands from customers, suppliers and authorities. Further if the market have high expectations on the producers compliance and if the awareness of existing theory and practices good
Here it is interesting to see how far the industry has come with their environmental work. And in which extent GSCM is understood and practiced today. This in order to later be able to point out in what general areas work is mostly needed.

RQ2. What are the advantages and disadvantages of implementing Green Supply Chain Management in Thai companies?  
This part aims at what management think of (the process) of implementing GSCM and which are the biggest challenges in their opinion. Motivations for these concerns with regard to other studies and/or theory. Additionally investigations of earlier studies in the subject could confirm difficulties that are frequent to appear when implementing GSCM.
This will provide answer to what the companies regard as the main reasons for GSCM and what they see as the obstacles towards it.

RQ3. How do the direct or indirect effects from the implementation of Green Supply Chain Management affect the decision-making in the Thai Electric and Electronic Industry through the process of becoming green?  
Companies in the TEEI that have implemented GSCM can give answer to what they experience as the most distinct effects of it. Additionally if the companies distinguish any (typical) direct or indirect effects on a short- respectively long-term basis.
Through this it is interesting to see how GSCM is regarded at Thai companies and how the application affects the companies at different times.

**RQ4. What experiences can be learnt from the comparison between theories of Green Supply Chain Management and actual implementation in Swedish and Thai companies?**

Existing theory gives some information for what are the most common reasons for implementing GSCM – these may be validated from Swedish successful implementations. And with comparison to the Thai-industry, if there are some major differences in strategies, methods or results from the two countries and/or the theory.

Here it is interesting to see how well the actual implementations of GSCM follow what the theory gives as best practices. Also answer whether the industries in Thailand and Sweden have different reasons for, and approaches towards, GSCM.

**RQ5. Which improvement potential are there in Thai EEI companies with respect to and with the help of Green Supply Chain Management?**

When implementing GSCM in the Thai companies, one should investigate to which extent the environmental and economic gains can be made with regard to today-state. Also in what areas the best combined results (environmental/economical) can be achieved, and the actions needed for this.

Here it is interesting to see with the combined results of other research questions, what potential Thai companies have to improve and gain from GSCM. Depending on how far they have come already.

**RQ6. What benefits come out of the use of Green Supply Chain Management and is this applicable for Swedish as well as Thai industries?**

This will investigate how companies benefit from GSCM implementation and compare these advantages in Sweden and Thailand. Further the balance between economic and environmental sustainability and how this is relevant in the companies’ decision making. These findings can provide answer to how executives value the green aspect versus the economic ones in decision making.

Here it is interesting to see if GSCM yields different advantages depending on which market the company acts on. Also how important the economical dimension of the changes will come into play.

**RQ7. How should Thai companies prioritize the different parts and actions in the supply chain management in decisions concerning greening of the same?**

The Thai companies’ actions in order to maximize the positive effects of GSCM should be studied and in which order these actions should be taken as well as the prioritized areas with regard to today-state.

The RQs could be divided into five main areas of investigation that could provide answer to these out of this thesis. This will show in what way, according to theory and best-practices, the Thai industry must work to become green(er). This could also provide answer on which methods or tools that suits
the today-state in Thailand. Wherefore this will help us in the work of concluding the RQs. Below are these areas listed with their corresponding RQ that should be answered and concluded later on.

- General environmental maturity and awareness in Thailand – RQ1,
- Environmental maturity within the TEEI – RQ1, RQ7
- Comparison with foreign markets and the TEEI considering GSCM – RQ4, RQ6
- GSCM in TEEI today – RQ1, RQ2, RQ5
- Future development of environmental awareness and GSCM in Thailand – RQ2, RQ3, RQ5

1.4 Delimitations

The environmental context of SCM is a wide spread and complex subject and therefore some limitations in the study has to be made in order to easier align the findings with the objectives and aim of the study.

The study will focus on developing and/or manufacturing companies in the EEI. This is based both on the relevancy of investigation in this industry sector as well as the authors background and previous knowledge within the same.

The studied companies, universities and supporting agencies in Thailand are all from the Bangkok region where the majority of Thai industries are located, especially within the EEI. This should give a just overall picture of the EEI in the country.

The matters concerned with traditional SCM will not in this study be discussed more than as a brief introduction within the theoretical framework. These matters concerns inventory levels, lean philosophies and actions etc. This is due to the complexity of the concept and the fact that it will not contribute appreciably to the greening of the supply chain and the environmental performance. In the case of non-existing SCM within a company there may be a need of some further exposition on the subject.

The research is focused on how companies are working with GSCM and the way of managing the environmental issues. The type of product developed or manufactured will not primarily be discussed if it does not have a great environmental impact on the supply chain and the company. Other possible outcomes such as increased health and security as a result of GSCM will not be regarded more in detail than as collateral strengths and an advantage to implement the concept.

The thesis will not result in explicit actions for chosen companies but as an overall view on the industry and as a guide in further work of developing the G SCM for companies in Thailand.

The project is limited to 20 weeks as the standard time frame for a master thesis. Out of the project time approximately 10 weeks will be spent in Bangkok for on-location research.

Energy source, e.g. nuclear or solar power, at the company will not be regarded more than briefly since how to reduce the consumption of energy will be the most important aspect for this study.
1.5 Thesis Structure

This section can serve as a guide for different types of readers based on experience in the subject, also as a summary to facilitate for the reader. For environmental experts and scholars focus should be at the sections objectives, result, discussion and conclusion. For environmental academics with less experience and knowledge but interest in the subject should add the theoretical framework and possibly the method chapter. A reader from the public with interest in the subject should mainly focus on the objectives and conclusions with the theoretical framework as a reference when needed. Of course this type of reader could benefit and are more than welcome to read the thesis in its full length.

Chapter 1 - Introduction

The initial chapter gives an introduction to the subject, both background in the environmental and why this thesis is needed. Further the main guidelines such as aim of the thesis and the research questions that will be the foundation of the research. Finally delimitations are provided that will frame the thesis and make the work-load reasonable and apprehensible.

Chapter 2 – Method

The Method chapter describes how the research are presumed and planned to be performed. The method theory is also presented for the reader to understand the preparation process and why the certain methods were chosen during the research.

Chapter 3 - Theoretical Framework

This chapter will serve as an important foundation to understanding the subject and hence the research result and following discussion. For the inexperienced reader i.e. within the area of the research, this chapter is very important for the comprehension. For experienced academics or scholars the main focus should be result, discussion and conclusions.

Chapter 4 - Results

In this chapter the results found during thesis research are presented. Including description of the respondents and result from the interviews. These will be further discussed in the following chapter.

Chapter 5 – Discussion

The discussion will compare result from research with existing theories from the framework. These are discussed and evaluated. This should provide understanding why the specific conclusions later are drawn.

Chapter 6 - Conclusions

The conclusions are answers to the research questions and the finale of the thesis. These are derived out of the discussion and give clear answers following the original objective.

Chapter 7 - Recommendations

The reader could in this chapter find recommendations on proceedings for the industry that this thesis research has found. Providing a starting point in future work, both for academic research and for industrial development, and also provides suggestions for future research.
2 Method

2.1 Research Strategy

When laying down a strategy for research one must reflect over what subject the thesis is about and what the aim with the thesis is. The choice of method to carry out the research with must be considered since there are several different strategies depending on the character of the task. In what way will data be collected? What type of sources will be used? Will we need to conduct experiments, visit institutions, make interviews or in any other way make some tests? These are questions one can ask themselves to clarify the options.

The strategy for this thesis is to initially brief review what existing theory and other studies in the GSCM-area can tell us about advantages and applications of and with GSCM. This is done in order to get an opinion whether our first drafting of topic is motivated. Here we also formulate our initial research questions which will work as guidance throughout the thesis. Thereafter we start a more extensive literature study with main focus on earlier studies and reports. Interviews and questioners are conducted in order to collect data and input from companies. This will give us a mixture of both primary and secondary data. Both Swedish and Thai companies are involved in this phase. Thereafter analysis of the (primary) data and comparison between the earlier conclusions and our own are made. Finally we conclude our research specific results and present recommendation, for the industry, on how to make use of them in practice.

2.2 Research Method

As the area of investigation is rather unexplored specifically in the chosen region, it is important to try to cover the area in the best way so that the results become valid. A literature study will be performed for us to gain a proper specific knowledge within the subject, in addition to our previous knowledge attained from the university courses. Literature will be sought among published documents and reports from scholars and universities worldwide, but also governmental and non-governmental projects or studies. The literature study shall provide enough knowledge and become the base for the later interviews. The literature should be carefully studied and relevancy and objectivity is important to keep in mind (see 2.5).

To get a good overall view of the situation in the industry a qualitative analysis is convenient (Starrin & Svensson 1994). This will result in a foundation for further studies in the area and a deeper scientific quantitative analysis in the future. Qualitative methods aims at investigating the why and how of research instead of calculating exact figures. In simplified terms qualitative means a non-numerical data collection which the research analyses. An investigation of this kind benefit from working together with the partners who will make use of the results in the end, since the study will map their progress and difficulties e.g. and try to facilitate development according to this. In our case these partners are primarily actors in the electronic industry in Thailand and Eco Design Consultant Co., Ltd.
Our research questions gives us an indication of that in order to collect the data we need to be able to answer them, a literature study, revision of earlier studies and interviews are needed. Characteristic to a qualitative method is that the research focuses on existing important results (from literature, other research etc.) with regard to the ideas of subject, rather than letting large statistic numbers and similar be a lodestar. The questionnaire design/interview sheet will not be of character of a large statistic project rather a method to get a better overall picture of opinions and prioritizes. Therefore a quantitative method will not be of interest as far as we can tell when choosing method. This thesis will consequently focus on qualitative results for the companies involved.

Some of our research questions are of character to be comparative (between Swedish and Thai companies). The data from Sweden will be attained from a questionnaire survey performed within the SEEI (see 2.4).

2.3 Interviews
The interviews fill an important role in order to gather information both on the today-state with GSCM in Thailand and both on managements view on the tasks ahead. For this purpose semi-structured interviews are planned. Semi-structured interviews mean that the interview is more like a conversation following a thread and with some specific questions to answer. Rather than a fully-structured interview for which can best be described as an oral questioner – questions are asked and answered in a specific order with little or no room to deviate (Fao) This gives us more flexibility within the interviews, which is important since the respondents will not all be of the same character rather than from different positions at companies and organizations.

With interviews as a method for gathering information and data, some pros and cons are obvious. To mention a few is the fact that the questions can be explained more in detail for the person answering them, compared to if a questionnaire is answered alone. But also the interviewer can accidentally influence the respondent with leading questions or body-langue etc. (Starrin & Svensson 1994). Another gain with interviews is that follow-up questions can be asked directly accordingly to how the interview progress (Nordin, 2006). Matters with difficult questions with respect to personal integrity should not be a problem in our case since the topic and questions are not personal in any way. This could otherwise be a problem.

During the interviews at least one of the authors of this thesis will be present at all time. Although this is strength rather than if someone else held the interviews, confusion of languages and cultural differences regarding how to communicate certain things are apparent. No obvious solution of this is to hand but it is important to keep the cultural and linguistic differences in mind.

2.3.1 Preparing the Interviews
The questions we intend to ask follow an overall pattern as; introduction of the interviewee, some questions of the general environmental awareness in the country, more specific questions in the GSCM-area as well as environmental development, and finally some further questions on the future development. As mentioned the specific questions are personalised with regard to the respondents position/assignment and to what the discussion lead to.
To decide which questions to ask we will look at our RQs and set up questions with aim to answer them directly if possible (see 2.6). Follow-up questions are not directly formulated in print rather than prepared by us in our heads since we will do semi-structured interviews and be able to follow the discussion accordingly to what the respondent answers. Some RQs will probably need more than one question at the interview to be answered.

2.3.2 Setting up the Interviews

Every interview will start with a brief review of the person who was subject to our questions. This was made in order to present that persons qualifications and to get an understanding of his or hers expertise. Additionally it will be interesting for validity of the answers later on. Thereafter some questions regarding the general environmental situation and work in Thailand will be held. Depending on the subject and how well the discussion progressed, we will later move on to more specific questions designed for that person.

When interviewing a professor in the subject of for instance the most common environmental problems for the industry then the answers could differ from the ones given by a representative from a company. Therefore it is good to analyses who has said what, and not just sum all of the answers and handle them regardless of their source.

2.3.3 Documenting the Interviews

All the interviews will be recorded on a digital voice recorder. This will help us later during the analysis of the answers. In most of the interviews additional notes will be taken to emphasize the essence of the respondents’ thoughts. Every participant will be asked to agree to have the interview recorded.

2.4 Questionnaire

A questionnaire is a good way to collect data from both small and larger groups. It is an easy method to use and the results are favourably handled for instance statistically. When constructing a questionnaire some things are important to recognize. First one must of course establish what the purpose with the questionnaire is. That in order to decide which questions are to be asked in order to answer the (research) questions one might have. If the questions asked are to complex the respondent might not understand them correctly or the answers might be hard to handle. The method of distribution and handling of data is also necessary to reflect at (Simmons 2001). Which method to reach the respondents and the form of the questionnaire is decided mostly from the type of respondent one is focusing on. For instance do the respondents have access to the Internet and are they probable to feel comfortable to answer the questions via computer? If the questionnaire is to be done by the respondents without any support from the author, then it is all so important that the form and formulation is easy to understand. If the respondents have not volunteered to the questionnaire rather than been asked to fill it, would that be a risk that the respondents will not have time for more than a short questionnaire?
Some further weaknesses with using a voluntary questionnaire could be that only those who feel comfortable to answer the questions are the ones that will respond. And therefore the answers will only reflect some part of the group. This is of course more relevant to postal questionnaires. Another matter that needs to be considered is if there is a risk that different respondents and the author interpreter meaning of words or questions differently.

On the strong side then a questionnaire enables the researcher to gather information from many people (sources) at the same time (Walonick 1993). The same questions are asked to many people and therefore the answers yield some data which have high reliability to the research and it easily can be quantified. Provided that the questions are easy to understand and no room for individual interpretations is at hand. Also it is possible to ask questions with anonymous respondents which considerate the privacy of the respondent (more than an interview).

With these comments in mind and the type of questions and respondents we chose to have for this part of our thesis, we chose to do a web based questionnaire for some Swedish companies. The web based platform will help us handle the data in a smooth manner as well as distribute the questionnaire.

When seeking respondents we will use the Internet to search for companies who have their business in the electronic and electric industry. No greater consideration to the companies’ size is to be taken. This since the basic theories and concept of GSCM still applies no matter the size of the company. We will design the questionnaire as a semi-structured one, meaning that it contains both closed and open-end questions that could provide a greater depth than fully structured counterparts. These should preferably be used, as in this research, when there is a need for the combination of quantitative and qualitative data\(^2\). This meaning that we will have both open-ended and closed questions. The questions we would like to answer calls for this and therefore a semi-structured form suite us well.

### 2.4.1 Preparing the Questionnaire

The questions for our electronic questionnaire will require a little more precision than for the interviews. This since we will not get an as easy chance to ask follow-up questions as during the interviews. When formulating the questions we will see which RQs that have direct relevancy to comparing the Swedish companies to the Thai companies. And if some RQ is in need of comparison or reference to other (read Swedish) market/company. Some closed questions are given specific suggestions to answer – multiply-choice – and those suggestions are formulated accordingly to what other research already has found as the most common answers for a similar or same question. This in order to avoid “inventing the wheel” again rather than focusing on how the respondents prioritize. Of course the respondent will get the chance to present an own answer if none of the suggested ones fit their profile. Some RQs probably need more than just one question to be answered.

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2.5 Relevancy and Objectivity

Personal values affect the conception of what could be a relevant question, fact or solution in a context. All earlier studies that have been made have been affected by the values the writer(s) had during their work. This is important to keep in mind when both reading others and writing your own material. One must always reflect over what might have been the authors purpose with a text or if there are some organizations behind it. A writer with connections to a certain company might not be as objective as one might ask, and therefore that source is to be critically evaluated if included. Also the sources and data that are referred to must be of relevance to the thesis. That could mean that e.g. variables and connections must be relevant to the study.

Although any author has a personal opinion regarding the subject of his thesis, a neutral attitude towards facts is a must. Not to suppress or over-emphasize certain facts (Eriksson & Wiedersheim-Paul, 2006).

2.6 Strategy to Answer the Research Questions

Here we present a brief description on how we expect to answer the research questions. This is the intended strategy for each RQ. If some major details and facts appear in other sources than the expected one, then nevertheless that will be used to answer the RQ.

**RQ1. In which extent is the Thai industry and market today ready for Green Supply Chain Management according to demands, awareness and cultural identity?**

We aim to attain a picture of the today-state with respect to (carried out) adjustments of their supply chain towards a more green management, through available newly produced reports and our own interviews. By primarily using our interviews at the Thai companies to search an answer. This RQ does not get answered only by asking it to one company. The need to combine the results from many interviews and perhaps especially what scholars say is therefore essential. Other research from the region also hopefully will help in painting a more general picture of the situation.

**RQ2. What are the advantages and disadvantages of implementing Green Supply Chain Management in Thai companies?**

An inspection of literature from other existing studies is done in order to seek possible similarities and see if there are any translatable conclusions for the Thai industry. If any is suspected, this is then controlled during the interviews with the respondents. The interviews play an important role here as well. The companies own idea of what for instance the biggest obstacles for GSCM are, will be handled during the interviews. The literature study will give us what is considered as general advantages and disadvantages. And combined with the interviews that will present a picture of the same in the Thai industry.

**RQ3. How do the direct or indirect effects from the implementation of Green Supply Chain Management affect the decision-making in the Thai Electric and Electronic Industry through the process of becoming green?**

Some research has already been made by others regarding how the leadership affects the process towards GSCM. With these studies we can compose a table of result which answers this question. Again the interviews will give us answers from the companies in Thailand directly on how they look at
these matters. Through a questionnaire Swedish companies will be asked of their opinion on what the direct/indirect gains of GSCM are. This in order to get a reference to what the theory and Thai companies says. Most significant for answering this Research Question will be the interviews at the Thai corporations.

**RQ4. What experiences can be learnt from the comparison between theories of Green Supply Chain Management and actual implementation in Swedish and Thai companies?**

When comparing the results from our interviews in Thailand we will have a picture of how their implementation of GSCM is. Thereafter we compare it with the theory we have got and possible with the Swedish reference study and see whether something is different and/or can be explained with help of that. This RQ is expected to be fully answered late in the process of this thesis since the theoretical base is first to be set through literature study etc. Then complete and handle the data from the questionnaire and the interviews and thereafter see what conclusions can be drawn.

**RQ5. Which improvement potential are there in Thai EEI companies with respect to and with the help of Green Supply Chain Management?**

This question is solved with the literature- and other research study to see what one can agree on is the best-practices. The interviews and earlier research questions give us a picture of the today state, which is needed to plan and prioritize the adjustments and action needed to have a GSCM. The literature study will provide us with probable advantages and improvements with GSCM. Combined with the today state (including ambition, maturity etc.) that will give what potential the industry has to improve and gain from GSCM.

**RQ6. What benefits come out of the use of Green Supply Chain Management and is this applicable for Swedish as well as Thai industries?**

Depending on the earlier research questions we will see at what level of maturity and what commitment Thai companies have of and to GSCM. The literature study, our reference study and our Thai study will altogether help answering this question. With mostly get the benefits from other literature, and the level of application to the Thai- and Swedish industry from the interviews and questionnaire. Especially the results from RQ5 are interesting here as well.

