Environmental Information Guidelines

Deliverable 9

Prepared by

ECOLIFE II

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From Products to Service Systems

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Part I Introduction

1 Introduction to this report

1.1. Definitions

Activity Based Costing (ABC)	*Accounting method that tries to identify and assign costs to the actual activity causing them. Is not using traditional overhead accounts.*
Design for Environment (DfE)	*Process aiming at creating products for a sustainable society.*
Electric and Electronic Equipment (EEE)	*A collective name for the wide variety of electric and electronic equipment.*
Emissions Trading	*An economic mechanism that aims at lowering the costs for implementation of for example the Kyoto protocol. Companies are given certain limits of allowed emissions. These are turned into emission credits. Companies can trade these emission credits in emission trading schemes.*
Environmental Accounting (EA)	*Accounting activities that aim at bringing environmental costs to the attention of corporate stakeholders.*
Environmental Cost	*No clear definition at hand. Traditionally seen as costs that occur due to activities such as waste treatment. In EMA, it's seen as everything that has environmental impact, which means that not only waste treatment should be seen as environmental cost but also the time spent, materials and processes used to produce the waste.*
Environmental Management Accounting (EMA)	*A tool that identifies, collects and analyses internal information needs.*
Environmental Management System (EMS)	*Working agendas on how the environmental work should be integrated in the day-to-day business.*
Non-Product Output (NPO)	*Those resources paid for, which are not turned into parts of actual products, for example waste and air emissions.*
Waste Electric & Electronic Equipment (WEEE)	*A directive from the European Union that includes regulations on how the waste of EEE should be handled.*

1.2. About ECOLIFE II

ECOLIFE II focuses on the product-service life cycle of electr(on)ic products, and involve key players in the electronics and automotive industries in all of the various stages of the product-service life cycle – from component suppliers and product manufacturers, to service and logistic suppliers and the end-of-life processors. The main activities of the Network will focus on the environmental and economic aspects of product design, functional innovation and service-system innovation.

The ECOLIFE II consortium has 27 partners, of which 17 are companies and 10 research organisations. The partners come from 10 countries - 8 EU Member States, 1 applicant country and 1 associated country. They play leading roles in, European branch organisations (e.g. ORGALIME, EICTA, EECA, ECTEL, CECED, CAPIEL), national branch organisations (FEI, BITKOM, FEEI), international standardisation bodies (ISO, ECMA, DIN) as well as other networks (CARE Electronics, UNEP, WBCSD, IRC).

1.3. Focus

There is an immense flood of information in our present society; a lot of people have computers and access to networks like Internet where everyone can gather nearly all kinds of information. In this hectic time, manufacturers within the electronic industry have to compete for getting the attention of innumerable public actors; they have to market themselves and their products to survive, but they also have to provide more information of knowledge to survive. Whilst the public gets access to more information, it also gets more demanding in *which* information it gets, and what it gets is also considered with more scepticism.
This report has focused on environmental related information, a kind of information that manufacturers have no problems producing as they have been working with environmental issues over a long period of time. This information is getting more and more important as it was already stated above, and this report has been done as a basic step in investigating the amount of information available and how the manufacturers could use it.

1.4. Objectives

As mentioned, manufacturers have worked with environmental improvement for a long period of time. They have tried different solutions to lower their environmental impact, e.g. some first looked at the manufacturing processes and improved them, then they went on to improve their products. This work is still going on, and lots of companies are now certified with Environmental Management Systems like ISO 14001, see more in chapter 3, to gain further from good environmental behaviour. Years of research have contributed to an immense volume of information and knowledge, which now can help creating a more sustainable society.

The problem, though, is to transfer this information in an understandable way to the right receivers and help them do their part in a future sustainable society. This is a subject where most companies so far have had little or no success. There have even been examples of products that have not been launched because of lack of communication of interesting environmental matters, i.e. the positive features were not communicated to a satisfying level so that customers could not understand the extra value of such a product. The main objectives for this work are to investigate the information at hand and to try to guide companies in how to use it; thereby defining two appropriate receivers, the right constitution of the information and the right way to transfer it.

Part II Today's activities

2 Questionnaire evaluation

To be able to understand what actions companies have taken in their environmental communication up to date, a questionnaire, see Appendix I, was made and sent to companies. The received answers have been collected and evaluated. The evaluation has then been used as a basic knowledge of how companies work and think as well as it has outlined how to proceed in this work, where electronic companies' communication of environmental matters are investigated. This evaluation section presents the questionnaire's results and what thoughts they have caused.

2.1. Seen results from questionnaire

The companies' environmental awareness today is growing continually and has made a much better life cycle management possible. Everything is not yet solved though and how the last bits are going to be put in place is a question the companies now work on. They sometimes express that they want to be left alone and find the solutions to these problems themselves instead of having legislation directing them. It was therefore a little bit surprising that legislation came as a joint second reason of why environmental communication once started, see *Figure 1.* below. Summing up, the external wants are a major reason of why the companies do perform environmental communication.

Many private households would most probably assume the marketing strategy as a driving force for companies, but here, space must be left for other interests. It must be kept in mind though, that even if the marketing strategy were to be the most mentioned reason, this would not be solely bad. If a company has made progress in the environmental field and is telling its customers this, then the customers in turn have the option to decide what to do: accept the information or not. As long as honest facts are marketed, it would only be positive if this lead customers to choose better products.

The fact, that most companies see their environmental communication as information to enlighten the public of its activities, is logic, see *Figure 2*. This goes hand in hand with the different kinds of reasons why companies publish environmental reports, see section *5.4.* In case of the questionnaire, a higher frequency of answers in the categories influence and instruction was expected. If private or at work, people are always users of electrical devices. Studies show that private households can save 25% of domestic electricity by changing their habits just a bit (Naturvårdsverket, 1996). The households would benefit from some kind of guidance that shows what these simple measures mean. If this knowledge could be brought to their places at work, even bigger savings could emerge.

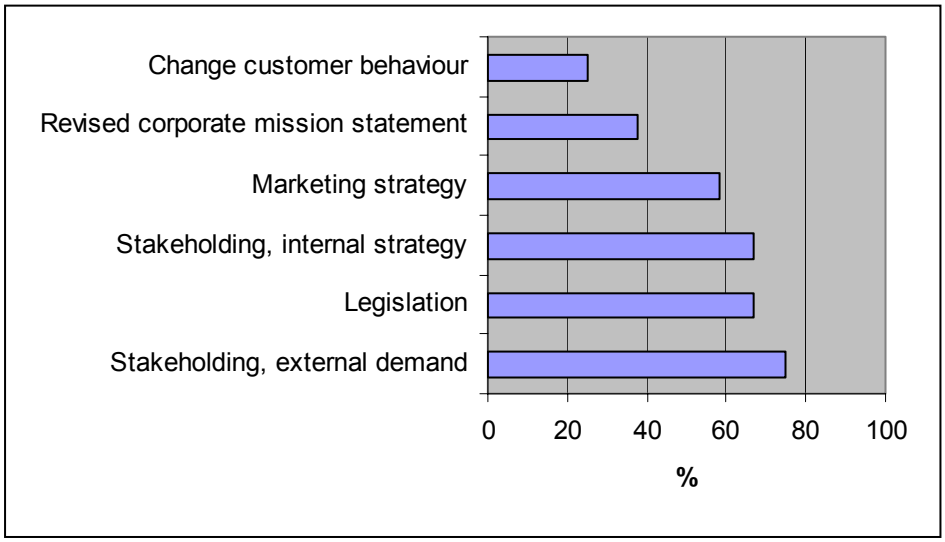

Figure1. Companies' reasons to perform environmental communication

But according to their answers companies do not think this way. With their products, they neither send information about environmental problems or what could be done to solve them, nor do they transfer easy to understand examples of possible savings, see Appendix I Question 4a. Only the companies know the reason for that, but they might see it as a task they are not directly obliged to solve or inform about. As it is, they have limited ways of informing their customers with information following the products, but just a few sentences or clear pictures of problems that are present today and/or in the future would make at least some people more aware of problems and solutions. When people find facts they consider shocking or hard to believe, they normally tell friends about it and one thing leads to another. Though, there is a chance that this fact can change. The companies normally do not provide this information, but 27% of the respondents considered such information important, and this might change future information activities.

From the same question, the information derived, that companies normally do not inform about available upgrading options, i.e. the situation when a customer does not buy a completely new product but, instead, buys new parts and then integrates them in the old product. This is just one example on how to save resources. Many of the responding companies are end producers and therefore did not pay too much attention to this question.

Overall there was a big correlation on what companies find important and what they normally send with their products, see Appendix I Question 4b,c.

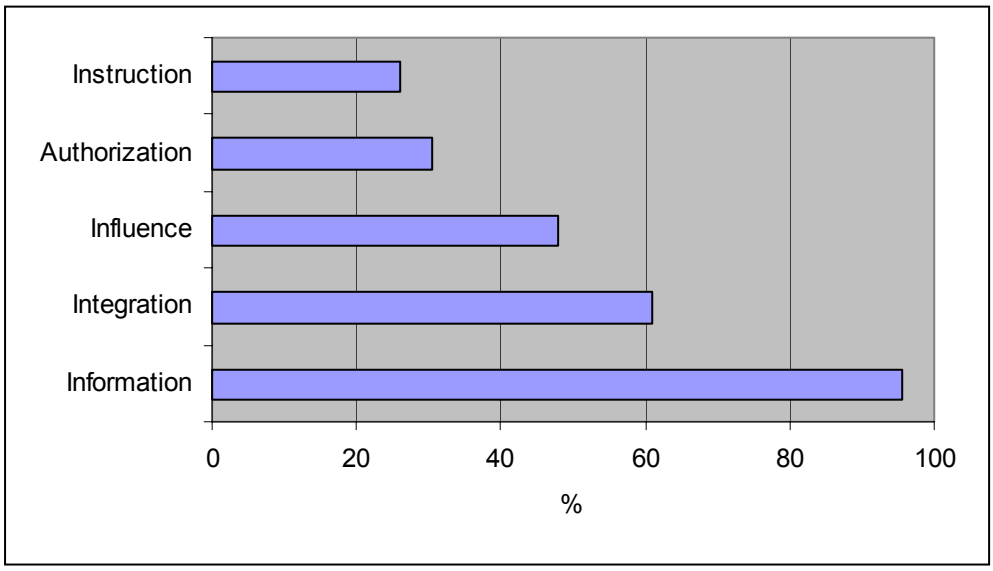

Figure 2. How companies see their communication activities

When it comes to stakeholders receiving information, the certification association, corporate customer, employee and supplier groups get the highest scores, see Appendix I Question 5a. This is not surprising as this is an area where companies evidently have had great progress. With suppliers and corporate customers, a big part of the communication performed with specific forms and since different Environmental Management Systems, EMS, see more in chapter *3*, have been implemented the engaged workers have to be continually educated. For the financial sector, including insurers, financial analysts, creditors and investment managers, higher scores were expected. Here, only the shareholders are seen as a top five candidate for the higher scores, and both insurers and creditors are seen among the lowest scores, see Appendix I Question 5b. Also warehouses do not receive very much.

Most companies use the Internet to broadcast their environmental information and the popular environmental report is also frequently distributed, see Appendix I Question 6. The fact, that the Internet has had a major impact on the way people communicate today, can also be seen in the way companies get feedback from stakeholders, see Appendix Question 7. It is a good thing that the stakeholders and companies have found the same favourite medium to communicate, and since the Internet technology is not yet fully developed things are most likely to become even better. Opinions about what is offered on the Internet today can be seen in section *5.1*.

When companies' activities are to be taken serious by outsiders, it is always better to have those actions rooted as high up in the corporative hierarchy as possible. Therefore, it is pleasing to see that the internal factors that matter the most for a company's environmental communication are corporate strategy, corporate culture and management, see *Figure 3.* The question on how a company sees itself in comparison

with the electronics industry as a whole when it comes to environmental image results in the fact, that many companies are very satisfied with their environmental work. In Appendix I Question 9 a figure of the results is given. Now, some remarks about the figures follow (note 5 is best, note 1 is worst):

- 43% of the companies thought their environmental image to be very good, note 5;
- 69% of the companies thought their environmental image to be 4 or 5;
- 48% thought their company to be better than the industry as a whole;
- 48% thought their company is as good as the industry as a whole, and 82% of these had their notes as 4 or 5, the rest had note 3;

The companies might not have any difficulties in performing their environmental work, but there are difficulties to get people believe in it. This truly is a supportive factor for performing an investigation of communication activities within the environmental work of the electronics industry.

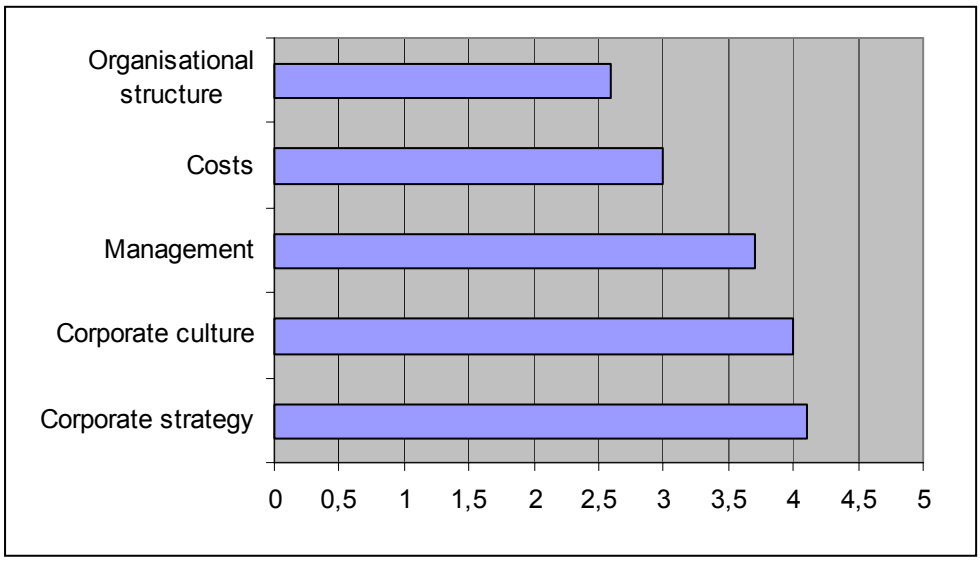

Figure 3. Importance of internal factors

As a final question, the companies were asked to predict the future and what changes there may be to environmental communication, see *Figure 4.* That legislation had the highest score was no surprise, and it might express the companies' want of a better outlined legislation regarding environmental work. Companies do not find today's legislation good enough and want politicians to step in and rewrite it with clearer rules that stipulates how companies' voluntary environmental work might be performed (Autischer, Greenpeace, 2002). What's also obvious, is that the next four categories are

all kind of linked together: an increase in demand requires new ways of communicating it; more specific information can be a wish for more facts or it can come as a result to the increased demand just like the new ways of communication can make the more fact based information important, and so on.

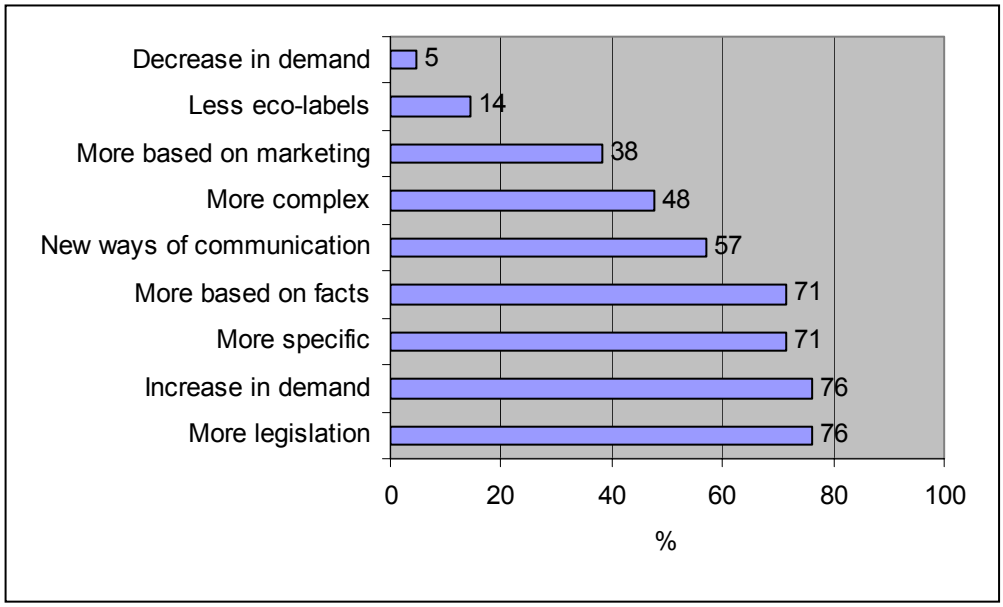

Figure 4. What companies think about environmental communication in the future

2.2. Conclusions of questionnaire results

The results were not too surprising. They show that the companies care about environmental matters and that they try to find solutions to upcoming problems. Pleasing was also that this work is rooted high up in the companies' hierarchies and therefore making it trustworthy for an outsider. Many of the companies estimate their environmental image as very good, and that may not be too surprising either, as they have worked for a longer period of time and with involvement from top management levels.

This report is intended to give companies guidelines of what is being done today and which future solutions might be used. Important stakeholder receivers of environmental information are to be defined and a discussion of which these might be can be found in section *4.1.1*.

3 Environmental management system

As could be seen in the questionnaire evaluation, Environmental Management Systems, EMS, have a role in why companies are performing environmental communication in a structured way. These systems are present as a mean of raising companies' ambitions within the environmental field but also to assure that companies are fulfilling the legislation that they have to follow.

At present, two EMSs are dominating the market: the ISO 14001 from the International Standardisation Organisation and the Eco Management Audit Scheme, EMAS, from the European Union. They are both voluntary programmes that a company must apply for to get certified.

