



KUNGL TEKNISKA HOGSKOLAN  
AUGUST 98

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AND THE  
ENVIRONMENT**

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## Preface

When I started to work in the thesis, the main goal was to do a benchmarking study of the Swedish paper manufactures, at the distribution level and in the European Union context, giving special attention to the environmental concerns in the distribution. The idea was to do a study based on information collected from the companies. In the beginning all the barriers I could see in the way seemed possible to overcome, time would show me how wrong I was. It is difficult to approach a company in order to obtain detailed information about its distribution strategy without giving something in return, it was missing *Quid Pro Quo*<sup>(1)</sup>. Due to these unexpected difficulties, which will be explained in the methodology section, I was forced to change the goal previously defined.

Instead of doing a benchmarking study, a more theoretical research work was performed, studying the environmental impacts of distribution, and how companies should act in order to be more ecological in this specific area. A special attention was given to what is being done in the Swedish forest industry and how some of the Swedish paper manufactures tackle the environmental issues in their distribution strategies.

Despite the difficulties mentioned above the experience of making a research like this, in a foreign country, was for me of great value. Not only I learned a lot about the environmental impacts of distribution and how companies can minimise them, but also how to proceed such a deep investigation and especially, how to structure a thesis in order to include in it all the relevant information. I believe that this experience will have a lot of positive effects in my future life, and for sure I will never forget it.

This thesis is divided in five chapters. In **Chapter 1** the objectives are presented and the methodology followed is also described. In **Chapter 2** a short presentation is made on how the European Industries face the environmental issues in their strategies. The importance of environmental requirements in the competitiveness of a firm and of an industry is also analysed. **Chapter 3** identifies the environmental impacts of logistics and in particular of some distribution strategies (centralization of inventory; 24-Hour operation and Just In Time). The impact of the different means of transportation is also analysed, and special emphasis is given to road transport. Still in the third chapter, some environmental measures affecting logistics activities are presented. It is also discussed how companies can act in order to be more ecological in their distribution strategies. In **Chapter 4**, a presentation of the Swedish forest industry is made, and the environmental measures in this particular industry are also summarised. In the last part of this chapter two case studies are presented, where the results of an analysis of two of the Swedish paper manufactures environmental practices are described. Finally, in **Chapter 5** some final remarks are made.

Environmental concerns are becoming increasingly important, they have an impact on most activities of business, and require strategic decisions and responses. Logistics management decisions such as those regarding the transport of raw materials and finished goods, or the location of plants and distribution centres, can no longer be made without considering environmental impacts. This thesis intends to give a broad understanding of the environmental impacts of logistics (in particular distribution), and how in theory, and also in practice, companies can be more ecological in this specific area.

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# CHAPTER 1

## OBJECTIVES AND METHODOLOGY

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### 1 – Objectives

The main goal was to do a benchmarking study in the Swedish companies at the distribution level and in the European Union context, giving a special attention to the environmental concerns in the transportation and distribution.

The following results were expected to be achieved:

- Understand the main factors that gave the Swedish companies their competitive advantage and the importance of the distribution in their growing process.
- Identify differences between the distribution strategies followed by the Portuguese and Swedish paper manufactures.
- Investigate the environmental measures taken by the companies in their distribution strategies.
- After taking into account the distribution strategies followed by the companies of the two countries try to find out which aspects of the Swedish strategy the Portuguese companies could follow, in order to be more competitive.

In the next section it is going to be explained why it was necessary to re-define these objectives and then, the new and final ones will be presented (pag.6).

### 2 - Methodology

Before I started to work in the thesis I read some literature of how to pursue a marketing research. Although this thesis can not be seen as a marketing research, the theory of how to pursue one can also be applied in this kind of research works. Figure 1 illustrates the steps that should be followed in a research project. In this section it is going to be presented how these steps were in practice followed.

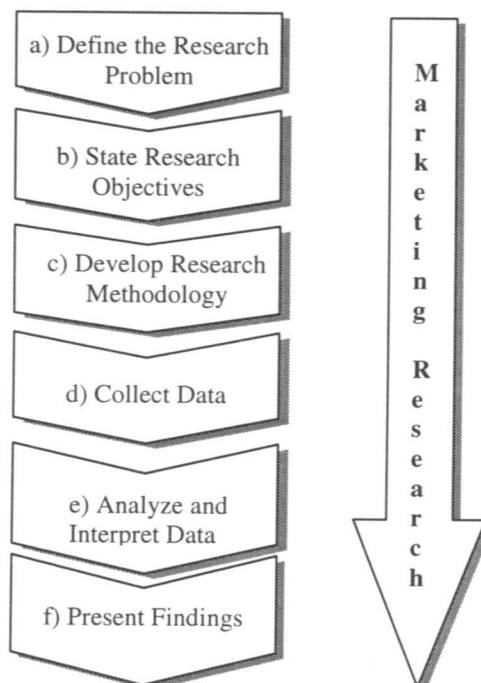


Figure 1 – Steps of a Marketing Research  
Source: *The Marketing research guide*

### a) Defining the problem

Since I didn't have a company supporting my thesis, and I was one of the few exceptions to the rule, I had to find a problem that I would like to study.

Being Distribution one of the subjects that I am interested in, and also one of the companies' most important competitive instruments, I first decided to make a comparison between the Portuguese and Swedish distribution strategies, giving a special attention to the environmental concerns in this specific area. In order to define the problem I had first to do some research about the Swedish industry. At this stage the book *Advantage Sweden*, the *Fact sheets on Sweden* and some other information collected from the Swedish export council were of great importance, allowing me to have a very good idea of the most important industries in Sweden.

### b) Stating the objectives

After the initial research I was ready to move one step further and define the goal and its background, delimitations and expected results. I may say that this step was of great importance because it led to the research results by providing the direction, and the scope of the project and it also served as the basis for developing the methodology to be used in the project. The objectives first defined were presented in the previous section.

### c) Defining the methodology

After the definition of the objectives I asked myself the following question:

*“ What specific types of information do I need in this particular research project? ”*

The attempt to answer made me reflect on the research objectives and allowed me to structure a methodology. I decided that it would be better if I divided the study in two parts:

**First Part:** I would examine the history of competition in the Swedish and Portuguese paper industry, having published data (literature, industry association publications, companies' annual reports, newspaper articles, surveys and the internet) as source of information.

**Second Part** I would try to perceive the distribution strategies of Fine Paper followed by the Swedish and Portuguese companies and their environmental concerns in this specific area. Having in this case as source of information what M. Porter calls Field Data, i.e., information gathered from interviews and/or questionnaires with industry participants and observers.

To carry out the first part of the study I did some research on how to conduct an industry analysis, so that I could know which information I should collect. At this point the book *“Competitive Strategy”* by M. Porter was of great help, as it gave me a broad understanding of how industries are structured and how those structures influence a firm strategy (Michael Porter's five forces model). I tried to collect the information according to the following framework, suggested by M. Porter in his book:

- Raw data categories for industry analysis:
  - Product lines
  - Buyers and their behaviour
  - Complementary products
  - Substitute products



- Growth (rate, pattern, determinants)
- Technology of production and distribution (cost structure, economies of scale, value added, logistics, labour)
- Marketing and selling (marketing segmentation and practices)
- Suppliers
- Distribution channels
- Innovation (types, sources, rate, economies of scale)
- Competitors
- Social, political, legal environment
- Macroeconomic environment

It was beyond the scope of the thesis to do such a deep study of the paper and pulp industry, nevertheless, this framework helped in finding a starting point in the collection of useful information.

After this, the problem was how to collect the data. The approach to this issue varies on the kind of data we are talking about: published data, or field data.

## **e) Collecting data**

### *Published Data*

I started with the collection of published data, which allowed me to have a broad understanding of the paper industry and of the environmental concerns in distribution activities. I believe this was a right start because this way I could, more effectively, spot important items and have some knowledge of the industry.

The main sources of this kind of data were:

- Companies
  - Annual reports
  - Magazines
  - Sites in the World Wide Web
- Industry Association
  - The Swedish Forestry Industry Association (Skogsindustrierna)
  - The Portuguese Paper Industry Association (CELPA)
- Literature and surveys about:
  - The Swedish Paper&Pulp Industry
  - Eco-Logistics
  - Others
- Journals
  - The Transportation Journal
  - Freight management and distribution today
  - Business strategy and the environment
- Magazines
  - Freight
- Organisations
  - European Union Studies
  - Organisation for Economic Co-operation and Development (OECD) studies

The way chosen to collect the information was to visit the companies' headquarters, in Stockholm, and ask for their annual reports. This source of information revealed to be of great value because I could find out what the companies seem to be proud of in their environmental performance, what they seem to be worried about, and what key changes have been made in their distribution activities.

The literature and surveys information was collected from the library of Stockholm School of Economics. Thus, I could study the history of the Swedish Paper&Pulp industry, how some of the companies in this industry become so competitive, and the environmental impact of distribution activities.

### ***FIELD DATA***

I also started to collect field data at the same time that I was doing the library research, by first conducting phone interviews and then sending in questionnaires. It was at this stage that some difficulties started to appear, forcing me to change the goal of the thesis.

Since I only had 20 weeks to do my thesis, I had to limit the study to one company in Sweden and to one company in Portugal, and for both of them I had to restrict the study of their distribution strategies to one particular kind of paper: Fine Paper<sup>(2)</sup>.

I first contacted them by phone, and simultaneously sending by fax a summary of the information that I would like to get from them, together with a presentation letter, so they could have in advance an idea of the information I needed.

In the case of the Swedish company (MoDo), after the first contact, I conducted a phone interview. The interview was made having as basis the summary of the information that I had sent before (see Appendix 1). It was after this that the company started to be less receptive to my questions. I believe that the main reason was for not having the time or the interest to collect the detailed information I was asking for. This process took almost one month, due to the busy schedule of the contact person.

Regarding the Portuguese company (Soporcel), after the first contact by phone I made a personal interview with one of the company's responsible. The interview went quite well and I was really hoping that they would send me the information that I had asked for. Unfortunately they didn't send anything and the telephone calls that I made insisting to send me the information didn't make any difference.

After this and with only two months left to finish the thesis, I thought it would be wiser to shift the direction of my thesis to a more theoretical way and then safer to accomplish at the appointed time.

As it is stated in the book *The Marketing Research Guide*, a researcher should “*plan his work; work his plan*”. This statement clearly shows that a research project is an interactive process, and the researcher has to keep that always in mind in order to make the right decisions at the right time. Experience showed me how much this is true.

After this change of plans, I had to go back to step b) and re-define the thesis objectives. Instead of doing a benchmarking study, a more theoretical study about the environmental impact of distribution activities and how companies could act in order to be more ecological in their logistics strategies was performed.

(2) Paper based on chemical pulp, which can be coated or uncoated.

Coated fine paper has a surface which enhances the printing quality;

Uncoated fine paper is normally used for copying and typing paper in A4 cut-sheet format.

In this context, the following results are expected to be achieved:

- Understand the impact of environmental requirements on competitiveness and on a Pan-European strategy.
- Identify the major impact of distribution activities on the environment.
- Perceive what can be done, at the distribution level, in order to harm less the environment.
- Evaluate the environmental awareness of the Swedish paper manufactures in their distribution strategies.

The sources of information of published data, didn't change, I just started to concentrate all my efforts on the collection of literature directly connected with environmental issues in distribution. Regarding the collection of field data, the only difference that is worth mentioning is that I opened the range of the companies to be studied. Instead of studying one with much detail I decided to study several in a more superficial way.

A questionnaire was prepared (see Appendix 2), and sent to the following companies:

- Stora
- SCA
- MoDo
- Korsnäs AB

The questionnaire was made according to the following sequence of steps:

**1. Planning what to ask:**

- Distributions channels
- Service level
- Physical distribution network
- Stocks
- Warehouses
- Information technologies
- Planning
- Environmental measures
- 

**2.** Formulating questions to obtain the needed information. I tried to ask yes/no questions and multiple choice answers to simplify the task of the respondent.

**3.** Reviewing the questions, making sure that they were clear, paying attention to the vocabulary, ambiguous meanings, leading questions, length, etc.

**4.** Deciding on the order of the questions

**5.** Working on the lay out

The intention was to get a general perspective of how the companies have settled their distribution networks and how they deal with the environmental issues.

### **e) Analysing and interpreting data**

Just two of the companies listed above replied to the questionnaire (MoDo and STORA). Although the quality of the answers was quite high, a phone interview was performed with STORA's respondent in order to clarify some of the answers.

In what concerns the questionnaires some remarks should be made:

- Questions number 3.5 and 7.5 were difficult to answer because it was impossible for the respondent to get a figure for them, as they were too broad.
- Questions number 7.7, 7.8 and 7.9 reflect the opinion of the respondent and not the company itself, which is something that was taken into account when compiling the case studies.

Some of the answers were validated by confronting them with the information available in the companies' annual reports. Some other answers were impossible to validate since they reflect the opinion of the respondent.