**RQ7. How should Thai companies prioritize the different parts and actions in the supply chain management in decisions concerning greening of the same?**

Theory and best-practices from literature studies of previous research and cases will show how the best prioritizes can be made. The interviews and study in Thailand gives the today-state of the industry and together this will help us answer this question.
3 Theoretical Framework

3.1 Thailand

The kingdom of Thailand, officially known as Prathet Thai or Muang Thai, is situated in the heart of South-East Asia with approximately 64 300 000 inhabitants (Landguiden, 2008). The capital and largest city of Thailand is Bangkok. The city is also the country's centre of political, commercial, industrial and cultural activities.

The economy in Thailand has grown rapidly since the end of Second World War with modern industries and gradual increase of the standard of living. "The Thai economy is largely dependent upon agriculture, industry and services, with the main income earners being manufactured goods, rice and other agricultural products, fisheries, minerals and tourism." (APCEL Report: Thailand). The country transformed during a couple of decades from mainly agricultural society to one where manufacturing and export of goods is making the growth rate high. Production consists mainly of cars, clothes and electrical products. Of these are the electrical and electronics industries since 1994 the most important export sector of the country. The main economic principles are built upon market economy and free trade. The modernization of the economies has pushed the wages to higher levels and the competition from other Asian countries such as China is increasing.

Despite the high growth rate still more than half of the people in Thailand living in rural areas, at the same time the rate of immigration to the cities are increasing. Most of those are moving into Bangkok with surroundings which is the only big city in the country and where most of the industries are located. The city and closest surroundings are suitable for industrial purposes since the area has a higher rate of educated labour than rest of the country, which is a general problem in Thailand (EEI, 2007). Only one out of four is participating in any higher education even though large investments have been made in education in recent years. This is an increase but still not enough to cover the demand for higher education in the industry. Still the development is going in the right direction and the rate of people that are able to read is among the highest in Asia (Landguiden, 2009).

In the end of 20th century the Thai economy was severely damaged by the Asian crisis and about 20(000) factories were closed. In the last few years the economy, industry and export have slowly recovered just to find themselves in the new global financial crisis in 2008. Thailand was one of East Asia's best performers from 2002-04, averaging more than 6% annual real GDP growth (CIA - World Factbook, 2009). Following this the export in Thailand decreased substantially.

3.2 Thai Electrical and Electronics Industries

Like the rest of the economy in the country, Thai electrical and electronic industries (TEEI) have developed much since the middle of the 20th century. This industry sector in Thailand has been a major driver of export growth for the country and the sector has seen substantial growth in recent years. Products that initially were imported from Japan and Taiwan are now produced in Thailand. The development in the TEEI is above all due to great investments from Japan, South Korea and Taiwan to mitigate the high production costs in the countries. Today goes almost half of the total
annual exports to Japan, the US and EU. Out of the total export more than 40% is related to Electrical and Electronic Equipment (EEE) (EEI 2007). The rest of the export goes mainly to China and Association of South East Asian Nations (ASEAN) countries.

According to Thailand Electrical and Electronics Institute (EEI) the EEE sectors consist of about 2 360 factories, with 534 000 employees (2007). These are to a great extent consisting of Thai entrepreneurs with small electrical businesses, foreign entrepreneurs with small to medium sized electronics businesses, whilst the medium to large sized electronics business are most often joint ventures between Thai and foreign investors. Over 60% of the employees within the sector are employed by larger companies i.e. companies with over 200 employees or over 6 million USD in assets for manufacturing (APO 2008).

The consumption of EEE has increased rapidly over the years since the financial crisis in the beginning of the 21th century. The waste management of these products at end of life (EoL) is close to non-existing. Some waste management concerning cathode ray tubes are systematic. The most EEE such as household products and home appliance are dismantled at the end of life phase by informal collectors with saleable parts needed by material recycling businesses. Defective products in factories are often destroyed and sent to landfill.

### 3.3 Environmental Legislation Affecting Thai Electrical and Electronics Industry

The currently existing environmental regulation and legislations in Thailand are compared to the ones in EU and Japan quite few and harmless. Compliance of foreign regulation is what most companies relies on for the ability of export to foreign customers and their demands. Main adjustments for Restriction of Hazardous Substances (RoHS) and Waste Electrical and Electronic Equipment (WEEE) directive have been made according to EEI (2007). But the burden is extensive especially for Small and Medium Sized Enterprises (SME). The main efforts are put on adjustments to RoHS more than design for recycling in compliance with WEEE.

Adjustment to the legislations remains difficult since proof and monitoring of compliance, new material quality and reliability testing are hard to regulate without proper certification bodies. Time and resources are also difficult matters as always with expenses and whom these are credited. Another big problem in Thailand is that personnel with knowledge in the environmental legislation areas often gets poached by larger companies enticed by higher wages (EEI, 2007). Leading to the small and medium size enterprises (SMEs) missing the crucial knowledge.

According to the Country Report on Thai Electronics sector (EEI, 2007) most of the demand of compliance with regulation in Thai companies comes from mother companies abroad. This implies that many companies within the first tier of suppliers will be driven by these demands. Following the

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3 The Association of Southeast Asian Nations (ASEAN) was established on 8 August 1967 with the signing of the ASEAN Declaration. The association consist today of ten member countries from the region and aims at stimulating economic growth, active cooperation, assistance, regional peace and stability. (ASEANWEB, http://www.aseansec.org/about_ASEAN.html visited on 250110)
chain to the second tier the compliance decreases dramatically. This compliance will though drive some of the environmental work such as need of certification, audits and documentation. The Thai government is aware of the need of sustainability to create competitivenes in the global market (EEI 2007). Both short- and long term projects in several different areas concerning environment and sustainability were initiated by the Thai government in 2005.

3.3.1 Waste Electrical and Electronic Equipment Directive

The Waste Electrical and Electronic Equipment (WEEE) directive is based on producer responsibility (European Commision). By promoting reuse, recycling and recovery of parts and materials the environmental impacts of WEEE treatment can be reduced significantly. Key aspects of the directive are producer responsibility, provide consumers with EoL procedures, dismantling information, hazardous substances in the product and provide governments with information about sales, take-back and recycling. The directive concerns ten product groups from household appliances and electronic tools to medical devices. In Thailand the directive is mainly reflected in the imported quantities of WEEE. According to official statistics there were 2 million tons of WEEE imported to Thailand between January and September 2005 and 1,200 tons between January and May 2005 (EEI, 2007). The large quantities of imported WEEE place a great burden on governmental measures and control. As mentioned earlier Thai industries put less effort on the WEEE compliance compared to those legislations easier to be measured and supervised by national and foreign customers.

3.3.2 Restriction of the Use of Hazardous Substances in Electrical and Electric Equipment Directive

RoHS aims to limit the use of hazardous substances which impact the environment (Directive from rohs.eu). The restriction covers the same categories of products as the WEEE directive. Substances as lead, mercury, cadmium should be replaced with minor exempts. 2004 a voluntary network called Thai RoHS Alliance was established. Participating SMEs could use the network to reduce efforts of implementation and general guidelines concerning RoHS. The majority of Thai producers claim to be familiar with the concept and to be RoHS compliant, great obstacles can be found in the adjustment process. Costs are high while technology and materials information is missing. In May 2006 84% of responding companies were aware of RoHS (EEI, 2007). Still there were almost the same amount of companies in need of help in any form i.e. training, consulting or further information regarding RoHS.

3.3.3 Energy-Using Products Directive

The Directive on Eco-Design and Energy-using Products (EuP) was announced by the European Commission in August 2003. The directive covers all products, parts and components that consume energy of all types. (Eur-Lex) Manufacturers and developers in Thailand are not very well informed of the directive. A survey from 2006 show that almost half of the companies did not know of the directive (EEI 2007). With only an alarming 8 % had sufficient information. Exporters in Thailand are
to a great extent familiar with the CE mark\(^4\) that certifies consumer safety, health and environmental requirements. What is mainly missing is the use of eco-design and energy efficiency requirements as well as the refined tools to perform these tasks as stated by Samuelsson (2008). Energy efficiency requirements are compulsory for some product categories in Thailand but cover far from all EuP.

### 3.3.4 Other Legislation and Regulations

The legislation from foreign countries is naturally mostly affecting the export companies in Thailand. Some additional national environmental legislation exists such as the Enhancement and Conservation of the National Environmental Quality Act and Industrial Standards Act (EEI 2007). Though these acts today fulfil the purpose it lacks the details to regulate the specific industries such as the EEI. The existing environmental legislation is aiming at conserving Thai environment by general regulation but is not sufficient and easy to come around if needed. Legislation adjusted to suite the Thai EEI with the most possible compliance to the above mentioned foreign directives. Another great need is regulations and guidelines for recycling, waste management and take-back, also including re-manufacturing and re-use. These actions which are today close to non-existing and creating large problems such as landfill, release of hazardous substances and other emissions.

### 3.4 Supply Chain Management

Competition is steadily increasing along with the globalization of the world market today and relationships with suppliers and customers are becoming more important and with growing expectations. According to this and demands of efficiency SCM has grown to play an important role in western countries and companies management since the 1990’s. The term Supply Chain Management first appeared as an inventory management approach with emphasis on the supply of raw materials. At that time it mostly included the management of inventory but as realization of the competitive significance increased the interest grew large as well as the complexity. Today there is an almost endless list of documented texts where definitions of Supply Chain Management (SCM) occur and libraries could be filled with adequate literature. Therefore it is hard to define the core philosophy of SCM into a shortened and brief text. When defining only the supply chain it is easier and more straightforwardness appropriate definition of the supply chain is the one by Mentzer et al. (2001): "A set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer". The SCM should therefore be the management of these activities. The supply chain is something that always just exists in businesses, while the supply chain management is a complex matter and demand great efforts from the organization within the supply chain (Mentzer, 2001).

Further the CSCMP is defining the managing part of the supply chain (SCM) as: "Supply chain management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third

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\(^4\) CE marking is a declaration by the manufacturer that the product meets all the appropriate provisions of the relevant legislation implementing certain European Directives. CE marking gives companies easier access into the European market to sell their products without adaptation or rechecking.

(What Does CE Marking Mean? – Department for Business Innovation and Skill)
party service providers, and customers. In essence, supply chain management integrates supply and
demand management within and across companies.\(^5\)

The traditional supply chain is founded on the order fulfilment process through the operative relation
between supplier and customer. The demand from customer occurs and creates a reaction through
the supply chain that will result in the product manufactured or delivered from warehouse to
customer.

\[\text{Figure 1 - The Traditional Supply Chain (Beamon 1999)}\]

During recent years demands and conditions for the supply chain have changed for manufacturing
and distributing companies. The core competencies are kept within the companies to focus the
business on what they know best. The result of this is that all other activities are, when possible,
outsourced. Following this many more firms are involved in the development process of the product
and this increases the demands on the supply chain and management of the different activities
within. The traditional SCM focuses primarily on the following tasks (Beamon, 1999)

- Production/distribution scheduling: scheduling the manufacturing and/or distribution
  schedule.
- Inventory levels: determining the amount and location of every raw material, subassembly,
  and final assembly storage.
- Number of stages (echelons): determining the number of stages (or echelons) that will
  comprise the supply chain. This involves either increasing or decreasing the chain’s level of
  vertical integration by combining (or eliminating) stages or separating (or adding) stages,
  respectively.
- Distribution centre (DC) - customer assignment: determining which DC(s) will serve which
  customer(s).
- Plant - product assignment: determining which plant(s) will manufacture which product(s).
- Buyer - supplier relationships: determining and developing critical aspects of the buyer-
  supplier relationship.
- Product differentiation step specification: determining the step within the process of product
  manufacturing at which the product should be differentiated (or specialized).
- Number of product types held in inventory: determining the number of different product
  types that will be held in finished goods inventory.

\(^5\) Definition by CSCMP, http://cscmp.org/aboutcscmp/definitions.asp retrieved on 300909
The results from adopting SCM are impressive and show great improvements of efficiency and cost savings at numerous companies (Stadtler 2007, USEPA 2000). These measurements are what the traditional SCM aims at and been developed to achieve. In some ways, like the lean concept of minimizing waste connected with SCM, this may result in increased environmental performance. Some aspects are though missed when environmental demands are looked upon like cost accounting systems that often hide the frequency and magnitude of the environmental costs that companies incur. Therefore the new concept of an even further extended supply chain is needed when adding the environmental demands - Green Supply Chain Management.

3.5 The Concept of Green Supply Chain Management

With new environmental demands from both customers and legislation the extension of the supply chain is necessary. The development need to be beneficial for the industry and at the same time create a sustainable environmental development to symbiotically co-exist. The challenge started about a decade ago by redefining the supply chain to the extended version. The traditional supply chain focuses mainly on minimized costs while performing a high customer satisfaction and service level. These increasing demands have led to a mature SCM and increased economic performance. The globalization and need of competitiveness is today handled with SCM. The need and interest of Industrial Ecology\(^6\) (IE) and Environmental Management\(^7\) (EM) is continuously increasing among companies and industries as well as the end customer. This has given a market where organizations and companies are now held responsible for the environmental and social performance of their suppliers and partners. These pressures are derived from a number of internal and external sources including employees and management, socially aware organizations, communities, governments and NGO's (Zhu et al., 2006).

Greening supply chains aims to balance marketing performance with environmental issues (Zhu & Cote, 2004). This produces the tasks to handle challenges such as for instance energy conservation and pollution abatement, with coexisting economical performances. GSCM is strongly related to inter-organizational environmental topics such as IE, product life cycle analysis (LCA)\(^8\), producer responsibility and industrial eco-systems. Simultaneously it is also in the range for ethics and sustainability concepts where environmental concepts are incorporated with social and economic influences. This so called triple-bottom-line (see Fel! Hittar inte referenskälla.) is recurrent within the literature and an important aspect of the GSCM and its practices. Defining the concept of GSCM is hard since the range is wide and the boundaries often dependent on the goal of the investigator (Zhu et al., 2005). It is ranging from green purchasing to integrated environmental supply chain management through supplier, manufacturer, customer and reverse logistics. Srivastava (2007) who classifies existing literature on the subject defines GSCM as "Integrating environment thinking into supply chain management, including product design, material sourcing and selection, manufacturing processes, delivery of the final product to the consumers, and end-of-life management of the

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\(^6\) Industrial ecology is an ontology of the idea of combining environmental, economic and business related theories at a problem, with goal to have a sustainable development.

\(^7\) Environmental Management refers to management of a business or similar with its impact on the environment as a reference to decisions etc.

\(^8\) LCA is a process for summarizing resource and environmental consequences for each functionally vital activity occurring from the cradle to the grave of the product or service investigated (Samuelsson 2008)
product after its useful life”. This means an environmental focus throughout every part of the product life cycle as well as every stage of the supply chain. The life cycle view is nothing new but integrating it with SCM gives a new dimension to the issue. A lack of system perspective is one major reason why companies in the industry in Thailand do not act more distinctly for GSCM (Setthasakko 2009). The profit has a higher value to the companies rather than environmental and social responsibility and the negative impacts their industry has outside the factories is not recognized. These findings are likely to apply to the TEEI as well.

Figure 2 - The Triple Bottom Line (ESRU, 2009)

Some changes, often connected to source reduction and disposal/reuse, are best performed in the early phases of a product's life cycle – the design phase. For an existing product the cumulative costs of making changes late in the life-cycle are much higher than in the early stages (see Figure 3). Also the potential to do so (change material etc.) can often be substantiality reduced the longer from the design phase the product is.

The procedure for handling environmental issues differs of course depending on which area one look at and with which level of ambition one has. For instance, if a company makes efforts regarding waste and disposal issues, then those actions of course are the solution of the “waste-problem” on a short term. In order to make a difference in the long term and ensure that the “waste-problem” does not have to be handled on a regular basis, then actions and appropriate decisions on a strategic level in the company is required. Preferably in the areas of source reduction since this will affect downstream disposal issues (LMI, 2005). This highlights the importance of seeing the SC as whole chain. Some problems and/or costs are inevitable transmitted through the chain if not taken care of. Both upstream and downstream must be regarded since costs somewhere in a company or corporation effect the whole business. Sub optimization is to be avoided. Keep in mind that the business goals still lead the process and the green supply chain work is to align with those (LMI, 2005).
3.5.1 Motives for Green Supply Chain Management

"A number of companies have worked with suppliers to eliminate unnecessary packaging and reduce hazardous materials quantities. Some companies are significantly improving both their environmental profile and profit margins by taking a strategic approach to purchasing." (USEPA, 2000)

There exist several drivers both internal and external for an organization to implement GSCM. As written in the manual by APO (2008) whatever the reasons are of starting to implement environmental thinking into the supply chain the focus areas should be the same. New Zealand Business Council for Sustainable Development (NZBCSD) describes in their report (NZBCSD 2003) these three areas as central:

- Improving the performance of the business's own operations
- Ensuring that the goods and services provided by suppliers are sustainable and working with suppliers to increase efficiency and competitiveness.
- Working effectively with customers and sales channels to design sustainable products and services.

The National Environmental Education & Training Foundation (NEETF) is further separating the internal and external general motivations. The main primary categories from their studies are concerning risk management, regulatory stance, enhanced brand image, international purchasing restrictions and customer pressure (Green Business Network, 2001). NZBCSD (2003) describes the same main categories with slight differences as adding improved efficiency and emphasizing the cost reduction even more.
Table 1 - Motivations for GSCM (Green Business Network 2001)

<table>
<thead>
<tr>
<th>Primary motivations</th>
<th>External motivations and possible effects</th>
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</thead>
<tbody>
<tr>
<td>Internal motivations and possible effects</td>
<td>Enhanced brand image</td>
</tr>
<tr>
<td>Risk management</td>
<td>Customer pressure</td>
</tr>
<tr>
<td>• Supply interruption</td>
<td>• Often appears in conjunction with a threat to brand image</td>
</tr>
<tr>
<td>• Long term risk to human health and the environment</td>
<td>• Frequently focused on high-profile brands</td>
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<tr>
<td>• Competitive disadvantage</td>
<td></td>
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<tr>
<td>External motivations and possible effects</td>
<td>International purchasing restrictions</td>
</tr>
<tr>
<td>• Desire to go beyond compliance</td>
<td>• Eco-labelling and product take back gaining momentum</td>
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<tr>
<td>• Suppliers knowingly or unwittingly provide materials containing problematic substances</td>
<td>• May drive the creation of systems for collection</td>
</tr>
<tr>
<td>• Supplier non-compliance poses production risks</td>
<td>• Frequently focused on high-profile brands transport, disassembly or recycling</td>
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<tr>
<td>Regulatory stance</td>
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<tr>
<td>• Desires to go beyond compliance</td>
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<tr>
<td>• Suppliers unknowingly or unwittingly provide materials containing problematic substances</td>
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<tr>
<td>• Supplier non-compliance poses production risks</td>
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<tr>
<td>Secondary motivations</td>
<td></td>
</tr>
<tr>
<td>Cost reduction</td>
<td>Increased innovation</td>
</tr>
<tr>
<td>• As suppliers apply pollution prevention</td>
<td>• Can result from supplier participation in new product development</td>
</tr>
<tr>
<td>Enhance quality</td>
<td></td>
</tr>
</tbody>
</table>

The extensive Aberdeen study from 2008 (Shecterle & Senxian 2008) over companies started to implement environmental initiatives into the supply chain show that the top five pressures driving the GSC are:

- Desire to be a thought leader for green/sustainability
- Rising cost of energy/fuel
- Competitive advantage/differentiation
Theoretical Framework

- Current or expected government compliance
- Rising cost of inbound and outbound transportation

A corresponding Swedish study (Almgren et al., 2008) show that the most common drivers among Swedish companies for improving the environment areas are authority’s demands/legislations (~55%). In Aberdeen the legislation-factor was 31%. A third study from Dubai (Rettab & Ben Brik, 2008) gives that “Local Governmental regulations” is ranked second most important (50.7%) as insensitive for green supply chain concerns. As a comment to this could be said that in the Swedish report *Det lönsamma miljöarbetet* (The Profitable Environmental Work) (NUTEK 2004) the authors say that companies who start their environment work due to competiveness or to meet customers’ demands, have had a better development when it comes to employment and economic growth, than those who does so due to authorities demands etc. These results come again in many other studies.