But what does a company have to do to be certified? Step one is to perform an environmental review that investigates the company's environmental impact as well as its organisation to take care of environmental subjects. The development of an environmental policy follows, which outlines the environmental work and which objectives are to be reached. The objectives are specifically saying what to improve or fulfil. These are then presented for the organisation in an environmental programme. The latter is a description of measures taken to achieve environmental objectives including targets and deadlines for when they should be fulfilled. To make sure that everything is working as it should afterwards, the actual environmental management system is designed. This is presented in a handbook and includes the organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy (European Commission, 2001[4]). The system is then reviewed at least once a year to see if all is working well.

4 Stakeholders

In this section, a short presentation of the different stakeholders and their respective influence on the companies' environmental communication will follow. Two stakeholder groups are then analysed in more detail.

4.1. Stakeholder groups

A stakeholder is everything that in some way is affected by or affects a company's daily existence (Marsh, 1998). An approach of decomposing these into subgroups can be done as in the following text:

- Financial sector: creditors, investment and fund managers, insurers, financial analysts and accountants. Creditors want security of possibilities to pay back loans, investment managers want to invest their customers' money in companies that might stand for a specific activity etc. More and more money is being invested in firms who also have a sustainable society commitment. The Dow Jones Sustainability Group Index, a list where companies are ranked according to their measurers to fulfil the thought of sustainability, has shown that companies listed here have a much better economical development than those not on the list (European Commission, 2001[2]). There also exist investment funds that only invest money in companies with a clear environmental policy.

- Corporate customers: large buyers of products, e.g. governments buying office equipment, but also suppliers, mail order firms or warehouses. This is a very large category that includes different interests: a warehouse does not require the same information as a supplier etc. This category is extremely important for a company. It contains outsiders, e.g. a supplier, as well as insiders, e.g. employees, and they all have a great interest in the companies' activities. A well-informed employee might do a better job and help the company fulfil its environmental obligations as well as producing better products that sell more. This will ultimately lead to a company with a high working safety, both in terms of not being injured as well as securing a job.

- Certification associations: there are many different organisations that set up rules which environmental characteristics a product or service has to fulfil if it wants to use special logotypes, for example computers are often certified with the Energy Star logotype, see more Appendix IV. This is the group that received the highest score in the questionnaire, and it might be so because the "actors" of this group normally have their own standards of how to communicate environmental information; firms are obliged to do so to keep their certification. A category of stakeholders that must be seen as quite well informed.

- Media: TV, newspapers and test magazines. The ever investigating journalism has a demand for information but also seeks it on its own. This is an interesting group. People do want information and normally the information provided on

TV or in the papers is welcome by the public. But when it comes to environmental matters the public does not seek information provided this way very often. Test magazines have 5-20% of the test results based on environmental attributes, but only about 10% of buyers care to let a test magazine chose the right product (Cooper, 2002). When a magazine is used, then normally just the winner is sought after, and this without reading the whole test, just the end results. TV and newspapers have an immense power but the question is if they are as interested in providing positive information the same amount as they are interested in disclosure of a company behaving badly.

- Authorities: both international and national, e.g. governments or consumer organisations. These institutions do have an immense influence on the communication as they make the game rules. This is a group with which companies might use lobbying groups as part of their communication activities, and it is therefore likely to be well covered.

- Legislation: both international and national. It is a category similar to the previous one.

- Special interest organisations: e.g. Greenpeace or WWF, so called NGOs (Non-Governmental Organisations). An extended dialogue with this group is to aim for, but big scepticism exists on both sides. It is not probable that a true partnership will arise with a common interest. The companies would gain from such a partnership, but at the same time would the NGOs lose their hard fought image as independent commentators.

- End consumer: both private and professional; the actual user of the product or service. A professional user (e.g. of an electronic device) is normally also a private user. It's positive, that companies have implemented activities in their work that take the environment under consideration, but this does not ensure that the employees will act the same good mannered way off working time. When the staff is doing the right choices at work, it is part of the daily routine, something that has to be fulfilled. But when that is finished, focus might change to include other areas such as family life and regeneration instead of investigating the environmental impact of personal behaviour and following activities and to try to make them sustainable. But since people do not have to change a lot to be able to influence their environmental impact, they have to be informed about how they contribute to the impact.

4.1.1. Conclusions of the stakeholder presentation

The above presentation was very short, and was only intended to show how many different contacts a company must have. Thanks to different new ways of performing day-to-day business, such as the implementation of EMS, some stakeholder groups have experienced an environmental communication improvement. More precise facts are transferred continually and in a standardised manner. The results of this are that

companies in general are more aware of their environmental impact and that they have tried to improve their behaviour more and better than the open public. One should not over-interpret this and claim that companies as such behave better just because of this, though. There is, of course, also a financial benefit for companies that are better at preserving the environment. This is expressed in saved resources, e.g. material, labour time and energy, and thereby also lower costs and a better chance to keep up with the competitors.

Areas of detailed analysis

One way of helping the public is to provide appropriate information, but as stated above most private users do not really care about environmental product attributes when a new product is bought. The question is if the users handle the product correctly throughout its total life cycle. Not all companies selling products to the private customers see them as very important to inform, but as stated above, it's possible to save about 25% of domestic electricity by changing behaviour just a fraction. One part of this report will thus investigate how companies communicate with private customers.

The second group for this paper's focus is the supply chain. This group is already important for the producers, as seen in the questionnaire, and there exists a thorough communication already. This goes hand in hand with companies' wish to be competitive and able to save money from process improvements, and this communication might be able to highlight improvement possibilities. Since the supply chain is seen as important, it would also be interesting to see how communication is performed and which mediums are used. The communication might seem to be satisfying as it is, but improvements are still possible and appropriate. New themes or tools may be available but unused.

Part III Investigation of Private Customers

5 Private customers

Within the questionnaire, private customers where the 8th most contacted group out of 23 groups, but on the other hand also a group that received many answers in the *never* category.

It's most likely that private customers need appropriate help to take their environmental responsibility and that producers can contribute to this demand. The private customers do not only exist as private users of for example electronic devices, they also have other positions in the society where they must handle this equipment, e.g. as employees, students or teachers. Therefore, they incarnate an immense power to make things better – or worse. A lot of the electronic equipment out on the market has its biggest environmental impact in the usage phase, see *Figure 8.*, and by considering this, the only plausible thing to do is to inform and educate the users, i.e. the people.

Unfortunately, this is not easily done. At the CARE INNOVATION conference 2002 in Vienna during the plenary discussion, one general manager of an OEM Environmental Management Organization in Europe, was very honest when he answered the question on how to integrate the public in and change its attitude towards the environmental work of and information from companies. He said he did not know. Companies that do inform the public do this in all the ways that are known to transfer information, and still they are not successful. Likely reasons for why this is not working:

- With the IT revolution more people have better access to information of all kinds. By now, this has not enhanced the public's opinion about companies in general and big companies in particular. Too many companies have behaved too badly to be easily forgiven by the public. There are statistics saying that only 15% of the public find companies honest and fair, and that 66% of the public find that the industry in general does not take enough social responsibility (Wheeler & Sillanpää, 1997). Today, if a company has neglected its duties, this will be spread much quicker to a greater population that will condemn the actions. The public's judgement about industry will change only slowly with every new positive report.

- Since companies are doing more and more marketing, the public does think of information as just another way for the companies to sell more products, and this even if the public wants environmental information (Cooper & Mayers, 2000). The public is disbelieving and cynic, yet interested. A double paradox arises: the public wants environmental information, but the vast majority is not willing to look for it and finally the public does not believe the information they receive from the industry. In fact, only about 10% of the customers really try to inform themselves before they buy a product (Cooper, 2002).

- It might not be the way companies provide the information; it might be the information content that is not appropriate for private customers.

The public is an important stakeholder group to reach. That is confirmed every time people are asked if they know what to do with used products, how to handle products and what different kinds of existing and frequently appearing eco-labels mean. This is of course also relevant for the other stakeholder groups, but today there is a situation where the companies are more aware of their environmental situation and its solutions than the private households (Miljörapporten, 2002).

In the end, it is not just for the well-being of the private customers that the companies have to transfer reliable environmental information to this group, it is also becoming a necessity to do so, as private customers today feel more powerful to influence companies in some way (The co-operative bank, 2003). A company that wants to stay competitive must take care of its customers, and at the same time, this activity might create the benefit of better enlightened customers that make better decisions.

In the following section some of the different ways companies use to transfer information to the private customers are presented. They are shortly described and commented.

5.1. Internet

Internet had its destiny proclaimed a long time. It is the medium that did the most important change in communication. For some it has been that already for some time now, but environmental communication still has a lot to learn (Isenman, 2002). The aim here is not to go too deep into theoretical concepts on how to use the Internet technology, but instead present what is being done today, how it works and what might be done in the future.

Almost every company today understands that environmental matters are do not exist just to make the products and processes “greener”, but also to differentiate business and products from other companies. Here, Internet homepages are an excellent possibility to create interest for the company. A homepage is a market place the customer has looked up herself/himself, and to not use this opportunity extensively would be considered a competitive disadvantage. Of course, this has put the focus on the design of the homepages, which look more like real time advertising campaigns than a place where hard product facts are being discussed. This seems just logic. With their homepages, companies are trying to proclaim their point of how life should be or look like, and this is of course based on the fact that companies today do not just sell products, they more and more sell lifestyles, or even more extreme: they sell the lifestyle that is connected with the brand name (Klein, 2000).

The first impression received from most of the electronic companies’ homepages is that a future is presented, confirmed with photos of people using some high tech devices in a futuristic atmosphere. Then the products come, and they are most likely the reason why

the page was searched for at all. The way to find something about a company's environmental action varies a lot: some have an easy to find environmental information link on the first page, some have an "about us" link where the environmental information can be found.

5.1.1. Offered information on the environmental pages

5.1.1.1. Environmental report

The environmental report can be downloaded and then be read on the computer screen. This is a successful use of the Internet technology and saves different kinds of resources: paper to be printed on, energy for printing and shipping the report etc. It is also a time saving moment for the reader, which no longer has to wait for the ordered printed version. Further information about the environmental reports can be found in section *5.4.*

5.1.1.2. Environmental policies

A company takes care of its environmental image as it informs about its different programmes and undertaken actions to become a more environmentally adapted company: when it started to think about the environment as an important part of its businesses, what it has achieved compared to previous years of producing and what it thinks of the future. These are facts normally published here.

Targets for manufacturing improvements

- 35% waste reduction in 2002 (year of reference 1994)
- 25% water reduction in 2002 (year of reference 1994)
- Reduction in emissions to air and water (year of reference 1994)
  Restricted substances (category I): 98%
  Hazardous substances (category II): 50%
  Environmentally relevant substances (category III) 20%
- 25% energy efficiency improvement in 2000 (year of reference 1994)
  ISO 14001 certification on all manufacturing sites in 2000

Figure 5. A common way to inform on the Internet (Source www.philips.com, 2002)

For an outsider most of the provided environmental policy information often tends to be plain advertising, hard to get a deeper insight for different figures that are mentioned. One easy example is when a company presents figures that express how much it has been able to improve its processes and thereby lowering different emissions. These are often presented with no deeper insight, just the actual improvements without any comparison to other years or what is normal within this or other industry sectors. The reader does not really gain any understanding from these figures and a reader that is halfway interested can easily unmask them as unnecessary information or a halfhearted try to improve the company's image.

Another critic situation is the homepage's last update. If a company e.g. has set certain goals for year 2000, and at the bottom of the page it is declared that the page was updated in June 2002, then the results for year 2000 must be published or the reader will declare the statement invalid and the environmental image will get jagged. This is an example that unfortunately is not very hard to find on the environmental pages of electronic companies.

The policy is thus to handle this issue with care if it is supposed to help improving a company's environmental image and customer appreciation. If that isn't the case, the question arises, if it's useful and reasonable to publish an environmental policy at all. If it is a page that will not be updated very often, it must be better to inform just very shortly about the company's environmental mission and guide interested readers to the company's environmental report or similar spots where updated facts can be found.

5.1.1.3. Product use

Unfortunately, this section is not found on all company homepages. A very good example comes from Dell Computer. Links to easily understand information on how to use a computer system the right way as to maximise positive environmental (and money) savings can be found under the headline *Optimizing your computer* (see the actual address in the reference list under Dell, 2002[1]):

It is possible to minimize environmental effects and maximize cost savings of computer use by knowing the facts and developing the right habits.

Energy Adopting some simple daily habits will minimize energy use, help the environment, and save you money.

- **Turn off your computer** Computers are designed so that frequent shut downs will not significantly affect them. In fact, turning off a system saves energy and may prolong the life of your computer.
- **Turn off your monitor** Remember to ALWAYS turn off your monitor at night and when not in use. Even if you have power management enabled for your monitor, leaving a monitor on all night uses significant electricity. If you need to leave your computer running for the day, get into the habit of turning off your monitor when you are in meetings or away for lunch.
- **Enable power management features** All Dell desktop and notebook computers come with power management features to minimize energy use. These features enable the computer to go into low power mode when not in use. Using a Dell Energy Star computer and monitor can save energy, money, and lessen pollution, but only if their power management features are enabled. For further information see, Energy Star Office Equipment Program.

- **Skip the screen "saver".** Active, moving screen savers don't "save" you any energy. Screen savers were originally designed to "save" the phosphorescent coating inside your monitor, but this is only an issue for monochrome monitors that are rarely used today. The best thing to do for your monitor and the environment is to turn off your monitor when you are not using it.

Printing You can reduce the environmental effects of printing by utilizing communication and editing tools on your computer.

- Increase methods of paperless communication such as e-mail.
- Edit documents on the computer or use the clean side of used paper for printing drafts. Double side print jobs.
- Purchase environmentally preferable printers, toner cartridges and paper.
- Buy recycled paper with high post-consumer content and recycled toner cartridges for your printer.

Another good feature of the Dell site is that product specifications can be found, for example how much energy a product consumes in the different modes, on/off/stand by. This is suitable for customers who try to find low energy products. For the 'off mode' it is also explicitly stated that for reaching zero energy consumption, the power cable has to be disconnected. The real benefit of choosing the best energy choice available is not fulfilled due to the fact that not all competitors provide this information. Apple Corporation has similar product specifications that can be downloaded, and these are also extended with information about recycling activities and environmental conscious design actions such as ISO material codes (Apple, 2002[1]).

If a company has an end-of-life-management this is also often stated on the Internet site. Information on who to contact and what benefits are gained from an adjusted recycling programme are at hand. In most cases, this end-of-life service is free of charge.

5.1.1.4. Quiz games of customer behaviour

This is an interesting section, but so far not very common. Two versions are presented now, Samsung's and Sony's (see actual addresses in the reference under Sony 2002[1] and Samsung Electronics 2002[1]).

Figure 6. Samsung's green index quiz

At Samsung there is a section called *green experience center* with subheadings as *green living, green lessons, green stories* and *the life of a product.* As an information source, the first two are interesting. In the green living section there are three different questions and answers, not all of them with an environmental profile, though. Easy to follow information on how to use and handle products in a manner to lower energy consumption, save money and enlarge the product life is presented. In *green lessons*, products that are important for daily life are to be chosen and followed by a small questionnaire on how the reader actually handles them at home. After the questionnaire is completed, a green index for the reader is produced and displayed, telling her/him how environmentally aware she/he is.

At Sony's homepage there is a link to *Eco Life.* This portal has a deeper and broader aim than Samsung's and is divided into three main sections: *Check your eco-awareness,*

Figure 7. Sony's eco awareness information (Source Sony Environmental Report 2002 CD)

What will become of tomorrow's earth and *Life of a TV set,* see *Figure 7.* All these sections are interesting in an informative and educational way. In *Check your eco-awareness* questions are asked about how products are to be used and about related personal behaviour. This is similar to the *green lessons* section of Samsung, but at Sony a more thorough explanation of possible improvements due to better environmental behaviour follows directly after the questions. The explanations are easy to understand with informative pictures as a further help. *Life of a TV set* shows which life cycle phase of a TV set has the greatest impact on the environment, see *Figure 8*. *What will become of tomorrow's earth* is a mind awakening section with information about problems and possible solutions for air, water, life, resources and forests.

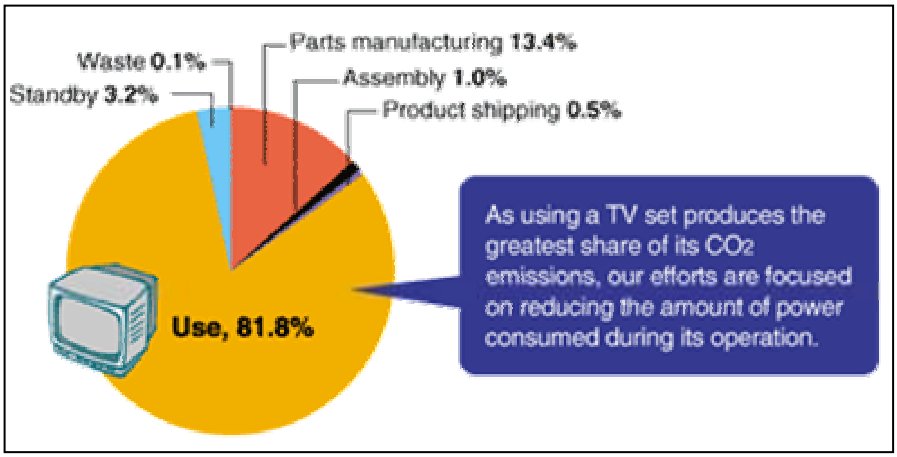

Figure 8. Environmental impact of a TV set throughout different life cycle phases (Source Sony Environmental Report 2002 on CD)

Both versions are good attempts of doing something new and make the information easier to get. They are of course not the complete solution to the information need, but what they can do is to surprise people and make them act in just a little bit more aware way. Unfortunately, they are Japan and Korea specific, but this does not mean that they are useless for Europeans or Americans. We all understand how much a kilogramme or a pound is, but it can be hard to understand what 500 kg of CO_2 mean for the environment or what 45% of a household's CO_2 emissions really mean. Sony has tried to solve this understanding problem by e.g. showing a picture of how many trees are

needed to neutralize a specific amount of CO_2 emissions. Sony also explains easy measures to lower the emissions. This makes the facts easier to understand.

