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SUSTAINABLE DEVELOPMENT AND LOGISTICS IN RETAIL INDUSTRY

MULTIPLE CASE STUDY: WAL-MART & CARREFOUR

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ABSTRACT

SUSTAINABLE DEVELOPMENT AND LOGISTICS IN RETAIL INDUSTRY MULTIPLE CASE STUDY: WAL-MART & CARREFOUR

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This bachelor thesis deals with green logistics. The research question is: How can a retail company be part of sustainable development thanks to its logistics strategy and actions? To carry out the study, the theoretical part is divided into four parts that are: sustainable development, logistics and environmental consequences, green logistics and introduction to retail field. The two first parts can be seen as the basis of the work as they explain sustainability concept and the consequences of logistics activities over the environment. The third part introduces green logistics, it constitutes the most important part of the study. The fourth one explains what is retailing. It stresses the importance of logistics in that field of activity as retailing companies have been chosen to be studied.

To carry out the study, a qualitative multiple case study was used. It was based on the analysis of Annual reports and Sustainability reports of the companies that were chosen, namely: Wal-Mart and Carrefour. The empirical part enabled to confirm what was found in theory. It also supplemented it by bringing some new points. The two parts are complementary.

The findings are related to the greening process of logistics in a retail company. Conclusions and recommendations have been withdrawn from the comparison of the multiple case as well as the comparison between theory and empirical findings. The main finding is that green logistics consists in some defined actions that require time and money and that is not necessarily possible for every retail companies of different sizes. Each company depending on its size can lead a different logistics strategy corresponding to what is affordable in term of money and time.

To summarise, this thesis gives all the possible actions to green the logistics process of a retail company. The result can be useful for every company of retailing as it gives an overview quite complete of the possibilities. However, adaptation to each case remains inescapable.

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1 INTRODUCTION

Background of the study

"In July 20th, 1969: the first man walked on the moon and became aware that the blue planet is a tiny fragile oasis, lost in the unlimitedness of the universe. At that time, only 3.5 billion human beings lived on the Earth. Today, we are 6.7 billions... a 91 % increase in only 39 years! "

If we believe demographic data, there are chances that the Earth would be populated with 10 billion human beings before the middle of the 21st century. But, in 2050, if every inhabitant of developing countries consumes as much energy as a Japanese people in the 70s, the world consumption of energy will be multiplied by four!

It is in this context that the following questions began to arise: how to give a minimum of wealth to these millions of people, women and children still deprived when the planet seems already suffocated by the wild taking of its natural resources? And especially, how is it possible to bequeath a healthy earth to our children? (French Ministry of ecology, 2008)

It is in the objective to bring concrete answers to those questions that born the sustainability concept. Sustainable development is nowadays a well known concept that takes part in the daily life. Sustainable development is a current topic from a social and economic point of view but also from an environmental one. Indeed the protection of the environment is getting more and more importance in the actuality through the Medias and politics. This is a subject that worths thinking. States, companies as well as citizens have to be aware of this issue.

During the world Summit of Johannesburg in September, 2002, the President of the French Republic, Mr Jacques Chirac, reminded that sustainable development requires a change of behaviour of each one - citizens, companies, territorial authorities, governments and international institutions - faced with such threats that endanger the people and the planet (social disparities, industrial and sanitary risks, climate changes, biodiversity loss...)

Companies have a lot of work to become greener. They have to change their way of doing in the production process as well as in the logistics area.

In this work we are going to focus our attention on the logistics level. Whether it is by choice (ethical company) or by obligations (world or regional regulations), companies are nowadays led to green their logistics process.

Purpose and structure of the study

From this, we can wonder the role of the retail companies in sustainable development. More especially, it can be interesting to see how can a retail company be part of sustainable development thanks to its logistics strategy and actions? The objective of retail firms is to satisfy clients and to offer them a high service level. To do so, they often apply logistics strategies that are not particularly environmental friendly but with the new environmental issue, they will have to green their logistics process.

For that reasons, I decided to study the green logistics in the retailing field. The aim of this thesis is to be useful for companies and even more for retail companies that would like to implement a green logistics strategy. In this thesis is gathered information about the means that a company can use to be part of sustainable development from the environmental point of view. It gives some key information about the greening process of logistics.

The study is divided into two parts: the theoretical and the empirical part.

The first part is composed of four parts: sustainable development, logistics and environmental consequences, green logistics and introduction to retail field. The two first parts constitute the basis of the work as they explain sustainability concept and the consequences of logistics activities over the environment. The third part introduces green logistics, it is the most important part of the study. The fourth one explains what is retailing. It stresses the importance of logistics in that field of activity as we focus our attention on it.

The empirical part is based on a qualitative multiple case study. It is based on the analysis of Annual reports and Sustainability reports of the companies chosen for the thesis: Wal-Mart and Carrefour.

2 SUSTAINABLE DEVELOPMENT

2.1 Sustainability

Although thinkings on sustainable development notion date back to 1970s, it is only in June, 1992, during the Declaration of Rio that 178 states adopted unanimously concepts about sustainability.

It does not exist a really clear definition of this concept. Sustainable development is part of a package: economic, environmental and societal. There are many different interpretations of this notion depending on the countries. Wealth countries put the stress on the environmental aspect when less developed economies understand it on an economic level and associate this notion to a fair distribution of wealth. (Charter & Tischner, 2001, 24-25.)

However, there is one definition that is used as a reference. Sustainable development was defined in 1987 by the World Commission on Environment and Development (*Brundtland Commission 1987*) as: *Development that meets the needs of the present without compromising the ability of future generations to meet their own needs*. In other words, sustainable development aims to provide a long-term vision for the society. Activities that meet present needs may have short-term horizons, however, they must include a long term perspective.

If we just use simple words, we can say that, within the framework of sustainable development, the production and consumption modes have to respect the human or natural environment. All the inhabitants of the Earth should have the possibility to satisfy their fundamental needs: to feed, find accommodation, dress, educate, work, to live in a healthy environment, etc.

Sustainable development is a subject that takes more and more importance years after years. This attention may be largely attributed to information provided by the media, through growing numbers of environmental and consumer interest groups (Fiksel, 1996).

2.2 The three dimension of sustainable development

Elements of sustainable development are often organised into three dimensions or pillars: environmental, economic and social. Sustainable development aims at achieving a real and lasting reduction of social and economic disparities as well as protecting the environment.

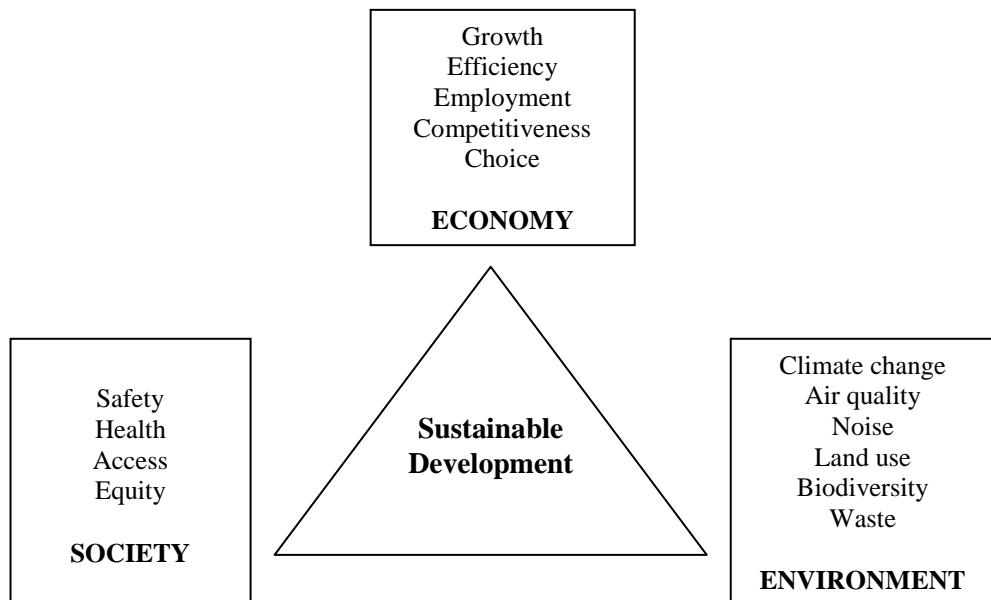


Figure 1 : « The three dimensions of sustainable development », based on Greenlogistics.org

According to EEA Financial mechanism (2005), the environment is the necessary basis for sustainable development. The economy is the tool to achieve it and the social dimension (good life for all) is the target of sustainable development.

2.2.1 Environmental dimension

The ecosystem is under strain from human activity. Fulfilling present needs while reducing the impact of human activity is a challenge.

It is necessary to secure the living and physical environment, including natural resources, processes and balances. Some simple, but fundamental, aims have been formulated, such as: limiting global warming; halting loss of biodiversity; controlling and limiting emission of persistent chemical pollutants.

The need to limit global warming illustrates how the environment is the basis for any sustainable development. The only way to control global warming is to reduce the emissions of fossil carbon significantly over a relative short time.

If the climate really comes out of its current balance, it may not be possible anymore to create the good life of the social dimension with all economic and other tools available. (EEA Financial mechanism, 2005)

2.2.2 Economic dimension

Traditionally economic development has been seen as the target and the environment as the tool through the use of resources. Economic prosperity is a very important element of sustainable development. It allows combating poverty, to finance remediation of old burdens, to make changes in development, etc.

However, not all economic growth implies improvement for sustainable development. Only economic growth at reduced environmental impact can be defended as being part of sustainable development.

The economy is a very powerful tool for sustainable development. Used in the right way, it provides efficient incentives to make choices for sustainable development. (EEA Financial mechanism, 2005)

2.2.3 Social dimension

The essence of the sustainable development idea is to shift the focus from the present needs to also include the future generations as well. A sufficiently good life for all humans, within present and future generations, is the target of sustainable development. By the way, the social dimension is important because sustainable development can only be achieved by people who feel that they have a fair share of wealth, safety and influence. The social dimension of sustainable development includes support of the civil society, its involvement in solving various types of issues and its participation in decision processes on different levels. The social dimension also includes the fight against poverty through employment, support to

sustainable livelihoods, antidiscrimination work, and social security for all. (EEA Financial mechanism, 2005)

2.3 Focus on the environment

In this thesis, the objective being to see how logistics strategy and actions of a retail company can facilitate sustainable development, we are going to concentrate only on one of the three dimensions, namely: the environment. In the following paragraphs, the aim consists in making an inventory of fixtures concerning air, water, raw materials and energy. We are going to focus our attention on these elements because they are important when looking at the health of the planet.

2.3.1 Air

Air takes an important part in sustainable development when talking about environment because it is more and more polluted.

According to the EPA (Environmental Protection Agency) website, pollution corresponds to unwanted chemicals or other materials found in the environment. Once released into the environment, many air pollutants can persist, travel long distances, and move to another environmental medium like water.

- Sources of air pollution

Air pollution comes from many types of engines, industries, and commercial operations. Pollution sources that move, such as planes, trucks, snow blowers, bulldozers, and trains, are known as "mobile sources." They contribute greatly to air pollution and are the primary cause of air pollution in many urban areas. They produce several important air pollutants, such as air toxics and greenhouse gases. Toxic air pollutants are those that are known or suspected to cause cancer or other serious health effects. As for greenhouse gases (GHG), they trap heat in the Earth's atmosphere and contribute to global climate change. The most known of GHGs is CO₂. (EPA website)

Apart from mobile sources, it also exists non-mobile sources of air pollution such as power plants, factories, manufacturing processes, etc...

In this thesis we are going to focus our attention on mobile sources as well as warehousing and manufacturing process for packaging.

- Evolution of air pollution

Here we are aiming to see the evolution of air pollutants principally those that are emitted by mobile sources. We focus our attention on them because we are interested in logistics and then mobile sources usually take part in the supply chain. We are going to see the evolution of greenhouse gases and more especially the evolution of CO₂ because it is the most important gas released in the logistics process through transportation.

According to the EPA website, greenhouse gas concentrations in the atmosphere have historically varied due to many natural processes (e.g. volcanic activity, changes in temperature, etc). However, since the Industrial Revolution, humans have added a significant amount of greenhouse gases in the atmosphere by burning fossil fuels, cutting down forests and other activities. Greenhouse gases absorb and emit heat so increasing their concentrations in the atmosphere will tend to have a warming effect.

- Evolution of CO₂ concentration in the atmosphere

The following data are based on the Intergovernmental Panel on Climate Change (IPCC, 2007)

Concentrations of Carbon Dioxide (CO₂) in the atmosphere increased by 36 percent from pre-industrial times to 2006 according to the National Oceanic and Atmospheric Administration's (NOAA) Earth Systems Research Laboratory. Almost all of the increase is due to human activities (IPCC, 2007).

- Surface temperature change

According to the National Oceanic and Atmospheric Administration's (NOAA, 2006) and the National Aeronautics and Space Administration's (NASA, 2006): since the

mid 1970s, the average surface temperature has warmed about 0.6°C. Moreover, the five warmest years over last century have likely been: 2005, 1998, 2002, 2003, and 2006. The top 10 warmest years have all occurred since 1990.

- Future Climate Change

According to IPCC (2007), greenhouse gas concentrations in the atmosphere will increase during the next century unless greenhouse gas emissions decrease substantially from present levels. Increased greenhouse gas concentrations are very likely to raise the Earth's average temperature, influence precipitation and some storm patterns as well as raise sea levels. The magnitude of these changes, however, is uncertain.

2.3.2 Water

Another big issue in sustainable development in the environmental dimension is the water. Indeed there are some important questions about water resources and water pollution. Nowadays, water resources are heavily managed and supplies are scarce in some regions. According to the UNESCO report on water (2006), implementation of adaptation measures, such as water conservation and the application of appropriate management practices will have an important role to play in determining the impacts of climate change on water resources.

- Water Availability

The world's water exists naturally in different forms and locations: in the air, on the surface, below the ground, and in the oceans. Freshwater accounts for only 2.5% of the Earth's water, and most of it is frozen in glaciers and icecaps. (UNESCO, 2006)

The quantity of freshwater that is available to a given country, without exceeding the rate at which it is renewed, can be estimated. There is a huge difference between countries. The average amount available per person varies from less than 50 m³ per year in parts of the Middle East to over 100 000 m³ per year in humid and sparsely populated areas.

Changes in temperature, precipitation patterns and snowmelt can have impacts on water availability. Higher temperatures will increase loss of water through evaporation. Climate change will increase existing pressures, for example in areas already suffering from water shortages. Land and mountain glaciers are shrinking more rapidly in recent years. Extreme weather events stemming from global warming, such as storms and floods, are likely to become more frequent and severe.

The growing uncertainty of surface water availability and increasing levels of water pollution and water diversions threaten to disrupt social and economic development in many areas as well as the health of ecosystems. (UNESCO, 2006)

- Pressures on water resources

The combination of both naturally occurring conditions and humanity's actions creates pressure on water resources. Climate change and natural variability in the distribution and occurrence of water complicate the sustainable development of water resources. Some of the main factors affecting water resources include:

- population growth, particularly in water-short regions
- major demographic changes as people move from rural to urban environments
- higher demands for food security and socio-economic well-being
- increased competition between users and usages
- pollution from industrial, municipal and agricultural sources.

(UNESCO report, 2006)

- Water pollution

Humans have long used water resources as 'sinks' into which they dispose of the wastes they generate (UNESCO, 2006). These disposal practices leave most wastes inadequately treated, causing pollution. This in turn affects surface waters and groundwater. Pollution can harm water resources and aquatic ecosystems.

Atmospheric contamination from vehicle emissions leads to water pollution. Acid deposition impairs the water quality of lakes and streams. High concentrations of

aluminium and increased acidity reduce species diversity and the abundance of aquatic life in many lakes and streams. Entire food webs are often negatively affected.

Despite improvements, it still remains a critical situation that impacts water resources and ecosystems in some developed regions of Europe and in North America. The situation remains an important issue in several developing countries (for example in China, India, Korea, Mexico, South Africa and Viet Nam) where there are typically lower emission controls and inadequate monitoring and evaluation (Bashkin and Radojevic, 2001).

In another way, water pollution can be the result of water cycle changes. Indeed, earth warming has consequences on water cycle: there are more flooding. These flooding can affect water quality as large volumes of water can transport contaminants into water bodies and also overload storm and wastewater systems. (UNESCO, 2006).