Summarized motives may change both considering trade of the company as well as the maturity of the environmental work as described in the Aberdeen (2008) study. The motives should reflect the organizations unique challenges and opportunities and a program may be developed out of this. This challenge is developed further in section 3.7 on how to create a green supply chain.

3.6 Creating a Green Supply Chain

There exists no absolute truth of how to develop a green supply chain. Several authors though give recommendations on the actions to perform to best adjust the existing practices. The emphasis differs depending on the supply chain and company character (Zhu et al., 2007). The difference is also significant, as mentioned earlier, depending on the author and investigation aim.

Greening of the supply chain can be divided in four parts as suggested by Rao and Holt (2005) where the performance should be measured and considered:

1. Inbound logistics;
2. Production or the internal supply chain;
3. Outbound logistics;
4. Reverse logistics, where supply chain stakeholders are working together to reduce or eliminate adverse environmental impacts of their activities.

Different actions should be considered in the different parts and somewhat depending on the character of company and their supply chain. Another view on the environmental initiatives is presented by Zhu et al. (2007) who divide the GSCM into five practices, which exist within the SC. The practices have a cross functional connectivity and overlap; they are integrative and often hard to decompose. Notwithstanding they can be important to highlight since the work on becoming green need a primal focus among these. The five practices are:

- IEM - internal environmental management
- GP - green purchasing
- CC - customer cooperation
- IR - investment recovery
- ECO - eco-design
In a survey of the Chinese industry sectors the EEI attained relatively higher level of GSCM implementation, especially in the practices of IR, GP and IEM. The authors (Zhu et al. 2007) argue that this may be due to greater pressure during export of products or cooperation with foreign companies. Continuing this linkage to foreign international supply chain may create understanding, knowledge and awareness. With this knowledge the Chinese manufacturers could improve adoption of GSCM practices to green their operations as well as reducing costs. The survey further shows the importance of internal management and support by top level management since all industry sectors in China except automobile industry have the highest mean value on IEM i.e. with the most importance to GSCM progress. These findings should cohere with the Thai industry, or at least what it is developing towards. Still there are several models with guides on how to green your supply chain. Asian Productivity Organization (APO) suggests that: “Once an organization decides to implement GSC, it should identify environmental issues (and impacts) along the supply chain and investigate opportunities for improvement.” (APO 2008).

The GSCM-model below is a collection of several of these guides integrated and adjusted to fit the Thai industries. The model is based on theories, actions and suggestions from the Green Productivity and Green Supply Chain Manual (APO 2008), NZBCSD (2003), Zhu et al. (2007), Beamon (1999), Brody et al (2008) and USEPA (2000).

3.6.1 The 5 step Green Supply Chain Management model

The composed model for this thesis, presented in Table 2, is derived out of the literature review from several authors’ previous work and research. The main frames and theory when developing this model comes from APO (2008), Beamon (1999), Brody & Ben-Hamida (2008), Green Business Network (2001), NZBCSD (2003) and USEPA (2000). These are all suggesting ways to develop an organization’s supply chain. What the previous research are missing is to deliver a general model for the whole supply chain and every maturity of company. Out of their suggested actions for greening the supply chain this model is composed. All of the actions in this model are from the research mentioned above but without prioritizing further the suggested actions are those assumed to best fit the Thai market. Many of the suggested actions are mentioned in more than one of the previous reports, although it may not be the exact words. When this occurred we rephrased or chose the one easiest to understand. Since the framework for the models are a literature review further and deeper investigations may be needed. The literature of previous research are not placed in order of precedence or ranked and hence the actions inherit this mutuality. The model is considered to work as a general guideline for TEEI companies willing to undertake the task of greening their supply chain. As can be seen, the model is quite brief and not detailed it must be reviewed to suit the company implementing the same. This is not a perfect model and as said may be reviewed prior to use. It will though work as a good foundation for companies in Thailand willing to change and implement these ideas within their organization. Since the model is not yet tested some changes could even be necessary for using it properly. This is also mentioned further in the section of recommendations (7.1 Recommendations). The additional information in section 3.7.2 and 3.7.3 on understanding the model and opportunities may be suitable for those that aim at using the model for help in GSCM implementation.
Table 2 - The 5 Step GSCM Model

<table>
<thead>
<tr>
<th>5 steps GSCM-model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1) Identify</strong></td>
</tr>
<tr>
<td>i) Form a team with an executive leader for the GSCM initiatives</td>
</tr>
<tr>
<td>ii) Collect supply chain information/data</td>
</tr>
<tr>
<td>iii) Map your risks</td>
</tr>
<tr>
<td>iv) Know where you stand</td>
</tr>
<tr>
<td>v) Review materials management practices</td>
</tr>
<tr>
<td><strong>2) Plan</strong></td>
</tr>
<tr>
<td>a) Opportunities</td>
</tr>
<tr>
<td>i) Identify opportunities</td>
</tr>
<tr>
<td>ii) Look at industry best practices</td>
</tr>
<tr>
<td>iii) Setting targets</td>
</tr>
<tr>
<td>b) Prioritize</td>
</tr>
<tr>
<td>i) Generate GSC options</td>
</tr>
<tr>
<td>ii) Evaluate options</td>
</tr>
<tr>
<td>iii) Prioritize options</td>
</tr>
<tr>
<td><strong>3) Decide</strong></td>
</tr>
<tr>
<td>i) Implementation plan</td>
</tr>
<tr>
<td>ii) Decision making tool</td>
</tr>
<tr>
<td>iii) Select approach</td>
</tr>
<tr>
<td><strong>4) Implement</strong></td>
</tr>
<tr>
<td>i) Implement changes according to plan</td>
</tr>
<tr>
<td>ii) Market progress</td>
</tr>
<tr>
<td>iii) Training, awareness and developing competence</td>
</tr>
<tr>
<td>iv) Get everyone involved – internally and externally</td>
</tr>
<tr>
<td><strong>5) Monitor</strong></td>
</tr>
<tr>
<td>i) Monitor and assess</td>
</tr>
<tr>
<td>ii) Management review</td>
</tr>
<tr>
<td>iii) Establish audit and improvement procedures</td>
</tr>
</tbody>
</table>

The circle in Figure 4 represents the five steps in the continuous work of greening the supply chain with the 5 step GSCM model. These origin from The Green Productivity and Green Supply Chain Manual (APO 2008) and should therefore suit the TEEI well. Still it is a very general model and good way to develop in many types of trades and organizations. What APO misses is a something that visualizes the continuous improvement, even though it is mention as an important aspect and the last step in their manual. That is why this figure was made and gives a visual picture of the procedures and also the continuous improvements. We see this as a second dimension to the model that makes it easier to understand and always keep in mind through the process of becoming green. By auditing the
improvement of changes the company should have the possibility to further develop and improve their supply chain to cut expenses even more while increasing the environmental performance even more.

Figure 4 – 5 Step GSCM model main stages and the way to continuous improvement

3.6.2 Understanding the Model

The stages in the 5-step GSCM model is here described more in detail. This model presents a general way to go in order green the supply chain. For individual companies the actions necessary to undertake might differ in extent depending on environmental maturity as well as type of the tasks depending of company trade and size.

3.6.2.1 Identify

The initial steps of the model aim at identifying the maturity of the organization and track the current procedures (Beamon 1999). By creating early the picture of where the company and organization stand today, the magnitude of the upcoming task should decrease (NZBCSD 2003). It will become the foundation for developing the GSCM hence one of the most important steps.

The overall picture in areas such as metrics and tracking of values and goals, leadership and technology are suitable to begin drawing (Colby et al. 2007). Also to define what the role of the environment is in your business is e.g. managing competitors, cost reduction or product differentiation (LMI 2005). This includes the mapping of risks which may occur due to environmental issues i.e. including health and safety risks as well as risk of increased cost of handling emissions and waste. APO (2008) emphasizes the need of information about environmental impacts or sustainability issues but also the information about business partners. Regarding the importance in
the area of leadership the report *The lean and green supply chain* (USEPA 2000) gives that it is necessary to assign an executive-level responsibility for green supply chain initiatives. Similar initiative is mentioned by in the Aberdeen research by Shecterle & Senxian (2008). The time-aspect is also emphasized. Without an executive champion, initiatives take longer to implement and are less likely to yield the anticipated results, the authors say. To have one point of accountability is as important as to give this position power to act and to handle different problems (remove internal roadblocks etc.). Formal responsibility for delivering the results expected from the project.

To be able at all to make some changes, one has to know where in the process to do them. What you don’t measure, you cannot change. It is therefore important to measure the correct things and to present the data in a way that it is comprehensible and relevant. One could describe the process of environmental work as “Find out what you want to do with it, then measure and control how you do it and tell it to you partners” (NUTEK 2005).

As presented by USEPA (2000) one should “Identify Costs, a systematic review of the facility or process is conducted to determine if and where significant environmental costs occur. This analysis enables the team to later focus where the probability for significant improvement is greatest.” Make sure that the costs are allocated at the right post. In some cases it can be hard to see what the costs of negative environmental actions are. They tend to disappear in other posts (USEPA 2000). Later on be prepared to centralize responsibility for all enterprise-wide green and sustainability initiatives. And to create the role of, or confirm, CSO and give that person the budget, responsibility and authority to marshal resources enterprise-wide.

### 3.6.2.2 Plan

The lean green supply chain (USEPA, 2000) summarizes the second step of our model well in "Evaluate which changes at which areas are most likely to yield significant cost savings and reduce environmental impacts. This yields a set of alternatives”. These alternatives will be discussed more in detail in section 3.7.3 with directly applicable actions and opportunities listed. It can be worth mentioning the importance of looking at the whole supply chain and not just the company’s own processes, because the fact of environmental impact throughout the life cycle and extended life of the product or service. Ask other professionals for help if in-house expertise does not exist. Be sure to benchmark other factories etc. in the same company for good practices (USEPA, 2000). An important element in render more effective organizations and to do the right things in the right manner, is to outsource components to specialists. That could be company/subcontractor with great knowledge about hazardous-material or packaging etc. They already have ability to handle their specialties with less risk of for instance collateral damage or unnecessary emissions etc. (USEPA, 2000).

The use of and help from technology is another key area. Essentials here are automation, data and outsourcing. Much is to win with small efforts with automated systems and special IT-solutions for instance. Technology is an enabler (Shecterle & Senxian 2008). In order to collect essential data, special software might be at great help (Cognizant 2008).

Have an end-to-end approach and see the supply chain as one life cycle system. Waste can in general be regarded as incomplete, ineffective or inefficient use of material, energy or other inputs in the
supply chain. The goal here is therefore to minimize the "bad" outputs and inputs as well as maximize the “good” outputs i.e. products and money (LMI, 2005). So where the waste descends from is where the actions are to be focused. Again one can acknowledge both the importance of seeing the product life-cycle as one SC as well as remembering that many problems or costs follow through the chain if not handled early in the life-cycle.

Try to find all opportunities along the whole supply chain, even those hidden and harder to possibly measure. Since the second phase of the step will be to prioritize the found opportunities the best possibilities will be evaluated and chosen. Prioritizing must reflect the balance between economical end environmental profits and should not negatively affect the company’s regular business. This is why evaluating and prioritizing is greatly important.

3.6.2.3 Decide
Deciding the opportunities will naturally lead to implementing the same and integrating these into the business. Since changes can be extensive and affect many a plan of the implementation execution must be drawn. APO (2008) proposes additionally to once again secure the plan with approval of management support. This kind of support reflects the commitment to environmental stewardship.

Show more detailed data for those who have use of it, depending on their role and position. E-solutions can be of great use to do this and to share information with external actors. Use the data as proof points to the market and the management. To incorporate environmental information in the decision-making process is essential in order to achieve results (USEPA, 2000). Many kind of decision-making tools exist and chose one suitable for the organization purposes and culture. NZBCSD (2003) have created one tool suitable for sustaining the supply chain that can be recommended.

The implementation plan will to a great extent cohere with supplier communication since much of the work and changes will affect these as well. This should be considered when elaborating the plan and even further with the actual implementation.

3.6.2.4 Implement
Once again the need of communication must be emphasized, external as well as internal communication. In the implementation step it is used for marketing, training and involvement. Gaining support and building awareness within the company is one of the most important tasks when implementing changes (APO 2008, NZBCSD 2003). Educate and train yourself and the staff. Training and education is necessary at all levels of the organization for the GSC to develop. Ensuring internal alignment around programs goals objectives requires that everyone understands not only their role but also the CSR’s position and that the entire company have commitment to the program. How active and progressive a company is in the matter of green activities for their supply chain is closely connected to the environmental attitude the company has, says Ghobadian (2009). And the ones who set up the rules for a company is in all the management. Setthasakko (2009) also points out that it is corporate culture and the human’s behaviour that plays a very important role in the success of, and getting rid of obstacles towards, green changes.
From Rettab and Ben Brik (2008) we see that in the Dubai-study the third most common obstacle in order to establish a green supply chain is lack of commitment. Also Walker et al. (2008) points out the commitment factor as a possible barrier green supply chain management. "The success of the implementation of environmental practices does not depend on the ability to manage technological systems. Instead, it is dependent on the ability to manage humans and culture" says Setthasakko in his report on Barriers to implement corporate environmental responsibility in Thailand (2009), in the fish industry.

Important data should be shared with everyone. Share information – have a hollow process. Marketing the process both internally and externally would help actors feel that they are participating. Set up measurable objects for subcontractors and partners. Make them understand what is expected of them and what standards you now hold. The stakeholders get to see results which serve as alibi for the whole project. Many executives have a misconception of how GSC efforts will impact their operations (LMI, 2005). Therefore it is important to give them hard facts and evidence that the process is profitable. A clear value will gain senior management support. Try to combine key-figures that show environmental benefits in numbers. And remember that different numbers address to different people (NUTEK, 2005). Other information might also give other benefits such as health and/or social stuff. "Due to the broad scope of these projects, insights and support from all of the groups affected by the changes are necessary" (USEPA, 2000). By this it is necessary to make sure everybody feels committed and participate in the greening. This is also to gain legitimacy to the project.

3.6.2.5 Monitor

To really see the effects of the implementation the changes must be monitored and assessed. Important is to have measurable indicators giving achievements substance. Monitor the subcontractor’s compliance/progress and tell them what you are measuring so that they can work towards high compliance. Once again what you don’t measure, you cannot change. Further than just showing the GSC achievements, the monitoring will work as foundation for future work with the supply chain and continuous improvement of the company's environmental performance. Customers can be informed of a products environmental “status” with environmental labelling, energy declaration or LCA. This can raise competitiveness of the product and the public image of the company. The price may still be a factor of choice or the certification might not be as specific or unfolding as one think. An ISO-certification is today common among most manufactures and might only function as an order-qualifier rather than an order-winner. Still, the cost for the company for an ISO14001 certificate could be rather substantial and therefore be followed up and taken care of in a strong way (NUTEK, 2004)

Audit and improvement procedures should be establish and the 5 step GSCM model is built to fill the purpose of continuous improvement. After auditing and evaluation of the progress the organization should be able to start over from the initial step and identify new opportunities. Through this environmental development will continue and environmental performance steadily increase.

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9 The standardization series ISO14000 is a collection of standards used for tools and guidance for organizations willing to change their environmental impact and become more sustainable. The ISO 14001 standard contains the demands for the environmental management system and serves as a foundation for the certification.
3.6.3 Supply Chain Opportunities

These initial managerial or organizational tasks needs to be accompanied by more direct actions to a company's supply chains, also referred to above as the opportunities of greening the supply chain. The actions to be taken into account are various and several authors suggest their preferred order (Wilkerson, 2008; APO, 2008; Beamon, 1999). The authors have often different suggestions caused by the aim of their investigation and emphasize different parts. For example looking further on Zhu et al. (2007) they emphasizes the importance of IEM for GSCM to truly progress i.e. internal to the organization and supported by management. Rao and Holt (2005) suggest a division of the supply chain into the four parts - inbound logistics, internal supply chain, outbound logistics and reverse logistics. These four has been chosen as the framework for the supply chain and possible actions have been listed under these and their subcategories. The actions are in no specific order more than sub categorized since the preferred actions are depending on several factor e.g. type of trade, maturity in environmental initiatives, already made alterations. There exist of course an extensive amount of possible actions and the ones listed below will work as an overview of possibilities. These must be adjusted to the specific company and what the opportunities derived from the 5 step GSCM model.

3.6.3.1 Inbound Logistics

The inbound logistics concerning activities and actions on the inbound side, this includes the collaboration with suppliers and transport of material and products into the processes. To a great extent this means choosing green suppliers and the collaboration with these (Brody & Ben-Hamida 2008). The important aspects are considering choosing suppliers that can show their own environmental performance since this reflects the company's own total impact (Rao & Holt 2005, APO 2008). Auditing the suppliers regularly will help guarantee this. Also to take into account the transportations to the factory will greatly affect the total environmental impact (NZBCSD 2003). Working with shortening distances, decrease fuel and energy use connected to this will also play a big part in both economical and environmental performance (Brody & Ben-Hamida 2008). One task should be to align shipments and use full loads should influence the impact considerably (NZBCSD 2003). This can be done with frequent use of computer tools and scheduling principles. This should not affect cost, quality or deliverance if handled correct.
### Table 3 - Actions for greening the inbound logistics

<table>
<thead>
<tr>
<th>Category</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suppliers</td>
<td>- Shift to green suppliers and review</td>
</tr>
<tr>
<td></td>
<td>- Develop a green purchasing policy</td>
</tr>
<tr>
<td></td>
<td>- Materials return policy with suppliers</td>
</tr>
<tr>
<td></td>
<td>- Integrate suppliers into environmental decision-making</td>
</tr>
<tr>
<td>Transport</td>
<td>- Align inbound and outbound shipments to reduce carbon emissions with less fuel</td>
</tr>
<tr>
<td></td>
<td>- Shorten distances by relying on local manpower and commodities</td>
</tr>
<tr>
<td></td>
<td>- Decrease fuel and energy use</td>
</tr>
<tr>
<td>Other</td>
<td>- Minimize raw materials waste</td>
</tr>
</tbody>
</table>

#### 3.6.3.2 Internal Supply Chain

In the internal supply chain is preferably where the initial actions and changes are taking place. This because the company need to know their own environmental performance to be able to make changes (NZBCSD 2003). With this information accessible and reviewed actions are closer to hand.

The internal supply chain can be further divided into sub-categories, products, processes, waste and safety. Product will include changes closely connected to eco-design and similar tools and methods, which are many and varying in both realization and result (NZBCSD 2003). Embracing the thought of re-designing the product is one of the primal and important parts i.e. re-designing for the environment according to APO (2008) and Brody & Ben-Hamida (2008). APO further claims that this can provide customers with more value at less environmental impact. Innumerable amounts of literature can be found and further studied in this subject.

Process is closely connected to the product, because the design of the product greatly affects the processes. What the sub-category will put focus on is quite traditional concerns from the SCM concept that actually will contribute to environmental performance i.e. inventory management and productivity. Where lean production is a good method to decrease both environmental impact as well as increasing productivity (Rao & Holt 2005). The more environmental concerns are internal recycling and cleaner processes (Brody & Ben-Hamida 2008). Rao & Holt (2005) further mention the packaging as a part of the outbound function but in this model it is an important consideration for the design of the product in the inbound function i.e. change material and shrink the packaging properly. This is also mentioned by Green Business Network (2001), APO (2008) and should be considered relatively easy but important task. The right knowledge for changing product or packaging is though essential for succeeding.