Samsung on the other hand says that by just opening the refrigerator door four times less every day will result in energy savings of 4.9 million dollars every year in Korea. A combination of Sony's and Samsung's is needed for an outsider to completely understand the situation, as she/he must not know the social culture of Korea or Japan. A descriptive example that might be easier to understand could be: a family has x electric household devices used y hours a day, but if they are turned off instead of put on stand by when not used, this extra activity would save z kg in emissions but also u € every year due to lower energy use. Calculating this for some different sized countries would really make it clear to the public how much they can influence the environmental impact of electronic devices. To use financial information is plausible since everybody understands the value of money.

5.1.2. Conclusions on the Internet section

Using the Internet as a tool for publishing environmental information can be successful. It is not yet perfect, but companies work hard on it. It is good that the environmental report can be downloaded and it is interesting to see the efforts of Samsung, Sony and others with their new "test yourself" information.

On the other hand, many companies offer too much information, which makes it hard to find specific requested parts. Since very few people look for environmental information, it is important that it is easy to find it and at the same time make it interesting for those not looking for it. This is obvious for companies that want to sell something, they know that the customers have limited time and shopping must be made easy (POP, 2003). This should also go for environmental information on the Internet. Users might pay per time unit when using the Internet and then they do not wish to have to wait a long time for a download or a time-consuming search for what they are after. Further information provided on the internet is often not product related and for a customer it's difficult to asses the environmental performance.

5.2. Environmental labels and declarations

Communication of environmental performances of products to customers through eco-labels is a delicate problem. It started in the mid 1970s and has grown ever since. At first it might have been a good way to inform the public in an easily understood manner, but it lead to marketing with environmental attributes that could not be verified always. Since labelling was becoming an important task for the industry in the beginning of the 1990s, the different ISO 14000 standards made environmental labelling a major task to be standardised.
There are three main mechanisms available to suppliers for the provision of environmental information to customers:

- **Standardised labelling schemes (Type I),** the so-called **Eco-labels**, awarded for products reaching a specified level of performance. These are administered by a variety of bodies: public sector; private sector and NGO. **High-level award schemes** (e.g. the Queen's Award for Sustainable Development in the UK) provide a few outstanding businesses with an additional, more valuable third-party endorsement.
- **Self-declared environmental claims (Type II)** account for most of the 'product sustainability' information currently in the market. They vary in quality from the clear and informative to the vague, unhelpful and misleading.
- **Third party certified environmental declarations (Type III)** provide specified and quantified environmental information based on full life cycle evaluation. The declarations are certified by a third body.

5.3. Labels

Standardised labelling schemes – so-called eco-labels - have proliferated over the past few years, so that there are now more than 35 operating around the world. Suppliers wishing to use these can choose between a number of formats:

- Single-issue labels, such as the Forest Stewardship Council (FSC) label on timber products or the "Freedom Foods" label of the RSPCA.
- Multiple-issue labels, such as the EU eco-label, which look at the overall impacts of a product across its whole life-cycle.
- Eco-rating schemes, under which products are awarded a rating, say on a scale of 'A' to 'G', based on their environmental performance. Most are single issue (for instance the EU energy label).
- Eco-profiling schemes, which provide factual information in a standardised format (for example the current UK voluntary car labelling scheme, which shows fuel efficiency and emissions).
- Social or ethical rating schemes, in which a number of social or ethical standards are met in order to satisfy an external assessment (e.g. 'fair trade' labels).

Many eco-label schemes are country-specific and some, such as the EU’s energy-labelling scheme for white goods, mandatory.

Now, most companies and other industry institutions have these comments on **eco-labels** as a communication tool:

- there are too many different programmes, which will only confuse the customers;

- diverse and costly test procedures;

- these programmes concentrate only on a small part of all items; industry thus means that voluntary agreements and developments based on a scientific consensus with government and environmental groups will have a far more beneficial environmental impact as it covers the whole spectrum of products;

- it takes too long until a product is certified, which is a big problem for an industry sector such as the electronics industry, where the time-to-market for and product life are short;

- it might be difficult for customers to see the label since the space left on the product packages is very limited;

- even if the industry is against eco-labels, some still might consider it as a solution if a market advantage is identified.

Too many programmes exist as to comment them all individually. There are characteristics though as to sum up the advantages from the present situation: companies see the labels as standard instead of really being a market advantage, the labels have intensified the competition regarding environmental innovations and the products have really achieved a better environmental performance (Karlberg, 1999).

Thus, the companies are trying to find other solutions, but still many of them use labels on a high frequency as a contact tool with private customers. According to the answers of the questionnaire seen in Appendix I, 79 % of the manufacturers that have contact with private customers use labels as a communication tool. When not only manufacturers are considered, the answers to the questionnaire also show that only 15% of the companies see a decrease in the number of different eco-labels in the future. As a fact, many companies create their own eco-labels due to the long and hard way of getting a product certified in an international programme. A short presentation of the most popular ecolabels can be seen in Appendix IV.

Figure 9. European energy label

But not only negative experiences have been made. In Denmark, the label called The Nordic Swan has had a positive influence on the market of environmentally adapted products, in this case hygiene products such as toilet paper. A study (Bjørner et al, 2002) showed that the label had a market share of 20% for environmentally adapted products. The rational of this is that if no product had been labelled within this group, then sales would go down by 20% for the environmentally adapted products. This does not imply though that the Swan label or any other would have an equal success in other countries as cultural differences such as the public's belief in guidelines from authorities also contribute to how consumers are shopping.

The European Energy Label, which enables the customers to gather the most important consumption characteristic data of an appliance and to compare this with that of other appliances directly, has also had success on the market, see *Figure 9*.
This is a mandatory requirement for home appliances sold within EU and, according to contacted retailers, the label plays a major role for most customers when they are deciding upon which product to purchase.

5.2 Self Declarations

In some case manufactures prefer to give customers specific information about environmental performances of their products rather than putting a label that cannot always describe or include all the relevant characteristics of the products. Also, customer requirements concerning environmental issues can change quite quickly and standardised label schemes are not suitable to be the right communication tools in this case.

Manufactures have then the possibility to provide voluntary information by self-declarations (Type II) in which they can include information such as material content, energy consumption, recyclability, etc. The level of this information can vary form case to case and from one producer to another.

5.3 Environmental Product Declarations

Type III Environmental product declarations (EPDs) give prospective customers information that allow them to compare the performance of competing products. They can be seen as "green technical specifications". The environmental product information derived from a lifecycle evaluation. Because it is based on a full lifecycle evaluation, EPD information is often very complex and detailed.

When they make purchases, either as individuals or as representatives of larger organisations, people need information to help them choose between competing products and services that can fulfil their needs. The information they use includes technical specifications, price information and third-party commentaries. Knowing this, it’s clear that purchasers need environmental performance information if they are to identify, or choose between, environmentally 'preferred' products and services.

Providing this kind of information is a new endeavour for suppliers. There are similarities between environmental performance information and *technical* performance information but there are important differences. For example, environmental impacts arise throughout the life-cycle of a product or service, while purchasers seldom have the same depth of understanding of these complete life-cycles as they do of issues relating to product use.

EPDs have started to become an accepted communication tool for environmental information on the European market as well as on international markets. However, EPDs are still at the beginning of their development and several initiatives could be undertaken to improve their further growth, including improving the harmonisation of EPD schemes, stimulating the supply side by improved access to good quality LCA data and stimulating the demand side by strengthening the link between public procurement and EPDs. It is important to note that these activities should be developed in combination since the future expansion of EPDs depends on success in all three areas (stimulate the supply side, ensure harmonisation of EPDs in Europe, stimulate the demand side). More information and details on EPDs can be at the respective homepage (EPD, 2003).

5.4. Instruction manuals

The instruction manual is often mentioned as a medium to transfer environmental information and about 65% of the companies in the survey said they use the instruction manual for this purpose. Here, the environmental facts have to share space with other product data, and therefore have to be easy to understand to be appreciated by the reader.

5.4.1. Available environmental information

A short list of present environmental information found in instruction manuals:

- Energy consumption: For electrical devices there often is information about energy use in different modes: on, off or stand by. If the product has a feature that puts the device in a low power mode in case of inactivity, this is also mentioned.

- Batteries: if it is a device powered by batteries it is always mentioned what to do with the batteries when they are out of power.

- After use: when the product finally does not work there is information of what to do with the product. Normally though it is just information that the local community waste manager should be contacted in case the customer is not sure of what to do.

- Usage: how to install and properly use the product as to gain longer life for the product is often mentioned.

- Recycling: if the company has its own recycling programme this is often mentioned. Information about where to send or transport products, and whom to contact if questions arise. Additionally, the benefits of recycling are often mentioned.

- Material: it is important for the companies to inform about the toxic materials the product contains. More important though might be to inform about which toxic materials are not present and why, e.g. CFC in refrigerators.

- Contact: to make it easier for the customers to be able to contact the company, information is provided about this.

5.4.2. Comments on available information

The fact, that companies provide environmental information in instruction manuals is favourable. The way the information is presented might not always be satisfying though. The manuals differ a lot in quality and not everyone is readable. This is a problem when it comes to information the customers are not so interested in while reading. Thus, the information has to be made interesting and easy to understand. In this case, pictures as depicted in *Figure 8.* might be a good way. Here, a customer directly sees what he or she can do to minimise the environmental impact and at the same time save money. To include information that use money in some way is always good, since everybody can relate to it. Information that explicitly points this is out is interesting, because a certain product's feature will decrease the energy use so and so much and that this in turn will save the user or the country he or she lives in a specific amount of money. According to the questionnaire not many people share this view; it is placed as 13th of 19 categories of what the companies find important.

Mentioning the energy use for products is good and it furthermore seems to be an unavoidable fact for the companies to publish. It would be even better if it also were stated explicitly how to reach zero energy consumption, i.e. the complete disconnection of the power cable. The energy use also has to be put in connection with something. Just to publish a figure of energy use is not something everybody understands. If the figure for the energy use of the present product were connected with a household's total use of energy, the customer would see more clearly how he or she could save energy and thereby money. *Figure 10.* and *11.* show examples of this from a community in Sweden (Aneby, 1999).

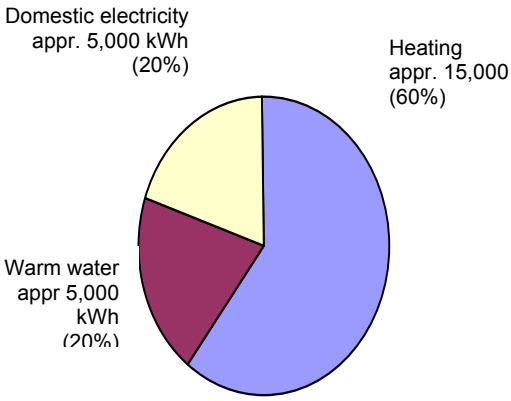

Figure 10. Energy consumption of a household

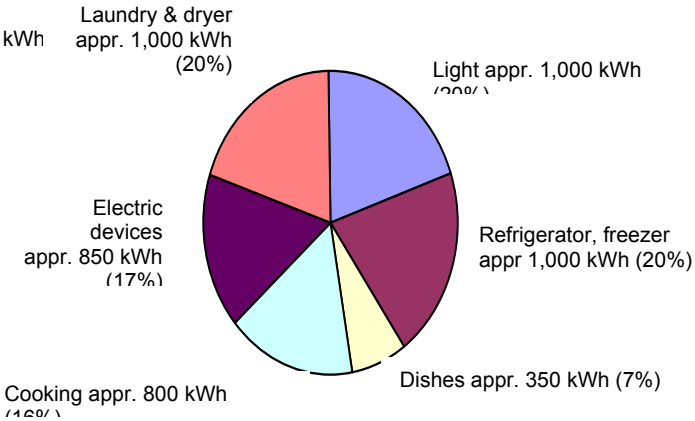

Figure 11. Domestic electricity divided in parts

Though, there are problems that make the environmental information in manuals complicated. One reason is the limited space, the information must be easy to get hold of directly and this is difficult when space is limited. Another reason is the fact that the information has to be presented in different languages. This is very time consuming and companies can have hundreds of different products and be obliged to provide manuals for every one of them; a task not easily solved.

5.5. Environmental reports

In the last decade, the amount of companies publishing environmental reports had continual growth. Today, more than 2,000 companies worldwide publish their reports and as for all publications, they differ a lot in quality and content. Since the companies' environmental awareness has grown, they try to use this awareness to create new market advantages and as a result, the reports are being examined and ranked by different organisations. The environmental report has therefore become a prestigious task to fulfil, and in average increased its number of pages to 86 for year 2002, an increase of 46% compared to year 2000 (Miljörapporten, 2002).

Figure 12. Kodak's environmental report

The environmental reports have different names in different companies. Some do not publish a specific environmental report but incorporate it as a part of their conventional financial company report; some publish a sustainability report, a collective name for

their social and environmental reports, and yet others call it an EHS report, as in Environment, Health and Safety. All these different types are regarded here as the same category of a communication tool.

5.5.1. Reasons for publishing a report

Stakeholders of all kinds pay more and more attention to environmental matters. Thus the companies have to find new ways of broadcasting the information the stakeholders want and in the late 1990s the environmental report had its great break through. Normally, a report claims to be written for all possible stakeholders, but a clear distinction between the underlying purposes can be seen (Ranking Umweltberichte, 2000):

- The market oriented report: is made by those companies, whose stakeholders normally would not consider as harmful to the environment. Either it is made to inform the public about the measures the company performs to keep its good environmental behaviour going, or it is made as an eco-marketing tool for the niche-stakeholders that are really interested in environmental matters.

- The image oriented report: is made by those companies, which are considered as possible environmental risks by the public, e.g. chemical industries or big power plants. They use the report as a mean of increasing its trustworthiness and confidence among the public and thereby gain bigger acceptance for its activities.

- The management oriented report: is made by companies whose management wants to put more attention to the internal environmental work. These reports are not offered directly to external stakeholders but have to be asked for explicitly.

Of course an environmental report can also be an EMAS certified company's way to present its obligatory information demands about its environmental work, as seen in chapter *3*. No matter what the underlying purpose is, there are lots of benefits identified for the companies fulfilling a report (GRI, 2002):

- Effective management requires a proactive approach and here, measuring and reporting of past and anticipated performance can be seen as a critical management tool.

- Continual dialogue with stakeholders is required in today's complex world. Reporting is a good tool for building, sustaining, and refining stakeholder engagement. It is superior to simply responding to stakeholder information requests.

- Relationships with external parties are keys to business success. The report as an open dialogue about performance and priorities can help strengthen these relationships.

- The report links internal functions of the corporation and opens internal conversations where they might not otherwise occur.

- It helps finding the trouble spots and unanticipated opportunities of the company.

So even if the report was seen as a market oriented approach at first, it undoubtedly helps the company to gain a profound understanding of its own activities. A really successful report thus has two-piece legitimate reasons: the better-informed stakeholder and the better internal knowledge of the company, which of course can be seen as a win-win situation.

5.5.2. Normally offered information

As the report is a deep going investigation of the company and whose results in most cases are thought to be offered to the public, a good report always starts with the managing director writing an environmental statement. This gives substance to the report's conclusions and results. The sequence in which the subjects are gone through there differs from company to company, but normally the same kind of facts is presented:

- how the company interprets sustainable development;

- what kind of EMS is present;

- environmental impact facts such as the consumption of water, energy and other resources;

- recycling programmes;

- better energy conservation products;

- and social responsibilities.

According to the latest ranking of the United Nations Environmental Programme, UNEP, the focus of the reports have changed from environmental subjects to social responsibilities (Miljörapporten, 2002). Wider information about the company's more active role in the society, such as education programmes for children and other partnerships with local communities, is presented.

The information is mainly presented as a text, complemented with pictures and diagrams for a better understanding. Some reports are a combination of a market

oriented report and an image oriented report and this especially applies for the European and North American reports. A private customer trying to find more than just the company's activities will be disappointed in most cases. If the company as a whole is interesting though, then the environmental report may be a good source of information.

5.5.3. Conclusions on the environmental reports

The environmental report can be seen as a win-win situation for the company, but to really reach this, the report has to be presented in such a manner that the reader perceives it attractive to read. It does not matter how good the results or activities are presented - if they are not explained or presented in an appropriate manner, there will be no positive reception. When western European and North American reports are compared with reports from major Japanese companies, this is very obvious. The first ones have, in most cases, a completely different layout and sometimes look more like product catalogues aimed at marketing a product rather than informing about a company's activities. This can go either two ways: make the reader more interested to go on as he easily understands what she/he is reading even if it is about the environment, or the reader gets appalled as he thinks he is reading a marketing brochure instead of trustworthy environmental facts.

As the UNEP published its ranking of the world's 50 best environmental reports, the best Japanese company was Ricoh Japan at place 17 (Miljörapporten, 2002). This might not be seen as a very poor result, but with the knowledge that Japan has had great progress in its environmental work and sometimes is considered as the leading country within this field, this may be a surprising fact. The Japanese reports in general have all the necessary facts, they even provide facts that are missing in most European reports – the environmental fact figures directly derived from the public's use of a company's products; but, unfortunately, they are not delivered in a very readable manner. European and American reports have clear diagrams and pictures and not too much text. Japanese reports put as much information as possible onto a page, often accompanied by a small character size. These are facts that make it even harder for the open public to take advantage of a well behaving company's activities.

Not all major electronic manufacturers have fallen for the environmental report though. Apple Computer explicitly states that they do not find it necessary to publish an environmental report as they consider their website on the Internet as a satisfying information source (Apple, 2003[2]).