The secondary data was carefully analysed and structured. Not all of it was relevant to the thesis, but I may say that it was relevant to my private knowledge.

### **f) Presenting findings**

The data collected is now being formally presented in this thesis. First an introduction to the subject is made, by speaking generally about the environmental awareness in the European Union. Then the environmental impacts of distribution activities are analysed, as well as, the environmental response of companies. Finally, the cases of two of the Swedish paper manufacturers are presented.

Some of the subjects could have been more developed like: the European Eco-industry and the EU environmental measures. They are presented in a more superficial way because they themselves could be the subject to another thesis.

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# CHAPTER 2

## ENVIRONMENT AND EUROPEAN INDUSTRY

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### 1- Introduction

Environmental quality is an important factor of our living standard. As such, meeting high environmental requirements has become an integral part of doing business and an intrinsic condition for the long-term competitiveness of the industry.

Meeting this challenge will depend on the ability of the industry and the policy-maker to identify and encourage opportunities for efficiency improvements, new products, service innovations and changing consumer's behaviour.

Pressure from well-organised environmental campaign groups and from media have forced companies, especially large companies, to carefully analyse and refocus their environmental policies. Also the European Union has become an important decision-making organisation on environmental issues. As a result companies and organisations are:

- much more conscious and sensitive to environment criticism regarding the use of raw materials, production methods, distribution activities or disposal of waste.
- more proactive to implement measures that avoid them being in confrontation with environmental campaign groups.
- much more alert to the risks of attracting adverse media attention or official or public criticism regarding their environmental activities or profile.
- much more proactive and realistic in their approach to environmental management programmes, audits and being in compliance with regulatory or legislative measures

### 2- The development of “green awareness” in Europe

Natural resources can no longer be used freely without conscientious regard for future consequences. Furthermore, there must be an investment to project against future injuries to the environment. One pressing concern is that those companies and institutions, which cause pollution, must be held accountable and must compensate society for the damage they cause.

The early efforts of environmental activists to force European consumers and institutions to deal effectively with pollution and related issues resulting from economic growth were most evident in Germany, The Netherlands, Sweden, Switzerland, and the United Kingdom. Such organizations as Friends of the Earth and Greenpeace have been active for some time at an international level. National pressure groups such as Beelona in Norway also investigate and act against companies, which they believe violate regulations meant to protect the environment (Cooper and Cabocel, 1993).

Support for green issues is no longer limited to a small fringe of activists. Environmental concerns are indeed nowadays expressed by a much larger group of Europeans.

The widespread environmental awareness in the mainstream population is best illustrated by the rise in most European countries of green political parties supported by a strong minority of the electorate. This in turn has prompted traditional political parties to support protection of the environment and has led to the implementation of new environmental legislation by governments throughout individual European nations and at the level of the European Community itself.

Among the results of this general awareness is the now widely accepted polluter pays principle. This principle was formulated as follows (Duhot, 1994):

*“Prevention action should be taken, environmental damage should as a priority be rectified at source, and the polluter should pay”*

Environmentalists and green politicians hope that more and more business will find it necessary (or profitable) to adopt aggressive programmes of environment management. The main reasons they offer for this change in attitudes are the following (European Commission, 1997):

- to reduce the risk of prosecution under environmental regulations
- to improve a company’s public image
- to minimise waste and save resources
- to bolster a firm’s competitive advantage and develop new markets

As a result, every business which makes or distributes goods in Europe is now subject to an increasing variety of complex environmental regulations.

### **3 – Environment and efficiency**

Well-designed environmental protection measures can help promote efficiency improvements. Until now, much of industry’s efforts to meet environmental requirements have focused on implementing end-of-pipe (EOP) solutions such as waste water treatment, dust filters, solid waste treatment, etc. EOP solutions, however, do not usually result in efficiency or productivity gains, therefore representing a pure cost to the firm. Clean technology, on the other hand, reduces the actual level of emissions produced in the first place thus improving the process efficiency. Although initial investment costs are typically higher than those for EOP solutions, there is often a short pay-back period.

One well-studied example that demonstrates the benefits of investing in resource efficiency measures is the Swedish Pulp and Paper Industry. In the United States, water discharge regulations were imposed on the Pulp and Paper sector during the 1970s without adequate phase-in periods, forcing companies to adopt best available technologies quickly. In Scandinavia a more flexible regulatory approach was adopted, involving the initial use of loose standards and adequate phase-in times coupled, however, with a clear signal that tighter standards would follow. This enabled Scandinavian companies to focus on the production process itself, and not just on secondary treatment of wastes. It was also possible for them to develop innovative pulping and bleaching technologies that not only met emission requirements but also lowered production costs. With the ability to produce totally chlorine-free paper, the Scandinavian Pulp and Paper industry was able to meet the growing niche of this particularly product, while its competitors lagged behind (European Commission, 1997).

## 4 – Environment and innovation

Used in the right way, environmental requirements can lead to the development of new products and new markets. Europe has witnessed significant growth of its Eco-industry which includes, amongst others, air quality control, waste management, waste water treatment, environmental consultancy and monitoring sectors. The OECD estimates that the market size of western European Eco-industry in 1990 was approximately ECU 43 billion, with an expected growth rate of 4.9% per annum between 1990 and 2000 (European Commission, 1997). However, the provision of EOP technology accounts for a large proportion of this industry and thus its growth is not necessarily a good indicator of improved industrial competitiveness. Indeed, much of the Eco-industry's growth probably reflects a transitory stage during which industry as a whole is coming to grips with meeting environmental requirements imposed on them. The next stage is likely to see industry internalising the management of these requirements and shifting to resource efficient clean technology solutions (European Commission, 1997).

The development of environment-friendly goods and services is a significant potential source of improved competitiveness for European Union industry. There is currently little data concerning the size and growth of these markets in Europe but there is little doubt that demand for goods and services that meet stringent environmental requirements is growing.

René Bryssinck (member of the European Commission's Industrial Research Advisory committee – IRDAL) said in a workshop on the environment (March 1994, Seville) that:

*“It is clear that in the coming years, European industry will be faced with a double challenge. First, it has to strengthen its competitiveness by keeping up with rapid global technological development. Secondly, it has to contribute at the same time to the improvement of the quality of life by developing and applying clean technology with the aim of reducing the negative impact of industrial production on the environment.”*

## 5 – Impact of environmental requirements on competitiveness

One consequence of globalisation is increased competition in goods, services, and capital markets. Developments in areas such as information technology, telecommunications, and transport have, combined with lower trade barriers and global corporate production strategies, increased the number of competitors able to operate in a market. As competition increases, so does economic efficiency, along with choice and value for consumers. For firms, however, increased competition means increased pressure. There is less slack in the consumers, and firms may have to operate on similar profit margins as more of them face competition from the world's best producers.

Strong competition in factor and product markets will give rise to a range of responses by firms with respect to their environmental performance. At one end of the spectrum, competition could drive firms to very poor, perhaps illegal environmental practices as costs are cut in every possible way. At the other end, environmentally superior products and production methods can be a source of competitive advantage in highly discerning and differentiated markets (Adams, 1997).

## 5.1 – Competitiveness at the level of the firm

For a firm, competitiveness means its ability to sell goods or services in the market place and stay in business. Loss of competitiveness could be manifested by loss of sales or loss of market share, and ultimately could lead to lower output and employment or even to plant closure or relocation.

Traditionally, the standard analysis has been that better environmental performance increases the costs to firms, and so reduces competitiveness. The increase of costs can be (Adams, 1997):

- direct and indirect
- in terms of fixed costs or variable costs
- in different ways, depending on the type of environment policy instrument

The challenge to that view is the argument that better environmental performance might also reduce costs and/or improve product quality, thus improving competitiveness, and is more likely to do so over time with technological development and innovation.

Environmental policy may well be a source of competitive advantage. Firms do not operate in a static environment. In the face of increased costs, firms will have a new incentive to adapt their operations, so as to reduce the economic impact of these increases. Some of the techniques that can be used by companies to identify, evaluate, and publicise their choice of environmental strategies are (Rogers, 1995; Fanchen and Connor, 1997):

- **SWOT Analysis:** An environmental SWOT (**S**trength, **W**eakness, **O**pportunity, **T**hreat) analysis involves assessment by corporate management of the internal strengths and weaknesses of the company with respect to environmental issues, and of the opportunities and threats being presented in the market place and in an operational context.
- **Environmental reviews:** Environmental reviews generally require firms to create an environmental database to facilitate assessment of their environmental performance, help in the compilation of audits, and support regular monitoring. An environmental review is thus a first step in the direction of a comprehensive environmental management strategy.
- **Total Cost Analysis (TCA):** TCA provides for: (i) use of a longer normal time horizon to account for avoided environmental liabilities; (ii) full cost accounting, in which overhead costs such as monitoring, inspection, training and taxes are incorporated directly as part of the analyses; (iii) inclusion of various uncertain costs and benefits, and probabilistic assessment. This brings benefits when: comparing EOP pollution controls with upstream approaches; in translating subjective judgements routinely used by management into quantitative terms; in assessing the impacts of uncertainty in upstream pollution control measures, and in providing a step towards life-cycle-costs analysis.
- **Environmental audits and reports:** An audit involves: (i) evaluating the data needed for environmental reporting purposes; (ii) assessing the environmental management system, which yields information for the setting of objectives for improvement; and (iii) verifying the methods employed, so as to take into account all data collected.

**Environmental reports** are documents published by firms, usually as a by-product of a more complete environmental audit. Publishing an environmental report can contribute to the identification of business opportunities. Significant sources of waste can be identified, and possibilities of recycling or better use can be considered. In addition, the reports can raise the confidence of shareholders and consumers about the “environmental friendliness” of the firms’ products.



- **Life-cycle analysis as a method of technology assessment (LCA):** The method consists of two stages. First, an inventory provides an assessment of the environmental impact of a system, examining the primary flows of raw-material removals and the ultimate discharge of waste, throughout the entire production process. Second, measurements are made of the part played by each identified factor in terms of various categories of environmental impact. LCA allows managers to orient decisions towards choices of products and processes that are more acceptable from the standpoint of their environmental impact, either before production or after.

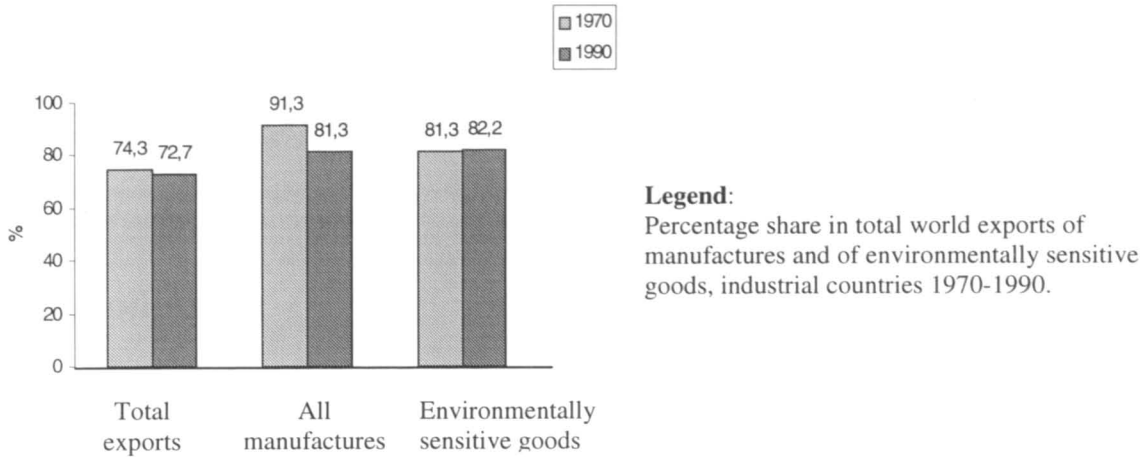
Recent case-study analysis undertaken for the European commission's: Forward Studies Unit, demonstrates that meeting high environmental requirements can have positive competitive effects. An analysis by the Austrian federal economic chamber highlighted a number of specific cases where recently introduced strict environmental standards (relative to those faced by their competitors) seem to have contributed to competitive position of some firms (European Commission, 1997).

## 5.2 – Competitiveness at the level of the industry

An industry is the aggregation of firms, but its composition will vary over time as individual firms' fortunes rise and fall. At the industry level, competitiveness arises from lower costs than those facing international rivals, or a higher value to the customer in the form of delivery, service, or quality.

As environmental policy aimed at reducing environmental damage caused by industrial activity it may well be expected to reduce the size of certain industries. If a particular activity is causing environment damage that a society wants to reduce, then part of having less of the undesirable side effects may well be to have less of the desirable outputs. The degree to which this is true depends on the extent to which the desirable products and undesirable environmental effects can be delinked. This ability will increase over time, given innovation and technological development.