Waste management is an important part for the environmental impact (Beamon 1999). Here the lean concept comes in hand that tries to minimize all kinds of waste within the production i.e. reduce all kinds from raw materials to non-value adding activities (Rao & Holt 2005). Connect the waste to
responsible business unit and make changes to decrease this. Also emissions and pollutants are here considered, thus these are today often already regulated it is an important aspect from an environmental point of view. This is at the same time one of the most challenging tasks facing industry (APO 2008). Those not complying with regulations should look at increased cost from fines, now or in the future. These demands will most certainly be harder in the near future as forthcoming legislations will arise (NZBCSD 2003).

An important aspect of the internal supply chain is the use of IT systems which will decrease paper transactions (Cognizant 2008). Furthermore it will follow the technical development in industries worldwide and support global collaborations. It will ease procurement and properly used it will contribute greatly to decisions and risk of misunderstanding. Such tools will though often demand investments and training of the users.

Table 4 - Actions for greening the internal supply chain

<table>
<thead>
<tr>
<th>Category</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
<td>• Redesign the product&lt;br&gt;• Replace material in the product&lt;br&gt;• Shrink and reduce packaging materials</td>
</tr>
<tr>
<td>Process</td>
<td>• Implement more efficient or cleaner processes&lt;br&gt;• See over inventory management and increase productivity&lt;br&gt;• Decisions of in house or third party manufacturing&lt;br&gt;• Repetitive handling&lt;br&gt;• Minimize the non-value adding activities&lt;br&gt;• Internal recycling of process waste</td>
</tr>
<tr>
<td>Waste</td>
<td>• Minimize energy use through improved energy efficiency of facilities and equipment&lt;br&gt;• Minimize emissions, water pollution and hazardous waste&lt;br&gt;• Disposal costs attributes to responsible business unit</td>
</tr>
<tr>
<td>Safety</td>
<td>• Look over safety issues&lt;br&gt;• Minimize health impacts</td>
</tr>
<tr>
<td>Other</td>
<td>• Eliminate paper transactions&lt;br&gt;• Implement IT systems</td>
</tr>
</tbody>
</table>

3.6.3.3 Outbound Logistics

Once again (see 3.6.3.1) the transport will be the important issue since it very much determine the level of the environmental impact from the outbound logistics in the supply chain (Rao & Holt 2005). Optimizing the distribution network will both affect environmental performance as service level, hence both the competitiveness and the greening. The actions are pretty much the same as on the
inbound side with consolidated shipments and shorter routes (Brody & Ben-Hamida 2008), the difference might be that it is harder to choose where shipments will go. On the inbound side preferred suppliers often can be chosen and thus the environmental impact estimated. Here it is harder since customers might come from diverse locations. By coordinating with partners and eliminating supply chain steps some of this is handled (Green Business Network 2001). Good strategic communication and developed purchasing coordination is crucial for customer and partner collaboration (APO 2008, NZBCSD 2003). This also implies green marketing and eco-labelling for satisfied customers, something which Rao & Holt (2005) see as the important link between environmental innovation and competitive advantages.

Table 5 - Actions for greening the outbound logistics

<table>
<thead>
<tr>
<th>Transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>o Optimize distribution network</td>
</tr>
<tr>
<td>o Shorter routes</td>
</tr>
<tr>
<td>o Consolidated shipments, when possible full loads in both directions</td>
</tr>
<tr>
<td>o Scheduling for improved traffic flow</td>
</tr>
<tr>
<td>o Minimize transport fuel usage, emissions, noise and idle time</td>
</tr>
<tr>
<td>Customer</td>
</tr>
<tr>
<td>o Alter service level agreements</td>
</tr>
<tr>
<td>o Coordinate with partners</td>
</tr>
<tr>
<td>o Eliminate supply chain steps</td>
</tr>
<tr>
<td>o Improve energy efficiency of facilities and equipment</td>
</tr>
<tr>
<td>o Economies of scale by buying directly from supplier</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td>o Green marketing and eco-labelling</td>
</tr>
<tr>
<td>o Set targets for reduction of energy consumption</td>
</tr>
</tbody>
</table>

3.6.3.4 Reverse Logistics

Reverse logistics are in many parts of the world developed, but in other more often in need of redesign and implementation. Already when designing the product designers have to take the lifecycle view and look at where the product will go and how (Brody & Ben-Hamida 2008). Therefore the design-phase affects how the result in this category will be. What can be changed directly within this phase is making product with reusable packaging and develop ways of recovering products for re-use or recycle (Green Business Network 2001, Brody & Ben-Hamida 2008). By reusing products or parts costs can be cut (Beamon 1999). This will though demand an efficient take back and recover process. Once again communication can be emphasized since take-back demand necessary collaboration from customers (Green Business Network 2001). Furthermore this will demand a certain level of awareness from the customer. Green marketing (see 3.7.3.3) can help contribute to this.
3.7 Environmental and Economic Benefits of Green Supply Chain Management

The majority of research exploring the area for GSCM is considering the initiatives of the concept, while little research investigates the impact on economic performance to give a competitive advantage. Significant findings in the link between improvements in competitiveness and economic performance through GSCM initiatives should clearly encourage companies even further, as mentioned by Rao (2005), not only in South East Asia but US and Europe as well. There is an ongoing need for research to provide an impetus for organizations to green their supply chains.

Given the existing literature it still remains controversial whether GSCM brings positive or negative economic performance. Zhu et al. (2007) indicates that environmental management such as GSCM has a positive relationship with an organization’s economic performance. It is suggested that success in addressing environmental issues can provide new opportunities for competition and new ways to add value to core business programs. Others claim that the implementation of GSCM only could harm the long-term profitability of an organization. One Swedish study could not find any correlation between marketing the environmental work itself and profit or other similar figures measurement (NUTEK, 2005). Bowen et al. (2001) suggests economic benefits are not achieved through short-term profitability and sales performance as they pose the concept to endeavour. Further, compliance with internal and external procedures posits considerable restrictions to opportunistic behaviour of firms as well as increased operational costs, which in turn may have a negative impact on firms’ financial performance (Cordeiro & Sarkis, 1997).

Within all of the areas from Rao and Holt (2005) previously mentioned (see 3.7) there are possibilities for financial gains when implementing the concept of GSCM. In the inbound logistics perspective (1) it is argued by several authors (Beamon, 1999; Bowen et al., 2001; Rao, 2002) that greening the supply chain has numerous benefits to organizations, in the range from cost reduction to integrating suppliers into environmental decision-making. Companies are today more willing to manage their suppliers’ environmental performance to ensure that materials and equipment supplied are produced in environmental friendly processes (Rao & Holt, 2005). This cost avoidance of purchasing hazardous materials will reflect the internalized costs associated with environmental harm (Beamon, 1999). Further environmental initiatives such as strategic environmental sourcing can improve the organization’s competitiveness and reduce risks.
In the production phase (2) of the green supply chain there are several concepts being used frequently by organizations today including cleaner production, DfE, remanufacturing and lean production. These are all based on commitment towards waste and pollution reduction. There is a significant cost avoidance of storing, managing, and disposing process waste, particularly as waste disposal becomes increasingly expensive (Beamon 1999). With an overview of the processes in the production a company might perhaps find areas in which the energy consumption can be decreased with new machinery, different scheduling or other methods. Lean production or manufacturing is aiming at simultaneously increasing production quality and enhancing quality through reduction of lead times, materials and general waste (Rao 2005). In South East Asia much of the manufacturing business is quality driven wherefore lean production should be favourable to apply. The method is expected to improve both environmental performance and competitiveness from three major factors: minimization of non-value adding activities, efficient work systems, and applicable human resource management.

Initiatives on the outbound side (3) that might improve environmental as well as economic performance are green marketing, environmental friendly packaging and distribution. The issue of packaging is environmentally relevant, as well as a costly activity, because of the heavy contribution to solid waste streams. Also the quite new development of regulations following the Packaging Directive (Seeba Fact Sheet Packaging Directive) in the EU can create larger expenses for organizations. Notwithstanding the lack of stringent waste management in South East Asia is a big problem creating dispersal. Much research promotes the approach of closing the supply chain loop (Zhu et al., 2006) to utilize all waste in reuse and recycling that may lead to enhanced economic performance. Closing the loop indicates the need of reverse logistics (4), something closely connected to the green marketing and customer relationship. Managing waste through reverse logistics or waste exchange can lead to cost reductions (Rao & Holt, 2005).

The document The lean and green supply chain (USEPA, 2000) presents examples of companies who have reduced their costs substantially with environmental actions in the supply chain. And the Aberdeen study gives fact on how well companies have reduced their costs in the areas of Transport and logistics, Energy, Operational and Facilities and Supply, with help of green initiatives. Rettab and Ben Brik (2008) finds in their study in Dubai figures that show the same general idea that GSCM is beneficial for the companies who adopt it, in the areas mentioned. Also the report Miljökommunikation i leverantörskedjan (2000) (environmental communication in the supply chain) from Sveriges tekniska attachéér (The Swedish Attaché’s of Technology) present the same positive result for companies applying GSCM. Altogether the previous research gives that GSCM is beneficial to the companies who apply it.

3.8 Performance Measures in the Green Supply Chain

As earlier mention a hard task is to measure the actual performance when it comes to environmental initiatives and actions. Therefore an early task should be to investigate what measurements could be of use to the company and the involved stakeholders. It is also to a great extent important for the companies to see what the actual result of the implementation is for a continuous improvement in the work on becoming green (Hervani et al., 2005). In the traditional SC performance measures are typically concerned with (Hervani et al., 2005; Beamon, 1999):
(1) Customer satisfaction, service, or responsiveness;
(2) Cost, profit, return of investment

These measures are quite straight forward and one key to the success of SCM. By letting stakeholders see (good) results of implementing SCM the reliance will increase and gain even more trust in the management system. For the GSC the performance measures can occur even more complex as several new aspects are added to the original few from traditional SCM when evaluating environmental performance as well. These new dimensions create various opportunities and a need of identifying the processes and the maturity of the company's SCM (Beamon, 1999). By identifying all inputs, outputs, by-products and resources a foundation for building an adapted measurement system for the company concerns. Instead of the measurements for the traditional SC, Beamon is suggesting six main classification categories for measuring environmental performance.

(1) Resource use
(2) Product recovery (re-manufacturing, reuse and recycling)
(3) Product characteristics
(4) Waste emissions and exposure hazard
(5) Economic
(6) Economic/emissions

Further the economic dimensions are important to every enterprise and therefore should be measured. Rao and Holt (2005) investigate the link between green supply chain management and economic performance and a number of manifest variables constitute the construct measuring economic performance:

(1) new market opportunities;
(2) product price increase;
(3) profit margin;
(4) sales; and
(5) market share.

As mentioned earlier the greening of the supply chain should create a competitive advantage to the business and should therefore be measured if possible. To see the actual improvement in competitiveness should also create incentives to continue work following the GSCM concept. Rao and Holt (2005) manifests variables considered to investigate competitiveness as:

(1) improved efficiency;
(2) quality improvement;
(3) productivity improvement; and
(4) cost savings

To summarize the important performance measures they can be divided into the three categories environmental-, economical performance and competitiveness. From these dimensions several measures appear and without any given order it is a managerial task to decide which of these to measure and evaluate. Important to remember is that the dimensions are connected and actions take coherent results in the different parts. Rao and Holt (2005) have through their research on how environmental initiatives affect the economic performance and competitiveness developed a model showing the connection between the different dimensions. In this case the three greening
alternatives (greening inbound, greening outbound and greening production) equals the environmental dimension. Through their empirical data from the region of South East Asia they show an increased economical performance as well as competitiveness from GSCM initiatives i.e. considering all supply chain steps together and not as parts found in previous research. Their final model in Figure 1 shows the investigated relationship between the different dimensions.

Figure 5 - Relationship between greening and competitiveness and economic performance (Rao & Holt 2005)
4 Results

4.1 Study at Thai Companies and Institutions

4.1.1 Preparing the Interviews

Our question forms were designed with regard of what type of representative we were going to interview – a corporate representative, supporting agency or a professor (see appendices). This in order to better be able pinpointing certain issues or aspects of the use of GSCM. The different sources have different input and can together give us good information for our study. All contacts were sent an initial presentation of us and our work before the interviews. Also information regarding the questions we planned to ask and in what areas we would like to move in the discussion. To inform the clients in forehand of the topic of the interview rather than just the rubric should help them prepare and give better answers when they know our objective in general. All the respondents were assured confidentiality but an exception from the above is respondent 8 since the interviews in that case were more improvised and held no formal structure. Though in that case questions from the prepared forms was used and answered.

4.1.2 Setting up the Questions

Every interview started with a brief summary of the person who was subject to our questions. This was made in order to present that persons qualifications and to get an understanding of his or hers expertise. Thereafter some questions regarding the general environmental situation and work in Thailand were held. Depending on the subject and how well the discussion progressed, we later moved on more specific questions designed for that person.

When interviewing a professor in the subject of for instance the most common environmental problems for the industry then the answers could differ from the ones given by a representative from a company. Therefore it is good to analyses who has said what, and not just sum all of the answers and handle them regardless of their source.

4.1.3 Documenting the Interviews

All the interviews were recorder on a digital voice recorder. Every participant agreed to have the interview recorded. This helped us later during the analysis of their answers. In most of the interviews additional notes were taken to emphasize the essence of the respondents’ thoughts.

4.1.4 Selection of Participants

In Thailand we got help from Eco Group, where the thesis was performed, and the supervisor on-site with finding suitable contacts for our interviews. After an initial brief presentation of our thesis to our supervisor and presented what we hope to achieve, a list of suggested contacts was made. We had the contacts in three categories’; company representatives, scholars and supporting organizations. These altogether represent a broad scope of knowledge and base of experience.
regarding the Thai industry. The different groups contributed with special knowledge in different areas of the subject.

Table 7 - List of Respondents

<table>
<thead>
<tr>
<th>Respondent</th>
<th>Representing</th>
<th>Respondent occupation</th>
<th>Organization main focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respondent 1</td>
<td>University</td>
<td>Assistant Dean of Engineering</td>
<td>SCM research</td>
</tr>
<tr>
<td>Respondent 2</td>
<td>University</td>
<td>Assistant professor</td>
<td>Research at Institution of Industrial Design</td>
</tr>
<tr>
<td>Respondent 3</td>
<td>University</td>
<td>Ph.D. in operational research</td>
<td>Research at department of industrial engineering</td>
</tr>
<tr>
<td>Respondent 4</td>
<td>Industry</td>
<td>Manufacturing Manager</td>
<td>Large foreign owned EEE manufacturer</td>
</tr>
<tr>
<td>Respondent 5</td>
<td>Industry</td>
<td>Senior manager</td>
<td>Foreign owned EEE manufacturer</td>
</tr>
<tr>
<td>Respondent 6</td>
<td>Industry/Supporting agency</td>
<td>Company manager/law-maker</td>
<td>Developing and producing EEE</td>
</tr>
<tr>
<td>Respondent 7</td>
<td>Supporting agency</td>
<td>Managing director</td>
<td>Environmental consultancy</td>
</tr>
<tr>
<td>Respondent 8</td>
<td>Supporting agencies/Industry</td>
<td>International company representatives from Thai-Danish collaborations</td>
<td>(Thai-Danish exhibition)</td>
</tr>
</tbody>
</table>

4.1.5 Respondents

Respondent 1
Respondent 1 is an Assistant dean of engineering at a university in Bangkok. He is currently doing research about wholesale and retail SCM at retailers like Carrefour and Lotus.

The interview with Respondent 1 took about 40 minutes and was held at the office of Eco Group.

Respondent 2
Respondent 2 is an assistant professor at a university in Bangkok. He is currently working at the institution of Industrial Engineering with areas of research such as manufacturing strategies, lean manufacturing, TQM etc. He newly received funding for studies of SCM in the computer manufacturing industry in Thailand.

The expertise of Respondent 2 is not environmental matters but still he could answer most of the questions we asked since he had carefully read through the questions we had mailed him. The interview with Respondent 2 took about 40 minutes and was held at a mall in the outskirts of Bangkok.

Respondent 3
Respondent 3 is a Ph.D. in operational research currently working at the Production Engineering Department at a one of the bigger universities in Bangkok, with many years of experience from
The respondent’s current research within the industrial engineering division concerns carbon credits and carbon trading. The research aims at creating methods for the industry by modelling carbon emissions within the supply chain and calculate benefits of these as well as waste reduction and sourcing policies. The research is though quite new to the participant why the current absolute expertise may be missing.

Environmental issues and the connected research was a dear subject for the respondent and enthusiasm in the subject and for our research permeated the session. The interview was performed in the office of the interviewee and lasted about 45 minutes.

**Respondent 4**
Respondent 4 is a manager at a foreign-owned company with about 600 employees at the site in Thailand. Although we had confirmed the interview and sent our questions in forehand the manager said he had not got our mail. Our session was combined with other meetings with the company and Eco Group, and therefore information regarding our interviews might have been lost. A second person from the company also attended the interview, but did not contribute to the discussion in any greater extent.

Due to difficulties with the language barrier an interpreter from the responding company attended our interview. Unfortunate this did not help appreciable. The interview was hard to carry through but never the less some good answers were given. The interview with Respondent 4 took about 30 minutes and was held at the company.

**Respondent 5**
The respondent is a senior manager at the Thai-branch for a larger foreign own company. The company’s products are sold in Thailand and most over Asia. The respondent has a Bachelor degree in Mechanical Engineering and a Master degree in MBA. This person has worked at other international companies in different executive positions for many years.

Recently this company expanded their environmental commitment and worked together with a consultant firm to intensify their environmental actions. This is something that was noticed in the interview since the respondent gave many answers that clearly showed that the respondent had a higher understanding of the subject. The interview was held at the company of Respondent 5 and took about 45 minutes.

**Respondent 6**
Respondent 6 is a company manager and also active in official Thai context. The respondent has a Ph.D. in operation research and a background in environmental engineering and industrial engineering. This person has many years experience of executive management both in Thailand and abroad.

There was no problem with the language during the interview. Though had the interviewee a very distinct opinion on the subject and was highly actively during the interview. This lead to that not all
of the questions from the questionnaire was asked by us. We rather let the conversation flow naturally with us asking fewer questions than planned but never the less getting relevant and interesting information. The interview was held at the office of Respondent 6 and lasted about 1.5 hours.

**Respondent 7**
The respondent is managing director representing an environmental consultancy firm. The organization’s main task is supporting clients to become greener in a way that they can achieve most green (environmental) competency as well as business competency. The firm is performing consultancy projects for both government and industry. For the industry it is about 80% within the EEI sector. The type of consultancy projects considering both business and environmental dimensions the company is said to be the only one in Thailand.

The respondent is also involved in the Federation of Thai Industry in the department of Electrical, Electronics and Allies Industries Club. The interview was held in the office of the consultancy company and lasted about 30 minutes.

**Respondent 8**
Respondent 8 is a collective of respondents from the Thai-Danish Exhibition: Eco Technologies For Industry and Private Homes. The group consists of foreign company representatives in collaboration with Thai companies during the Partnership Facility Program (PFP), and officials from the Danish embassy in Bangkok.

The exhibition and seminar was the outcome and display of several years work and cooperation between Thai and Danish companies within the PFP. An initiative by the Danish International Development Agency (Danida) introduced in 1996. The focus of the program was on sustainable energy, cleaner technology and production, reduction of emissions, waste management and environmental audit and management systems. The PFP initial goal was also to provide opportunities for a more active private sector participation in environmental activities. By hosting the event the initiators wanted to broaden the awareness of use of environmental friendly technologies in industrial production even further. The seminars were unfortunately in Thai but the exhibition was free to walk around all the time.