2.3.3 Raw materials and energy

Energy is central to social and economic well-being. Indeed, it provides personal comfort and mobility, and is essential to most industrial and commercial wealth generation. However, energy production and consumption place considerable pressures on the environment, including contributing to climate change, damaging natural ecosystems, tarnishing the built environment and causing adverse effects to human health (European Environmental Agency, 2002).

In this part, we are going to see the evolution of the total world energy consumption. (Annexe 1)

The two graphics corresponding to this part are in the annexe and the data come from two sources: the International Energy Agency (2007) and the BP Statistical Review of World Energy 2007.

World primary energy consumption increased by 2.4% in 2006. The Asia Pacific region once again recorded the most rapid growth, rising by 4.9%, while

consumption in North America fell by 0.5%. Chinese energy consumption rose by 8.4% and China continued to account for the majority of global energy consumption growth.

- Oil

Global oil consumption grew by 0.7% in 2006, the weakest growth since 2001 and half the 10-year average. Consumption grew by just under 650,000 barrels per day (b/d) to reach 83.7 million b/d. Chinese consumption grew by 6.7%. OECD consumption declined by about 400,000b/d, the largest decline since 1983.

- Natural gas

World natural gas consumption grew by 2.5% in 2006, below the 3.4% growth seen in 2005. Declining US and EU consumption was offset by strong growth in Russia and China. In the US, gas consumption declined for the second year in a row, despite an increase in gas used for power generation. European consumption fell, due to a combination of high prices and warmer-than-normal weather. Russian gas consumption increased strongly, accounting for nearly 40% of the global increase. Chinese consumption grew by more than 20%. Gas production rose by 3% in 2006. Russia accounted for the largest incremental growth in production, led by rapid growth among independent producers.

- Other fuels

Coal continued to be the world's fastest-growing hydrocarbon in 2006. Global consumption rose by 4.5%, below last year's rapid growth (+5.7%) but well above the 10-year average. Consumption growth in China, the world's leading coal user, moderated from the strong growth seen in 2005 but remained above average. Chinese coal consumption grew by 8.7% and China accounted for more than 70% of the growth in global coal consumption. Consumption in the US declined for the first time since 2002. Elsewhere, coal consumption rose by 3.5%, well above the 10-year average.

Nuclear power output rose by 1.4%. OECD countries accounted for two-thirds of the global increase, due to a combination of increased capacity utilization and capacity upgrades.

Hydroelectric generation increased by an above-average 3.2%. Capacity expansion in China, India and Brazil, along with increased rainfall in the US, offset declines in Canada and Scandinavia.

After having presented the whole situation of energy in the world, we will focus our attention on oil because it is the energy that is the most important for logistics. Indeed, transports use a lot of this resource.

Proved oil reserves continue to climb in the long run. Reserves have grown 72.9 billion barrels since 2001 and 159.2 billion barrels or 15% over the last decade. 2006 oil reserves stand at 1208.2 billion barrels. (Annexe 1)

This increase is positive. However we have to take into consideration the great increase in the consumption. In the Annexes 2 and 3, we can see the evolution of production and consumption of oil. The important information is that consumption knows a higher growth in percentage than production. (Respectively 0.7% and 0.4%) Even if there is quite a lot of resources the problem is that the consumption is too high. Moreover the more important is that consumption of oil is usually synonymous of pollution.

On the annexe 4 we can see that transport is the most important consumer of oil because it represents 60.3% of the total consumption of oil. Moreover if we calculate we can see that its consumption passed from 1026 Mtoe to 2069 Mtoe which corresponds to an increase of 101.6%. That is significant and that is why it is nowadays an important issue. Transportation is a sector that definitely needs to begin a green process.

3 LOGISTICS AND ENVIRONMENT CONSEQUENCES

3.1 Activities in logistics

Logistics is the function responsible for the flow of materials from suppliers into an organisation, through operations within the organisation, and then out to customers. (Waters, 2003, 5)

It is easy to see the role of logistics in a company that produce goods because tangible goods clearly have to be moved. However, even organisations providing the most intangible services move some goods around – perhaps paperwork or consumables – so they still need logistics.

Materials are all the things that an organisation moves to create its products. These materials can be both tangible such as raw materials and intangible such as information.

The Council of Supply Chain Management Professionals (CSCMP) highlights the combination of materials and information flow in the definition of logistics. According to it, logistics is the process of planning, implementing and controlling the efficient, cost effective flow and storage of raw materials, in process inventory, finished goods and related information from point of origin to point of consumption for the purpose of conforming to customers' requirements (Rushton, Croucher & Baker, 2006, 6).

In a more general way, it is usual to talk about supply chain. This supply chain consists of the series of activities and organisations that materials move through on their journey from initial suppliers to final customers. Along this journey, materials may move through raw materials suppliers, manufacturers, finishing operations, logistics centres, warehouses, third party operators, transport companies, wholesalers, retailers, and a whole range of other operations. Sometimes, the supply chain goes beyond the final customer to add and re-use of materials. (Waters, 2003, 7) Logistics is part of all this supply chain.

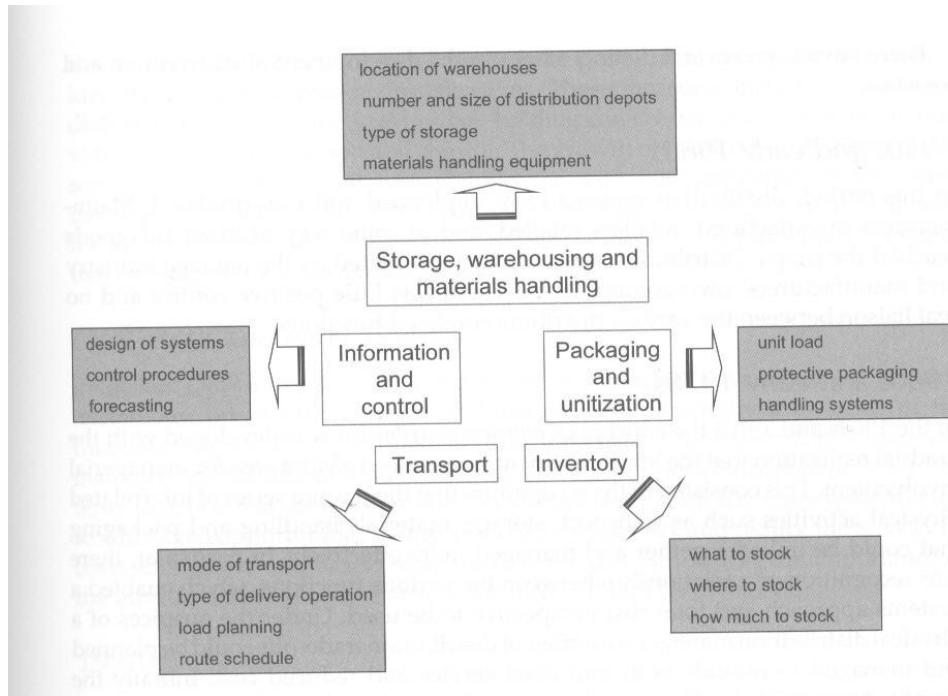


Figure 2: “The key components of distribution and logistics”, based on Rushton, Croucher & Baker (2006, 7)

The scheme above shows all the actions that belong to the logistics process. More precisely, if we follow some materials moving through an organisation, we can see that the following activities are normally included in logistics. We will see them in the order they are usually realised: purchasing, inward transport, receiving, warehousing, stock control, order picking, materials handling, outward transport, physical distribution management, returns, recycling and waste disposal.

Alongside the physical flow of materials is the associated flow of information.
(Waters, 2003, 13-14)

3.2 Aims of logistics

The supply chain and by the way logistics, is a sequence of events intended to satisfy customers.

Logistics managers have two main aims. The first one is to move materials into, through and out of their own organisation as efficiently as possible. The second one is to contribute to an efficient flow through the whole supply chain. Traditionally,

managers concentrate on the first of these two aims, focusing on those parts of the supply chain that they directly control. But if each organisation looks after its own logistics properly, materials will move efficiently through the whole chain, thus achieving the second aim.

Looking for an efficient movement of materials does not describe really precisely the aim of logistics. Indeed what does efficient exactly mean?

We can find several answers to this, including fast deliveries, low costs, little wastage, quick response, high productivity, low stocks, no damage, few mistakes, high staff morale and so on... Although these are all worthy goals, they are indicators rather than real objectives.

According to Waters (2003, 17-18), to find the real aim of logistics, we must relate it to the wider objectives of the organisation.

Ultimately, the success of every organisation depends on customer satisfaction. By the way, the overriding aim of logistics can be define in terms of customer service.

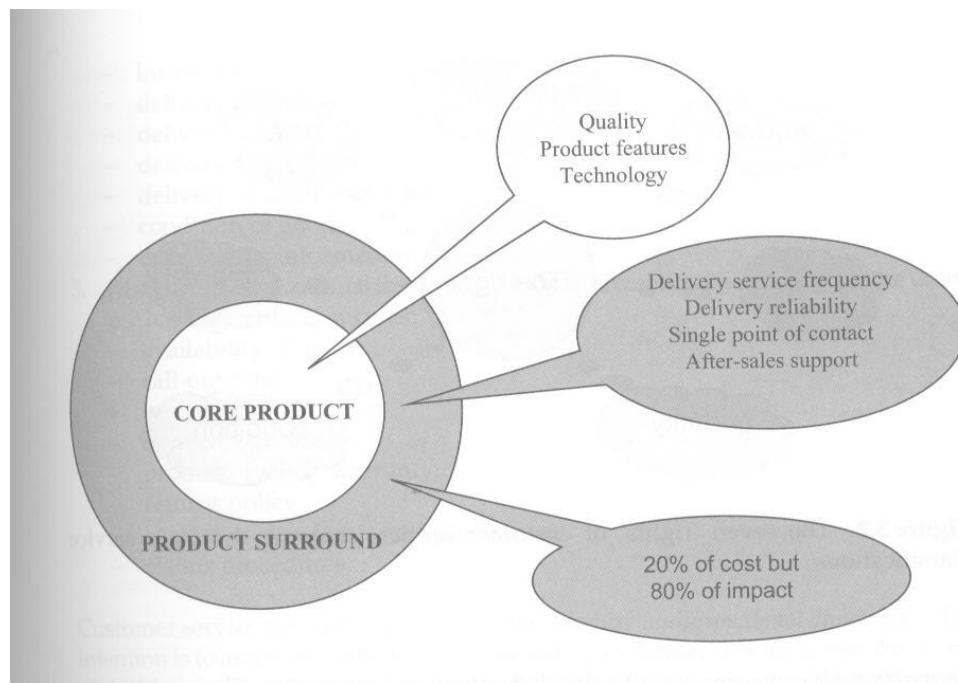


Figure 3: “Core product versus product surround”, based on Rushton, Croucher & Baker (2006, 35)

On the above scheme, the service elements, which can be called the “product surround”, represent the availability of the product, the ease of ordering, the speed of

delivery, and after-sales support. It is recognized that the product surround elements are very important in determining the final demand for a product.

According to the Pareto 80/20 rule, it is estimated that product surround or logistics elements represent about 80 per cent of the impact of the product but only represent 20 per cent of the cost. Thus, no matter how attractive the product may be, it is essential that the customer service elements are satisfactory and logistics plays a crucial role in providing good customer service.

The logistics department has to organise the movement of materials in the best way to achieve high customer satisfaction. It must provide a high quality service with low or acceptable costs.

We can phrase this balance in terms of perceived customer value. Logistics adds value by making products available in the right place and at the right time. If a product is available at the place it is needed, logistics is said to have added place utility. If it is delivered at the right time, logistics has added time utility. Then, the aim of logistics can be defined in terms of getting the highest customer utility or perceived value and actual costs. (Waters, 2003, 18)

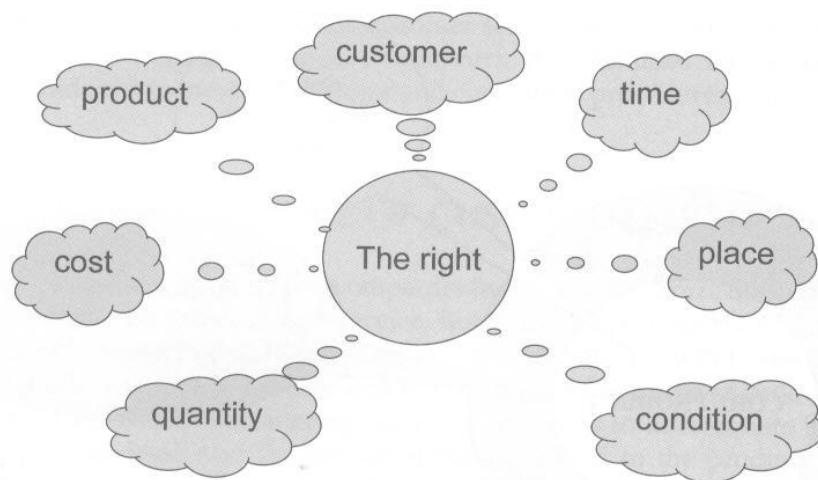


Figure 4 : « The seven rights of customer service », based on Rushton, Croucher & Baker (2006, 36)

The aims of logistics are often summarised as getting, the right materials, to the right place, at the right time, from the right source, with the right quality, at the right price. It depends however on how we define “right”.

Managers have to design logistics that are flexible enough to satisfy a variety of needs.

Harrington (1996, 254) summarises this double role by saying that “logistics is both the glue that holds the materials / product pipeline together and the grease that speeds product flow along it”

3.3 Link between logistics and environment

Now we have seen the activities and aims of logistics, it is not difficult to see the link between logistics and environment.

Indeed logistics activities such as transport, packaging and warehousing have consequences on the environment. Moreover, the aims of logistics always searching consumer satisfaction by reducing costs and delays in delivery are even worse for the environment. According to Simms (2006), the way in which companies make things has changed beyond recognition since the early days of manufacturing. Globalization, outsourcing and just-in-time production have led many traditional companies to separate into different parts, many of which no longer fall under their direct control. From this sentence we have to understand that nowadays, there are new complex supply chain strategies and they cause damage to the environment.

Indeed the Internet allows companies to co-ordinate their activities and exchange information quickly and efficiently. Products and components can be transported by land, sea and air through complex webs of suppliers in elaborate ways. Companies are learning that there is competitive advantage to be gained in the way they orchestrate their supply chains.

In this part, we are going to see the consequences that logistics has on the environment. Usually we talk about externalities. “Externality is an economic concept that refers to activities of individuals that have consequences, positive or negative, on other individuals” (Rodrigue, Slack & Comtois, 2006). This concept is relevant for environmental issues since many of the consequences are assumed by the whole society. If the concept of externalities can also be applied to beneficial impacts; however in the case of transportation many of the significant externalities are negative.

We will first start with transport externalities and then we will see the impact of packaging over the environment.

3.3.1 Transport and environment

The number of studies estimating the impacts of freight transportation on the environment continues to grow. They reveal in more detail the negative impacts which are occurring. Data from the U.S. and Europe indicate that the effects of emissions are significant and will continually increase if intervention is not made. (Rodrigue et al. 2006)

Transportation modes have known some changes. They are now more and more mechanized and that is why freight logistics systems generate negative externalities. The basic types of transport externalities attributed to the environment fall mainly within air and water pollution: acid rains and climate change are good examples. While consuming large quantities of energy, especially oil, trucks, planes and other modes of transport emit numerous pollutants. “With a technology relying heavily on the combustion of hydrocarbons, the impacts of transport over environmental systems has increased with motorization”. (Rodrigue et al. 2006)

According to Eye for transport (2007), the link between transport and environment is not difficult to see as up to 75% of a company’s carbon footprint comes from transportation.

- Two methods to categorize impacts of transportation on the environment
- Rodrigue et al (2006), divide the impact of freight transports into three points:

- Direct impacts: they include immediate consequences of transport activities on the environment where the cause and effect relationship is generally clear and well understood.
- Indirect impacts: are the secondary (or tertiary) effects of transport activities on environmental systems. They involve relationships that are often misunderstood and difficult to establish.