Case-study evidence at the firm and sectoral levels suggests that certain European industries and companies have suffered adjustment cost following the introduction of high environment standards. Nevertheless, a preliminary analysis made by the World Bank (see figure 2) found that the industries most affected by higher environmental standards have performed relatively well in international trade over a period in which regulatory compliance costs were rising (the period assessed was 1970-1990). Industries covered by the analysis included pulp and paper, petroleum products, chemical, coal mining, fertiliser, cement, ferrous and non-ferrous metals, metal manufactures and wood manufactures.



**Figure 2**

*Source: The competitiveness of European Industry- European Commission, 1997*

As it is shown in figure 2, industrial countries (with strict environmental standards) have had more export success in these environmentally sensitive industries than they have had in their manufacturing industry as a whole. While their share of total world exports decreased from 74.3% to 72.7% between 1970 and 1990 and their share of all manufactures declined from 91.3 % to 81.3% the share of exports in environmentally sensitive industries was almost stable displaying only a marginal decline from 81.3% to 81.2%.

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# CHAPTER 3

## GREEN LOGISTICS

---

### 1 - Introduction

Recent years have witnessed many changes in the environment within manufacturing companies compete. Among the most prominent changes, have been an increase in global competition, the emergence of new manufacturing philosophies, a greater emphasis on information technology, and the integration of value-added activities throughout the supply chain.

For the past decade, manufactures have faced much greater pressure on their ability to bring new products continuously and effectively to the market. To recover the huge investment required to develop and introduce new products, companies must look beyond their domestic markets to similar market segments around the world. As a result, the ability of manufacturing firms to gain access to global markets has become fundamental to competitive success (Fauchen and Connor, 1997). Obtaining global market share is now critical to long-term survival. So too, manufacturing companies must develop new skills in areas that have long been overlooked. One such area is logistics.

Logistics processes can help the firm that is operating in a global environment to gain a competitive advantage by delivering the right products in the right amount at both the right time and the right price regardless of where the product is manufactured or marketed.

Similarly, a firm that behaves proactively on environmental issues might be able to reap strategic advantage by foreseeing opportunities. That's why environmental assessment should be an aspect of logistics decision-making.

Concern for the environment has long ceased to be a preoccupation of fringe lobby groups; it has moved into the mainstream of governmental and business interest. Neither governments nor companies can now afford to be negligent towards the environment. Regulation is increasingly designed to limit the adverse environmental impacts of various economic activities. Therefore, companies are very careful to present a green image to the public. Advertising in particular, is often aimed at providing the green credentials of a company. Both the users and providers of logistics services have good reason to be concerned about their environmental credentials. The transport and storage of goods is at the centre of logistics activities for many companies, and can be problematic.

### 2 – Environmental impact associated with logistics

The environmental impact of logistics activities must be considered in terms of (Cooper and Browne, 1994):

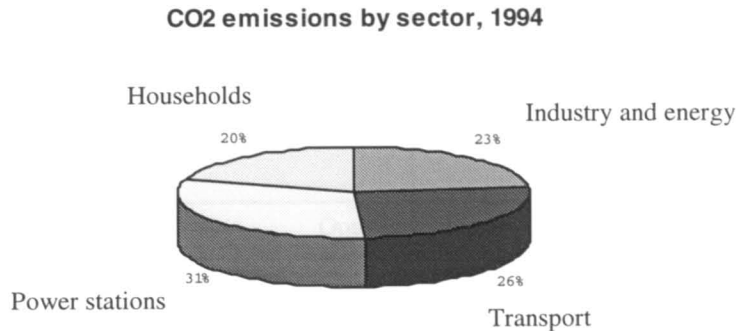
- the kind of goods that are stored and transported. Companies producing or carrying hazardous goods have special responsibility. The environmental consequences of accidents are potentially very serious. BASF, the Germany chemicals combine, now has a policy of consigning its goods by rail and inland waterways whenever possible, because it is thought that there is a greater risk of accidents on the roads.

- the kind of freight transport used. All of them have consequences for the environment, and the acceptability of these consequences is increasingly being called into question.
- in the recognition that logistics represents a holistic approach, in which component supply, production of finished goods and their distribution must be considered as a continuous stream of activity, having each element of activity impacts on some or all the others.

The aspects of pollution and other forms of environmental nuisance, which are generally associated with the manufacture, transport and distribution, are (Cooper and Cabocel, 1997):

- **Air Pollution:** Transport of both goods and passengers is considered to be the source of 26 percent of all carbon dioxide emissions in Europe (see figure 3), thus making it a major contributor to the “greenhouse effect”. Although road transport is considered to be the main source, kerosene combustion by aircraft engines also releases air pollutants. A similar effect directly through the operation of diesel-driven engines or directly from the burning of fossil fuels to produce electric power. In addition, the use of chlorofluorocarbons (CFC’s) in air-conditioned and refrigerated transport vehicles is attacked by environmentalists as a leading cause of destruction of the ozone layer in the earth’s atmosphere.
- **Water Pollution:** The “wilful dumping” into rivers, lakes, and oceans of residues from manufacturing processes, especially those associated with the chemical or nuclear industries, or from incineration and water treatment plants, is a major cause of water pollution. This issue also affects the waterborne transport industry, where accidental oil and chemical spills pose a major risk to the environment. In addition, road runoff containing fuel, lead, and other pollutants contaminates both surface and ground water supplies.
- **Noise Pollution:** In such a densely populated region as Western Europe, there is considerable concern over the nuisance caused by the operations of both freight and passenger vehicles, whether by road, rail, or air transport, especially at night. EU studies have shown, for instance, that the noise of a single truck is perceived by people to be the equivalent of that from six automobiles.
- **Aesthetic Pollution:** The public has grown increasingly sensitive to “landscape disfiguration”. New logistics infrastructures projects such as high-speed rail transport systems, airports, or more simply high-bay warehouses have stirred vigorous protest.
- **Traffic Congestion:** Congestion caused by rapid increases in both passenger and freight traffic has already reached alarming levels in Western Europe. Moreover, according to a green paper published by the European Commission, road haulage (expressed in ton-kilometres) is expected to increase by 42 percent between 1990 and 2010, whereas rail transport should rise by 33 percent during the same period. Within a few years, it is estimated that 16 of the 27 major airports in the European Community will reach the point of complete saturation, unable to accommodate additional flights. In addition, severe congestion will likely worsen along the main road and rail corridors and in the metropolitan centres of major European cities which have not been planned to accommodate large volumes of vehicle traffic. Clearly, these growing problems will have a major impact on companies’ abilities to manage their logistics operations.
- **Waste Disposal:** This is one of the most pressing challenges facing both business and public authorities in Western Europe. There has been an exponential increase of packaging-related and other waste generated by consumer society. In reaction to past carelessness in dumping harmful substances and to the potential liabilities of maintaining landfill areas, several local authorities

now refuse to grant permits for new disposal sites. The costs of dumping have therefore risen considerably.



**Figure 3 – CO<sub>2</sub> emissions in the EU**  
*Source: Frontier-Free, Europe Newsletter (June 1996)*

Most of these causes of environmental damage have attracted increased attention from the public, the news media, and governments. In response, both national and EU authorities have introduced measures with a view to preventing and limiting environmental damage linked with the manufacture, warehousing, and transport of goods.

### 3 – Distribution strategies and the impact on the environment

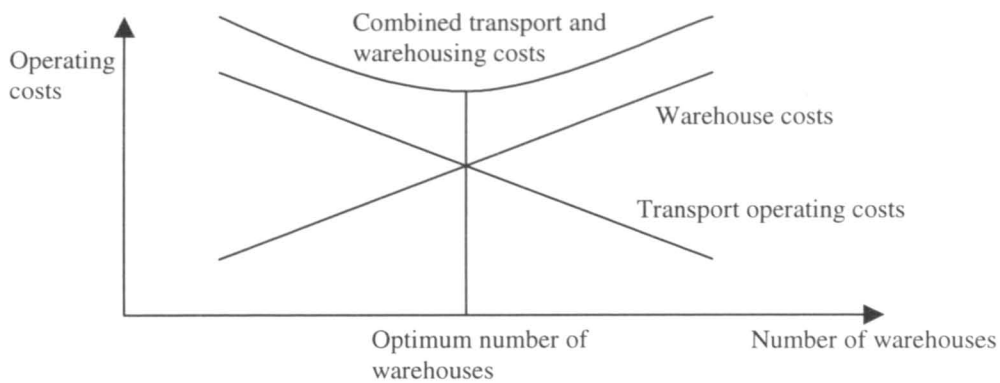
Distribution is one of the activities of a firm that provides the means whereby the right product is delivered to the right place at the right time. A distribution executive has the task of planning, co-ordinating and controlling all the physical movement of goods or services and the raw materials and components embodied in them and thereby providing a level of timely availability for customers. In doing so he is especially concerned in determining what storage facilities and levels of inventory are required; what modes of transportation are appropriate; what unit sizes are most efficiently handled; and how communications are best accomplished between the organisation and its customers to trigger the delivery process (Christopher and Mole, 1982).

The increasing competition, the rise of global markets and growing economic integration have between them contributed to a greater awareness of the importance of logistics in business strategy. These lead to the appearance of new techniques and strategies. The most important logistics innovations, which are directly connected with distribution were (Cooper and Browne, 1994):

- centralization of inventory
- 24-hour lorry operations
- Just-In-Time delivery

#### 3.1 – Centralization of inventory

One of the classic relationships in distribution is the trade-off between warehousing and transport: as the number of warehouses is increased, the cost of operating them also increases, but transport operating cost falls, for a constant throughput of goods through the warehouse. Figure 4 illustrates the implications for combined warehouse and transport operating costs.



**Figure 4 – Trade-off in transport and warehouse operation costs**

*Source: European Logistics, 1994*

Over the years, there has been a modification of the rule, which now also takes into account the cost of holding inventory in warehouses. Variation in this cost has been formulated into the “Square Root Law”, which states that safety and cycle inventory requirements are related to the square root of the number of warehouses in a distribution system. Thus, moving from a system of ten depots to a completely centralised system using one depot would, in theory, reduce the inventory requirement by 68 per cent (Cooper and Browne, 1994). Although there are some important objections to an unbounded application of the square root, many companies, and especially those carrying high-value inventory, have converted to a system of distribution based on a central, national warehouse, rather than maintain a network because of the considerable savings in inventory costs.

The distribution system has primary and secondary transport components. Primary transport is concerned with the transport of goods from factories to warehouses, while secondary transport entails the final delivery of goods from warehouses to the customer. The purpose of retaining the interface between primary and secondary transport is to ensure that goods being delivered to customers are carried on the right size of vehicle. Secondary transport vehicles are often small-medium in size to meet the conditions for urban delivery, while primary transport vehicles are often as large as possible to secure technical economies of scale (and thus low unit costs) on long-distance hauls along major highways. Normally secondary transport costs are 2 to 3 times bigger than primary transport costs.

In many cases, the centralization of warehousing, in itself, has little impact on secondary transport, since final delivery has to take place with or without centralization (when the warehouses are carefully located to minimize secondary transport), but it has dramatic consequences for primary transport.

What usually happens is that savings in inventory costs, which have been an important focus of distribution policy for many companies especially the ones that produce high-values goods, more than outweigh increased costs in primary transport (Cooper and Browne, 1994). It is only for products with a relatively low value that centralization does not work. Advanced economies, in the course of becoming wealthier – as been the trend in the European Union – tend to transport larger volumes of high-value goods. Consequently, the attraction of centralized inventory becomes stronger and more primary transport is generated.

The location of this central warehouses, commonly known as depots or distribution centres, are increasingly coming under environmental attention, because (Worsford and Blair, 1996):

**First** : they consume large amounts of land.

**Second:** they attract high volumes of commercial traffic and other vehicles on a 24-hour per day and 7 days per week basis. In situations where the distribution centres are located in close proximity to communities it can result in adverse consequences for the residents: noise, smell, safety threat, and nuisance from operational activities during unsocial hours.

In short, the environmental implications for centralized inventory are:

- the increased pollution
- visual consumption
- fuel consumption
- increased demand for road space

### **3.2 – 24-hour lorry operation**

The decision to operate lorries round the clock is often linked to warehouse centralization. As supply lines between customer locations and warehouses become longer (as a result of centralization) there is the danger that levels of customer service will deteriorate. The multiple shifting of vehicles is one way of ensuring that, for example, inventory is replenished more promptly and that out-of-stock situations are avoided. However, some companies have introduced round-the-clock working of lorry fleets for the benefits that they can gain from this practice. The initiative has often come from manufacturing, where many companies run factories on both day and night shifts. By spreading their fixed costs, notably the capital cost of machinery, these companies reduce their unit production costs, and this helps them to remain competitive.

The benefits of round-the-clock operation are not alone sufficiently great to reduce many companies to switch from day-only operations. This is partly due to labour costs being a high proportion of total operating costs. Paying drivers extra money for working unsocial hours means that many of the gains from spreading fixed costs (such as vehicle licences and insurance) and reduce investment (such is a smaller vehicle fleet) are undermined by higher labour costs.

From an environmental point of view, there are some benefits from round-the-clock scheduling of vehicles:

- reduce fuel consumption
- decrease of the daytime congestion on roads

There are also certain disbenefits: as noise disturbance at night.