5.6. Sustainability reports

As mentioned before, there are also other forms of communicating a company's environmental behaviour to the public. Producing and release of a sustainability report is one such possibility. A sustainability report not only focuses on environmental aspects, but also on economic and social impacts. Another common name for practicing the goals of sustainability (reporting) is Corporate Social Responsibility (CSR). The World Business Council on Sustainable Development defines CSR as *"the continuing*

commitment by business to behave ethically and contribute economic development while improving the quality of life of the workforce and their families as well as of the local community and society at large". A key feature of CSR is a commitment from the organisation to report on all its activities in an open, transparent and balanced manner reflecting all three pillars of sustainable development. The publication of a sustainability report requires the company to broaden the scope of its reporting activities, to go beyond the quarterly disclosure of financial information and address the wider environmental and ethical implications of its activities, products and services. In the recent years, the interest in sustainability reporting was increasing: more restrictive governmental issues due to environmental concerns, more aware financial markets that put more and more emphasis on social aspects, brand image, and reputation, and finally, the public ("everyday people" and NGOs), that increasingly watch company behaviours. Furthermore, stakeholders expect to be able to trust an organisation's sustainability report.

5.6.1. Constraints in producing a sustainability report

There are a couple of constraints in producing a sustainability report. The main reasons are:

- lack of an appropriate data gathering system
- troubles in collaborating across business units to gather the data
- troubles in determination and evaluation of available information from across the various business groups
- troubles in defining boundaries for the report's content
- troubles figuring out whether to report on a facility-based level or an international level (depending on size)
- troubles in deciding how integrated the data should be with the financial report
- difficulties in communicating the need for reporting to upper management

Reporting is just one phase of an overall CSR programme in a company, so if it hasn't been built into the programme in the early phases, it might be difficult to introduce later on.

5.6.2. Content of a sustainability report

Basically, there is a considerable flexibility in the precise contents that a company need include in the report. However, in the last few years a number of initiatives have emerged that have developed reporting guidelines to assist companies wishing to publish a sustainability report. Some of the key organisations, including the Global Reporting Initiative (GRI), the International Chamber of Commerce and the United Nations, suggest outline structures and key performance data for inclusion in the document.

Despite the growing trend to involve stakeholders in the reporting process, it is not commonplace for large multi-national companies with many different business interests to carry out stakeholder consultation; there are potentially too many target audiences with widely varying expectations. Furthermore, under these circumstances it is very difficult to prioritise the issues and indeed the stakeholders. But there is a trend to tailor the content and the style of the report according to the audience based on stakeholder research, for example producing more quantified reports for financiers and directors. However, the disadvantage of this procedure is higher expenses.

It's desirable to avoid publishing incomplete or unreliable data. This is an important aspect of reporting, as the reporting organisation must have total confidence in its data should it be required to explain or defend the information or its position on a matter at some later date. This legitimate concern may become increasing pertinent should sustainability reporting become a compulsory exercise at some future date.

5.6.3. Guidelines on writing a sustainability report

The decision on doing a sustainability report is a decision with many consequences. As already stated above sustainability reports ideally should be part of a bigger, more sophisticated concept. Releasing a badly drafted report may result in a negative (public) feedback or even in a declined reputation. There are no statutory guidelines or limitations that have to be kept, but demands to know "how to write a pleasant sustainability report" grew over time. In 1997, the Global Reporting Initiative (GRI) was launched. It is a long-term, multi-stakeholder, international process whose mission is to develop and disseminate globally applicable *Sustainability Reporting Guidelines ("Guidelines")*. These *Guidelines* are for voluntary use by organisations (corporate, governmental, and non-governmental) for reporting on the economic, environmental, and social dimensions of their activities, products, and services. The aim of the *Guidelines* is to assist reporting organisations and their stakeholders in articulating and understanding contributions of the reporting organisations to sustainable development (Global Reporting Initiative, 2003).

GRI encourages the use of the GRI *Guidelines* by all organisations, no matter how experienced or professional the reporters are. GRI provides flexibility in that way, that it is left open, how detailed the *Guidelines* are fulfilled. Reporting "in accordance" with the *Guidelines* is an option, not a requirement, and aims at those, willing to report at a high level. Alternatively, informal application of the *Guidelines* is possible, too. At this level, a reporter may only pick some portions of the performance indicators and add other portions at own will. This allows incrementally improved reports.
GRI recommends that reporting on economic, environmental, and social performance be timed to coincide, and possibly integrated, with other external reporting, such as annual financial reports and quarterly earnings statements. The media used for reporting can range from traditional printing to various multi-media technologies including the Internet and CD-ROMs. Internet-based reporting will facilitate frequent updating of some aspects of GRI-based reports. However, continuous reporting should not replace periodic consolidated reports.

5.7. Other environmental or sustainability reporting guidelines

There are a big number of environmental or sustainability reporting guidelines available, released by different organisations in different countries caring about the reports' content, style and methodology. The "Deutsche Institut für Normung (DIN)" has even released a norm (DIN 33922) that deals with the creation of environmental reports, providing guidelines for doing so. Its intention is to initiate a "dialog with the public". The focus is put on giving understandable information to the readers about a company's environmental behaviour. Another goal is to make the various stakeholders understand and accept each others view. Communication and dialogue-orientation are the most important points within DIN 33922.

On an international level there are in general three different types or styles of reports coming either from US, Japan or Europe. The "Commission on Transnational Corporations Intergovernmental Working Group of Accounting and Reporting" (ISAR) and the "Public Environmental Reporting Initiative" (PERI) play a more important role in this context. On a European level, the creation of a so-called "Polluting Emissions Register" (PER) is planned. Further information about the various reporting guidelines, including a list of them, can be found on the Internet (Van der Molen, 2003).

Part IV Investigation of Supply Chain

6 Supply chain

According to the questionnaire evaluation in chapter *2*, a company's suppliers are often contacted when it comes to environmental matters. This must be seen as a logic act of a company that has a purposeful environmental management. To be really effective in lowering the products' environmental impacts, a company has to leave the own boundaries and try to influence its suppliers to act in a more aware way. All the suppliers have some kind of environmental impact and if a company wishes to reach the complete environmental improvement potential, it has to formulate and communicate its environmental demands throughout the supply chain. Another reason is that customers and other stakeholders do not always differentiate between a company and its suppliers and may hold companies accountable for the suppliers' environmental practices. This means that involving the suppliers in the environmental work is a way of protecting the own company from losing the public's confidence.

In this chapter some of today's ongoing measures of involving suppliers and managing the supply chain as well as different tools for better understanding of the environmental adapted product development processes thereof presented.

6.1. Supply chain environmental management

As stated above, a company needs to involve partners outside the own company to be really successful with its environmental procurement measures. This has been intensified over years but is not to be seen as a formulated and structured standard. A relatively new knowledge/working agenda is underway which is confirmed by the fact that different names for the same tool exist: Supplier Environmental Management, SEM, Supply Chain Environment Management, SCEM, or even Environmental Supply Chain Management, ESCM. In this report SCEM will be used as a collective name.

The environmental work of the electronics industry has improved a lot since it was made clear that its products and processes were not as harmless as assumed at first, and it is sometimes considered as a forerunner regarding environmental activities compared to other industry sectors.

Cooperation with many different partners changed the closed internal "four walls" work to activities recognized as having "no walls" (NEETF, 2001). There are many different ways of performing this no walls work, but one characteristic is clear: in most cases it is not limited by demands that suppliers comply with current regulations, but that they take an active part in the efforts to lower the environmental impact of products (Nilsson et al, 2000). SCEM is seen here as the collective name for all these different approaches.

6.2. Questionnaires as communication tool

One of the most common ways of performing SCEM contacts and communicating environmental matters within the supply chain has been an extensive use of questionnaires. Environmentally aware companies have asked their suppliers to submit information on how they handle environmental matters, e.g. what kinds of materials are present in the products and if the company has an EMS. At the same time, companies have demanded suppliers that avoid the use of specific hazardous substances which are mentioned on the companies' material lists.

Unfortunately, there is a lack of industry standardisation for these questionnaires and they are therefore difficult to complete due to their ambitious size but rather ambiguous state. The questionnaires have put extra burden on the suppliers and they sometimes feel that they have to perform comprehensive activities that have no relevance in the end. This irrelevance is due to lack of knowledge in the questioning companies to completely evaluate and interpret the answers from the questionnaires (Nilsson et al, 2000).

If the questionnaires are to have future success the companies must be aware that the information they are asking for must be (Nilsson et al, 2000):

- relevant and expressed as demands that the supplier should fulfil;
- collected and worked on as to
- estimate it and change it into basic data for decision-making.

If this is how a company communicates with a supplier the development of appropriate questionnaires is a true challenge. Two examples on how a questionnaire might be designed are given in Appendix II.

6.3. Material declaration list as a communication tool

Just as with the questionnaires, material declaration lists are something that manufacturers ask suppliers to fill out to a considerable extent. These can often be part of the questionnaires, but as a more standardised approach to this work is under construction, they are presented in this separate section.

The ever increasing demand of material declarations has attracted attention by different industry associations, who in turn have made guidelines for the broadcasting of product specific information or tools to simplify the collecting and documentation of appropriate data. This section presents some published recommendation documents on what material declarations should incorporate. The presented recommendations are those that most companies refer to as some kind of standardised declaration guidelines they wish to be compatible with. Last in this section is a presentation of different proactive and company specific activities that suppliers have to follow if they wish to be accepted as a supplier.

6.3.1. EIA's Material Declaration Guide

EIA stands for Electric Industries Alliance, an industry alliance in the State of Illinois representing the U.S. electronics community. They have investigated the subject and prepared a material declaration guide, with the latest edition published 2001 (EIA, 2001).

Figure 13. EIA Logotype

6.3.1.1. The guide's content

EIA has prepared an easy to understand material declaration guide. A short introduction and guidelines on how to use the guide make it easily managed. It has three major parts:

- Introductory guidance: explanations of the scope of the guide, how to use it and a definition list;
- Appendix A: the actual material list;
- Appendix B: the actual declaration sheet.

Appendix A is the section that is used when working with the declaration guide. Here the user has to find the materials in question in either of three different categories:

- Controlled materials, those materials that are already banned from use or are subject to a voluntary industry phase-out. If a manufacturer uses materials of this kind intentionally, i.e. uses them with knowledge of their existence, then she/he must specify them on the Appendix B data sheet.
- Restricted materials, those materials that are prohibited in some, but not all, applications. Materials in this list have all the different prohibited applications listed. As for controlled materials, the user has to specify intentionally used materials in Appendix B's data sheet.
- Materials of interest, those materials that are not banned but such that the industry wants to know about if they exist in more than 1000 ppm. This is done as a guiding help for industry to be able to answer customer and other inquiries.

When all materials in the product are identified and found in the different categories, then the user simply fills in the data sheet form in Appendix B. The three different material types in Appendix A all have their own sections in the sheet, which therefore has an easily overlooked composition, see Appendix II of this report.

6.3.2. EICTA's Guidance Document on the Appliance of Substances under Special Attention in Electric & Electronic Products

EICTA stands for European Information & Communications Technology Industry Association, and is situated in Brussels/Belgium. Its daily work is to accelerate industry growth and prosperity in the European Union, and as a part of that it informs its members about actual policy developments at EU level. The guidance document is published in collaboration with the European organisations CEFIC, EECA, EUROMETAUX (EICTA, 2002).

Figure 14. EICTA Logotype

6.3.2.1. The guide's content

This is not a declaration guide as the EIA guide described above. EICTA's interest is to raise the knowledge of substances commonly used in electric and electronic products. Environmental risks and effects of a given substance are presented, but these should not be understood as proposed substitutions of existing used substances. They are more to be seen as a way of strengthening the customer/supplier relationship and are only for information; a possibility for companies to easily become attentive about what is going on.

There are no forms to be filled out or any calculation to be done. It is just about educating the companies about material characteristics and not to give them a tool for broadcasting this information. EICTA and its partners have decided to present every substance in the following way (see Appendix II for a complete example regarding alkenes):

- Chemical compound: which substance is actually being presented;
- Special applications: in which applications the substance is to be found;
- Benefits: positive reasons for using the substance;
- Reasons for special attention: why to be careful with the material, environmental or human reasons;
- Evaluation: summary of facts;
- Recommendations: e.g. how to use best, how to switch to another substance etc;
- Current affairs: what is happening within the EU or other legislative areas with this substance;

- Further information: contacts for more information are specified;

- Voluntary eco-labels and eco-declarations: restrictions existing for this substance in the different voluntary programmes.

EICTA has decomposed the vast material information in these categories and therefore made it easy for companies to understand the problems connected with a substance. Plans for the future may therefore be made easier. The way to inform stakeholders about substances in product components is not solved or made easier by this guidance.

6.3.3. ECMA

Figure 15. ECMA Logotype

In the late 1950s when more and more computers were used, the need grew for standardised operational techniques. This led to the forming of European Computer Manufacturers Association, ECMA, in 1961. The work has since then been concentrated in Standardizing Information and Communication Systems. In 1995 the Technical Committee TC 38 was established, and it has since then been working on the definition of product-related environmental attributes. The committee published the second edition of the Technical Report TR/70 Product Related Environmental Attributes 1999, which presents a catalogue of environmental related parameters to be included in the product data declarations (ECMA, 1999).

6.3.3.1. The guide's content

This guide lists the different kinds of information that TC 38 thinks should be included in a supplier's declaration. It is a "best practice guide" put together by ECMA, which has tried to transform lots of different standards into one with 13 information subcategories that are to be published in a product declaration. All 13 different categories can be seen in Appendix II and some comments follow in this section.

- Extension of product lifetime: if it is possible to upgrade the product it should be stated, as well as how long spare parts will be available and how long it will be possible to get service on a product after end of production.

- Materials: a list of materials that should not be in higher doses than the natural background levels is presented.

- Disassembly: information on design features as to facilitate disassemble and/or recycling by professionals.

- Other take-back information: availability of take-back schemes for products.

6.4. Material declaration tool

Another solution to declare which different kinds of materials are present in products can be found on the homepage of the GreenPack organisation, www.greenpack.org. GreenPack has designed a tool that is open to the public on the Internet until at least 1st October 2003. What happens thereafter is not yet decided. But, this tool is thought to simplify the deep going declaration of material contents as it lets every supplier in the supply chain add her/his specific parts or components for a specific product and let unknown items be passed on down the supply chain to other suppliers. A product will so to say be declared in a step-by-step manner and this will simplify the declaration task enormously as it is not a task for a single end producer to solve. There are several ongoing projects regarding this subject (European Commission, 2002).

6.5. Company specific activities

As stated in the beginning of this chapter, more and more companies and other institutions are interested in environmental facts. In many ways this has led to improvements in the supply chain, but this has also led to more complex work that is not always easy to overview. The guides are seen as measures to create standards for this communication. But no complete solution has yet been found. It could therefore be suitable to inform about some companies' measures regarding supply chain communication.

On Ericsson's homepage, www.ericsson.com, different kinds of brochures can be downloaded for a presumptive Ericsson supplier. There are the guidelines she/he has to follow, e.g. to be prepared to present life cycle inventory data for processes and products and to be prepared to present material contents according to Ericsson standards (Ericsson, 2003[1]). Ericsson has also constructed a website solely regarding material data and this is their solution to the need of a communication standard and it is totally web based and open for everyone (Ericsson, 2003[2]).

Similar to Ericsson's supplier demands are those of Volvo. Maybe Volvo as a car and truck manufacturer is not really suitable here as an electronics manufacturer, but it is a big customer for electronic product producers and therefore relevant in this respect. The automobile industry has also had stricter regulations to live up to compared to the electronics industry over the last years. This has helped the automobile sector to be ahead of the electronics in the environmental work (Nilsson et al, 2000). It could be that the electronics industry can gain from the automobile sector's experience. All suppliers or contractors must have knowledge of Volvo's environmental policy and an internal working procedures plan that lives up to Volvo's demands. Volvo has also published black, grey and white lists, which include chemical substances which must not be used within the Volvo Group, chemical substances whose use within the Volvo Group shall be limited and substitutes for hazardous substances (Volvo, 2003).

The Ford Group, to which Volvo cars belong, is seen as the leader within the automobile sector when it comes to environmental progress (Karlberg, 1999). The Ford

Supplier Network, FSN, has been established on the Internet to simplify the communication with all of Ford's suppliers. Through this site, the different environmental requirements are communicated and the site also offers different learning opportunities (Ford, 2003). Thanks to the implementation of electronic reporting it has been easier for Ford to receive and evaluate information about the suppliers' environmental progress (Karlberg, 1999).

These are just some examples where most supplier requirements have been found on the Internet so far. Beside others Philips CE, Motorola, Electrolux etc. have already material declaration tolls in place since several years.
In general companies just inform that they do have environmental requirements on the companies who want to become suppliers and sometimes list their demands or materials that are forbidden in their production.

6.6. Guidelines for Design for Environment

As seen above SCEM activities try to influence the environmental impact of the supply chain. In this work, strategies like Design for the Environment, DfE, can be included. Since many companies outsource the development and production of their products, is it appropriate to include the DfE activities in this section. It can be seen as a way of communication within a SCEM programme; a tool that outlines the different subjects that are parts of an environmentally adapted product.

However, DfE activities are not fully integrated in the day to day work of electronics companies. There are different identified reasons for this (European Commission, 2001[1]):

- Management has low awareness of DfE and the existing legal measures.
- Normally the companies, especially Small and Medium sized Enterprises, SME, do not see the use of DfE; they do not know the real benefits.
- The designers or developers have no or limited knowledge of environmental impacts from different design options.

Further it is often necessary to carry out LCA study, which is very time consuming and complex. The following section presents ways on how to communicate DfE requirements in the supply chain.

6.6.1. General DfE Handbooks

There exist many printed handbooks that go through the basic principles of what DfE actually is and what a company has to be aware of to successfully implement DfE in the day to day work. They are normally in the form of background facts or checklists and do not really include strategies for *how* to implement DfE activities in a company. A sample of a handbook's content could be (Bergendahl et al, 2000):

- What DfE means;
- Environmental impacts in different life cycle phases;
- Information about materials: how they are labelled, their environmental impact in different processes, hazardous substances etc.;
- Environmental legislation;
- End-of-life guidelines: recyclability and waste handling etc.;
- Case studies of successfully integrated DfE activities in companies;
- Useful addresses where more information can be found.