During the exhibition and seminars there was time to speak to the program participants. All projects were on display and discussions around these and environmental issues were performed. No structured interviews were performed but still many of the interview questions (see appendices) were asked and proper answers were given. The respondents could all give the picture of how to collaborate and work in Thai industries, with knowledge and means to compare with similar work in Europe and the US. Further presumed the similarity between Danish and Swedish corporate culture and society could fill a gap between the study in Sweden and Thailand.

Questions, answers and the interviewee details were written down on-site on a laptop to make sure no information was forgot. The number of people on the exhibition could have been a cause of distraction, but since most of the interviews were performed during seminars the surroundings were
calm. The various individuals were approached at different times and separately from each other and not as a group at the same time.

4.2 Results from Interviews in Thai Electrical and Electronics Industries

Although the participants of our study did get slightly different questions during the interviews (see Appendices), depending their area of knowledge and hence could answer the best, the results are here summarized all together. This is to easier grasp the main objective with the interviews which was to sum up a picture of the today state in the Thai EEI with respect of environmental awareness, environmental maturity, the use of GSCM and further development within these areas. From this conclude how far they have come today with GSCM and where and how to proceed.

4.2.1 Environmental Maturity in Thailand

Many of the respondents have pointed out the fact that the awareness, or more correct the consideration of the environment, among companies is very low except among the largest players. Companies may be aware of the global environmental problems but do not see the benefits of themselves review their organizations environmental impact. The reason for mostly larger companies to active within the area are considered that they have global customers and the fact that they export to e.g. U.S and Europe who in their turn have other and harder environmental demands. From authorities as well as from customers. This drives the companies to manage their supply chain and/or products produced in Thailand with respect to e.g. the European demands. It will also result in companies have easier access to knowledge and in many cases ready-made solutions, policies and directives from mother companies as mention by respondent 5.

Companies with only domestic customers, or at least no direct contacts with western markets, usually do not have any incentive to green their products or supply chain. The awareness and knowledge of environmental issues within these types of firms should be considered moderate according to respondent 5 and 7. Today choosing a green product among the public is a matter of income level as claimed by several of the respondents. High-income persons are more willing to choose the green option as long as it still has a competitive price. According to respondent 8 this also holds for as long as the greening will not affect the peoples lifestyle e.g. changing to solar panels is considered good as long as the house owner do not have to cut down on the electricity usage. The respondent also points out his feeling that Thai people in general have difficulties grasping the thought and need of environmental friendly or greent products.

Respondent 6 though, did not want to endorse external demands on the companies, neither from customer nor consumer, other than governmental laws. The respondent believed strongly in (economical) incentives and laws, rather than complying with what the customers wants. The focus on the importance of strong laws and enforcement of them is highly emphasized from this respondent. Though also mentioning that today many laws are conflicting or inconsistent and revisions are necessary. Claimed by another respondent 8 the problem is that very few people are willing to take the political risk of making decisions of environmental enforcement and laws, which makes governmental errands run through an extremely slow process and taking too long time.
Respondent 7 see that the government are willing to change and the intent is good but limitations in budget, manpower, resources and bureaucratic systems is what slowing down the procedures. Intentions are good and government is aware what is going on globally.

Two of the respondents (1 and 2) have both stressed the need of educating the public in environmental matters early on in the school. The second grade has been mentioned as an example of when to start teaching of the importance of taking care of the environment. This could hopefully lead to a new generation (of corporate leaders) who are more concerned of making green decisions, although the primarily goal still will be to make money.

Education in the laws is regarded from Respondent 6 as important since the knowledge can be poor. The Thai juridical system has many laws in which some conflict and can cause problems for companies who act accordingly to obsolete laws. Especially since some (larger) companies are “arrogant and spoiled” and believe they know the law but they do not, Respondent 6 says.

The matter of mindset and general knowledge regarding environmental matters is not to be underestimated, accordingly to Respondent 1, 2, 5 and 6. The will to do right must come from inside. This should be changed since the bargaining power of the customer is increasing alongside with the number of options according to respondent 5. The problem is that even if the will exist many people say they do not afford to think of the environment, thinking of buying hybrid cars and solar panels to their homes. What many people may not understand is that even smaller actions will help like recycling of bottles, changing to energy-saving light bulbs etc. Although on the subject of the possibility to recycle products is regarded from many respondents as hard to do since there is no real systems or infrastructure for this in Thailand. One respondent asks for the industry to apply the concept of Design for Environment, in order to facilitate take-backs and recycling of products.

4.2.2 Environmental Maturity in Thai Electrical and Electronics Industries

ISO standards and certification is used by all of the EEI companies surveyed, and claimed to hold a strong management support from the respondents. Though according to respondent 6 the certification process and auditing in Thailand can be questioned. From the discussion on EMS systems, certification and problems of their credibility that they are easy to retain he is quoted that in Thailand to get certified it is to "just put it on a sticker". The company of respondent 4 have implemented ISO 14001 and fully follow this, they states. The EMS has strong support from management and from the mother company and much of the environmental initiatives also origins from the mother company. The ISO-certificate was highly rated at the company and regarded as enough effort regarding environmental issues. ISO certification is most often also demanded from suppliers. This along with RoHS, WEEE and Reach directives are the most common environmental approaches in the country, but according to respondent 5 only the very basic principles are fulfilled without further efforts.

Although SMEs probably do not see the necessity of going green, some basic understanding of the importance of environmental issues nevertheless exist. Still the reasons for not implementing GSCM or other steps to comply to the need of sustainable activities seems to be that the companies does not acknowledge the problems, plain ignorance and that they are more interested in cosmetic
activities (calling themselves green rather than being green), accordingly to Respondent 6 especially but some of the others as well.

One problem stressed by respondent 7 could be that TEEI companies often position themselves mainly as part manufacturers and sub-contractors, which is why eco-design is not considered not needed. Within the industry there are very few original brand owner or engineering manufacturers. This makes only those answering to external e.g. export demands to comply with environmental initiatives and regulations. Since changes are made of demands globally towards the increased need of Eco design there has to be changes made also in Thai industries for future competitiveness.

The main obstacle for environmental initiatives according to respondent 7 is the mindset of the people within the industry. Aside this obstacle there is a need of help from government with issuing regulations and laws, providing instruments and tools e.g. through tax-refund mechanisms.

Respondent 5 can see three different types or levels of customers who consider environmental work. First level is those who are ready to comply with demands and regulations originating from foreign customers or markets. This first type is mainly Thai-owned companies. Second level could be multinational, Thai owned companies or direct foreign investment in Thailand. Often middle to large sized firms that are aware that green technology is coming and see the possibility to create competitive advantage out of this. The third level is almost solely companies with direct investment from mainly EU and US with headquarters abroad. These companies are very much aware of the environmental issues and have already practiced environmental work for several years. They have internal environmental policies within the companies e.g. for reducing greenhouse gas emissions.

Respondent 5 connects to this and adds the possibility for bigger companies to invest in environmental concept programs as a big difference. A smaller company lacks both the economical dimension and in many cases the knowledge. A bigger company does not take as big effect from the uncertainty in demand and uncertainty of investment return the way that SMEs do the respondent continues.

Some companies and academic people try to research issues in advance such as carbon emission levels since regulation probably will occur in the future according to respondent 3. Some Thai companies may use methods such as LCA but it may be hard to see the benefits for the companies according to Respondent 3. Hence new tools should be developed more suited to the Thai EEI. LCA only consider the general view and misses the details. Respondent 3 have the idea that the industry must be separated into the different sectors and specific tools should be applied on these.

Respondent 8 told the story about new better machines developed using methods with less chemicals that no one in Thai industries was interested in since the price was higher than the competitors. Development continued and when the machines also could provide a decrease of 50% in water usage the interest increased although the higher price. This shows that in Thai industries it is often not a question of only environmental concerns and quality. The original price or the cut expenses during usage are more decisive. In the race between price and quality, price always win as claimed by another respondent in the group (8). The price contra environmental ability is mentioned by all of the respondents as a (much) stronger factor for most of the customers. This goes for companies as well as for private customers.
Knowledge, expenses and interest are all mentioned by several respondents to be part of the reason why environmental work is not wide spread. If the companies and employees are aware the question is who should assess these and who should pay for the assessment.

4.2.3 Green Supply Chain Management in Thai Electrical and Electronics Industries

The concept of SCM is stated by several respondents to be known by most industries in Thailand, especially the bigger actors with either foreign mother companies or a majority of foreign customers. Respondent 1 said that implementing SCM should be the first step and after that GSCM can be introduced. Respondent 7 disagree that this is the case and continues that the reason for people might say willing to implement SCM first is so that can say they are going to go green, but they are doing it later. The fear of high cost for environmental initiatives is high. Contrary to this positive effects from GSCM could mainly be lowering costs considers respondent 7. By showing companies green is lowering cost interest should increase. This is a strategy for advertising the GSCM concept as well as other green initiatives – to show by success-stories and by numbers that it is possible to lower costs/rise profit by environmental actions – that every respondent support and believe is a good way to go.

The green-demand should origin from the customers. In this order since the Thai industry now start to understand the need of SCM but do not think of greening yet. The concept of SCM is mostly known among the big companies but still not practiced in larger scale at SME’s. As an example of this the fact that Respondent 4 did not recognized the concept of GSCM the slightest. Respondent 5 strongly believes that including for example energy efficiency and eco-design into the product will get more customer interest than just the environmental reason itself. This since energy prices are increasing and will probably continue to. Only green as a sales argument is difficult to succeed but with the added reason of saving money through lower energy consumption it becomes much easier.

GSCM and the concept sustainable are increasing a lot in popularity. The problem is how to apply this, the lack of tools. According to respondent 3 GSCM is becoming more popular for research and people are getting aware at least in the academic world, which may be a good stepping stone. Researchers are currently trying to figure out how to green the SC and the reason to do it. The respondent could see obvious reasons for EEI companies’ origin in export demand to affect the environmental awareness. Though in other industry sectors the reasons may not be that obvious.

In general today the greening of organizations is just for the image according to several respondents (3, 6 and 7). Many companies realize the need of green competition. Companies want to go green without fully understanding the concept. Many changes have to be made but it is a hard task and many companies may lack knowledge of how and that it actually is possible to be green and save money. Companies have to realize there is a need of becoming environmental friendly to survive in the future competition.

Respondent 7 asserts that many companies make green actions to change the supply chain but are most often not aware of the concept of GSCM. Several companies see the greening trend and use this to market and advertise their product, but there is a lack of system to prove these green
initiatives is the opinion of respondent 7. There is a need for a new system of proof. Several schemes
exist but these are limited to specific sectors, therefore a new standardized system is needed
applicable for all product categories. Some companies though have realized profit possibilities and do
so to earn money e.g. by selling carbon credits (respondent 3) or by making more energy efficient
products (respondent 6) Lean manufacturing is one solution to lowering a company’s impact that
have been implemented in some Thai companies. Lean manufacturing is a good example of a
concept that both minimize waste i.e. the environmental impact, as well as maximizing profitability.
One company has taken in consultants to review their products and apply eco-design to their
currently developing projects. The main goal is to increase the environmental performance as well as
the profit. The representative (respondent 5) claims though that it took some time to convince the
company and the management that this was possible. Their previous mindset of environmental
initiatives resulting only in increased cost has been changed. The project is in its initial process of
implementing and the effects of the eco-design are yet to be seen, but the respondent strongly
believes in a positive result. This problem of management only sees the expenses of the initiatives
are also stressed as one of the bigger obstacles.

The concept of GSCM can help companies a lot by one actor in the chain affecting or demanding
others in the chain to environmental initiatives consider respondent 7. The initiator of the GSCM
must teach the other and take care of these implementing as well. This will increase the business
opportunities at the same time helps promoting the initiators own business. The problem is though
the harmonization of the whole chain since companies often have their own green solutions and
many business owners do not realize the need or profit out of collaboration and strengthening the
supply chain. Thai owners often have a too big focus on themselves and see the relationship with
suppliers only as customer and supplier, without the need for cooperation according to respondent
7. This is established by respondent 6 who do not see any need at all to interfere with the partners of
the company and their activities. The respondent sees the matter of, for instance setting
environmental demands to your suppliers, as more philosophical. And do not believe, by principle, at
all that a larger actor has the right to tell others in the supply chain how to act. The only way to make
them go green is by lawmaking and incentives.

In Thai EEI when choosing suppliers all that is considered is quality, cost and delivery time. No green
at all even though the government launched a green procurement policy to buy more products from
green companies. The ability harmonize the supply chains is one reason there exist a need for
standardized ways of GSCM and SCM according to respondent 7. The company of respondent 5 has a
great will to become environmental friendly, as only product assembler with outsourced production
they are close to this goal. At the same time they realize that their big environmental impact lies
within their suppliers and sub-suppliers manufacturing processes. Today they only demand RoHS and
Reach compliance but they also see a need to demand even more environmental changes from the
suppliers to be able calling themselves environmental friendly. Though this task is extensive and
takes great effort and a lot of time.

Companies in Thailand are developing own methods for processes to reduce environmental impact
and thereafter certifies the given process. The initial step of lowering emissions can probably easily
be made. These initial actions often concern capturing the emitted carbon. After that greater efforts
has to be made which often means higher expenses? The problem stressed by respondent 4 except
the expenses is often the wrong focus and neglecting of details. For example companies tries to capture the emitted carbon dioxide but not really reducing the causes of the emissions. The importance of the product is stressed highly from Respondent 6. The respondent believes that “Technology is the key to environmental problems. The challenge is to change the behaviour of people. I am trying to change the lifestyle with my products”. This implicates eco-design as the main solution to greening the organization and the SC.

4.2.4 Development of Green Supply Chain Management in Thai Electrical and Electronics Industries

Respondents 3, 5 and 7 mentions that they are certain that Thailand will follow the world trend and get a deeper understanding in the environmenal problems among the public. There is certainly a need for companies to realize this to maintain their competitiveness. In a few years the environmental awareness will be a big issue also in the Thai academic world and in Thai industries. Thailand has the need to develop environmentally, towards European standards. Everyone in Thailand - government, companies and consumers need to go green believes respondent 5. Continuing with the fact that the country is moving in the right direction but changes are going too slow. The greening of the supply chain have to start with management first, like all organizational changes according to respondent 7. Depending on managements view on the GSCM concept the changes may differ. Everyone got their own picture of what GSCM is since it is a very new concept. Starting by defining what the GSCM concept really is should be the first phase in development.

The one thing (almost) every participants has stressed is governmental regulations and legislation. This is conceived to be the most effective, and sometimes the only, way to get companies to go green. Note though that one respondent (6) was very critical towards the government’s ability to effect environmental issues. The respondent had no trust in that the knowledge to do the right things is among the politicians. Although still strongly stressing lawmaking as a good method. Respondent 8 also has the concern that governmental decision-makers often talks about the environmental issues and what has to be done. The respondent believes though that the slow processes and lack of decisions mostly origin in expenses and the question on who is going to pay. Always when there are funding involved more people are interested in the projects. Respondent 3 says that international policies miss the perspectives of the different countries and it may harm the competitiveness. For saving the world it may be good but there are other concerns and perspectives to look at first, especially for developing countries. Regulation could limit some problems, but grander agreements like G8 or Kyoto protocol may not work due to the differences in international competition. Thailand today cannot compete with EU or US. There are other mechanisms better suited for promoting environmental friendliness. It is a matter of punish or reward. Right now the developing countries need the rewards of becoming environmentally aware, more incentives as also mentioned by respondent 6. Respondent 1 also points out that by presenting good Asian examples of implementing GSCM could work as incentives for Thai companies in the EEI. To provide and present success stories is a good way to create a positive attitude towards environmental initiatives also mentioned by respondent 7. Though continuing by mention that there is a great lack of these success stories from the Thai industry.
Respondent 8 tells that "It always comes down to the money. That is always decisive". The bottom-line is cost and without extra money it is hard to become green. By making tools showing the benefits and how to cut expenses by using these should be a great incentive for all companies. Important to notice is that just make things green is not always a solution, the companies need to be shown explicit why and how they can help. Creating tools for small companies to apply is one solution stressed by respondent 3. Respondent 8 sees energy efficiency and decreasing of energy use as the most important means for development. This will be even more important as the respondent foresees higher cost for energy in the near future. The pro active companies will have a great advantage. Respondent 3 is also looking into future development and says "It is now possible to price carbon. By measuring and reducing carbon you can reduce cost and it is easier to relate back to the cost of the product. More carbon means more cost and this may get companies to think more of their actions impacting the environment." Respondent 7 says "Future environmental issues and GSCM is going to become more and more popular every day. People should develop tools and methodology that can really give value to the customer. Show them not only past success case, but improve the business and sustainable management - both business and environment." Both this and the public awareness must be changed in the future. Respondents though estimated these changes to about 5-10 years from now. For providing structure and change to the issues of legislation, market demands and managerial mindset.

Also support from the interviewees has been given to our thesis that by clearly showing the advantages and returns of GSCM, e.g. cut expenses, a company can become more positive towards applying the same. The objective is to change their attitude towards environmental work and to show them that it does not only mean increased costs rather than lowered costs (in some time).

4.3 Reference Survey at Swedish Electrical and Electronics Industries

Since a reference to the Thai industry was sought on how they handle the subject of environmental issues and awareness, a web survey was constructed for Swedish companies. This was sent out to 67 companies within the EEI in Sweden. The reason for this part of the study is to, together with existing research, get a general picture of the today state at Swedish companies with regard to environmental awareness and particular GSC related matters. This in order to see possible differences in the attitudes towards and strategies around GSCM in a country, Sweden, that is generally regarded as prominent in environmental work (Environmental performance index 2008) and Thailand.

By comparing Thai and Swedish companies answering especially research question 4 will be helped. This research question is of its character targeting theory and practices of GSCM that are not in particular connected to a specific market or region. Therefore a more solid answer to that question will be attained if gathering data from the two countries rather than only one. Also local practices and governmental regulations will affect the results less with international respondents. Other research question will also benefit from the comparison, although more indirect.
4.3.1 Respondents

The selection of companies who was sent the questionnaire was done accordingly to their business. Companies in the Swedish EEI was selected and sent an email with a short description of our persons and assignment and a link to the questionnaire with a request to fill it out. In some cases when a suitable employee or position could not be identified by us, a request for the address to someone with environmental matters as their responsibility or task was sent to the company first. After about one week a reminder was sent to those who had yet not answered.

The percentage of answers of our net-survey was 15% which is lower than normal for this type of survey. 20-30% would have been expected (Almgren et al., 2008). The reason for the low answer frequency is commented further in the discussion.

In most of the cases the questionnaire was sent to a person with responsibilities in the environmental areas. This since we assumed that it would be a suitable position to answer our questions. At many of the smaller companies with few employees, someone in the management answered the questions.

4.3.2 Results from Reference Survey

Nine out of ten respondents say that they have an environmental policy at their company, and that they comply with it fully. Only one respondent say they do not have a specific policy like that. Strategies on how to comply with their environmental policies differ from one and another. Although some answers were a bit vague and a bit cliché, most of the companies at least have a strategy or plan on how to achieve their environmental goals. These strategies can be to “regularly review” the work or just to “follow the environmental plan”.

The environmental awareness at the companies is self-assessed to an average of 5.1 on a 7-grade scale where 7 is high awareness. The result is lower (4.7) when asked of their opinion on the industry’s awareness in Sweden in general. Although with a bit more spread in the answers with grades from 3 to 7 and a standard deviation of 0.9 instead of 0.72 as for the self-assessment of their own awareness.

The major drivers among the companies in our survey are internal. On a scale 1-7 where 7 is external, the average is 4.5 with a median at 4.5 also and standard deviation of 1.1. To manage a sustainable development for the future (translated from Skapa en hållbar utveckling för framtiden) was given as the foremost argument for development in environmental areas from half of the respondents. The second most popular answer, with 33% of the answers, was General Environmental Awareness (translated from Allmän miljömedvetenhet).