Not all freight companies will readily be able to introduce nigh-time operations for their vehicle fleets, although there are significant environmental advantages. The main reason is that customer restrict the times for delivery, often for safety reasons or to avoid noise disturbance to nearby residents.

### **3.3 – Just In Time deliveries**

Just-In-Time (JIT) delivery is a technique which aims at eliminating waste at and providing a smooth and continuous flow through the production process. Stock levels are kept to an absolute minimum, yet replenished in time to feed the production line, being widely regarded as one of the most successful innovations in logistics in recent times (Cooper and Browne, 1994).

In a European context JIT has the following implications (Cooper and Browne, 1994):

- a closer relationship between supplier and manufacturer
- a closer relationship between shipper and carrier
- more frequent deliveries, but of smaller amounts (which has stimulated manufactures to turn from their own-account transport services to using high-quality less than truckload options provided by professional carriers).
- intensive information flows between supplier, manufacturer and carrier.

Many applaud JIT as a major advance in supply chain management but what about the environmental implications of JIT? The implications of JIT delivery for transport are indeed dramatic. Instead of a large vehicle delivering, say, weekly, the requirement is for much smaller vehicles to deliver daily or, in some cases, several times each day.

In Europe, where planning controls are often tight and component suppliers long established at distant locations, JIT means an extensive use of public road network. This inevitably means environmental deterioration, with several, smaller vehicles being used to carry the same amount of goods as a single large vehicle that was used before the introduction of JIT. The result is more fuel consumed and more pollution.

In addition to increased air pollution and greater energy use, there will also be the likelihood of greater noise disturbance and visual intrusion, as more small vehicles are used in place of large ones. Vibration might be reduced, but this is the only aspect of JIT deliveries that could lead to a favourable outcome. Moreover, another consequence of JIT may be the transfer of goods from rail to road, a development which is generally considered to have negative environmental consequences.

## 4 – Road transport and the environmental impact

The single point consistently emphasised in the last section and in many reports regarding environmental impacts of distribution activities is the role of road traffic. In terms of other transport modes it is road traffic that has most adverse impact on the environment. Road transport is a popular mode and one that is used by a greater number of people on a more regular frequent basis than rail, air or water.

In view of this it is not surprising that road traffic is seen as responsible for generating numerous impacts on the environment, such as vehicle noise (from engines, tyres, doors, horns, etc.), damage and pollutant emissions. Presently, a number of road related issues are giving rise to deep concern and controversy (Worsford and Blair, 1996), such as:

- a) the argument for and against roads
- b) road congestion
- c) road transport and air pollution
- d) road transport as a user of finite resources

### a) The argument for and against roads:

During recent years there has been vociferous and growing opposition to any more road building, especially motorways, on environmental grounds. Equally, there are others who argue that more roads are an economic necessity. Both arguments are summarised in table 1.



Arguments in favour of road transport	Arguments against road transport
<ul style="list-style-type: none"> <li>• Roads allow for door-to-door deliveries, enabling goods to get to the market quicker and cheaper.</li> <li>• A good road system keeps down the costs of transportation</li> <li>• A modern fast and flexible road system is essential for economic and social reasons.</li> <li>• Good roads are important to industries maintain</li> </ul>	<ul style="list-style-type: none"> <li>• The high financial costs of road building and maintenance</li> <li>• Road transport is fuel inefficient, consuming large amounts of finite fossil fuels.</li> <li>• Roads destroy the countryside, bring pollutant fumes into the countryside, threaten wild life, plants and lead to severance of communities.</li> <li>• The environmental and health problems associated with increasing levels of road congestion, air pollution and noise</li> <li>• The disposal of scrapped vehicles, batteries, tyres, oils, etc.. Poses a health and environmental problem.</li> </ul>

**Table 1**

Source: *Freight Transport and the Environment, 1996*

### **b) Road congestion:**

Despite the post-war road expansion of the roads programme, a position of disequilibrium between demand for road space and the supply still remains on the road network. The result is ever-growing congestions problems, making for greater inefficiencies in road transport and environmental impact. Unfortunately, it is not just motorways and main roads which are feeling the effects of increased volumes of traffic. Congestion is also a major problem in cities, where average speeds have been reducing.

Congestion makes the distribution industry relatively less reliable, more expensive to move freight and overall less productive. Congestion not only makes for an inefficient use of resources, but vehicles are at their environmental worst when sitting in a traffic jam. Commercial vehicles, in common with most road vehicles, are more likely to be most polluting in urban and stop/start driving conditions, where they are subjected to traffic lights, road works and delivering and collecting operations. In these conditions diesel engines are incapable of working to their full efficiency, with the result that they produce more fumes and smoke and burn more fuel.

It comes of no surprise, that sectors of society, government and business increasingly accept that radical action of some sort will be necessary in the future to reduce traffic levels, perhaps through greater constraints on all road traffic movement.

### **c) Road transport and air pollution:**

In several industrialised countries throughout the world the level of air quality has consistently deteriorated as road traffic volumes have increased. A survey made by the Royal Commission on Transport and the Environment in the UK (see table 2), concluded that a growing proportion of air pollution is now caused by road vehicles. In comparison with other transport modes, i.e., rail, air and shipping, road is the main contributor to the emissions pollutants, carbon monoxide (CO), nitrogen oxides (NOx), volatile organic compounds (VOCs), particulates and sulphur dioxide (Sox). The impact of these pollutants are summarised in table 4.

<b>Airborne pollutants from Transport: Estimated emissions in the UK (1992)</b>					
<i>Emissions from transport (thousand tonnes)</i>					
	<i>Road</i>	<i>Rail</i>	<i>Air</i>	<i>Shipping</i>	<i>Total</i>
- Carbon monoxide	6,029	0,012	0,011	0,019	6,071
- Nitrogen oxides	1,398	0,012	0,011	0,019	1,574
- Volatile organic compounds	949	8	4	14	975
- Particulates	215	NR	1	3	219
- Sulphur dioxide	62	3	3	60	128

**Table 2**

Source: *Freight Transport and the Environment, 1996*

#### d) Road transport as a user of finite resources:

Road transport is considered by many to be a fuel inefficient mode, consuming large amounts of finite fossil fuels (petrol and diesel). In comparison with other transport modes road is the largest consumer of petroleum fuel, using about three-quarters of the total, as indicated by the figures in table 3.

<b>Petroleum Consumption by Transport Mode (1983-1993)</b>				
<i>(million tonnes)</i>				
<i>Mode</i>	<i>1983</i>	<i>1986</i>	<i>1990</i>	<i>1993</i>
Road	25,75	29,34	34,96	35,55
Railways	0,78	0,75	0,61	0,60
Water	1,12	1,06	1,26	1,25
Air	4,60	5,53	6,61	7,13
Total	32,25	36,68	43,44	44,53

**Table 3**

Source: *Freight Transport and the Environment, 1996*

The World Energy Council in a 1992 report – *Energy for Tomorrow's World* – pointed out that reserves of fossil fuels, particularly oil and natural gas, at present rates of consumption may only last forty years. Furthermore, reserves of these energy sources are concentrated in a few regions and countries. Many of these regions and countries are perceived to be subject to geo-political forces which may disrupt supplies or create price volatility. As a result, it is anticipated that the real price of oil will increase. Despite developments in alternative fuels, road transport will be heavily dependent on oil well into the 21<sup>st</sup> century (Worsford and Blair, 1996).

## 4.1 – Commercial vehicles and the environmental impact

The road distribution industry consists of commercial vehicle fleets, of every shape and size, and distribution centres. Both are sources of potential environmental impact, especially if poorly operated and managed. However, it is frequently commercial vehicles, especially heavy lorry activities, which tend to attract most attention. Such vehicles often find themselves directly in the environmental firing line for a variety of reasons (Worsford and Blair, 1996):

- the size of the commercial vehicle is often out of proportion in relation to the road, the street or other vehicles;
- the movement and activity of commercial vehicles during unsocial hours generates unacceptable noise and disturbance for nearby residents;
- commercial vehicles are often perceived as being responsible for causing congestion and parking problems, especially in narrow town and city streets;
- commercial vehicles can cause visual intrusion when active or parked in densely populated areas;
- commercial vehicles activities can result in vibration and damage to roads, pavements, street furniture, underground services and property;
- commercial vehicle “rat-running” and parking in residential areas are particularly annoying to local people;
- commercial vehicles on the road can generate spray, dust, dirt and be intimidating for other road users.

At a more specific level, commercial vehicles can be particularly annoying when active at distribution centres located in close proximity to residential property.

As a result of recent developments, there are two aspects relevant to commercial vehicles which are increasingly becoming the focus for attention (Worsford and Blair, 1996):

### **1 - Commercial vehicle size and safety:**

In terms of size dimensions and weight commercial vehicles have gradually become larger and heavier. By 1999, in harmonisation with the other EU Member states, it is expected that the mpw of trucks will be allowed to increase from the present 38 tonnes to 40/44 tonnes. These trucks have also become bigger in dimension; a present day articulated truck can be up to 16.5 metres in length. Additionally, while the total truck pollution has remained static, the proportion of heavy category trucks (articulated) has been increasing and now represents 31% of all vehicles in the range greater than 3.5 tonnes.

A common complaint by other road users is that because of great engine power, weight and size the modern heavy truck can be an intimidating vehicle, often perceived as a danger and safety threat.

### **2 - Diesel fumes and health:**

Commercial vehicles are almost universally fuelled by diesel, a fuel perceived to be dirty, smelly and harmful to health, such as respiratory related diseases. Traditionally, the diesel engine has been regarded as “cleaner” than petrol engine. According to vehicle manufacturers 99.7% of diesel emissions are innocuous, however there is some concern about the 0.3% of  $\text{NO}_x$ , CO, HC and particulate matter – PM10s. Green campaign groups have expressed concerns about these particles, claiming that diesel engines produce 100 times more particulates than petrol engines fitted with a catalytic converter. The impacts of diesel fuels are summarised in Table 4.

Diesel engines are fuel-efficient and produce less Co and CO<sub>2</sub> emissions than petrol engines, but they are nonetheless responsible for greater quantities of soot and particulate matter. Medical and scientific concern has grown about PM<sub>10</sub>s, because of the possible adverse link with health.

Exhaust Emissions and their Effects		
<i>Pollutant</i>	<i>Symbol</i>	<i>Effects</i>
Carbon dioxide	CO <sub>2</sub>	Global warming
Carbon monoxide	CO	Toxic effects at high concentration only
Volatile Organic Compounds (Urburnt hydrocarbons)	VOCs (HC)	Photo chemical smog; ozone damage to materials and vegetation; respiratory problems
Oxides of nitrogen (mainly nitrogen dioxide)	NO <sub>x</sub> NO <sub>2</sub>	Photochemical smog; ozone formation; respiratory problems; damage to materials and vegetation
Pariculate matter	PM	Respiratory problems; damage to buildings; acid rain
Sulphur dioxide	SO <sub>2</sub>	Respiratory problems; damage to buildings; acid rain

**Table 4**

*Source: Freight Transport and the Environment, 1996*

## 5 – Other means of transportation and their environmental impact

### 5.1 – Rail transport

Rail is usually seen as more environmentally friendly than road transport, therefore, some environmentalists defend that it should be used more for freight movements. Nevertheless, there is still some environmental impacts of this mode of transportation. The main environmental impacts of rail transportation are (Carpenter, 1994):

- **Noise and vibration:** the problem of noise is particularly acute in urban areas, although tracks tends to be placed in areas of lowest population density or placed in a way that minimises the noise. The type of traction, wagons and track conditions, and heavy axle loads on rails and rail joints determines the noise of freight trains. In the same way as for other modes of transport, there are stringent limitations at night, i.e. either quieter or fewer freight trains.
- **Air and water pollution:** Pollution into the atmosphere is both directly caused by emission from diesel engines and indirectly from the power stations that generate electricity for trains using electrified track. Another possible cause of local air pollution could be dust from open wagons carrying coal, iron ore, aggregates or excavated soil. Derailment or collisions of freight trains carrying hazardous substances pose possible dangers.
- **Land use:** This is the most significant long-term impact on railway. The land that is taken may comprise residential property whose loss is traumatic for the time but for which financial compensation can be offered; or it may be wildlife habitat where any loss is a permanent reduction of an often scarce natural resource.

## 5.2 – Air transport

The two most important environmental impacts of the air transport industry are noise and air pollution. Most environmental complaints against airports centre are: aircraft noise (especially night-time noise) and aviation engine emissions. In addition, there are frequent complains about the heavy volumes of surface traffic (train, buses, coaches, commercial vehicles and cars) that airports attract, thereby generating an additional demand for new roads and rail links. For people living within the surrounding airport both surface and air traffic and supporting infrastructure can be the source of considerable environmental impact and disturbance.