- Cumulative impacts: they are additive, multiplicative or synergetic consequences of transport activities. They take into account the varied effects of direct and indirect impacts on an ecosystem.

The U.K. Round Table on Sustainable Development has also summarized the externalities of logistics activities. The impacts fall into three categories as well but here, they correspond to the three dimensions of sustainable development.

Economic Impacts	1. Traffic Congestion 2. Resource waste
Ecological Impacts	1. Greenhouse Gases Cause Climate Change 2. The use of non-renewable fossil fuel 3. The effects of waste products such as tires and oil 4. Ecosystem destruction and species extinction
Social Impacts	1. Negative public health impacts of pollution 2. Crop destruction 3. Injuries and deaths resulting from traffic accidents 4. Noise 5. Visual intrusion 6. Congestion deterring passenger travel 7. Loss of Greenfield sites and open spaces 8. Deterioration of Buildings/Infrastructure

Table 1: “Impacts of logistics systems”, based on UK Roundtable on Sustainable Development (1996)

Although most of the externalities listed in the table above could be categorized as environmental externalities, we often associate current environmental concerns with externalities resulting from vehicle emissions.

Given the two methods of categorization of transportation impacts, we can say that in this part we are going to focus our attention on direct impacts and more especially on the greenhouse gases emissions and climate change.

- Energy used for freight transport and consequences

Various organizations showed that freight logistics carriers are a significant source of pollutants causing environmental impacts.

Diesel is the most commonly used fuel type in freight modes such as rail, marine and trucking. Unfortunately, diesel combustion products can also cause significant negative impacts.

At the global level, climate change and stratospheric ozone (O_3) depletion are important concerns. CO₂, a greenhouse gas (GHG), as mentioned in part 2.3.1, is a product of fossil fuel combustion and therefore is released in diesel exhaust. Consequently freight transportation contributes sizably to GHG releases, and to effects on the global climate. (Ang-Olson & Ostri, 2005)

Aircraft, including those used for logistics operations are commonly powered by jet fuel. Emissions are composed of about 70% CO₂. Regional effects of the pollutants are fairly similar to those of diesel vehicles, but the global impacts are different due to the variations in altitude at which planes emit exhaust gases. Generally, exhaust from airplanes increases the quantity of GHG in the atmosphere, enhancing the effects of global warming.

- Focus on the situation in the EU and in the USA

The European Union

- Road transport

According to the European Environment Agency (EEA, 2008), freight sector chooses road transport more often than any other transport mode. This sentence is illustrated by the figure below.

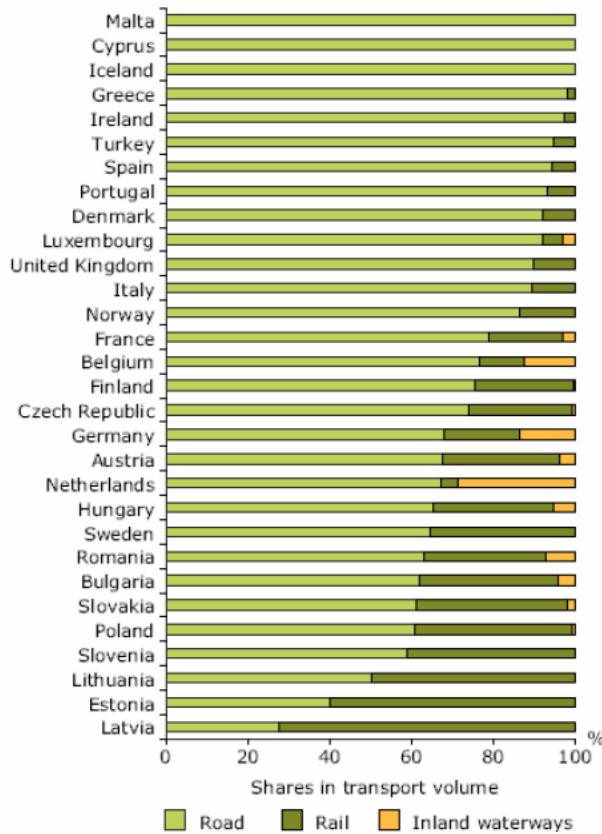


Figure 5: “Modal split of freight transport volume”, based on European Environment Agency (2006)

The problem is that road transport is one of the most pollutants modes behind air transport. The number of goods vehicles in European member countries has risen significantly from 23.5 million in 1995 to 35.0 million in 2004 which represents a 49 % increase (DG TREN, 2007a).

Apart from this information, the EEA report (2006) points out the important difference between small and large trucks. Large trucks are up to 2.5 times more efficient per ton transported goods. Between 1990 and 2005 all vehicle sectors grew, but the number of small trucks grew faster than the number of large trucks. With these data, we have to understand that market conditions have dictated a fleet development that is less favourable from an environmental point of view.

- Air transport

As for air freight transport, it grew by 31 % between 1995 and 2005 (EU-25) (DG TREN, 2007a). Moreover, air transport continues to grow faster than increases in efficiency. It means that it is responsible for an increasing amount of greenhouse gas emissions. The majority of the pollutants emitted by air transport affects the local environment and have impacts on the climate.

In the coming years, it will be important to take advantage of the modes of transport less pollutants such as rail and sea.

- Rail transport

Between 1995 and 2005, rail freight grew by 8 % in EEA member countries. Rail had a 10 % share in the movement of freight in 2005. This growth is lower than the growth in transport in general and therefore it still represents a loss of market share. Rail freight has a number of advantages over road freight, including lower emissions of pollutants such as greenhouse gases and higher carrying capacities (EC, 2007d). Rail has the potential to reduce emissions of greenhouse gases from freight movements if a shift from road systems can be achieved.

- Water transport

To finish, transportation of goods by water is one of the lowest polluting modes. It is however by far the largest sulphur emitter in the transport sector.

Sea freight grew by 34 % between 1995 and 2005 in the EU-25 Member States, bringing the share of freight carried by sea to 39 % (1995–2005, domestic and intra-EU-25 transport only).

Inland waterways also have an important role to play in moving freight. The benefits of inland waterways include reliability and unexploited capacity. The energy efficiency of inland waterways is also a key benefit and ensures that it is a competitive alternative to rail and road transport. It has been estimated that the energy consumption per ton-km of transported goods by inland waterway is one sixth the consumption of road transport and half that of rail. The external costs of inland navigation are also anticipated to be up to seven times lower compared to road transport. (EC, 2007e)

Due to the large loads that can be carried by water transport, energy efficiency per ton can be very high. But while shipping has significant advantages in terms of overall carbon emitted per ton pollution, sulphur emission is still a concern.

The USA

In April of 2005 the U.S. Department of Transportation (USDOT) published a report, titled "Assessing the Effects of Freight Movement on Air Quality at the National and Regional Level" (Ang-Olson and Ostria, 2005). The results indicate that emissions from freight transportation sources, especially in urban areas, are significant contributors to pollution at both the regional level and with regards to greenhouse gases. In addition, the primary mode causing pollutant emissions from freight transport is shown to be heavy-duty vehicles.

Apart from that, the U.S. Department of Energy, points out some interesting new data. On one hand we learn that trucks dominate urban and intercity freight transport in the USA. Further to this, the organization focuses its attention on an important fact: the idling of trucks, which is an important contributor to pollution. Indeed, the US Department of Energy estimates that over 800 million gallons of diesel fuel are consumed each year in the U.S. as a result of idling trucks which is equivalent to more than 3 billion litres. This study also shows that a single truck typically idles for about 1830 hours each year (Clean Cities Program, 2005).

Results of another analysis conclude that about 34% of engine run time for long-haul trucks is spent idling and that around 41% of truck drivers do not take any steps to reduce their idle time.

One trucking company revealed that idling accounted for 50-60% of the time their truck engines are running (Lockwood, 1999). These data are relevant because it is important to be aware of the impacts of the idling of trucks.

- Future trends in transport and consequences

Many studies have analyzed the long-term trends of freight transport. The results indicate that the amount of freight transported, and subsequently environmental externalities will continue to grow unless some shift in behaviour is made. According to a paper published by the European Commission (2001), "unless major new

measures are taken by 2010 in the European Union so that the Fifteen (countries) can use the advantages of each mode of transport more rationally, heavy goods vehicle traffic alone will increase by nearly 50 % over its 1998 level" (European Commission, 2001).

Vehicle under-utilization has been cited as an indicator of excessive freight transport vehicle use. The problem is addressed in terms of empty running and load factor considerations. Load factor represents the percentage of capacity, measured in weight or volume. Under-capacity trips impose excess costs on freight companies and vehicle under-utilization is a problem in industry. From an environmental perspective, under-utilization causes greater emissions than the case in which full-utilization is achieved due to the additional trips being made. European freight vehicles are found to have low and declining load factors by weight, with the exception of air transport. Causes of empty-running include geographical demand imbalance, scheduling constraints and vehicle incompatibility.

To summarise, we can say that transport freight has important consequences over the environment through pollution. The externalities are even bigger because of some factors that are: use of the most pollutant modes (trucks and planes), increase in small trucks, idling and under-utilization of trucks in term of load.

3.3.2 Packaging and environment

Now we have seen the externalities of freight transport over environment, we are going to see those of packaging.

Research from Packforsk (2005) shows that taking overall resource use into account, the negative impact on the environment is higher if a product is under packaged rather than over packaged. Indeed, if a product is under packaged, it can be altered. In this case, all the materials used for its production and during the supply chain are wasted. The role of packaging is then to prevent waste. However, packaging also generates waste and it is here where we are going to focus our attention.

Producing packaging has quite negative consequences on the environment. There is an increase in the number of packaging due to social and demographics changes.

Indeed, there are smaller households, an ageing population and an increase in the number of people living alone. Then companies have to adapt their supply of goods by offering single portion packaging. Production of packaging means a high consumption of raw materials like oil for example. The problem is that as seen in 2.3.3, use of energy is very high and keeps increasing but raw materials are not infinite. By the way, excess packaging means resource waste as too much material is used. In the following table, we can see the amount of energy used in the UK to produce packaging for several fields of industry (like Food, Clothing...) compared to the energy used for good production, freight transport, etc...

GJ unit (Gigajoule)	Food & Drink	Clothing & Personal care	Home & Interior	Education, leisure & Transport	TOTAL
For goods production	21.0	26.0	24.0	38.0	109.0
For packaging production	4.6	1.0	0.7	0.8	7.1
For transport from factory/farm to shop	1.6	0.2	0.1	0.2	2.1
For heating, cooling and lighting shops	1.3	0.1	0.1	0.1	1.6
TOTAL ENERGY CONSUMED	28.5	27.3	24.9	39.1	119.8

Table 2: “Comparison of Selected Energy Requirements (GJ/year, UK)” based on Monkhouse, Bowyer & Farmer (2004)

The quantity of energy used for packaging is far smaller than this that is used for production. It represents 5.93 % of the total energy required for industries in the UK. However, packaging needs more energy than freight transport or heating and lighting shops. By the way, it is an issue that worths attention.

Apart from this aspect, the production process of packaging can pollute both air, water with emissions of hazardous gases or reject of dirty water. It of course also pollutes lands. Indeed with packaging we are confronted with the issue of recycling. It is important to be aware of the affect of a product at the end of its “life”.

Total waste quantities continue to increase in most European countries. The amount of waste generated is equivalent to approximately 3.5 tonnes per capita per year (COM, 2003).

Despite the European Packaging Waste Directive 94/62/EC, adopted in December 1994, to prevent waste, the amount of packaging waste continues to increase in most European countries mainly because of lifestyle and demographic trends. The total amount of waste packaging generated within the European Union (15 Member States) in 1997 was around 60 million tonnes (COM (2003) 250 op cit), and over the period 1997 to 2001 the amount of packaging waste generated increased by 7 percent across the EU as a whole. The EEA estimates that this trend is set to continue and could increase by 18 percent from 65 million tonnes in 2000 to 77 million tonnes in 2008.

According to figures presented in the Commission's proposal to amend Directive 94/62, packaging waste represents about 17 percent of the municipal solid waste by weight and 3 percent of the total waste stream. For some materials, such as glass, plastics and paper/cardboard, packaging waste represents a high share of the total material waste, about 70 percent for glass, 60 percent for plastics and 40 percent for paper and cardboard. (COM, 2001, 729)

If we summarise, we can say that packaging has two major impacts on the environment. First of all it is a source of pollution when producing it and also at the end of its life when it goes to landfill. To finish it also consumes a lot of raw material for its production so it contributes to the raw materials scarcity.

4 GREEN LOGISTICS

The combination of the two words “green” and “logistics” is particularly evocative. Logistics is at the heart of the operation of modern transport systems. It implies a high level of organization and control over freight movements that have been possible thanks to modern technology. As for greenness, it has become a common

word for a range of environmental concerns, and is usually considered positively. It is employed to suggest compatibility with the environment, and like logistics, it is something that is perceived as beneficial. When put together, the two words suggest an environmentally friendly and efficient transport and distribution system. This concept is seen as really desirable but its application is far more complex. Indeed there are many paradoxes in this concept. (Rodrigue et al. 2006)

In this part, we are going to focus our attention on three activities that take part in logistics and that are often the best known, meaning: transport, packaging and warehousing. We are going to see how it is possible to green these operations.

4.1 Transport

Logistics does not have a good reputation for environmental protection. Indeed it is transport function which is by far the main source of negative externalities. Transport has also been identified as the only major sector whose CO₂ emissions are forecasted to increase in the next 20 years. (Green logistics 2008)

Although trucks tend to dominate the modal split for inland freight transportation in most regions of the world, a comparison of emission factors versus marine and rail reveals that the latter two options are more favourable for many reasons than road transport. Trucks are found to have greater costs, fuel consumption, and emissions per ton-mile of freight transported. If we go further in research, we also find that rail indicate significantly greater costs and environmental impacts than those for marine transport by barge.

When talking about environment protection, some paradoxes appear in the transport strategies adopted by companies. Indeed, companies have to consider some important parameters when applying a logistics strategy and those latter are not necessarily in accordance with sustainable development.

First of all, time is essential in logistics. Indeed, by reducing the time of flows, the speed of the distribution system is increased, and consequently, its efficiency. This is mainly achieved by using the most polluting and least energy efficient transportation modes. Rodrigue et al. (2006) explain that the significant increase of air freight and

truckling is partially the result of time constraints imposed by logistical activities. The time constraints are themselves the result of an increasing flexibility of industrial production systems and of the retailing sector. Logistics offers door-to-door (DTD) services, mostly coupled with just-in-time (JIT) strategies. The more DTD and JIT strategies are applied, the further the negative environmental consequences of the traffic it creates. Indeed DTD and JIT services imply the multiplication of deliveries because of an increase in the frequency of supply. The number of trucks increases which leads to more congestion and more pollution.

Another paradox in green logistics is the reliability. Indeed, at the heart of logistics is the overriding importance of service reliability. Its success is based upon the ability to deliver freight on time with the least threat of breakage or damage. (Rodrigue et al. 2006). Logistics providers often realize these objectives by using the modes that are perceived as being most reliable. The least polluting modes such as rail or sea are generally regarded as being the least reliable in terms of on-time delivery, lack of breakage and safety. Ships and railways have inherited a reputation for poor customer satisfaction, and the logistics industry is built around air and truck shipments which are the two least environmentally-friendly modes.

After having seen the situation in transport and the existing paradoxes, we are now going to see in which actions would consist a green logistics strategy.

- Maximisation of trucks capacity

In transport, a green strategy would consist in maximizing the capacity of delivery trucks. This means avoid under-utilization of trucks. By transporting the maximum volume or weight that can fit in a lorry, the company improves the energy efficiency of the mode of transport. Indeed according to the Eye for transport report 2007, maximizing the truck capacity can reduce a company's fuel consumption by as much as 30%.

- Vehicle routing and scheduling

Another green solution consists in central planning in transport operations. This requires the use of routing and scheduling software, GPS, in-cab communication. It is complicated and time-consuming to plan and implement but according to Alan

Rushton (2006, 165), it enables improvements in the utilization of trucks, trailers and drivers. It can reduce waiting time and consequently reduce idling that is very polluting. It also reduce overall vehicle distances travelled. Route engineering then optimize fleet efficiency. This is consequently a way to reduce air pollution.