As for the benefits from environmental work, the economic arguments dominate. Improved business possibilities, financial benefits and lower costs, improved company image and some general arguments such as Save the environment for next generations etc. were given most frequently. The presented obstacles for implementing and taking environmental actions and initiatives are a bit more scattered than the drivers. Some of the areas mentioned are management’s commitment, financial ability and hard price pressure on the products, lack of knowledge from the constructors and time. When asked of the obstacles with larger environmental and structural changes the answers were
time, knowing how to prioritize, know-how and to get the staff committed to the project and of course costs as the foremost ones. The number of companies who say they have knowledge about the concept of SCM is 40% in our survey. And 33% has heard about GSCM. Any statement in what the respondents interpreter or define SCM or GSCM as was not made in this survey.

Although not even half of the respondents say they know what SCM is, still many have done some work specific to their supply chains. In order to improve the companies supply chains they have trained their staff and actively managed their suppliers (purchasing). In many cases focus is on reaching higher quality by working with Lean and ISO 14001 (and other tools). The reasons for these actions are mostly to cut lead-times and improve quality. Lean and ISO are specifically mentioned in 40% of the cases as when asked what work they have done with their supply chains. To specific add some green aspect to their supply chain is considered not to be imminent, but the majority thinks that the need could arouse in the future.

For the future, almost every company says they will invest more time and money in environmental matters. No time plan for this is given though. Some mentions related to this that new laws and regulations will demand further investments in this area. One respondent gives specific research as a reason for investments. Regarding experienced environmental-hazardous activities, some companies see chemical handling and RoHS as big issues at their part. One respondent found the RoHS-directive to be a hard matter to handle. Also energy consumption is mentioned. And from others, waste handling, emission control, transport and working environment are the major concerns. Waste handling is the foremost common repeatedly answers, especially dangerous waste (from the production) such as chemicals etc.

No greater problems with identifying where and how to find help and information regarding environmental matters are presented. The general opinion is that they know where to go if they want to get additional information or support. Although one respondent express that they do find problems knowing exactly what regulations and laws etc. are saying, and that information regarding this is not that easy to find.
5 Discussion

5.1 Research Method

The research method used in this thesis were qualitative methods, which aims at investigating the why and how of research instead of calculating exact figures. Qualitative method as research method served the purpose well since the objective was to find ways of how to develop the Thai industry according to the GSCM concept. Through the interviews discussion of the today state was carried through something that is hard to achieve with quantitative research. This as well as getting the management point of view at the concept today and prerequisites for the future.

Prior to the semi-structured interviews a relatively extensive literature study was performed within previous research in the area of GSCM and connected relevant literature. This gave us the proper knowledge base to perform the interviews with confidence and the possibility to keep the discussion going during the interviews. The knowledge though could possibly close our minds a bit since many of the reports can give a subjective picture in their chosen area of research. Therefore the importance of closely examine the literature relevancy for this thesis. Something that has been done throughout the whole thesis research.

Semi structured interviews as research method also served our purpose very well. Even more since the GSCM was less spread than believed beforehand. This gave us the opportunity to more freely discuss the subject with the interviewees as mentioned as an advantage by Nordin (2006). In those cases when there was no knowledge of GSCM or the concept of traditional SCM, the discussions was often steered into environmental awareness and the respondents view on prerequisites for future development and Thai environmental awareness in general.

5.1.1 The Interviews

Our interviewing technique has improved over time. This may have given more adequate answers in the later interviews, and the developed skill could also have made us to ask the right questions or presented these in a way giving us the answer wished for. Interviewing technique is somewhat of a science and many years of practice should be needed to attain expertise (Starrin & Svensson 1994). In general we consider our questions and interviews suitable and reliable to serve as a foundation for the discussion and draw further conclusions.

One problem realized during this research is the problem of time and scheduling for the interviews. On the one hand we had the advantage of high flexibility ourselves, on the other the respondents had their regular tasks to perform and found with much lower flexibility to consider. This was a reason for some frustration and maybe one reason why not more interviews was performed.

The communication with the respondents preceding the interviews was mainly through e-mail and combined with language barriers this method of communication could have been another reason for not succeeding to attract more respondents. Meaning that some might have not fully understood the purpose without interview and/or the required effort from the respondent’s part. The choice to do
interviews with the Thai companies were right since a written questionnaire probably would have resulted in difficulties handling the answers since obviously some of the questions were hard to understand from a technical point of view, for some of the respondents. The interviews gave us a chance to explain what we meant or rephrase some questions (Nordin, 2006) as why this method is preferred.

From most of the interviews we could draw the same general conclusions. Especially with regard to awareness of the environmental problems (from the EEI) in Thailand, the awareness of GSCM and actions needed to come across with the environmental issues in the industry. This will present the general picture that is discussed below and concluded in chapter 6.

5.1.2 The Questionnaire

As a tool to get information from Swedish companies the questionnaires was satisfactory. We should though be honest that wise after the process we would have formulated some of the questions in another way. An example of this is to give the multiple-choice questions more alternatives to choose from. Also after having done interviews in Thailand some areas might have been interesting to put more light on in the Swedish questionnaire, as for instance more in detail see how the view on the government’s effect is/can be. But of course this is hard to know in forehand what specific areas the Thai-companies would emphasise.

We have no clear explanation to the low answer frequency of the survey. Some theories to this could be that the companies just did not have the time for a survey. In spite of that we said it would not take longer than 5-10 minutes. Although smaller companies might not have the time or staff resources to dispose to a questionnaire. Or they might have felt that it did not interest them to be part of a student master thesis, rather if it would have been some consultant firm etc. who was the addressee. Perhaps we should have been clearer that the companies, if participating, would have received the report directly if they so wanted and the benefits they might draw from it. Another explanation could be that the wrong person got the questionnaire i.e. one that was not able to answer the questions. Since the survey was sent to the persons only supposed to be suitable (with a note of forwarding to a more suitable employee if existing), this event possibly occurred and forwarding was not possible or disregarded.

We have no method of seeing if some companies have begun the survey but then aborted. That could have been useful when analysing the results from the questionnaire. We did see that every time we sent out a reminder to those who yet had not answer, some additional answer did come in. At a total we sent out two reminders. It would have been more satisfactory if we could have a higher quantity of answers, but still we feel that the answers we got gives us reasonably amount of data to use.

There exist already previous studies in the area of which we intend to do ours. And these are in some cases extensive and broad but nevertheless do not give answer to all of the questions we would like to have. Therefore we felt it was necessary to do an own questionnaire and study. And the results from it points in the same general direction as previous ones.
5.1.3 Respondents

With a wide scope of respondents from the different sectors the broader picture was provided. The different groups provided their special knowledge in the subject and mostly contributed in the way we hoped beforehand. What one can realize is that special knowledge in one area could mean lack of knowledge in another, this must be regarded through the analysis. Additionally it will be interesting for validity of the answers. This is somewhat handled in our analyses of the individual answers by reflecting on the position of the respondent. In this way we could more easily handle the answers and result from our interviews.

At first glance there may seem as a lack of respondents from some groups, especially from the industry. What can be realized when looking closer is that answers are to a great extent correspond with each other between the respondents. This made the conclusion that the number of respondents is sufficient and thereof the information provided by these a good general view. Also concerning the fact that GSCM is not that far spread within the industry, the general environmental view and knowledge from institutes and academics could count for the industry as well. At least to see what the future may bring to the industry since academic research often lead the way in these developments, and that some of the respondents are trying to develop and spread the methods and theory among the industry.

Language difficulties was in several cases an obstacle to attain the number of answers or ones encompassing all areas aimed to be surveyed. The language barrier existence was something we were expecting but is hard to prepare for. Despite that all interviews provided useful information for the research.

Cultural barriers occurred in the way that Thai industry managers do not understand the environmental awareness and need of a green image, since there is no great demand for this in the region. When interviewing people within the industry we came with the Swedish or western of saving the environment out of good will. A thought that we would have to abandon when realizing this do not exist in the Thai culture today. The main and single argument of changes today in the Thai industry seem to be money - how to profit and how to cut the expenses - something that will be discussed further.

One should be aware that the Swedish reference study only included companies - no academics or supporting organizations. This might have affected the results from that study in ways that companies might have been tempted to give a picture of them that they would like to be looked on, not perhaps the true version of how they actually perform. But also since the form of the survey as a web survey rather than interviews. Most of the questions are of the character that they do not leave any greater room for the type of conceit that could bias the results. Also when asked on their own environmental awareness, the results are not extreme at any way. This could however be because of cultural reasons and that they want to tone down their own excellence and only giving a modest answer. This however is considered not to be a problem. And therefore the lack of impartial partners (such as academics etc.) in the Swedish study is not to be regarded as a problem for this thesis.

Companies can only answer for themselves and what they do, questions from these about Thai awareness may be in some ways misleading. A concern for validity may be the possibility of the
companies wanting to show a good image of them towards this research. Confirming that they should stay anonymous within the thesis should though have compensated this behaviour. Though the possibility of the occurrence should one always be aware of analyzing the given answers.

5.2 Environmental Maturity

5.2.1 In Thailand

The awareness seems to increase steadily from what is found through interviews with scholars and representatives from the universities, as well as previous research from the theoretical framework show (EEI 2007, APO 2008). Also some of the companies (supporting agencies) realize the need of educating and to have educated employees also in the environmental area. This could also be judged as a better foundation for a successful implementation of GSCM or similar environmental development concepts.

Still the general awareness and concern regarding environmental issues is low. According to our interviews people is not that concerned about making green choices when buying products. Therefore the industry does not get demands from the customers to improve in these areas. A big necessity in order to render a wide spread knowledge regarding the environment is education and information. This will hopefully in the long run generate a mindset change among the public and contribute to both greener decisions being made from companies as well as customer demands that drives this development.

As mentioned education is needed both in the lower grades aiming at yielding an understanding and create awareness. As well as in higher levels such as universities. At the moment the environmental related courses at the universities seem to be few and either at a basic level or not that popular among students. And courses with combined environmental influences and business related subjects are not to be found. This is nevertheless sighted in a near future at some universities. Also collaborations between companies and universities in the area of environmental courses for the employees can be seen developed for the near future. Education around the subject is highly relevant though it do not assure increased awareness or change of mindset by itself. Especially within the profit driven industry other approaches for environmental development would be preferred primarily.

The recycling industry in Thailand is poorly developed as stated by EEI (2007) and this is closely connected to the influence the products have on the environment. If no recycling or take-back of the products is done then most of the products end up as waste after it’s used.

One of the approaches also stressed by several respondents should be legislation from the Thai government. The problem of slow bureaucratic processes though prevents a reasonable development. This issue is of course more of a political nature than concerned by the GSCM concept and no detailed solutions on bureaucracy matters should be discussed. Also the fact that adjustment to the existing legislations remains difficult since the lack of proof and monitoring of compliance (EEI
Still development implies a pro-active approach from companies for sustainability, especially in areas such as pollution prevention, use of hazardous substances and other emissions, where regulation and legislation limits will be harder in the future according to several respondents. The same is stated in EEI’s country report (2007) that both short and long term environmental legislation projects are under going for developing legislation. It is notably though that many of the respondents strongly emphasize the governments and the power of legislations as much needed measures. What though may be needed are versions of directives such as WEEE, RoHS and EuP (see 3.3), which are adjusted to fit the Thai market and economic possibilities.

5.2.2 In Thai Electrical and Electronics Industries

Some companies and people in the organizations are aware of the global environmental problems but do not see the benefits of them review their organizations environmental impact. This is why changes must start from the top level management, as stated in the survey by Zhu et. al. (2007), and those seeing the possibility and necessity. As a majority of the respondents from the industry claim the most common drivers for environmental actions are derived from foreign mother companies. It is of course good no matter where the demands come from. But the companies only commit to these actions with goal to comply with the demands, and that will not suit any further development (locally in Thailand). The process of becoming green demands higher commitment than that. Creating this commitment is something seen as one of the biggest obstacles for green initiatives in the theory (Rettab & Ben Brik 2008). Companies with only domestic customers usually do not have the incentives to green their products or supply chain. These incentives must in some way be found or created, either from customers, from management or from the government. Each one of these can affect companies in different ways. The types of incentives or motives could be many and some of these can be seen in Table 1 (Green Business Network 2001). As well as from many earlier success stories and best-practices described by e.g. Shecterle & Senxian (2008). Many of these are also the foundation for the 5S-GSCM model which brings the essence out of the best practices and produce further motives for implementation and initiatives (see 3.6.1 through 3.6.3 and additionally 5.4.4). Customers can put pressure on companies by using their power of choice. If management realize the economical benefits of environmental work, and/or just simply start to prioritize in a different way positive results are possible as stated by several authors in the theoretical chapter 3.7. And finally if the government sets up the rules for companies with regard to for instance emissions, waste handling, green taxes and others, and then make sure companies comply with the laws, the green results are bound to happen.

Wherever the drivers’ origin is there is a great need in the TEEI to raise the level of these since research in this thesis (see chapter 4 Results) show that these are close to none. We see the need of customers demanding more (this can be done without accepting an increased price for the product), changing mindset of management as well as awareness of profitability and competitiveness should increase and that governmental initiatives must be augmented. These changes may take time but in Thailand we find a need to really push the development forward at the moment, wherefore governmental initiatives should be the most substantial.

Few people in Thailand are willing to take the political risk of making decisions of environmental enforcement and laws according to our respondents. Still among those the belief of the power of
legislations and governmental interference is very high. There is a strong confidence that if the government legislates some laws then that will be one of the most powerful ways to make lagging companies to start acting in areas affected by those laws. The bureaucratic process of pushing through new laws etc. is an obstacle to this.

One problem may lie within the fact that the EEI business of manufacturing and production is not that pollutant during the procurement (respondent 7) and also quite developed globally according to Zhu et. al. (2007). The usage phase is often what matters while eco-design e.g. improvements for energy efficiency becomes the common solution. This is one part of the GSCM but far from covering the whole concept as described in chapter 3.5. Concerning that managers do not look at the whole supply chains environmental impact one realizes that their apprehensions and concerns are not that extensive.

Take-back systems are neither common nor established (EEI 2007). Meaning that when a product is used for the final time the chance of it ending up only as landfill is big. We see two reasons for this. One is that the life-cycle perspective is not adopted with respect to Design for Environment, reuse of components and dismantling. And the other is that the recycle industry is not developed and hence designing for re-use or recycling today becomes unnecessary or disregarded. This should though be further developed and investigated since it is one of the major prerequisites for sustainable development, as Beamon (1999) argues for the extended supply chain and closing the loop (also Zhu et. al. 2006). This is extracted from the large environmental impact as well as the great ability to improve.

5.2.3 Comparison with Swedish Electrical and Electronics Industries maturity

From our survey in SEEI we can see that Swedish companies rank their own awareness higher than the companies do in Thailand found through the interviews. The origin of the main drivers for the Swedish companies are stated as external accordingly to them self. When presenting what the strongest arguments for environmental actions are at the companies, they mostly give "Sustainable development" and "General environmental awareness" rather than "market demands" or "legislations and regulations". This shows possibly that either the Swedish companies have a basic different view of the importance of environmental actions, or that they are perhaps just saying these nice things to show off. With our experience from the Swedish culture and knowing of how the environmental debate sounds in the country, we would like to think though that the reason for the different answers regarding motivation for green actions origin from a different view of the whole issue.

The use of tools such as ISO and Lean concept is much more wide spread among Swedish companies. Although the concepts of GSCM is not known specific at every respondent in the reference study, many still seem to have taken different actions in order to manage their supply chains (without calling it SCM). This implies where the development in Thailand is heading although with the great advantage that they can start right away. The development should go quicker if the right tools are used and greater efforts are made, which is somewhat the great concern. Realization that this is a big
chance for the whole Thai industry competitiveness should gain interest with both managers and government officials.

Although the study in Thailand and Sweden are not exactly the same with respect of method or questions asked in the research, we find that the major differences are in the basic view at the environmental issues. The measures taken at Swedish companies seem to derive from an idea that the greening of the supply chains (and mainly the production) is necessary for competitive and juridical (laws and regulations) reasons. And at the same time the actions taken are done with cost reduction as a motivator. Our study in Thailand shows that the fundamental view on environmental issues differs from the Swedish. And that this is one of the major reasons why many of the steps for greening the industry yet not have been taken.

5.3 Green Supply Chain Management in Thailand

5.3.1 Today-state in Thai Electrical and Electronics Industries
Comparing the answers from the different sectors of interviewees (industry, academics and supporting agencies) concordance exists to a great extent. The level of maturity within the TEEI is by all seen as low, and though the awareness can be found the willingness to initiatives is low. The perpetual question of who is going to pay for the changes is mention regularly during the interviews and emphasized in all sectors. Nevertheless an interest for the concept of GSCM is also seen, especially when mentioned that changes can be made without great investments. In this case it is more lack of knowledge that interferes why this thesis with its findings should be of great interest.

Environmental work or initiatives exist in the TEEI according to several of the respondents but not in the form of and with knowledge in the concept of GSCM. Actions that are made to the supply chain and also conserving environment most certainly exist but they are often changes made for efficiency or due to regulations. The same counts for the Swedish companies in the study. Making changes according to the concept of GSCM may be similar with the difference that the concept emphasizes the need to see over the whole organization as well as the whole extended supply chain. This is stressed by several previous studies such as NZBCSD (2003) and APO (2008). This should be one of the first areas to do some work in for the Thai industry - to start looking at the products whole life cycle and way through the supply chain. Preferably this may be done according to the 5S-GSCM model found in the theoretical framework of this thesis (see chapter 3.6.1). In those cases that a respondent has acknowledged some supply chain management, the actions have not concerned more than one tier upstream. This is not enough if the industry want to come across with environmental problems since reviewing suppliers is an important task stressed highly among others by APO (2008) and NZBCSD (2003). Communication i.e. through several tiers will produce better opportunities for change and collaborations (Green Business Network 2001). Remember also that costs follow a product through the supply chain if not taken care of or eliminated early.

If the industry does not really fully understand the concept of GSCM then of course changes are hard to do. Since some of our respondent’s advocates first starting working with SCM, and then adding green, one could ask himself if the education of GSCM is satisfactory. Why not fully go green from
the start or at least simultaneously incorporate green in the SCM implementation? The work to make changes later are often more expensive than to have considered them from the start, e.g. with possibly transaction costs. This is stated and visualized by Lindahl et. al. (2000) (see Figure 3). A related problem is that GSCM is not yet as defined as needed although some efforts have been made and described in the theoretical framework (see chapter 3.5). Many versions exist but no absolute truth. Where the number of versions could be decreased from research and pilot projects, but the absolute truth is harder to find. It could be hard to grasp the concept and even harder if not aware of traditional SCM (chapter 3.4) or have the sufficient environmental awareness. This might explain why some companies (both in Sweden and Thailand) do not say they apply GSCM when they actually do in some extent. And in some extent give answer to why the interpretation of when and how to add green to SCM is as found consistently confused.

How to measure environmental performance is as mention many times before, a hard task. But at the same time essential according to Hervani et al. (2005) and Beamon (1999): This is needed at the Thai companies to understand their development, something that is not done today. The theoretical part on Performance Measures of the GSC (3.9) chapter describe ways of actual and greatly needed ways of measurements. Important for companies to develop own methods and tools to measure and see how they perform. What you do not measure you cannot change.

Again it is important to remember that costs travel downstream in the supply chain. And therefore it might not be obvious at first exactly where savings are being made, since the total gain of some actions might result in many smaller savings. The financial benefits from lowering energy consumption are for instance easy to calculate, since that is reflected on the energy bill. But this also requires that the energy costs in e.g. a production are allocated in the correct way. As studies such as APO (2008), Rao & Holt (2005) along with many others show the total economical benefits from applying GSCM can be substantial in the end.