These handbooks are either ordered from an organisation or downloaded for free from the Internet. It is also common that large companies like Ericsson, Nokia or Siemens have their own internal handbooks on how to develop products in an environmentally adapted way. These are normally not intended for external users. The section "*Other links*" in the literature references contains some Internet addresses where general DfE handbooks can be found.

6.6.2. Specific guidelines

Due to a deeper research in the DfE field, more specific and purpose oriented guidelines have been developed. This is of course also dependent on the more frequent use of computers in the product development activities.

Designers are no environmental experts and should not be, but they have to understand the importance of developing a product with good environmental characteristics. Even if they know the basic principles of DfE they can use help to be able to determine which design concept is most appropriate if optimal environmental impact is considered. A first step to provide this knowledge could be the handbooks mentioned above, where designers are educated to understand the importance of the total environmental impact. But this is not enough; a designer also needs tools that show the size of the environmental impacts for different design concepts to simplify the decision processes.

It is very important to mention that such guidelines can only offer principles and rules which are more or less generic; however the solutions are to be tailormade. Thus guidelines can be used to direct the efforts for environmental improvements in a certain directions. Further it is important in this context to be able to set priorities, to test environmental improvements as regards their stakeholders and financial/technical feasibility than turning into the rules/guidelines circle again and again.

According to a study performed in Denmark, Norway and Sweden 80% of designers and product developers think that they have lack of information about material attributes (Ecoplan, 2002). This led to the development of the previously mentioned material declaration guides.

These lists are not assisting the designers and developers with profound knowledge about materials as they solely inform which to avoid and minimise the use of. A designer that tries to minimise the environmental impact of a product needs material guidelines with updated environmental data for relevant materials, components and processes to simplify the decision making process and the arising impacts of respective decisions. The continuously ongoing development of new materials makes printed versions of such guidelines inappropriate. A much better solution would be Internet based databases as they are easily maintained. During research for this report only one database like this has been found, but unfortunately it was under development and finally put on ice due to financial reasons (Munther, 2002).

Positive aspects with this guide were a general description of material characteristics such as how it is produced and if it is cheap or expensive, the appropriate products it could be used for (with pictures), alternative material choices and if it is mentioned on a list with undesirable materials (Ecoplan, 2002). At hand were also environmental facts throughout the life cycle such as end-of-life characteristics. Information was given in an easily understandable text in distinct separated sections. According to the market study for this product, it was welcomed by 88% of the participants as a source for information they cannot find anywhere else (31%) or as a complement (57%) to existing information (Ecoplan, 2002). This shows that there is a great demand for a guideline like this.

For the electronics industry a third version of DfE guidelines is available on the Internet. These can be very comprehensive and cover most areas of DfE with activities such as (Ecodesignguide, 2003):

- Basic training on how products in general interact with the environment;
- Education on how DfE works with included case studies that show how some companies have implemented and used DfE techniques;
- Guidelines of important tasks throughout the life cycle, e.g. what to think of when choosing materials (energy use, banned substances, how alloys will effect recycling processes etc.);
- List of links to further information sources.

These guides are specifically made for the electronics industry and this makes it possible to include an “environmental calculator”. This tool is based on general life cycle data and predefined electronic components, and therefore an environmental impact inventory for a specific product design can be examined. Designers are thus

given the opportunity to compare different concepts and their environmental impact at the designing stage, which immensely facilitates the decision process.

The user has to state which components she/he will use, which materials, which different manufacturing processes, if the product is to be packaged, how transportation will be carried out and usage phase characteristics. The calculator then answers in terms of energy units and a designer can easily see which alternative has the lowest environmental impact.

On the Internet, it is easy to find a wide variety of a different kind of material databases, see some listed in the section "*Other links*" in the literature references. The information at hand is very technical with data covering almost everything there is to know about the material, e.g. chemical formula, how to handle it, different physical aspects etc. But, a designer that is trying to develop an environmentally adapted product is not assisted in her/his efforts with this kind of material database as the most important information, i.e. information about the material's environmental characteristics throughout the product's life cycle, is missing. These guides are helpful when a company is having concerns of how to handle a substance to minimise presumptive risks such as working safety, but it is not appropriate compared to the previous mentioned guides to raise the environmental awareness of a designer and thereby simplify his or her decision making process.

6.6.3. Experiences from today's activities

The DfE strategy is not new but it needs to be strengthened if sustainable products are to come out on the market. Another positive aspect of DfE is that it works as a tool for companies to communicate with each other, helping them to follow a programme with "standardised" formulations. Many different guidelines and handbooks have been published and more are on their way, but even so companies express wishes that are not fulfilled by now. From the literature, one wish is mentioned more often than others: the wish of more good examples from companies that have already implemented DfE and what they have gained by doing so. Since most handbooks are filled with facts saying that these savings or improvements are to expect from a well performed DfE programme, the companies' wish must be to see more detailed and concrete case studies. Important here is that the included case studies must come from companies that are similar in size and have similar activities so that the results can be easily translated to fit the own company.

Even companies that are sceptic about the programme, have staff that wants to implement it. What this staff needs is not DfE guidelines in the first place, but tools that enable them to persuade the sceptic persons in the organisation of the positive effects of investment in environmental work (Bergendahl et al, 2000). The sceptic persons are often part of upper management levels that develop a company's overall strategy, and to be able to influence them is vital. Upper management often has low awareness of DfE in general and this knowledge gap must be closed (European Commission, 2001[1]).

Persons directly involved in the product development need help to make the right environmental decisions. This help must be easy to understand and use rather than straightforward material data for discussions of different concept aspects that do not lead anywhere (Bergendahl et al, 2000). This data should also be specific for the electronics industry to really facilitate the work. It is important for the designers that the information is presented in a way they understand, not only in their own native language, but also free from too many technical expressions when it comes to environmental matters (European Commission, 2001[1]).

One expressed wish is very compatible with the strategies of SCEM. Due to the often very comprehensive and sometimes expensive work to collect environmental data, companies want to have more collaboration with each other to exchange experiences and avoid double work. To learn from each other and at the same time make an innovative working climate possible, this would most likely be appreciated by everybody.

6.7. The EFQM Excellence Model

In addition to a sustainability report, the European Foundation for Quality Management (EFQM®), created in 1988, has developed an EFQM Excellence Model for the establishment of an appropriate management system (*see Figure 16.*).

The EFQM Model is a non-prescriptive framework that recognizes there are many approaches to achieving sustainable excellence. The model's framework is based on nine criteria. Five of these are 'Enablers' and four are 'Results'. The 'Enabler' criteria cover what an organization does. The 'Results' criteria cover what an organization achieves. 'Results' are caused by 'Enablers'. The nine criteria are:

- Leadership
- Policy and Strategy
- People
- Partnership and Resource
- Processes
- Customer Results
- People Results
- Society Results
- Key Performance Results

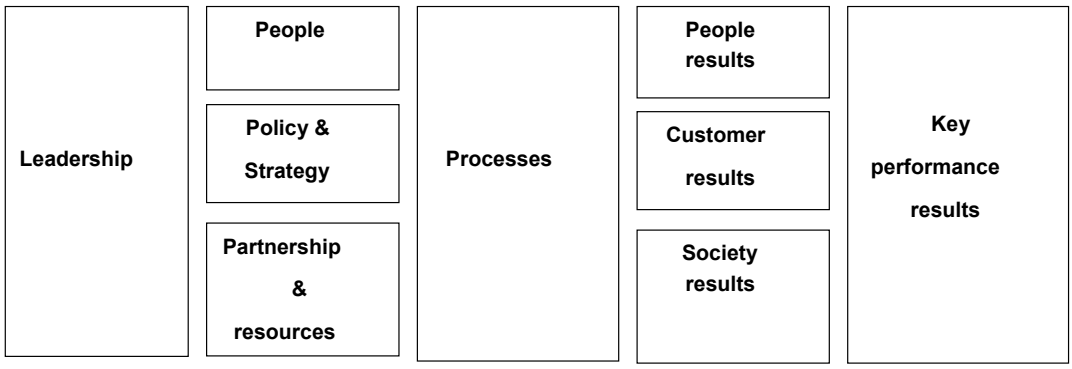

Figure 16. Business Excellence model

Excellent results with respect to Performance, Customers, People and Society are achieved through Leadership driving Policy and Strategy, People, Partnerships and Resources, and Processes. To develop the high level meaning further each criterion is supported by a number of sub-criteria. Sub-criteria pose a number of questions that should be considered in the course of an assessment.

When the EFQM model was created in 1990 after the Japan Deming and the US Malcom Baldrige its purpose was to help industrial companies to assess their Quality Management System and to recognize those showing a high commitment to quality. The European model has been the first , however, to introduce criteria and parameters specific to environmental and social/societal aspects. The European companies have considered from the start that these were mandatory in a Total Quality Management (TQM) approach.
In the late 90's many companies and organisations , members of EFQM, have understood they will have to go beyond TQM and strive for sustainable Business Excellence.
The revised model, explained above, has been published in 2000 based on several fundamental concepts of Excellence with special focus on :
-Results Orientation: balancing and satisfying the needs of all relevant stakeholders
-Public Responsibility: the long-term interest of an organisation and its people are best served by adopting an ethical approach and exceeding the expectations and the regulations of the community at large

Business Excellence goes beyond TQM and the new EFQM Excellence Model give to all the types of organisations (private and public, large and SME's) a framework to implement, assess and communicate an integrated approach to a sustainable organization with a positive and advantageous company image – visible to all stakeholders.

6.8. Environmental Accounting

Environmental accounting does already exist in many companies today, but in a form that might not be suitable for its purpose. This is due to lack of understanding of

environmental costs in the traditional accounting systems as well as for the management in a company. With today's situation in mind, where stakeholders are more interested in knowing about companies' environmental activities, a well performed environmental accounting could be a very valuable communication tool.

This section will present the positive sides of an environmental accounting and thereby give the reader some ideas where he or she might be able to implement this in the own company. The following paragraphs will describe what environmental costs are, how they are handled today and what negative effects they bring. There will also be shown that implementing a new way of thinking must not be too complicated; it is more a question of starting somewhere and make experiences and then act from there.

This is not a complete guide of how to implement environmental accounting. Instead, the focus is put on a tool that can help a company to better understand its costs and at the same time show the possible use of this in environmental communication.

6.8.1. Definition of Environmental costs

There are many different interpretations of what an environmental cost actually is, and there is no accepted standardisation at hand. Traditionally though, environmental costs are often seen as end-of-pipe costs, such costs that occur when cleaning up after a production site or costs that come from waste treatment. This cost interpretation is not enough for a company that wants to use environmental accounting in a more efficient manner. To do so, it simply must change the way it sees environmental costs.

In many literature sources, waste has been given special attention. It is seen as material, including water and energy, that has been paid for but which has not been turned into a marketable product (United Nations, 2001). This non-product output, NPO, includes solid waste, waste water and air emissions. The producing part is much more interesting to control as the value of NPO is estimated to be 10 to 100 times the cost of disposal (United Nations, 2001). A method to allocate costs will be shortly described below.

To not make it a task too difficult to solve, most companies have found a way to split environmental costs into two categories, private and societal. This separation is compatible with the US Environmental Protection Agency's, EPA, pioneer work from the mid 1990s where it stressed the fact that environmental costs should be separated this way. The categories stand for:

- Private costs: the internal environmental costs a company incurs or are legally responsible for, e.g. costs for protection equipment. These costs can affect the company's financial bottom line.

- Societal costs: costs imposed on individuals, society and the environment for which the organisation is not directly held accountable, e.g. environmental degradation for which firms are not legally liable (US EPA, 1995[1]).

In the first place, a company is interested in the private costs as these have direct impact on the company's financial achievements, but it must be noticed though, that specific costs can be seen as private in one country and as societal in another. It can also be the case that some external costs transform to internal costs, e.g. environmental regulations tighten. Thus, the companies are made legally liable to more costs.

Almost all of the literature was unanimous about the fact that the important thing is not to categorise an environmental cost absolutely right, but that it is more important that all costs are given the right amount of attention so that a company can act right and make correct decisions.

6.8.1.1. How costs are handled today

A company is interested in its costs for a number of different reasons. The information that costs provide for a comp any is vital for its survival. If management is given wrong information, then its decisions are also most likely not going to be appropriate for solving the actual problem. It would therefore be very interesting for most companies to implement an environmental accounting system, a system that tries to identify important company specific costs and thus help managers and others in exchange of information. This information is very important to be able to perform an appropriate decision making process.

But why should this not work with today's accounting principles? Experts in the area claim that environmental costs are either not tracked by today's principles or they are hidden in so called overhead accounts (White, 1999). These overhead accounts are normally used as collectors of many different costs, e.g. rent, waste removal, repairs, maintenance, cleaning, packaging, energy etc. Thus, the costs are not allocated to specific products or services.

This means that a product can e.g. be assigned costs for waste treatment of materials that are not present in the actual product. A product's estimated manufacturing cost may therefore be much higher or lower than the actual case. This makes the pricing of the product extremely hard and most likely incorrect. This then leads to missed opportunities in process improvement, product mix and budgeting, things that in the long run could be important for a firm's survival.

6.8.2. Introducing Environmental Accounting

Environmental accounting is the collective name for a number of different accounting activities that aim at bringing environmental costs to the attention of corporate stakeholders (US EPA, 1995[1]). These activities can be on a corporate level but also on a regional or national level, including governments, nations or societies. The focus for this section is the corporate level and the term to use here is environmental *management* accounting, see below.

6.8.3. Introducing Environmental Management Accounting

The use of environmental management accounting, EMA, is primarily seen as a tool that identifies, collects and analyses internal information needs (US EPA, 1995[1]). This information can probably used for external purposes, too. Why should a company not inform stakeholders about gained improvements in a language, i.e. money, they all understand?

The thought behind EMA is to close the information gap that is present in today's accounting systems and provide companies with the right kind of information data. This is then ultimately used to increase material efficiency, reduce environmental impact and risk and reduce costs of environmental protection (United Nations, 2001).

EMA normally has a monetary as well as a physical unit for cost accounting. The physical unit represents material flow balances for water, energy and material. This double sided construction is thus able to inform about both the financial and non-financial aspects of a company's environmental performance. As present accounting systems inform the stakeholders about the physical part, the physical side is not further investigated here - the true innovative use of EMA is the monetary side.

An EMA system could be as big as a company wants but as noted above EMA is still in its infancy phase and it would therefore not be advisable to implement a new accounting system at once throughout all sections of the company. A plausible way of working should be to implement it in a smaller part or process of the organisation that is manageable (EPA Victoria, 2003). Focus also has to be put on how the organisation is defining an environmental cost, should it solely include end-of-pipe thinking or should a broader interpretation set the limits. The leading categorisation of environmental costs comes from EPA's work in the mid 1990s, seen in *Table 1*.
These costs are differently hard to measure, and here they are described in a descending measurably order:

- Conventional costs: the costs of using raw materials, supplies or utilities. These are normally not seen as environmental costs but less use of these would result in e.g. less waste and a more environmentally preferable situation.

- Potentially hidden costs: costs that may be hidden from managers in overhead accounts. *Upfront* are costs that incur prior to the operation of a process; *voluntary* and *regulatory* are costs that incur in operating a process; *back-end* are costs of current operations that will occur in the future.

- Contingent costs: costs that may or may not occur in the future. May be neglected in current accounting systems.

- Image and relationship costs: costs that are incurred to affect subjective perceptions of stakeholders. Can include costs of e.g. environmental reports or community activities. These costs are not hard to measure, but the benefits of these can.

Which strategy a company should use to implement EMA is not discussed here, but the Australian study resulted in a step-by-step plan that can be seen in Appendix III. This might be suitable for other companies to follow or simply get an idea of what actions have to be undertaken. The leading opinion among the researchers is, though, that it really does not matter where a company starts; EMA is a technique that is working with incremental progress. There is one technique though that is more mentioned than others when it comes to the starting point of EMA, the so called Activity Based Costing tool, ABC. This tool is described below in this chapter.