- Driver training

When using road transport, a green logistics strategy would be to increase fuel efficiency. This is possible thanks to the education of drivers. Indeed, training drivers improves fuel consumption. They have to be told that idling is a big contributor to pollution as seen in part 3.4.1. Then they have to turn vehicle engines off when not in use. It would be good also to use broad vehicle technology to monitor driver performance. This would be a way to teach them how to drive in a green way.

- Preventive maintenance programs

A company can also reduce fuel consumption and then pollution by a good maintenance of the fleet. Consequently it is good to follow preventive maintenance programs because slipping clutches, blocked air filters, fuel leaks, poorly inflated tires and binding brakes all use fuel unnecessarily.

- 3PL provider

For companies that are not specialized in freight transport a good option would be to have partnered with a 3PL (Third Party Logistics) provider who can help them with green initiatives. A green behavior would be to work with logistics suppliers who meet green criteria.

- Use of new green technologies

When using road transport, companies should try to use the latest technologies, including aerodynamics and hybrid & alternative fuels in order to reduce emissions of pollutants.

- Modal shift

An even greener logistics strategy would be to shift from road to rail transport or from air to ship or road transport.

(Rushton et al. 2006; Eye for transport. 2007)

4.2 Packaging

The European Packaging Waste Directive 94/62/EC defines packaging as all products made of any materials of any nature to be used for the containment, protection, handling, delivery and presentation of goods, from raw materials to processed goods, from the producer to the end user or consumer.

It consists of:

- Primary packaging: the individual sales unit to the final user or consumer;
- Secondary or grouped packaging: packaging which groups a certain number of sales units together but is not part of the product itself, and
- Tertiary or transport packaging: packaging which facilitates handling and transport.

In simple terms, the role of packaging is to ensure that the product gets from the end of the production line to the final consumer in good condition.

Packaging therefore plays an important role in preventing waste in three respects:

- Preventing wastage of the product itself when it passes from producer to the consumer ;
- Preventing wastage of all the resources that go into making the product, transportation, selling and using it;
- Preventing wastage when the product is at home.

Johansson (2002) looked at the influence of packaging on product losses in the home.

It was considered that, to a large extent, the environmental debate has focused on packaging and its environmental impact, without much consideration of the environmental benefits of packaging in protecting the product and preventing waste.

'Both product and packaging cause environmental impact and if the package cannot fulfil its protective function, for instance because its material contents have been reduced, the total environmental impact from the product-packaging systems increases due to increased product waste'.

Consequently, packaging can be seen in two ways. Firstly, packaging prevents waste. Packaging is not a product in itself: it is a means of delivering a product to a customer in good condition and is designed to ensure that the product passes through the supply chain without being damaged.

However, secondly, packaging becomes waste at the end of its life. It is for this reason that industry has taken a number of steps forward in terms of packaging minimisation. Despite measures adopted by industries, the amount of overall municipal waste generated continues to increase. Much of this increase is due to demographic and lifestyle changes and is therefore outside of the influence of the packaging chain. However, businesses can help compensate by continuing to design lighter weight packaging and by offering consumers a wider range of pack sizes so that wastage of goods and food is also reduced.

- Necessity of packaging

In many instances, under-packaging can cause more waste than over-packaging, in terms of both energy and raw materials. The negative impact of product wastage due to inadequate packaging is substantially higher than the impact of using more packaging to protect the product. It needs to be emphasised that packaging has a role to play in the prevention of product and resource wastage.

If companies reduce the amount of packaging with the sole objective of reducing the amount of packaging waste, they discard risks increasing the amount of goods which are thrown away because they become damaged or spoiled as they pass through the supply chain. It is important to be aware that these damages and losses place more pressure on natural resources. Packaging needs to be designed in such a way that it will protect the product through the supply chain and can be handled efficiently throughout the distribution system. Packaging that is used to transport the product from the production line to the consumer is often overlooked when considering the environmental characteristics of product packaging because it is not ‘visible’ to the final consumer. Transport packaging is usually removed before the consumer sees the product, unless used by the retailer to facilitate bulk display or if the consumer is making a bulk purchase. For this reason, its functional importance is often either unknown or underestimated.

In green logistics, the challenge is to design packaging systems to get goods from production to consumption without damage using the minimum amount of resources and generating the least amount of waste.

The logistics of the product supply chain have many implications for the way in which packaging are designed. Packaging needs to withstand the pressures of the transportation system chosen, including transportation by road, rail, sea or air, or indeed a combination of all of these modes. This varies according to the market for the product and whether the packaging first goes to a separate packer-filler before further distribution.

Packaging for distribution needs to take into consideration a number of factors, including:

- Containing and protecting the products;
- Ability to withstand pressure from stacking;
- Resistance to conditions throughout distribution, such as vibration, vertical impact and climatic conditions;
- Ease of handling and transport;
- Avoidance of the use of more than one packaging material wherever possible, for ease of recovery;
- The ability to carry information for safe delivery and rapid identification of the packaged product, for example bar coding or new RFID (Radio Frequency IDentification) technology;
- Providing effective space utilisation during storage, handling and transportation. This involves modular designs which can fit onto international standard pallet sizes or which can maximise the dimensions of an air-freight container. Packaging height is not standardised but varies in accordance with the fragility and weight of the contents;
- Secondary packaging can also assist with sales promotion, for example where pallets are used at the point of sale.

Packaging needs innovation that results in improvements, some of which are targeted at or have the effect of reducing the environmental impact.

After having seen the situation in packaging and the existing paradoxes, we are now going to see what are the possibilities to design a green packaging.

In the European Union, the European standards body, CEN, has produced standards when designing or selecting a packaging in order to reduce the use of resources throughout the supply chain. Essential requirements are:

- To minimise packaging volume and weight in line with safety, hygiene and product/consumer acceptance;
- To design packaging to permit recovery after use as a material, as energy or by composting (re-usable packaging must also be capable of recovery);
- To manufacture packaging to minimise the presence of hazardous substances in emissions, ash or leachate when packaging waste is incinerated or landfilled.

(INCPEN, 2003)

- Minimisation of packaging

There has always been a cost imperative to reduce the amount of materials used to produce a pack. However, minimisation is also an objective of environmental policy. When packaging is reduced then fewer resources are used. Moreover reductions in weight and size can result in resource savings at the distribution level. Indeed, if packaging is smaller then a bigger quantity of goods can fit into trucks or any other modes of transport. The efficiency of distribution through transport is improved. To finish, less packaging is placed on the market then there is less packaging waste.

There are many examples where industry has pursued minimisation objectives, with positive end results. For example, the average weight of a glass container has been decreased by approximately 30 percent since 1980 and the thickness of supermarket carrier bags has reduced by approximately 45 percent over the last 15 years. (Monkhouse et al. 2004). The INCPEN underlines however that it is critical to consider the functional requirements of packaging and to ensure that minimisation does not result in the adverse effect of increased resource waste.

- Shift in materials used

Changing the materials used for packaging can reduce the environmental impacts. Changing materials (or their combinations in layers) can, for example, facilitate recycling, etc.

Changing materials

The concept consists in replacing materials by other ones when they can fulfil the same function. It consists in substituting a material for another one that is more environmental friendly. We can take the example of Philips which shavers packaging used to comprise a plastic inner pack and a cardboard cover box. The inner pack is now made from moulded cardboard so the whole pack can be recycled with used paper. Now 10 percent less material is used and savings are made on storage and transport, as a result of the stackable nature of the inserts.

Using biodegradable materials

Biodegradable materials are materials that are capable of decomposing rapidly by microorganisms, such as bacteria, under natural conditions. Most organic materials, such as paper are biodegradable. Then there are possibilities to make biodegradable packaging. For example, in the UK, Sainsbury decided to introduce biodegradable packaging as a substitute for conventional plastics.

Removing layers of packaging

The idea is to remove layers unnecessary in order to reduce materials used in packaging. For example, the new design of Duracell's battery packs has eliminated the need for blister packaging and enabled batteries to be packaged in a single material - cardboard.

Another example is at Marks and Spencer, garlic bread used to be sold wrapped in film with an outer box providing the product information. It was recognised that the outer box had no benefit for the consumer or the product and so the company moved to printing on the wrap. This removed an entire layer of packaging.

- Design packaging for reuse

In the same way that packaging can be designed to encourage recycling it can also be designed for reuse. As pressure to minimise packaging increases, retailers are increasingly looking for ways to protect their product but minimise waste. One way of doing this is to make the packaging part of the product. The packaging can then be kept and reused by the consumer increasing their enjoyment of the product and at the same time serving a functional purpose.

Another way of doing this is by creating a system, which allows packaging to be used again. It is often assumed that the only types of packaging which are sent back to the factory and used again are beer and soft drink bottles. This is not the case. There is extensive use of reusable packaging in business-to-business trade: reusable wooden and plastic pallets, drums for chemicals, plastic crates and others.

4.3 Warehousing

All organisations hold stocks. Stocks occur at any point in the supply chain where the flow of materials is interrupted. Usually organisations arrange for stocks to be kept in warehouses. Most warehouses are designed for raw materials, collected before operations, and finished goods during distribution to customers. To a lesser extent, warehouses store work in progress, consumables and spare parts. In practice, these warehouses might be open fields or sophisticated facilities that give the right conditions for frozen or delicate materials or databases that hold stocks of information. But to simplify we can just refer to warehouses as any location where stocks of materials are held on their journey through supply chains. (Waters 2003, 283)

The prime objective of most warehouses is to facilitate the movement of goods through the supply chain to the end customer. There are many techniques used to reduce the need to hold inventory, such as flexible manufacturing systems, supply chain visibility and express delivery. Many of these have been encompassed in a range of supply chain initiatives such as just-in-time (JIT), efficient customer response (ECR) and collaborative planning forecasting and replenishment (CPFR). However, even with these initiatives, it is often necessary to hold inventory.

Warehouses operate as an integral component of the supply chain. By the way when making decisions about these facilities several areas of the business have to be taken

into account, the most important one being: market/industry trends, supply chain strategy and customer service levels. Every warehouse has some specificities and should be designed to meet the specific requirements of the supply chain of which it is a part. Nevertheless, there are certain operations that are common to most warehouses. These operations tend to apply whether the warehouse is manual in nature with fairly basic equipment or whether it is highly automated with sophisticated storage and handling systems. For an inventory holding warehouse, typical warehouse functions and material flows are shown in the figure below.

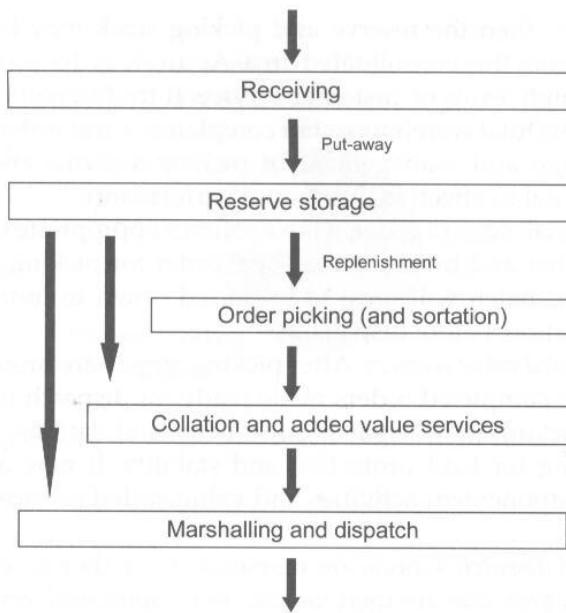


Figure 6: “Typical warehouse functions in a stock-holding warehouse”, based on Rushton et al. (2006, 261)

Most goods that pass through a warehouse are packaged. This may be, for example, to contain the product, protect or preserve it, improve its appearance, provide information, or facilitate storage and handling as seen in the part 4.2. Frequently, this packaging is at a number of different levels, such as directly enclosing the product, containing a number of primary packages, or some form of outer packaging to facilitate transport handling.

The nature of packaging is very important for warehousing operations, particularly as customers may require the goods at any of these levels. Thus, some customer orders may be for individual items (eg in the primary packaging), for cases of goods (eg containing a number of items) or at some greater quantity (eg a full pallet load of

goods). Most supply chains are structured around the unit load concept, whereby goods are transported, stored and handled in standard modules. Again, these may be at different levels, for example with goods being placed in plastic tote bins, which are placed on pallets, which in turn may be loaded in ISO containers for export shipping. The use of such unit loads enables transport, storage and handling systems to be designed around modules of common dimensions. In warehousing, some of the most frequently used unit loads are as follow: small containers such as tote bins, wooden pallets made to standard sizes, cage and box pallets, roll-cage pallets and intermediate bulk containers (IBCs). (Rushton et al. 2006, 265)

After having described the activities that take place in warehousing, we are now going to see which actions could green the warehousing process.

As said previously, warehouses are often buildings, except in the case of open fields for certain types of raw materials. For that reason, logistics does not have a good reputation for environmental protection demonstrated by the use of green field sites for the construction of warehouses. First of all, buildings of facilities require high quantity of raw materials but further to this, the daily running of warehouses often needs a lot of energy.

However, in the field of warehouses, we can find several practices that can be part of sustainable development.

- Energy efficient buildings

The management of a building can be green. A good heat insulation is the first step to reduce the energy used for heating. In certain case it can be possible to have solar installation on facilities so as to produce a part of the energy necessary to run the business. This can be summarised as implementing energy efficient building practices. Companies can install energy efficient motors and lighting. In some cases, companies can switch fuel. The main objective is to save energy as well as water when it is possible.

- Staff training

On another hand, green running of warehouses can start with the education of the staff at an environmental level. Indeed quite a lot of people have to work in

warehouses so training of the staff is very important to teach them how to work and to behave in an energy efficient way.

- Good maintenance

In case of sophisticated warehouses like refrigerated ones, the equipment needs to be maintained regularly.

- Relocation of warehouses or DC (Distribution Centre)

Another solution to green warehousing process is to relocate facilities when it is possible so as to be nearer to points of delivery. Relocation of DCs has an impact on transportation length and by the way, reducing transport journey enables to reduce pollutants emitted by transport modes.

(Rushton et al. 2006; Eye for transport. 2007)

5 INTRODUCTION TO RETAIL FIELD

Trade plays a major role in the economy: retailing and wholesaling are two of the most important employers and represent a share of more than 10% of the GDP.

Retailing can be a fairly general description for an industry. All businesses that sell goods and services to consumers fall under the umbrella of retailing, but from here, several kinds of businesses exist. There are department stores, discount stores, specialty stores, and even seasonal retailers. One specificity of retailers is that they are at the end of the supply chain. Nine out of ten retailers sell food through supermarkets, cash & carry and convenience stores.

About 75% of all retailing companies are small to medium sized with sole proprietorship. The dynamic of trade industry is given by the big players (Wal-Mart, Metro, Aldi, Ahold, Tesco).

Position	Name of company	Sales volume 2006 in Mio US-D	Country
1	Wal-Mart Stores Inc.	348650	USA

2	Carrefour S.A.	97861	F
3	The Home Depot Inc.	90837	USA
4	Tesco plc	79976	UK
5	Metro AG	75225	D
6	The Kroger Co	66111	USA
7	Target Corp.	60141	USA
8	Costco Wholesale corp.	59490	USA
9	Sears Holding Corp	53012	USA
10	Schwarz Unternehmensreihand KG	52422	D

Table 3: "The world's largest retailers in 2006", based on Kotzab & Bjerre (2005)

The decisions taken by retail managers are complex because they have to provide consumers with products and services by combining location, assortment, staff motivation, selection of target customers, supplier negotiation, pricing, merchandising in a competitive and global environment.

Each retailer tries to differentiate itself from the competition, but the strategy that the company uses to sell its products is the most important factor. Here are some different types of retailers:

- Department Stores - very large stores offering a huge assortment of goods and services.
- Discounters - these too tend to offer a wide array of products and services, but they compete mainly on price.
- Demographic - these are retailers that aim at one particular segment. High-end retailers focusing on wealthy individuals would be a good example.

In a general way, retailing helps to overcome the distances between production and consumption. It tries to make products available at lower costs. Retail logistics thanks to the use of IT plays an important role to makes operations more efficient. (Kotzab & Bjerre, 2005)

5.1 Retailer strategies

Strategic planning (positioning) and management (operational) in retailing has developed over the past decades.