5.3.2 Consequences of Green Supply Chain Management Implementation in Thai Electrical and Electronics Industries

As no TEEI companies in our study are found to use the GSCM concept in the supposed meaning accordingly to the theory presented in this thesis based on previous research and findings, the consequences of the implementation are only speculative. Though some companies, as mentioned, are adapting to environmental concerns in a way that are in line with the concept (see chapter 3.5). The consequences will hence be judged out of the environmental awareness and the today-state of the industry, also the theoretical framework will provide useful information to this. The part will work as a basis for the exposition of the discussion on future development in the region as well as the conclusions drawn. It should be seen as the bridge connecting current status and what the future can and hopefully will bring.

We could consider the basic (or missing) level to be an advantage when starting to develop GSCM at the companies, hence no previous work will interfere with previous changes. Otherwise new actions could counteract other environmental initiatives. Hence starting from a blank page must not be considered a disadvantage. What should not be blank is the knowledge and experiences from previous attempts (if any), since these provide important information about the business and
opportunities. As the first step in the GSCM model this information together with all accessible relevant information should be gathered (Colby et al., 2007 and NZBCSD 2003). Emphasized that this may cause a large initial effort but will pay back in the long-run and should not scare companies ready to start the GSCM implementation. Although the information gathering may result in great efforts and some time-consuming activities, the initial actions do not have to demand greater investments. As cost is told by all respondents to be the main motive of business, and the largest obstacle to environmental initiatives, this also must be emphasized. GSCM provides management with ways of thinking and handle decisions, through all parts of the supply chain, which serve the good of the environment as well as the company performance. By implementing the ideas of GSCM the management will provide the organization with guidelines that will affect the supply chain as a whole. This will decrease the actual impact of the products, an impact that GSCM additionally will help people to understand and realize. Also preferred cost-avoidance (Beamon, 1999) is closely connected here. This is one of the concepts strongest motives and the one that open the eyes of management at TEEI companies at the interviews.

The mindset of management at companies is today a big problem to change according to respondents in Thailand. This is utterly important since the changes need to start with the management (APO, 2008). And in companies without demands from foreign mother companies even more important. The mindset of people, especially managers, must be changed for the environmental impacts to decrease. One should be aware that if GSCM implementation is done headless or do not show progress, success and profitability in a not-stated short period of time, we see the risk of the initiatives might lose sanction from company managers. Another advantage this provides is that companies implementing in the near future should get a head start to its competitors, and the pro-activeness, supported by Green Business Network (2001) will in the long run pay back from a stronger market position, preparation for unexpected changes and adherent cost, risk management and several other aspects. Being one step ahead could make companies more interesting for foreign investors, since environmental demand almost solely is high among those according to research at TEEI companies, and hence prepared when energy prices will increase and legislations come into play.

The cost of not being environmentally friendly (green) will increase substantially in the future, in SEEI as well as TEEI according to both this thesis theoretical framework, thesis research and previous findings (e.g. EEI, 2007; Brody, P & Ben-Hamida, M., 2008). Due to increased demands, harder legislations with better compliance audits and assumed increasing energy prices. This implies pro-activeness and development of appropriate models starting today.

Educating the industry and inform them more in depth of the theory and advantages of GSCM (such as those provided in the theoretical framework) should accordingly to our respondents help them realize that it is not something you have to do in steps (from SCM to GSCM). Once again information and education plays an important role (as shown in our 5S-GSCM model). Previous studies (Bowen et al. 2001; Rao, 2002, Zhu et al., 2007; Rao and Holt, 2005;) show findings on the financial benefits companies can make from GSCM. Millions of dollars have been saved at some companies (USEPA 2000). But still there is a lack of success-stories from Thailand. This could create insecurity among others and contribute to the hesitation of the advantages and benefits to be made. Since the larger companies in Thailand are mostly foreign own and with influences and demands from other markets,
we see the pressure they can put on their sub-contractors is important. As well as providing the know-how on how to become green. Preferably longer up-stream than just to the first tier.

Finally although it is a debate at some corners of whether GSCM brings profit or only costs (see chapter 3.7), we find that the majority or previous research as well as our own findings in the interviews show that the advantages exceed the downsides considerably. In the case of TEEI some initial obstacles might involve costs that are not as common for a mature market. But this should however not deter the companies to apply GSCM. As mentioned, it might become easier to apply in the future (with higher education among the staff etc.) but most likely not cheaper.

### 5.4 Environmental Development in Thai Electrical and Electronics Industries

#### 5.4.1 Incentives for Development

As seen from the theoretical framework the advantages to implement GSCM are many stressed by several authors and previous research, even though a clearer definition is needed for the concept and models of implementation. With the theoretical framework as a foundation a model has been created that should suit the TEEI (as well as other similar markets, regions and companies with no previous or basic environmental work). With this model the basic and first steps can be carried through without major investments. The mindset and awareness may change through performing the initial steps and the continuous improvement should be emphasized. This model together with realization of the possibility to cut expenses should serve as good motives for TEEI companies to start investigating possibilities of GSCM further.

From the performed survey results tell that drivers for Swedish companies are mainly of economic character i.e. improved business opportunities, financial benefits and lower cost, improved company image (leads to competitiveness). This can be discussed not to reflect the Thai market since development level is far different. What though must be interesting for company managers here is the statement that environmental initiatives, such as GSCM, is told to improve business opportunities, financial benefits and lower cost (Beamon, 1999; Bowen et al. 2001; Rao, 2002, Zhu et al., 2007; Rao and Holt, 2005 and several others). This must to a great extent be independent of region and market. With knowledge at hand and adjustment to the certain market or region these results could be even more prosperous.

Legislation and regulation may not be the best incentive since it could affect more like punishment as claimed by respondent 4. Still they could be necessary for development, at least among those not realized the importance of global sustainability. The problem in Thailand is mostly concerning who will create those laws and when as several respondents mentioned. This should be recommended for further investigation and research. Additionally how to audit the compliance. As respondent 4 mentioned the regulatory proceedings in developing countries by following international environmental directives may only affect negatively, without any comparable liquidity among Thai companies. This is important to realize by the law-makers.
Finally, the fact established, through our interviews with expertise and business representatives, that the costs for negative environmental actions will rise (e.g. through energy costs and (toxic or hazardous) waste handling) should function as another incentive to go green.

5.4.2 Environmental Development

As stressed earlier, unanimous by the authors of this thesis and several respondents, the need of raising awareness among the public in Thailand is crucial for further development. This because demand from end customer and consumer drives the development accordingly. The question is where and how this increased environmental awareness shall begin. Education is discussed to be one big influence, but the realization and effect of this should be investigated further. Education should provide knowledge of changes that do not mean expenses, teach the way of thinking environmentally. These free adjustments are as important as the larger nation-wide extensive investments. Education may start from governmental initiatives, NGO's or in the primary school. A concern this evokes is though how to find people with enough experience and knowledge to teach in the subject.

One can see in Thailand that western culture spreading out more and more. Hopefully this involves the positive parts of environmental initiatives and awareness. This is far from certain and the effects of this could as well be negative, therefore the need of efforts to steer the development in the right direction with good influences. Future development among the people’s awareness demands education and possible subsidies from the government. People in Thailand do not have the money to fully comply with sustainability, or the possibility since the green products or choices not always exist.

In the industry many changes must be made in the future and some development and initiatives can be seen already. Still the matter of money is crucial also here. For full compliance the companies need subsidies or proof that initiatives and actions actually cut cost or make profit. This highly stresses the need of success stories from the region, something that pilot projects with governmental support can provide. As for the general people these industrial changes will not occur from nothing. A general change of mindset is needed among managers at companies since initial support from these are needed (APO 2008). This is hard since they today are mainly driven by cost, quality and delivery, with biggest focus on the first mentioned as our interview findings tell. Hence this once again accentuates the need of success stories and actual proof of profitability (more than those found in 3.7 and especially proof from Thailand. Additionally managers in the industry should realize, possibly from looking at foreign implementation that competitiveness can increase by these initiatives. Moreover mindset should change when (if) further and harder legislation is introduced. Something that is under work from what this research provided. Several respondents also believe that increased energy prices are to be found in the near future. Still the development will take time and respondents estimated this time-span to probably 5-10 years, until legislations, (domestic) market demands and the mindset is changed. The accuracy of the time-span cannot be judged properly, but from this research it is probable. If not accurate the time is judged likely to be more years than the mentioned.
Another argument that should facilitate the change of mindset is based on cost saving. This indicates that a change of mindset concerning environmental issues with management in Thai companies should change in the future. Without giving answer to when and how, forced or by own will the changes will come among both public and industry.

5.4.3 Development of Green Supply Chain Management in Thai Electrical and Electronics Industries

Despite what some may believe the industrial developments do not need to go through SCM, the GSCM can be implemented starting right away. This is an opportunity for companies to start from a clean sheet and with the right tools and knowledge not as expensive as believed. As research is going on of defining GSCM (also specifically for the Thai industry claimed by respondent 4) this misconception of implementation methods may disappear. The 5S-GSCM model is also a guide trying to reduce this belief and for easier implementing the concept. Hopefully this provides knowledge and guidelines to managers and other people willing to change. At least there seem to exist willingness to future implementation of GSCM. Among the interviewed companies one can anticipate a minor realization that the future competition in the EEI might demand a greener organization and environmentally friendly products.

The need for future development of environmental concepts people in general need to realize that changes do not necessarily mean expenses. For GSCM this realization lies with the management, but knowledge should be spread to all involved parties for full compliance. Though knowledge may cost and the question is who should pay for education or hiring expert consultants? Changes may in some cases also demand investment and therefore the importance of showing the actual cut expenses resulting from the GSCM concept as previous findings show (and also discussed in section 5.4.1). Research that is going on at many instances will hopefully provide further knowledge in the future and proof of the concepts benefit when implemented in TEEI. To fully comply with the concept and develop through continuous improvement investments in the future have to be made. These should be seen as long-term investments and should in the end be of benefit for the company. With higher competitiveness and thus increased economical performance (as earlier discussed) these investments should be closer to hand. With assumed higher energy costs in the future (Brody & Ben-Hamida, 2008) as well as increased demand and legislation managers should become aware of the importance of the subject. GSCM is an excellent way to develop the organization within all these areas.

As all environmental initiatives in TEEI success stories from GSCM are needed (preferably from implementation specifically in the TEEI or other ASEAN countries) and these are hard to find at the moment. Governmental subsidiaries for green projects may be one way to create these. If government representatives realize this need the future should look much brighter. It is also important to emphasize the need of not only punishment i.e. for not complying law and legislation, but motives and good incentives in the future. Today it is even hard to find the punishment or fines for non-compliance of legislations established by the respondents through the interviews for this thesis. There is the need of proper environmental legislation and compliance to this. Legislations and
regulations are under way to be updated, although in slow bureaucratic processes, and the future should bring better compliance to these if not proven inoperative.

Swedish companies which in general must be considered in front of Thai companies in the development, tells from our study that they see environmental initiatives as a way to actually gain money and raise the competitiveness. Without further proof an assumption can be made that this development in time will reach Thailand. What this research emphasizes is the possibility to actually make this profits early by begin soon, especially if getting a head-start in the region. This of course requires knowledge and the right tools. Still an open mindset towards the initiatives and no need of large investments can make companies develop a lot.

5.4.4 The 5 step Green Supply Chain Management model

The 5 step GSCM model developed by the authors of this thesis from best-practices and previous research in the subject should be applicable for TEEI companies. The model provided with this research, described in section 3.7.1 with additional explaining parts in section 3.7.2 and 3.7.3, is one way that can be used as a guideline for implementing the concept. Since it is combined from several other reports on previous research it should be discussed in this section. Also the prerequisites for implementation, advantages and disadvantages of the model will be discussed.

One advantage is that the models do not need any earlier initiatives within the company that aims at increasing environmental performance. Since the model emphasizes continuous improvement and is built around a convolute development of increased performance every company will be able to adjust to the model. Also those already started to take environmental initiatives. Vital is to evaluate the organizations current procedures and environmental status (maturity). Additionally looking over the whole supply chain performance and impact i.e. including suppliers in several tiers and the extended supply chain. The model gives guidelines and additional actions that are primarily to consider within the extended supply chain. These actions as found in section 3.7.3 are not prioritized since this depend on many variables i.e. trade, market, maturity and several others (see 3.7.3). Utilizing the model require prioritizing these opportunities and hence some efforts. The advantage of this is management possibilities to consider cost versus performance enhancement as a part of the priority.

What the model further is based on is the dimension of cost and that the implementation does not necessarily mean expenses. This should be suitable for the TEEI since every respondent stressed the issue of expenses. The model and the concept of GSCM argue to a great extent that changes could cut cost, more than the investments made (if any at all). This made without intruding, or possibly enhancing, the dimensions of QCD - quality, cost and deliverance. Dimensions which at the moment are the most important to TEEI company managers.

To implement the model there is still a need of a certain level of knowledge. To give some of this the enclosed sections (3.7.2 and 3.7.3) provides helpful information both on the use of the model as well as possible and preferred actions of implementation. The model might not suit every company in its original design and should in most cases be seen as guidelines and from that adapted to fit the
company practices. Hence some knowledge of how to adequately adapt this model is requisite. In its original form the model can be used for all companies.

Speaking against the model is the fact that it is not yet fully tested, more than what the previous research used for development. Nevertheless the research used is all asserting improvements from using their concept. The combined use of these methods will not automatically give a multiplied effect, but it will though provide a complete model for the GSCM concept implementation for all levels of environmental maturity.

5.5 Summarized Discussion

We find our method of research to be suitable for this study. Different steps in the process are handled accordingly to appropriate methods of work such as forming questions and questionnaire, examine literature and put together a theoretical framework and processing the results from interviews accordingly to this.

Environmental maturity in Thailand in general is to be regarded as low. Neither private nor corporate customers have any greater experience in setting demands on products or services from a green perspective. Mostly it is the price and delivery that are the solely most important aspects when placing orders or choosing subcontractors. Much is to blame the general awareness in environmental matters. The view on how one personally or through a business effect the environment through different actions is not commonly considered. Therefore procedures to handle these matters are not considered as crucial at this time.

Accordingly to our study the concept of SCM is scarcely known among TEEI. International companies do have knowledge in this area but seem to rarely handle the supply chains themselves longer than to the first tier. Among SMEs education and implementation of SCM is spreading but does still not affect the majority of companies. Consequently GSCM is not commonly known or implemented in Thailand. The effects of GSCM is mostly considered raised costs rather than lowered. And no obvious advantages are accepted in general. This together with lack of knowledge in the environmental area leads to the fact that GSCM is only implemented by chance or by direct directives from, often foreign, management. The foreign own companies often have other markets than just the Thai to considered, and therefore have other and more firm legislations to regard.

In order to motivate companies to adopt GSCM some general actions are suggested. Legislations in the area of environmental effecting procedures are required. There is a great belief in the effect the government has in the matter of setting the rules for companies with respect to e.g. accepted emission, waste handling etc. Many request distinct legislations in these areas. Also the general awareness and consideration of environment is suggested to lead to better understanding of the importance of green activities, both from customers and companies. Education is the key for this but still the results is to be seen in many years from now. To motivate companies in a near future to implement GSCM the advantages of the concept must be made obvious. Together with successful examples from those (around the world and in Asia today) who have gained from GSCM. If presenting the values a company can make and savings that can be made the will to implement the
concept should spread more rapidly and more easily win acceptance. Much of this is to convince the
managements of the gains from GSCM.

From existing theory and practices a 5-step-model is presented in this thesis. By following this model
companies can seek to gain knowledge in the area of GSCM. Accordingly to the maturity level of a
company they can more easily find where to begin the strive for a more green SCM. The 5-step-
model presents an overview in what areas which actions is considered as important to take. The
work is a continuous process but is helped by the model to prioritize the process’ different steps
accordingly to where the company stands today. Since the model is a combined framework from
existing literature, theory and research the most crucial and commonly practiced methods are
presented which gives a broad overall picture of how the process of going green can look like.
6 Conclusions

RQ1. In which extent is the Thai industry and market today ready for Green Supply Chain Management according to demands, awareness and cultural identity?

The maturity level for the Thai industry is measured accordingly to how well the companies acknowledge the environmental aspects for the supply chains and advantages from GSCM. Through the research in Thailand it is stated that there in general is a lack of demands from (local) customers and companies (subcontractors) in the areas of environmentalism. Pressure from these parts should drive the development for more green products and production, but today it is mostly the largest foreign own companies who have a concern for this. There exist awareness regarding environmental development and some of its benefits, but the matter of costs and who is going to pay for it is a big concern for many companies, which stalls the improvements. In general the maturity level is low and already implemented GSCM-steps are few.

Legislations are in the area of environment not sufficient to motivate changes for the companies. But there is a development happening in this area although it moves slowly. Mainly because the political will is not strong enough and bureaucratic obstacles occur. It is considered as a political risk to strongly emphasize environmental actions. Growth is prioritized.

Knowledge about Supply Chain Management is spreading also to small and medium size companies but still the green aspect is yet to be added. Also the practice of SCM has still not been embraced by the majority. The scepticism seems to come mostly from the lack of information and knowledge about the costs related to (G)SCM and how it can benefit the companies. And since there are no real pressures to apply the companies refrain from this. Again, the understanding of making business with a green tuning is considered something for the future. The effect of not doing so is today not regarded as eminent.

RQ2. What are the advantages and disadvantages of implementing Green Supply Chain Management in Thai companies?

This thesis presents what previous research and theory show as the advantages and disadvantages with GSCM. These theories applied to the Thai industry combined with further research some matters of advantages and disadvantages can be seen. Our findings show that the previous implementation of GSCM in the TIEE is scarce and therefore the analysis of the advantages and disadvantages of GSCM is mostly to come from literature and other research.

As advantages the theory show that implementation can increase simultaneously economic and environmental performance of companies. This naturally goes for the Thai companies as well. Since no previous work of any greater extent has been done in this area most of the "low hanging fruits are yet to be plucked" meaning that there are problems that are easy to solve without any greater effort. Also there should be no interference with similar initiatives, of the same reason. Despite what some may believe, the GSCM can be implemented rather immediately without practising SCM first, or developed simultaneously. This of course after adequate training in the GSCM concept principles. Applying GSCM should increase company competitiveness both domestic and global. As the (domestic) customer demands for more environmental friendly (produced and influencing) products
Conclusions

increase, as well as legislations in the area tightens, changes in the areas SCM affect will become necessary for everyone in the market. Therefore those who apply GSCM early will also have more time to develop and adjust to this and thereby generate a stronger position in the market. Another advantage from using the concept is that companies can procure a comprehensive picture of their environmental impact, from themselves and through the whole supply chain. This can further help to increase the environmental awareness. Accurate and regular audits and reviews of suppliers should produce better communication and hence point towards increased and more efficient collaborations.

The disadvantages of the GSCM concept are quite few and handled properly their significance can be diminished even more. One of the main disadvantages of GSCM for the TEEI is the fact that it is not well known, and therefore demands educational efforts in order to become successful. If knowledge is missing at the time of implementation the concept may be seen as unnecessary and the result reflecting this. Thus if the results not occur quite instant there is a risk of the power of initiative to fade away. This makes continuous improvement hard and realization of proper implementation emphasized. To obtain knowledge some investments should be made but these should also be paid back in the long run from implementing the concept. Additionally upcoming research, such as this one, helps in providing some of this knowledge.

The concept may seem extensive, especially reviewing the own organization, therefore the misconception of large investments occur. Previous studies from other countries show this as well. With a concept (and a model) that is developed through several rounds and reoccurring steps this can be handled. The continuous improvement may be seen as a disadvantage in this region since this means continuous work efforts. If the concept is giving direct response and results this should be turned into an advantage instead.