Estimates for air pollution put carbon dioxide emissions from air transport second only to road transport but the gap is considerable, with road accounting for almost 80% and air taking almost 11% (European Commission, 1997). However, airports and airfreight will continue to feature strongly in the needs of all those commercial business with urgent goods to be moved quickly to world markets.

## 5.2 – Maritime transport

The most important environmental impact of maritime transportation is water pollution, although it is also responsible for air pollution. Ships produce waste products in the form of oils, oily water and other harmful substances that have a harmful impact on the marine environment. This mean of transportation is commonly known for having a low impact on the environment.

## 6 – Rail Vs Road

Though there are claimed environmental advantages for switching over to rail, it is an unfortunate fact that in modern logistics rail as a freight transport mode faces numerous disadvantages. These include:

- many goods are not suitable for transport by rail, especially time-sensitive goods;
- many distribution destinations and points of origin are not rail connected;
- most goods distributed by road are moved short distances and are, therefore, unsuitable for rail;
- it is claimed that a 100% increase in rail freight would only represent one year's worth of growth in road transport;
- many companies are reluctant to use rail because they perceive it as being unreliable, uncompetitive and inflexible and as presenting a poor image;
- passenger carriage tends to be given a higher priority than freight.

In comparison with other modes (rail or water), road transport offers a number of advantages for both operators and end-users, such as:

- speed of delivery / collection
- flexibility of use
- versatility
- competitively priced
- greater productivity, reliability and efficiency
- highly professional services.

Despite these disadvantages, a number of developments in the 1990s are providing new hope and opportunities for railways in the future (Worsford and Blair, 1996):

- In the light of rising diesel costs and congestion, a number of major distribution companies and their customers are looking into the use of combined and intermodal transport.
- Today, property developers and distribution companies are taking a fresh look at warehousing and distribution facilities, especially those sites that have existing rail connections or that offer clients the prospect of a rail link.
- In 1994 a Freight Transport Association (FTA) report – *The Rail Freight Challenge* – pointed out that recent developments in the political, environmental and commercial arena have stimulated renewed interest in the viability of rail freight and its prospects as a sustainable and cost-effective alternative. The challenge according to the report is to adapt to the potential new marketplace by identifying the strengths and weaknesses of rail and by developing its services to provide a genuine alternative.

## 7 – Environmental protection measures affecting logistics

The European Union began issuing official rulings on environment matters before 1973, when the commission's first proposal for an environmental action program was accepted by the council of ministers. The discrepancy among the various national rules, in contrast to efforts by the EU to promote a common regulatory framework, has been a constant source of confusion ever since 1973. Germany, The Netherlands, and Scandinavia have taken the lead in adopting protective measures at local, regional, and national levels (Cooper and Cabocel, 1993).

Both national and EU approaches to environmental rules are influenced by a commonly accepted belief that any business activity must be evaluated in terms of its "total cost" to the environment. A key tool in this approach is the LCA (Life-Cycle-Analysis), discussed in a previous section of this paper. This technique calls for understanding the overall environmental impacts of producing, distributing, and disposing of all materials related to any product or service. Thus, logistics activities (especially those in the transport sector) are a key concern. Another principle affecting business is one which holds polluters directly liable for any environmental damage resulting from production or distribution.

### 7.1 – The European Union environmental policies

The European Commission has been focusing on three general categories of concern (Cooper and Cabocel, 1993):

- reducing or preventing environmental pollution or nuisance
- taking positive steps to improve the environment, and
- co-operating with other international organisations concerned with the environment.

Various actions have been taken by the commission and the individual European states in order to remedy the sources of pollution that can be specifically associated with the logistics process:

- transportation
- infrastructures
- waste

### 7.1.1 – Transport related environmental concerns

In Europe, both the Commission and the governments of individual countries have been active in researching ways to limit the environmental impacts of transportation.

Transport is the dominant source of certain types of air pollutants: in particular, transport is estimated to be responsible for about 80% of carbon dioxide emissions in the EU. For nitrogen oxides and hydrocarbons, estimates indicate that transport causes between 50% and 60% of all man-made emissions, and furthermore it produces 40% of all emitted particulates (European Commission, 1997).

The Commission published a white paper on the future of the common transport policy, entitled “*A global approach to the construction of a community framework for sustainable mobility*”, in December 1992. The white paper proposes a range of measures and initiatives designed to facilitate the integration of environment concerns and adapted to the needs and characteristics of the different forms of transport. They include (Duhot, 1994):

- i) more stringent standards for energy consumption and operational pollution;
- ii) possible recourse to fiscal and economic incentives;
- iii) careful environmental impact assessments at the planning stage of transport infrastructure, and
- iv) additional measures to provide for the safer carriage of dangerous goods.

The EU now sets many standards and issues Directives for Member States on a whole range of issues, which have direct relevance for the transportation activities. These include (Worsford and Blair, 1996):

- regulations on vehicle weights, size and dimensions
- driving hours limits
- vehicle noise and emissions limits
- the movement and disposal of hazardous goods
- road safety matters
- regulations on combined/intermodal transportation
- air quality regulations

Governments now accept, as a matter of policy, that environmental matters must be viewed and solved within an international context. Furthermore, there are mutual benefits in seeking common solutions to common problems.

### 7.1.2 – Infrastructure related environmental concerns

Whether planning new infrastructure or finding new ways to use existing infrastructure, no actions can be taken today without assessing their environmental impacts. As the volume of transport increases in line with the decreasing availability of land and the growing density of population, many local authorities (especially in northern European countries) are showing little if any enthusiasm for new infrastructure developments.

City authorities in countries like France and Italy have introduced stringent rules regulating delivery times. In some instances, they have totally banned freight and passengers traffic in historical city centres (Cooper and Cabocel, 1993). Such efforts to reduce urban congestion are likely to become more common throughout Europe. It is likely that individual countries will eventually introduce either “pay-as-you-use” schemes (road pricing) on the most congested roads.

Concerns with congestion affect not only transport infrastructure but also individual company projects to establish new manufacturing or warehousing facilities. Delays or refusals of building permits may lock new warehousing projects because such facilities are expected to cause increased traffic congestion.

### 7.1.3 – Waste disposal and recycling schemes

As one of the most controversial issues at local, national, and EU levels, waste management focuses on three general objectives (Cooper and Cabocel, 1993):

- 1- reduce and eventually eliminate packaging waste, especially by decreasing the levels of non-reusable or non-recyclable waste;
- 2- promote vigorously the extensive collection of all materials which can be revised, recycled for new uses, or valorised (to produce energy for example);
- 3- ensure the safe disposal of all other waste materials.

The EU concept is based on two fundamental priorities: reduction of waste quantities, and maximum recycling of products.

Over the next years, as the volume of waste automobiles, batteries, electronic components, and many other materials increases, manufactures will likely be forced to bear greater responsibility not just for environmentally proper production, packaging, and distribution but also for the disposal of such products after their usefulness ends. Some nations are devising regulations, which will compel manufactures to take back and recycle discarded automobiles, tyres, batteries, and electronic components in appliances, computers, photocopiers, and television sets. In some cases, these obligations will be imposed by law; in others, by voluntary agreement between industries and governments (Worsford and Blair, 1996).

## 8 – The environmental response to the environmental challenge

Traditionally, distribution companies viewed environmental issues as a threat to their business, something to be avoided and not a challenge or opportunity that could also produce benefits and cost-savings. Thankfully, that view no longer prevails and a more enlightened attitude towards best environmental practice is now more common throughout all sections of the distribution industry. Much of the credit for this is due to the following:

- the example being set by leading companies within the distribution industry by introducing best environmental practice initiatives and encouraging others to do so.
- the encouragement towards higher environmental standards and the proactive stance taken by the leading trade and professional institutions.
- the encouragement by the media in terms of the granting of awards and publicity coverage for those companies engaging in best environmental practice.
- the sponsoring and funding of joint academic/industry research programmes by government departments encouraging initiatives towards best environmental practice standards.
- the establishment of professional environmental standards.



## 8.1 – Environmental initiatives

In order to lay the foundations for best environmental practice, some companies have launched a series of initiatives such as the setting of performance targets, establishing environmental audits, management assessment and training schemes, partnerships involvement with government and academic establishments.

The trade press has also been fundamental in encouraging the industry towards higher environmental standards through annual awards. Each year since 1986 the journal *Motor Transport*, grants a prestigious environmental award to a company within the distribution industry which has demonstrated environmental practice that goes above and beyond the minimum requirement (Worsford and Blair, 1996).

High level conferences involving senior management are another method of disseminating information on the environment. These events, which are usually well attended, provide a forum and opportunity for senior managers to learn new ideas and to share, express and seek the latest views on the environmental scene.

Government departments have founded numerous initiatives between academic institutions and individual distribution companies in environmental programmes. For example, the department of transport in UK funded a major research programme, between the University of Westminster and Exel Logistics into establishing a blueprint for a model distribution centre operating to best environmental practice. The published output from this project has not only been taken up by the British distribution industry, but it is currently being translated into Spanish and French (Worsford and Blair, 1996).

At a specific level the distribution industry's environmental response has tended to focus on improvements in the following key areas:

- technology led solutions in terms of the commercial vehicle, such as improving the environment efficiency of the traction units, trailers, engines and fuels.
- better use of technology and operational methods to improve environmental performance.

These improvements are detailed bellow.

## 8.2 – The modern commercial vehicle

During recent years, there have been major developments on the technology front in relation to improving the overall environmental performance of the commercial vehicle, especially in terms of lower engine noise and greater fuel efficiency. It is not uncommon to find that major truck manufacturing companies are devoting up to 40% of their research and development budgets to environmental project development work. These projects would include developments such as:

- improvements in vehicle design
- greater care in material selection
- seeking means to reduce engine air noise
- fuel efficient engines
- the use of alternative fuels

The end result is that at a technical level, truck and component manufacturers have been highly successful in producing a generation of commercial vehicles which are much more fuel efficient, produce less pollutant emission and are relatively quieter. In short, a much more Eco-friendly vehicle.

The following points typify the range of key environmental improvements made by manufactures to present day commercial vehicles (Worsford and Blair, 1996):

- **Noise** : the fitting of engine hush kits and other noise reduction techniques keep the allowable noise levels within (and below) the legal requirements.
- **Fuel efficiency**: the application of new technology, such as burn engines, electronic fuel injection, the use of lighter materials in the construction of the bodywork and other aerodynamic styling methods, has resulted in a very fuel efficient vehicle.
- **Pollutant emissions**: commercial vehicle manufactures are well aware that there are a variety of measures. During recent years the major manufacturers have been producing commercial vehicles to Euro II (standard for heavy vehicle emissions) emission standards. Currently they are gearing up to meet Euro III standards.
- **Recycling**: today up to 90% of the material weight of a modern commercial truck can be recycled. This includes materials such as steel, cast iron, rubber, aluminium, plastic, lead, copper and zinc. Manufacturers also have policies towards the safe removal, disposal or recycling of a vehicle's liquids, oils, brake fluids, fuel and CFCs.
- **Tyres**: manufactures have gone to great lengths to improve the rolling resistance of tyres. For example, according to Michelin the rolling resistance of tyres is now 80% lower than that of the original solid tyre of more than a century ago. Noise reduction options are now available.
- **Alternative fuels**: all groups within the distribution industry recognise the commercial and environmental benefits of using alternative fuels. As a result there has been numerous joint trials taking place among truck manufactures, fuel suppliers and operators in the use of alternative fuels. e.g. CNG (compressed natural gas), rape seed, biomass, ethanol, low sulphur diesel and battery power.
- **Vehicle construction**: the use of lighter, but much stronger materials in building traction and trailer units is becoming more common, resulting in vehicle weight savings, greater fuel savings and, therefore, less emissions.

### 8.3 – Technological and operational improvements

A wide range of technological and operational improvements are now being used by companies and their customers to make their activities more environmentally acceptable. Many of these have been joint ventures and research initiatives carried out with other companies or in partnership with government departments and academic institutions. Typical of these measures are the following (Worsford and Blair, 1996):

### *Empty running*

The use of a vehicle on the road network when it is carrying no load or partial load, is an area of concern and a feature highlighted recently by governments as one of the problems the distribution industry needs to tackle. This practice is not only wasteful of resources in causing unnecessary mileage, but adds to congestion and pollution. If possible, it is better from a financial and environmental point to operate a vehicle with maximum loads. Operators are increasingly seeking to rationalise their use of vehicles with the aid of technology, for example, the use of double-deck trailers and dual-purpose trailers. Double-deck trailers are the same length as conventional trailers, but have a lower wheel base and, therefore, are capable of taking 60% more payload. The dual-purpose trailers is constructed in such a manner that it is capable of taking a wet cargo (milk or oil) on an outward trip and dry load (goods stacked on pallets) on the return trip. Exel Logistics, in conjunction with British Sugar, has developed a dual-function trailer incorporating four collapsible bags capable of carrying either bulk or packed goods. Instead of returning empty after delivering bulk granulated sugar, the tanker has the capacity to take a return payload of dry goods.