The Fast Moving Consumer Goods (FMCG) sector is characterized by over-capacity, pressure on prices and margins (due to discounters) and search for more cost-effective ways to reach end-users. There is some market saturation but it depends on local conditions and retail operation.

- Retailer strategy development

Until recently, retail strategies were based on two models:

- Wheel of retailing in which all retail formats go through 3 transition stages: initial stage focusing on price, development stage focusing on better service and a maturity stage focusing on investments and sophistication that leads to stagnation or new concepts. This upscaling of the retail concept continues until there is room in the market for new entrants using price as competitive advantage. The wheel model is for describing developments in the retailing sector. For individual retailers, we use life-cycle strategy model (innovation, acceleration, maturity, and decline).
- Adaptive strategy model: thorough analysis of the environment and adaptation to the results of this analysis focusing on fulfilling uncovered demands in the market. This strategic thinking resulted in the development of two basic strategies: cost leadership and differentiation.

Retailers are no longer distributors of supplier's products but develop their own positioning and end-user segments by optimizing internal operational and external positioning elements.

- The cost leadership strategy and its elements

The aim of this strategy is to achieve the lowest cost position in the Fast Moving Consumer Goods sector. Discounters market acceptable products at reasonable prices. Some cost leaders need to cut prices to achieve high sales levels.

The general idea is to build a productivity loop: lowering costs by having better logistics or better supplier relationships or JIT delivery or systems for better inventory control or better labour scheduling... Then the company can lower margin so lowers prices so improves return on investment so increases sales per m² to develop sustainable cost leadership (price leadership or market above average) or

Every Day Low Prices (EDLP) and Every Day Fair Price (EDFP). Logistics is a major factor in finance and operations performance as it related time and inventory.

- The differentiation strategy and its elements

It consists in selecting one or more choice criteria and positions the retailer to meet these criteria. Differentiation is equivalent to a niche strategy focusing on a few target segments, retailers have to be careful to specific segments.

The differentiation strategy is labelled positioning strategy and stands for the 5Ps.

Place

It's one the most important end-use criteria. One element is distance between stores that influences retailers' potential market to cover and attract end-users. According to the wheel, stores grow in size but are faced with limited sales per m² (shop in shop, more assortments).

Internal use of space for different categories requires an analysis of the space needed for the category in order to differentiate the offer to end-users, and balancing the size that'll provide a profitable turnover per square meter.

The quality of the location is a key factor as it has to match the habits, demands and taste of the target segments.

Also important, layout and design are part of the positioning strategy as they create "home-site" identification. There have to be constant monitoring and testing of solutions to match store interior needs and physical shopping patterns.

Product

Merchandise intensity is measured by how much money that has been invested per m² at cost in inventory, the higher merchandise intensity, the higher sales per m². Higher merchandise intensity can be costly and retailers wonder if they have to expand depth and width of categories, assortment. Category management includes defining the role of different categories in building the overall attraction of assortment.

Price

It's the positioning of the value/quality combination offered to end-user. If the retailer doesn't want to be stuck in the middle, it has to take managerial decisions such as combining assortment and price.

The uses of private labels, private brands and own brands has increased a lot in Europe (first Carrefour in 79 Produits Libres, up to 35% discount). There are successful thanks to adverts, commitment in continuous development, strong displays and easy to distinguish. The second generation came in 80, the price was not enough to sustain competitive edge and the retailer's brands were up-graded. The retailers then used their name on their products to support them and communicate low price. The third generation focuses more on differentiation than cost leadership. More sophisticated products are launched but they have a limited level of innovation. Few retailers have entered the fourth generation which are value added own brands and differentiated through product quality, innovation and/or design. They support and are integrated part of the retailer's strategy.

People

Service levels are linked with the type of retailing and desired positioning and are often measured in terms of number of consumers that the management accepts queuing.

The knowledge element is also important: level of knowledge the employees should possess by training or hiring staff that already has it. Other form of knowledge is the basis for changing organizational design and expands team responsibility by keeping employees informed.

Promotion

If the store is not a winner on one or more of the other four elements, what is left is promotional advertising to generate immediate response. The promotional element deals with information:

- Internally: store management, staff, regional organization, and
- Externally: promotion (special events), advertising (in-store events) and toward competitors.

The promotional strategy can be seen as summing it all up in terms of communication of the chosen positioning based on people, place, product and price.

5.2 Aspects of retail logistics

Logistics is recognized as a core competence of retailing. Having a good assortment is not enough; emphasis is put on market dynamics (product life shortened, concentration process, globalization, excessive competition...) and on retail logistics. Price battles put pressure on retailer's cost structure; many retailers operate with a loss. Successful retailers operate logistics below 10% of total costs whilst increasing logistics service. Logistics help retailers to operate profitability and avoid harmful price battles.

- A model of retail logistics

Retail logistics is complex (many nodes) and depend on internal and external factors. Externally, suppliers, IT, competitive situation are crucial for success. The retail grocery logistics is relationship-based. Internally, procurement and distribution influence quantity and quality, location, range of products, size if store are important. Depending on format, logistics handles between 5,000 and 400,000 SKU (Stock Keeping Unit). The use of distribution centre allows JIT operations.

5.3 Evolution of retailing

Over the past couple decades there have been sweeping changes in the general retailing business. The overall number of retail outlets is in decline but the average size of outlets has increased considerably. A universal development has been the growth of large out-of-town "one-stop" superstores and hypermarkets. In some parts of the world the retail business is dominated by smaller family run or regionally targeted stores, but more and more this market is being taken over by billion dollar multinational conglomerates like Wal-Mart, Sears, and the likes. The larger retailers have managed to set-up huge supply/distribution chains, inventory management systems, financing pacts and wide scale marketing plans. These changes have all had influence on logistics strategies and operations. An

important retailing policy has been the move to maximize selling space in stores, often at the expense of stockrooms. The consequences are that stocks and buffers in retail stores have been reduced or eliminated in favour of the continuous flow of products into the stores. This necessitates more responsive delivery systems. (Rushton et al. 2006, 95)

Online retailing also known as e-commerce is the latest form of retailing. This type of non-shop retailing is increasing and participates to the evolution of new logistics strategies that are not especially good for the environment. Indeed it often leads to a multiplication of small deliveries which means an increase in traffic and pollution.

E-commerce is easy and changes retailing because there is no physical stores and products are cheaper. But there are limits of pure internet-based retailers such as: technical issues, planned buying pattern, positioning and complex product differentiation. The adaptation of internet as channel of distribution depends on direct communication possibilities, cost savings and above all customer accessibility. Indeed, even if there is a steady growth of access and use, only 6% of the earth population is on line. Moreover there are legal, psychological, security and time barriers.

Europe is around 2 years behind US-American standards. There is a stagnation of online sales. Logistical assumptions behind a raise in B2C e-commerce are difficult to believe because of problems of deliveries. The growth in B2B e-commerce is more important.

Consumer direct services refer to online-services for food and grocery items with use of electronic means for ordering purposes. It's challenging because of home delivery services and low loyalty. Most shoppers buy on internet because it's convenient, shopping hours are unlimited and order status info is immediate.

Source used for part 5: (Kotzab & Bjerre, 2005)

6 RESEARCH PROBLEM & CONCEPTUAL FRAMEWORK

6.1 Research problem

The thesis deals with sustainable development, at the logistics level, in the retail field industry. It explains the concept of sustainable development and shows up how to introduce that concept at the logistics level in a retail company. It then goes over the three main activities in logistics that are transport, packaging and warehousing and gives some key answers to the question how to green the logistics process.

The subject is relevant because it is topical. Indeed the Medias have played a key role in the awareness development of sustainability. Now customers are aware of the issue and an increasing number of them wants to consume in an environmental friendly way. Consequently, companies have to adapt their strategy and lead some ecological actions.

As a consequence, the research question is: How can a retail company be part of sustainable development thanks to its logistics strategy and actions?

There are several objectives for this study:

- To study the literature written about sustainable development and logistics.
- To discover and understand the greening process of logistics mainly at the three following levels: transport, packaging and warehousing.
- To design and carry out an analysis focused on retail companies concerning their logistics strategy.
- To present the results of the research, the aim consisting in informing people about the greening process of logistics. This study can be useful for companies and even more for retail companies that would like to implement a green logistics strategy. In another hand it can be useful for customers. It is important that they become aware of the consequences of logistics and they can choose to buy to certain retailing companies according to their environmental actions.

6.2 Conceptual framework

The framework is based on the structure of the thesis that is represented through the table of contents.

We find the two important elements of the study which are the environment and the logistics channel.

The environment is represented by a circle which can be seen as the Earth. We find the air on the top and the water as well as the natural resources at the bottom.

The company with all the logistics activities are in the centre because they are part of the environment and they contribute to the pollution of the planet.

The scheme concerning logistics is based on a figure of Waters' book (2003). Here are represented the main actors of a distribution channel: the external supplier, the retailing firm and the external customer. There is no detail so as to give a very simple view of the channel, the aim being to be easily understandable.

In the logistics process we focus our attention on the main activities that are transport, packaging and warehousing. These three variables are indeed the three on which companies can easily act so as to green the logistics process.

Conceptual Framework

7 METHODOLOGY

7.1 Basic paradigm chosen

Qualitative study

Malhotra & Birks (2000, 156), defines the qualitative research as “an unstructured, primarily exploratory methodology based on small samples, intended to provide insight and understanding.” The definition goes further, saying that qualitative study enables respondents to reflect upon, and express their views. It seeks to encapsulate the experiences and feelings of respondents in their own terms.

Quantitative study

This type of study is defined by Malhotra & Birks (2000, 156) as “a research methodology that seeks to quantify the data and, typically, applies some form of statistical analysis.” Moreover, according to the same authors, in quantitative study, respondent identity is methodologically unimportant. The very essence of sampling theory is that a sufficiently large randomly chosen sample will represent the views, behaviour or attitudes of any known population as a whole.

The choice of qualitative data

In my case it is not so easy to define the nature of the study because the reasoning has elements from both methodologies. However, I would say that to carry out this thesis, I decided to choose as basic paradigm a qualitative study.

In qualitative studies, interview is usually used so as to have the feelings of the respondents. In this case I did not conduct any interview. The work is based on Annual Reports that are produced by the companies themselves. In this way it is a qualitative study because the sources are reliable ones and they do not only give some quantitative information but describe as a whole the situation of the company. Annual Reports provide qualitative data. Further to this we can see in that reports some schemes and statistics, but the majority of the information is expressed as sentences.

I decided to carry out a qualitative study because in my case the aim is to inform companies and people concerning what can be done at the green logistics level in the

retail field industry. It was important to compare the theory with what happens on a concrete level. By the way, to reach the goal, it was relevant to observe and explore the behaviour of some firms concerning their logistics strategy. The observation of the companies actions was possible through the analysis of their annual reports. The latest had enough information, moreover, it would have been impossible to have interviews with logistics managers from Wal-Mart or Carrefour.

7.2 Data gathering

7.2.1 Sample

Sample is always important in study, whether in qualitative or quantitative study. In qualitative research sample is limited to only some few cases contrary to quantitative research where there is a larger number of cases so as to reach a statistical significance.

According to Miles & Huberman (1994, 27), qualitative samples tend to be purposive, rather than random. In other words, qualitative researchers work with small samples of people that are selected. This selection enables the researcher to reach more accurate data in order to have a more in-depth understanding of the topic.

For my study, I decided to choose as sample the two biggest retail companies in the world: Wal-Mart and Carrefour. I will explain this decision in more details further in the study.

7.2.2 Data collection methods

Definitions of the methods chosen

Archival method

It refers to the study of past events in order to understand the present and the future. In this case the researcher uses conversations, interviews and written sources like data of previous studies, statistics, organizational documents (such as company

annual reports, etc...), media and cultural documents (newspaper articles, historical review, etc...)

The case study

It consists in studying past and present issues to make recommendations to organizations. The study can be led either through a single case or a multiple case.

A single case can be used to test a theory or a model in an organization or to identify the distinguishing characteristics of an extreme or rare situation in which an organization is.

As for a multiple case, it can be used to compare the organization that is studied with others in a systematic way.

The source used for this paragraph is: Kaartinen 2008.

In this thesis, I used the archival method basing my research on the following written sources: the annual reports and the sustainability reports of the companies as well as articles from online newspapers and magazines. As said previously, my sample is composed of two companies so it is also a multiple case study. Concerning the annual reports and sustainability reports, I decided to study two reports for each company so as to see the evolution. I decided to study the more recent of them: 2007 for Wal-Mart and 2006 for Carrefour and an older report that dates back to 2002. I selected this dates because I thought that in five and four years there should have been a clear evolution.

7.3 Data analysis

The data analysis consists in four main steps: data assembly, data reduction, data display and data verification.

Data assembly is the transcription of data from the recording. This stage did not appear in this study. Indeed I did not carry out any interview so there was no recording. That is why the first step in the data analysis was the data reduction.

At data reduction stage, data is selected according to its value, its importance. If there are pieces of information that are not valuable when regarding the framework of the study, they will not be part of further analysis. This stage is called data reduction because it sharpens, defines and sorts out the data so as to get verifiable “final” conclusions, which is very closed to “data condensation.” (Miles & Huberman 1994, 10-11)

Data display consists in the organization of data. A display could be described as the choice of the columns and rows within a matrix of data to be analysed. This method is not reducing the data but only considering certain factors to analyse them. (Miles & Huberman 1994, 10-11) The writer compresses the information collected so as to be able to draw the conclusions.

Data verification refers to the comparison between the primary data (the annual reports) and the secondary data (literature from the theoretical part). This comparison gives even more value to the study because it is based on several points of view. The two parts: theoretical and empirical are complementary, they give the possibility to see how things are going on in the field.

7.4 Quality assessment of the study

Malhotra & Birks (2000, 667) presents objectivity as a virtue that should guide report writing. The report should accurately present the methodology, results and conclusions of the project, without slanting the findings to conform to the expectations of management. The researcher has to be strict and objective when carrying out the study and presenting the results.

In my case I did not carry out the study for one of the two companies observed in this work. Moreover, I did not have any contact with manager from these companies. To finish, as a student I am not linked with the retail industry so consequently I was not influenced by anyone.

Reliability is the problem of consistency of the study. The researcher has to ask himself if the process of the study is consistent, reasonably stable over time and across researches and methods. Reliability depends partly on objectivity.

In that study the data were collected and transcribed very carefully. The objective was to respect the truthfulness of the data collected and to keep the authenticity of the information. The annual reports have been read carefully. My study is reliable because the empirical findings matches the theoretical ones.

Validity refers to the plausibility, the sturdiness and the conformability of the findings. (Miles & Huberman, 1994, 11)

Validity is divided into two dimensions:

Internal validity

It is considered as the most important of both. The internal validity can be summarised with the following questions: “Do the findings of the study make sense?”, “Do we have an authentic portrait of what we are looking at?”

According to Mc Daniels and Gates (1999, 247) the internal validity allows to reveal the research findings that make sense and to illustrate the theory.

In my study, the internal validity is respected because the theoretical part and the empirical one operate as a mirror. We find the same important topics in each one and there is no contradiction between them.

External validity

It corresponds to the possibility of generalization of the study. Here, the researcher should ask to himself if the conclusions of his or her thesis have a larger impact, in other words, are the conclusions transferable to other conditions; can this work be extended to other works?

The external validity has been respected in this study. The size of the sample is really small but it is not a single case. Consequently a comparison is possible, then we can

say that the study can have a larger impact. It indeed can be a model for companies from the retail field. In this study, I focused my attention on big companies because information was easier to get but in a general way, we can say that what is done in these firms can also be achieved in smaller ones.

The ultimate objective of a study is to be utilisable. The researcher must then wonder if the findings have any pragmatic value. In other words, he or she has to take into consideration the utilization of the work. The following question is important: “Does the thesis represent any interest to somebody?”

In this case, the thesis can be useful for companies and even more for retail companies that would like to implement a green logistics strategy. Indeed, this work gathers a lot of valuable information. It explains the actions that a company can do to be part of sustainable development from the environmental point of view. It gives some key information about the greening process of logistics.