The advantages clearly exceed the disadvantages, something that promotes the concept. With proper knowledge, at time of and about the implementation, the possible disadvantages should decrease even more and their significance diminishes. Further this disadvantage could, if handled in the right way, be turned into an advantage and strength of the concept.

RQ3. How do the direct or indirect effects from the implementation of Green Supply Chain Management affect the decision-making in the Thai Electric and Electronic Industry through the process of becoming green?

Since the implementation of GSCM is not that widespread in Thailand the effects in the TEEI are hard to establish. Hence the research question is hard answer straight forward. As previously stated some initiatives have however been made. These mostly concern just compliance to legislation or directive from (foreign) owners.

The profits and advantages from GSCM are not well known among company management. And that will affect the decision-making meaning that the GSCM is not adopted. Proved increased economic performance from implementation should facilitate decisions towards the concept. If presented Thai success-stories the industry would feel a greater desire to implement GSCM. And also realizing that there do not have to be great investments for greening (parts of) the supply chains. Additionally giving the possibility to compare the investments with resulting profit from the initiatives.
Preferred would be to search for success stories from ASEAN countries since the domestic are absent. This could be helpful for the early (initial) development in Thailand. For increasing the level of environmental initiatives these success-stories are very much needed. Governmental allowance to these kinds of projects is essential and will contribute to the power of initiative in the decision-making.

RQ4. What experiences can be learnt from the comparison between theories of Green Supply Chain Management and actual implementation in Swedish and Thai companies?

As noted in this thesis the drivers for environmental actions are a big issue for why the situation in the Thai industry is as it is with regard to maturity and GSCM progress. It is obvious that the reasons for implementing GSCM and doing other green activities differ between the two countries. In Sweden the companies in our survey give a (distinct) picture that they do environmental actions in their supply chain (and production) with overhead argument that it is necessary to preserve the environment. Combined with a fairly good apprehension that the green actions are also good for competitive reasons. Support for this is to be found in the 5 step model and other theory. The same view in the Thai industry is not yet as common. Regarding environmental awareness Swedish EEI is something Thai counterparts should strive for.

Companies in both nations states legislations as important drivers towards green activities. During the interviews in Thailand many stressed this as utterly important. From GSCM theory we see that the government is an important external actor to put pressure on the companies. And this is confirmed in our study as well. Other external sources like socially aware organizations, communities or NGO’s have not been mentioned by the respondents in Thailand. While Swedish companies in some extent acknowledge these as drivers, as well as the own employees health.

In the search for success-stories Thai companies can find those among foreign companies e.g. from the SEEI. The domestic ones from the country and the EEI are conspicuous by their absence. The Swedish study shows no apparent need for positive examples in order to stimulate green actions. But then the environmental debate and culture in Sweden is another and many influences (drivers/positive road-models) already exist. These success-stories can by their example play the role as motivation such as enhanced brand image and help the lagers to show what the industries best practices are in their field of work.

In both countries the use of environmental instruments such as ISO etc. is common. The concept is spread in both industries, but not all are satisfied with the certification in Thailand. This since it is rather easy to attain (ISO certificate) and does not really do that much for further development. And not specifically in the SCM area. The usage and help from environmental instruments like ISO is helpful in the GSCM work at a company accordingly to the theory. Not the least when making decisions mapping where you stand etc.

In all some companies in Sweden and Thailand are doing the right things according to the theory of GSCM. But the knowledge that this is mentioned in e.g. the 5-step model is not wide spread. And in many cases, especially in Thailand, the whole picture of the idea of managing the supply chain is insufficient. No learning’s on how the theoretical practices diverge from actual implementation has
been made, other than to stronger emphasize the governments affect through legislations as to motivation for the companies. From what we can tell the theory still stands.

RQ5. Which improvement potential are there in Thai EEI companies with respect to and with the help of Green Supply Chain Management?
Since the steps taken up till today in the area are few and short, the (theoretical) potential to increase values and improve is high. Though for the potential to actually carry any affect there must exist a will to change and to realize environmental impact and its consequences for the company. Then both examples from other countries and the theory show that economical benefits and environmental ditto is to be made. As mentioned many low hanging fruits are to be plucked initially. But when that is done and the more substantial changes begin then several other parts affect the result as well. Such as demand from customers and others in the market, legislation and management. Together these three create a great potential. Stand-alone they are worth much less since the process will become much more slow and unruly. Still some obstacles interfere with a fully successful development in a short time. The major reason is of course the issue of knowledge. And until legislations, (domestic) market demands and the mindset are changed it will probably take 5-10 years. But again, the potential is high, but the road to fully usage of it is long. It will demand dedication and strive for continuous improvements.

RQ6. What benefits come out of the use of Green Supply Chain Management and is this applicable for Swedish as well as Thai industries?
Previous research show that the potential for better financial performance goes well in hand with the environmental actions. It should be established that companies who apply GSCM can make big savings and therefore increase their profit. Although there is a big difference between the markets and regions for the Swedish and Thai companies in this study, the benefits from GSCM could be concluded to be similar. Though green image may not be a strong and important competitive argument today in Thailand, the need will be found in the future. In the matter of balance between economic matters and environmental sustainability in the decision making, the results from the TEEI are not sufficient to be able to draw any obvious conclusions from. The benefits mentioned from Swedish respondents are lower costs, better environment, improved image and business opportunities. The theory tells us that the TEEI will also find these advantages when the companies have matured and adopted GSCM.

RQ7. How should Thai companies prioritize the different parts and actions in the supply chain management in decisions concerning greening of the same?
The current level for most of the Thai companies is at a basic low. By following the 5 step model the theory and best practices to become green and managing the supply chain in a green way is facilitated. Areas to prioritize are described in the 5 step model. The model advocates procedures following a cyclic pattern through - identify, plan, decide, implement and monitor. By continuous improvement following this pattern environmental performance should steadily increase. This without neglecting the dimensions of cost, quality and deliverance.

TEEI companies that today are at a very basic level should initially look at their own processes and procedures, evaluating their own environmental performance. Creating measurement tools and indexes are in this phase very important for the continuation of improvements. What you do not
measure you cannot change. Knowing the company's status and maturity will set a foundation for planning actions. The 5 step GSCM model suggest several actions in different parts of the supply chain. These parts can be prioritized different depending on business but all part must be considered. One of the main arguments for this model is that it gives a comprehensive view over the supply chain. Where the main focus of the initial step is directed can only be decided by the company itself, thus a management decision. By increasing the company's own environmental performance a greater possibility occurs to demand compliance to environmental initiatives. Preferably the GSCM model should be used also for those, hence knowledge and experience could be shared with further improved communication as a result.
7 Recommendations

7.1 Recommendations

Much of the findings in this thesis derive from a lack of knowledge in the environmental area. In Thailand there is a need to create a sustainable development (as in all parts of the world) and the awareness and demands for green products must be encouraged. How this is done cannot this research conclude and should be further and deeper investigated. Though some possible ways have been discussed and among these governmental subsidies, education or legislation can be suitable. In the matter of education the universities could try to give courses that combine environmental thinking with business theories. And the government in Thailand could be more aggressive in their areas mentioned in this thesis.

For companies with scarce knowledge in the environmental areas the use the 5S-GSCM model presented in this thesis can be helpful when starting their green work. We recommend that further studies in GSCM are done (especially for implementation in the specific region) but the 5S-GSCM model can be a good map for those studies. Start from the very beginning and develop a plan suiting the organization and the business. Continuous improvement is important and keeping a balance between business- and environmental goals.

Starting by increase the own businesses environmental performance is crucial. If the company itself cannot show proper environmental figures it will be very hard to convince other supply chain actors to comply. Therefore audits of the companies own performance is the initial task in almost every case.

Funding from the government for research on the subject might be necessary as well as funding for spreading the knowledge around the concept. Success-stories from TEEI should be searched or created as a part of a positive development of the interest for the concept. Also collaborations with foreign companies (such as the Thai-Danish exhibition described in this thesis) should be encouraged and stimulated. This provides both knowledge and positive experiences.

7.2 Further Research

During this thesis of course not all paths have been fully investigated and areas of less knowledge have been found. Therefore we would like to suggest and emphasize certain areas suitable for further research where we find a lack of adequate research. This thesis can be used as a source or a basic foundation for that work. Suggested topics to study further are:

Around the Green Supply Chain Management concept

- To develop a model for helping TEEI companies (and those from other industry sectors) review suppliers in green purchasing decisions.
Investigate and test the 5 step GSCM model in the industry. Is this model applicable globally and in all business sectors or should it be reviewed further for industry use? Should models be developed for specific industry sectors?

To study the problem of measuring environmental performance and develop ways that suits the TEEI according to economic liquidity and environmental preferences or problems.

Calculation of the actual profits or cut expenses from implementing environmental methods such as GSCM in TEEI which yields in presenting "success-stories" to management and employees in the Thai industry.

Other investigations include:

- Investigation on Thai law-making and decision processes. Specifically for the environmental laws and legislations. Who will create the environmental laws and at what time?

- Investigation in which ways the authorities set pressure on the industry to change and comply with environmental regulations and policies. Which laws should be strengthened and/or created? How would a drastic rise of e.g. the energy price affect the industry?

- How to increase the environmental awareness in developing countries without increased expenses for the customer or producer.

- Investigate the possibilities of building a recycling system for obsolete electronic products or Closed-loop system for manufactures in Thailand.
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Appendices

Appendix I – Interview Questions for Industry

Initial introduction
1: Who are we speaking to and what is your role at the company? Also what is you background?

2: Please give a short description of the company that you represent?
   • The products
   • Size
   • Customers (size/ national/ international?)

3: Where in your (primary) products supply chain does your company locates itself?
   • How much power do you have to affect the (whole) supply chain?
   • Do you have most of your collaborators upstream and downstream?

General environmental awareness
4: What do you believe is the major environmental issues/problems with or from the EEI in Thailand today?
   • Is there a understanding of the problems?
   • Is perhaps the level of knowledge regarding the problem and methods to solve it, and/or emissions and other direct environmental effects (such as polluting etc.) the biggest problem?

5: What would you say are the biggest obstacles towards environmental initiatives among companies?
   • Undefined demands, expected high expenses, diffuse problems etc.?

6: How wide spread is environmental work and awareness (in general) at companies in Thailand?
   • Is it possible to give a general picture regarding the level of knowledge and efforts?
   • Do environmental initiatives take place and if so, are these successful and of the right type?

7: What are the foremost important reasons and arguments for your company’s development towards green?
   • Governmental demands, customer demands, a will to help save the planet, cut costs etc.?

GSCM/environmental development
8: What do you know about the concepts of SCM and GSCM?
   • Are these commonly known concepts in Thai industries?
   • Are these practiced?

9: In which extent has work been done with the supply chain earlier, perhaps with (green) lean?
   • Do you have well developed and updated MRPs and ERPs etc?

10: What are your present strategies for succeeding with your environmental commitment (if you have one)?
    • Energy usage (less, greener), partner scrutiny, re-design the SC, emissions, waste etc.
11: What would you say are the biggest external and internal obstacles for a (larger) greening-process?
   - Knowledge, management trust, time, fail to see the importance/gains etc.?

12: With your current knowledge and process of going green, what are the priorities you do/ intend to do?
   - Are there any specific areas (such as leadership and management, reducing energy costs etc.) that you see as more important/ crucial to deal with?

13: In which way do economical and environmental matters converge at your company?
   - Are environmental issues regarded in decision-making? Or is only the economical arguments presented?
   - Are some (economical or environmental) aspects regulatory held higher than the other?

14: Do you know what your competitors have done in the GSC-area?
   - What does the market sets for kind of demands in the area of environmental friendly products and/or production?
   - Do you know of any example of a customer or contract that you have lost because of lack of green standards?

**Discussion of the concept of Green Supply Chain Management**

15: What were the early and most important gains you made (with applying GSCM or similar)? Any foreseeing long-term gains?

16: To allocate production costs can be difficult for some posts such as energy cost etc. Operating expense relevant to environmental issues is easily “hidden” or “invisible” at some overhead-post. In your opinion, how good is your company in allocating these costs?

17: At your company, is there a specific (executive) position for environmental issues or sustainable development etc.? What mandate does that position posses – how big influence and power to affect decisions and management does he or she have?

18: Do you keep track and (carefully) measure your energy consumption and emissions? Do you know what those posts cost your company?

19: Future – what would you say of the future regarding environmental awareness, actual progress with e.g. CO2-emissions and environmental work in Thailand in general?
Appendix II – Interview Questions for Scholars

Initial introduction
1: Who are we speaking to and what is your role at the institution/school? Also what is your background?

2: Please give a short description of the institution that you represent?
   • Number of students (total at University resp. inst.)
   • Areas of research
   • International contacts and awards?

3: What kind of research do you currently work on?
   • Do you also give classes and courses on the research topic?
   • Have you been teaching long of the subject?
   • Is the course literature etc modern and up to date?
   • Do you receive any support from any company or organization?

4: Is the interest among students high regarding environmental and business related courses?
   • Will the corporate-leaders of tomorrow have a greater understanding of environmental issues and green processes?
   • If not, why do you think that is? And what is needed to be done in order to increase the interest among students to take courses in the environmental area?

5: How important do you believe the schools are to educate and spread interest regarding environmental awareness?

General environmental awareness
6: What do you believe is the major environmental issues/problems with or from the EEI in Thailand today?
   • Is there a understanding of the problems?
   • How is the level of knowledge regarding the environmental problem and methods to solve it?

7: What would you say are the biggest obstacles towards environmental initiatives among companies?
   • For example the problems of undefined demands, high expenses, diffuse problems etc.?

8: Is there a (big) difference between the rhetoric of environmental commitment and the actions taken – both from companies’ and from political point of view?
   • Do companies say they are green (wants to go green) but are not (trying at all)?

9: How wide spread is environmental work and awareness (in general) at companies in Thailand?
   • Is it possible to give a general picture regarding the level of knowledge and efforts?
   • Do environmental initiatives take place and if so, are these successful and necessary?

10: What are the foremost important reasons and arguments for companies’ development towards green?
    • Accordingly to themselves, why are they making efforts with environmental issues?
11: Do you have any suggestions for preferably strategies or areas to handle first in Thailand?
- Energy usage (less, greener), partner scrutiny, re-design the SC, emissions, (hazardous) waste etc.?

**Questions with focus on GSCM.**

12: What do you consider the advantages and disadvantages with GSCM in general?

13: In which extent would you say the Thai industry and market is ready today for GSCM according to demands, awareness and cultural identity?

14: Which, do you believe, are the first actions to look at and consider doing when implementing GSCM?

15: Which improvement potential is there in Thai companies with respect to and with the help of GSCM? Which, if following improvement, are the most important actions to undertake?
- How should companies prioritize the different parts and actions in the supply chain management in decisions concerning greening of the same?

16: What are the early and most important gains you see that companies can make from GSCM? What are the foreseeing long-term gains?

17: Have you studied and compared theory and implementation of GSCM at other countries, and how well would you say the theories are developed in the area at the moment?
- Have you discovered any typical obstacles or areas that are hard to come across with when implementing GSCM?
- Do companies in general have a good correlation between business goals and the environmental goals?

18: What is your opinion on the management role in the process of GSCM? And how should the green be included in decision making?

19: Future – what would you say of the future regarding GSCM implementation in Thailand?
Appendix III – Interview Questions for Supporting Agencies

Initial introduction
1: Who are we speaking to and what is your role at the institution? Also what is your background (education, experience)?

2: Please give a short description of the organization that you represent?

3: What is the main type of support that your organization provides?

4: How important do you believe the schools/universities are to educate and spread interest regarding environmental awareness?

General environmental awareness in Thailand
5: What do you believe is the major environmental issues/problems with or from the EEI in Thailand today?
   • Is there an understanding of the problems?
   • How is the level of knowledge regarding the environmental problem and methods to solve it?

6: What would you say are the biggest obstacles towards environmental initiatives among companies?

7: Is there a big difference between the rhetoric of environmental commitment and the actions taken – both from companies’ and from political point of view?
   • Do companies say they are green (wants to go green) but are not (trying at all)?

8: How wide spread is environmental work and awareness in general at companies in Thailand?
   • Is it possible to give a general picture regarding the level of knowledge and efforts?
   • Do environmental initiatives take place and if so, are these successful and necessary?

9: What would you say are the foremost important reasons and arguments for companies’ development towards green?
   • Accordingly to themselves, why are they making efforts with environmental issues?
   • Do companies in general have a good correlation between business goals and the environmental goals?

10: Do you have any suggestions for preferably strategies or areas to handle first in Thailand?
   • Energy usage (less, greener), partner scrutiny, re-design the SC, emissions, (hazardous) waste etc.?

Questions with focus on Green Supply Chain Management (GSCM).
11: What do you consider the advantages and disadvantages with GSCM in general?

12: In which extent would you say the Thai industry and market is ready today for GSCM according to demands, awareness and cultural identity?

13: Which, do you believe, are the first actions to look at and consider doing when implementing GSCM?
14: Which improvement potential is there in Thai companies with respect to and with the help of GSCM? Which, if following improvement, are the most important actions to undertake?
   - How should companies prioritize the different parts and actions in the supply chain management in decisions concerning greening of the same?

15: What are the early and most important gains you see that companies can make from GSCM? What are the foreseeing long-term gains?

16: What is your opinion on the management role in the process of GSCM? And how should the green be included in decision making?

17: Future – what would you say of the future regarding GSCM implementation in Thailand?
   - Will the corporate-leaders of tomorrow have a greater understanding of environmental issues and green processes?
Appendix IV – Swedish Survey Questionnaire

Företagsnamn
Antal anställda
Verksamhet och produkter

1: Har ditt företag en miljöpolicy?

2: Vad har ditt företag för strategier för att nå de uppsatta miljömålen och kraven?

3: Hur väl utbredd är miljömedvetenheten vid ditt företag?

4: Hur stor anser du miljömedvetenheten generellt vara vid svenska elektronikföretag?

5: Vad anser du vara den främsta drivkraften för er att utvecklas positivt på miljöområdet?

6: Från vilka håll kommer de främsta drivkrafterna och incitamenten att utvecklas positivt på miljöområdet?

7: Vad anser du vara det största hindret mot miljöinitiativ vid svenska elektronikföretag?

8: Känner du till begreppet Supply Chain Management (SCM)?

9: Vad har ditt företag tidigare gjort för att förbättra/anpassa försörjningskedjan gentemot produktens utformning och marknadens krav?

10: Om förbättringar gjorts tidigare vilka var de drivande krafterna till dessa förändringar?

11: Har du hört talas om begreppet Green Supply Chain Management (GSCM) tidigare?

12: Har ditt företag aktivt arbetat med att förbättra era försörjningskedjor ur en miljösynpunkt?

13: Anser ni att det hos ert företag finns ett behov att miljöanpassa försörjningskedjorna?

14: Kommer ditt företag i framtiden att satsa mer tid och ekonomiska resurser på miljöfrågor?

15: En försörjningskedja (supply chain) kan delas in i olika förädlingssteg. Inom vilket eller vilka områden av kedjan är ditt företag verksam?

16: Vilka miljökrav eller lagar finns det som påverkar ditt företags huvudsakliga verksamhet?

17: Har ditt företag något miljöledningssystem och/eller någon certifiering inom området?

18: Vilka är de främsta miljöfrågorna ni har att hantera inom ert företag?
19: Har företaget stor möjlighet att påverka valet av era leverantörer och andra aktörer längs med hela försörjningskedjan?

20: I miljöarbete rent generellt, vilka anser ni vara de största svårigheterna eller problem med sådant arbete/strukturovandling?

21: Vilka fördelar ser ni med att miljöanpassa sin verksamhet?

22: Anser ni det vara lätt att få information/hjälp om och med miljöarbete?