There has been a significant shift in the attitude of major users of road distribution towards the subject of sharing vehicles (shared loads). The use of on-board computer technology and improved electronic communications has facilitated backloading (carrying a load on the return trip).

### *Night-time trunking*

An increasing amount of long distance road freight now takes place during hours when roads and motorways are less congested. According to FTA research over 30% of heavy vehicles operate on trunking routes during nighttime hours, thereby reducing environmental impact.

### *Vehicle size*

Some companies have been making greater use of low weight/low emissions vehicles operating in environmentally sensitive areas, such as city centres.

### *Depot activities*

Depots can generate a number of environmental impacts. Greater consideration is now given to depot location, the routes vehicles use to travel to and from the depot, staff behaviour, the problems of noise, smell and intrusion, the environmental enhancement of the site with fencing, shrubs, trees and earth banks.

### *CFCs*

The distribution industry uses large quantities of CFCs in refrigerating trailers and cold storage facilities. Companies within the industry have taken a lead in the elimination, minimisation and phasing out of CFCs and this is already well under way. When they are available, CFC-free alternatives will be used.

### *Energy conservation*

Companies have introduced energy audits resulting in radical improvements at cold store plants, depots and office buildings.

### *Speed limiters*

A number of companies have already lowered the speed limits to heavy vehicles.

### *Recycling & waste*

Extensive waste management programmes have been introduced to recycle water, packaging and other materials.

### *Driver training*

It is estimated that 10% fuel savings can be achieved with improved driver skills.

### *Air-steam Inspirator*

A new British invention developed in the 1990s. This engine bolt-on technology is designed to reduce vehicle exhaust pollutants, while allowing greater fuel efficiency. The device uses exhaust heat to produce steam from a water tank, which is induced into the engine. This results in reducing the peak flame temperature and burning the fuel more effectively.

## **9 – The future**

The development of a more Eco-aware society means a considerable adjustment in attitude for some elements of the distribution industry. Limitations on road vehicle movements in inner-city areas are likely to become increasingly common to reduce the impact and burden on inhabitants. It is possible that the objective of curbing inner-city traffic will be achieved through a combination of measures, like (Worsford and Blair, 1996):

- the banning of all traffic from specialised zones
- the banning of road traffic according to vehicle category (vehicle size, weight or emissions levels) from specified zones.
- the banning of road traffic according to time of day, or day of week, from specified zones
- the use of low weight, low emission vehicles is likely to be encouraged for inner-city distribution

### **9.1 – National road traffic controls**

It is no longer considered acceptable that building more roads is a solution to ever growing congestion problems. At level of nations it appears that official action designed to curb road traffic growth will be as follow (Worsford and Blair, 1996):

- the closing of slips roads onto motorways at peak times to regulate flow
- putting traffic lights on motorways slip roads to control the rate at which vehicles can merge with motorway traffic
- the introduction of variable speed limits
- separate motorway lanes for short and long distances traffic
- separate motorway and trunk road lanes for freight traffic
- allowing the use of bus lanes for freight traffic
- increasing the price of fuel (petrol and diesel)
- the introduction of computer-aided road traffic management systems to smooth out traffic flows on heavy congested sections of the road network, thereby making better utilisation of available road space

- financial inducements and other measures to encourage more use of other transport modes such as rail and water, e.g. road pricing and other demand pricing solutions.

The various measures being currently proposed will seek to make better use of the existing road networks, rather than resort to the building of more roads.

## **9.2 – Changing patterns of distribution**

Most road traffic congestion and air pollution takes place in urban areas where traffic levels are most dense, generating greatest environmental impact. Heavy traffic levels impose delivery, collection and parking problems for commercial vehicles. If distribution of goods is to continue in a cost-effective and efficient manner then it is inevitable that there will be changes in the pattern of distribution.

### **9.2.1 – Improving urban freight transport**

#### **▪ Promoting Joint Delivery**

In order to improve the urban traffic environment measures need to be taken to promote the change in the form of urban delivery from independent transport using vehicles owned by each shipper, to consolidate transport using public haulage. Furthermore, the number of delivery vehicles must be decreased by joint delivery of several trucking companies having the same consignees or delivery areas (OECD, 1996).

#### **▪ Effective Utilisation of Urban Facilities**

In order to decrease on-street parking for the loading and unloading of cargo in urban areas, the implementation of comprehensive measures is needed. Examples are the improvement of shippers' facilities to provide parking space for the loading of cargo, including the rationalisation of the present system and the promotion of parking area improvements and more effective use of street parking lots (OECD, 1996).

#### **▪ Advanced Dispatching System**

In order to improve urban traffic congestion by increasing the loading rate of urban delivery vehicles and decreasing inefficient transport, it is necessary to utilise the application of advanced information systems for dispatching and vehicle scheduling, such as computer aided dispatching systems using mobile data communication systems, positioning and digital road maps (OECD, 1996).

### **9.2.1 – Developing distribution terminals**

The new distribution terminal policy aims at promoting the development of advanced logistics systems to improve the efficiency of freight transport. The background of the new policy stems from the fact that a new demand is emerging in logistics activities. It includes, for example, the need for high-speed transport using the expressway network and the idea of the hub-and-spoke system that requires heavy equipment such as high-speed sorting machines, automatic storage systems, digital picking systems and a large land area.

#### **▪ Construction of Distribution terminals as part of a Nationwilde Network**

In order to cope with traffic congestion and environmental problems in urban areas, one feasible measure is to construct distribution terminals as a central facility for concentrating the usage of

heavy vehicles on expressways. The heavy vehicles are likely to deliver their loads to out-of-town transit points for onward delivery to urban areas by smaller alternatively fuelled vehicles. Such changes in the pattern of distribution will allow operational activities to continue in a productive manner but with a lower environmental impact. However, these practices will bring significant increases in operational costs and a balance between environmental and commercial interests will need to be realised (OECD, 1996).

### **9.2.3 – Promoting advanced information systems**

It is necessary to study policies not only for the development of advanced communication technology but also for the development of information infrastructure and software from the viewpoint of rearranging the freight transport system as a whole. These policies will include the rationalisation of transport and delivery planning systems and the advancement of mobile communication systems to exchange information on the position of vehicles, to transmit cargo information, and to conduct data interchange by Electronic Data Interchange (EDI) systems or the like.

#### **▪ Rationalisation of Transport and Delivery Planning Systems**

It is important to promote the rationalisation of transport and delivery planning systems or location planning at delivery facilities by using digital maps on the nation-wide road network (OECD, 1996).

#### **▪ Advancement of Mobile Communication Systems**

Real-time positioning of vehicles and the information on collected cargoes can be more efficiently exchanged by using mobile communications systems. Furthermore there is the need to improve freight transport management by using road traffic information systems (OECD, 1996).

#### **▪ Development of EDI Systems between Shippers and Trucking Companies**

EDI or similar systems between shippers and trucking companies are needed in order to promote the rationalisation of production management and storage management. Actions could include closer relationships between ordering and vehicle management, synchronisation of total production, such as quick response to requests, and more frequent collection of small size cargoes (OECD, 1996).

## **9.3 – Future generation of commercial vehicles**

There is little doubt that the commercial vehicle will remain the dominant mode for the distribution of goods for the foreseeable future, though they may change in shape, size and design and use of power. The flexibility and versatility commercial vehicles presently provide, and which other transport modes cannot currently match, mean it is not realistic to talk of other modes replacing the commercial vehicle. However, the demand for cleaner air, means that road vehicles will have to meet higher environmental standards and lower emission pollutant levels.

In anticipation of the stringent environmental standards expected during the next century, manufactures are well advanced in the development of new concept vehicles. Particular attention is being directed at the development of eco-city distribution vehicles. This is in the light of continuing urbanisation and concern over poor air quality and pressure for tighter controls on vehicle

movements. From a specification perspective these future commercial vehicles will ideally be low-weight, dual-fuel or hybrid, with extremely low pollutant emissions.

#### **9.4 – Further environmental pressures**

It is anticipated there will be further environmental pressures in the form of legislation, regulations and restrictions against the distribution industry from a variety of sources: local authorities, national governments and European Union.

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# CHAPTER 4

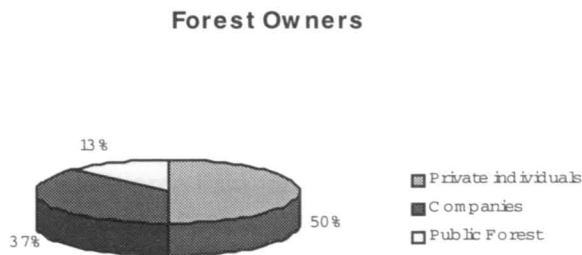
## THE CASE OF THE SWEDISH FORESTRY INDUSTRY

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### 1 – Swedish forest industry

#### 1.1 - Introduction

Over half of Sweden's area is covered with forest, mainly conifer, so it is only natural that forest products have been and remain an important industry.



**Figure 5 – Forest Owners**

*Source: The Swedish Forest Industry Association*

As it can be seen in figure 5, about 50% of all forestland belongs to private individuals, companies own 37% and public authorities own the rest.

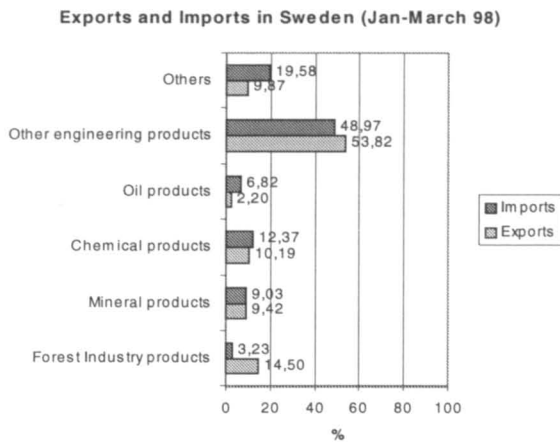
Sweden is one of the leading exporters of pulp, paper and saw timber. STORA and SCA are among Sweden's biggest industrial groups. Other leading groups are MoDo, the previously state-owned Assidomän, Södra Skogsägarna, Korsnäs AB. In recent years Swedish forest product companies have made major acquisitions in the EU.

#### 1.2 – Economic significance

The Forest Industry accounts for 14.5% of total exports (figure 6), and provides direct employment for 100.000 people.

Although the engineering industry and various high-tech sectors have grown in significance, the forestry industry still plays an important role in Swedish economy. The forestry industry is a base industry around which many other industries have developed. It provides work for the IT companies which develop process control systems, for thousands of small companies, for entrepreneurs who operate the forest machines, for the hauliers who transport the timber and for the various types of service companies. The engineering industry, the chemical industry, the construction industry and the many transport companies are all major suppliers to the forest industry.





**Figure 6 – Exports and Imports In Sweden**  
 Source: *The National Statistical Bureau*

### 1.3 – Environmental strategy

Environmental work began more than 25 years ago in the Swedish forest industry (Skogsindustrierna, 1996). The strategy chosen was to be “clean at source”, i.e., to try to minimise the presence of pollutants by changes in the processes. Only when these measures are no longer sufficient other techniques to reduce emissions to air and water are applied.

#### *Investments*

In the last 25 years, the Swedish pulp and paper industry has invested about 25 billion Kronor, in environmental measures (Skogsindustrierna, 1996).

#### *Improvements*

The attitude of the Swedish forest industry is that the remaining environmental problems shall be solved. The processes and the purification techniques are being successively improved, and new energy and material efficient products are being developed.

#### *Environmental management and Eco-auditing*

Increasingly, companies in the Swedish forest industry are introducing environmental management systems, such as EMAS and ISO 14001 (see fact box), to guarantee high quality in environmental work. Environmental audits are “green” balance sheets which are becoming more common and comprehensive.

**EMAS**, which stands for “Eco-Management and Audit Scheme”, is a voluntary system adopted within the EU with the aim of fostering environmental management within industry and providing the general public with information about the environment programs of the participating companies. In order to qualify for registration, a company is required to adopt an environmental policy, prepare a detailed environmental report, define objectives for its environmental work, introduce an environmental management system, update the environmental program and the management system at least once every three years, conduct an environmental audit and arrange for an inspection accredited environmental verifier.

**ISO 14001** is an environmental management system developed by the International Standard Organization (ISO). The ISO 14001 standards are based on a simple equation: better environmental management will lead to better environmental performance, increased efficiency, and a greater return of investment (Tibor and Feldman, 1996).

### *Environmental policy for transport*

Transport has come increasingly into focus from an environmental point of view. Every third tonne of cargo loaded on a ship for export, in Sweden, is from the forest industry. On dry land the forest industry is the biggest transporter with 35% of the flow of goods on the railways, and 23% of road transport. The forest industry has drawn up a policy with the intention of reducing the environmental impact of transport activity (Skogsindustrierna, 1996).

## **1.4 – Swedish forest industry, environment and transport**

The forest companies need efficient transportation to supply their industrial plants with raw materials and to distribute the products to their customers. As Sweden's biggest transport-user, utilising road, rail and sea transportation, and as a major user of various type of vehicles, it is important for the forest companies to follow and try to influence developments concerning environmental questions in the transport sector. Therefore, the Swedish forest industry has developed an environmental policy for transports.