8 RESEARCH FINDINGS AND ANALYSIS

8.1 Wal-Mart

8.1.1 Presentation of the firm

Wal-Mart Stores, Inc. is an American public company, which has over forty years experience in retailing field. It runs a chain of large discount department stores. It was founded in 1962 by Sam Walton. Ten years later, it was registered on the New York Stock Exchange. According to the 2007 Fortune Global 500, it is the world's largest public company by revenue (US\$ 378.80 billion). Its headquarters are located in Bentonville, Arkansas, USA.

Wal-Mart is the largest grocery retailer in the United States, with an estimated 20% of the retail grocery and consumables business, as well as the largest toy seller in the U.S.

Wal-Mart also owns and operates the North American company of Sam's Club. It operates in Mexico as Walmex, in the UK as ASDA, and in Japan as Seiyu. It has wholly-owned operations in Argentina, Brazil, Canada, Puerto Rico, and the UK. Wal-Mart's investments outside North America have had mixed results but its operations in South America and China, which are two big markets, are highly successful.

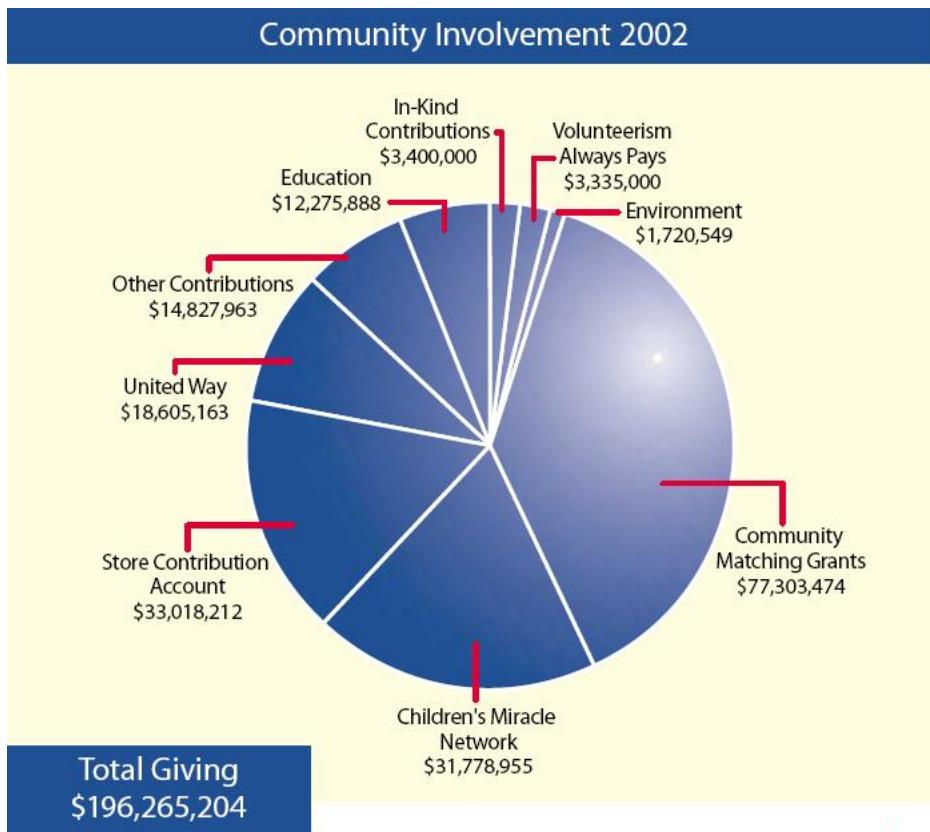
I have chosen this firm for the empirical part because Wal-Mart is the first retailer in the world. Today, all together, Wal-Mart counts 6,500 stores and Sam's Club locations in 14 markets. It employs more than 1.9 million associates and serves more than 179 million customers a year. At the sight of these figures, we can imagine that logistics or supply chain management represents an important issue for the company. It is then interesting to see how Wal-Mart manages its logistics strategy and how it is concerned by the sustainable development. Indeed, as the biggest world retailer, Wal-Mart has a role to play.

8.1.2 Annual report 2002 summary

In the Wal-Mart Annual Report 2002, there is almost no allusion to sustainable development. The protection of the environment is nearly absent from the paper. The emphasis is put on the productivity of the company and on its financial results. There is only one reference to the environment in the paragraph dedicated to the value of Wal-Mart: United by Compassion, Making the World a Better Place – One Community at a Time. In this part, the report talks about the value of the company. It says the following: “Our founder, Sam Walton, believed in servant leadership. He taught it so passionately and wove it so skilfully into our culture that our Associates are naturally committed to community service with compassion and integrity. Our emphasis is in four areas: children, communities, education and the environment”.

The three first points are developed in details but for the fourth one concerning the environment, there is no further information. We can just see in the diagram below that Wal-Mart gave \$ 1,720,549 for the environment in 2002, (it represents only 0.87% of the total donation). However, we do not know to which association it was given and how it was used. Moreover, it only consists of donation by the way, there

is no real environmental strategy neither green logistics strategy developed into the company.



8.1.3 Sustainability report 2007 summary

In the Annual report 2007, Wal-Mart changes radically its approach. After having stressed the productivity in the report 2002, it seems that now, the company focuses more on its corporate values and especially on sustainable development. Indeed in 2007, this point seems important for Wal-Mart as there is a page dedicated to that subject at the very beginning of the report. Below is some extracts of the page:

“[...] The need for sustainable business practices is increasingly urgent. What’s good for the environment can be good for business. [...] That’s why we unveiled the packaging scorecard for our U.S. Wal-Mart and Sam’s Club suppliers this past year. The goal: reduce packaging by five percent by 2013 – an effort that will be equal to removing 213,000 trucks from the road. [...] These are just some of the many initiatives that reflect the Company’s commitment to leadership in business and sustainability. [...]”

2007 is also the year of the first “Sustainability Report” from part of Wal-Mart. In this report that is available online, the company describes its actions concerning sustainable development focusing on the three dimensions that were developed in my theoretical part.

Here we are going to see the actions that the company takes at the environmental level and more precisely concerning its logistics strategy. We can find in the Wal-Mart “Sustainability report” the three important points of logistics: Buildings, Transportation and Packaging (Waste).

For some points, the company explains what has already been done but in general, this report gives some actions that will be taken in the coming years. For each, it fixes goals. By the way, it is too early to say if the actions will be achievable but with these initiatives, we can see that Wal-Mart has undertaken steps in the way of environment protection.

In this part we will have a look at the initiatives of the company on the three important levels: first buildings, then transportation and to finish packaging (waste).

- Buildings

Past and present environmental actions:

In 2005, Wal-Mart opened two experimental stores to serve as their testing ground for new innovations. In here, they are testing innovative technologies like solar and wind power, bio-fuel heating systems, daylight harvesting and radiant heat technology to reduce their reliance on non-renewable energy.

From the learning of these two experimental stores, the company decided to open in 2007 again two high-efficiency prototype stores.

In a general way, Wal-Mart is exploring new technologies to improve lighting, HVAC (heating, ventilation and air-conditioning) and refrigeration units so as to decrease its energy use and greenhouse gas emissions.

Concerning lightening, Wal-Mart is using LEDs (light-emitting diodes) for building external signage and it has started to install them in new refrigerator and freezer cases across the USA because they have already proven successful. These bulbs enable to reduce energy consumption. In the report, Wal-Mart indicates that over the life time of one LED bulb, 500 lbs of coal are saved, which is the equivalent of 1.1 ton. Moreover, one LED bulb has the same lifetime as ten traditional bulbs, so it saves a lot of bulbs from the landfill.

For self energy efficiency, the company is piloting a solar plant project in 22 locations throughout California and Hawaii.

To finish, Wal-Mart also tries to identify, implement and test 50 non-energy-related innovations to conserve resources when building stores. The company looks at innovations such as water conservation, rainwater harvesting, and use of United States Green Building Code recognized materials or construction debris recycling.

Wal-Mart through ASDA in UK has begun to shift construction materials for building. They have opened a store in August 2007 with a timber frame. Wal-Mart says in its report that by using wood from certified sources rather than steel, the building's design eliminated the need for 500 tons of steel and will save 450 tons of carbon emissions.

What is forecasted for the next few years:

Wal-Mart is planning to open this year a second-generation high efficiency store prototype incorporating the learning from the first generation opened in 2007.

General goals to be achieved in the next few years:

- To reduce greenhouse gas emissions by 20 percent in every existing stores;
- To open viable prototypes by 2009 that are up to 30 percent more energy-efficient than in 2005;
- To be powered 100 percent by renewable energy.

- Transportation

The trucking fleet of Wal-Mart is one of the largest private fleet in the world. We can see in the report that the number of trucks is increasing: in 2005 there were 6,936 trucks and in 2006 there were 7,075. The issue of the company is to combine the growth of its activity and its fleet, with the protection of the environment. However in spite of the increase of the fleet, we see in the report that the total miles driven are decreasing from 2005 to 2006 (from 817,096,803 to 810,283,850) as well as the metric tons of CO₂ (from 1,320,408 to 1,298,324).

Wal-Mart explains that through its several initiatives. The most important relies on the improvement of fuel efficiency. This is possible thanks to technological

innovations such as new tire designs, inflation systems, new model trucks, trailers and engines. It is also possible thanks to the use of auxiliary power units which were added to the trucks in early 2006 and which give the truck drivers the comfort of air conditioning and heating without having the truck's engine running.

Wal-Mart has also undertaken the initiative to work with manufacturers of truck engines and rear drive components to produce a hybrid, class-height pilot truck in the 2009-2010 timeframe. In the report, the company explains that hybrid trucks will electrify components to reduce horsepower/fuel needs and recover energy that can be transferred to electric motors that will power the truck in lower speed operation. The objective of innovation is to optimize aerodynamic design of truck and trailer to deliver maximum fuel efficiency on future designs.

- Packaging

Concerning packaging, Wal-Mart has set three main goals:

- Replacing PVC (polyvinyl chloride which is a hard plastic) in Private Brand Packaging;
- Reducing packaging 5% by 2013;
- Becoming packaging neutral by 2025.

To achieve these goals, the company has set a strategy. It relies on the creation of Sustainable Value Networks (SVN) among which we can find the Packaging SVN. This one is comprised of approximately 200 representatives from areas such as government, non-governmental organizations, academia and industry. The collaboration between Wal-Mart and its network enables it to lead innovative projects. At the packaging level, the main result has been the establishment of the Packaging Scorecard. This one was unveiled to all suppliers of the company in February 2007. The role of the scorecard is to evaluate the Wal-Mart suppliers around the world on the sustainability of their packaging and rate them relative to their competitors. That scorecard is based on a list of metrics that Wal-Mart calls the 7 Rs of Packaging:

- Remove: eliminate unnecessary packaging, extra boxes or layers;
- Reduce: "Right size" packages and optimize materials strength;

- Reuse: pallets and reusable plastic containers (an initiative of Wal-Mart consists in switching from cardboard shipping crates to reusable plastic. This change allows boxes to be used 60 times instead of once. According to Wal-Mart the adoption of plastic crates reduce waste by more than 1,400 tons annually);
- Recycle: use materials made of highest recycled content without compromising quality;
- Renew: use materials made from renewable resources, select biodegradable or compostable materials;
- Revenue: achieve all above goals without raising costs;
- Read: get educated about environmental sustainability.

Thanks to the scorecard, Wal-Mart's suppliers are evaluated and those that do not make the grade risk being dropped.

At the same time, the firm works with its suppliers to help them understand how scorecards can add value to their own business and it suggests improvements.

Wal-Mart is making information on packaging alternatives and environmentally friendly packaging materials available to the suppliers. The company has already switched from petroleum-based plastic (PBC) packaging to corn-based polyactic acid (PLA) for some of its fruits and herbs containers. PLA is an annually renewable resource and can be composted in some municipal operations.

In the report, Wal-Mart says that its leaders in Waste SVN identified an opportunity to reduce 5 grams of plastic from their Sam's Choice water bottles. This reduction means more than 9.6 million lbs. of plastic saved from being used which is equivalent to 21,000 tons.

Below are two other examples of initiatives that Wal-Mart took concerning packaging.

The company has replaced the non-recyclable wax-coated boxes used for its Rotisserie chickens with more sustainable recyclable boxes. According to the firm, the results are the following:

- Million less boxes go into landfills each year;
- New boxes can go directly into baler for recycling.

In 2005, Wal-Mart partnered with a packaging supplier to improve the packaging of its Kid Connection toy line.

By making the packaging a little smaller, Wal-Mart explains that in 2005 they saved:

- 3,425 tons of corrugated materials
- 1,358 barrels of oil
- 5,190 trees
- 727 shipping containers

Sources that are used for the paragraph 8.1 Wal-Mart are based on the Annual report 2002 and Sustainable report 2007 found on Wal-Mart website: www.wal-mart.com

8.1.4 Evolution of Wal-Mart green logistics strategy

In five years, the evolution is huge because there is no green logistics strategy in 2002 and there is one in 2007 that is quite developed. The strategy in 2007 affects the three main levels of logistics: buildings, transportation and packaging. We can say that the evolution has been quick and that the awareness is very recent.

8.2 Carrefour

8.2.1 Presentation of the firm

Carrefour SA is a French international hypermarket chain, with a global network of outlets. It is the second largest retail group in the world in terms of revenue after Wal-Mart. Carrefour operates mainly in Europe, Brazil, Argentina, Dominican Republic and Colombia, but also has shops in North Africa and Asia.

The group was created in 1957 by Marcel Fournier and Denis Defforey. Its headquarters are located in Levallois-Perret, France.

The Carrefour group pioneered the concept of hypermarket which consists in a large supermarket and a department store under the same roof.

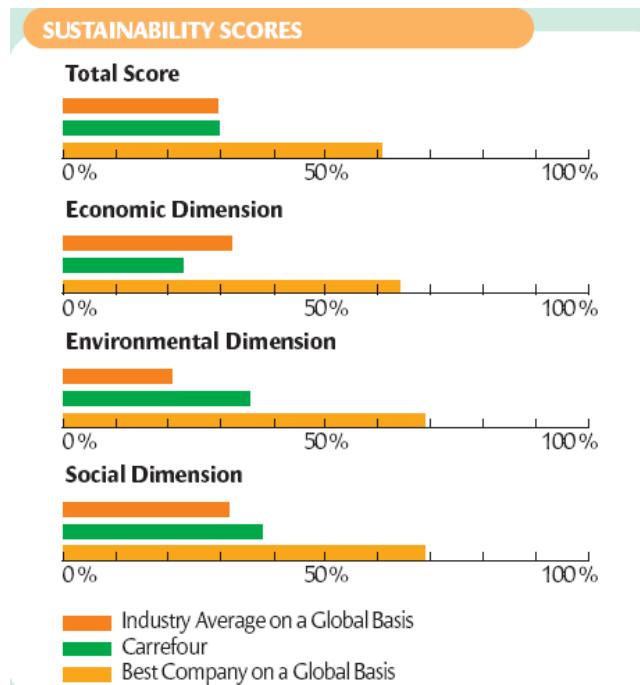
I have chosen this firm for the empirical part for the same reason as Wal-Mart. It is an important company in the retail field. It will also be interesting to compare these two companies because they are from different nationalities. By the way, we will see how different they perceive and include the notion of sustainability in their logistics strategy.

8.2.2 Sustainability report 2002 summary

In 2002, Carrefour edits a sustainability report for the second time. This report assesses the overall performance of the firm on the three dimensions of sustainable development that are economy, society and environment. Here, we are going to focus our attention on the environmental dimension.

From the beginning, we know that for the first time, in 2002, Carrefour was listed on the DJSI (Dow Jones Sustainability Index) World Index. The Dow Jones Sustainability Indexes, launched in 1999, are the first global indexes tracking the financial performance of the leading sustainability-driven companies worldwide.

The performance of the company at the environmental level is revealed on a scheme. It is quite good as it is higher than the score of the Industry Average on a global basis.



We also know that the company was qualified for the first time to “Storebrand Principle Funds” portfolio of ethical companies by Storebrand: the Scandinavian’s leading ethical funds manager. The firm was rated fourteenth out of eighty five companies in its sector.

With all that information we can understand that Carrefour had already started to lead a sustainable strategy in 2002.

In that part we are going to see the actions listed in the report of 2002 concerning the greening process of logistics.