Potentially hidden costs		
Regulatory	**Upfront**	**Voluntary (beyond compliance)**
Notification	Site studies	Community alliance/
Reporting	Site preparation	Outreach
Monitoring/testing	Permitting	Monitoring/testing
Studies/modelling	R&D	Training
Remediation	Engineering and procurement	Audits
Recordkeeping	Installation	Qualifying suppliers
Plans		Reports (e.g. annual
Training	**Conventional costs**	environmental reports)
Inspections	Capital equipment	Insurance
Manifesting	Materials	Planning
Labelling	Labour	Feasibility studies
Preparedness	Supplies	Remediation
Protective equipment	Utilities	Recycling
Medical surveillance	Structures	Environmental studies
Environmental insurance	Salvage value	R&D
Financial assurance		Habitat and wetland
Pollution control	**Back-end**	Protection
Spill response		Landscaping
Storm water management	Closure/decommissioning	Other environmental projects
Waste management	Disposal of inventory	Financial support to
Taxes/fees	Post-closure care	environmental groups
	Site survey	and/or researchers
Contingent costs		
Future compliance costs	Remediation	Legal expenses
Penalties/fines	Property damage	Natural resource
Responses to future	Personal injury	Damages
Releases	damage	Economic loss
		Damages
Image and relationships costs		
Corporate image	Relationship with	Relationship with
Relationship with	professional staff	Lenders
Customers	Relationship with	Relationship with
Relationship with	workers	host communities
Investors	Relationship with	Relationship with
Relationship with insurers	suppliers	Regulators

Table 1. How US EPA has categorised environmental costs. (Source US EPA 1995[1])

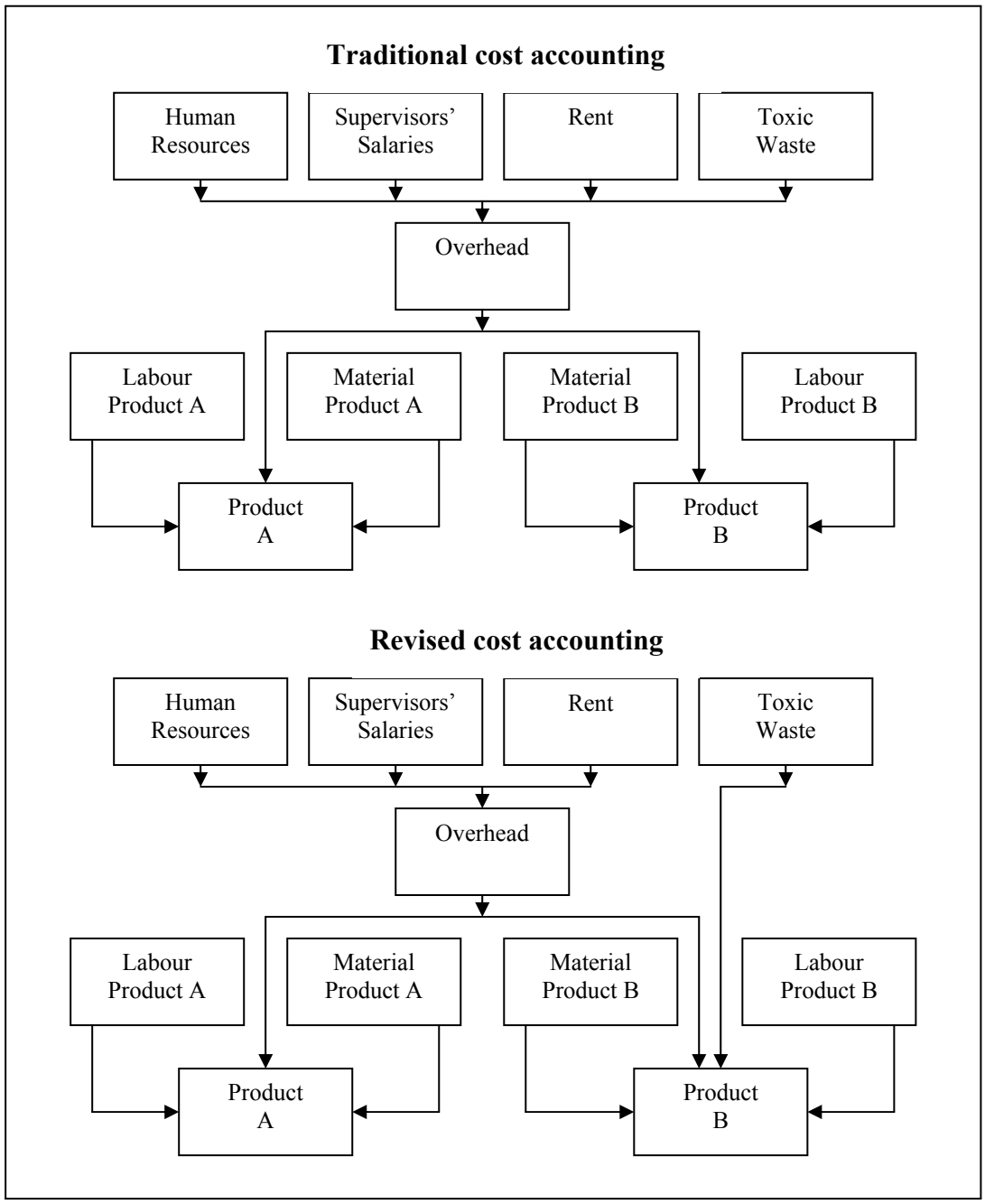

Figure 17. Above Traditional and below Revised cost accounting system (Source US EPA, 1995[1])

6.8.3.1. Proved Advantages

When literature dealing with this subject is consulted, EMA seems to have the solution to many different accounting problems and to the information outcome of such accounting. Different lists of improvements are easily found. EMA, though, is primarily seen as a decision improvement tool by most experts and the US EPA has listed three categories in which EMA has decision-making advantages (US EPA, 1995[1]):

- Cost allocation: getting around the overhead accounting problem. To allocate costs to the products or processes that create them gives stakeholders the chance to develop alternative solutions that will lower these costs. A simplified schematic structure of this can be seen in *Figure 17*. The picture shows costs for two different products, both in a traditional accounting system, where the costs come from overhead accounts, and an EMA, where it is realised that the toxic waste actually only comes from product B, which therefore should be assigned all of these costs.

- Capital budgeting: determining what kind of investments to perform. It has normally been the case that environmental costs have not been included in the financial analysis in investment alternatives. This has led to missed opportunities in financially attractive investment alternatives in new cleaner technology.

- Process and product design: with environmental costs included, the designers and decision makers are given easy to understand information that facilitates the decision-making process. This can supplement the information from other DfE techniques a company is using. One basic thought is, that the best way to keep costs down, is not to try and minimise them once the product is being produced, but to design the costs out of the product from the very beginning (Kulmala et al, 2001).

This report has its focus on cost allocation and information opportunities. Product development is also a very interesting area for a company that is trying to enhance its supply chain communication. Together with SCEM and DfE interesting synergy effects could emerge.

As with most literature concerning new techniques for environmental improvement within the industry, the EMA literature is full of positive thinking of where EMA could be implemented. EMA as a way of working is not brand new, the most significant work was done in the mid 1990s and is still the leading guide of what it means and its consequences, but EMA is nevertheless not part of day-to-day business in many companies. This is also true for many other environmental improvement techniques. A company wants to see success from other companies before it considers an implementation of its own. It is therefore pleasing to find publications that make results from companies' success stories available in some way. One such publication comes from the four Australian companies that were participating in a six month EMA project,

and within it, many different positive effects are described (EPA Victoria, 2003). An interesting fact of this study is that the companies were all representing different sectors (education, plastics manufacturing, provision of office services and wool processing), but they all experienced almost the same positive effects. It is easy then to assume that even a company from the electrical/electronics sector would experience some of these effects.

It is another report, though, that completely brings it to the point of why EMA is taken into consideration for this report. The company AT&T in the USA performed a study of the subject (in their vocabulary under the name "Green Accounting") in 1995 and there they stated that:

"... the best business focus for Green Accounting is the collection and use of information for internal management, because making better decisions will result in improved performance for external reporting." (US EPA, 1995[2])

Some gained experiences and effects from the Australian companies will be listed here in short and a complete list of results from the study is presented in Appendix III. (EPA Victoria, 2003).

- At the beginning it is very important to have support from senior management but also to ensure that this support is clearly communicated throughout the organisation that is participating in the implementation of EMA (this was also mentioned in EPA, 2000). This seems to be true whenever a new way of working is to be implemented, compare with SCEM, section *6.1*.

- EMA should be seen as a way of working with incremental progress.

- To be successful, staff with different skills must participate in the EMA team, preferably people who understand existing accounting system, people with environmental background and people who understand the material flows within the company. Without a coordinated strategy it is likely that staff from different sections simply will not communicate.

- Failures to properly account for environmental costs were shown to be responsible for lost opportunities in improving the organisation's financial performance. It was also shown that fairly low cost changes to the existing accounting system could improve how business operations were conducted.

- It was shown that waste costs were normally understated.

To implement EMA is so to say a learning-by-doing experience that will most likely improve not only the internal environmental work but also the external communication ability. How an implementation could be done is presented in Appendix III in a step-by-step schedule.

6.8.4. Activity Based Costing method

The use of activity based costing, ABC, in accounting activities is not new. Accountants are normally familiar with this technique. What most surely is new, though, is to include the environmental costs as they are described above. But if accountants familiar with the tool are supported with other needed skills to understand environmental costs, see previous section, then ABC seems to be the most preferred way of working in EMA. When implementing new methods of day-to-day business, it is important not to include too many changes at once, as the outcome might be allocated to the wrong sources afterwards since the new system is not completely understood. ABC might therefore be the most appropriate way of starting an EMA system as it is a relatively well known technique with results whose sources are known. To include environmental costs should therefore not cause too complicated extra work and accountants can interpret the results and gain further understanding of the EMA system on the way. The organisation as a whole is then able to do incremental improvements – one of the main ideas of an EMA system. Hence, improvements are likely to be rather easily identified. It is important, though, that not only accountants understand the benefits of ABC and this section therefore gives a brief introduction on how ABC works.

6.8.4.1. Basic theory

ABC as accounting method was introduced in the early 1990s. Traditional accounting could not keep up with the changes that had occurred over the years in how companies did business. The major change was due to the ever growing use of overhead accounting which resulted in misleading information (Emblemsvåg, 2000).

The greatest distinction between traditional accounting principles and ABC is the way costs are said to emerge and allocated and the orientation of the accounting. In ABC, costs are caused by the use of activities whereas traditional accounting says that costs are caused by the objects, e.g. the products or services being produced, and their use of resources. Traditional accounting normally assigns costs to objects based on volume related reasons and not what actually has happened during the production. ABC is process-oriented as it is interested in what is actually being done and not what the organisational chart says. These differences are described below and can be seen in *Figure 18*.

The arrows in the picture are directed the way they are due to the fact that ABC gives detailed information about the processes whereas traditional accounting simply allocates costs down to an object without considering which activities have been undertaken to produce the object. ABC is based on the assumption that an object consumes activities, i.e. the actual processes undertaken to produce the object, and that these activities in turn consume resources. This derives from the idea that costs cannot be managed, only activities undertaken can be managed and once these are managed, the cost aspects will change as a consequence (Emblemsvåg, 2000). Fully understanding of the underlying processes enables management to control capacity at hand, either if it is surplus, lacking or misallocated, and thereby facilitating allocation of efficiency opportunities.

Objects are then assigned costs with the help of so called cost drivers, i.e. the factors that cause costs. The resource driver is a cost driver that estimates the cost of resources consumed by an activity and the activity driver is a cost driver that estimates the cost of an activity consumed by the cost object. The drivers identify the actual cost behaviours on a cause and effect basis: the activities an object causes and how these effect the use of resources. This could e.g. be normal overhead costs such as R&D time. An object that incurs many R&D hours should also be assigned more R&D costs compared to other short-time developed objects. This is completely different from traditional ways of allocating costs based on e.g. product volume assumptions.

Since ABC is process-oriented, questions such as "what needs to be done" and how resources should be allocated the best way can be answered. This clearly points out the ability to help managers in decision-making processes compared to traditional accounting. The traditional accounting would only be able to answer which resources are at hand but not how these should be allocated or if they would be an efficient solution to the problem (Emblemsvåg, 2000).

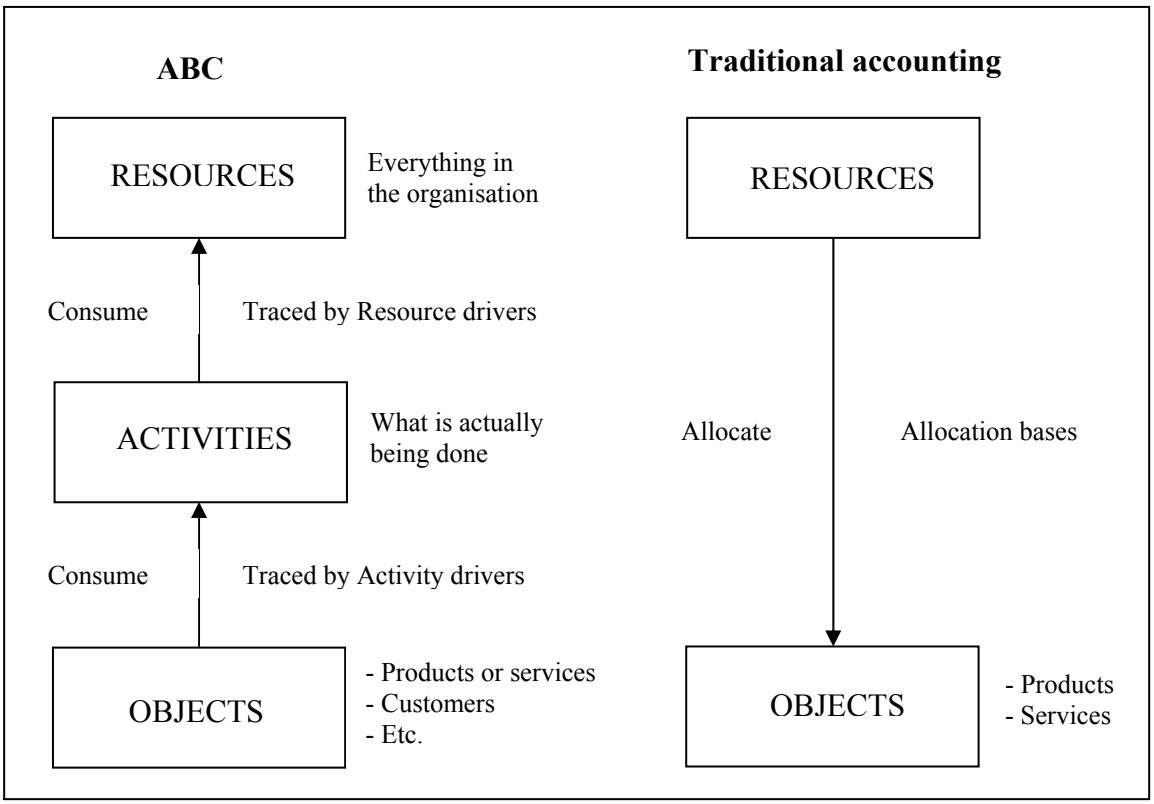

Figure 18. ABC method compared with traditional accounting.
(Source Emblemsvåg, 2000)

6.8.5. Conclusions on EMA

Companies that implement an EMA system that takes environmental costs into full consideration must be ready to invest in time as it is a change of the day-to-day business. A negative side of change is that not everybody is comfortable with it, especially if the upper management is not supportive or the situation has not been thoroughly announced. It is also likely that managers will be uncertain to implement a new strategy that they do not fully understand or have insight to. The most important task to do before an EMA is implemented is therefore to fully understand the current accounting system in the company (EPA Victoria, 2003).

If a company has decided to implement EMA, then it also must give staff and system enough time to evolve so that the positive incremental improvements have a chance to emerge. The case studies mentioned above have shown that chances of improvement were seen even in such a short period as six months. These also stressed the fact that activity based costing is a method that should be given attention as its basic principles are compatible with the EMA idea of true cost allocation instead of the use of overhead accounts. The use of ABC was plausible as it is a method that accountants normally are aware of as well as the cost allocation thinking of an EMA system.

The positive side of working with EMA and ABC is that a company can learn where its costs really come from and this enables the managers to make the right decisions more easily. A well performed EMA has many different possibilities to influence a company's environmental work, e.g.:

- It will facilitate the identification of possible efficiency improvements which is a way of lowering the environmental impact.
- Both, internal and external communication, are given an instrument that provides easy to understand environmental progress information.
- It could help internal staff to get more committed and thereby help them doing a better job, something the environment and the company's financial side will gain from.

In this context, the advantages of using EMA can be summarised as follows:

- Once Environmental Accounting is adopted, either from many companies or even from governments itself, it will have a very wide spread effect, because almost everybody would be effected.
- The implementation into well known (economic) accounting systems cause a fast acceptance and many can handle the field of ecology with familiar matters.
- If Environmental Accounting reflects the company's or national value, the communication would be self solving and automatically.

- The routes of communication are well known and are already accepted ones. For example the implementation of accountings into environmental reports, national green accounting declarations or simply the reflection at balance sheets or at financial statements.

Whereas, the following obstacles may appear:

- The accounting methods are controversially discussed and up to today have neither a standard nor are widespread agreed. This bears a lack of confidence in calculated results.
- Environmental Accounting is a thematic discussed since at least 10 years, but it is still a rather theoretical field and only some case studies or vague steps into this field are known so far. There is no wide spread adoption of this thematic and not many people can handle it respectively. For example case studies are known so far from Norway, The Netherlands, Sweden, France, Canada, The Philippines, Namibia, Germany, and the United States most of them have been funded and are not "self runners" so far.
- Being or acting "green" is not naturally a matter of course in all fields of industry. Thus, too intensive communication or a fully adoption of environmental matters as a core policy of a company is often seen still as specific and not main stream. For example "green baskets" at the stock market are still supposed not to be the strong market drivers.

The environmental communication is given a tool that facilitates communication as it is provided with environmental facts expressed in monetary units. This is good, but one thing must be remembered though: it is not a new way of communication, only new facts are presented. The problem of reaching the private stakeholders is still there, but there is still a great chance for an enhanced supply chain communication as the ABC allocation gives a better understanding of the processes at hand, something that could be valuable in supply chain improvements.

6.9. Communication Due To Emissions Trading Activities

An emissions trading system is basically not a communication tool, but companies participating in such a system are given an opportunity to transmit easily understandable information, i.e. information expressed in units of money. This is something everybody can relate to and also understand and it is therefore suitable as public information.

The idea of emissions trading is not a common knowledge of the public and therefore could this section also be put in chapter *8*, where ideas for the future communication are listed as subjects that need further research. Emissions trading already exists, though, and companies are participating, and this justifies the placement in the report. Companies are herewith given an opportunity to use an existing fact in their communication; it is not just another idea of what might be useable as a communication tool.

This section therefore contains background facts about the environmental problems caused by use of e.g. energy, the measures that have been developed as means of reducing the negative impact and what the emissions trading system actually is and how a company could be able to use this in its communication of environmental matters. The way on how to use this additional information in exactly the right way is not described here, the focus is to make companies aware of a new opportunity in communication activities, a chance that should not be neglected.

6.9.1. Background facts

6.9.1.1. Kyoto protocol

Today's most known and talked about programme that aims at working against climate change is the Kyoto Protocol. It was adopted in 1997 by the parties of United Nations Framework Convention on Climate Change, UNFCCC, in Kyoto, Japan. The protocol outlines that the overall GHG (Greenhouse Gases) emissions should be at least 5 per cent lower in the first commitment period, year 2008-2012, compared to year 1990 for market economy countries, i.e. those countries present on the Annex I list from UNFCCC (United Nations, 1997). This restriction shall keep climate change under control. All other countries are excluded from the demands of the protocol, but they are welcome to initiate GHG emission lowering programmes on their own. The 15 European Union countries are all obliged to lower their emissions by at least 8 per cent compared to year 1990 (United Nations, 1997), but the EU states have agreed upon a burden sharing system that have even harder regulations for some countries and softer for others.