### ***ENVIRONMENTAL POLICY FOR TRANSPORT***

- The forest industries shall work to develop environmentally adapted transport systems
- The forest industries shall strive for environmentally adapted transport systems based on analyses of environmental loads through the whole of the transport chain.
- Activities shall be determined after considering what is technically feasible, economically viable and ecologically justified.
- Environmental work shall be characterised by holism and conducted with the aim of achieving continuous improvements.
- When choosing suppliers for transport, environmental aspects shall be given great weight.
- The forest industries shall actively cooperate with national and international authorities and organisations. The forest industries see the question of climatic change as a global issue, which requires co-ordinated international efforts in the transport area.

### ***MEASURES TO BE TAKEN***

As a major transport-user on the market, the forest industry tries to take every opportunity to put forward measures which will speed up the process towards increasingly environmentally-adapted techniques. In this context, companies in this industry intend to apply the following measures (Skogsindustrierna, 1996):

- Choose the means of transportation together with the customer and the supplier, giving environmental aspects a great weight.
- Give high priority to cleaner fuels.
- Apply the new IT techniques as widely as possible. Access to digital information about the road network provides the pre-requisites for the forest industries to reduce transport work while

making transport more efficient. A national road data-base is being set up with Swedish Road Administration as the principal and in close co-operation with the forestry sector.

- Exchange wood raw material with other forest companies, in order to limit road transport This is already being made and there is a potential to develop this even further, with the help of IT techniques, which the sector intends to take advantage of.
- A high utilisation of vehicles by using the maximum allowed loading weights. This limits transportation and, thereby, fuels consumption and emissions.
- When constructing and transporting on the companies' own forest motor roads, they should take advantage of opportunities for great energy efficiency and reduced wear.

## **2 – The Swedish paper manufactures**

### **2.1 - Introduction**

Some research of how some of the Swedish paper manufactures handle the environmental issues in their distribution strategies was carried out. Two cases are going to be presented: MoDo and STORA. The information was collected from company documentation (annual reports), questionnaires and interviews.

No special criteria was used in the selection of the companies to study, they were chosen because they both are leading companies in the Swedish Pulp&Paper industry and also because they are known for giving considerable thought to which environmental policies they should adopt in their distribution strategies.

Regarding STORA case, the information presented has to do with STORA environmental work before the merge, in June of the current year, with ENSO (a Finnish paper company). It is not possible to say, at this moment, if the environmental procedures now adopted by STORA will remain in the future.

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# **CASE 1 – MoDo PAPER**

## **ENVIRONMENTAL CONCERNS IN LOGISTICS**

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### **1 - Introduction**

The company to which this case study refers is one of the biggest Swedish paper manufactures. The group has production facilities in Sweden, Great Britain and France. It has the group organisations in most European countries, in the USA, Singapore and Australia. Agents and distributors in many other countries also sell MoDo's products. MoDo's core products areas are: fine paper with focus on office paper (in particular A4 paper); printing paper such as newsprint and improved newsprint; and virgin fibre based paperboard of high quality.

Competing against 600 companies in Europe, MoDo Paper won, the award of "*Excellence in Supply Chain Management*", in 1997. A competition for the best performance in logistics, organised by the UK magazine *Logistics Europe* and the international consulting firm KPMG in co-operation with UPS Worldwide Logistics. MoDo's Paper new logistical and transportation system is expected to markedly reduce transport costs, as well as satisfying rigorous demands for service and flexibility. The system also involves environmental benefits as a result of lower resource utilisation.

MoDo has demonstrated a big concern with the environment, being the pioneer in publishing an environmental report. This case study presents some of the measures taken by MoDo Paper and the MoDo Group in order to minimise the environmental impact of distribution activities.

### **2 – MoDo's environmental policy**

At a global level MoDo has a strong commitment to the environment as indicated by its policy statement in Box A.

### **3 – Business approach**

The MoDo philosophy concerning the impact of transport and distribution on environmental issues is to make stringent environmental demands when purchasing transport services. This is because external freight companies handle most of the transportation.

In order to obtain a better perception of the effects of transportation on the environment, in relation to the effects of manufacturing processes, a life cycle inventory was made for various products. The aim was to identify the stages in the transport chain where measures to reduce environmental impact would have the greatest effect. This study provided useful information for introducing the environment demands when purchasing transport services.

### *ENVIRONMENTAL POLICY*

The environment is the concern of the entire Group. It is essential for the development of MoDo that full account is taken of environmental constraints.

#### *Environment protection*

MoDo's business operations shall be managed in a manner which ensures the protection of the environment, the efficient use of raw materials and energy, and the promotion of sustainable development. Our environment protection measures will be characterised by a holistic approach and will be pursued with the aim of achieving continuous improvements. In order to guarantee sound environmental standard, environmental audits are performed at the individual units within MoDo.

#### *Responsibility*

The primary responsibility for day-to-day environmental activities rest on the managers of our mills and the corresponding managers of other mills. When major decisions are to be made on the environment, the mill manager or the corresponding manager shall confer with the Group's Environmental Director.

The allotment of responsibility at each of MoDo's units shall be clearly define in writing.

Any risk of breakdowns or disturbances which could influence the environment shall be reported, so that preventive action may be taken. In the event of serious disturbances or breakdowns that could harm the environment, the environment shall be given priority over production.

#### *Forestry*

MoDo's forests and forestry activities will be managed to ensure a high yield and a sustainable supply of wood, subject to the fullest consideration being given to the needs of the environment. Forestry will be practised in such a way as to protect vital ecological processes. The methods used must ensure biological diversity.

#### *Products*

Our products shall be harmless to humans and to the environment. Functional and environmental demands shall be considered in an overall perspective. MoDo shall allow the needs of the market to determine product development.

#### *Marketing*

Marketing with the use of environmental arguments shall be factual and based on a comprehensive approach.

#### *Development*

MoDo shall have a long-term environmental strategy, and keep abreast of the development of environmental requirements within its areas of operation. All opportunities shall be taken to combine efficient production with effective environmental protection. Methods, processes and products which cause a reduced impact on the environment shall be given priority over other comparable alternatives.

#### *Purchasing and demands on suppliers*

Environmental considerations shall be taken into account in connection with the purchase of goods and services. MoDo's environmental requirements shall be satisfied by suppliers.

#### *Information*

Openness and objectivity shall characterize our approach. Our personnel, customers and other relevant parties shall be kept comprehensively informed on environmental matters

#### **Box A**

*Source: MoDo Environmental Report 97*

MoDo environment objectives can be presented as follow:

- seize all possible opportunities to co-operate within the company and with other companies as a means of reducing the total amount of transport.
- gradually raise the demands for environmentally-adapted technology when procuring means of transport and external transport services.

## 4 – Distribution system

MoDo Paper keywords in the approach of distribution activities are:

**Simplicity:** means that the distribution system is made simple by minimizing the number of people and companies involved. The system itself may be complicated, but it must be easy to operate.

**Concentration:** means that the volumes transported are concentrated among fewer distribution partners.

**Economy of scale:** is achieved by maximizing the total volumes of each movement.

**Cooperation:** is illustrated by the arrangements that MoDo Paper makes with other business areas of the MoDo Group with distribution companies and also with competitors. This increases flexibility and leads to faster and less expensive transportation.

It was not possible to gather all the information necessary to make a complete study of the MoDo Paper distribution system, therefore, just some practical example are going to be presented:

- MoDo Paper has an agreement with the Swedish State Railways (SJ), which has complete responsibility for the distribution of paper from the paper mill at Husum to Denmark. SJ collects the paper at Husum, takes it by road to the nearest railway station and loads it onto wagons. The wagons are added to a block train containing wagons of truck cabs from Volvo trucks in Umeå destined for an assembly plant in Ghent in Belgium. The wagons containing Paper are uncoupled from the train in Helsingborg or Copenhagen for distribution by rail or road to customers in Denmark. With this new approach MoDo Paper avoids lorries to sometimes travelling empty.
- The distribution of paper from MoDo paper's mill at Husum to Norway and inside Sweden is now handled by one single distributor, ASG, which has taken over the overall responsibility for distribution. When an order reaches the paper mill, information about the customer, volume, paper grade, delivery address and delivery date is sent via EDI to ASG. This enables ASG to plan distribution so as to achieve maximum efficiency, e.g. avoiding lorries having to drive empty. Under this model the manning throughout the distribution chain has been reduced and the arrangement has brought lower costs for both MoDo Paper and ASG.

## 5 - Transport

Most of MoDo's products are delivered to customers in Europe. Several different distribution systems with terminals in several strategic locations handle most of these volumes. The systems are based on distribution by sea to terminals and trans-shipment to truck or rail for delivery to the end customer.

**Truck:** trucks are used mainly to deliver products from terminals on the continent and in Great Britain to customers, and for deliveries to customers in Sweden. Since the distances are comparatively short, the total transport volume carried by truck is relatively small. External haulage contractors are used for most of these transports. Return loads can usually be arranged.

**Rail:** Rail is used for long-haul transportation between terminals and customers on the continent, for instance in Switzerland, Austria or Italy. Some shipments from Swedish mills to customers on the continent also go by rail.

**Ship:** Most of the products distributed from Swedish mills to the rest of Europe are carried by ship, using several systems: for instance in cooperation with SCA. The arrangement with SCA, which includes transportation from Husum, Domsjö and Iggesund, has led to a reduction in fuel consumption per tonne-kilometre of 22 per cent, and a corresponding reduction in emission levels. The same volume is now shipped by five ships instead of six that used to be needed. Projects have been started to reduce the sulphur content of the fuels used. For this the ships' engines will have to be converted. Fuel with low sulphur content to suit this type of engine will also have to be made available at the ports of call.

MoDo Paper's transport system leads to effective utilization of the various means of transport, which in turn produces financial benefits as well as protecting the environment by reducing resource consumption and environmental impact.

## 6 – Environmental measures

In the last recent years MoDo group have introduced the following measures:

- Infrastructural efforts, by concentrating and isolating goods-flows.
- New railway wagons, and chartering of better vessels
- Materials handling at the mills are regularly adapted to the environment. Old diesel engines vehicles are replaced by new ones with a superior environmental performance or by electric vehicles wherever possible
- MoDo Merchants have introduced "Green Departures", whereby customers will be offered slightly longer delivery times, which will enable the company to plan its distribution more efficiently. This will shorten its "delivery rounds", which will reduce the environmental impact.

## 7 - Certification

MoDo Merchants was certificated in 1997, according with ISO 14001. One important effect of the introduction of this international environmental management system on the activities of merchants is that a larger proportion of not only production but also the distribution chain is incorporated into an active environmental program. When customers of the merchants, such as printers and retailers, also introduce environmental management systems, and their customers do the same, the chain will be complete. MoDo Group expects to have all the mills and the forestry activities certificated in accordance with ISO 14001 by 1999.

## 8 - Future

MoDo expects to continue to reduce the impact of transportation by closer cooperation to improve transport efficiency and by making more stringent demands when purchasing transport services.

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# CASE 2 – STORA

## TCA – TRANSPORT CHAIN ASSESSMENT

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### 1 - Introduction

This case study refers to STORA, which is one of the world's leading companies within its various product areas. STORA is an international industrial group with operations based on forest raw materials. From these raw materials, the group mainly produces pulp for paper production, which is processed to become graphic paper, board and packaging paper. Saw timber products are also produced. The group has operations in 20 countries worldwide, 89% of the groups' sales are conducted within Europe.

Each year, STORA transports 7 to 8 million tones of finish products. Transport operations are mostly performed by external contractors, making STORA one of Europe's largest purchaser of transport services and enabling the group to encourage increased concern for the environment on the part of transport contractors.

In this case study it's going to be presented the tool developed by STORA in order to minimize the environmental impact of transportation.

### 2 – STORA environmental policy

STORA has had a group-wide environmental policy since the mid-1980s. The environment policy in force today was adopted in 1994. The group policy sets out principles upon which environmental work is based. Within each individual operation, environmental work conforms to a locally defined policy. In this context, STORA as a whole, as well as each STORA company, is committed to continuous effort aimed at:

- establishing as a long-term goal the development of all STORA's operations to achieve sustainable production.
- practicing a long-term, sustainable forestry policy that preserves biological diversity.
- producing, developing and marketing high-quality products that are safe for people and the environment, with the emphasis firmly on minimizing the total environmental impact.
- using production methods that are resource-efficient and safeguard both the internal and external environment.
- introducing environmental management systems that are compatible with EU regulation No. 1836/93 relating to voluntary adoption of Union's environmental management and audit scheme.
- informing employees, providing supplementary training, and encouraging them to become involved in environmental matters, as well as conducting an active dialogue with interested parties regarding relevant environmental issues.
- aiming to go beyond the requirements stated in environmental laws and regulations, while also working to ensure that laws and standards in the environmental area are harmonized at an international level.
- encouraging a balanced approach regarding the reuse of recycled fiber and its utilization as an energy source.