- Buildings

To green the running of its stores, Carrefour conducted a research. It consisted in studying one hypermarket so as to make a review of the greenhouse gases emitted by it. The review investigated the direct and indirect greenhouse gas emissions associated with the store activity. The aim of that study was to evaluate which activities were responsible of emissions so as to identify potential ways of reducing the latter.

The study found direct emissions to be around 340 TEC (tons of carbon equivalent) per year which corresponds to 57kg of carbon equivalent per square metre of sales area. According to that research, the most pollutant activity concerns foodstuffs

because 70% of the greenhouse gas emissions come from the production of foodstuffs processed in the store to make bread, meats, deli products, etc...

Conducting that kind of study enables the Group to have facts and work on the areas that need to be rethought.

Apart from that kind of “eco-audit”, the group undertook other actions to green the running of its buildings. For example in order to develop the use of renewable sources of energy, Carrefour Spain tested solar panels on five of its store. Another example is in Italy where Carrefour buys electricity from an association that sells hydroelectric power. Carrefour Italy is also member of the European Green light Programme that aims at reducing the power consumption of lighting fixtures.

- Transportation

First it is interesting to have some key facts and figures about Carrefour transport activity. In 2002, in the four major European countries (France, Spain, Italy and Belgium) there were 40 million pallets carried by 1.5 million trucks each year. Deliveries were made every day to the 778 hypermarkets, 3 to 6 times a week to the 2,320 supermarkets and once every 1 or 2 weeks to the 2,322 convenience stores. In France, an average of 7 trucks a day on the road operated deliveries to each hypermarket and 1.2 per supermarket.

We are going to see now what actions did Carrefour undertake so as to green its transportation process. In 2002, the Group launched a partnership initiative with logistics operators so as to have a closer look at what was possible to be done in transportation to alleviate the environmental impact from product shipments. Some areas of environmental progress were then identified like: alternative methods of shipment and optimising truck loads and routes. To lead further research in these areas, four working groups composed of ten to twenty volunteers and jointly run by a logistics service-provider, an industrial supplier and a Carrefour Group manager, met several times in the year. The findings of the working groups are presented below:

Rail transport

Rail-only transport accounted for mere 8% of goods transported in France. Consequently, Carrefour and its partners investigated two solutions to develop rail transport that were:

- A dialogue with the French railways to improve service quality. Two projects were launched in that way.
- A pilot project conducted with Procter & Gamble to test the feasibility of combining rail-road transport to carry detergents in France. According to the project, this would reduce CO₂ emissions since 1% of additional freight transported by rail would prevent 3,000 tons of CO₂ from being released in the atmosphere.

River transport

A pilot project was conducted. The idea consisted in shipping 120 containers of textile products. The mode had proven as reliable as road and more cost-effective in the way that it saved 100,000 litres of diesel which is equivalent to 270 tons of carbon.

With this project Carrefour wanted to test the efficiency of this mean of transport with the aim of gradually extend it to all textiles. With this success, Carrefour looked at the possibility to ship some 2500 containers annually.

A feasibility study was also underway to investigate whether the same delivery route could be used to import consumer electronics.

Road transport

At this level Carrefour tried to maximize its truck load. In 2002, trucks were filled to 75% capacity.

The Group also investigated alternative fuels that release less CO₂ into the atmosphere. 2002 was the year of testing natural gas vehicles that supplied 120 convenience stores and supermarkets in the Paris conurbation.

Moreover, Carrefour's online sales service which delivers goods directly to consumer homes tested in 2002 two delivery vans that run on natural gas.

To finish, Carrefour Italy tested an alternative fuel dubbed "Aquazole" that is a water diesel mixture that releases 40% fewer toxic particles.

• Packaging

Concerning packaging, the firm created a European working group composed of "food" and "non-food" packaging specialists. This group worked under the coordination of the International Purchase Office and its aim was to elaborate a guide

about packaging conception. The guide defined the environmental criteria at the level of packaging. The ultimate goal consisted in “disseminate best practices throughout the Group.”

At the same time, Carrefour, in the main European countries that are France, Spain, Italy and Belgium reduced the environmental impact of its packaging.

In the report we find the following figures: in 2002, Carrefour France saved 484 tons of raw materials.

The same year, Carrefour France launched several projects concerning packaging among which one was awarded by the French National Packaging Association for its environmental quality because it enabled to save 70 grams per units which represented 66 tons of raw materials per year. It also had consequences on transport with a 12% cut on downstream transport.

8.2.3 Sustainability report 2006 summary

In that part we are going to see the actions listed in the report of 2006 concerning the greening process of logistics.

- Buildings

First of all, the report 2006 gives some detailed facts and figures. For consolidated stores at the Group level in 2006, the consumption of energy was as follows: 863 GWh of gas and fuel and 567 tons of refrigerant consumption (cooling and air conditioning).

Carrefour Hypermarkets have a proactive environmental policy and are committed to controlling their consumption of water and energy.

Concerning the control of water, the hypermarkets are committed to optimizing both energy use as well as the production of renewable energy.

Here are some examples of best practices: in France, the St-Quentin-en-Yvelines hypermarket has a green roof (or eco-roof). This provides natural thermal insulation and minimizes the use of air conditioning.

The Chambery hypermarket relies on renewable energy: a geothermal system that uses ground energy and 200 sq.m. of solar panels to produce energy.

To finish, in 2006, Carrefour Italy opened a hypermarket which the roofing is designed to collect rainwater, and electricity comes from the hydroelectric power plant.

As for water management, the Hypermarkets are committed to rationalizing the use of municipal water, to minimizing the discharge of wastewater and to controlling their impact on rainwater management.

In this report, the Group Environmental Manager Mr Paul Rowsome is interviewed and answers to the following question: “How can a Group like Carrefour contribute to the fight against climate change?”

Focusing our attention on stores and warehouses, Mr Paul Rowsome says that the group can contribute at two levels. *“Carrefour group can help to directly and indirectly reduce greenhouse gas emissions. Directly, by cutting its consumption of gas, fuel and refrigerants in its consolidated stores and warehouses. Indirectly, by reducing the consumption of electricity in his stores and warehouses as well.”*

To do so, Carrefour works with their energy providers and equipment makers. The group has also to involve a partnership approach. That is why in 2006, in France, the group concluded a three-year framework agreement with the ADEME (Agence de l'Environnement et de la Maîtrise de l'Energie which means Agency of the Environment and the Control of Energy) to work on their stores.

If we go deeper in the explanations, we see that Carrefour sought to optimize its use of energy by measuring it post by post, by raising employee awareness so that they change their behaviour, and by making use of energy efficiency through regulation, maintenance and the use of innovative technology.

For example, in France all the hypermarkets have rolled out an energy management control system. It consists in an automated system that manages the electrical facilities by regulating energy consumption in order to avoid waste.

In the report, the firm gives us the percentage that represents each activity in the total energy consumption. Cold production represents the major energy consumer (45% of total energy consumed in stores). To remedy, Carrefour resorted to the installation of glazed doors for frozen food cabinets. Concerning air conditioning, it represents 20% of total consumption. To reduce it, the company uses a free-cooling in mid-season (September-October and March-May) to cool the store naturally by opening roof

skylights and thus cutting the need for high energy consumption air-conditioning. As for lighting, it represents also 20%. To reduce it, Carrefour uses now lights with integrated electronic ballasts that consume 20% to 25% less energy and last at least 40% longer. To finish, laboratories consume 15% of the total energy. To remedy, Carrefour closed butcher laboratories that were previously open to the sales area. It reduced also the height of laboratories and cold cabinets, which made it possible to cut the need for cooling.

To make progress, Carrefour has to measure its impact on the environment and in 2006 the company kept using its key performance indicators including energy consumption, refrigerant consumption and logistics emissions of CO₂ that was set up in 2002 for the first time.

In another hand, the Carrefour Group makes use of “sustainable construction” principles. In this report, the Quality and Sustainability manager, Mr Stéphane Dufort is interviewed. He says that the company developed a HEQ approach (High Environmental Quality) and works with the local community. When opening new stores or expanding existing one, the group tests innovative technical solutions so as to save energy and water. Carrefour France remodelled its pilot store in Saint-Maur-des-Fossés. The results that are in the report of 2006 compare the year 2005 to 2006. The results are as follows: 11% electricity-savings for cold production based on investments in new technologies; 40% electricity-savings for lighting, by using neon lighting with electronic-sodium ballast and natural lighting; 25% gas-savings, thanks to the “smart building” system; and 35% savings in water by using ice removal ramps of the fresh fish department and water-savings systems.

As for the construction of buildings, the stores prefer sustainable materials over other ones. For example, all hypermarkets give preference to the use of solvent-free paint, or if necessary to paints with the lowest solvent rates, for the inside of their buildings.

The group produced a “Guide to best sustainability practices” which is useful in case of creating, expanding or remodelling a store. This guide has been distributed to all store directors and translated into English for use internationally.

- Transportation

At this level, the group says that it integrates sustainable development into its transportation approach so as to limit CO2 emissions and its environmental impact.

The integration takes place in three steps:

- Massification of flows, which requires setting up a national logistics network with integrated and sub-contracted warehouses;
- Streamlining flows and transport trips

To optimize its logistics flow, the Carrefour group can decide the frequency of deliveries and the truck occupancy rate in transport trips. In each case, the goal is to reduce the number of trucks and the distance travelled. To optimize deliveries, Carrefour is adapting the frequency of pick-ups at suppliers to the stores' actual needs. To reduce the number of trucks used, the store delivery time slots are also being spread out. To fill the trucks better, several types of goods, in particular dry and fresh products, are mixed, using innovative packaging like Eurack. Eurack packaging makes it possible to stack store pallets by product family. It enables to save ground space, by the way, transport is optimised and the products are not damaged. Finally to optimize its flows, the company works hand in hand with its suppliers and logistics providers and uses "backhauling" and "pooling". Backhauling consists in using trucks that have completed store deliveries to collect any goods ordered at suppliers and deliver them to the warehouses. As for pooling, it consists in asking suppliers to organize among themselves to gather their goods and use a single truck for delivery to the stores or warehouses.

The report says that in two years, there were 9,500 fewer trucks on the road in France. It explains the results by the optimization of the hypermarkets downstream transport of food products. Carrefour resorted to an increase in co-deliveries (+27%). It also optimized trucks putting more pallets per trucks as well as optimized pallets with twenty five additional percent of packages per pallet.

- Study of alternative transport methods.

To reduce its environmental impact, the Carrefour group has promoted alternative transport methods in several European countries (France, Spain, Italy, Romania, and

Poland): water transport, rail road, etc. In France, one-third of container supplies headed to the Paris region's non-food warehouses (bazaar goods and textiles) travel by river on barges along the Seine between Le Havre and the port at Genevilliers. Each year river transport leads to a savings equivalent to 340 tons of CO₂ emissions. The Group is also encouraging its logistics providers to use vehicles that consume and pollute less, and it is testing alternative fuels (delivery vehicles running on natural gas, study on bio fuels, etc).

- Packaging

Carrefour optimizes the packaging of own-brand and retail-banner products with respect to volume and grammage. They continuously test new materials to cut impacts at source.

In another way, reusable containers are also used in the shipping and packaging of fruits and vegetables so to ensure savings in cardboard boxes and wooden crates.

In 2006, Carrefour Belgium launched the first sugarcane-based tray for the packaging of minced meat. This tray is 100% natural, with no fossil fuel materials or GMOs. With 20 million trays each year, the annual savings in polystyrene is estimated at 300 tons.

Sources that are used for paragraph 8.2 Carrefour are the Sustainable reports found on Carrefour website: www.carrefour.com

8.2.4 Evolution of Carrefour green logistics strategy

We can see a clear evolution between 2002 and 2006 in the logistics strategy of Carrefour. The green aspect was really present in 2002 but it concerned more research about the company situation. Concerning buildings, Carrefour launched a research but the concrete actions are not so numerous. As for transportation, it is the same, the company tested some way to develop the rail transport. At this step it was just a small-scale try in the optics to develop the idea if it was a success. We can say that 2002 was the beginning of a green logistics strategy and made the inventory of fixtures so as to take actions in the following years.

In 2006, we see that there are far more actions taken. Ideas that were successful were implemented such as the rail transport for all textile products and bazaar goods. Some other actions are developed in the building field. We see that now, Carrefour does not work alone on its green project, but works in partnership with specialised associations like the ADEME for example. To finish, in the latest report, there are many more figures to give facts. This shows that the company leads a clear strategy based on clear facts. The company gives the impression that it really knows where it goes.

8.3 Comparison of the cases

On a general level, we can say that the awareness has been much more faster for Carrefour than for Wal-Mart. Indeed, in the Wal-Mart report, the first actions in green logistics date back to 2005 whereas Carrefour started in that field at least in 2001, date of its first Sustainability report.

Concerning Wal-Mart, we find in its report more goals to be achieved than real actions that have already had results. In the case of Carrefour, there are already a lot of results, that is why we can find quite a lot of figures in its sustainability report that illustrate its green logistics strategy and its results.

Now that we have compared the two cases on a general level, we are going to compare them in a deeper way taking into account the three basic dimensions that are from the beginning: buildings, transport and packaging.

For an easier understanding of the three following tables, a caption has been used. The following silicon chips are used:

- ❖ For the actions that were described in the theoretical part and that the company leads
- ✓ For the actions that are characteristic of the company itself

We can say that the more actions are undertaken, the further the company is in the greening process. Moreover, it is also very positive when the company takes initiatives and leads some specific actions that were not described in theory. It shows the interest of the firm in that subject and its eagerness to innovate.

8.3.1 Buildings

	WAL-MART	CARREFOUR
Buildings	<ul style="list-style-type: none"> ❖ Energy efficiency Solar plants Wind power Bio-diesel heating systems Daylight harvesting Use of economical bulbs <p>✓ Innovations</p> <p>Research for innovations in the following fields:</p> <ul style="list-style-type: none"> - Water conservation - Rainwater harvesting 	<p>✓ Proactive environmental policy</p> <ul style="list-style-type: none"> - Eco-audit - Water management policy (minimisation of discharge of wastewater, rationalization of municipal waste use) - Partnership with energy providers and equipment makers - Agreement with the ADEME to lead a work on 3 years - Partnership with local community - Sustainable constructions: HEQ approach <p>✓ Assessment of progress</p> <p>Use or performance indicators (energy, consumption, refrigerant consumption..)</p> <p>❖ Energy efficiency</p> <ul style="list-style-type: none"> - Use of energy management control system that is an automated system - Solar panels - In some countries, electricity bought from association that sells hydroelectric power - Green roof (collection of rain water) - Thermal insulation - Geothermal system <p>❖ Good maintenance</p> <p>Importance of maintenance</p> <p>❖ Staff training</p> <p>Implication of employees</p>

Concerning buildings, we can see that Carrefour's green strategy is far more developed than this of Wal-Mart. The important point in Carrefour report is the word "policy". Indeed, the company leads a real environmental policy at the building level. The firm has a strategy that is developed and that is older than this of its competitor. The green actions are undertaken further to green audits. In the environmental policy of Carrefour, we can see the three elements that were described at the beginning in the environmental dimension of sustainable development. The Group tries to implement strategies that take care of air, water as well as raw materials and energy.

Indeed, the French Group developed actions to reduce its energy consumption. This has an impact on both air pollution and raw materials. Indeed, by doing this, on one hand, Carrefour reduces its carbon footprint which means that it reduces air pollution. On the other hand, it tries to consume less energy to reduce its impact on natural resources scarcity.

Now, concerning water, the company leads a water management policy so as to reduce its consumption and to pollute it less. We can say that the environmental policy of Carrefour is complete, as it takes into consideration all the important elements of the ecosystem.

In the building field, we can say that Carrefour's strategy is far more achieved than this of Wal-Mart. Indeed in the sustainability report of the French company, there are facts, figures that support the actual results of the actions. In Wal-Mart report, most figures are some goals to be achieved. There is no real result for the moment. It is understandable as this company started its environmental awareness later. The results of the research and innovations that are taking place at the moment will only be visible in some years.

Apart from that, we can see that Carrefour's policy is largely based on partnership or work with other association or providers. It banks on a team work to achieve its environmental policy. That can be seen as a very positive point because it is necessary to imply suppliers and to call out every entity that can be helpful. We can say that a work team is always better than an individual one and it is the key success: to be well surrounded.