Within the Kyoto protocol, the six most important GHGs are taken into consideration when it comes to regulating the emissions. These are (IETA, 2002[1]): CO_2, CH_4, N_2O, HFCs, PFCs, SF_6.

6.9.1.2. Impacts of the Kyoto protocol

The necessary activities to fulfil the Kyoto regulations are going to be expensive. For the EU countries, researchers have estimated the annual cost to be between 6 and 9 billion Euros, and this cost difference depends on if different economic measures such as emissions trading systems will exist or which types of industry are going to participate in such systems (Mantzos, 2000). These costs are not to be neglected, but the economic effects must not be too harmful to the future growth development of the Earth as some negative thinking experts are claiming (Azar & Schneider, 2002).

6.9.1.3. Activities to limit the costs of the Kyoto protocol implementation

Within the Kyoto protocol, four different international measures are listed as means of lowering the costs of implementation. Three of these measures are referred to as

flexibility mechanisms. The fourth measure is known as Joint Fulfilment and it is thought to function as a burden sharing system. It is the basis for the EU's strategy that not all of the 15 countries will reach the 8 per cent reduction. The EU as a whole will still have 8 per cent reduction, but some countries, such as Germany and the UK, must reduce more whilst others, such as Spain and Portugal, are allowed to increase their emissions compared to the 1990 levels (IETA, 2002[2]).

The flexibility mechanisms are collectively referred to as an emissions trading system, and they all rely on the idea of an emission credit system. The credits are created by a regulating party, e.g. a government, or through emission reduction activities or both, and they stipulate how much emissions a company is allowed to emit. Emission credits are normally distributed to parties through an auction. Once the credits are created, they can be bought, sold, traded or banked for future use. It is also likely that some credits will be retired in the future as to create an environmental benefit. A company that has higher emissions than it is allowed to have must either pay a fine or purchase credits from other parties in the emissions trading system.

An emissions trading system is thought to include all the different GHGs, but as CO_2 is the most important one, all other GHGs are supplemented with an internationally agreed CO_2 converter to simplify the measurement.

6.9.2. The European Union Emissions Trading Scheme

This system is thought to be the most cost effective way to lower the CO_2 emissions in the EU and it only includes industry sectors that are CO_2 intensive, as these are thought to be able to lower the emissions at the lowest costs (European Commission, 2001[3]). Participants come from electricity and heating production, the iron and steel industry, refineries, the chemicals industry and the pulp and paper industry. The EU is also expecting a learning-by-doing effect of this system as it is launched three years before the first commitment period of the Kyoto protocol. Experiences are to be made and then used in the future global competition of emissions trading systems.

It is thus a system that at a first glance not seems to be important to an electronic devices manufacturer, but it must be kept in mind that this is just the beginning. When the Kyoto protocol is in charge, there might be changes to which industry sectors are to be included. The Swedish governmental initiated inquiry, which examines the feasibility of making use of the flexible mechanisms of the Kyoto Protocol, proposes that also emissions from such sectors as transportation and/or residential/commercial buildings should be part of the trading system (Jansson and Carlsson, 2000). This might have more impact on the electronics industry than the present EU proposal.

6.9.3. Other emissions trading activities

The EU system is the first that includes countries as participants, but it is far from being the first emissions trading system. Since the beginning of the 1990s, a pollution trading system, called The Clean Air Act, is implemented in the USA, and has turned out to be

rather successful. Its focus is on the various pollutant emissions. Countries like Canada and Japan also have their own emissions trading systems. The newest system is the UK Emissions Trading Systems, ETS (in some sources named UKETS), that exists since April 2002.

ETS sets out how the UK intends to meet its Kyoto Protocol Commitment and it is also thought to be a learning-by-doing experience for participating companies and the government. It is scheduled for a five year period between 2002 and 2006 (Defra). In ETS all six GHGs from the Kyoto protocol are included. Companies enter into the system voluntarily and there exist three different ways to do so (Defra, 2003):

- As a Direct Participant: a company is to make absolute emission reductions compared to its emission levels in 1998-2000. If the company succeeds in fulfilling this goal then the Government pays the company a fixed sum for every emission tonne it has reduced, so called incentive money. How much the Government is obliged to pay and how much a company has to reduce its emissions were agreed upon at an auction in March 2002. There, 34 participants agreed to reduce their emissions to an average of 12%, and the Government has to pay £53.37 in incentive money for every tonne reduced, which means that the Government will spend £215 million over the five year period. The average 12% mean that the 34 companies will reduce the emissions by 4 million tonne CO_2eq over the five year period (Defra, 2002). A company that is interested in becoming a Direct Participant can enter the system today even if it did not attend the auction. It must agree to the payment per tonne and the 12% reduction though (Harris, 2003).

- Companies taking part in the UK Climate Change Agreements, CCA, already have emission or energy targets to fulfil. They can use trading in ETS either to help achieve these by buying credits, or they can sell credits if they have performed better. These credits are not fully compatible with those in ETS as the CCA credits are based on a relative improvement, i.e. they are e.g. energy efficiency improvements. There are approximately 5500 companies participating in CCA (Harris, 2003).

- Companies in general may participate in UK emission-reduction projects and then sell the achieved credits to ETS.

An interesting fact in ETS is, that not only big and CO_2 emission intensive industry sectors are represented in the system; diverse parties such as a bank and a museum are also included as well as the household appliances firm General Domestic Appliances. It is in fact the world's first economy-wide emissions trading system (Defra).

But the ETS also takes SMEs in general into consideration as it allows them to act as a group. It might be difficult for SMEs to enter into the system as it demands management and administration time, and thereby also costs, and the so called group participation is put together as a solution to this. The idea is that an agent or a third

party is able to carry out many of the functions required of a participant in the scheme. This agent is in the most favourable situation the agent for many firms and is acting on their collective behalf. The costs could thereby be kept at a minimum (Defra, 2002). This only confirms the suggestion that an emissions trading system might be something for an electronic devices manufacturer to consider and prepare for.

At the moment, the ETS is not compatible with the EU scheme, but as soon as the EU scheme has its final form, the UK administration will try to undertake necessary actions to make the two systems compatible with each other (Harris, 2003).

6.9.4. Discussion of how to implement an emissions trading system in environmental communication

The emissions trading solutions as a help to lower the implementation costs of emissions reducing projects are not new, but until now they have not been widely spread throughout the world economy. This has - to some extent - changed due to the EU scheme that forces emission intensive industries to act, and with the Kyoto protocol entering into force 2008 further force on other industry sectors will be present as well. There might be no other opportunity for companies than to participate in some kind of an emissions trading system, and why not see this new legislation as an opportunity to strengthen the communication?

It is obvious that CO_2 emissions play an important role today. Almost all of the environmental reports available for this project mention CO_2 in some way, and it is thus important for a company to try and enlighten its stakeholders that it is conscious about the problems connected with CO_2. Some examples:

"Energy use leads to CO2 emissions. Measuring the ratio of CO2 emissions to net sales, or turnover, is not only a relevant environmental indicator, but also an important financial guide to overall company performance. Ericsson's environmental profile can be understood by examining carbon dioxide emission generated through employee activity – such as commuting, work-related travel, telecommuting, electricity used in offices and energy used in manufacturing. For the purposes of this profile, we have looked at all areas of our business operations where energy is utilized." (Ericsson, 2001[3])

"Along with atmospheric water vapor, CO2 is one of the major greenhouse gases that cause a rise in Earth's temperature. The greenhouse effect is a serious threat to the environment as it alters Earth's normal weather patterns. In response to this global problem, Samsung Electronics actively conducts research and other measures to abatement CO2 emissions at its plant sites." (Samsung, 2001)

"Even so, when considering the entirety of our operations, including our sales and R&D facilities, the level of our CO2 emissions in 2001 was 94% of the 1990 level in terms of unit value of sales. In Japan, our energy conservation activities resulted in a CO2 emissions reduction of approximately 21,000 tons (about 4% of the previous

year's total emissions by Group companies in Japan), an amount commensurate with a ¥700 million expense reduction." (Canon, 2002)

These are good attempts, but one effect from the new regulation is that people in general are most likely to be better informed about the CO_2 problems, and they might therefore scrutinise the companies more thorough about this matter. The companies have to answer that increased knowledge and present facts in a more accurate way.

There is a double effect: on one hand, the company shows concern about the CO_2 problem and undertakes activities to minimise its contribution to climate change, and on the other hand, it is able to show that this has been done in such a manner that the costs could be limited. This is pleasing not only for the environmentally concerned stakeholders but also for the financial ones. Reduced use of energy gives less CO_2 emissions but also lower energy costs, i.e. a cost saving operation. But the lower amount of CO_2 emissions also gives emission credits to trade, which then have the same effect as another cost saving operation.

A well outlined internal strategy for emissions trading would likely be able to help management understand the importance of emission reduction projects, an understanding that is often lacking by company staff members who strive for implementing environmental conscious techniques, see section *6.8*.

For some companies, there might be a big advantage in the synergy effect of using the emissions trading effects and at the same time be involved in a Supply Chain Environmental Management (SCEM) project, described in section *6.1*. If there is a true cooperation between the companies, their individual specialist knowledges can be used to design and produce the best environmentally adapted product available, possibly also resulting in some emission reductions. These would then be easily transformed to emission credits if the companies participate in an emissions trading system. For the best outcome, the companies should participate in a system that allows them to join as a group and where one single organisation is allowed to handle all of the companies' administration costs, as described in the UK ETS above.

Of course this would lead to resource and money saving effects in the first place, but the possibility to use this effect for increasing cooperation in external communication activities would be very valuable and should not be neglected. It has to be positive for a company to be able to show that it is not working alone on this matter, because if many organisations work together in solving a problem, then one basic thought is that the achieved result should be bigger/better than the sum of the companies' individual improvement work. This collaborative information would thus have a greater chance for acceptance in the society.

6.9.5. Obstacles and advantages of communicating green issues

After taking a look at the various Emissions Trading schemes and their approaches to implement them, a final summary on the obstacles and advantages of environmental communication will be given. The following obstacles, related to the communication of green issues, can be noticed:

- GHG Trading and the Kyoto protocol are widely discussed, but people also hear that some nations easily went off from contract (e.g. USA) or some have conceded exceptions (e.g. overestimation of forests in Russia or Canada). Thus confidence in this thematic is relatively low or might be lost, that might be followed by a negative effect at communicating activities for Emissions Trading.
- As the goals of reduction currently seem not achievable, expectations are going to the direction of an inescapable cost increase for energy and energy intensive products.
- People still see environmental actions, especially if promoted from governments, strongly connected to an increase of cost. For example eco-taxes in some countries underline this feeling (that is obviously wrong, if looking at industrial "green activities" of many companies; author's comment). This might lead into the wrong feeling of a general cost increase, if once the Emissions Trading will be established, nevertheless the company is a certificate buyer or seller.
- Environmental requirements that lead to more efforts for companies, such as for example costs for over-levelled emissions, will be handed over directly to the product and thus to the end-customer. Thus Emissions Trading might let grow the feeling that the end-customers pay the ecological benefit. Communication from companies to customers might have then an ironic tune (suffer from this).

On the other hand, the advantages of communicating green issues can be summarized as follows:

- Emission Trading and Kyoto have a very high name recognition and many people are informed about these facts. So communication from companies is rather a must than at arbitrary green actions where it might be a positive add on information. Communication is a pre-requisite, no communication would lead to negative effects in public.
- As everybody is involved in Emissions Trading either by formulating boundary conditions (governments), indirectly (privates or society) or directly (companies which are depending on reduction levels, which they have to fulfil and have no free choice of participation), communication beyond and between all involved parties is complex, very different but pre-requisite. No communication would lead to a rather negative image.

- Communication about Emissions Trading might be rather easy, because the thematic and keywords are well known and the system itself, more or less a stock exchange trading, is principally known and understood.
- Communication about positive results through or from Emissions Trading will have wide spread effects. It is a world wide, global system that hopes to punish environmental fools and award green winners. Thus positive news from companies could have the touch of a global winner.

6.10. Communication with recycler industry

The supply chain section of this report has primarily presented different tools for performing environmental communication or tools that support the communication by giving it new usable facts. These tools were in the form of material lists, DfE guidelines, SCEM, EMA or Emissions Trading. This section is about something else: the recyclers.

6.10.1.1. Communication obligations

The WEEE directive (Waste Electrical and Electronic Equipment), which was published in February 2003, sets out the framework of future communication obligations. One of the basic requirements in the directive is the need to transfer information to different stakeholders in a community. EEE producers are here given special attention in Article 11, *Information for treatment facilities*:

"In order to facilitate the reuse and the correct and environmentally sound treatment of WEEE, including maintenance, upgrade, refurbishment and recycling, Member States shall take the necessary measures to ensure that producers provide reuse and treatment information for each type of new EEE put on the market within one year after the equipment is put on the market. This information shall identify, as far as it is needed by reuse centres, treatment and recycling facilities in order to comply with the provisions of this Directive, the different EEE components and materials, as well as the location of dangerous substances and preparations in EEE. It shall be made available to reuse centres, treatment and recycling facilities by producers of EEE in the form of manuals or by means of electronic media (e.g. CD-ROM, online services). […]" (European Commission, 2003)

This is clearly a task for producers that they have to fulfil in future, but depending on how a specific Member State wants Article 10, *Information for users*, to be fulfilled, this information need could also be a task for producers. In Article 10 it is stated that users of EEE should be given enough information about e.g. available collection systems, the potential environmental effects of WEEE and the users' role in contributing to re-use, recycling and other recovery forms of WEEE (European Commission, 2003). To get an idea of how the situation is today, Swedish EEE end-of-life operators were asked about their views of information needs. At the point of asking

them (March/April 2003), the Swedish producer responsibility system had been implemented for approximately 21 months. This was the outcome:

- Users do not get enough information about available collection systems. Producers might inform, in e.g. instruction manuals, that the goods must be disposed of separated from other municipal waste, but how and where the users have to find out on their own. It could be a task for sales people to inform about, but one recycler pointed out that examples exist of large household appliances stores that do not know about producer responsibility.

- The public's knowledge about WEEE was seen differently, some meant that they know about producer responsibility but not exactly the meaning of it; others said that because of the mixed content in waste coming to the treatment facilities, it's assumable that the public is more interested in getting rid of things rather than handling them right.

- The recyclers do not get any information from the producers at all. This might be due to the fact that the new products, those that entered the market after the producer responsibility system was introduced, have not reached the recyclers yet.

- The recyclers want information about which hazardous substances are present and the exact location of these substances. It would also be appropriate to list the location of components that the producers find valuable for re-use matters.

- The largest amount of WEEE comes from private households, and companies are thought to have the largest possible improvement factor. This stresses the importance of appropriate information about collection facilities, environmental impact etc.

- New products are in general better/easier to handle. They contain less hazardous substances (or substances that are not known to be hazardous) and products that have used DfE techniques (that use e.g. snap-fits or one type of screw head) are easier to dismantle. New compact computer monitors are seen as a problem, though.

- A delighting fact: in some cases the recyclers have been asked by producers to contribute with their specific knowledge in the design phase of products.

This makes it clear that if the producer responsibility should be as easy as possible to fulfil, information about the products as well as handling information for the users must be present – just like the WEEE directive says. But the way this should be done is yet an unanswered question. As soon as the public is acting correct, the producers must be prepared to be responsible for a waste amount that will grow very fast. They can help themselves to manage this, partially with better designed products. DfE must therefore get the attention it deserves.

6.10.2. A method for informing the recyclers

Most important in this section is the communication with the recyclers, and there might be an appropriate tool under construction, at least for some industry sectors. This goes by the name of ELIMA, which is a joint European research project (Elima, 2003). ELIMA aims at optimising a product's life cycle in economic and environmental aspects. The basic principle to fulfil this is based on the transfer of appropriate information. The way ELIMA is thought to be constructed is seen in *Figure 19*.

ELIMA is a system where recorded product data can be transferred to a data base. Products are to be equipped with an integrated sensor, memory and communication package, the so-called IDU. The IDU identifies and records different kinds of dynamic data such as time, temperature, humidity, mechanical shock and vibration under the different life cycle stages. These data show the different environmental conditions that the product is subjected to during its entire life, e.g. how a user is actually using the device and under which conditions. The static data is assigned during the design and manufacture phases. Typical static data could be about how to handle the product at service or end-of-life stages, how potential hazardous materials are identified and where they are positioned etc. Static and dynamic data are then transferred to a collective infor-mation system and together they give answers to the product's and its components' state throughout all life cycle stages. The data analyst is able to see, e.g., how the product has been used, for how many hours and in what conditions, if service has been undertaken and which parts have been removed or substituted etc.

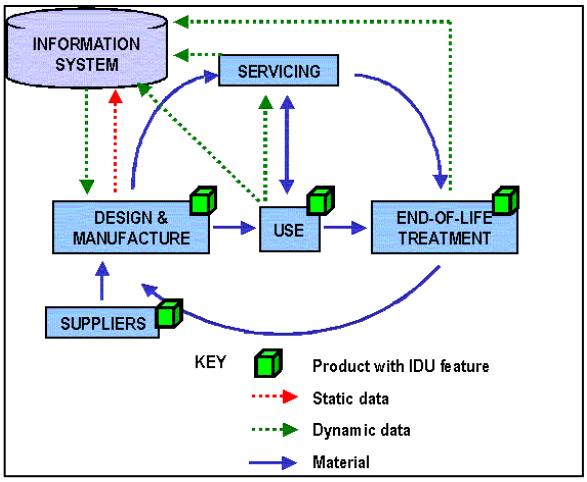

Figure 19. Graphic of the ELIMA system (From www.elima.org, 2003)

The producers and their stakeholders are given information that previously has been hardly verifiable. To get actual data instead of more or less exact estimated data is of course very valuable. There are many different areas where this data would be of interest, but for communication with recyclers these advantages are specifically mentioned (Elima, 2003[1]):

- The recorded data might show that a product has not been used in too severe conditions and that it might be re-used as a whole.

- The data can show that certain components have been more stressed than others, and these could then be removed.