- promoting transportation systems that contribute to environmentally sound overall solutions
- preventing the occurrence of environmental accidents and assessing the environmental consequences in advance before new operations are initiated or old operations are phased out.

### 3 – Business approach

STORA believes that environmentally correct solutions require a global perspective of both group's own operations and the environment. The term *Ecobalance* was chosen by STORA to define the objectives of its environmental quality work. In logistics aspects, *Ecobalance* requires that:

- transport shall be regarded as integral parts of product life-cycles and therefore it will be included in environmental programs.

In order to achieve environmentally correct transports, STORA has been establishing close cooperation with customers and transport contractors. Since 1995, an environmental management system has been developed, which is called Transport Chain Assessment (TCA). With this tool, STORA expects to improve the quality of transportation and reduce the environmental impact it causes.

### 4 - Transports

STORA purchases almost all transport services, but since transports account for a substantial portion of product value, STORA feels responsible for the environmental impact of transports.

STORA's efforts to adapt transports to the environment are based on the Transport Chain Assessment (TCA) concept. TCA involves evaluating all parts of the transport chain from the mill to the customer. TCA philosophy says that:

- It is goods that generates the transport not the other way around. And thus, the goods shall bear the environmental impact of the transport.
- Energy transport chain is unique.
- There are potentials for improvement in every mode of transport.

TCA methodology consists of the following three main steps:

#### **STEP 1**

The first action taken is an environmental evaluation of all STORA transport suppliers. The assessment includes a questionnaire that the transport supplier must answer. The answers to the questionnaire are evaluated in a system called Company Management Performance ASSESSMENT (COMPASS). This system is the base for starting an environmental discussion with STORA transport suppliers.

The suppliers that pass the test become green in the system. The others become yellow, and stay under investigation. A supplier becomes red if he is not reaching the minimum level of environmental management that STORA has set out.

## **STEP 2**

The second step in TCA is to quantify the emissions and energy consumption that STORA transport means. The first mapping of the environmental load it is called “The Baseline, 1995”. It shows the 1995-status of STORAs transports environmental impact in a large number of “Environmental profiles”.

A single environmental profile shows energy consumption and emissions for a specific transport chain or transport link. The profile is based on data collected from STORA transport suppliers. Co-operating with STORA suppliers and customers is the key in decreasing the environmental impact of transports.

## **STEP 3**

Improvements and suggestions on the transport environmental area which STORA collects in the “Project Portfolio” and the environmental work are continuously carried out internally and together with STORA transport suppliers. The result (decreased emissions and energy consumption) STORA is able to quantify by comparing with the “Baseline’95”.

This systematic way of working not just is important but also supports the work with the development of new transport solutions for the future.

In practice, the dialogue that STORA establishes with the transport contractors and customers, through TCA, can lead to more rigorous environmental standards for vehicle producers as well as to an increase in return loads, more efficient combined loads and adjustment of delivery times and transportation methods. Long-term cost-effective transports are energy-efficient and impact less on the environment.

## **5 - Certification**

Within the Group-wide environment function which is part of STORA Corporate Research works a team of environmental coordinators, whose assignment is to support STORA’s units in their task of introducing environmental management systems. The environmental coordinators assist the mills with their EMAS planning.

Table 5 shows the ongoing work to introduce environmental management systems (such EMAS and ISO 14001) in industrial operations.

Achieved and planned introductions of environmental management systems				
Year	1995	1996	1997	1998
No. Of Units	2	1	12	16

## **6 - Conclusion**

STORA will need transportation in the future, therefore, the environmental work with their transport suppliers will continue.

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## CHAPTER 5

### FINAL REMARKS

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In Chapter 2 it was seen that competition is increasing and companies can gain some competitive advantage by implementing environmental practices in their strategies. There is still no clear empirical evidence of the impact of high or even relatively high environmental standards on competitiveness. Nevertheless, an environmental policy can be better attuned to the imperatives of globalisation and competitiveness, to the extent it can be: i) conducive to innovation; and ii) conducive to efficiency.

The impacts of distribution activities on the environment are several, as it was seen in Chapter 3. Although there are clearly important benefits from implementing strategies such as Just-In-Time delivery, centralisation of inventory and 24-Hour operation, there is also a downside. The environmental implications of such strategies are indeed significant thus, should not be ignored by the companies. From the means of transportation analysed, road transport is the one that has most adverse impact on the environment. The advantages connected to this kind of transportation makes it clear that the commercial vehicle will remain the dominant mode for the distribution of goods in the foreseeable future, although the use of combined transport should also increase. A lot of research it is being done, by the major truck manufacturing companies, in order to improve the environmental performance of the commercial vehicles.

The environmental measures established by the European Union, which have a direct impact on distribution activities are the ones related to: transportation, infrastructures and waste. For companies within the distribution industry that operate in a global environment, the treatment of packaging waste is a big challenge and should not be underestimated. There is no doubt that the European Union will increase the environmental pressures and regulations in these specific areas.

The Swedish Forest Industry for long that has been taking actions in order to harm less the environment, by: 1) developing an environmental policy for transport, 2) investing in research projects. The companies within this industry have a big concern with the environment, establishing stricter environmental policies. From the analysis made to the distribution environmental strategies followed by MoDo and Stora is it possible to conclude that in order to minimise the environmental impacts of distribution they are more demanding when purchasing transport services and open to work more closely with their suppliers.

There are measures that can be taken by companies in order to harm less the environment, however, only profitable companies can afford to carry out environmental projects. From this flows that environmental measures cannot be seen as isolation phenomena separated from the rest of the business.

In 1972, in a conference about environment in Stockholm, the environmental advisor of the World Bank, Mcnamara, stated the following:

*“ The question is not whether there should be continued economic growth. There must be. Nor is the question whether the impact on the environment must be respected. It has to be. Nor, least of all, is it the question whether these two questions are interlocked. They are. The solution of the dilemma resolves clearly not about whether, but about how.”*

After twenty-six years, although there has been some progress, the dilemma still prevails in many business areas. But nowadays companies are benefiting from the wide range of environmental developments and experience, as a result they are:

- better equipped and in a stronger position to ask the right questions, identify the problems and seek the appropriate solutions on environmental issues;
- better able to initiate staff and management training programmes on environmental awareness, performance and improvements;
- better able to gain from the considerable body skills, knowledge and experience accumulated, at both technical, operational and managerial level on environmental related issues;
- better equipped to ensure that environmental mission statements, benchmarking standards, audits and target performances become a more common feature within industries;

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## **APPENDICES**

## **APPENDIX 1**



# DISTRIBUTION

**Product:** A4 paper

**Characteristics:**

Relation Volume/Wait

Relation Value/Wait

Others

**Market:**

Main markets in Sweden:

Main markets in Europe:

## 1. PHYSICAL DISTRIBUTION CHANNELS

Sweden:

Channel	Retailer	Wholesaler	Sales office
%			

Europe:

Channel	Retailer	Wholesaler	Sales office
%			

## 2. CUSTOMER SERVICE LEVEL

How is it measured?

- Order cycle time (time from order to delivery)
- Availability from stock
- Delivery service frequency (to one customer within a specific time space)
- % of fully satisfied orders
- % of orders satisfied at the first request
- % of articles damaged or lost
- Others

### 3. PHYSICAL DISTRIBUTION NETWORK

Where are the factories, warehouses, sales office and the markets located. The flows between them (by volume) and the routing delivery service.

- Warehouses

Number

Location

Dimension

Technologies (warehousing systems and equipment to move the products)

How are the orders picked?

How is the efficiency of the order picking measured?

- Service level
- Number of articles per hour
- Number of orders per day
- Others

- Transportation

Transport policies

Which are the means of transportation used for the Swedish and the European markets? For each one of them which are the delivery frequency, lead times and capacity.

- Stocks

Stocking policy

How is it managed?

Is there any performance measures?

- % of lost stock
- Stock rotation
- Others

- Information technologies

Which are the ones used in: inventory management, order processing and shipment/carrier management.

- Planning systems (Material Requirements Planning, Distribution Requirements Planning, others)

## **APPENDIX 2**

Note:

This questionnaire is specially directed to issues related with the distribution of *Fine Paper*. I believe that it will not take you more than thirty minutes to fulfil it. Please feel free to add as many comments as you want and if you find some of the questions not so clear, I would be grateful if you note it.

Name: \_\_\_\_\_  
Charge in the company: \_\_\_\_\_

**1. DISTRIBUTION CHANNELS**

1.1. Which are the main markets in the EU?

- Sweden     Netherlands     Austria     \_\_\_\_\_  
 GB     Germany     Belgium     \_\_\_\_\_

1.2. Which are the channels used in the EU?

Channel	Retailer	Wholesaler	Sales office
%			

1.3. Are any of them owned by SCA?

- Yes, % \_\_\_\_\_  
 No

**2. CUSTOMER SERVICE LEVEL**

2.1. Is the customer service level measured?

- No  
 Yes, How?  
 Order cycle time (time from order to delivery)  
 Availability from stock  
 % of fully satisfied orders  
 % of articles damaged or lost  
 \_\_\_\_\_

### 3. PHYSICAL DISTRIBUTION NETWORK

3.1 How many factories in Sweden? \_\_\_\_\_

3.2. How many factories in the rest of the EU? \_\_\_\_\_

3.2.1. Where are they located?

- |                                 |                                      |                                  |                                |
|---------------------------------|--------------------------------------|----------------------------------|--------------------------------|
| <input type="checkbox"/> France | <input type="checkbox"/> Netherlands | <input type="checkbox"/> Austria | <input type="checkbox"/> _____ |
| <input type="checkbox"/> GB     | <input type="checkbox"/> Germany     | <input type="checkbox"/> Belgium | <input type="checkbox"/> _____ |

3.3. How many warehouses in Sweden? \_\_\_\_\_

3.4. How many warehouses in the EU? \_\_\_\_\_

3.4.1. Where are they located?

- |                                 |                                      |                                  |                                |
|---------------------------------|--------------------------------------|----------------------------------|--------------------------------|
| <input type="checkbox"/> France | <input type="checkbox"/> Netherlands | <input type="checkbox"/> Austria | <input type="checkbox"/> _____ |
| <input type="checkbox"/> GB     | <input type="checkbox"/> Germany     | <input type="checkbox"/> Belgium | <input type="checkbox"/> _____ |

3.5. Which are the means of transportation used within the EU markets?

	Boat	Train	Truck
%			
Subcontracted (Y/N)			

If you answered yes, please write the percentage

3.6. How many times are the products handled (until they reach the customer)?  
\_\_\_\_\_

3.7. The transportation of fine paper is made separated from the other forest products?

- |           |                          |                          |                          |
|-----------|--------------------------|--------------------------|--------------------------|
|           | Boat                     | Train                    | Truck                    |
| Always    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Sometimes | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Never     | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

### 4. STOCKS

4.1. How are they managed?

\_\_\_\_\_

\_\_\_\_\_

4.2. In which part of the process are the products stocked?

\_\_\_\_\_

\_\_\_\_\_

## 5. INFORMATION TECHNOLOGIES

5.1. Is there any computerised system to manage the warehouses?

- No
- Yes, Which one? \_\_\_\_\_

5.2. Is there any computerised system for Routing/Scheduling?

- No
- Yes, Which one? \_\_\_\_\_

## 6. PLANNING

6.1. Which are the systems/models used for planning?

- Material Requirements planning
- Distribution Requirements Planning
- \_\_\_\_\_

6.2. How is the production planned?

- According to forecasts of the demand
- According to the orders
- \_\_\_\_\_

6.3. How is the distribution planned?

- One month in advanced
- More than one month in advanced
- Less than one month in advanced (days) \_\_\_\_\_
- \_\_\_\_\_

## 7. ENVIRONMENT

7.1. SCA has an environmental policy?

- Yes
- No

7.2. Does SCA have any joint working with customers over environmental factors?

- Yes
- No

And with other companies?  Yes  No

7.3. When purchasing transport services does SCA make any environmental demands?

- No
- Yes, Which ones? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

7.4. What measures have been taken by SCA in order to reduce the environmental impact of transportation?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

7.5. How much of the packaging waste is recycled? \_\_\_\_\_ %

7.6. Are the logistics activities environmental audited?

- No
- Yes, When SCA started to do it? \_\_\_\_\_

7.7. In your opinion, at a distribution level, how important it is to be environmental?

Very important      Of no importance

7.8. Do you think that in the near future companies will have to adopt a "greener distribution strategy"?

- No
- Yes, why? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

7.9. From a scale of one to ten, how would you classify the environmental conscience of SCA when it comes to distribution activities? \_\_\_\_\_

7.10. Which areas will SCA give environmental priority in the future?

- Production technology
- Transportation
- Forestry
- Management of resources
- R&D
- \_\_\_\_\_

Will you mind if I contact you for a personal interview or to fulfil a second questionnaire?

- Yes
- No

**TACK SÅ MYCKET!**







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