Further to this, a good point in the green logistics strategy of Carrefour, is the use of performance indicators. The latest are useful to see what is really achieved. They have a role of test: do the actions undertaken have positive results, what is the evolution of the situation at the building level? With the establishment of such indicators, we can see the eagerness of Carrefour to check its work. Do the actions undertaken lead to progress and what is the evolution? Performance indicators are a good tool to evaluate the progress and go forward in the actions.

To finish, we can say that in the French company, greening of the buildings is seen as a whole process. It starts from the construction, with the use of more friendly environmental materials, use of green roof, thermal insulation etc, to the training of employees.

In that field, we can say that Wal-Mart does not have the same approach. This is not a global view of the process. The American company banks more on new technologies than on the education of its employees. We can maybe say that the awareness is not complete and there is still a work to do at the mind level. In buildings, it is important that everybody would be implied in the green strategy. Maybe Wal-Mart focuses too much its attention on technologies when the simple actions of people can also have a first important impact.

8.3.2 Transport

	WAL-MART	CARREFOUR
Transport	<ul style="list-style-type: none"> ❖ New green technologies <p>Improvement of fuel efficiency through:</p> <ul style="list-style-type: none"> - new tire designs - new inflation systems - new model trucks, trailers and engines - use of auxiliary power units - alternative fuel <p>Partnership with manufacturers of trucks and components in order to produce a hybrid truck in the 2009-2010 timeframe</p>	<ul style="list-style-type: none"> ❖ Routing & Scheduling <ul style="list-style-type: none"> - Partnership with logistics providers: use of pooling and backhauling strategy - Co-deliveries <ul style="list-style-type: none"> ❖ Modal shift <ul style="list-style-type: none"> - Alternative methods of shipment: development of rail and river transport in France <ul style="list-style-type: none"> ❖ Maximization of trucks capacity <p>Trucks filled to 75% capacity thanks to:</p> <ul style="list-style-type: none"> - product mixing - use of Eurack <ul style="list-style-type: none"> ❖ New green technologies <p>Alternative fuel under tests</p>

Here again, we can see a difference in the degree of realization of green transport strategy. Wal-Mart focuses totally on the new technologies. It hopes to reduce its environmental footprint thanks to technological innovations.

On the other hand, Carrefour banks on the diversification of its actions. Indeed, in Carrefour's strategy, we find almost all the points that were developed in the theoretical part whereas Wal-Mart really focuses its actions on one level. Like for buildings, Carrefour leads a true partnership with its suppliers to make them lead a greener strategy. It consists in finding new ideas of transport organisation like pooling and backhauling, terms that were explained before and which aims are to reduce miles driven and by the way reduce pollutants emissions. This is the equivalent of scheduling and routing, concepts that were seen in the theoretical part.

Moreover, Carrefour tries to develop its activity at the level of the least polluting means of transport as we saw in the theoretical part, namely the rail and river transports. It also operates co-deliveries and tries to use the optimal capacity for its truck loading. On those levels, there are no mentions of such strategies at Wal-Mart. The American company that has one of the largest private fleet in the world prefers to look at some technologies that would improve the fuel efficiency of its trucks. In that way, we can say that Wal-Mart green transport strategy is far less complete than this of Carrefour.

However, Carrefour does not lead as much research on technological innovations as Wal-Mart does concerning tire design, inflation systems, etc... The road transport remaining by far its most important means of transport in its activity, we can say that it is a really negative point in its strategy of green transport.

8.3.3 Packaging

	WAL-MART	CARREFOUR
Packaging	<ul style="list-style-type: none"> ✓ Specialised network Packaging Sustainable Value Network: works on innovative projects ✓ Evaluation system Packaging scorecard: 7 Rs of packaging ✓ Partnership with suppliers Work with suppliers: <ul style="list-style-type: none"> - informs them - suggests improvements ❖ Shift in materials used Switch from polluting materials to annually renewable resources for fruits & vegetables ❖ Minimization of packaging Decrease in weight of plastic bottles 	<ul style="list-style-type: none"> ✓ Team work European working group ❖ Minimization of packaging Optimisation in volume and grammage ❖ Changing materials Test of new materials ❖ Design packaging for reuse Reusable for fruits & vegetables 100% natural tray for minced-meat

In that field, Wal-Mart seems to have a step forward on Carrefour. It has an important network and works hand in hand with its suppliers so as to help them to make progress in that field. Indeed, it provides information to them on how making

green packaging. We can say that the pressure that Wal-Mart puts on its suppliers is a good point because it helps them to go in the right direction. For this reason, the scorecard is a really good tool to measure and put a certain degree of pressure on suppliers so as to have better results. This scorecard is built around the 7 Rs, that is a very complete strategy. In that latest, we find all the points developed in the theoretical part. Are added two new points that are Revenue and Read. The more important of these two new concepts is Read. Indeed, Wal-Mart stresses the importance of being educated about the subject of green packaging. This is really important and it can constitute a key element in the future success of the company packaging greening process.

It seems that the American company puts a stress on packaging whereas for the French company it is the less developed point of its green strategy even if it leads some actions in that field.

9 CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusions

Summary

As seen previously in the study, the aim of this work is to discover the greening process of logistics focusing our attention on three main variables: transport, packaging and warehousing. The research question of this thesis is: How can a retail company be part of sustainable development thanks to its logistics strategy and actions? In order to carry out this study, two kinds of data have been used: primary data and secondary ones.

If we proceed in a chronological way, we first used secondary data that correspond to the theoretical part which is based on books and articles. This first part was divided into four main parts which are: sustainable development, logistics and environmental consequences, green logistics and introduction to retail field. It was important to have a look at the sustainability concept as it is the basis of the work. Then it was logical to make a brief description of logistics activities, defining their aims and stressing their consequences over the environment. Once the logistics externalities

explained it was necessary to set out the green logistics concept that arose some years ago to bring some solutions to the environmental issue. This part is the most important one of the theoretical part. Here are explained all the actions that a company can undertake so as to green its logistical process. This part functioned as a mirror with the empirical part. To finish, the last part of the theoretical part concerns the retail field. It consists in a brief introduction to it because the study is focused on this part of activity.

Findings versus theory

Once the two parts finished: the theoretical and the empirical one, we can see that we find the same things in each part. We can say that the empirical data assess the theoretical part. Indeed in the first part we focused on three levels because it seemed that it was the three main fields of activities of logistics. When going deeper in the research by analysing the actions taken by the two biggest retail companies in the world, we find that these one lead a green strategy that is focused as well on these three levels: transport, packaging and warehousing.

Thanks to the empirical part, information on warehousing, corresponding to buildings is more developed. We find some new methods to green the logistics process at this level. We can say that the two parts are complementary and together they bring an overview very complete of the topic chosen.

We can also see that it exists a lot of actions possible to green the logistics process and usually one firm cannot undertake all these actions. It is too difficult to accomplish everything. In the cases chosen, we see that Carrefour has a strategy more developed on the building level whereas Wal-Mart is more efficient on the packaging level. Moreover there is a difference on the strategy chosen. The actions depend on that strategy.

9.2 Recommendations

It is not so easy to give recommendations to these two companies because even for Wal-Mart that has just started its actions, they seem to be really aware of the problem of environment when talking about logistics. Both works with associations

specialised in that field to become greener. They have some experts in their network to help them. By the way they are well surrounded to succeed in their task.

However, I could try to give recommendations to smaller retail companies that would like to implement a green logistics strategy. To start it is necessary to have a clear vision of its activity and to see how this one is polluting the environment and on which level of logistics in particular. As Carrefour did, it is important to lead an “eco-audit”. It can be good to analyse one’s carbon footprint in which we can see all the energy consumed to run the business in the buildings as well as all the fuel consumed for transportation. It can also be good to analyse one’s water footprint: how much the company uses water and how much waste in it does it let. Those analysis are the first step to go through before beginning any actions to green the process. When there are clear facts and figures, the company can then establish some actions to lead. For that, it is necessary to put some objectives very clear in a written environmental policy. It is important to establish a time table as well to have some limit in the time and see the evolution of the work. Then to achieve the objectives, the company can have access to every actions that have been described above. To carry out the actions, the company needs the cooperation of its suppliers and the help of some associations. The establishment of indicators is very important to evaluate the actions and see the evolution of their results. We can say that the most important is not to implement a strategy but to evaluate it, to see what is good and what is not, to be able to correct it.

How far the findings can be generalized?

The empirical part is based on only two cases but we can say that the generalization is really possible to other companies from the retail field. Indeed, actions that can be taken in the greening process of logistics are usually the same. We saw in the cases that the two companies focus their attention on three main levels: buildings, transport and packaging. These dimensions are usually those on which firms have possibilities to have positive results.

Even if generalization is possible, we have to say that actions undertaken by these two companies require quite a lot of time and money as they led researches and innovations on a technological level. By the way it could be sometimes too difficult to achieve these actions for small companies from the retail field. We can say that the actions analysed in the empirical part are more accessible to big companies than

small ones. Indeed, leading research represents important investments that small firms cannot necessarily afford. Moreover, we saw that to green the process, having partnership with other associations or providers is really positive. Usually, small companies have a smaller network than multinational, by the way, it is more difficult for them to lead a real team work with other organizations, Here are some limits of the generalization of the findings, however, the greening process for retail companies in logistics remains theoretically the same.

Assessment of the conceptual framework

The conceptual framework is a self-made one. It has been built according to the different theoretical sources. I wanted it to be very simple to provide an understandable view of the global topic.

After having finished the empirical part, I did not change the framework because I thought that it gave a good picture of the subject as a whole. Of course it is not perfect, there is space to improve it but it has the advantage to be easily understandable.

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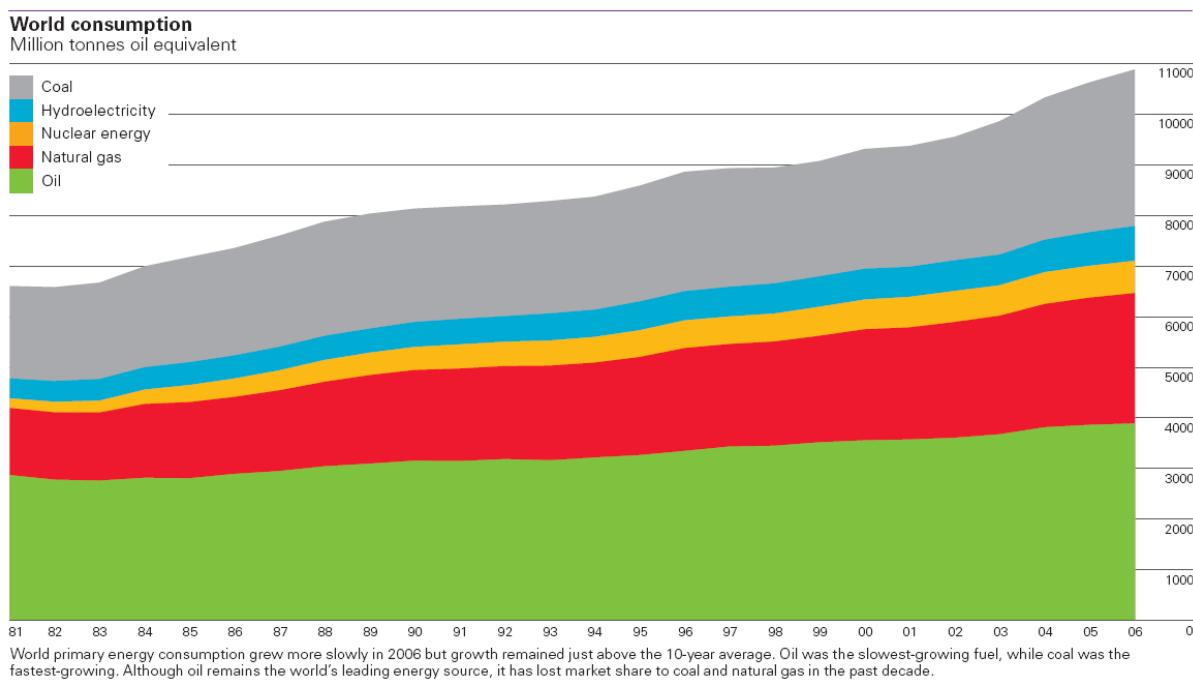
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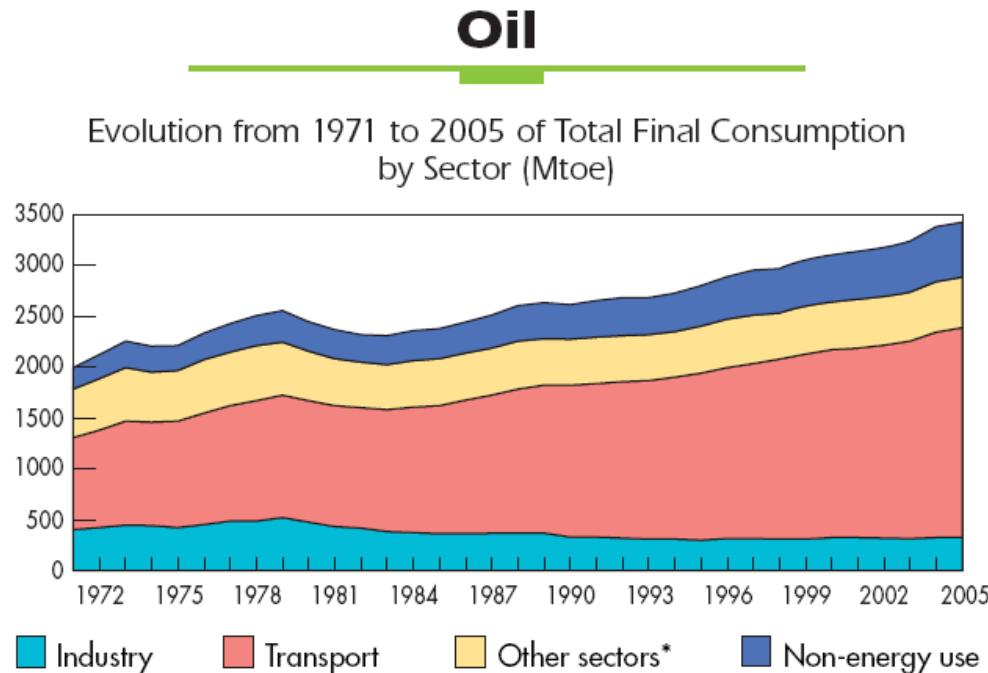
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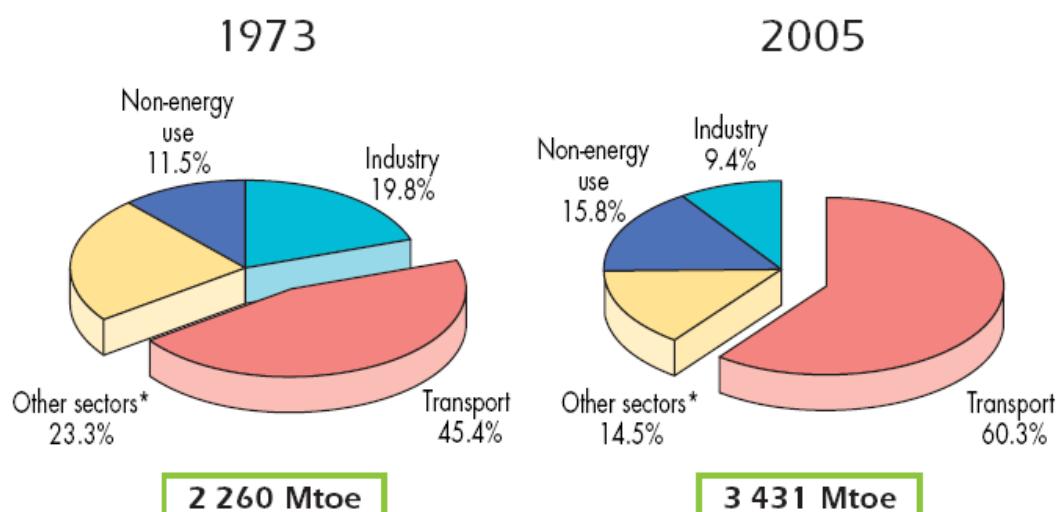
ANNEXE 1



ANNEXE 2



1973 and 2005 Shares of World Oil Consumption



*Other sectors comprises agriculture, commercial & public service, residential and non-specified.