- The data gives the end-of-life operator an opportunity to sort removed components in different price categories for a future market of re-useable components.

For the end-of-life treatment this could enhance and simplify communication to be very cost-saving since the products carry all necessary information. They will know how to dismantle products, where hazardous material is located, which components can be re-used and what their remaining lifetime is. Producers are given valuable information about how the products are actually handled by the users. This will increase their knowledge and can lead to enhanced product development. The maintenance is simplified as the system can show what has gone wrong.

The system is not ready for a broad implementation, but there are on-going projects that will show the system's abilities. A basic principle must be that the users of the system have easy access to appropriate data if the system wants to be successful. The data management must therefore be very well structured as there will be an immense amount of information available. It is likely that the end-of-life treatment must be very efficient to be able to offer second hand components at competitive price levels and not much time can therefore be spent on data analyses. The situation might be similar for product designers who want to gain understanding of the users' product handling.

This is how the ELIMA organisation describes a future scenario:

"A future ELIMA example product might be a domestic washing machine, containing energy monitoring functions, recording of usage and malfunctions and having software upgradable from a link to a home network. Data could be stored or transmitted to the producer for analysis. Faults could be diagnosed remotely to improve maintenance, or locally using the product's memory. At the end-of-life, recyclers would read data from the machine and from the producer's database, referenced by the serial number, and make decisions on reuse/remanufacture/recycling of parts. The database could be accessed and updated by suppliers, distributors, etc. and the data would be "mined" for valuable information (such as use patterns pointing to new product developments) by the producer." (Elima, 2003[2])

Part V Conclusions and future research

7 Conclusions

This report has clearly shown that EEE producers really are committed in communicating environmental matters with its different stakeholder groups.
When companies communicate with the private customers almost all different mediums known are used to transfer the information. Most commonly, the Internet is used, where the companies publish an immense amount of information. Many companies even publish too much information there and in such a manner that the user has troubles finding what she/he is looking for; it is easy to lose the overview. It is also not always obvious where this information is located - often enough it is hidden behind the link leading to general company specific information and once that site is opened, the user must search for the specific environmental link. Of course, most Internet sites exist to present products or solutions for the potential customers in an interesting manner; to do something else would be a waste of resources, which could be used in a better way.

The information provided is presented in such a manner that it is not always easy to find it. Private users want environmental information, but they are not really willing to find it themselves in most cases, approximately only 10% of them take this subject in consideration when buying things, and if any information should be given to them, they are likely to dismiss it as just another marketing strategy to sell more products. This customer behaviour plus the way the information is presented are a bad combination and it most likely means that even if an interested user tries to find easy to understand information about basic environmental matters she/he is likely to lose interest.

Further most of the information provided is too “technical” that is not putting environment in a wider context of interest for the consumer and the language used is not derived from the usual world in which they are living; a well known problem of government and academia when they communicate about this subject.

The producers, though, are interested in reaching the private customers to inform them about the producers’ environmental activities. This could be seen in the questionnaire’s results in the very beginning of the report, and the investigation firmly confirms this. At the beginning of the research on this work, it turned out, that the private customers are more important to the companies than the survey showed – much because of the products’ environmental impact during their usage phase but also because most companies do not know how to reach the private customers but see them important to reach. Companies should inform about environmental matters, but to a lesser extent than today and focus on subjects that are more important for the customers and thereby the environment.
Moreover the issue of credibility have to be considered, e.g. by formation of “information coalitions” which have a higher credetibility for the consumers than just company info.

Today's information is too vague, almost solely based on intellectual understanding and based on the environmental activities of *companies*. That fact that companies have improved their environmental understanding is obvious and it is also logic that they want to inform about this, but it is not appropriate. Appropriate environmental information from producers to private customers should be based on basic understanding of today's environmental problems and their solutions. Customers must be pushed to the point of "feeling" the necessity of acting the right way; so to speak, it should be an instinct and not a choice. To reach this takes time, but producers could help in the initial phase by providing information about how products can and should be used. Easy examples of this could be similar to what Dell is providing: turn off your monitor when not working on your computer, do not use screen savers as they have no function today, disconnect your cable if zero energy use is a matter, etc. The information must be impossible to misunderstand and free from interpretation possibilities, i.e. it should not be possible to use the information in more than one way.

The results from the questionnaire also showed that the least important reason for performing environmental communication was to change customer behaviour. This points out to a problem. If customers do not change, then industry improvements do not matter so much, and the problem with customers caring but not acting will still exist. Producers cannot reach or influence private customers' behaviour if they provide extensive information about all the different improvement activities performed or in how many different international environmental research projects they participate in and so on. This even might be contra-productive. It should be enough to say that these products are designed and manufactured the best way possible, but that this will not be so important if they are not used the way they are supposed to, handled with care and disposed of in the right way. It should be clear that this part is up to the users to fulfil. This information completed with the above mentioned results that there is not much the customers have to think about – or said in another way: not to think about, just to do. Why should a producer not be able to demand from its customers to take their environmental responsibility just the way the customers demand the companies to do?

These ideas are compatible with facts that can be found in the WEEE directive. There it is explicitly stipulated that every member state must make sure that the public is given appropriate information so that the waste treatment is made as easy as possible and that the public understands which potential risks exist if the WEEE is disposed of in the wrong way.

Even if the public gets appropriate environmental information, this must not lead to a better behaviour, the public might still need an easy to identify reason for choosing the environmentally better adapted products. One way to solve this could be that the producers do not abandon the use of eco-labels completely. This is an easy and straight forward way for customers to easier understand which product they should choose, and it is said that eco-labelled products are responsible for 20% of sales of environmentally adapted products. It is also likely that even if customers know more, they still want it to be easy at shopping; they have limited time and maybe they do not want to waste too much time searching for environmentally adapted products that are not easy to identify.

To promote the use of labels is most likely not what the EEE industry wants to hear. It thinks that there exist too many different labels and that this will only confuse customers and finally takes too long to get a product certified, something very crucial for EEE where time to market and total life are rather short. There should be a harmonisation of the labels if the use of them should pay off. To use labels might be a way of getting customers to act "green" without the necessity of being "green". How this should be solved has not been investigated here but some thoughts have arisen. There have to be as few different labels as possible, and this should also go for an international point of view. It should also be easier to certify products. Maybe a company could be given the right to certify its products directly and then have them controlled on a yearly basis. Should a company abuse this and certify products that are not good enough, an appropriate penalty could be the withdrawal of the licence, fines or other economic sanctions.

To make this work, better and more legislation compared to today would be required. Companies in general are not keen on seeing more legislation as they rather want to solve the problems themselves. There are hardly any companies found to be left alone working on solutions for a better environment because there have been too many scandals with companies behaving badly. This, in turn, has led to stronger reactions from stakeholders who demand more and better corporate information and stricter regulations for what companies should be allowed to do. Most likely they will not give up this subject and would not tolerate that the companies should be left on their own to solve the problem. The companies that answered the initial survey made clear that legislation was the second most influential reason to start environmental communication in the first place, and one thing that has occurred more than once is the demand from companies that politicians should release regulations that are more precise than the current ones.

People might wonder how the two quite different demands of no regulation/stricter regulations are compatible. It is not too hard to understand, though, that they are both about how easy the day-to-day business should be for a company to perform. With no regulations a company sets its own agenda but it must still have the other companies under supervision so that no market share is being lost. The stricter regulation is also clearer as it stipulates more precisely what must not be done. This makes it much easier for a company to perform well, compared to a company that does not exactly know what is allowed and what is not. A way out of this dilemma is to set boundary conditions and define the playing fields where markets and competition can deliver the best results.

There is also the idea around to expand legislation to a two sided approach. On the one hand to the supply side and industry by the mentioned EuP Directive (latest proposal on 01.08.2003) and on the other hand to the demand side and the consumers by taxation of consumption.

If private customers should receive just basic information, the supply chain must possibly be seen from a different point of view. It is stated that companies as such care more about the environment than the general public, and this company commitment must not fade. It works relatively satisfying today but there are possibilities for improvement. SCEM seems promising with possible synergy effects from cooperation between companies with different qualifications, which would enable improvements in the complete life cycle. Of course it is not easy to implement a complete new way of working, but hopefully the benefits outweigh the resources needed for implementation.

Exactly the same applies to the use of environmental accounting. It strengthens internal communication and understanding, which make better decisions possible. These better decisions are based on the use of improved accounting techniques that specify where costs actually originate. A company that really understands what it is doing is likely to have a fair chance of changing things for the better. This better understanding of potential benefits is crucial for companies. In the case of DfE techniques one major aggravating circumstance was that people could not clearly see the purpose for using such a tool, and since trial and error might not be the right strategy here, something must help them to understand the situation. Case studies performed by other companies were sought-after, i.e. a company would like to see what problems and benefits other companies experienced before they will try it on their own. This is evident but it might be too long a process to wait for appropriate case studies to emerge from potential competitors. A better way might be to investigate it by using tools, e.g. Activity Based Costing, that are able to show the economical benefits of a planned change in the day-to-day business. Tools showing financial benefits are always preferred since money units are something that most people have a relation to and are able to interpret. The positive side effect of ABC is that it is suitable to be used in an incremental manner; start small and expand.

In a final remark it must be stated that the supply chain as a whole seems to be on a promising way forward. If it all started with rather static different company specific lists of prohibited materials, then the situation today is that there are new, more dynamic techniques present or under construction. It will be interesting to see if there is a future for web-based DfE guidelines, which would help designers immensely in choosing appropriate materials or design features. However there is also the risk to overflow the designer with information which he can’t handle any more. Therefore companies should also try to integrate Ecodesign into its business.

8 Future research

In the report, it is stated that private users of EEE must be able to get relevant environmental information of the products since most of them have the largest impact during the usage phase. The question was also raised if EEE producers should participate to great extent in this. To be sure about which strategy to follow this subject must be further investigated. Private users must have easy access to information. If producers still want to be part of a successful strategy, a possible solution could be built upon cooperation. It would be interesting to see if major EEE end producers could work together and have joint responsibility for one information site on the Internet. This site should be easily accessed from the companies' homepages and available in different languages with facts about how environmental problems are caused, what the private customers can do and what politicians and companies do. If another party, such as the United Nations, the European Union or NGOs would also be part of it, this could give the project enough credibility and the public would likely find it trustworthy.

The use of labels should not be abandoned completely but it would be interesting to see if it is possible that an eco-label could be valid all over the planet. Within the EU, the EU flower has gained acceptance among customers and this shows that, at least, it is possible to think of a one-world eco-label. The eco-label certification process was also questioned and examples of how this could be done were presented. Of course, these assumptions must also be investigated thoroughly before anything can be recommended.

But there are more dimensions of the eco-label. The ones used today mostly tell customers that this is a product which has been designed and manufactured in an environmentally adapted way, but a new study, published in Sweden in 2002, showed that the use of labels that point out products that have higher environmental impact could have better results (Grankvist, 2002). The situation today shows that even if a customer is concerned about the environment this does not automatically lead to a better behaviour due to eco-labels. The labels mostly affect the very interested customer and leave the other customers unaffected. Those labels presenting negative environmental information do succeed in reaching also the group with just an intermediate interest. A parallel to the EU Flower is easy to draw. This identifies the energy consumption for different electronic devices such as refrigerators and washing machines. Sales staff of retailers confirms that private customers really pay attention to this label and most commonly choose products with good energy efficiency.

Producers can contribute in spreading knowledge about environmental matters and make people change their behaviour. This should, as mentioned before, not be done the way it is today. The future will have more electronic products than imaginable today and it is therefore extremely important that the public knows what it "has to do". But how can we change the way we are behaving? There is no simple answer to this; there are too many ways of reaching this. A person might change her/his behaviour either because the change is forced upon her/him or the person wants to change it, i.e. has a need for changing it. This self declared will to change environmental behaviour is not

likely to come from a major part of the society and another way must be found. To force a change is time consuming and ineffective since the will to change is lacking. A much better way is to learn to do it right from the very beginning, to make it a part of day-to-day life when people are young. As children spend much time in school this could be a suitable place to integrate information on good environmental behaviour.

9 Thoughts for proposals for communication concepts

The report's results are used as basic knowledge for describing a communication concept for each investigated stakeholder group: the private customers and supply chain. These are presented as a company's direct communication activities with the stakeholders, i.e. there are no steps in between the company and the stakeholders. There could be other suitable solutions to this problem. Sales staff in shops turn out to have an important influence on buying decisions; in approx. 50% of the cases their advice counts strongly. Environmental issues are brought up relatively infrequently by customers which have leaves room for information and education on this subject.
However within this work, the focus is solely concentrated on the direct communication between private customers and companies.

The private sector should get tailored information to their needs and in a language they understand. Today's widespread information transfer is not appropriate. Private customer must receive information about how the companies are behaving, but the very important information task to solve is not solved that way. This is obvious since there really is a large transfer of information today, with yet unsatisfied private customers. The problem in reaching them is described as a paradox: they are interested in environmental matters, but they normally do not seek information and if they are provided with information from companies they hardly believe in it. If a customer today should really search for information, though, she/he will get too much and too unspecified, she/he will not know where to start.

The concept proposed herein aims at getting private customers to understand that they must solve their part of the problem just as the companies must solve their part. A cooperation between electronic manufacturers and authorities such as the European Union, United Nations or similar, should be initiated, and this cooperation should present easy to understand basic facts in easy to understand ways. Appropriate mediums for this could be the Internet as well as TV commercials. These assumptions are based on a result from the questionnaire: Internet is the favourite medium for communication between companies and its stakeholders. People do also spend much time in front of the TV and even if commercials are not appreciated by everyone, specifically designed commercials could be mind awakening.

The facts must be of a kind and transmitted in a way that is felt rather than understood. This means that the facts also should be understood intellectually, but it is even more important that they cause a more sublime reaction, a reaction that so to say exists in the mind and body; an instinct. Most people probably know that things are not going the right way today, but yet are just a minority in doing something to change this development. No big change has to occur as it was stated in the introduction to the report to make the situation better, i.e. people do not have to change their way of living too much, and a recurring theme in the report says that it is important to get people acting green without being green. This seems not achievable with intellectual facts only. What should be transferred are facts that explain today's environmental problems, why

they occur and what could be done to solve them. In the last part the information must be two folded: this is the task of companies and this is the task for the open public, there is no such thing that only one side is to blame.

To give an example of what is meant with information that is felt as more than an intellectual statement, a Swedish TV campaign in the 1980s that aimed at getting more people to use the seat belt when riding in the back of a car will be described. The short, about 15-20 seconds, TV commercial was a cartoon. A child steps into the back seat, the driver steps in and puts his seat belt on. The car takes off and soon there is a front to front collision. The driver's seat belt is doing its job, but the child in the backseat is transformed to an elephant as it is thrown forward during the crash, and this transformation eliminates the good work of the seat belt as the driver is crushed by the weight of the elephant…

A cooperation of this kind, including companies and authorities, must be at hand if an information campaign wants to put pressure on the open public to find acceptance. It would be suitable to include NGOs as well, but that is hard. Their task is to be independent, to investigate politics as well as business matters and this independence could get jagged if they join with the business side. But, when it comes to an information campaign whose overall aim is to make things better, they might be interested in participating, too.

It's difficult to come up with a really new concept for the supply chain – things are developing fairly well; however a lot of improvement potentials are still untapped. There is also the risk that the momentum in this field is reduced by not considering this topic in the upcoming legislation. Of course, it would be very good to integrate the new ways of day-to-day business, e.g. Environmental Management Accounting or Emissions Trading schemes, to strengthen the communication. There might be opportunities to do this in a Supply Chain Environmental Management system. These could be designed throughout the whole spectrum of activities, on one end the education activities and on the other end a true cooperation where the companies use their specific qualifications to be able to cover all aspects of a problem.

The Emissions Trading activities are more successful if there is cooperation on the matter. Nowadays, companies primarily join as single members and they agree upon how much they are to lower their emissions and to what costs. If this were to be done in cooperation with companies from the supply chain, synergy effects would be likely to emerge. Greater emission reductions could be reached, and this to a lower cost for the participating companies as they use each other's specific qualifications; a good product would be even better designed which also would mean easier production, maintenance and end-of-life activities: a perfect win-win situation. Of course this would also be the case even if it was not part of an Emissions Trading scheme. Emmission trading should have clear geographical system boundaries in order to avoid that rich countries buy off their liabilities in the developing countries.

Another synergy effect of Emissions Trading scheme cooperation could emerge if the scheme got extended to also cover other institutions such as commercial buildings, which was proclaimed as possible by a Swedish investigation, and if the manufacturers somehow were allowed to use gained credits from these. One part of the reduction from these buildings could emerge because of their improved equipment, which has been developed and produced by someone who might see themselves as responsible for this reduction and therefore also should gain something from it.

Even if SCEM were not to be used to a greater extent than today, Emissions Trading and Environmental Management Accounting are tools that can be very easily used to strengthen communication. They present facts in a way that everybody understands, i.e. they talk in terms of monetary units.

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White list of chemicals, www.tech.volvo.se/standard/docs/100-0004.pdf (2003-06-08, 12.45)

Other links

Material Databases:

www.matweb.com

http://www.ecs.umass.edu/mie/labs/mda/dlib/material/material.html

http://www.ire.org/datalibrary/databases/haz/

RoHS Directive:

http://europa.eu.int/eur-lex/pri/en/oj/dat/2003/l_037/l_03720030213en00190023.pdf

General DfE guidelines:

http://extra.ivf.se/dfee ”Handbook for design of environmentally compatible electronic products. A daily tool for designers.

www.mst.dk “Electronics and the environment. A guide to the selection of components”

www.electroind.fi/ymparisto/eng_guide.htm “Environmentally oriented product design”

http://dfe-sce.nrc-cnrc.gc.ca/home_e.html “Design for environment guide”

DfE guidelines on the Internet:

www.ecoscan.nl (Test version to download, then CD to buy)

www.ecodesignguide.dk

www.ecodesign.at/pilot

Link site:

http://www.eco-shop.org/Links/Others/ecoshop_links_others.htm

Appendices